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

MEMBERS

Ryan Batchelor – Chair
David Ettershank – Deputy Chair
Melina Bath
Gaelle Broad
Jacinta Ermacora
Wendy Lovell
Sarah Mansfield
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John Berger
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Rachel Payne
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WITNESSES

Associate Professor Ailie Gallant, Chief Investigator, and

Dr Kimberley Reid, Research Fellow, School of Earth, Atmosphere and Environment, Faculty of Science, Monash University, Australian Research Council Centre of Excellence for Climate Extremes and Australian Research Council Centre of Excellence for 21st Century Weather.

The CHAIR: Welcome back to the proceedings of the Legislative Council Environment and Planning Committee's Inquiry into Climate Resilience. We are joined by representatives from the ARC centres of excellence for climate extremes and the weather of the 21st century.

All evidence that we take is protected by parliamentary privileges as provided by the *Constitution Act 1975* and the provisions of the Legislative Council standing orders. Therefore the information you provide to us today is protected by law and you are protected against any action for what you say during the hearing, but if you go elsewhere and repeat the 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 we take is recorded, and you will be provided with a proof version of the transcript following the hearings. Transcripts will ultimately be made public and posted on the committee's website.

Welcome. My name is Ryan Batchelor. I am the Chair of this committee and a Member for Southern Metropolitan Region. I might ask other members of the committee to introduce themselves to you. Mr Ettershank.

David ETTERSHANK: Hi, David Ettershank from the Western Metropolitan Region, and I am also the Deputy Chair of the committee.

Sarah MANSFIELD: Sarah Mansfield from 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 morning. Melina Bath, Eastern Victoria Region.

The CHAIR: Online we have –

Jacinta ERMACORA: Jacinta Ermacora, Member for Western Victoria.

John BERGER: John Berger, Member for Southern Metro.

The CHAIR: If both of you could introduce yourselves, give us your full name and the organisation you are appearing on behalf of, then I will invite you to make an opening statement.

Ailie GALLANT: Great. I am Associate Professor Ailie Gallant. I am from Monash University, and I am here representing both the Australian Research Council Centre of Excellence for Climate Extremes and the centre of excellence for weather of the 21st century.

Kimberley REID: I am Dr Kimberley Reid, I am a research fellow at Monash University and, like Ailie, I am also representing the ARC centres of excellence for climate extremes and 21st century weather.

The CHAIR: Wonderful. I might ask, if you wish to make an opening statement, for you to do so now, and then we will proceed to some questions.

Kimberley REID: Good morning. As I just said, my name is Dr Kimberley Reid, and I am a climate scientist. My research focuses on the causes of extreme rainfall, patterns and trends in Australian rainfall and how we can improve rainfall predictions. For the past seven years the Centre of Excellence for Climate Extremes has led national research into fundamental science of climate extremes: what causes them, how they are changing and how they will further change in the future. We represent the leading climate and weather

researchers in Australia, and we are grateful to the committee for inviting us here today. Victoria is a national leader in climate action, and we commend the Victorian government for setting ambitious but necessary emissions targets to reach net zero by 2045. The most immediate and direct way that we can improve climate resilience is to lower greenhouse gas emissions. Surface air temperatures in Australia have already risen by about 1.5 degrees Celsius and are continuing to rise. Resilience to weather and climate hazards has always been necessary. Fires, floods, storms and heatwaves are nothing new to the state of Victoria. However, climate change is now moving the goalposts, so some of these hazards are likely to occur more often and be more severe as our climate continues to change.

I will now outline some of the specific risks to Victoria, but please refer to our written submission for more details. Heatwaves are getting hotter, longer and more frequent and will continue to do so. There is considerable opportunity to increase our resilience to heatwaves through infrastructure, which my colleague Dr Ailie Gallant will discuss more, but also through public awareness campaigns. The intensity of extreme rainfall is expected to increase as well as more frequent swings between very wet and very dry conditions. We need to prepare for the possibility of longer and more intense droughts punctuated by periods of flooding. In other words, our infrastructure needs to be designed to handle both sides of water extremes. With increased heat and drought, bushfire risk will also increase. The number of days with very high fire danger in Victoria has already increased by 40 per cent. Global sea levels have already risen by 20 centimetres, with an additional 20 centimetres expected in the next few decades. This means Victoria's valued coastal infrastructure is at risk of inundation and erosion. Extreme wind and hail can cause considerable damage to the built environment, but since they are short lived and challenging to observe, there is significant uncertainty about their future risks. Finally, as the risk of severe weather increases, so does the risk of compound extremes – that is, when multiple hazards combine to cause greater impacts than if the events had happened separately, such as heatwave followed by a bushfire or two back-to-back flooding events.

The final key point I would like to make in my opening statement is to raise awareness about the rise of highly localised information on climate risk. Regarding future weather risks, we can say in general what is likely to happen over Victoria, but it is not possible to say what will happen on a suburb-by-suburb scale and definitely not on a building-by-building scale. We also want to encourage state and federal governments to use our expertise. We work at the cutting edge of climate and weather science, and this information is crucial for decision-making around climate resilience. Despite the uncertainties in how extreme weather events may behave in the future, there are still ample opportunities to mitigate risks within the present climate. The most immediate and direct way that we can improve climate resilience is to lower greenhouse gas emissions. I will now hand over to Dr Gallant, who will speak directly to the role of infrastructure and the built environment in climate resilience. Thank you.

Ailie GALLANT: Thank you, Dr Reid; and thank you, Chair and committee, for providing the opportunity to speak here today on climate resilience. As I said, I am here representing both centres of excellence. My relevant research expertise is on rainfall variability, drought and heatwaves, and I also have some research experience looking at the interactions between heatwaves and the built environment. My statement today discusses climate resilience, which relates to the built environment and infrastructure in two distinct ways.

The first way concerns the resilience of our built environment and infrastructure to the direct effect of extremes and high-impact weather but also from the longer term climate changes. Climate extremes compromise climate resilience when weather hazards occur together. For example, Victoria experienced periods of concurrent heatwaves, fire and drought during the Black Summer of 2019–20. But resilience is also compromised when we have what we call the cascading effect of repetitive extreme events. For example, that Black Summer was followed by parts of Victoria experiencing extreme rainfall and flooding, in 2021 and again in 2022 and 2023. This repetitive exposure leaves communities and landscapes vulnerable and resources stretched, making recovery and longer term adaptation to the climate more difficult. We expect that some of these weather and climate hazards will happen more often as we move further into a warming world, causing challenges to maintaining infrastructure and resources.

The second way that climate resilience relates to the built environment is that the built environment itself can compound the effects of weather, climate and climate change. For example, the built environment retains heat, known as the urban heat island effect. This effect causes urbanised areas to be warmer than surrounding non-urbanised areas, particularly at night. Heat islands in excess of 5 degrees have been recorded in Melbourne.

We applaud the efforts of the Victorian government in considering climate resilience in planning and for its recovery efforts with the repetitive disasters that we have experienced in recent years. Some key points today that I am happy to provide more detail on include information on urban heating and its effects, including options to mitigate urban heat; other examples of how climate change can be incorporated into planning for the built environment – for example, actions that reduce the impacts of flooding; information on high-impact weather, which is distinct from extreme weather but can have significant impacts that should be considered in planning decisions; advice for incorporating possible future climates into planning processes for the built environment and infrastructure; information on adapting to natural year-to-year variability in addition to climate change to increase climate resilience; and also advice on best practice for using climate science for decision-making on climate resilience. Thank you. We welcome your questions on this important issue.

The CHAIR: Thanks very much to both of you for that statement. Let us start with you, Dr Gallant, on heat and heat island effects. Obviously it is clear from the averages that temperatures are changing at an average level, but you mentioned that there are parts of our community where the extremes are getting worse. I wonder if you can talk a little bit to me about where we are seeing those sorts of intensifications of the effects of those heat islands. Where do we see them the most, and then what are the best steps you think we need to take to recommend mitigation for those effects?

Ailie GALLANT: Absolutely. Urban heat really refers to areas that are built up. These are typically areas like cities, where there is a lot of concrete asphalt and very little vegetation and also where there are concentrations of people. Urban heat really acts in several ways. The concrete itself kind of acts like a big hot water bottle, so to speak, which heats up during the day, and then it re-emits that heat during the night. That is why urban heat islands tend to be more prevalent during the night-time than during the day. But for people in these urban areas, urban areas can also feel hotter during the day simply because there is a lack of shade and a lack of vegetation. That lack of vegetation also means that there is less effective evaporative cooling from that vegetation as well. The areas where we do see urban heat really tend to be in the larger built-up areas, cities like Melbourne and even Geelong, but some studies have shown that they still do have effects even in suburban areas where you have built-up environments.

There are also many studies that show that there are ways to mitigate that urban heat, and there are a few things that we can do. There are things like decreasing the amount of heat that gets into those cities in the first place by reflecting solar radiation that comes down from the sun, so basically painting roofs white. That actually is a really effective way to reduce daytime temperatures, which goes on to have an effect at night, because the cities do not quite get hot enough in the first place. Another way is by increasing the fraction of vegetation: street trees, green open spaces, garden spaces, things like that. The amount of vegetation naturally increases the amount of water that is retained in the cities, and the more water we have, basically the more energy we get from the sun going into evaporation rather than heating, so that acts as an evaporative cooling effect. Those two ways have been shown to be very effective in reducing urban heat.

The CHAIR: Who do you think needs to take responsibility for thinking about these issues, and what mechanisms do you think are best used to address some of these concerns?

Ailie GALLANT: I cannot comment specifically on the procedures by which that should happen. That is outside my area of expertise.

The CHAIR: Sure.

Ailie GALLANT: But yes, I can say that those mitigation options, at least in modelling studies, certainly work very effectively and have been implemented around the world very effectively.

The CHAIR: So things like tree canopies and street trees would all be part of it?

Ailie GALLANT: Yes, absolutely.

The CHAIR: The planning of communities in our cities, where we have got physical infrastructure and parkland together – do you think those would be useful?

Ailie GALLANT: Yes, but also areas where there is an absence of street trees. There have been several studies around the suburban areas of Melbourne that have shown that in areas with mature street trees the

surface temperatures underneath are a lot cooler, particularly on those hot summer sunny days, simply because of the shade. Of course these have big health implications for keeping people comfortable.

The CHAIR: From an urban planning perspective, it is important that as part of our planning processes we ensure that communities are designed with a view to having that kind of canopy grow over time. Obviously it is hard to put mature trees into the ground, but we need to facilitate that growing over time.

Ailie GALLANT: Yes, absolutely. There is an area of building design called heat sensitive urban design, and that has certainly shown that there are many ways to be able to do that, including, as you say, planning for increasing the number of street trees and having large mature trees or at least the potential to grow large mature trees, maintaining green spaces and also things like even some buildings having vegetation growing on the outside of them, for example. Those kinds of things can actively cool cities.

The CHAIR: What happens if we do not prepare like that?

Ailie GALLANT: So if we do not prepare, what ends up happening, particularly as you get urban growth and these cities become larger, is the heat islands become larger. What studies have shown is that heatwaves, for example, tend to have the biggest health effects; remember, the heatwaves are actually the largest killers in Victoria. Particularly during heatwaves we find urban heat islands are worse than they normally are, by around 3 degrees or so. Let us just say you have a normal urban heat island of around 2 degrees; that would mean that you have an urban heatwave of 5 degrees during a heatwave instead of 2 degrees. What that can mean is that increases people's vulnerability to those heat extremes. There are certainly cities around the world right now who are actively incorporating that planning for what we call heat-sensitive cities into urban design and planning to reduce temperatures, because if we do not, we will continue to see urban areas likely warm at a faster rate than non-urban areas.

The CHAIR: Thanks very much. Mr Ettershank.

David ETTERSHANK: Thank you for your presentation today and your submission. One of the barriers that you identify in terms of developing adaptation has been a lack of consistent data across all sectors. I would be interested if you could just elaborate a little bit on why that is a problem and what should be done about it. Do we need a single point of truth? What is realistic?

Kimberley REID: With climate projections, for example, some of these are done on a state-by-state level. So you have the Queensland government running their own projections of climate change and the Victorian government doing something differently. Ideally a sort of national coordinated program to share the data that is available so that we are all on the same page is really important. The second issue is that climate data, particularly future projections, has a lot of uncertainties and caveats which may not be clear to non-scientists, so this data is available and people might just take it at face value. I think what is really important is that climate scientists need to really work with the people who are using this data. I think the uncertainty sometimes frightens people. People want exact answers of what is going to happen to their house in the future, but scientifically we cannot provide that information. That information is still available, but it is just filled with uncertainties, and so I think it is really important that people understand that, although there are uncertainties, we can still prepare and we can still undertake a lot of mitigative action even if we do not have the precision that we might want. Especially climate scientists working with other industries to interpret that data I think is a key thing. Do you have anything to add?

Ailie GALLANT: Just to add, I think particularly with the rise of AI there are a lot of products that at least claim to have very high precision and accuracy, and we would just like to say beware, effectively, because that accuracy and precision just simply is not possible with current knowledge. So it is very important to consider that there are uncertainties in future projections, and we may be heading for a warmer, drier climate. That is what is most likely expected, but there is a possibility that it will become warmer and wetter. So we need to think about these storylines and be prepared for both eventualities in case we do end up going down that warmer and wetter pathway and not the warmer and drier pathway that seems more likely at this stage.

David ETTERSHANK: That is an interesting contribution. You talked about heat islands and street trees and suchlike. I have got Brimbank in my area, which I believe is our hottest region. We are seeing a big push from government now for densification and really tight multistorey built form. How does that work in terms of heat islands and heat retention and suchlike and mitigation for that?

Ailie GALLANT: That is a great question. I certainly think the evidence shows that as you densify you get bigger urban heat islands, but again, there are ways to mitigate that. These are things like not making dark-coloured buildings, for example. Dark-coloured buildings and allowing buildings with black roofs hugely increase the amount of heat that those things retain, whereas lighter colours, even light grey colours as opposed to dark grey colours, actually surprisingly make a big difference to how much heat is retained. As I said before, with heat-sensitive urban design there are also ways to put things like gardens on roofs to help mitigate these things. In my opinion, densification does not come at the expense of being able to mitigate that heat. It is being conscious of it, aware of it and incorporating those ideas into planning so that we do not amplify the urban heat island more than is already there.

David ETTERSHANK: Is any of that currently captured in the planning codes and regulations?

Ailie GALLANT: I cannot comment on that. I am not aware.

Kimberley REID: It is not our expertise, unfortunately.

The CHAIR: They are not planners. I think they are scientists.

David ETTERSHANK: All right. That will be a question for another day. No, that will be fine. Thank you, Chair.

The CHAIR: Ms Broad.

Gaelle BROAD: Thank you very much for your contribution today. What are the most significant barriers at the moment to delaying current upgrades to infrastructure?

Melina BATH: That was an easy question, Gaelle.

Gaelle BROAD: Yes, I know. You are stumped.

The CHAIR: A very narrow one too.

Ailie GALLANT: I think in terms of barriers, I cannot comment specifically on barriers outside scientific barriers as it is not our area. In terms of thinking about the effects of climate change, increasing climate resilience and integrating that into the planning process, I think that is something that the science very much suggests is necessary. As we move forward, we know that we are in a continually changing climate. We are going to be, as Dr Reid described before, moving those goalposts over and over as we move forward through this world of climate change. So the question then becomes how you incorporate that into planning, and I think in our opinion we need to plan for the climate of the future, not for the climate of now. So if we are thinking of infrastructure that will be around in 2070, you need to build that infrastructure for the climate of 2070, taking into account that it needs to be resilient to a range of things that might happen. This brings me to the second point for planning, that we need to adapt to not only a changing climate, but a variable climate. As we said before, things like fires, things like heatwaves, things like floods are nothing new. The climate is variable and we go up and down. We will never have a situation where a future climate will get rid of floods – we will always have floods – so in planning we have to be resilient to the fact that hazards will always be there and that climate variability will always be there, as well as these shifting goalposts of climate change. I hope that answers your question.

Gaelle BROAD: Yes. No, we certainly are continuing to see building happening in flood zones in Northern Victoria Region, so it is a concern. You have talked a lot about the metropolitan situation, but do you feel regional areas are very vulnerable to things like hail and floods, fires, droughts? What are your thoughts on that?

Kimberley REID: Absolutely. I think regional areas in particular are very vulnerable to wildfires, floods, droughts and hail at times as well. I think one of the barriers in my opinion is just lack of public education and public awareness, which I think is something that could be overcome relatively simply, especially when we have relatively cheap mitigation options, like having a white roof, that people could implement on their own places, but I would assume that most people probably do not realise that. I think public awareness of the hazards that are around in people's environment and how they can take relatively simple measures to prepare, for example, even for a bushfire risk – I mean, there is a lot of education in Australia about clearing vegetation

around your home, which is really good, but even for other risks like clearing your gutters, or having succulents near your window is apparently something that can help reduce fire risk because there is more moisture in the plants to prevent the fire burning your house. So all these simple measures I think just could be part of a public awareness campaign that individuals can do on their own properties to prepare.

Gaelle BROAD: You talked a lot about the need for white roofs and to avoid the dark. I know in Colbinabbin there is a large solar project development and locals are concerned about the microclimate and the impact, because it is literally – how many is it? It is millions of panels that are going into that area –

Wendy LOVELL: 740,000.

Gaelle BROAD: Yes. Well, there you go – thousands, I should say, of panels.

Wendy LOVELL: And 300 batteries the size of shipping containers.

Gaelle BROAD: Yes. So when I was there it is huge – it is paddock after paddock after paddock that will be filled with –

Wendy LOVELL: 645 hectares.

Gaelle BROAD: Yes, 645 hectares. Thank you. Wendy has been there too recently. So I am interested in your comments on that, because there are a lot of vineyards in the region that expressed a lot of concern about the changes to the climate. Obviously it happens with roofs in metropolitan areas, but what are your thoughts about the impact on that town?

Ailie GALLANT: I cannot comment specifically on that development. We would have to do research to have a look at that. But what I would say is that with urban heat islands, they do not tend to impact outside the urban area, so any heating is contained within the city or area itself. I am not sure what the implications are for something like a solar farm – again, I cannot comment on that specifically – but at least in urban environments, you can go 5 kilometres out to a rural area and you will not see that urban heat island impacting so much. But in terms of other barriers or things that are actually happening now for regional areas, some of the other things I can comment on are, as an example, the Australian rainfall and runoff guidelines that are used for flood estimation for engineers have actually just been updated nationally to incorporate climate change. So some of those things have already happened, and I am aware that some local councils in Victoria in regional areas are coastal towns. Coastal councils have incorporated sea level rise into their planning decisions. I think those things are already happening, but I am also aware that there are perhaps inconsistencies in what councils can do and then taking that up if people are not happy with that decision.

The CHAIR: I will go to Ms Ermacora. We might be able to pick it up in the course of those questions.

Jacinta ERMACORA: Thank you and thank you for being here today. It is intriguing to listen. I just want to stay with page 5 of your submission, in particular where you have said:

> Socio-economic advantage is also strongly correlated with urban heat in Melbourne …

and then you cite Brimbank with +10.75 degrees Celsius compared to some other areas. Can you just tell me a little bit more about that, perhaps the inequality or the unequal spread? Then I am going to ask you about what action or solution or recommendation you would make. The first question is: tell me about that inequality of heat.

Ailie GALLANT: The socio-economic issues around heat mainly are associated with extreme heat and the ability of people to cool themselves. As I said, the urban heat island acts usually at night, but we know that particularly in people aged over 65 we get an increase in mortality – that is, deaths – when we have daily minimum temperatures above 24 degrees Celsius. We get an increase of around 20 per cent in excess deaths when that occurs. So the socio-economic argument comes into this when we think that those in areas with socio-economic disadvantage are less able to cool themselves. I am aware that there have been efforts for awareness campaigns and emergency alerts for heat in the last few years to make people aware of extreme heat on days forecast to be a heatwave day or an extreme heat day and to go to their local shopping centre or find a place with air conditioning or use fans and things like that to cool themselves. But that is largely where those socio-economic issues come in. Also, those areas of disadvantage also tend to be those more industrialised

areas, with fewer street trees, things like that, so they often tend to be a little hotter as well simply because they do not have those things that we spoke about before.

Jacinta ERMACORA: Yes, thanks. I am interested that there has been already discussion about lots of future planning and you are recommending that. But we have got these areas that are already experiencing climate change in an unequal way, and it is not just the Pacific Islands, it is also Brimbank. I would also suggest there are urban communities in regional areas that would also experience it more than some others in leafy suburbs. What would you recommend about the present and even to mitigate or redress that inequality? Do you have some kind of recommendation to do that? Because it is one thing to look forward and plan all future roofs to be white –

Ailie GALLANT: I think there are many ways that we can reduce people's vulnerability to things like heat and other aspects of climate change as well. Heat is the most obvious one, but as an example, I just spoke about the heat warning system, supplying people with fans at least, if not air conditioning. There are also things like heat relief centres, so places where people can go for air conditioning and things like that, or those awareness campaigns we talked about before and providing that immediate relief. I think those are the most obvious ones that would be available.

Jacinta ERMACORA: Would you support the notion of work being undertaken in the space of climate resilience equality?

Ailie GALLANT: I think I would support that, yes. Absolutely.

Jacinta ERMACORA: Thank you.

The CHAIR: Dr Mansfield.

Sarah MANSFIELD: Thank you. Thank you for your presentation and for your submission. You referenced the idea of best practice using climate science in decision-making. One thing that I think occurs is because decision-making at all levels of governments is often slow there can be big lag times in terms of incorporating science into eventual decisions. You mentioned sea level rise being incorporated into the planning decisions of some councils, but they are having to rely on the Victorian planning provisions, which have a benchmark level of 0.8 metres sea level rise when it is widely acknowledged that that is very much out of date now, and it is expected to rise more than that. The lag timing in updating those provisions means that those councils are really going to have to wait until that is adjusted before they can make further changes. What I am wondering about is do you have recommendations on how to better incorporate climate science in a more nimble way into the decision-making processes that does not mean we are always 10 steps behind? Another example might be in flood modelling where you will have flood modelling that is done, it is not updated for 10 or 20 years, and then suddenly there is fresh flood modelling done that shows that actually a whole area is at risk of flooding, because of again that lag time in updating the data and the information.

Kimberley REID: I really think this speaks to Dr Gallant's point about preparing for a future climate. A lot of the flood modelling will be based on the present climate, so the rules that are 20 years old are based on what was done 20 years ago, but if we are already incorporating the future climate information into the current policies, then we are at least already planning for the future flood risks today.

Ailie GALLANT: I would echo that. I think by planning further into the future perhaps than you think you need to to bake in that planning time you may end up being slightly over resilient – if that is a thing – but you at least have that resilience baked in from the start. I think continued dialogue with not only climate scientists but also other experts so that you are at the forefront of the science; oftentimes the science that is being incorporated into some of these things – we have talked about the rainfall run-off estimations. That is science from a decade ago that is being incorporated now, so continued dialogue with experts. I commend the fact that there is a climate science report that is put out and tabled in the Victorian Parliament every five years.

Melina BATH: It is due.

Ailie GALLANT: It is. I think things like that are a very good thing to keep updated with the science. But I think, yes, continuing dialogue is a way to do that, not only with climate scientists but other experts as well.

Climate change does not work in silos, and neither should we. So consulting in a very interdisciplinary way is very useful.

Sarah MANSFIELD: Are there models of that sort of practice that either exist in certain parts, whether it is in Victoria already or in other jurisdictions, that you can cite where –

Ailie GALLANT: I believe there are models. I am not aware of them though. That is outside my area of expertise.

Sarah MANSFIELD: No worries. In terms of the issue around the built environment itself contributing to climate resilience, you mentioned heat islands. Are there other ways that the built environment can contribute to climate impacts?

Ailie GALLANT: Absolutely. One of them is with respect to flooding. Obviously surfaces like concrete and asphalt are largely impervious, so we do not get water that falls from extreme rainfall events, for example, seeping into soil as it would in a forest; instead it runs off. That can hugely amplify or even create, effectively, things like flash floods under extreme rainfall events.

Sarah MANSFIELD: What sorts of things can be done to reduce that? Again, I guess we have got increasing urbanisation and density in some areas, more concrete and more asphalt.

Ailie GALLANT: Porous concrete exists. I believe it is more expensive, but it does exist. Again, maintaining the presence of soil via green spaces and things like that have certainly been effective with reducing run-off in cities which leads to flooding.

Sarah MANSFIELD: Thank you.

The CHAIR: Ms Lovell.

Wendy LOVELL: Thank you. I am sitting here having deja vu. Dr Reid, did you give evidence to us for the flood inquiry?

Kimberley REID: Yes.

Wendy LOVELL: Thank you. That solved that one. Ailie, sitting here it is like you are channelling my dad. It is like having a conversation with him, so I am loving your presentation. We talked about heatwaves, infrastructure and the need for tree canopies and stuff. Current planning is not really going down that line. We are seeing more and more smaller blocks in new estates, where we are seeing houses built on every square inch of the block within a metre of each other, no gardens, no trees and no eaves on the house. Even though they are saying they are building them to 5, 6, 7 stars or whatever, there is none of that tree canopy or verandas for mitigating heat in the homes. Also we are seeing infill in the traditional suburbs. The quarter-acre blocks and now the backyards are being built on, again reducing that green space, and now we are hearing about additional towers being put into many of these areas as well. I just wonder if you think that the current planning settings are correct or whether they need to be looked at. Obviously we need more homes, but we are now seeing these very tiny 400 square metre or smaller blocks creeping out into the regional areas. Gisborne and Sunbury are full of them, where there is just no room between these houses. Even at Riddells Creek now they are talking about a development that would double the size of the town and completely change that town, with places where some of the blocks are as small as 100 square metres.

Ailie GALLANT: I cannot comment on whether the planning settings are correct. What I can say is that, from a heat perspective, densification will increase your urban heat island. However, there are ways to reduce its effects, so incorporating those ways, as I have already spoken about, is a way to at least partially mitigate that. But from a science perspective you will get more widespread urban heat in denser areas. That is what I can say.

Wendy LOVELL: During the last election we had a policy about increasing tree canopy in some of the older suburbs in Melbourne, and when it came out I was really surprised. I grew up in Williamstown, and Hobsons Bay was one of the areas that had the least tree cover. When I thought about it, I thought, 'I walked from home to the shopping centre, and there wasn't a tree, not even on the street.' They have now put in some

jacaranda trees and stuff, but obviously those older settled areas were completely cleared. Are there any sorts of recommendations or policy settings for increasing tree canopy in some of those areas?

Ailie GALLANT: I am not aware of the settings, but what I can say is that street trees are certainly a very effective measure to reduce urban heat. You can see from the data that when you have a street lined with big, tall canopy trees you have a cooler street, so encouraging that would certainly be a way to reduce the urban heat island across the city.

Wendy LOVELL: I just want to go back to the solar panels. Gaelle talked about the proposal at Colbinabbin, a huge proposal. We have also had them built within the irrigation area. Every time one of these goes in there is significant concern in communities about the heat island effect. In Colbinabbin there are a number of wineries that are close by. They are really concerned about it changing their microclimate and the effect that that would have on their grape growing. We have had it in places just out of Shepparton where it has been in amongst orchards and things like that. You said there is no evidence that there is a heat island effect in regional areas, but have you looked at the microclimate effect on horticulture and agriculture in the areas?

Ailie GALLANT: No. There is no evidence because there is no research on it. It is not that there is no evidence. There is simply no research on these things, as I am aware. I am happy to take it on notice and go and look for some, but I am not aware of anything at this stage.

Wendy LOVELL: So that could be a recommendation that we make?

Ailie GALLANT: Yes.

Wendy LOVELL: That there is the research done, yes.

Kimberley REID: There is evidence showing people working with the solar farms – so farmers using them to provide shade for their animals or people putting solar panels over dams to prevent evaporation and loss of water. So I think there are ways that we can work with the solar farms too.

Wendy LOVELL: There is not much room around them to do anything else in those paddocks.

Kimberley REID: No, but –

Wendy LOVELL: Other than maybe having a few sheep to keep the grass down, it is not conducive to running a –

Kimberley REID: Just finally, the impacts of climate change if we do not transition will be far worse on these communities than the microclimate impact.

The CHAIR: Thank you. Mr Berger.

John BERGER: Thank you, Chair. Thank you both for your appearance this morning. Your submission addresses storms and extreme wind events. To what extent are the extreme wind events like those in February and September this year influenced by climate change?

Kimberley REID: Extreme wind is unfortunately very challenging to observe, because it happens so quickly and we are relying on station data, which is scattered around, to observe these events. So unfortunately there is a lot of uncertainty surrounding this. However, what we can say is that we expect thunderstorms to become more intense as the climate warms, and that therefore means more intense windstorms when they occur.

Ailie GALLANT: As Dr Reid said, unfortunately again, the research is lacking in this area simply because wind is so hard to observe. This is an active area of research in the centre of excellence for the weather of the 21st century, but we are a very new centre, so that has not been undertaken yet. But I cannot add much more to what Dr Reid said – only to say that this is an active area of research and unfortunately we do not have the answers to that at the present time.

John BERGER: Just over September, anyway, the wind events we have had have been quite damaging and quite fierce. I have never seen anything like it in some areas, and I just wonder, well, where is this all coming from? It just seems to intensify with each event. So I am looking forward to that research.

Kimberley REID: We can say that strong winds are caused by strong differences in temperature gradients. We often get big wind events in spring in Victoria because the ocean is still cold. The ocean still thinks it is winter, whereas the land is beginning to heat up as our winters, in particular, get warmer. So if our winter is warm, we can get much hotter land temperatures and therefore stronger differences in the temperature between the land and the ocean, and this may enhance some of the strong wind events in spring that we are seeing.

John BERGER: Thanks, Chair.

The CHAIR: I am just trying to understand the science drivers behind the wind events. Clearly one of the issues that you mentioned is that we have an observational problem – that it is hard to observe these wind events because of the location of observation stations – but climatically it is reasonable to expect more of them because they are generated by the differences in, essentially, surface and air temperatures. Is that right?

Kimberley REID: I think particularly for spring we have had some pretty warm temperatures just coming out of winter, so with the oceans still being much colder than the land those stark contrasts in the temperature across the land and ocean can cause huge wind events, which we saw a couple of months ago in Victoria. We also do expect storms to become more intense, and that is when we get our really big wind events.

The CHAIR: Okay, thank you. Ms Bath.

Melina BATH: Thanks, Chair. Thank you for your evidence. It is a very big pot of worms. There might be some questions that you can take on notice from me. I do want to go to coastal inundation and coastal communities. We have got roughly 3000 kilometres of coast in Victoria. We have got roughly a hundred towns, and we have got well over a million people who live in those towns. You are talking about risk. You said, and I am not trying to get you, that there is scientific uncertainty in relation to a lot of this data because we cannot go forward 75 years to 2100. But the government has put out a sea level rise by 2100 at 0.8 metres and has therefore put a planning inundation overlay on those. We have seen people being knocked back for planning in our regional communities – in our coastal communities. I want you to talk from a scientific point of view, with an overlay for us that we are making recommendations to government, on where we need to ask government for more help. Where does the boundary lie between mitigation – you have talked about mitigation quite a bit, and rightly so – and elimination of risk? What more support do communities need to help prepare our coastal communities in this case? What do we need to tell government?

Ailie GALLANT: One thing I would say, to go back to your first point around the uncertainties, is with future climate change uncertainties in some areas we are very confident with what is going to happen. Sea level rise is one of those. Temperature is another one of those. Uncertainties happen at the more local level, and unfortunately with things like rainfall that is where the larger uncertainties lie. The uncertainties around sea level rise I would say are small. We should expect significant sea level rise into the future, and coastal communities should be planning for future sea level rise.

Melina BATH: How can government support those coastal communities? Because otherwise it ends up being on the local council and individuals. What is our recommendation to government on that?

Ailie GALLANT: I think that is something that we probably cannot answer specifically, because our expertise is not in the policy and planning area, it is in the science area. You talked about the coastal sea level rise. There are data portals and things that have done this modelling and show the areas. The other thing we have to consider with sea level rise is there is the general trend but then there are also changes in storms, and those changes in storms can lead to what we call storm surge. That is the winds pushing the ocean in, and that leads to an extra risk as well. There have certainly been ways that local councils, for example, have mitigated that risk or reduced that risk through beach nourishment, building seawalls and things like that. Sea level rise unfortunately is one of those things that are baked into climate change for a very long time. We will continue to get sea level rise with current climate changes for 100 more years – many, many more years – into the future. You talked about elimination versus mitigation –

Melina BATH: I just want you to quickly delve into that, or take it on notice.

Ailie GALLANT: Eliminating risks is obviously a very difficult thing to do. Mitigating risks is a lot easier to do. Eliminating risks with ever shifting goalposts with sea level rise would be quite drastic measures for planning I would think.

Melina BATH: As a scientist what does the state government need to do to support those communities better?

Ailie GALLANT: I think identifying the risks and the areas of coastal inundation that are likely and communicating those risks.

Melina BATH: Thank you. I have got a lot of questions, but I am going to run out of time. You said beach nourishment, and you are not opposed to beach nourishment where it is applicable, or walls, like for hard engineering solutions where it is –

Ailie GALLANT: Beach nourishment and seawalls have been measures that have been implemented to reduce the effects of sea level rise.

Melina BATH: Thank you. I have got another question, which you might take on notice for me. Have ARC scientists looked into the volume of CO_2 emissions that occur in a broadscale, large-scale bushfire? I would say, for example, in 2019–20 across all of Australia, but you can use Victoria. Have you done any quantifiable assessment on that? Then I guess my other question would be in relation to what ARC's view is on the practical application of reducing that, broadscale. Reducing to net zero is great, but what else? That is one facet, but we need to have operations on the ground that are working now to mitigate bushfire.

Kimberley REID: There has been research into the carbon emissions coming from bushfires. I do not have the numbers off the top of my head, but we can take that on notice.

Melina BATH: Thank you very much for that. And the second part – is that something that you might be able to take on notice as well?

Kimberley REID: As in what we can do during a fire?

Melina BATH: No, practically. House roofs are one thing, and succulents at the window, but with these mega fires what practical applications would ARC be looking at to mitigate bushfires, i.e. preventative burns or manual fuel reductions, those sorts of things. What is your position on that?

Ailie GALLANT: That is outside the remit of our centre. We do not deal with planning decisions around bushfires. We investigate weather related to bushfires but not necessarily the bushfires themselves.

Melina BATH: Okay. All right.

The CHAIR: Thank you, Ms Bath. Dr Reid and Dr Gallant, thank you so much for joining us today. You will be provided with a copy of the transcript to review before it is published. With that, the committee is going to take a break for lunch.

Witnesses withdrew.