T R A N S C R I P T

LEGISLATIVE COUNCIL ENVIRONMENT AND PLANNING COMMITTEE

Inquiry into Climate Resilience

Melbourne – Wednesday 9 October 2024

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WITNESSES

Dr Jonathan Spear, Chief Executive Officer,

Llewellyn Reynders, Director, Research and Policy, and

Caroline Evans, Principal Policy Officer, Infrastructure Victoria.

The CHAIR: Welcome back to the proceedings of the Legislative Council Environment and Planning Committee's Inquiry into Climate Resilience in Victoria. We welcome our witnesses from Infrastructure Victoria.

Before we kick off, obviously all evidence we take is protected by parliamentary privilege as provided by the *Constitution Act 1975* and the 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 these same things, those comments 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. Transcripts will ultimately be made available, made public and posted on the committee's website.

My name is Ryan Batchelor. I am the Chair of the committee and Member for the Southern Metropolitan Region. I will get members of the committee to introduce themselves, starting with our Deputy Chair.

David ETTERSHANK: Thank you. David Ettershank from Western Metropolitan Region. Hi.

Sarah MANSFIELD: Sarah Mansfield, Western Victoria Region.

Wendy LOVELL: Wendy Lovell, Northern Victoria Region.

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

Melina BATH: Good afternoon. Melina Bath, Eastern Victoria Region.

The CHAIR: And online we have?

Jacinta ERMACORA: Jacinta Ermacora, Member for Western Victoria.

John BERGER: John Berger, Southern Metropolitan Region.

The CHAIR: Welcome to the three of you. Maybe for the purposes of Hansard, if you could introduce yourselves and the organisation you are appearing on behalf of, then I will invite you to make an opening statement.

Jonathan SPEAR: Thank you, Chair. I am Dr Jonathan Spear, Chief Executive Officer of Infrastructure Victoria.

Llewellyn REYNDERS: And my name is Llewellyn Reynders, and I am the Director of Research and Policy at Infrastructure Victoria.

Caroline EVANS: And my name is Caroline Evans. I am a Principal Policy Officer at Infrastructure Victoria.

The CHAIR: Thanks very much. We have got a bit of time. We decided to program in a little bit more time than we normally would for this session, given the importance of your recent work, so we are not as constrained by our opening statement as we would normally be. I might hand over to you and let you take us through the work that Infrastructure Victoria has been doing on the topic as relevant to the committee.

Jonathan SPEAR: Thank you, Chair. It will be a pleasure. Maybe just to start with, a reminder that Infrastructure Victoria is the state's independent infrastructure adviser. We advise on all things infrastructure that are related in some way to the Victorian government and advise the government of the day, but we also have an important role in advising Parliament primarily through our 30-year infrastructure strategy that we table every few years in Parliament and our other research. The work we will talk about today is actually a mix of work that we have done through all the strains of the channels of work that Infrastructure Victoria does.

The submission that we have provided you with primarily focuses on our work on adaptation of infrastructure to climate change and some research that we have entitled *Weathering the Storm: Adapting Victoria's Infrastructure to Climate Change.* Our submission also covers a couple of other matters that perhaps we could talk about later on if you would like to. It looks at work on opportunities to decarbonise infrastructure – so reduce the amount of infrastructure that is embodied and enabled – and then some other recommendations we have made in the 2021 version of our 30-year strategy. Copies of all of those have been provided to the committee.

Turning to our research on *Weathering the Storm: Adapting Victoria's Infrastructure to Climate Change*, what this work really tells us is that Victoria's infrastructure was not built for more frequent and severe weather events that are related to climate change. Our infrastructure is now exposed to greater damage from events like bushfires, flooding, landslides and extreme wind than previously was the case, and much of our infrastructure was designed and built in a period and under conditions that were not as frequent or as extreme in terms of what we are facing at the moment. Our research finds that early adaptation action can reduce the risk of damage and the extent of harm to communities, importantly, and also early adaptation can reduce the costs of repair and recovery. The challenge is that it is very difficult to do everything everywhere all at once when we look at the scale of infrastructure we have across the state, the thousands of kilometres of roads and powerlines, for example, and the different types of climate-related severe weather events that we are currently facing and are likely to continue to face in the future. So what our work is looking at is how the Victorian government can prioritise these adaptation actions in light of that challenge. Where do we act in an adaptive, preventative way, or where do we prepare to respond? What we find is that there are opportunities for infrastructure adaptation to be targeted and cost effective, and often it is the lower-cost interventions that reduce many of the climate hazards. They do not always eliminate them, but they can certainly reduce them. It is things like infrastructure maintenance, for example, and we will take you through some of that later on, but sometimes big upgrades and relocations can be more tightly targeted to the highest priority places as opposed to more cost-effective ways to adapt infrastructure. Infrastructure managers we know are needing clearer obligations and guidance and tools about what is expected of them. We have talked to a lot of them, and they are in some cases quite confused about how they should be planning and where they should be prioritising their work. That is, if you like, the headlines of the research that we undertook.

Of course the reality is Victorians are already experiencing and paying some of the costs of climate change related weather damage. There are a variety of ways you can calculate this, and many organisations have done this. We have not calculated it afresh. But our report talks through some of those, and many of them are in the billions of dollars. On one calculation, between 2007 and 2016, extreme weather events cost Victoria an average of $2.7 billion a year. The other thing we noticed in doing this research is that when you look at the amount of money that state and federal governments spend following extreme weather events it is really only a few cents in every dollar that is invested in more long-term adaptation of infrastructure as opposed to recovery for communities. It is likely to continue to be the case that governments do have a role to play in spending money helping communities recover, but that few cents in every dollar seems much too low to us in the face of the likelihood and predictability of this occurring again.

The way we undertook this research was to look at what other governments and other jurisdictions have been doing all around the world and around Australia and to look at existing information that was available. Then we did a strategic-level assessment of all the different types of climate change related risks that exist and looked at the data we have got about where infrastructure is located to get a sense at a first pass as to what were the highest risk climate-related events and what were the types of infrastructure that were most exposed. I want to emphasise that this is not a very fine-grained analysis. It was a first pass that no-one had ever really done before, looking all across Victoria at all the different types of risks and all our infrastructure types. But it gives us a sense of what are the areas of highest risk and categories of infrastructure at highest risk and also what are the intersections or relations between different types of infrastructure that might make them more vulnerable – if one is affected, the way that rolls on to affect others. Then what we did is look at how to assess the different

options for adaptation, so what the process might be to even work out how can we undergo all sorts of different types of adaptation for infrastructure and then assess them on a cost–benefit analysis basis. That is also something we are not aware of anyone having done before, certainly in an analogous context like this.

That was the method we undertook, and then we made some policy recommendations to the Victorian government in light of that. What we find is that infrastructure can be adapted in many ways. We can do things like change the type and frequency of maintenance activities. We can manage vegetation to mitigate the effects of floods, bushfires or severe weather events. We can repair more quickly and get ready to repair more quickly after an event. We can retrofit infrastructure. We can build it with different materials or designs. Sometimes where those adaptations are not going to give us adequate levels of assurance we can actually move our infrastructure, but that is probably our last resort. The other thing we found is that adaptation is not a one-size-fits-all thing; rather, climate risks are different according to the different asset types and their different locations. What that means is that having good information about what infrastructure we have got in particular places and what the current and future projections around climate-related risk are is really important at a local level for a department or portfolio or an asset manager to actually understand the level of risk and which adaptations are going to work well for us. I guess that is part of the challenge about that fine-grained information that we need.

The third thing that we found in doing this work is that there are quite positive economic returns from relatively low-cost adaptation measures, and that is what our cost–benefit analysis and our options analysis showed. In that assessment of all the different risks that infrastructure faces across Victoria we found that probably the three highest risks that we thought were worth focusing on are roads that are prone to floods, roads that are prone to bushfires and local area electricity distribution networks that are exposed to high-wind events. What we did in each of those cases was take a hypothetical scenario where we used real-world data and we were able to look at adaptations for each of those three different things: the flood-prone roads, the bushfire-prone roads and the high winds hitting electricity distribution. We were able to look at a range of adaptation measures from pretty low intervention to sometimes very high intervention. Moving a road or having it become a causeway is a very high-cost intervention.

What we found in relation to flood-prone roads is that preventative maintenance or building them with materials like foam bitumen stabilisation, which is a method that makes them much less prone to being washed away, gives quite a good return on investment under both current climate conditions. But also we looked at more severe future climate conditions. They are giving us a positive return on investment of between $5 and $8 for every dollar you spend on preventative maintenance or between nearly $3 and $4 for things like foam bitumen stabilisation. In relation to bushfire-prone roads often the problem is not the bushfire; it is the erosion that follows that in the months afterwards. We found that more frequent maintenance activities, boring but important – clearing out from those drains all that wreckage after a fire is one – are key things to stop the damage. With electricity distribution infrastructure, while the focus is often on undergrounding it, actually our analysis found that in some instances insulating and bundling local cables together was quite an effective way of reducing the risk and quite a cost-effective way of doing it too.

I am really happy later on to talk through more of that cost–benefit analysis work. But it gives us this sense that actually you can go through a process of going, 'What's the risk, what are the options to address that risk and assess their efficacy and what's the cost–benefit analysis on doing that to inform decision-making?' While we have only done it for these particular examples, it is a replicable methodology that others can use too, and we hope that others will use it. As I mentioned earlier, one of the key challenges is then we have done this work, but infrastructure managers certainly are in need of some clarity. They are in need of clarity about: how do they assess risk? Which climate models and projections do they use? What options should they be assessing? What cost–benefit analysis approach should they take? Even if they do all of that, is there going to be any money to pay for adaptation measures that they identify as being good options?

I think that then probably logically takes us to the recommendations we have made to the Victorian government in our research. The first one was a need to boost the priority and oversight for infrastructure adaptation. There do exist, as you are probably aware, infrastructure adaptation plans that departments and portfolios have under the *Climate Change Act*. We observe that they do not have a high priority for infrastructure adaptation with the climate adaptation strategy the government has, and there is not much focus on energy infrastructure and its adaptation. While the Victorian government does not own or operate much, if any, energy infrastructure, it is clearly a key vulnerability that also has follow-on effects to our other infrastructure if it is affected, so that

seemed to us to be a gap. So including all the different infrastructure types that the Victorian government has responsibility for in future adaptation plans is an important point, we thought, and being clear about which agencies are responsible for actually implementing those plans and reporting more frequently on progress would be useful.

The second thing we have called on in our recommendations is to coordinate and standardise climate projections. The problem is not that there are not climate projections; there are lots of them, and we understand why that is. There is scientific uncertainty. Models are being updated and improved with better information all the time, and that is fine. The challenge we have is for Victorian government officers and asset managers to actually be planning off a consistent set of assumptions, just like we do when we plan for population growth, for example, or land use, which is something we are often doing in Infrastructure Victoria. The consistency of a set of assumptions around 'Well, what climate change projections are we working to?' would be really helpful as well as continuing to invest in more local-level assessment about climate risks so that there can be better assessment of the risk and the adaptation options for each individual bit of infrastructure in its particular location.

Thirdly, there is a need to use our existing asset management systems to improve resilience. The Victorian government has an asset management framework, and departments and agencies have policies and protocols about how they manage their assets. Climate change guidance is not really strong in those currently, and given what we are already facing and are likely to in the future, a greater emphasis and clearer guidance about how the asset management frameworks and policies should account for climate change and increasingly adapting our infrastructure would be really useful.

Similarly, while we have high-level guidance around risk management, climate risk is not particularly integrated into the Victorian approach to climate risk management, and in our report we point to a counterexample in New South Wales where they have very clear guidance around risk management approaches across their infrastructure. We think that the Victorian government risk management framework should have detailed guidance about how to assess climate-related risks in infrastructure and integrate that into decision-making, and there are some international standards that exist that could be also brought into this.

The fifth recommendation we make is about alignment of climate risk and financial risks in infrastructure. There is a growing movement in corporate governance and reporting for companies to be assessing, identifying and reporting on the degree to which their activities are exposed to climate risk. Much of that relates to carbon, but it is not exclusively about carbon. The Victorian government currently reports on climate risk at an aggregated level, the risks of climate change to the whole of the government assets. That is a good start. It would be even more helpful if portfolio by portfolio there was assessment and reporting of the climate risks and the highest risk that each portfolio is facing. That would really help focus everybody's minds on this challenge but also help to develop capability within each portfolio about how to do that assessment and how to prioritise the greatest risks in each portfolio.

The sixth recommendation we make is to update business case and investment guidance. There would be value in updating the sorts of business case guidelines that our colleagues in the Department of Treasury and Finance have and having technical guidelines and templates so that we include explicitly the risks and impacts of climate change in our decision-making when we are making investment decisions in business cases. There are a number of existing guidelines that could be updated that would help that, and also climate change risks and guidance methodologies could be integrated into the Victorian government's approach to economic evaluation. What I mean by that is that we have demonstrated a way by which you can do cost–benefit analysis of adaptation investments. It would be really helpful if some of that was endorsed and made standard practice throughout the Victorian government.

Last but by no means least, we have recommended that confidence be built that good adaptation measures will actually receive some funding. We heard loud and clear from a lot of stakeholders that there is a bit of a break in the circle, if you like, of the motivation for people to actually invest in better information and capability because there is a lack of confidence that there will be any investment made to adapt our infrastructure. We look around the world and we see places like Canada and New Zealand who are a bit ahead of Australia in terms of climate adaptation. Each of them has dedicated infrastructure adaptation funds for climate change, and that does serve as a bit of a motivator for departments and agencies to invest in this capability and understanding.

They are the recommendations we have made to government. We have provided the committee with all of the underpinning technical work that we have done. There is the main report on weathering the storm. There is a technical report about our methodology that we used, which the committee may find useful, particularly because it draws out more around how we do that assessment of risks and options and cost–benefit analysis, as well as a number of technical reports from consultants around the risk assessment and how we did the cost–benefit analysis. I will leave it there, Chair. Thank you for allowing us a little bit longer to explain that work. I am really looking forward to assisting the committee with the conversation around this important topic.

The CHAIR: Thank you, Dr Spear. It was a very comprehensive opening, and we very much appreciate it. Let us start at the cost, because that is motivating for many. You mentioned a $2.7 billion a year figure. Am I right in thinking that is what we are currently spending, in your assessment, on an annual basis to deal with the consequences of climate change events in the state?

Jonathan SPEAR: Yes, that was an estimate from between 2007 and 2016, and it was an average estimate.

The CHAIR: Right.

Jonathan SPEAR: We looked for and were not able to locate a more recent credible number that we would rely on. We are an evidence-based organisation, so we were keen to make sure that any number we used was credible. Having said that, in light of the number of events we have had in Victoria since, it may be that that annual number is a higher number than the $2.7 billion average when you think about what we have experienced in recent years.

The CHAIR: In recent years – fires, flood, storms, yes.

Jonathan SPEAR: Yes, and that is consistent with what we and others are observing, which is that we are experiencing more severe events more frequently.

The CHAIR: You would expect that cost-growth curve to not be linear, given the changing nature of events. You would expect there to be an escalation in the quantum, given the frequency and the severity?

Jonathan SPEAR: Yes, but I would probably defer to people like those who work in the insurance industry who can perhaps assist you with a sense of the spikiness, which is not a technical term I am using, of the degree to which particular events have economic costs.

The CHAIR: I appreciate that. I suppose what I am trying to get to here is that clearly in thinking about what government should do, there is a cost of doing nothing, which is that we are bearing the costs of the consequences of these events now, so it is not cost free.

Jonathan SPEAR: That is absolutely the case, and we are experiencing that almost every year now in one form or another. In recent years it has been floods and wind that have been salient in our minds. In prior years of course it has been bushfires. They have been very expensive events for individuals, for insurers and for state and federal and local governments, and we only expect that to continue.

The CHAIR: Yes. You mentioned improving what some might consider the unsexy internal processes of government in terms of Treasury and the way we go through budgeting processes, doing cost–benefit analyses. To my mind they are some of the most important things we need to deal with because they drive the behaviour of agencies and they help shape the investment decisions that government make. Can you talk a little bit further about what specifically you think we need to improve in terms of the way we assess business cases internally within government, or are there recommendations the committee could make about options to improve the assessment of business cases to deal with the climate change risk, to help mitigate future costs?

Jonathan SPEAR: Yes. There are a few ways, and my colleagues may wish to add to this, Chair. It starts with definition of the problem we are trying to deal with. That sounds perhaps an obvious thing to say, but in all business cases you want a really good problem definition. Part of the challenge we have currently got in forming good business cases for adaptation is the quality of the information we have about risk and where that risk is likely to strike, therefore justifying investment. The first piece is improvement of the quality of that risk information and the standardisation of the projections that we are using.

The second is the quality of the options we are putting forward. One of the things you will see in our work is that in each of those three case studies where we dove into flooded roads or bushfires or wind-affected electricity distribution networks, we looked at about 10 or more options for each of them. So it is improving the capability of the public sector and those we work with to identify 'What are all the available options?' rather than leaping to the first and most obvious one. Then it is around developing the capability to do the cost–benefit analysis – which is a little bit different to a normal cost–benefit analysis because of some of those uncertainties – and then embedding that in the business case processes as well and the consistency of the cost–benefit analysis. They would be some of the ways in which we would improve it, I think. Llewellyn and Caroline, would you like to add to that at all?

Caroline EVANS: Yes. I think in terms of the economic assessment – to just talk a little bit more about that – we have adopted quite a unique approach. What we did was we looked at research that has been conducted all over the world and also here in Australia, and we built a number of other components into our cost–benefit analysis. That included looking at embodied emissions; this is the greenhouse gas emissions that might be associated with implementing the adaptation measures themselves. We also looked as far as possible at the direct, the indirect and also the intangible costs and benefits – some of these costs and benefits that are a little bit more difficult to equate. We looked at those as far as possible. We also looked at maladaptation – some of the unintended consequences of implementing some adaptation options – and we also looked at adaptation pathways.

In a sense we know that there is a lot of uncertainty around climate change. So adaptation pathways provide a way of bundling some of the adaptation measures together for great effect or sequencing them over time. So if you have a location that needs more attention, then you can increase the amount of adaptation for that location as more information emerges over time. We built these sorts of ideas and things that we have seen in other places into our methodology to make it something that is quite unique as well.

Jonathan SPEAR: Chair, one other thing I would add is: much of what I and Caroline have been describing is business cases to adapt infrastructure that is primarily focused on the adaptation challenge. I think the other piece of improving business cases and investments is: there are all these other investment decisions we are making for new infrastructure. There is a real opportunity to start on the right foot with those investment decisions by building into our planning, our options and our templates for planning for new infrastructure things that we are already factoring in – the more frequent and severe climate change-related weather events we are going to experience. We have got the challenge of our existing legacy infrastructure and how we adapt that, but at least the new investments we are making are taking adaptation and resilience into account from here on in when we are building new infrastructure.

The CHAIR: Thank you. Mr Ettershank.

David ETTERSHANK: Thank you, Chair. Thank you for your reports. I found them extremely useful in terms of common sense and potential applicability. Speaking of potential applicability, I really like the infrastructure and greenhouse gas report. That in was September, I think, that you submitted that. Have you had a response from government to that report?

Jonathan SPEAR: That is the advice we have given the Victorian government on reducing greenhouse gas emissions.

David ETTERSHANK: I think you said it should be implemented within six to 12 months.

Jonathan SPEAR: That is right. We have not had a formal response from the government, and the government is not required to formally respond to that work. What I am pleased to say is that there is movement on this in Victoria – and across Australia, actually. We are increasingly seeing at the transport and infrastructure ministers meetings, the national meetings, things like agreements to account for embodied and enabled emissions in business cases and to adopt an agreed standard value for carbon for the purposes of business cases and a standard tool for measurements as well. So that is good progress. The Victorian infrastructure delivery agency has issued a policy recently about how it is going to undertake and account for embodied emissions. Those things are a really good start.

There is further work to do in terms of making the decarbonisation of infrastructure business as usual, particularly by governments thinking about no- or low-build solutions as a first option – you know, looking at different ways through policy, through price, through technology and through changes to service delivery to get

more out of the infrastructure we have got before we build new infrastructure – but also for them to build into their business case processes and things like a value of carbon and an expectation that when we go out to market we ask contractors who work with us in building infrastructure to deliver lower carbon solutions. At the start that is likely to take some time to be embedded. That was actually what our advice was – to take it step by step. There is certainly still some more work to do.

David ETTERSHANK: Okay. I have got a number of questions, and I am not sure what sequence to go in. This might be a bit of a big one, but in terms of weathering the storm and in terms of the infrastructure and greenhouse gas report, if you were taking a major government project, let us say the replacement of the 44 public housing towers, and taking the logic that underpins your reports, can you give us a little checklist? If we were pulling those things together and if you were stalking that – how we are going to replace 44 public housing towers – what would it look like in terms of applying the recommendations from your respective reports?

Jonathan SPEAR: Look, it is a really interesting question, and I would like to preface this by saying this is not something that we have done detailed work on –

David ETTERSHANK: Sure.

Jonathan SPEAR: although we have certainly, in our 30-year infrastructure strategy, recommended both greater investment in social housing and upgrading, and in some instance the replacement of, existing social housing. We have certainly recommended that. With some of the principles that we have got in these reports what you would look at is applying the climate adaptation lens to infrastructure, and we certainly think of social housing as infrastructure. What we would be wanting to do is an assessment of the degree to which those towers are currently or will be exposed to climate-related risk in the future. While the case studies that we looked at were focused on things like flood and fire and wind, of course one of the other things is extreme heat. That is one of the other ones that comes up too, and that is certainly an issue for the built environment. We have previously identified and recommended that there be improvements to social housing so that it is more resilient to both extreme heat and extreme cold. To do that we would need good local-level information and then to assess a range of options about how they might be adapted. On the thinking around the reduction of carbon in building infrastructure, we would think about – well, over the whole life cycle of providing that sort of social housing over future decades, what are the embodied and enabled emissions of those? That could look at the practicality of adapting and reusing the existing infrastructure as well as replacement of what the embodied carbon would be in both. But it would be, importantly, the operating carbon over time, and that would be an interesting question for both. Then the third thing is that, while we might be focused on adaptation of infrastructure and we might be focused on emissions in our discussions today, there is a real issue about people and the quality of life for people in that social housing infrastructure now and into the future and the services that they have got access to. They would be the sorts of things that I think we would be looking at.

David ETTERSHANK: All right. As we understand it, the proposal is that all of them are just going to be bulldozed; they are all just going to be demolished and replaced. So I am understanding in terms of where you are at that before you would make that decision you would actually do some of the calculations you are talking about in terms of the embodied carbon and the adaptation of the buildings before you actually made the decision to bulldoze them?

Jonathan SPEAR: I want to be very clear: we have not done a specific assessment or given specific advice about the way in which they should be done. Generally we would recommend, for any sort of infrastructure investment that is being made, thinking about, firstly, what all the different ways in which the need that this infrastructure is meeting can be delivered and working through all the different costs and benefits. What we would observe is that with embodied and enabled carbon it is not currently the practice that that gets counted, and we think there is a value in doing that, and climate-related risk and opportunities to adapt to that risk are also not being accounted for in standard practice.

The CHAIR: Thank you, Mr Ettershank. Ms Lovell.

Wendy LOVELL: Thank you very much. You talked about looking at roads, particularly roads that have been damaged by floods and fires. I wonder if you have looked at any other issues around not just the damage to roads from floods and fires but the need for new infrastructure. Particularly I am talking about the

Shepparton bypass and the second river crossing in Shepparton. As you would know, the Midland Highway was cut at the Peter Ross-Edwards Causeway, which divided our community but also divided our state. It is an important freight route. Had we had that second river crossing built to the north of the city at a height above flood levels, we would not have been cut off. Have you looked at the need for new infrastructure to service the state going forward, given that we are more likely to have floods of those levels?

Jonathan SPEAR: Yes. Thanks for your question. We did not specifically look at the Shepparton bypass, just to be very clear. What we did in our work was to think about where we have particular road networks that might be cut and what the flow-on effects of that might be. That is one of the reasons we chose flood-affected roads as the case study that we looked at, because there is the effect on the road and as you have just described, it can have those broader effects on the freight network, for example.

Wendy LOVELL: You must have looked at the Midland Highway, because that was obviously cut and it is a major freight route.

Jonathan SPEAR: Yes. So what we did in the assessment of risk was we looked at the existing flood overlays that are in the planning system as well as the existing bushfire overlays, and what that did was give us at least a first-cut assessment of what some of those places are that are exposed to flood and bushfire. Then, to build on your question, what we looked at was, for a rural road that is subject to flooding, what all the different ways are in which we might adapt that and what the cost–benefit of that would be so that we are able to do that through that suite of options from preventative maintenance – so boring but important stuff about cleaning out the drains in time –

Melina BATH: It is not boring in the country.

Jonathan SPEAR: Yes. It is not boring when it floods, not at all. It is important. So it is investing in those sorts of things or building the road with foamed bitumen stabilisation so that, yes, it might flood but when those floodwaters subside you have still got a road and you can still use it, which is what they have been doing in some bits of Victoria and in Queensland as well, all the way through to: do you move the road; do you build a new road? Now, that of course is a very high-cost option.

One of the things we point out is: sometimes you might invest in that high-cost option of a causeway or of lifting a road up. It will have a low cost–benefit analysis if you just do it for the climate adaptation purpose. Some roads are very critical links and some might have other benefits that you can take into account in the business case.

Wendy LOVELL: With the causeway it was not so much water – yes, there were a couple of areas where it had a little bit of water over it – but it was the animals on the causeway that were the main problem but also bubbling of the road afterwards. But certainly Shepparton needs to be looked at.

Llewellyn REYNDERS: Can I just clarify that the example we looked at was in the metropolitan area, so it was not a rural flood, it was a metropolitan flood.

Wendy LOVELL: Okay.

Jonathan SPEAR: Yes. That is true. Thank you for that clarification, Llewelyn; that is correct.

Caroline EVANS: And just to add to that further, for our road cost–benefit analysis we actually had two. The first one was to look at the damages to roads as a result of flood events, so saturation of the road and washout as well; the other cost–benefit analysis for roads was to look at the accessibility to roads as a result of bushfires and landslide events.

Wendy LOVELL: Can I just ask why you only looked at metropolitan flooding, not regional flooding, given that our roads are terrible – and they were terrible before the floods – and, although David's area was significantly impacted, the main impact of the floods was in regional Victoria?

Jonathan SPEAR: Partly it was led by the evidence we had about where the highest risks were, but also we wanted to explore some case studies that were diverse. The bushfire-related effect one is a rural road case study; the metropolitan flooding one is a metropolitan one, and that is also related because of the amount of traffic that you see on some of those metropolitan arterial roads. That is why it is important to look case by case, because

they will have different effects, and the effect of a flood on a metropolitan road is going to be a bit different to the effect of a flood on a regional road.

But to answer your question straight, we did the metropolitan road flood one because that was one of the highest risks that came up in our assessment. We are well aware and acknowledge that floods to regional roads are also a significant risk and effect on regional communities.

Wendy LOVELL: Thank you. Also, you talked about electricity networks; you looked at electricity networks that were exposed to the high wind and said that whilst everyone talks about undergrounding, some of that can be solved through bundling and insulation. Have you also considered looking at the impact of bushfires? Because if we go back to 2006, I think it was, the transmission lines were cut in the north-east. You would remember it mostly in Melbourne by the day everyone had to walk home because the trains and the trams did not work and the lifts did not work in the buildings. Then again in 2009 of course we had significant debate around the impact of the distribution lines on the starting of the fires at Kilmore East.

Jonathan SPEAR: Yes.

Wendy LOVELL: It is always an issue, every time we have a bushfire, and of course we are talking a lot about transmission lines in northern Victoria at the moment with the VNI West. Have you considered looking at the regional lines and whether we can do some of that better as well?

Jonathan SPEAR: We did include regional transmission lines in our overall assessment of risk. They certainly do come up as a risk in some of those places and for some of those reasons you have described – particularly high wind and bushfire -related risk. They were not the ones that we shortlisted for assessment; we shortlisted the electricity distribution risk for a detailed case study. We have not looked in detail at the cost – benefit analysis of those different options for transmission lines. That of course could be done.

The CHAIR: Thank you. Ms Ermacora.

Jacinta ERMACORA: Thank you. Thank you for your presentation and thanks for putting up with these questions from online. I just want to go to – I have asked about this previously today with others – existing infrastructure and the best way to evaluate existing infrastructure as to its vulnerability. That is my first question – I will leave it with that, and then I have some others.

Jonathan SPEAR: Sure. That is a good question. Caroline, I might let you talk about that because you led a lot of the work on the assessment of vulnerability of infrastructure. Would you maybe like to describe some of what we did there? What Caroline will describe is available to the committee in our methodology report and technical reports. Thank you, Caroline.

Caroline EVANS: Yes. Absolutely. Thanks for the question. In terms of the risk assessment, we looked of course at the likelihood and the consequence of events on infrastructure, and we also looked at the vulnerability of infrastructure in a sense that we looked at it from the exposure side. What we did as part of the high-level risk assessment was we undertook a geospatial mapping exercise to look at the areas across Victoria that have a higher exposure to different types of climatic hazards and also at different asset types. Those asset categories were for hospitals, for electricity transmission and distribution, as Jonathan was just talking about, and also for roads. So as part of that geospatial mapping exercise what we wanted to do was identify at a high level those areas across Victoria that do have a higher exposure to those sorts of events. Then we ended up with an exposure score which indicated to us those areas that did have a higher risk. On the basis of that we then took the next stage of the project towards conducting an economic assessment of different types of adaptation measures that can address those risks for those vulnerable locations.

Jacinta ERMACORA: Yes. Thank you. I am particularly interested in communities or places that might be more vulnerable than others. Have you placed an equality lens over the work that you have done in terms of socio-economic circumstances or similar?

Jonathan SPEAR: I think placing an equality lens is a really valuable way to look at things, and we often do that actually with the work we are doing at Infrastructure Victoria. In the instance of this risk assessment work that we have done, it is a first-pass strategic assessment to get a sense of, well, what are the risks, what are the most significant ones we need to focus on and then how can we adapt to those? Having said that, that does

give us some sense of some of the areas that have got particular types of risks. Again that might be something, Caroline, you would like to talk about in terms of some of the risks in different regions at least. What I would want to emphasise is that probably more detailed work needs to be done to define these risks, but we do have some sense of the types of risks in each region.

Caroline EVANS: Yes, absolutely. We did identify, and again this is at a very broad level, different regions across Victoria that do have higher exposure, say, to flood events and also to bushfire events. Some examples of those regions might be the Hume region or the Loddon–Mallee region. Our geospatial mapping exercise really showed those areas and highlighted that for roads, for example, the majority of roads are exposed to floods and also to fires. For electricity distribution networks, there is a higher exposure to bushfires and also extreme winds. They were the things that came out as quite high in our exposure analysis.

Jacinta ERMACORA: That is terrific, and as you say, a first pass of that. Would you also recommend that a deeper or a next-level analysis take account of equality and vulnerability of communities, just adding that lens in?

Jonathan SPEAR: Well, there are probably a couple of needs. One is we know that this assessment that we have done is at a first-pass level with existing information, and we know that some of that is dated and not as detailed as we would like it to be, so there is certainly opportunity for a more detailed assessment of risks. The other thing we know from research here and overseas is that there is a real connection between vulnerability to climate change and extreme weather events on the one hand and those who are less advantaged. There is real value – and you probably would want to actually combine the two, in terms of identifying particularly those who are exposed to heat events but also those who have been through a flood or a bushfire. We know from research and experience that those who are less well-off do not have the backups financially or through other networks that some other members of the community do, and that makes them more vulnerable.

Jacinta ERMACORA: Thank you. I think that is a yes that we should be doing that next level on taking that perspective. I think if we just take a pure perspective without adding values or priorities, then we miss out. I think the replacement of the housing towers is a reflection of that in a way – that everybody deserves beautiful high-quality climate-resilient accommodation – so thank you for that. I just want to go on with, you have mentioned other jurisdictions there – are there other jurisdictions that do this kind of stuff more generally better than us that we could learn from?

Jonathan SPEAR: Yes, there are. I mean, none of them stand out universally as being the jurisdiction that is doing it super well, but there are patches and examples of good practice that we observe throughout the report, and often it is the case studies that you will see. For example, New South Wales have got some pretty good guidance on how to include climate change risk in risk assessment more consistently. Ireland have pretty good information that is publicly available about the nature of risks to inform the public. We see our colleagues in Queensland doing a pretty good job in terms of making their roads more resilient post the floods that they have had up there. I am probably missing a few. Llewellyn and Caroline, are there any other examples?

Jacinta ERMACORA: It may be worth maybe taking that on notice, Chair.

The CHAIR: Yes.

Jacinta ERMACORA: It might be useful for the committee to receive a list that you have reflected on subsequent to today, if that is agreeable to everybody.

Caroline EVANS: I think as a point of reference in our major report we also have a number of case studies. Some of these case studies are within Australia; some of these case studies are internationally based as well. They would be a really good point of reference I think to help just add to the information base there.

Jacinta ERMACORA: Thank you.

The CHAIR: Thanks, Ms Ermacora. Dr Mansfield.

Sarah MANSFIELD: Thank you. I think throughout your reports you have identified that there really needs to be a whole lot of change across government, across different departments and across different government agencies embedding climate data and climate risks into business as usual. Do you see a role for perhaps a

standalone body to help oversee some of that work or guide some of that work, whether it is the whole adaptation, a lot of these things that you identify or at least discrete parts of it? Would they benefit from some sort of standalone entity?

Jonathan SPEAR: We thought about this when we were doing this work and concluded that that is probably not the best pathway. The primary reason for that is that climate adaptation is going to become the new business as usual whether we like it or not, so it is probably better if we have got whole-of-government policies and practices and that these capabilities and approaches are embedded across the life cycle of how we think about, maintain and operate infrastructure rather than it becoming that agency over there's job. We have a number of organisations who can help provide assurance around the degree to which that is being done over time that are standing agencies like the Auditor-General, but our view was actually this is a capability and a process that needs to be embedded more broadly.

Caroline EVANS: Sorry, I was about to say, just to build on, Jonathan, what you were saying, with our recommendations, one of the things that we wanted to achieve was to reduce the administrative burden as much as possible. We recognise that budgets are limited and resources are limited as well, so a lot of what we are suggesting is really add-ons to existing processes that are in place.

Sarah MANSFIELD: One of the things that is challenging is understanding who takes responsibility for making sure this is done. Even in the example that you gave about the New South Wales risk assessment guidance, whose responsibility is it to develop that and ensure that it is implemented right across the board? Do you have any recommendations around where those responsibilities should sit?

Jonathan SPEAR: Yes, we do. Of the business case and assessment processes and asset management processes that I talked to in my opening, many sit with Treasury. For risk assessment we have the Victorian Managed Insurance Authority, so they provide guidance. There are a number of existing organisations, departments and portfolios that have roles where they can make specific changes to guidelines, and we do not think that needs a new agency to do. It is the embedding of it, the prominence of it and the making of it business as usual that is really important for climate change adaptation and for decarbonisation of our infrastructure as well.

Sarah MANSFIELD: Great. In terms of incorporating climate modelling and data into decision-making and the consistency of that across departments, that was an issue that I think you identified, and it is something where we have seen issues in things like the sea level rise that is being used in planning decisions or flood modelling that is based on decades-old information and then suddenly changes overnight. How do you see that being improved? How do we ensure that standardisation occurs, and who takes carriage of that?

Jonathan SPEAR: What we recommend in our report is that there be an agreed set of projections that we all work from, not necessarily a singular one because some of them change over time, their sensitivities. We think that testing decisions against different sensitivities of change is really useful, but setting a number of them would be useful. We do this in other areas of government planning. We do it in population, we do it in land use, we do it in transport network planning. We can also do it in climate assessment, where DEECA or one of the central agencies can issue some guidance around 'These are the central projections and assumptions we are going to use and plan for.'

Sarah MANSFIELD: Yes, great.

Llewellyn REYNDERS: Just to add to that, the Irish example we gave previously is a really good one, because it was not only that they set out, 'Look, here's our agreed projection,' but they also work with stakeholders to really understand what type of data, what type of information and what numbers they are looking for and then build that into the way they present data so they can make the data as usable as possible for the people trying to use it in decision-making.

Caroline EVANS: Just to add to that further, that was an element of our recommendation around data as well, providing that additional training on how to use these datasets as well. That was part of what we recommended.

Sarah MANSFIELD: Great. Local governments play a big role I think in this space, and we have concurrently got an inquiry into local government going on. Even as part of this inquiry we have heard from

some. They already face a significant challenge with asset maintenance and renewal, and some of that is to do with financing of the local government sector. Most of the councils we have talked to have raised the issue of challenges in funding betterment. Has your work identified any opportunities to support local government with that?

Jonathan SPEAR: Our starting point is that we are advisers to the Victorian government and Parliament, particularly on Victorian government infrastructure. So our assessments and recommendations – we are focused on them. Having said that, we know from our consultations, which included local government, that they are many similar challenges. Actually much of what we are recommending around Victorian government assets and infrastructure is applicable to local government, and they have got the same 'can't do everything everywhere all at once' challenge as well. So actually applying similar approaches, and for local government to be able to use tools, projections and ways of assessing that the state government uses for local government infrastructure would probably be very useful for them too.

Sarah MANSFIELD: Thank you.

The CHAIR: Ms Bath.

Melina BATH: Thank you very much for appearing. My mind is expanding at a great rate today. I am going to go back and pick up on the roads. Can you just relate to us where the bushfire-prone road was, or roads, that you looked at? Do you remember what part of the state?

Jonathan SPEAR: Sorry, it was not a particular road. Each of the case studies was a hypothetical place. What we did do is take some real-world data from different places to do that, but it was not a particular location.

Melina BATH: Sure. We have seen I think in the last 12 months that there has been a drop in government funding for road resurfacing. If you go out to any regional MP, one of the key things that will be of concern to the community is deteriorating roads. You said vegetation on the sides, in the gutters – absolutely, and you do not need to drive far. These are big concerns. From your case studies what was a key recommendation in relation to building better infrastructure and resilience for those bushfire events? If you would like to take it on notice, please do, but if you want to speak generally.

Jonathan SPEAR: No, that is okay.

Melina BATH: Thank you.

Jonathan SPEAR: The best way to do it is probably to talk you through the sorts of options we looked at for adapting bushfire-affected roads. What we looked at was a range of things, from programmed drainage clearing and vegetation management to start with, and my spoiler is that is the one that came out the best. So that one –

Melina BATH: And the recommendation for that?

Jonathan SPEAR: So we have not made a specific recommendation, rather what we have said is 'Here is a methodology you can apply' because this intervention, this approach of the program maintenance and drainage clearance in this case study came out really well. It will not necessarily get the same result in every place, which is the importance of local-level data, local-level assessment. But what we certainly find is that in this example, where you have got a rural road that is prone to bushfire, having program maintenance and vegetation management before and after the fire has a return on investment of between $5 or $11. That is a $5 or $11 return on that investment, so that is –

Melina BATH: That is tremendous; that is significant.

Jonathan SPEAR: a pretty good result.

Melina BATH: Yes, absolutely. A compelling case, as you put it.

Jonathan SPEAR: Contrast that with some of the other options that we looked at and actually many of them did not come out that well. There are certainly risks of erosion and landslips and so forth that happen after

fire, and you lose the vegetation and there is rain and so forth. They can work by doing meshes or other interventions that will reduce it, but the return on investment was often below one.

Melina BATH: It is high-intensity engineering, whereas cleaning out gutters can be hole proof. Thank you. I will come back to a question if I have time on roads, but I want to talk about renewable energy. You mentioned embodied carbon. I think you said something was not standard practice by government. I am interested when we talk about renewable energy – wind turbines, on- and offshore; solar plants installation and batteries – that we in Victoria look at the whole of life of embodied carbon. Sometimes I think there is a great focus on 'It's not producing any CO_2' but if you look at the whole-of-life cycle of that piece of equipment, infrastructure, it has embodied carbon and it does produce CO_2. I am interested in what Infrastructure Victoria would say to government when you are planning key infrastructure pieces – renewable energy certainly is some of that – about how we can get the best out of our bang for our buck but also of the world.

Jonathan SPEAR: Sure. We would certainly recommend that any infrastructure investment, when the assessment of that is done and cost and benefits and so forth is undertaken, that that include both the carbon embodied in its construction and delivery and operation and so forth through its life cycle, as well as carbon avoided.

Melina BATH: Correct. That is right, a balance.

Jonathan SPEAR: Also if you are doing this properly, you are also looking at the alternatives of course. Particularly in a Victorian context, where we are transitioning from coal-fired power to these other ones, yes, there will be embodied emissions in transmission lines and wind turbines and so forth. There is also going to be many, many, many, many, many, many tons of embodied emissions from the continued operation of coal power plants or their replacement with other options. You have to look at the base case of what you are comparing against.

Melina BATH: That is right. Sure, thank you. Leading onto circular economy and some of the case studies round the world, in Europe and Germany et cetera, where you see your circular economy and of course the whole ideas about renew, recycle to the nth degree minimise waste. Where there is that red bin waste, then you are seeing energy from waste plants and the government has a policy and a scheme out in relation to energy from waste – I am not calling them incinerators because that is an old-fashioned view but a modern technology – have you, Infrastructure Victoria, ever done any research on that?

Jonathan SPEAR: We have. We have provided a whole dedicated piece of advice to the Victorian government on recycling and resource recovery infrastructure. In fact we have appeared before a version of this committee prior in talking about that.

Melina BATH: Yes, I think I was there. Refresh us in the limited time I have.

Jonathan SPEAR: There is certainly a role for waste-to-energy infrastructure. There is a hierarchy of waste, and you were starting to describe that before in terms of reduce, reuse, recycle. If you cannot do those sorts of things, then often the next one is to seek to use that residual waste for energy rather than it going to landfill only, if that is a technically available option.

Melina BATH: Achievable option.

Jonathan SPEAR: Yes.

Melina BATH: Sure, thank you. Just going back to roads and the National Transport Research Organisation, I feel that Queensland has engaged with them very well. You have used Queensland a couple of times today about the advanced technology for our road services and transport in general. Is the Victorian government utilising that organisation as much as it could, or is there something that the Vic government should be learning from this? We want the best technology and the best outcome and longevity for our roads and infrastructure, but let us look at roads.

Jonathan SPEAR: I think you are probably best to ask the NTRO or the Victorian government about how they are working together. I do not think we are in a position to comment on that. To be clear, with things like foam bitumen stabilisation, which I have talked about previously, it is being deployed in some places in

Victoria as well. Now, Caroline happens to be an expert on roads and road resilience and so forth. You may want to add to that in terms of the technologies that we are deploying in Victoria currently.

Melina BATH: Is there a pathway to more adaptation and utilisation of these new technologies?

Caroline EVANS: Yes, I certainly think that there is a pathway. Jonathan just mentioned foam bitumen stabilisation. That is actually a proven technique up in Queensland. It is being used in New South Wales as well. As Jonathan said, it is being used in some parts of Victoria too, so that is an approach that can be considered, if it is suitable for a particular location. That is where the localised assessment, again, is really important. There are other techniques that we looked at for roads. What we did with our assessment was we categorised our adaptation measures into those that were higher cost type measures; those that were lower cost, like nature-based type solutions; maintenance, such as preventative maintenance, which actually came out really well with our return-on-investment analysis; and some hazard management type responses as well. We assessed eight different types of adaptation measures in those different categories to see how they stacked up in a cost–benefit analysis. We looked at viaduct-type options, which is what Jonathan has also spoken to, and program maintenance was another type of method that we looked at, so there are a number of different options that we included in our analysis.

Melina BATH: Thank you. And I am unashamedly not apologising about roads in Victoria, because they such an important infrastructure piece and lifeline for our community. So thank you. I think my time is up.

The CHAIR: Sure is. Thank you. Mr Berger.

John BERGER: Thank you, Chair. And thank you, everybody, for your appearance this afternoon. Just a different tack: do you see a role for traditional owners in helping government navigate climate resilience, and if so, what might that look like?

Jonathan SPEAR: That is a great question, Mr Berger. I have just got to say we are at a pretty early stage of our understanding of that. The short answer is yes. They may well have good information about their local country and the way it is likely to perform under different climate conditions but also the implications of any adaptation so we avoid maladaptation as well. Caroline talked about maladaptation before, so the risk is in doing an intervention to adapt infrastructure that has an unanticipated adverse outcome. There is probably both a positive lens on this that traditional owners may have a view about risks and how to adapt to them but also avoiding damage to country. But I do not want to overextend the degree to which we have done detailed work on that, Mr Berger. We, like many organisations, are on a journey to better understand how to do that well.

John BERGER: No worries, thank you. Thanks, Chair.

The CHAIR: No worries. Mrs Broad.

Gaelle BROAD: Thank you very much. I really appreciated your contribution, particularly just on the NTRO, because I think I actually visited there and was very interested to learn about how that small increase in funding could really create a much stronger road. It seems that Victoria certainly has got plenty of capacity to improve the use of that new technology, because other states are certainly leading the way currently. You have highlighted some of the vulnerable locations, and they do seem to be located in regional areas. Do you think that we should see a greater share of funding for new infrastructure in the Victorian state budget because of that?

Jonathan SPEAR: We have not done work where assessors look at 'Does that mean that there should be a rebalancing of this?' Governments have always got a tricky balance in terms of the degree to which there is investment in metropolitan versus regional areas, and there are a whole lot of factors that relate to that, one of which is where population is. Current and future projections are that most of Victoria's population will be in Melbourne and our regional cities. On top of that, regional Victorians, wherever they are, can have a reasonable expectation of adequate quality infrastructure.

What I think this work brings into that consideration is a new factor that we need to be taking on, which is that climate change is going to affect all of Victoria. It is going to affect Victorians in different ways, and we know that some of our challenges from climate change, particularly bushfire, are ones that probably disproportionately affect regional Victoria. There are certainly some other effects though that are shared across

metropolitan and regional areas – coastal inundation affects Melbourne and our regional areas; flooding does as well; high winds do. So it is not necessarily the case that the conclusion to be drawn is 'Oh, we should rebalance somehow metro versus regional infrastructure funding because of climate change adaptation.' What it does show though is that getting much better understanding about where those risks lie and what the biggest risks are so we can choose the adaptations is really important, and some of them absolutely are going to be in regional areas.

Gaelle BROAD: Yes. We have heard from previous witnesses that the impact is being felt by regional areas, and I guess at the minute we have seen up to 13 per cent spent in previous state budgets on new infrastructure has been spent on regional areas, but we have 25 per cent of the population. So putting the impact of extreme weather events on that and the need for this preventative work makes you think, yes, perhaps that needs to be revisited.

I am interested too in your report. I think it is quite extensive, like 300 pages. I did do a word search. I could not see the word 'levee' in there, and I know levees are a really big issue in regional Victoria, because most of them are located in regional Victoria. Recently with the flood inquiry we looked at the breaches that have occurred and the damage that that can cause to public infrastructure, on private investment and facilities and everything too. I was very interested in your thoughts on what could be done in this area, because there have been calls to actively monitor and maintain levees because they are full of holes. I have been to a number of them, and they are not properly maintained or there is no regular inspection program. Is that something that you think should be supported in looking at preventative measures? Because we know levees are talked about in places like Seymour. They are needed in Rochester around the hospital. We have been to Loch Garry. I think residents around Benjeroop have raised it and in Kerang, so I am talking right across the board. Tyntynder Flats is another one, near Swan Hill. What are your thoughts on that levee infrastructure and how important it is to regional Victoria?

Jonathan SPEAR: We have not done a detailed assessment or detailed work on levees. We are really conscious that there has been that inquiry where you looked at it in some detail, and we do not seek to duplicate that work.

Gaelle BROAD: I guess we did talk about the need for it to be reviewed, but yes, I am interested in your thoughts.

Jonathan SPEAR: I think what that draws out, of course, is that levees are one of the adaptation options that are available, and if you apply the work that we have done with that lens to levees, you go, 'Well, okay, one of the ways that we can reduce or eliminate risk of flooding that might be driven in part by climate change is you could have a levee solution.' Now, it is not the only solution, and there are also different ways to do different types of levees. We looked at not a levee but a viaduct option for the flooded road scenario, and we found that that would be very effective but would also be very expensive, so we had a low cost–benefit analysis just for that road. Levees are certainly one of the options available. What we would suggest is to not think about it as being the option available and to assess it against the other options for adaptation.

Gaelle BROAD: I guess this inquiry is looking at recommendations for the future, and because levees are so critical to regional towns, do you think it would be good to support that regular infrastructure maintenance and inspection program around levees?

Jonathan SPEAR: I do not think we could go as far as that because we have not done the work. What we would say is that in thinking about the ways in which infrastructure can be adapted to climate change, levees should be one of the options amongst all the others that are considered and assessed, because that will then guide the degree to which continued investment in levees is the preferred approach or whether there are other options that maybe we have not thought about before that can still deliver good results to the community with a good return on investment. That is likely to be an answer that is dependent on each local situation.

Caroline EVANS: Just to build on that, with our methodology it is really providing a toolkit so that different types of adaptation measures can be considered using maybe the approach that we have shown in our report. It is really showing the steps that can be undertaken to find the appropriate return on investment coming out of a suite of different types of adaptation measures.

Gaelle BROAD: Can I ask another one, or is that my time?

The CHAIR: That is your time. Very quickly, before we go: we have talked a lot about risk adaptation. Do you think we have got assets in the state that are unprotectable from the impacts of climate change?

Jonathan SPEAR: We may have. I do not think we know enough about the precise nature of the risks and the options to adapt to them to answer that conclusively yet, and that is why further work on getting more fine-grained assessments about local-level assessment of risk of particular infrastructure assets would be really valuable.

Llewellyn REYNDERS: Just to add to that, you could probably bulletproof anything, but how much are you willing to spend? That is really the question. You could probably build your own domes around things if you really wanted to, but there comes a point where you kind of go, 'The cost–benefit analysis does not stack up.' So the question is not whether you can protect; it is whether it is worth the investment to protect.

The CHAIR: Thanks very much. Do you have a question you want to put?

David ETTERSHANK: Yes. I am happy to put this as a question, or for you to take it on notice. Given your research I would really like to know what a good estimate is for what Victoria should be spending on adaptation. In your report you say we do not spend much on it, but I am not seeing what is a good amount, so could you perhaps tell us what is? How does what Victoria spends on adaptation compare to other jurisdictions – other states and such like? And following on from that, if there was money applied, what would be the priorities for urgently spending additional funds on climate adaptation measures?

Jonathan SPEAR: Happy to answer that now. Firstly, we do not have a number, because we do not have enough information currently to come up with that number. It relates to the previous question, actually, because we need to do more fine-grain work about the exact places and the highest risks to inform where the investment is. What we do know is that those few cents in every dollar that we are spending on adaptation rather than recovery seems way too low, on any account, when –

David ETTERSHANK: But you have got no benchmarks if we were looking at, say, a percentage of gross state product or something for what would be –

Jonathan SPEAR: No. When you look at other jurisdictions like New Zealand and Canada, they are creating funds that are ranging from hundreds of millions of dollars to – correct me if I am wrong, Caroline – the Canadian one is around $1 billion Canadian. Keep in mind that what we are recommending is that adaptation becomes part of business as usual, so there is an opportunity for us to be using business as usual maintenance funding and targeting that to help some of this task. So it is not all new money, and also when we build new infrastructure, build it so it is a lot more resilient.

Like a number of areas of public policy, we are unlikely to ever reach perfection in this. But what we do need to do is have a greater level of focus and rebalance both the amount of spending we are having on recovery so there is more on future resilience, and make sure that we are at least incentivising some additional investment through a fund that actually focuses everyone's mind so it becomes business as usual. I know that is a somewhat unsatisfying answer to your question.

David ETTERSHANK: Deeply.

Jonathan SPEAR: It is because we need more information and more work about exactly what the priorities should be, and then having done that we should focus on those priorities and those priority risks. Government is always going to have limits to its resources, and that is why we think an application of the sort of approach that we are recommending, which is to do the assessment of risk, prioritise those risks, look at your options, look at the ones that get the best return and then start investing in those – that is the way to go.

The CHAIR: All right, and at that point, Dr Spear, Mr Reynders, Ms Evans, thank you so much for the comprehensive evidence you have given us today. We really do appreciate it. You will receive a copy of the transcript soon for review. And with that, I will declare today's proceedings closed. Thank you.

Committee adjourned.