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**TRANSCRIPT OF PROCEEDINGS**

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O/N H-945335

**MR B. WALKER SC, Royal Commissioner**

**IN THE MATTER OF THE MURRAY-DARLING BASIN ROYAL COMMISSION**

**ADELAIDE**

**2.26 PM, TUESDAY, 23 OCTOBER 2018**

**Continued from 27.9.18**

**DAY 32**

**MR R. BEASLEY SC, Senior Counsel Assisting**

MR BEASLEY: Good afternoon.

PROF TSCHAKERT: Hello. Good afternoon.

5 MR BEASLEY: Is that Professor Tschakert.

PROF TSCHAKERT: Yes.

10 MR BEASLEY: Have I pronounced your name correctly? I know you told us the other day, but then you told us to call you Petra and, today, I have to call you Professor Tschakert. So did I say it right?

PROF TSCHAKERT: That's fine with me, indeed.

15 MR BEASLEY: Okay. Very good. Well, we're about to – just before we take evidence from you, Professor, can I begin, Commissioner, by saying we acknowledge this land that we meet on today is the traditional lands of the Kurna People who we respect has a spiritual relationship with their country. We also  
20 acknowledge the Kurna People as the custodians of the Adelaide region, and their cultural and heritage beliefs are still as important to the living Kurna people today.

Commissioner, this afternoon, we have Professor Tschakert from the University of Western Australia and Professor Mark Howden who is Director of the Climate Change Institute at the Australian National University. They have both had a role as  
25 authors or editors of the recent Sixth Assessment Report by the International Panel on Climate Change. There is a – before we take evidence from Professor Tschakert, there is a huge number of documents that have to be tendered. By huge number, I mean hundreds. I won't do it today. We're going to do it by means - - -

30 THE COMMISSIONER: Can we do it by - - -

MR BEASLEY: - - - of giving you a list.

35 THE COMMISSIONER: - - - just a list? Yes.

MR BEASLEY: Yes. All right. Now Professor Tschakert, you told us before you would like to take an affirmation, rather than swear on the Bible; is that correct?

40 PROF TSCHAKERT: That is correct, indeed.

MR BEASLEY: All right.

45 <PETRA TSCHAKERT, AFFIRMED [2.29 pm]

**<EXAMINATION-IN-CHIEF BY MR BEASLEY**

5 MR BEASLEY: First of all, I apologise for the delay, Professor. It's one of a number of technological problems we have had due to budgetary constraints with this Royal Commission. Professor, you have a PhD from the University of Arizona in arid lands resource science; is that correct?

10 PROF TSCHAKERT: That's correct, indeed, yes.

MR BEASLEY: And you also have a degree from Karl-Franzens University in Austria. What's that degree? I've got medfield written here, and I'm not sure whether that's equivalent of a master of philosophy.

15 PROF TSCHAKERT: That is, indeed, the equivalent of a master in philosophy, and I have a double major in geography and economics and French.

20 MR BEASLEY: All right. And you are currently the Centenary Professor in Rural Development at the University of Western Australia, and you've held that position since May 2015?

PROF TSCHAKERT: Correct.

25 MR BEASLEY: And you have recently had an involvement as an author in the IPCC Assessment Report Number 6; correct?

PROF TSCHAKERT: Actually, we call it the Special Report on 1.5 Degree Global Warming - - -

30 MR BEASLEY: Thank you.

PROF TSCHAKERT: - - - which is part of the sixth assessment cycle, but it is a special report.

35 MR BEASLEY: All right. Thank you for that clarification, and can I just ask you, you were one of the drafting authors of the summary for policy makers; correct?

PROF TSCHAKERT: That is correct.

40 MR BEASLEY: You also, I think, were a contributing author to Chapter 3.

PROF TSCHAKERT: That is correct as well.

45 MR BEASLEY: Just let me find my reference to that. Chapter 3 was on the Impacts of 1.5 Degree Celsius Global Warming on Natural and Human Systems; correct?

PROF TSCHAKERT: That is correct, yes.

MR BEASLEY: You were a contributing author, but you were a lead author for Chapter 5, which is on – essentially on adaptations. The chapter is called Sustainable Development, Poverty Eradication and Reducing Inequalities.

PROF TSCHAKERT: I would like to correct you here.

MR BEASLEY: Yes.

PROF TSCHAKERT: I was coordinating lead author of the chapter.

MR BEASLEY: I was about to correct myself.

PROF TSCHAKERT: I have a ..... with two other coordinated lead authors.

MR BEASLEY: Yes. All right. And you are listed as both, under Australia and Austria, as a contributing lead author.

PROF TSCHAKERT: Yes, that was an executive decision by the technical support unit to list all authors who have passport in one country, but work in another country to list them with both countries. So it was not a personal decision, but an executive decision of the lead - - -

MR BEASLEY: It's not a typographical error. Can I ask you to go back to basics? What is the International Panel on Climate Change and what does it do?

PROF TSCHAKERT: It's called the Intergovernmental Panel on Climate Change and it is the scientific body that assesses the state of the ..... knowledge on climate change. The IPCC does not conduct research itself. Its mandate is to study the literature, the available literature, and to synthesise it either in regular large assessment reports, and we have completed the fifth assessment report in 2014, or to address the literature on a very specific topic, as we had it, in this case, on 1.5 degree global warming.

THE COMMISSIONER: Professor, I should understand this as being what in other areas I would call a review function; is that right?

PROF TSCHAKERT: It is, indeed, a review, correct, as we assess the available literature and synthesise it.

THE COMMISSIONER: Now, the copies I've got have a rather peremptory message on every page:

*Do not cite quote or distribute.*

And I wondered whether I should have added to that, “Indeed, do not read it.” I’m joking. I assume that was an embargo pending final approval by your group. Is that correct?

5 PROF TSCHAKERT: It’s actually not an embargo, but we are in the last stage of editing and correcting any potential misspellings. The content stands, but the final version will be released as soon as our final editorial changes are completed, and this will probably be next week.

10 THE COMMISSIONER: I don’t wish – my report will be later than next week, I can assure you. So it won’t embarrass your group, I hope, if we do, in fact, cite and quote from this material: is that right?

PROF TSCHAKERT: You may do so, indeed.

15

THE COMMISSIONER: Thank you.

PROF TSCHAKERT: Just keep in mind is that if you do cite, the page number may shift - - -

20

THE COMMISSIONER: Of course.

PROF TSCHAKERT: - - - given some editorial changes. So what you cite currently on page X may actually not be on page X when the final document comes out. Keep in mind, as well, there will be some final layout questions regarding the cover page and so on. The content will not change.

25

THE COMMISSIONER: Thank you very much.

30 MR BEASLEY: Just a couple of basic things with the report, and it uses the terms “high confidence, medium confidence, low confidence” and other terms like “very likely, likely, unlikely”. They’re specifically defined terms in the report; correct?

PROF TSCHAKERT: Correct.

35

MR BEASLEY: And we – the guidance for that is at – Commissioner, is at page – chapter 1, page 40.

PROF TSCHAKERT: Yes.

40

MR BEASLEY: I take it you – do you have a copy of the assessment report with you? You don’t have to get it now, I’m just asking. You’ve got - - -

PROF TSCHAKERT: I have the summary - - -

45

MR BEASLEY: You’ve got the summary. All right. I was going to ask you some questions about Chapter 5. Do you have Chapter 5?

PROF TSCHAKERT: I do, yes.

MR BEASLEY: All right. Good. So I'm just taking the Commissioner to section 1.6. You will see there, Commissioner - - -

5

THE COMMISSIONER: Yes.

MR BEASLEY: - - - "very low, low, medium high", etcetera, is defined as is "in terms of likelihood, likely, for example, greater than 66 per cent", etcetera.

10

THE COMMISSIONER: Yes, thank you.

PROF TSCHAKERT: So I – if it helps, let me clarify.

15 MR BEASLEY: Yes, please do.

PROF TSCHAKERT: The IPCC has a norm to use likelihood statements when quantitative evidence is available. So everything which comes out with models, which comes out as – out of measurements, in a sense, quantitative is assessed by using the likelihood scale.

20

MR BEASLEY: Yes.

PROF TSCHAKERT: And that's in per cent probability.

25

MR BEASLEY: Yes.

PROF TSCHAKERT: There is, however, a large body of literature that does not use quantitative assessments and for this body of literature, including much of my own work, the confidence statements are used, and confidence is always derived from agreement and evidence.

30

MR BEASLEY: Yes.

35 PROF TSCHAKERT: So how much evidence is there in the literature on the particular issue and how much agreement there is? If you have robust evidence and high agreement, and you will see that in the confidence guidelines, automatically, you will get high confidence.

40 MR BEASLEY: Is that affected at all by – I mean, I imagine there's publications that have – and no doubt universities and, perhaps, even authors that have a certain reputation and others that don't. I mean if 99 scientists from reputable universities said it's likely that temperatures will increase by 1.5 degrees by 2030 and Lord Monckton says, "No, they won't", you wouldn't say that there's contrary evidence,  
45 would you? It depends on it - - -

PROF TSCHAKERT: No.

MR BEASLEY: - - - being reputable peer reviewed publications; correct?

PROF TSCHAKERT: So we assess quality as well as quantity; correct, yes.

5 MR BEASLEY: Yes. All right. Thank you. You describe yourself to us as a human environment geographer. Can you explain what that is because I want to leave it to your area of specialist knowledge?

10 PROF TSCHAKERT: Yes. So, I'm a geographer by training, but geography has several subfields. You can be a physical geographer and work on geomorphology, you can be a human geographer and work on demographics or economic geography. I'm a human environment geographer because I work at the intersection of livelihoods, people's wellbeing and environmental sustainability. So I'm interested, particularly, how people who live at the margin of society, whether that's the social  
15 or environmental margin of society, eke out a living, how they understand environmental changes, how they understand climate change, what they can do about it and how we as researchers, as scientists, can facilitate adaptation, decision-making in an uncertain future. So I work at the intersection of human geography and physical and environmental geography.

20

MR BEASLEY: All right. So if you forgive me, I don't want to take you – I think I will deal with the summary aspects of Chapter 3 with Professor Howden. I want to stick to Chapter 5 with you because it's an area you obviously have your main line of specialist expertise, and I imagine that's why you were one of the three coordinating  
25 lead authors; correct?

PROF TSCHAKERT: Correct.

30 MR BEASLEY: Do you have a copy of Chapter 5 with you?

PROF TSCHAKERT: Yes, I do.

MR BEASLEY: I can't give you a – each chapter has got a – starts at page 1.

35 THE COMMISSIONER: No, no, no, that's all right. I've got it in front of me.

MR BEASLEY: And, interestingly, they don't use paragraph numbers either, Commissioner.

40 THE COMMISSIONER: I'm just holding my tongue on that.

MR BEASLEY: Just looking at the executive summary on page five dash – or page 4 of this chapter, I was interested to see there's actually a definition of sustainable development in the glossary which I wanted to particularly draw the Commission's  
45 attention to because – this is glossary at page 49, Commissioner:

*Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.*

THE COMMISSIONER: Sorry, page - - -

5

MR BEASLEY: If you go down to the glossary.

THE COMMISSIONER: At page?

10 MR BEASLEY: At page 49 of the glossary.

THE COMMISSIONER: Of the glossary. Hang on.

15 MR BEASLEY: Yes. So there's a number of – almost all these terms are defined.

THE COMMISSIONER: Got it. Got it - - -

20 MR BEASLEY: So just bear with me, Professor. When we get to a defined term, I'm going to assist the Commissioner by taking you to the glossary.

PROF TSCHAKERT: Yes.

THE COMMISSIONER: I have it now, thank you.

25 MR BEASLEY: So, 49, the reason for taking you to that, Commissioner, is you will see that:

30 *Finally, sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs and balances social, economic and environmental concerns.*

So there is a triple bottom line. It's just not in the Water Act, but it's here.

35 THE COMMISSIONER: Yes.

MR BEASLEY: So this chapter is really about ideas and approaches for people to adapt to a future where the climate is changing, particularly, if it's getting warmer and dryer.

40 PROF TSCHAKERT: Yes and no. So this chapter addresses a particular aspect of the special report which is captured in the title.

MR BEASLEY: Yes.

45 PROF TSCHAKERT: And this is a very long title, but it says at the very end of this long title 'In the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development.' So "in the context of sustainable

development and efforts to eradicate poverty”. So Chapter 5 looks particularly at “in the context of sustainable development and efforts to eradicate poverty”. Both Chapter 3 and Chapter 4 deal more explicitly with adaptation than Chapter 5 does. However, Chapter 5 assesses both adaptation and mitigation in the context of sustainable development and in the context of the sustainable development goals, SDGs, as was in the mandate, the plenary approved outline for this particular chapter.

MR BEASLEY: And adaptation itself is defined in the report, and there’s three – well, there’s two kinds of adaptation discussed: incremental adaptation and transformational adaptation. Can you explain those to the Commissioner?

PROF TSCHAKERT: Yes. So adaptation is a concept that is widely used in climate change scholarship and in climate change practice. So the simplest – the most simple definition, if you want, of adaptation is adjustment to changes that are observed. Incremental adaptation, and we have the definition – I suppose you have it in front of you as well, in – from the glossary means that the essence and the function and the integrity of the system and ecosystem or process is maintained, and its incremental meaning ..... transformational adaptation is taking adaptation a step forward with the goal to transform the system, an ecosystem, a socio-ecological system that, in itself, has proven unsustainable or incapable of adapting to any further changes.

There are other definitions of adaptation that researchers use that are used in the publications that underline the IPCC and the special report, including one that I used personally which is adaptation are all efforts to reduce risks from climate-related hazards and protect the things we collectively, individually value. So keep in mind the adaptations in the glossary are always a consensus-derived wording, and those that you see here that are used systematically in the report, summary for policy makers and the underlying chapters.

THE COMMISSIONER: Professor, just to give me a concrete understanding of how this language conveys the relevant concept, if one were to propose that in a particular region, in order to recognise a significantly increased risk of unavailable irrigation water, that the farming in that region move from irrigated rice, say, to dry land wheat. Would that be just a rather large step in the way of incremental adaptation, or would it be transformational adaptation?

PROF TSCHAKERT: It would fall in the transformational adaptation because the type of agriculture would indeed radically change.

THE COMMISSIONER: Yes.

PROF TSCHAKERT: You can think about incremental adaptation within, to use your example, rice-based agriculture by drought proofing or flood proofing the cultivars of rice, but you would still stick to rice as your main cultivation method.

THE COMMISSIONER: Yes.

PROF TSCHAKERT: Whereas dry land farming for floodplain raising would be a type of transformation adaptation.

5

THE COMMISSIONER: Thanks very much.

MR BEASLEY: When we had a discussion the other day, we were discussing the Murray-Darling Basin community's reaction – or at least part of the community's reaction to the publication of the Guide that was published before the Plan was legislated and various protests and the Plan being burnt, and you indicated, perhaps, a lack of surprise at that reaction, given that the Plan – the Guide was more or less handed to the community and their reaction simply sought without any further work done. You've described adaptation to me as a far more complex process involving sitting down with groups of people, working out their goals, having frank discussions about their aspirations, how they might fit in with changes to climate. Can you explain that further to the Commissioner?

PROF TSCHAKERT: Yes. So two points here. The first one is very simple. If you stick to the glossary, you have another term slightly further down on the adaptation, and that term is adaptation pathways.

MR BEASLEY: Yes.

PROF TSCHAKERT: And then there's a reference to pathways. Maybe, first, looking up that term on the pathways because I'm going to use it in just a moment.

MR BEASLEY: And - - -

PROF TSCHAKERT: So if you look – scroll to pathways - - -

MR BEASLEY: If it helps you, tell me if it doesn't, but there's a pathways into the future diagram, I think you referred us to at Chapter 5 at page 34. I don't know whether you want to use that in the course of your explanation.

35

PROF TSCHAKERT: I will, indeed.

MR BEASLEY: Okay.

PROF TSCHAKERT: Let's go step by step.

MR BEASLEY: Yes, please. Go ahead.

PROF TSCHAKERT: So if you want to scroll to pathways which is on page 40 of the glossary.

45

MR BEASLEY: Yes, 39 on mine.

PROF TSCHAKERT: Yes, it says - - -

THE COMMISSIONER: We have got it, yes.

5 PROF TSCHAKERT: It says “adaptation pathways”, and I’m going to read it and then explain why it is widely used in publications and research as well as in practice. It says:

10 *A series of adaptation choices involving trade-offs between short-term and long-term goals and values. These are processes of deliberation to identify solutions that are meaningful to people in the context of their daily lives and to avoid potential maladaptation.*

So let me explain.

15

MR BEASLEY: Yes.

PROF TSCHAKERT: 10, 15 years ago, most research on climate change adaptation looked at adaptation options or strategies. You know, hard adaptation, building a dam; soft adaptation, for example, using seasonal climate forecasts. These are all options, individual strategies. But the realisation has been that it is actually not about these individual strategies or options, and it’s not even about finding a right mix for these options. It is really much more a process of decision-making. So the understanding of adaptation has shifted from an action to a process. Decision-making, deliberation, of learning to incorporate new insight, experiences, new climate information at every critical junction along the way. So there is growing research on adaptation pathways as decision-making processes that involve a set of actions that are sequenced over time.

30 So we can think about adaptation as certain strategies and options that make sense on the given body of knowledge. We can think about them as identifying low hanging fruits, or no regret options, to identify those strategies first that will not cause any harm to other options or to particular ecosystem functions, to particular social functions. And if we can think about adaptation strategies sequenced in time to do what we can do now based on what is most valued by different stakeholders and to rethink our choices at critical junctions, tipping points, when there are particular threats to an ecosystem, when there are particular threats to social systems and correct the action before such critical junction or thresholds are crossed and to avoid maladaptive action. So if you look at the diagram that, Richard, you referred just to earlier - - -

40

MR BEASLEY: Yes.

PROF TSCHAKERT: - - - we can see adaptation pathways. That’s on page 34 of our chapter - - -

45

MR BEASLEY: Yes.

PROF TSCHAKERT: You can visually understand how these pathways evolved over time. And if I get you to locate that graphic; it's blue, green and grey. So you can think about an adaptation pathway that starts in the past, and what you see is a big arrow and we call this – research calls it the dominant pathway. That's the  
5 decision trajectory taken in the past. You can see those light blue arrows shooting off that main dominant path. These were possible pathways not taken. So you can think about the Basin Plan as the dominant pathway in the past, the blue one. Even though there would have been other possible pathways with other decisions with different stakeholders involved and different solutions, but they were not considered.  
10 They were rejected.

Now, what's important to understand about adaptation pathways is how we move from the present into the future. This blue pathway, the dominant pathway from the past, let's say the Basin Plan, could continue – that would be the grey area – as  
15 business as usual. Maybe with a little bit of tweaking. Maybe with actual climate change projections included. It would still have various options, and you can see those little bubbles in there, decision points, over time. Or it could – the dominant blue one now, could shift to a transformative pathway or transformation that gets to a much more desirable future, desirable both for ecosystems, for social actors, but also  
20 for efforts to stay within the target of the Paris Agreement which is to be well below two degree warming globally and better than 1.5.

So you can think about adaptation pathways as decision-making processes over time that take into account a variety of knowledge, a variety of values and a variety of  
25 decision path. Now, it is very clear and the literature speaks to that, that some adaptation pathway experiences are easier than others. Adaptation pathways are difficult when there is a very entrenched path dependency to the pathway taken in the past because that narrows down potential future options, precludes alternatives, precludes what may be locally most relevant, zooms in on the practices and visions  
30 of existing governance regimes while overlooking alternative possible solutions.

MR BEASLEY: So that would apply to a community - - -

PROF TSCHAKERT: Yes.  
35

MR BEASLEY: - - - that's used to a certain amount of water every year and that may have to adapt to a future where, because of a warming trend in the climate, there will be less water.

PROF TSCHAKERT: That is correct. So having a good understanding of what the future is likely to bring, this is where climate projections play a role, helps to understand what the likely consequences will be and helps a diverse set of stakeholders who all come with different values, different agendas, different  
40 priorities, different aspirations to discuss, to deliberate, to negotiate what matters most, what would be an acceptable loss and what would be an intolerable loss and  
45 which actions need to be taken today and tomorrow to avoid going down a slippery slope towards intolerable losses.

MR BEASLEY: But if - - -

PROF TSCHAKERT: Just - - -

5 MR BEASLEY: Go on, you finish.

PROF TSCHAKERT: Just one more sentence here.

MR BEASLEY: Yes.

10

PROF TSCHAKERT: This understanding of – or this deliberation of acceptable versus intolerable losses is inevitably tied to trade-offs. It's unlikely, in any case, not only for the Murray-Darling Basin, that everything we value today can be maintained tomorrow. The question is what are the things we value most, for what reason, where we're willing to make – to acknowledge and to let go of what we value and how can different priorities and aspirations combine in one acceptable pathways that does not diminish values and aspirations from other stakeholders. So this is what adaptation pathway thinking and planning is about.

15

20

MR BEASLEY: What I was going to ask you in relation to adaptation pathways is that – and this may be a missing element to the Basin Plan because it doesn't seem to be there, but no participant in a discussion about adaptation pathways, whether they're an irrigator whose business relies on water, whether they're a business person in a local community, whether they're an environmentalist, whether they're a politician, a decision-maker, none of that – there can't be a sensible discussion about adaptation pathways in relation to climate change unless you first, fundamentally, take into account what the best available science is telling you about what the likelihood is for the future climate. If you don't accept or don't factor in that it might get warmer or there's a likelihood, it's going to get warmer and there's going to be less water in the system, then you don't even start the process properly; correct?

25

30

PROF TSCHAKERT: You're absolutely right .....

35

MR BEASLEY: So if you do what the Basin Plan does, which is to do its moulding based on the climate from 1895 to 2009 and stop there, it's not a great place for a discussion about what the future might hold for the Basin.

40

PROF TSCHAKERT: You're absolutely right. It's actually irresponsible, reckless to ignore the best available science we have today, when we plan about the future. Absolutely.

45

MR BEASLEY: There is no plan for the future, is there, if you are ignoring what the likelihood – what science is telling you is the likelihood and the evidence we have is the science is very robust that it's going to get warmer, we are not sure how much less water is going to be in the system, but no one is telling us that it's not going to get warmer, and it might get warmer quickly. Unless you accept that, then

all the discussions and the pathway you've just outlined for the Commissioner never even gets going in a proper way.

5 PROF TSCHAKERT: That is correct. The science is very clear about the warming trends. The science is very clear about the increased frequency, duration and severity of hot days and heat waves. The science is very clear on reduced run-off, meaning reduced water availability. Science in this case, in terms of making projections of how much less and when – keep in mind the science relies on modelling efforts, simulations. Models are always a simplified representation of reality. Models  
10 always use a certain set of parameters. Different modelling groups, based on their own understanding of science, based on availability of data, would select a certain set of parameters over another set.

15 Nobody who works in climate change adaptation would rely on one single model. We all rely on a set of models and we understand what we call an envelope and of the range that we can expect from certain models, whether that's on run-off, evaporation, temperature, and we operate with the envelope, not one single model that could get discredited because of a certain set of parameters or indicators. And it seems to me that the availability of models in Australia is inordinately high and the  
20 rigour of the models is definitely strong enough to produce a reliable and robust envelope for projections. I worked in West Africa 10 years ago and we operated with the best available models that came out of South Africa then, 10 years ago. So it would seem incomprehensible to me if the models that we have in Australia today would be less rigorous than the model we had for West Africa 10 years ago.

25 MR BEASLEY: That's probably right. I think it's a policy decision.

THE COMMISSIONER: Professor, as I understand it, it may be that there is something that some might call a rationale for not requiring in the Basin Plan  
30 anything particular or specific, let alone quantitated or directional, to be included in environmental watering plans or in any other aspect of the plans that govern the access and use of the resource. And it is something like this, that ours is a very variable climate. We have more than a century of pretty reliable data in the Basin, which records a very wide range of experience for precipitation and, thus, run-off. I  
35 don't think they've done anything in terms of increasing evaporation.

And they treat the Plan as having currency for about a decade and they say, whether it's IPCC or any other source, we don't expect to see shifts of experience outside of the range already established by the last hundred years plus, over the next decade on  
40 account of, or attributable to or caused by climate change – you would be familiar with the exotic range of possibilities in the language people use to connect so-called climate change with on the ground, instant, immediate phenomena. And, as I understand it, it's by that means that, rather than being reckless, some people, I gather, propose that there's nothing wrong at all about saying we expect that climate  
45 change will have a range of most likely outcomes over a relatively extended period, say, the next 30, 40, 50 years, but our administration is about the next 10 years or a fraction of 10 years.

And we don't think that climate change will produce shifts which are any greater than the range we have already dealt with or we are already used to or, again, a collection of, to my mind, relatively unsatisfactory nebulous language. Now, I have a generalised unease about that explanation, that it treats the last 100 years plus as if it were a homogenous or monolithic display and that the fluctuations in it are simply an aspect with which we can all live and it doesn't seem to me to do much about the adaptation required by an increasing population, increasing ambition, at least, to produce foodstuffs and fibre, and the combined pressure of soil degradation and water reduction.

10 And so I've been left really quite frustrated and very curious about how the Basin Plan can seriously say that they deal with the risk by, as it were, accepting as true and not requiring anything to be done because you can come back and think about it for the next 10 years. And I'm sufficiently cynical, particularly about government, to believe that then another 10 years starts and a similar-minded administrator says, "We have only got to worry about the next 10 years in this plan and climate change doesn't produce radical shifts on the scale of 10 years, so we can repeat what our distinguished forebears did."

20 But then 10 years after that the same process and I have in mind the well and truly boiled frog by this point. This seems to me to be a rather clumsy treatment of 10 years is long enough for a governmental plan but not long enough for it to take into account what Parliament has required it to take into account, which is the risk of climate change. At the moment, I feel as if I'm in some cloud cuckoo land or, mix my metaphors, it's all catch 22. You accept the risk and you say, "But it is happening on a time scale with which we either shouldn't, couldn't or needn't deal decade by decade." Maybe that's right. It strikes me as counter intuitive.

30 I have had evidence to me suggesting it's wrong because it puts off the evil day you've referred to where you have to make those choices about what you're going to try and retrieve or protect and those things when you have to give up. The crudest example that comes to my mind is that some land clearing may still be appropriate in order to increase the acreage that produces protein, calories, fibre, etcetera. It may be a Faustian bargain but it's one that needs to be addressed.

35 But I'm at a loss at the moment to understand why we should accept this notion that if you take it decade by decade it turns out, lo and behold, you don't have to do anything in the face of something which I think these people do genuinely regard as in train. So we're not talking about climate change denialists on whose effusions I will spend no time in my report – I'm not going to waste public money dealing with it. So I'm talking about people who accept the phenomenon but then say you deal with it by watching it. Can you help me there?

45 PROF TSCHAKERT: I don't envy you in your situation or in your position. I have three points here. So the first is that learning from the past, you know, is it a reasonable thing to do. We should not dismiss this as invalid but we have abundant evidence from the literature, from Australia – in essence, from all continents and all

scales, that people record what worked in the past, as an adaptation strategy no longer works because reality has changed. So there's abundant evidence in the literature to that, that doing what we did in the past is no longer sufficient.

5 We know that. We also have abundant evidence from emergency management officers – folks who work with the EMA – Emergency Management Australia, disaster risk managers who repeatedly say, and I know that because one of my ..... is the former director-general of the Emergency Management Australia. So he has asked the risk managers who repeatedly say, “In this fire, in this flood, in this cyclone we have seen and witnessed what we have never, ever seen before. It exceeded our wildest imagination. We would have never thought that this could ever happen.”

15 You can find this in witness statements of Cyclone Yasi, for example; it's in the Queensland floods; it's in the Canberra fires; it's everywhere. So to trust the past and trust – trust, and believe that the past will replicate itself is incredibly short-sighted, when we do know – and that is across scholarly publications across the ..... chapters, fourth, fifth assessment report, in the special report now, that the intensity and frequency of extreme events has increased and will continue to increase. So to not change policy for the next 10 years simply because some people believe that it's good enough to stick with past insight – I come back to my word – it's irresponsible, when we do have much better projections on what the future could bring.

25 The second point comes back to adaptation pathways, and the beauty of engaging in an envelope climate scenarios. There's nothing wrong to take, as the bottom line of an envelope, the knowledge from the past, data from the past, trends, averages, extreme events from the past. But as the uppermost boundary of the envelope, we ought to take what climate modelists and those who work on projections – that's not me but my colleagues do – can project. So one article that I shared with you looks at possible scenarios for water availability for the Murray-Darling Basin and it looks at 30 1.6 degrees warming by 2030 compared to 1990. And it does project that the water that was hoped to be saved, one-fifth of the entitlement to be reduced to rivers – that that warming would evaporate and would not be available to the ecosystems nonetheless.

35 Not to take such a projection or a scenario into account would reduce – and I think this is where the recklessness comes in – would reduce the option space we want to lay out for ourselves. In the adaptation planning logic, it is important to identify strategies that can be taken, as I said earlier, now under the current governance regime and strategies that would kick in if certain conditions are reached. 40 Adaptation planning wouldn't go by year or by decade. Saying, you know, “By 2019 we ought to do this” and, “By 2020 we are going to do this” and, “By 2024 we're going to do this.” But to identify, anticipate and identify possible tipping points in the ecosystem and the social systems and know what to do a priori to prevent such 45 tipping points to happen.

And in that planning process we ought to imagine worst case scenarios. That does not mean that action needs to be taken today to prevent that worst case scenario. But it does mean that we creatively think today what action should happen if there are indications to reach that worse case scenario and to avoid crossing that threshold.

5 And the last point I want to make is that despite the bewildering resistance among policy makers to accept the results from this special report and any other climate change science, farmers, community members, citizens – regular citizens who want to visit – spend their vacation as tourists in the beautiful wetland – are acutely aware of climate change and actually demand climate change action, responsible climate  
10 change action that does take into account the best and evidence-based science and sensible policy. So I think there is a growing population in Australia, also given the drought over the last couple of months that will not go away without sensitive plans that include climate change as the core criterion.

15 THE COMMISSIONER: Now, it's fair to say that we haven't had anyone, let alone anyone serious, suggesting that climate change as required by Parliament to be considered in making and administering the water plan – the Basin Plan, doesn't exist. There's nobody who has come along to expose themselves to our testing in  
20 that fashion. The method that is built in to the all-important designation of how much water should be, as it were, returned to the environment, the amount that comes between the historical consumptive take and the so-called environmentally sustainable level of take, includes a device for adjustment or as it is sometimes called, reconciliation.

25 And so by what are called supply measures or efficiency measures, it is supposed or proposed that there can be an adjustment to the amount that needs to be returned to the environment because you will either get just as good agricultural output from less water or you will get the same or better environmental outcomes from less water for the environment. And it's proposed that water be allocated presently for  
30 consumptive use on the basis of these measures. And not to worry – and I'm being a little rude here – not to worry about the inadequate science or lack of justified confidence of those environmental outcomes because come 2024 there will be a reconciliation. We will examine what had been proposed against the then  
35 experienced reality, and then with the wave of a hand people say, "And if it turns out we were wrong, then we will adjust back." That's the so-called reconciliation. And it has troubled me because the social and personal plight of farmers and their communities seems to me to be an immensely important element.

40 It troubles me that we are not all that far away from 2024, and certainly in its draft report the Productivity Commission, and in my Commission's work our preliminary views would suggest that there is zero chance of all of those environmental outcomes reaching the level necessary to justify the adjustment in favour of consumptive use. In other words, there will need to be a reconciliation, a reverse judgment. And at  
45 least in theory, one would have thought that needs to be close to immediate. That is, you would be discovering that what you had been doing for the last five years was mistaken and had increased consumptive use over what was, in truth, an environmentally sustainable level of take.

That seems to indicate that when you adjust back or reconcile you won't be taking another five years to do so. You would be doing so, as it were, on the basis of better late than never. So you were wrong five years ago. You didn't look at it for five years. Now you've looked at it. Now you discover it's wrong. That sounds to me  
5 like a relatively disruptive change to the business plans, for individuals, for the local economics of communities, and a rather – what will I call it – dispiriting approach  
land use planning as well as – I do stress the human element. I mean, we are talking  
about individuals, some of them making careers, others making businesses, others  
making homes. It all seems a bit ramshackle, is a word that comes to my mind. And  
10 I was wondering about that when you were introducing me to the glossary in terms of transformational adaptation, for example.

That sounds to me transformational in a pathological sense, that you sort of set the  
15 system up for something which will be a rather large change. I've been playing with the idea that – and it occurs to me your last answer is relevant to this – that, if you will forgive my language, that if you had for the trade-off between consumptive use and environmental water, an algorithmic approach that built in what you call your  
tipping points or your litmus test on various, mostly environmental indicators, then  
there would be, as it were – likely to be a smoother, less seasonally disruptive  
20 approach. Most agriculture is seasonal, even with permanent plantings. All annual agriculture is intensely seasonal. So that seems to suggest that there's a reality or substance to a timescale of change which should bear some tolerable relation to how farmers would plan their plantings, bankers decide whether to fund farmers, commodities, brokers and dealers decide whether to place orders.

25 Not to mention, of course, taxation authorities make their demands and governments handout subsidies, all of which, generally speaking, not entirely artificially is on an annual basis, representing, obviously, one cycle of the seasons. Am I on the wrong track in thinking that we, at the moment, are setting up for rather undesirable  
30 maladaptations by increasing an expectation, a vested interest, if you like, that come 2024, when people are told, "Well, we're going to have to go back because we had this wrong", there's going to be, surely, political and social impetus to say, "Well, that's all very well, but it's too late now."

35 PROF TSCHAKERT: Yes. Yes, I think that the situation in the Basin is – well, it's messed up, for lack of a better word. I think water demands are contested, have been contested, will be contested, will continue to be contested. I don't think – in addition to a projection that may or may not come true in 2024, what you have is a situation  
40 where people have been told, rather than a situation where people have ownership over process and a stake in the decision-making process. And so inevitably the volatile situation, the reluctance, the hostility that, Richard, you described to me and that we discussed last time is not so much an outcome of the actual quantity of reduction, even though that is undesirable, but it's due to the lack of inclusive  
45 governance processes.

MR BEASLEY: And a proper adaptation pathway doesn't commence by a decision-maker saying, "This is how it is and this is how it's going to be."

PROF TSCHAKERT: That's correct. That's correct, yes. So this collaborative pathway incorporates researchers, scientists, politicians, environmentalists, farmers, miners, indigenous populations to allow their knowledge to be made visible, to come to the fore and then to decide what possible actions can be taken, should be taken, and what levels of loss to deal with the reality that is very likely. Such processes also – and I think that's important and that's a particular area of mine that I spend more and more time thinking about is how we deal with inevitable loss. So it's not surprising that hostility emerges when there is no space to learn how to live with loss and there is no space to learn how to engage and embrace grief. There is fantastic research that shows how to embrace grief and loss in an anticipatory way.

A term that is used is anticipatory history. How can we already start to come to terms with something that is not going to be with us in the future? And these are processes of engagement and processes of collective action that do incorporate people's values, even if the outcome at the end is the same and X amount of water will be returned to the river flow. It's about the process of engagement rather than just telling a population or a constituency that this is the fact and this is what people ought to do. There is an increasing worry in Australia in general about the concept of resilience, and it's part of, you know, an entire policy narrative, policy discourse, that the Australian states, like other states, would like to see their citizens ideally as resilient citizens, resilient citizens that can adapt by themselves, that can make the right choices but on their own, ought to be reinventing themselves to take care of something which, really, truthfully, ought to be the responsibility of the state.

And so there is research in adaptation pathways. The example we use in our Chapter 5 comes from London, about the similarly idealistic expectations of the citizens of London to be resilient. And that suits people well, entrepreneurial, who have unlimited resources, but it doesn't suit those who are already vulnerable. In the City of London, these are ethnic minorities, these are poor people, these are homeless people. In the Murray-Darling Basin these are farmers who are already stretched to the limit, who already are indebted, who now find themselves with the responsibility to shoulder adaptation and being resilient. It's just not possible. And people are going to revolt to that – against that, because it's an unfair – it's an unrealistic expectation.

And to circumvent a backlash it seems to me that a collective action process that involves, in the case of the Murray-Darling Basin, natural restructures organisations – there are well over 20 of them who are well connected even though they don't have any executive authority, are ideally positioned to engage in such a process that is more inclusive and allows people to lay out their own visions. And I'm not sure what the overarching authority is that allows these visions and possible trade-offs to come together. Maybe it is the Royal Commission or maybe it is the report that will lay out how this may happen. But certainly – and I sent you another article that lays out how that vision – what that process could be. I think that's the way to pursue it. That's a roundabout way to answer, Commissioner, your question, but I think that it's just a fundamental – a fundamental shift in the way we have to think about how

to engage with uncertain futures. And we cannot leave out populations and simply dictate to them what ought to be done.

THE COMMISSIONER: Thank you.

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MR BEASLEY: I want to ask you about some of the work you've done in south-western Australia where there has been a real change in weather patterns since the mid-1970s, but before I do that, there was an aspect of Chapter 5 that I was interested in that I wanted to ask you about, which was Chapter 5 says that increasingly, in terms of adaptation pathways, the concepts of equity, fairness and justice have to be considered, and they're all defined terms, which I found both brave – not that I found anything – I found myself in general agreement with how those terms were defined, although I did find it quite brave to define what “justice” means. At a practical level, how does it work in terms of an adaptation pathway, to take into account concepts of equity and fairness and justice?

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PROF TSCHAKERT: Good question. So, as you can imagine, for us in Chapter 5, with a chapter title that included reducing inequalities, the jump from inequality to equity and justice was not a very big one, intellectually. Politically, of course, it was a huge one because we could already see in the grounds of review that certain countries were not entirely comfortable with wordings around equity and fairness and justice. Nonetheless, it's a fundamental element. How that works out in practice – let me give an example that stems from water – access to water and access to electricity in South Africa. Urban areas that have clearly a political legacy of apartheid, and if you want, if you allow a comparison, a social environment that is ripe with contestation, conflict, disagreement, maybe to an extent that we cannot imagine in Australia.

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How equity and justice and fairness feature in adaptation pathway thinking is that whatever decisions are made should not make the poor, the disadvantaged, the marginalised worse off. That's the essence. So in negotiating access to water and electricity in South Africa in a context of increasingly inequitable urban settings, keeping in mind that the poor and the most vulnerable and most disadvantaged should not be worse off is the guiding principle. So it should allow decision-makers to, again, be part of the decision-making processes, even those who otherwise don't have a say, don't have a stake, articulate what is important in their lives, and, as you can imagine, it's of high relevance for people in informal settlements to have access to electricity and water at affordable prices.

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So deliberation and contestation are inevitable. Contestation doesn't mean it has to have all been volatile conflict, but the fact that there will be disagreements is a given, and pathway thinking requires us to engage in contestation and disagreement and to allow these various options and visions to coexist, and to find a consensus that is, like the 10 year plan, re-evaluated at critical points in times because – why? Because people's options and people's values also shift with time.

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MR BEASLEY: Thank you. You've been involved, you told us, in an adaptation pathway process work in Western Australia over the last four years. Can you just tell the Commissioner something about that, please?

5 PROF TSCHAKERT: Yes. A slight correction, though. It's a four-year project funded by the ARC, the Australian Research Council.

MR BEASLEY: Yes, my apologies.

10 PROF TSCHAKERT: And we're in year 1. So we have only started. But - - -

MR BEASLEY: I blame the note taker for that error. But go on. I was listening.

15 PROF TSCHAKERT: So I'm ongoing to share something which I'm not sure you have in front of you. I sent it over email. And it's an article that I wrote with colleagues in 2017.

MR BEASLEY: Hang on, just give me a second. I have seen that diagram, so I must have looked at it. Is this one of the articles you sent through today?  
20

PROF TSCHAKERT: Correct.

MR BEASLEY: And what's the title of the article? Climate Change and Loss as if People Mattered.  
25

PROF TSCHAKERT: Here you go.

MR BEASLEY: Yes, okay. Yes, I have almost got in front – yes, I've got that diagram. We all have.  
30

PROF TSCHAKERT: So this diagram is the core of the research project that we're conducting in Western Australia along a 400 kilometre transect from just south of Perth into the central wheat belt.

35 MR BEASLEY: Can I just ask you to give some context to that. Is that one of the areas that have been affected by a fairly continuous reduction in rainfall since about the mid-1970s?

PROF TSCHAKERT: For the wheat belt that is, indeed, correct.  
40

MR BEASLEY: Yes. Thank you.

PROF TSCHAKERT: Yes.

45 MR BEASLEY: All right. So figure 1.

PROF TSCHAKERT: Figure 1. So look at the left-hand side first: A Present. So the way we're trying to think about climate change impacts and losses is along two axes. You can see a horizontal axis which is values. To the right-hand side highly value, what people value very highly, and to the left-hand side what people don't value that highly. The vertical axis is climate change impacts: significant top, and limited at the bottom. Out of the two axes result four quadrants. The upper right one is the one that we worry about most because it affects what people very highly, being at risk, under threat from significant climate change impacts. In the particular case here – keep in mind that's a heuristic. That's an example. What people identify as most valuable to them is their identity as farmers. Think about the central wheat belt, rainfed farming and farming as a livelihood. Whereas health, they may value as less important, even though a little bit on the threat of climate change as well. So what we're interested in is what we call a lost space. That's the entire red bubble. So what is at risk in the context of climate change and in the context of what people value very highly is their identity as farmers, especially male farmers who carry a lot of responsibility for their household and their farming enterprise.

The yellow arrows are how possible losses could be reduced through adaptation. So adaptation is an option for farming, identity, land – maybe not so much for health. So the idea here is to understand how do – the many things that people value highly, how do those overlap with significant risks from climate change and what is it that people can do today to reduce those risks? And we're interested in how they make these trade-offs, saying we value and we are willing to protect identity and farming more than our own health. What's interesting then is the next step is to say what is it people are likely to do in the future, and we can think about the future as shifting risks from climate change, likely increasing, as well as more information about climate change itself, as well as more information and actual more strategies for adaptation.

So what you then see is that all of a sudden what is valued shifts because, in this case, the person has opted out of farming and is putting her health at centre – is valuing, more, her health. However, health is now increasingly threatened by climate change as well and adaptation options have decreased. So the point here is to, instead of – and I come back to the Plan – instead of imposing on people to reduce water for consumption, for urban users, for farming users is to say what is it they're willing to give up now because it's not that important? What is it they're absolutely ready to defend at all costs, and where can value trade-offs be made without further – further disengaging, further upsetting, further alienating people who are committed to a certain lifestyle?

MR BEASLEY: That's the limit of adaptation, is it, where you reach the point where the change means we no longer have what we value the most?

PROF TSCHAKERT: Correct. Limits to adaptation is the point at which it's no longer possible for people to protect what they value, and these trade-offs can only be understood through discussions, deliberations. It's very clear that trade-offs – that people are interested in how other people make trade-offs, and I think everybody

understands that not everything is – matters as much as everything else. And we cannot blind ourselves to the utopian idea that everything we value today will exist tomorrow. So this graphic, if you want, is the cornerstone of what we do in our four-year project.

5

Understanding, first, what people value, what they care about, what they want to protect, different stakeholders, farmers, urban residents, residents, doctors, emergency managers, hire managers, how climate change puts what people value under threat, and how they are willing to make different trade-offs with different pieces of information at different points in time, and through – I have to look at my notes here – through, I'm going to read this to you, deliberative workshops and integrative mapping of future pathways, how potential losses and grief can be addressed today to help overcome what will be social losses. So - - -

10

15 THE COMMISSIONER: Professor, do you find out, I take it, what people value by – starting by asking them?

PROF TSCHAKERT: Correct.

20 THE COMMISSIONER: What do you do after that to find out what they value?

PROF TSCHAKERT: We – so - - -

25 THE COMMISSIONER: I should confess, though, that's not an innocent question. I don't accept at face value what a lot of the evidence has told me people value in irrigation communities.

PROF TSCHAKERT: What did they say?

30 THE COMMISSIONER: Well, they say they value the community continuing, children at the school, shops in the street, families making their lives there, and it's very difficult to disagree with any of these things which are not coincidentally related to motherhood. Yes, they are compelling, perennial goods, I agree. However, many of the people represented by spokesmen or spokeswomen who say those things to me are very taken by the catalogues of machinery retailers who are going to sell them machines by which they will be able to reduce the amount of labour, that is, the jobs that other people will have, planting, tending, and harvesting their crops.

35

40 In other words, it's all very well for somebody like me with the contested issue of irrigation water to be told that communities are susceptible to devastation if reduced water for irrigation leads to reduced jobs, but the same communities don't display any resistance whatever to changed uses of agricultural chemicals or machines or labour hire methods which will reduce the number of people employed in the bush. Now, the number of people employed in the bush per calorie of food produced or  
45 kilogram of fibre produced has, my guess would be, reducing constantly from about 1860 onwards and by very large numbers. Hand in hand, no doubt, with the reduction in the number of horses engaged in the processes.

And so I'm very wary and, I have to say, have become a little jaundiced about being told that there is a threat to community through the lack of jobs and, therefore, the lack of families, therefore, the lack of social support by a reduction in the water that a farmer uses, but there seems to be no hue and cry raised about somebody investing  
5 money to put their neighbours out of a job. How am I meant to square that? I mean, in other words, I am just very sceptical about somebody engaging with me earnestly, looking into my eyes and saying it's a terrible thing to remove a job from a small rural community. I might be prepared to agree with that on a very sentimental basis. I mean, I live in the city. My forebears came from the country and it's relevant they  
10 came from the country. They didn't stay there, and that's, as you know, a global trend. We don't, generally speaking, want to stay in the country unless it's our second home and we don't make our living from it. And so I'm a bit wary about this idea of asking people what they value and believing what they say.

15 PROF TSCHAKERT: So let me just respond to that with a little anecdote that I learned when I worked in West Africa. Even under colonial times, local populations would make up all kinds of responses to colonial officers, either to please them or to provide a certain narrative that suited them in the moment, and so I can fully sympathise with you that whatever people may tell you may not truly be what  
20 matters most to them, or it may only be relevant at a sentimental level. My counterargument now would be – and it comes back to what I consider as inclusive and collaborative inferential research is to allow – or to create the space – in our case, it's a four-year project and not just one interview in a – to provide a space that allows people to commit and participate in a process where they themselves can  
25 work through the difficult trade-offs between the main things they value.

So our process is, even though it starts with a surname, starts with interviews, it includes what we call walking journeys to walk through areas that people identify as meaningful, as important for ..... economic purposes, to diagramming community  
30 engagements, community discussions, arts activities, to an iterative planning that doesn't happen until year three or four. So it's a process of engagement. And I think, ultimately, people are – I've rarely encountered people who are just simply oblivious to potential future realities. So coming back to this one - - -

35 THE COMMISSIONER: Yes.

PROF TSCHAKERT: - - - there's a – in our scientific – or will ..... be our scientific analysis or synthesis of what people say. It's a process in which stakeholders themselves articulate how they make these value trade-offs and how these trade-offs  
40 change over time and what, ultimately, they're willing to let go of. So which is ..... I think the same as before. It cannot be a decision that we make to scale that inclusiveness of the process where people feel they have understood well what the rest of the consequences may be, and they are part of a decision-making process that includes them as valid participants that have a voice and that allows them ownership  
45 over process, even if that process is difficult and even if that process is ultimately resulting in some inevitable loss and some very difficult trade-offs.

And I have a PhD student who is from Vietnam who works on adaptation and transformation in Vietnam. Vietnam is an authoritarian regime. It has an adaptation plan with a fantastically sounding name. It's not implemented because people don't have the ownership over it. Nobody knows about it. Nobody cares about it and, yes, the government can crack down on them, but, ultimately, I think what's – what we want in a country that values our local citizens is to think about processes and allow them to contribute and be part of it, even if the outcome is not, you know, the rosy future that we may all dream about. We should not be oblivious to the fact that it is going to be difficult.

10

MR BEASLEY: Professor, you sent through some articles not long before you gave – you started your evidence. One was an article Adaptation Services of Floodplains and Wetlands under Transformational Climate Change. The first author is Dr Matthew Colloff. We actually have that in evidence. It's Royal Commission exhibit 26 because Dr Colloff gave evidence and we've discussed the paper Climate Change and Loss as if People Mattered. You sent through two other articles though.

15

One is headed – it's from Reliance – sorry, Resilience Alliance Inc, Building Resilient Pathways to Transformation When No One is in Charge, Insights from Australia's Murray-Darling Basin with a number of authors including Dr Colloff. Was there any particular part of that article you wanted to draw to the Commissioner's attention? I – page – I'm not sure it has got a page number here, but a section on it recommending various bullet points as a process that engages stakeholders for participative development of resilient based regional plans was what caught my eye, commencing with negotiating collective vision for the region. Was there anything else in this article that you wanted to take us to?

20

25

PROF TSCHAKERT: So thanks for (a) printing them, looking at them. I realise I sent them last minute, but I'm glad you have them.

30

MR BEASLEY: We are all speed-readers here.

PROF TSCHAKERT: I think what this article does very nicely is to lay out how difficult it can be to embark on such a pathway approach. So if you want, this is not an article that is naive about the difficulties of pathways in a contested environment, but, nonetheless, lays out how it could work in the context of the Murray-Darling Basin. That is the first point. The list of bullet points on page – this is an annoying journal; it never has page numbers.

35

40

MR BEASLEY: Yes - - -

THE COMMISSIONER: Right. The list of bullet points on the bullet point page, yes.

45

MR BEASLEY: I'm not sure whether the Commissioner is going to have page numbers in his report.

THE COMMISSIONER: No, he's going to do it by colour.

PROF TSCHAKERT: I ..... see the list – well, a dozen bullets or so. I think that's a good one but maybe, more importantly, are the two following pages - - -

5

MR BEASLEY: Yes.

PROF TSCHAKERT: - - - that talk about how to coordinate what is called fragmented governance, and that's under the section:

10

*Is the action a prerequisite for the whole pathway?*

THE COMMISSIONER: Yes.

15 MR BEASLEY: Yes.

PROF TSCHAKERT: And I think, most importantly, the last full page that speaks to equity, the sequencing of actions - - -

20 MR BEASLEY: Yes.

PROF TSCHAKERT: - - - and that's what I think I explained earlier, that the sequencing is fundamental in such an iterative process because it allows us to identify actions that are important and possible and desirable for a certain period of time. And sorry to shift slight focus here, but I'm going to hold this one up, which I think you've seen as well before.

25

MR BEASLEY: Yes.

30 PROF TSCHAKERT: It's an illustration of an adaptation pathway in the Australasian chapter, Chapter 25 of the - - -

MR BEASLEY: Now, hang on. I've got that. Just bear with me.

35 PROF TSCHAKERT: So Chapter 25.

MR BEASLEY: Yes, I've got that. What page is that? 1386?

PROF TSCHAKERT: 1386.

40

MR BEASLEY: Yes, I've got that.

PROF TSCHAKERT: The reason I'm pulling it up for you is because I think it illustrates very nicely what sequencing of actions could mean.

45

MR BEASLEY: Yes.

PROF TSCHAKERT: Right. So you see a certain stretch or land of a pathway, that's a certain sequence until there is – until the next decision point or tipping point, and then another sequence of actions. And these sequences of actions allow us to reconsider and recalibrate based on experiences, new insights, new information,  
5 strategies that have not worked, strategies that could be scaled up. So that's the logic of sequencing.

MR BEASLEY: Actually, thank you for taking me to that because that reminds me I did want to ask you about this section of this Australasia – chapter 25 of the 2014  
10 report. If you go back – do you have that there, 1385?

PROF TSCHAKERT: Yes.

MR BEASLEY: The page before. I think the section Psychological and Socio-  
15 Cultural Factors Influencing Impacts on, of and to Climate Change commences where we commence, that adapting to climate change relies on individuals accepting and understanding the risks and opportunities. So first we have to get to point 1, that we're all on the same page that there are – this thing is going to happen and we need to work out what the options are and what we want to do about it. I notice you've  
20 got:

*The majority of Australasians accept the reality of climate change and less than 10 per cent fundamentally deny its existence.*

25 I think that 10 per cent all works for News Limited.

PROF TSCHAKERT: That was five years ago.

MR BEASLEY: Yes. You've then taken us to the figure 25-3. I just wanted to ask  
30 you about, at the top of page 387, in the fawn-coloured box, there's a sentence that says:

*Even then, widely used techniques can help reduce challenges for decision-making, including the precautionary principle –*

35 which we are familiar with. Then it has got:

*Real options, adaptive management –*

40 we have discussed –

*no regret strategies or risk hedging.*

I just wanted to ask you, what is meant by “no-regret strategies”? What does that  
45 mean. We will make a decision and we – bugger the consequences?

PROF TSCHAKERT: No. No-regret strategies are also used as low-hanging fruits. So no-regret strategies are those that will not lead to undesirable consequences.

5 THE COMMISSIONER: So no downside?

PROF TSCHAKERT: Sorry?

THE COMMISSIONER: No downside?

10 PROF TSCHAKERT: Yes, you could say it that way.

THE COMMISSIONER: Right. Why would you - - -

15 PROF TSCHAKERT: So whatever we do, we will have no regrets because we know that a particular action is not resulting in maladaptive practices somewhere else or a particular action is not going to increase risks in the long-term.

THE COMMISSIONER: So if you can say of a proposal that it can only help or be neutral but it won't hurt, that's a no-regret strategy, is it?

20

PROF TSCHAKERT: Say this again, please?

THE COMMISSIONER: If you can say of a proposal that it will either help you or be neutral but it will not harm you, then that's no regrets, is it?

25

PROF TSCHAKERT: You could say it that way. I think what is meant here, however, are specific strategies that would not result in undesirable outcomes. So if you say, well, you know, in the case of the Murray-Darling Basin to replant native vegetation in certain areas that have been eroded is probably a no-regret strategy because it really doesn't do any harm. So the idea here is to identify these no regret options first because these are the low-hanging fruits. These are the easy wins, (a) they are feasible, we know that and (b) this is maybe more important, they provide immediate, positive examples, success stories that serve as motivation for an entire constituency or various constituencies to work for them. So no regrets is, "Yes, we ought to do those."

35

MR BEASLEY: What does "risk hedging" refer to?

PROF TSCHAKERT: I do not know or do not remember. It's a particular term. I don't use it so I cannot comment on that.

40

THE COMMISSIONER: Well, I know what it means in commerce and financial matters. So I assume it means it's a process which self-consciously attempts to reduce the damage caused by a predictable outcome that you seek to avoid.

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PROF TSCHAKERT: That's possible. I think it is, indeed, a financial term but that's outside of my area of expertise. So very likely.

THE COMMISSIONER: All right.

MR BEASLEY: And finally, Professor, you sent through a short article from environmental science and policy titled ‘What’s the Problem in Adaptive Pathway Planning, The Potential of a Diagnostic Problem-Structure Approach’. Was there  
5 anything in that article that you wanted to draw to the Commissioner’s attention?

PROF TSCHAKERT: Yes, and that can be very brief.

10 MR BEASLEY: Yes.

PROF TSCHAKERT: It’s a brief article as well.

MR BEASLEY: Yes.  
15

PROF TSCHAKERT: It deals with experiences from integrated catchment management in Victoria. So it’s another Australian example. So not so much fully Murray-Darling Basin but the analogies are good indeed. So the authors make – raise concern that adaptation pathway planning that is increasingly used also has  
20 downsides if it is poorly implemented. And poorly implemented means that we make an assumption when we impose a priority – one pathway as the preferred one or as the likely one, thereby crowding out other possible options or pathways.

There’s also a danger, the authors tell us, to assume that goals have been agreed upon  
25 even though goals and values often differ widely. And if we don’t spend time understanding how they diverge, the pathways we identify will be of no use. And the last danger they remind us of is that very often there is a tendency to jump to technical solutions because they seem easier, and shying away from the more complicated and more time consuming social and political options that require  
30 deliberation and negotiations and everything we have talked about. So ultimately they remind us that we need transparent processes for engagement.

We need to engage different constituencies. And we need to grapple with the complexities across scale. Very often, and I think all of us, we’ve worked in some  
35 kind of restructures management, we understand that it’s often quite simple to understand complexity at one scale, patch scale, a community scale but we do have trouble understanding how complexities interact across multiple scales – community, catchment, regime. And so they remind us that we have to really spend time on this and that we need to systematically, in these pathway decision-making processes,  
40 evaluate synergies and trade-offs. And the best way to do that, they argue, is through participatory engagement or participatory research or participatory action research which is precisely what we do in our research brand in Western Australia.

MR BEASLEY: Professor, I have to congratulate you. The Commissioner and I are  
45 in a competition to ask the longest question in the history of Royal Commissions and you managed to – the Commissioner has hit the front and you still manage to answer comprehensively and understandably. In fact, the Commissioner not only set the

record; he broke the record with his next question. Is there anything you feel that you would like to say additionally? I've exhausted the questions I wanted to ask you. Is there anything you feel it would be useful to add to the discussion we've had today?

5

PROF TSCHAKERT: Well, thank you for that additional opportunity, but I think I've exhausted myself as well.

MR BEASLEY: Good.

10

PROF TSCHAKERT: Actually, I've shared what I really wanted to get across today. I certainly do hope it is helpful and it allows you to provide a recommendation that is really for the benefit of the entire Basin and all its constituencies. But if I had to underscore one last time the importance of inclusive decision-making, inclusive and iterative decision-making and deliberation, I have hereby done it.

15

MR BEASLEY: Yes, you have.

20

THE COMMISSIONER: Professor, then, apropos of just that, how do we – without becoming facetious, how do we square that with Parliamentary processes?

25

PROF TSCHAKERT: I don't have a good answer for that. But I think you're in a better position than I am. I think working with, as my colleagues argue, the national resource management organisations and government entities that already understand the benefit of taking climate change seriously and using them as champions, I think is the way to go. I mean, my understanding is that government is never monolithic. It always has cracks that we can work with, opportunities that we can work with. I think you're in a much better position than I am to understand who these individuals are, who these constituencies are, and to – allowing them as allies without alienating those who are sceptical.

30

MR BEASLEY: Thank you, Professor.

35

THE COMMISSIONER: I'm much obliged. That has been more than merely helpful. Thank you very much.

MR BEASLEY: Thanks for your time.

40

PROF TSCHAKERT: My pleasure.

<THE WITNESS WITHDREW

[4.20 pm]

45

MR BEASLEY: So we are only slightly late by an hour. So you think he has to go at 4.30. So 20 minutes.

Hello, Professor.

PROF HOWDEN: Yes, that's me.

5 MR BEASLEY: I'm very sorry we are so late.

PROF HOWDEN: That's okay.

10 MR BEASLEY: All you need to know is it wasn't my fault.

PROF HOWDEN: No worries.

MR BEASLEY: Do you have to leave at 4.30? That's what I was told?

15 PROF HOWDEN: I can probably hang in there for a little bit longer but not too much.

MR BEASLEY: All right. Do you have a drop-dead time, then?

20 PROF HOWDEN: That's okay. I will just send a text while we're going and I will ask for a bit of leeway. Take the time that we need.

MR BEASLEY: All right, Professor Howden, do you wish to have your evidence – do you want to swear an oath or do you want to take an affirmation.  
25

**<STEWART MARK HOWDEN, AFFIRMED [4.12 pm]**

30 **<EXAMINATION-IN-CHIEF BY MR BEASLEY**

MR BEASLEY: Professor, you are currently the Director of the Climate Change Institute of the Australian National University.  
35

PROF HOWDEN: That's correct.

MR BEASLEY: And you've held that position since February 2016.

40 PROF HOWDEN: That's right.

MR BEASLEY: And before that, am I right that from February 2000 to February 2016, you were a Chief Research Scientist at the CSIRO.

45 PROF HOWDEN: That's right.

MR BEASLEY: And you were the Climate Adaptation Leader.

PROF HOWDEN: Indeed. I was the team leader.

MR BEASLEY: All right. And you have a Bachelor of Science with first class Honours in Applied Ecology from the University of New South Wales.

5

PROF HOWDEN: That's right.

MR BEASLEY: A Doctor of Philosophy in Tropical Grassland and Ecosystem Management, Griffith University.

10

PROF HOWDEN: That's right.

MR BEASLEY: You were the vice chair of the Intergovernmental Panel on Climate Change and a contributor to the IPCC since 1991 with roles in the second, third, fourth, fifth and now sixth assessment reports.

15

PROF HOWDEN: That's correct. I'm still a vice chair of the IPCC.

MR BEASLEY: All right. And you shared the 2007 Nobel Peace Prize with, amongst others, Al Gore.

20

PROF HOWDEN: That's right. A very small slice of that.

MR BEASLEY: You're making me feel inadequate, almost no one does that to me. Anyway. I'm going to ask you some questions now. Before – I just wanted to go through the, if I can take you – do you have a copy of the recent assessment report? It won't matter if you don't.

25

PROF HOWDEN: This is the IPCC one?

30

MR BEASLEY: Yes.

PROF HOWDEN: Yes, I've got that on my screen.

MR BEASLEY: All right. I just wanted to go through a couple of very basic things so we get them on the record. And I'm focusing at the moment on the summary for policy makers. And the first section 'Understanding Global Warming of 1.5 Degrees Centigrade' with the report saying that:

35

40

*Human activities are estimated to have caused approximately one degree of global warming above pre-industrial levels with a likely range of 0.8 to 1.2 degrees C. Global warming is likely to reach 1.5 degrees C between 2030 and 2052 if it continues to increase at the current rate. High confidence.*

45

The terms likely and high confidence, I've already taken the Commissioner to the section of the report that explains what's meant by the terms likely, not likely, very likely, what is meant by the terms medium confidence and high confidence and so

that's the position that I've just read out, that position about the likelihood of reaching an increase of 1.5 degrees C between 2030 and 2050 is a position where there is a – first of all a lot of peer reviewed literature that is generally in agreement between – there's a great deal of agreement between the research and the literature on that issue, on that statement.

5  
10  
PROF HOWDEN: Indeed. So there's agreement within the literature but also agreement between the projections of temperature change and the observed temperature change.

MR BEASLEY: Now, I also wanted to ask you this. I think some people have a reaction that 1.5 degrees increase on average, so what. And the difference between 1.5 degrees increase on average and two degrees is only .5 so, so what? You gave me an example of the last ice age and the average temperature change there. Can you put that, what I've just said, in context for the Commissioner, please?

PROF HOWDEN: Yes, that's right. So if we look at our historical temperatures compared with the temperature in the last ice age and there's roughly a five degree difference between them, so an ice age, which effectively turns parts of the Earth into a snowball versus our relatively equable previous historical climate, there's only five degrees. So when we are talking about half a degree or one degree it's quite a significant change in a global context.

MR BEASLEY: So the five degree decrease in temperatures for the last ice age had the oceans about 125 metres less in depth than they are now.

PROF HOWDEN: That's right. So so much water was piled up on Antarctica and in glaciers across North America, Europe, etcetera, that the sea level dropped around about 120 metres. So if you're around any parts of Australia's coastline, the coastline was way out from where it is now and that's why Tasmania was joined to the mainland.

THE COMMISSIONER: Well this is very serious, that will affect waterfront land values.

35  
PROF HOWDEN: Absolutely.

THE COMMISSIONER: We should do something.

40  
PROF HOWDEN: Indeed.

MR BEASLEY: I also wanted to ask you about the section in Australasia from the 2014 report, and I think that you were one of the contributing authors to that.

45  
PROF HOWDEN: That's correct.

MR BEASLEY: And I just wanted to ask you whether – I mean, this is a 2014 report – I wanted to ask you whether there’s any – has been any changes in the expressions of high confidence, etcetera, in relation to this report. So this report certainly says that annual average rainfall is expected to decrease in south-western Australia, high confidence, and elsewhere in most of far southern Australia through the 21<sup>st</sup> century. Is that – any change in that prediction?

10 PROF HOWDEN: No. It remains very consistent with what was in that IPCC report.

MR BEASLEY: And also this chapter 25 in the 2014 report suggests that fresh water resources are projected to decline in far south-west and far south-east mainland Australia, high confidence. Any change in that?

15 PROF HOWDEN: No. That would be consistent. If anything, I think the only changes have been a view that the climate changes are probably going to come faster than would have been indicated in that report.

20 MR BEASLEY: Just picking up on that, inclined to come faster, one of the things that I think when we had a discussion – you said you know Professor Pitman who has already given evidence to this Commission. One of the things he told us during the course of his evidence that if he was going to be critical of climate scientists, it is because they’ve been a little bit on the conservative side when they’ve spoken to – sorry – at least in relation to published peer-reviewed journals about the potential speed and degrees or extremities of climate change. And when he actually speaks to policy makers he is a bit more direct about what he really thinks is going to happen. Is that a view you share?

30 PROF HOWDEN: I think I would agree with Andy on that one is that science is inherently a conservative enterprise, so people tend to want to be sure before they go public. And the higher the profile, the issues, the more sure you want to be. And so that’s – there’s a degree of conservatism. When we are looking at IPCC reports and synthesis, there’s a degree of conservatism there as well because they are a synthesis of all different perspectives and also because within the summary for policy makers there’s a governmental approval process which also tends to ensure a degree of conservatism. So, generally speaking, what we see coming out of that is what Andy talked about, which is that the science assessment tends to err, if anything, on the conservative side rather than on the alarmist side of the coin, if you want to use those words.

40 MR BEASLEY: I wanted – did you say you had a copy of the Australasia section for the 2014 report handy?

45 PROF HOWDEN: I do, yes.

MR BEASLEY: I wanted to ask you a few questions about figure 25-1 on page 1378.

PROF HOWDEN: Yep.

MR BEASLEY: Because I have had a little trouble understanding that. Tell me when you've turned that up.

5

PROF HOWDEN: Yes. 1378.

MR BEASLEY: Yes. So the table has got Annual Temperature Change at the top, and we've got in the left-hand side Trend Over 1901 to 2012 where I think there has been this roughly average one degree Celsius on average rise in temperature. Then we've got some scenarios in the four right-hand boxes for the mid-21st century and the late 21st century. From reading this chapter and other parts of the report, am I right when it refers to RCP2.6 that that's projections based on having a scenario that involves strong mitigation against climate change?

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15

PROF HOWDEN: That's correct. So the RCP2.6 is scientific code for a low emission scenario. So the 2.6 refers specifically to an average increase in what's called radiative forcing. That's the energy coming to the earth of 2.6 watts per square metre.

20

MR BEASLEY: By a low emission scenario what does that actually mean? That means a reduction from emissions at the moment by a percentage term or - - -

25

PROF HOWDEN: That's right.

MR BEASLEY: How much carbon dioxide reduction is involved in a low emissions scenario?

30

PROF HOWDEN: A very substantial amount. So a low emission scenario is actually much more consistent with keeping temperatures around about two degrees Celsius, whereas at the moment we're heading much more towards four degrees Celsius.

35

MR BEASLEY: Right. And RCP – and, of course, the Paris Agreement is designed to keep it well below an increase of two degrees by 2030; correct?

PROF HOWDEN: That's right.

40

MR BEASLEY: RCP8.5 is a scenario based on high emissions, I think.

PROF HOWDEN: That's right.

45

MR BEASLEY: Is that based on continuing – does a high emission scenario mean continuing on a current trend or does it involve even more?

PROF HOWDEN: That's right. At least for the next several decades on the same emissions trend, sort of plateauing out towards the end of the century. So that would

be, in other words, what we would think of as a business as usual scenario because that's where we're pretty much heading at the moment.

5 MR BEASLEY: Well, that would, based on – I mean, the late 21<sup>st</sup> century, you have almost got Ayers Rock belting on – that's like six degrees – four to six degrees change in Central Australia and around four degrees for the rest of Australia.

10 PROF HOWDEN: Yes, that's right. You probably wouldn't want to climb the rock under those circumstances.

MR BEASLEY: No. But that's – I would be right in saying that is a scenario that would involve catastrophic impacts if those temperature rose by four degrees on average.

15 PROF HOWDEN: On average, that's right. So the sort of frequency of extreme heat events would increase radically under those scenarios. And one of the challenges in those scenarios is our bodies are adapted to moderate heat, and under extreme heat we simply can't rid of the heat we generate internally and we overheat. So we need to either find an air conditioner or find shade or a swimming pool to jump into to stay stable temperature wise.

25 MR BEASLEY: My body has adapted to incredible fluctuations in temperature because the office I've got isn't properly air-conditioned, but that's another budgetary problem of this Royal Commission.

THE COMMISSIONER: Professor, that's human bodies, and then there's plant physiology.

30 PROF HOWDEN: Crops, yes.

THE COMMISSIONER: Do I understand correctly that if one were to choose four degrees as an increase in the annual average that necessarily entails a dangerous increase in the frequency of days with temperatures so high, presumably often accompanied by moisture so low as physically to kill the organism?

35 PROF HOWDEN: Yes. So a lot of our native plants and animals are adapted to extreme conditions. And so, provided they remain somewhat undisturbed so that they can actually maintain behaviours, and then frequently they can manage that. The challenges are often with our introduced species, such as animals like cattle and sheep, and also our introduced crops ..... or mangoes.

THE COMMISSIONER: We not being koalas, we can't live on eucalypts, but we do presently think that we need wheat.

45 PROF HOWDEN: That's right.

THE COMMISSIONER: And I don't think wheat can survive beyond a certain temperature, can it.

5 PROF HOWDEN: No. So, generally speaking, once temperatures increase much above the mid-20s we start to see declines in yield. When we see temperatures during flowering of wheat in the low to mid-30s that substantially kills the flowers, so you don't get any grain. And what we've already seen across Australia is that the first hot day, which is greater than 35 degrees, coming about three weeks earlier across the eastern wheat belt, so those are the killing temperatures that really impact heavily on wheat yields. So crops like wheat and barley and similar crops have distinct temperatures where, which once they are exceeded, can impact on those physiological processes, impact on yields, impact on death rates. And it's the same with animals. What we call heat stress is a combination of temperature and humidity, and already that impacts on our production. So in the northern parts of 15 Australia that's a restriction in production, and for sheep in northern Australia it restricts their reproduction, so they can't reproduce. So there's many different physiological impacts of high temperatures.

20 THE COMMISSIONER: Thanks.

MR BEASLEY: One of the reasons we were slightly late is the Commissioner asked a world record length question of our previous witness. I'm going to try and break it now because barristers are very competitive, but I want to put this to you. One of the things that you told me when we had a chat the other day was that you considered downplaying the risks associated with climate change as unethical as a scientist or as a policy decision-maker, I think, you mentioned in that context as well. I just want to ask you a – it's a simple question, but I need to put it in a slightly long context. You're familiar with the CSIRO's work on the sustainable yields project where they made certain projections for temperature changes and changes in run-off for the Murray-Darling Basin work they published in 2008 which in terms of median change by 2030, they predicted that there might be a reduced total of surface water by four per cent. There would be reduced flow at the Murray Mouth by about 24 to 30 per cent. And a general prediction of it being warmer and, therefore, dryer in at least the southern part of the Murray-Darling Basin. Are you familiar with that 35 work?

PROF HOWDEN: I am.

40 MR BEASLEY: And in 2009, the CSIRO also gave advice to the Murray-Darling Basin Authority on modelling for the Basin Plan and this, Commissioner, is exhibit RCE392, where the advice they gave the Basin Authority was this:

45 *The climate sequence for modelling over the period of implementation of the first Basin Plan (next 10 to 15 years) should be based on scenarios ranging from the recent climate over the past 10 to 20 years (a very dry scenario, although dryer conditions are possible), and future climate scenarios obtained using the daily scaling method described above.*

Now, we know that for policy reasons, the Basin Authority chose not to include climate change projections in its modelling for working out how much water in volumetric terms on average should be restored to the environment. You understand that?

5

PROF HOWDEN: I do.

MR BEASLEY: All right. That was a matter, just to complete the context in which I want to ask you this question – that was a matter that in 2011 the CSIRO – and I’m referring to exhibit RCE9, Commissioner – the CSIRO also, in a report that they prepared for the Basin Authority about modelling a Basin Plan that involved restoring 2,800 gigalitres a year to the environment, they noted that the Basin Authority had made a policy choice not to directly address projected impacts of future climate change and water availability. They understood that the MDBA’s policy approach was an extension of what was said to be a policy of not requiring a change in water users’ rights.

In other words, rather than addressing and including climate change projections into their modelling for the Basin Plan, the Basin Authority took the view that climate change would just be taken care of because if there’s not as much water, people won’t get as much allocation under a particular entitlement. And they then went further by – there’s a report, RCE352, where some scientists did a report outlining how the Basin Plan was incorporating climate change within it. One of the ways they said, in this report, that climate change was being incorporated into the Basin Plan was because they had done their modelling based on the extended climate sequence from 1895 to 2009.

And it therefore captured all the wet and dry periods for the last 114 years up to 2009. They otherwise said that the Basin Plan had taken into account climate change because it notes that climate change is a risk. Now, having said all that, when I put to Professor Pitman that it seemed like madness to me, as a lawyer, not as a climate change scientist, but as a lawyer, that climate change projections were not incorporated into the modelling for the Basin Plan, the first thing he said, which I didn’t understand at the beginning, was stationarity is dead.

35

In other words, he began by criticising the fact that you have got a plan for the future that is based on climate data from 1895 to 2009 and stops there, as though nothing happens from 2009 onwards. And then expressed a view that he didn’t see it as using the best available science not to incorporate climate change projections into the Basin Plan modelling. And I’m being very conservative in the language that I’m choosing to use there. Can you tell us what your view is in relation to the way the Basin Authority has chosen not to include climate change projections in its actual modelling?

PROF HOWDEN: Yes. Look, thanks for that question. I can’t give you definitive answers because I wasn’t part of the processes.

45

MR BEASLEY: Sure.

PROF HOWDEN: But I can – I can comment on that. For my – my perspective is the statement that Andy Pitman made is right; is that if we are wanting to estimate  
5 risk in terms of water allocations, then we need to understand more than just about climate variability. So, in a sense, climate variability is the ups and downs from year to year of what happens in our climate and our river flows. Climate change is the trend within that. And – and so it’s the difference between – if you want to think of it like signal and noise, the noise is the – is the year to year variation and the signal is  
10 the upwards or downwards trend associated with climate change.

And if we’re to – even up to 2009, I think there was enough evidence to say that climate change was already impacting on river flows within the Basin and climate within the Basin. So that trend, in a sense, had already been established. So there  
15 was a signal as well as the noise. So if you couldn’t determine that signal, that signal of climate change, then you would just be making an assessment of climate variability, the year to year risk, and – and what we know is even the last 100 years is not necessarily a good estimate of the total possible risk associated with flows within the river. So in the long term, we’ve probably had wetter periods and drier periods  
20 than we have seen within the last 100 years or so.

But the situation now is different because we have got a trend, a signal, one which is driven by humans, and that particularly has started to be expressed post-1970 and up to 2009, it’s increasing in its strength and we anticipate that that will continue out  
25 into the future fairly much in the same direction and at the relatively same rate as we’ve seen in the last 10 or so years. So, for me, not including that climate change trend in those analyses means that we were omitting information which was pertinent to future water allocations in the Basin.

MR BEASLEY: One of the questions that the Commissioner has asked witnesses that have got climate change expertise is to put the position of the Basin Authority, which has said, “Well, we can change the plan in 10 years. So we can look at how climate change is happening in 10 years and then we can do it again 10 years after, if we have to.” Does that sound like a – do you agree with that as an approach to take  
35 into account climate change?

PROF HOWDEN: Look, it is one way of dealing with it. I think what you would actually say is that those 10 year periods are – at the rate at which change is projected within the Murray-Darling Basin, a 10-year period could actually encompass quite  
40 significant changes, average changes within the flow regime of the Basin. So, in a sense, you’ve – you’ve got steps which are quite high, and if you wanted to make a smoother change which was more responsive to the change in environment, you would make those steps a bit lower, so you would have the reviews a little bit closer together, so – so not quite so sort of chunky and substantive.

45 So – and I would have probably argued that you – ideally, inclusion of climate change should have happened at the start of the process so it actually sets up a

precedent for how it could be updated. So rather than including a whole new component within a review of the plan, it was just an updating of an existing component. And for me, that would have been – even if you set that at a relatively low component in the first case, it would have actually set up a process which was  
5 relatively easy to update rather than a more contentious inclusion later.

MR BEASLEY: Can I ask you this: the Basin Plan was legislated in 2012. Climate change science was certainly robust enough by 2012, wasn't it, to identify with a high degree of confidence a warming and drying effect in the southern part of the  
10 Basin in 2012; correct?

PROF HOWDEN: Absolutely. So if you look at that IPCC report that you referred to before, and on page, I think it's 1387, it has some images of run-off in Australia.

15 MR BEASLEY: Yes.

PROF HOWDEN: Most of that was drawn from literature, the studies from 2009 to 2011.

20 MR BEASLEY: Yes.

PROF HOWDEN: So certainly by 2012 you could have compiled that and got an answer very similar to what the IPCC got.

25 MR BEASLEY: Well, those graphs that you are referring to, I won't open them now but my memory was in terms of a one degree average rise, about – depending on where you in the southern part of the Basin, a five to 10 per cent median drop-off in run-off but double that if we get towards two degrees.

30 PROF HOWDEN: That's right. So they were assessed as percent changes in run-off per degree of temperature change.

MR BEASLEY: And it's not the sole purpose of climate change science but an important part of climate change science, am I right, is to identify risk for people that  
35 depend for their living on businesses that can be impacted by climate change and for decision-makers, politicians, etcetera; correct?

PROF HOWDEN: That's right.

40 MR BEASLEY: And if you don't incorporate the risk of climate change into your actual modelling or projections or your plan other than to say it is a risk in words, you're actually not taking into account that risk at all.

PROF HOWDEN: Yes. Saying the words it is a risk is a very, in a sense, colloquial  
45 use of what is actually quite a technical term. And a technical term would actually be risk is assessed as probability or likelihood - - -

MR BEASLEY: Yes.

PROF HOWDEN: - - - by consequence. So if you are assessing there's some probability of a, you know, 20 per cent reduction, say, in river flows, which have  
5 very major consequences, you can still have a very high risk even though the probability is quite low, simply because the consequences are very high. So I would frame risk as probability by consequence and that then starts to be able to be included in whole of Basin models.

10 MR BEASLEY: I mentioned – we discussed before in that very long question I asked you, the CSIRO's report in 2008 from its Sustainable Yields Project about projections for the Basin. That, of course, was 10 years ago. How have those projections stacked up in terms of the state of knowledge now or the views now in terms of projections?

15 PROF HOWDEN: Yes. So those used the suite of climate models that were developed for the IPCC back some years, so that was called the CMIP3 set of models. We are now into the CMIP5 models. CMIP is the inter-model comparison sort of label. So those models – there's a whole series of much newer model runs  
20 which are better resolved in terms of some of the climate factors and climate drivers. And so there's new climate information which is available but, as far as I know, it hasn't really been integrated into the sort of whole of Basin assessments for run-off that we saw in that previous assessment report, the one with the red graphs on it, the change in run-off per degree Celsius. We have got the next IPCC report coming up  
25 due to be released in three years time – four years time and I imagine there will be an update of those figures, which will incorporate the latest information.

MR BEASLEY: We will sadly be finished.

30 PROF HOWDEN: I know, but - - -

MR BEASLEY: Can I ask you this, just now that you've mentioned there's another IPCC report in three or four years. The first assessment report was 1991; correct?

35 PROF HOWDEN: That's right.

MR BEASLEY: And we are now up to the sixth. The projections made in 1991, how have they stacked up in terms of what's the actual real data is, is it over the period '91 to 2018?

40 PROF HOWDEN: There are significant updates and improvements in terms of the precipitation information. The temperature trajectories were reasonably robust for a given emissions sort of scenario, like high emissions or low emission scenario. So they were pretty robust even ongoing back to the early 90s but there has been major  
45 improvements in the other climate factors such as rainfall and in particular seasonality and intensity of rainfall. Once we get to the IPCC third assessment report we are starting to see a bit of a plateau in terms of improvements. So the

improvements per assessment report on an every seven year basis have slowed compared with the early stages where there was rapid improvement. Generally speaking, we anticipate, again, only incremental improvement from the latest sets of models. So the broad picture will remain – will likely remain very similar to what we've seen in the past.

MR BEASLEY: The reports define climate change and global warming for us. Are they – those definitions are one that you would suggest that the Commission use?

10 PROF HOWDEN: Yes, I think the IPCC ones are to some extent the gold standard for definitions.

MR BEASLEY: Yes. All right. And I did notice that in the summary for policy makers, the high level of confidence expressed that a large factor in climate change is due to historical and ongoing CO<sub>2</sub> emissions. Nothing has changed there.

PROF HOWDEN: No.

MR BEASLEY: The reason I ask you is that I saw on ABC Television a few weeks ago that Pauline Hanson suggested that climate change was caused by the sun and the moon. It did occur to me that the sun has a warming factor on the planet but is the moon responsible for climate change, as far as you know?

PROF HOWDEN: No. No, there's no legitimate evidence that the moon does that. Obviously, it affects our tides and things on that scale but not on the climate change scale.

MR BEASLEY: It's possible she was confused.

30 THE COMMISSIONER: I think Mr Beasley is interested generally in what might be called lunar theories.

PROF HOWDEN: It could well be the case.

35 THE COMMISSIONER: Professor, could I ask you this, about what I will call – I'm very interested in your suggestion, maybe admonition that smoother rather than chunkier adjustments to the experience of climate change in the context of water resource governance would be a good thing to consider. I happen to agree and I'm very interested in that.

40 PROF HOWDEN: Yes.

45 THE COMMISSIONER: If it translated to the nitty-gritty of how much water can be used for consumptive use, we have, as it were, the general approach dictated by the Water Act as follows: Ascertain a level of water in the river below which – what I'm going to call environmental values – would be compromised. Do not allow water to be taken consumptively that would reduce the water in the river below that

level. Thus the amount that can be taken is the excess, if any, between what I will call that no environmental compromise level and what is available in the river.

5 Now, the rivers vary, particularly in Australia. And so the statute actually requires these things to be done on what it calls a long-term average basis. Leave that important matter to one side. If the administration actually proceeded on the basis that the river was assured of getting that environmentally no-compromise level, then all the risk not only of variability but also of climate change would be on the consumptive user, would it not?

10 PROF HOWDEN: That's right.

15 THE COMMISSIONER: And so one way – I'm not suggesting a good way – but one way of taking into account the risk of climate change is to ensure that everybody understands first we look after the environment and then we can use consumptively what, if anything, is leftover. By the way, bankers and farmers, be aware that may be a steadily diminishing amount.

20 PROF HOWDEN: That's right. So that, what you're proposing there is essentially a political choice rather than a scientific choice. So you're actually looking to, you know, make trade-offs between different, legitimate uses of water and if you set a priority for one use of water and your total available water goes down but that is a fixed amount then it disproportionately influences any other user within the system.

25 THE COMMISSIONER: Yes.

30 PROF HOWDEN: And that particularly is important in dry years. So when we're looking at, you know, wet and dry years so we're still seeing, you know, the occasional wet year like 2010-11 so it's not those years but it's actually the dry years where alternative uses hit really hard. So in dry years, your trees suck up a lot of water, as you've got plantations. In dry years, that's when your farm dams intercept most of the water that otherwise would go into the rivers. In dry years, that's when your urban systems use more water because people are watering their gardens. So that's the real stress event where these issues really cut in.

35 THE COMMISSIONER: Thank you. So that's really, it seems to me to illustrate there surely will be any number of ways in which you can take account of the risk of climate change, but the beginning of it will be to try to appreciate the risk to build in what I call a measure of adaptive management. So a continuing empiricism and then  
40 to choose from the political smorgasbord where you are going to allocate the economic and social risk.

45 PROF HOWDEN: That's right. Indeed. And my comment before about the big steps, the height of the steps, the risers on the stairs is if, as the sort of rationale for exclusion of the Basin Plan was proposed was that there was going to be an adaptive management approach, then if it's to truly be adaptive, then that re-evaluation and

recalibration would, I would argue, probably need to happen more frequently than every 10 years.

THE COMMISSIONER: Yes.

5

PROF HOWDEN: 10 year gaps is not truly an adaptive system. That's a very sort of chunky irregular step-wise system rather than something which is operating smoothly. The challenge, of course, in a variable environment like our river systems, our climate, is how to separate out what's going on in the system. So what's human  
10 caused and what's natural and what's caused by the climate and then starting to try to figure out how to adjust the allocations, given those different factors.

THE COMMISSIONER: But even without climate change, once one takes an appreciable amount of the run of the river for consumptive use, you are definitely  
15 having an effect, mostly detrimental, on the environment.

PROF HOWDEN: That's right. And that has been the conclusion of a large number of studies over many years, is that we can only draw so much out of the river without compromising the ecosystem function.

20

MR BEASLEY: Sorry – professor, I know I asked you that you were a contributing author to the Chapter 25 on Australasia for the 2014 report, I think I may have forgotten to ask you what your role has been in relation to the assessment report just published?

25

PROF HOWDEN: So in the 1.5 degrees warming report?

MR BEASLEY: Yes.

30 PROF HOWDEN: I had, effectively, two roles. One was, I was a review editor of Chapter 4, which the strengthening adaptation and mitigation chapter and a review editor, essentially, has a quality assurance role. So it's making sure all of the comments made on the chapter are dealt with fairly and appropriately. And so that's, you know, almost acting as an oversight role in terms of the eventual chapter. And I  
35 was also – because of my Vice Chair role, I had a – an overarching role, in terms of guiding the whole process through and ensuring the integrity of the process, the integrity of the content, and its suitability for the – the signatories to the Paris Agreement who commissioned that report in the first place.

40 MR BEASLEY: Given that answer, I can't resist asking you this, although I think it's only fair that you be given a chance to respond. And I'm not asking you this because I think that the – because I think the Commissioner is going to treat climate change denial seriously because I'm confident that he's not. But this report was described – this 2018 1.5 degree report was recently described by a Sydney  
45 journalist, columnist, as a hysterical missive – leaving aside the fact that I think a missive is meant to be a reference to a letter, not a 1000-plus page report.

In terms of being hysterical, I would like to give you your own chance to respond to that, but one of the things that I've picked up in reading some of the material was the summary for policy makers in the 2014 report which has a series of four graphs, which I'm sure are designed to be graphs for climate change for dummies, but what  
5 they show is a global average of land and ocean surface temperature changes from 1850 to now – or to 2014; globally average sea level change from 1900 to now; globally average greenhouse gas concentrations from 1850 to now, and global anthropogenic CO<sub>2</sub> emissions from 1850 to now.

10 And whilst, no doubt, there's a complex relationship between all of these things, they each show a trend upwards in a fairly similar style, a trend upwards of land and ocean temperatures, a trend upwards in sea level change, a trend upwards in greenhouse gas concentrations and a trend upwards – dramatic trend upwards in CO<sub>2</sub> emissions. Is that the best evidence in terms of climate change for dummies that we  
15 should look at or is there something additionally you think we should – the Commissioner should have reference to?

PROF HOWDEN: Look, in terms of providing a quick reference to key indicators of the issue, I think that's a pretty good start. You could also throw in graphs of  
20 other greenhouse gases like methane and nitrous oxide and you could have the same sort of upwards curves of those. So, for example, methane last year was the highest methane concentrations on record in the atmosphere just like crystallised carbon dioxide concentrations on record. And so you have a consistent perspective between the core drivers which are the greenhouse gases and key issues of response: global  
25 temperature, sea level rise, regional temperature, changes in the hydrological cycle, changes in sea ice, changes in, you know, icing on land, etcetera. Just – and just to go back a couple of questions, you asked a question about the effect of the sun. So in the - - -

30 MR BEASLEY: Don't tell me Pauline Hanson is onto something.

THE COMMISSIONER: No, that's the moon.

35 MR BEASLEY: Pauline Hanson is onto something, is she? She has mentioned the sun and the moon.

PROF HOWDEN: Sorry to prick that bubble.

40 MR BEASLEY: Yes.

PROF HOWDEN: So the – so within the IPCC's special report on 1.5, there's a temperature graph which actually shows three curves. That's the temperature increase caused by anthropogenic greenhouse gas emissions; the temperature change as a function of natural variability, that's the sun, El Nino and volcanoes, and then  
45 combination of the two, and that's mapped against observed temperature change. And so when we combine the natural – which, essentially, hasn't gone up. So there's

a few dips, when we get a volcano like Pinatubo, that cools the global climate and it slows the ocean sea level rise down for a couple of years.

5 But when that effect dissipates, when the particles get out of the upper atmosphere, then everything keeps going as it was before. So when you take out – or when you add the natural variations from volcanoes, etcetera, to the human induced variations caused by greenhouse gas emissions, you see a very close correspondence between global – observed global temperature and the modelled global temperature, and that, I think, would be an update of the top graph there because it actually has those  
10 different components, the natural, the human and the combined and how they match very closely with the observed temperature record.

MR BEASLEY: Yes, I think there is a graph along those lines in the recent report, but I won't be able to tell you the page at the moment, but I'm sure I saw it.  
15

THE COMMISSIONER: Professor, when you said "highest levels on record", does that include the measured or inferred levels from prehistoric ice cores, etcetera?

PROF HOWDEN: Yes. So the longest continuous ice core goes back about  
20 800,000 years, but then we have got discontinuous methods of assessing both temperature and carbon dioxide concentration and many other things, and they go back a long – a lot further than that, but we have to go back about two million years before we saw, sort of, any carbon dioxide concentration somewhat similar to what we've got at the moment. So pre-industrial carbon dioxide concentrations were  
25 around about 280 parts per million. We're now at 410 parts per million and that's driven by – mostly by fossil fuel extraction, that's oil gas and coal, but also land use change, so, you know clearing Australia, clearing of the Amazon, clearing of Asia, clearing of North America.

30 THE COMMISSIONER: Thank you.

MR BEASLEY: One of the things – I'm paraphrasing here and someone will correct me if I've paraphrased too inaccurately, but one of the things the Basin Plan requires the Basin Authority to do is give advice in relation to climate change and  
35 climate change risks. I am paraphrasing. One of the matters that Professor Pitman lamented on, I think, was the fact that following the sustainable yields project in 2008 which only ran, I think, for just over a year, there has been very little government investment in climate change research, and queried whether we were, therefore, doing enough either for the MDBA to fulfil that function or generally. Is  
40 that a view you share or do you have a different view or - - -

PROF HOWDEN: Look, climate change investment in Australia has plummeted. So it has gone down in terms of the climate science, the sorts of things that Andy Pitman works on. So the climate modelling, the oceanographic measurements, those  
45 sorts of things, but it has gone down much, much faster in terms of understanding climate impacts and responding to those impacts. So we currently are 75 per cent

below the trend line of output from the science community compared with – so that started going down around about 2013 - - -

5 MR BEASLEY: Sorry, I don't quite understand that; others might. "75 per cent below the trend line", what does that mean?

PROF HOWDEN: So if we look at output in terms of, say, publications as a measure of activity - - -

10 MR BEASLEY: Right. Yes.

PROF HOWDEN: - - - from the climate science or the adaptation science community, so people looking at impacts and response to those impacts that was going up exponentially. You know, it was actually going up a bit faster than linear, and if we look at where we would have been in 2018 versus where we actually are, we actually are 75 per cent down from where we would have expected to be based on that trend line. So an absolute shredding of the adaptation capacity and adaptation output in Australia just at the same time as we're seeing unprecedented climate changes.

20

THE COMMISSIONER: When does that date from, that departure from trend?

PROF HOWDEN: I did an analysis for a Keynote presentation at the Australian Adaptation Conference, that was earlier this year, and we're just about to publish that in environmental research letters. So in that study with environmental research letters, we've done a global analysis. So seeing if this is a pattern which is repeated across the globe; in which case, Australia isn't unusual. And we've also done that for the US, and in both the US and globally, publication numbers continue to rise; whereas, in Australia they've fallen dramatically. So we are unusual, and so the things that are happening in Australia aren't particularly Australian. They're not reflected in the broader science community across the globe.

30

THE COMMISSIONER: So when did we start to tread this steadily independent degenerate role?

35

PROF HOWDEN: It's – it's gone down fairly steadily since 2013.

MR BEASLEY: There was an election in 2013. Did that have anything to do with it?

40

THE COMMISSIONER: No, I don't think we'll ask ..... yes. That's right. Thank you, Professor. Yes.

PROF HOWDEN: Whilst there, I – there's probably two points that I make just to catch up on – on previous questions which moved on.

45

MR BEASLEY: Yes.

PROF HOWDEN: You made a comment about hysterical reports.

MR BEASLEY: Yes.

5 PROF HOWDEN: I just make the point that the IPCC is there to inform the policy. It's not to prescribe policy. We're a policy informing body, not a policy prescriptive body.

10 MR BEASLEY: In part you're responding to the Paris Agreement, aren't you?

PROF HOWDEN: We're – exactly. And in that particular case, there was a request from the signatories to the Paris Agreement to undertake this study. Normally for an IPCC report that is actually signed off by the governments of the world in a plenary process and – and the governments actually have input into the scope of each report and the choice of special reports. So – so we've got – after this special report on 1.5, we have also got special reports on the oceans in cryosphere – the cryosphere is the ice-covered areas of the globe – and then subsequently one on sustainable agriculture, greenhouse gas emissions and food security. And so governments actually have a strong role in selecting this subject for special reports and in determining the scope of those special reports.

25 So in relation to the 1.5 degrees report, to call it hysterical is a gross misleading statement because all the IPCC did was say the governments have already chosen two temperature targets, two degrees and 1.5. And the IPCC simply said if you want to achieve we'll say 1.5 degrees, these are the things you need to do to get there. If you want to achieve two degrees, these – this is the array of combinations of ways of getting there and these are the costs and benefits of that. And then for each of those two temperature targets, they're saying, well, if you end up at two degrees, these are the impacts and these are the adaptations you may need, and if you actually end up at 30 1.5 degrees, these are the impacts and these are the adaptations you need. So there's nothing hysterical about the choice of scenarios that the IPCC did. The choice of the scenarios was undertaken by governments, not by IPCC.

35 MR BEASLEY: By governments. Yes. Yes. That exhausts the questions that I wanted to ask you, Professor, but is there anything – sorry. Commission, do you have anything? Is there anything that you feel that we've missed or that you would like to highlight either from the recent report or in relation to climate change adaptation generally, the Basin Plan, etcetera, anything we've discussed today?

40 PROF HOWDEN: Yes, I guess – I guess there's a – the point of uncertainty and the sort of use or misuse of uncertainty, which I think is – reasonably central here. And – and so when we look at future scenarios of temperature, to a large extent, there's two types of uncertainty there. One is the emission scenario, whether we keep on going as we are or whether we go into a sort of post-Paris, you know, very green emission reduction sort of world. And that has a big impact on future temperatures and rainfall and river flows. And then there's scientific uncertainty, which is just, 45 you know, our lack of understanding of the processes in terms of the climate and

how they propagate into river flows and our lack of data that actually supports those processes and that understanding.

5 And the really big uncertainty is actually our choice of futures, whether we reduce  
our emissions or we increase our emissions. And that uncertainty increases over  
time. So it's relatively small now because if we went green that wouldn't make  
much difference in 10 years time. But if in a hundred years time it would make a big  
10 difference. So when people talk about uncertainty as an excuse for inaction, it's  
really important to tease out those two sources of uncertainty. And so if it's science  
uncertainty, I would say that the science has been fairly consistent for about 20 years  
that climate change is going to reduce flows within the Murray-Darling Basin.

15 So we can go back to, I think, a paper by Arnell et al in 1990 which painted out that  
scenario. And so directionally, the likely impact of climate change has been known  
for a long time and additional research has just confirmed that direction of likely  
change. So often when you're dealing with large-scale strategic risk assessment,  
that's what you're after, is direction of change. We're not after precision, like is it  
18.8 per cent reduction in river flows?

20 MR BEASLEY: Yes.

PROF HOWDEN: Is this going down a lot or a little or may it go up? And so that's  
the information that feeds into sort of broad-scale risk assessment from my  
perspective. And – and I would say that there are other factors within the Murray-  
25 Darling Basin and more broadly in terms of water use in Australia which were just as  
uncertain as that science uncertainty there. So, for example, our choice of population  
growth over a decade results in something like 15 to 20 per cent change in  
consumption, assuming consumption per capita stays constant, over a decade. So  
that's actually a much greater change in a decade than we're likely to see in terms of  
30 climate change.

35 But no one said we can't make decisions on water allocations because of that. But,  
you know, that's actually a similar order of magnitude change as or greater than the  
climate change. And so just because things are changing and just because they're  
uncertain and, you know, we don't know exactly where it's landed doesn't prevent  
you from making good decisions.

MR BEASLEY: Thank you.

40 THE COMMISSIONER: Thank you.

MR BEASLEY: Thank you very much for your time, Professor, and we've sorry  
we've gone well past 4.30.

45 THE COMMISSIONER: Yes.

PROF HOWDEN: That's okay. I got a reply text which said I was okay to delay.  
And so - - -

MR BEASLEY: Excellent.

5

PROF HOWDEN: No, I appreciate the interest and I hope the Commission goes really well.

MR BEASLEY: Thank you.

10

THE COMMISSIONER: I'm much obliged. Thank you so much for your help.

PROF HOWDEN: No problems. If there are any follow-up questions, I'm happy to field those, as well.

15

THE COMMISSIONER: You're very kind. Thank you.

MR BEASLEY: Thank you for that. Thank you.

20

PROF HOWDEN: Cheers.

THE COMMISSIONER: Bye.

25

**<THE WITNESS WITHDREW**

**[5.11 pm]**

MR BEASLEY: So we are – that – we're adjourned until the 30<sup>th</sup> of October.

30

THE COMMISSIONER: Then we will adjourn to the 30<sup>th</sup> of October. Where will that be? At the Town Hall. Thanks. Good. Can I just say thank you to everybody who dealt with the technical emergency. I'm impressed. Thank you. Thanks for your patience.

35

**MATTER ADJOURNED at 5.12 pm UNTIL TUESDAY, 30 OCTOBER 2018**

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