



COMMONWEALTH OF AUSTRALIA

# Official Committee Hansard

## SENATE

ENVIRONMENT AND COMMUNICATIONS REFERENCES  
COMMITTEE

**Extreme weather events**

FRIDAY, 7 JUNE 2013

CANBERRA

BY AUTHORITY OF THE SENATE

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## SENATE

### ENVIRONMENT AND COMMUNICATIONS REFERENCES COMMITTEE

Friday, 7 June 2013

**Members in attendance:** Senators Bilyk, Birmingham, Cameron, Waters.

#### **Terms of Reference for the Inquiry:**

To inquire into and report on:

- (a) recent trends on the frequency of extreme weather events, including but not limited to drought, bushfires, heatwaves, floods and storm surges;
- (b) based on global warming scenarios outlined by the Intergovernmental Panel on Climate Change and the Commonwealth Scientific and Industrial Research Organisation of 1 to 5 degrees by 2070:
  - (i) projections on the frequency of extreme weather events, including but not limited to drought, bushfires, heatwaves, floods and storm surges,
  - (ii) the costs of extreme weather events and impacts on natural ecosystems, social and economic infrastructure and human health, and
  - (iii) the availability and affordability of private insurance, impacts on availability and affordability under different global warming scenarios, and regional social and economic impacts;
- (c) an assessment of the preparedness of key sectors for extreme weather events, including major infrastructure (electricity, water, transport, telecommunications), health, construction and property, and agriculture and forestry;
- (d) an assessment of the preparedness and the adequacy of resources in the emergency services sector to prevent and respond to extreme weather events;
- (e) the current roles and effectiveness of the division of responsibilities between different levels of government (federal, state and local) to manage extreme weather events;
- (f) progress in developing effective national coordination of climate change response and risk management, including legislative and regulatory reform, standards and codes, taxation arrangements and economic instruments;
- (g) any gaps in Australia's Climate Change Adaptation Framework and the steps required for effective national coordination of climate change response and risk management; and
- (h) any related matter.

**WITNESSES**

**CAMERON, Mr Rob, Assistant Secretary, Office of Health Protection, Department of Health and Ageing. 1**  
**DUNLOP, Mr Ian Thomas, Private Capacity ..... 17**  
**FIRMAN, Dr Jenny, Principal Medical Adviser, Office of Health Protection, Department of Health and Ageing ..... 1**  
**MORRIS, Ms Megan, First Assistant Secretary, Office of Health Protection, Department of Health and Ageing ..... 1**  
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**CAMERON, Mr Rob, Assistant Secretary, Office of Health Protection, Department of Health and Ageing**

**FIRMAN, Dr Jenny, Principal Medical Adviser, Office of Health Protection, Department of Health and Ageing**

**MORRIS, Ms Megan, First Assistant Secretary, Office of Health Protection, Department of Health and Ageing**

**Committee met at 09:05**

**CHAIR (Senator Birmingham):** I declare open this public hearing of the Senate Standing Committee on Environment and Communications in relation to its inquiry into the recent trends and preparedness for extreme weather events. The committee's proceedings today will follow the program as circulated. These are public proceedings. The committee may also agree to a request to have evidence heard in camera or may determine that certain evidence should be heard in camera.

I remind all witnesses that in giving evidence to the committee they are protected by parliamentary privilege. It is unlawful for anyone to threaten or disadvantage a witness on account of evidence given to a committee, and such action may be treated by the Senate as a contempt. It is also a contempt to give false or misleading evidence to the committee. If a witness objects to answering a question, the witness should state the grounds upon which the objection is to be taken, and the committee will determine whether it will insist on an answer, having regard to the grounds upon which it is claimed. If the committee determines to insist upon an answer, the witness may request that the answer be given in camera. Such a request may of course also be made at any other time.

I welcome representatives from the Department of Health and Ageing, in particular, Ms Morris. Thank you for talking to us today. As you will be well aware, as departmental officers you will not be asked to give opinions on matters of policy, though this does not preclude questions asking for explanations of policy or factual questions about when and how policies were adopted.

The committee has received your submission, numbered 126. Do you wish to make any amendments or alterations to your submission?

**Ms Morris:** Thank you, no.

**CHAIR:** Thank you, Ms Morris. Would you care to make a brief opening statement before we proceed to questions?

**Ms Morris:** Thank you, but no. I am sorry; we have just had two days of estimates!

**CHAIR:** We all appreciate that it has been a long couple of weeks for everybody.

**Ms Morris:** Thank you. I do apologise, I am hoping that my two colleagues will turn up, but there was a time change recently and they obviously were not aware of it or did not see the change in their diaries. I will do as best I can for you.

**CHAIR:** Thank you. Could you start off by giving us an understanding of the role the federal department plays in terms of assisting, coordinating and guiding states in terms of their responses to extreme weather events and preparedness for them?

**Ms Morris:** In Australia, as you would be well aware, responsibility for health is split between the Commonwealth and states. The states run the public hospital system and public health. In an extreme weather event—and we unfortunately suffer from fires, floods and cyclones, usually around Christmas and in January, every year—with respect to their health systems, the states bear the brunt of responding.

The role of the Commonwealth is to have the Australian Health Protection Principal Committee meet. The committee is chaired by the Commonwealth Chief Medical Officer, Professor Chris Baggoley, and every state chief health officer is on that committee, which I will now refer to as AHPPC. We are in constant contact with whichever state is affected to ensure that they have enough resources to cope with whatever it is they need to do within their system. An example of what we could do in that circumstance would be to check that there are enough qualified nurses who specialise in burns treatment and that they have enough space in their public hospital system. If the affected state cannot take the overflow in the private system some patients can be transferred to other states. It is a very cooperative arrangement, and that committee can, and does, meet at very short notice.

The other role of the Commonwealth in extreme weather events—I hope that I am not pre-empting further questions—is in relation to the responsibility for residential aged care facilities, pharmacy and general practice, in terms of the initial response. And in many cases we have provided follow-up assistance through mental health programs.

**CHAIR:** How in practice does the responsibility particularly for residential aged care facilities play out?

**Ms Morris:** What happens in practice is that our office—it has the unfortunate acronym of OACQC, which stands for the Office of Aged Care Quality and Compliance—and our state officers, because we have offices in every state or territory, work very closely with nursing homes to find out if they are under any threat from whatever the event is, such as flood or fire, and alternative accommodation is found for those residents. So in recent floods in January there were quite a lot of evacuations in Queensland. There may have been some in Victoria, but I know that there were basically evacuation provisions for any aged care facility that was under threat.

**CHAIR:** Thank you, Ms Morris. The committee has received some specific evidence relating to how events have played out in Queensland previously. I suspect Senator Waters is going to ask about those matters, so I will let Senator Waters do so.

**Senator WATERS:** Thanks, Chair. Thank you very much, Ms Morris, for holding the field on your own this morning—very capably so far. I appreciated also your submission, which I thought gave a good outline of the role the Commonwealth plays.

**Ms Morris:** Thank you, Senator.

**Senator WATERS:** I am interested particularly in the response to the Queensland events, so I want to flesh out some of the comments you made about aged care. First of all, you mentioned on the first page of your submission that you had learnt some lessons from both the Victorian fires and the Queensland floods. Can you expand on what those lessons were? What would you do differently next time and would there be any additional resourcing requirements for you to improve?

**Ms Morris:** With your indulgence, I may wait until the cavalry turn up. Dr Firman in particular was in the Office of Health Protection at that time. I was not in my role at that time, so I could give you some comments but I would prefer to give you informed comments.

**Senator WATERS:** Sure. Let us go back to your role in the aged care sector during the Queensland floods. Can you expand on that a bit for us?

**Ms Morris:** All right. The role of the Office of Health Protection in relation to aged care at that time was that there was no role, basically. There was no need for a role. If we cannot value-add through coordination or information, we are better off to step out because otherwise it is just another level of handling that takes up time.

I will be speaking on behalf on another part of the department, and it will have to be at a general level. What I understand their role to be, and I saw the paper trail as it went around the department to the state office and also keeping ministers and the executive informed, is to stay in touch with residential aged care facilities on the ground who are at threat from flood, fire or whatever is happening and to ensure that there are beds available somewhere else. Sometimes that will mean moving patients to a range of other aged care facilities in the area, but in country areas, as you can understand, there are not a lot on the ground in any case.

I know of one residential aged care facility, I think it may have been in Victoria—I would not want to be held to account on this—where the residents were moved to the local hotel. They were probably too old to available themselves of the facilities there, I suspect. But there is a variety of arrangements made and it really depends on what is available in the infrastructure within an area. Of course within a metropolitan area, you have a lot more options, but metropolitan areas, with the exception of Brisbane, are rarely threatened by flood.

**Senator WATERS:** Yes, with the large exception of Brisbane!

**Ms Morris:** In country Australia, as you would all be well aware, depending on where you are there is a limited choice of alternative accommodation. So sometimes it will be commercial tourist accommodation, sometimes it may be the local pub, sometimes it could be that the hospital has some spare beds if there is a hospital there—it really varies. But they do work very hard to ensure that the residents are safely moved and that there are a range of protocols around how you do that, what you need in place to move the residents. You know, they are not thrown in the back of a ute and driven off somewhere.

**Senator WATERS:** Is there preplanning to identify those alternative beds?

**Ms Morris:** I am guessing that there would have to be.

**Senator WATERS:** I am interested in the mental health aspect to the extent that you are able to elucidate that for us. Clearly the mental health effects of natural disasters are enormous, and particularly when they are repeated within a short time thereafter, as we have had in Queensland with the floods. What role does the department play in that?

**Ms Morris:** The department already has—or the government has—a program called ATAPS. I cannot tell you what it stands for, but that funds mental health services. After the Victorian fires of a few years ago, there was additional assistance for mental health services. The emphasis on the mental health services is usually in the recovery stage. At the very beginning, when the crisis is happening, it is not useful and there are other priorities. But if it is something that has been quite psychologically devastating, and has a prolonged recovery—especially things that affect whole communities; it can be very difficult—a lot of effort is put into that.

Yet again, we would work very closely with the state or territory jurisdiction. Of course they have their own services. There is also, at the time, a lot of very well-meaning people who want to help but may not necessarily be qualified to help. I remember I was not in the Office of Health Protection at the time of the Victorian fires, but I was running the primary and ambulatory care division. One of the challenges we had was that great community spirit of people wanting to engage and help, but well-meaning help without skills can sometimes not be very useful.

**Senator WATERS:** Are there any programs to better marshal the good will of community members who may lack the training?

**Ms Morris:** I could not answer that for you. I do not know if you can take things on notice at a hearing like this, but I would be happy to take that on notice and get you some further information.

**Senator WATERS:** Yes, I think you generally can.

**Senator BILYK:** Just to pick up on Senator Waters' last comment, I know that in the Tasmanian bushfires earlier this year the state government had a really important role to play in respect of helping to coordinate all those individuals from the communities who had ideas and things. If I can just put in a plug for the Tasmanian government in this regard, I think there is a lot that other governments could learn from what Tasmania has learnt previously and was able to implement in this year's events.

**Ms Morris:** I think we would affirm that, Senator. And I think Tasmania had learnt a lot from previous bushfires.

**Senator BILYK:** I think that is correct.

**Ms Morris:** The response was very well coordinated. It did help that the bushfires were on the coast, so you could get to the beach and get to water.

**Senator BILYK:** They were on a river way, yes; a canal.

**Ms Morris:** We observed them, and we stay in constant touch with any jurisdiction that is affected.

**Senator BILYK:** And the recovery process as well. Not only the initial response but also the whole recovery process has been really well coordinated, involving the whole of the community.

**Ms Morris:** That is excellent. That is good to know.

**Senator BILYK:** All of the reports that I have had from people are that they are really—they might not be happy, but they know that the best is being done for them. Their lives are still turned upside down in many, many cases, but they know that everybody has come together in the best possible way. There is a lot that other states could learn with regard to that.

Ms Morris, I just wanted to ask if you could give—sorry, I think you have actually answered part of this question anyway, but I was interested in your submission where you said:

Contact by critical incident teams, to assist with mental health recovery in this early stage can do more harm than good, until basic needs are satisfied.

You have said that in some areas that can cause more problems than would be helpful.

**Ms Morris:** That would be the combined experience of Commonwealth and state governments.

**Senator BILYK:** Yes, and I understand that, according to your submission:

... around 80 per cent of people who experience a traumatic event ... will recover without requiring ongoing assistance.

But I should imagine that when things are unfolding—and it is often not just an hour, it might be days or a week or whatever—nobody knows who the 80 per cent are and who the 20 per cent are.

**Ms Morris:** That is exactly right.

**Senator BILYK:** So there would be a critical need for people to be able to talk to somebody, at least, and to have enough people on the ground that if people feel—

**Ms Morris:** Yes, I think that comment is probably made in terms of priorities and timing. There are things you need to do as soon as the disaster hits. There is immediate and sometimes terribly acute medical assistance that is needed. So basically you triage the physical injuries, and you have to do that immediately.

**Senator BILYK:** Of course.

**Ms Morris:** I have no training as a psychologist or a clinician, but I do understand there is a period of probably about five to seven days within which if you do not get to people who are traumatised they are going to get quite significant post-trauma stress resulting from it.

**Senator BILYK:** Yes, thank you. That clarifies it a bit for me.

**Ms Morris:** The comment was made in terms of priorities from day one.

**Senator BILYK:** You mention that the National Health Emergency Response Arrangements plan will include heat stress plans as they are developed.

**Ms Morris:** Yes.

**Senator BILYK:** Is that as they are developed by individual states? How does that work?

**Ms Morris:** I will just explain briefly about the Australian Health Protection Principal Committee, AHPPC. I suspect that some of the departments with whom you deal regularly work within a Commonwealth-state structure and have Commonwealth-state ministers' meetings. There is the standing committee on health, which is ministers, then there is AHMAC, which is all health CEOs. AHPPC is a subcommittee of the CEO level. That then has, I think, five subcommittees, and a lot of the work that they look at is developed by those subcommittees. They have a committee that looks at antimicrobial resistance, there is Communicable Diseases Network Australia, there is public health laboratories, there is blood borne viruses and sexually transmissible infections and there is an environmental health committee.

**Senator BILYK:** Reinforcements!

**Ms Morris:** I am very pleased to see Mr Cameron and Dr Firman! Just as well the Department of Health and Ageing are very fit. How long since you have done a triathlon, Rob?

**Mr Cameron:** Quite a while.

**Ms Morris:** It is a long time since he has done a triathlon, but she does run.

**Senator BILYK:** It is, as you say, very useful.

**Ms Morris:** I will just let them get their breath.

**Senator CAMERON:** I think Ms Morris has been doing a very good job.

**Senator BILYK:** A sterling job!

**Ms Morris:** It is a long time since your last triathlon, Rob.

**Mr Cameron:** February, yes, too long.

**Ms Morris:** If you could repeat your question, Senator?

**Senator BILYK:** I would be lucky to be able to remember it. I was asking how, under the emergency response plan, the national heat stress plans are developed. Is it with individual states? How do they actually work?

**Ms Morris:** I was explaining that we have AHPPC and its subcommittees. I know that NatHealth at present is looking at heat stress issues, but the actual heat stress plan?

**Mr Cameron:** Clinical treatment of heat stress, and the way that individual hospitals deal with heat stress, is typically a matter for state- and sub-state-level planning. That has largely got to do with the niceties of and the individual capacity—as opposed to capability—of individual hospitals to deal with large peaks, large surges. Dr Firman can probably talk much more about the clinical aspects of treating heat stress. I certainly cannot do that. When we have an incident that is of enough size, and it could be state-wide or it could be a couple of states experiencing a prolonged heatwave, the Commonwealth would, we would, become interested because we are concerned about the capacity of hospitals and individual places of treatment, if they are not hospitals, to manage the peak as well as maintain their normal, baseload services. People still have heart attacks; babies are still born. People get admitted for all sorts of diseases all the time, routinely, so this really is peak activity. We start to get interested then so that we can prompt, if required, and offer to coordinate, if needed, load-sharing distribution of patients and that sort of thing.

**Senator BILYK:** Are those plans predominantly focused on the elderly, or are they across the demographics?

**Ms Morris:** I think individual states have their own heat plans.

**Mr Cameron:** They do.

**Ms Morris:** South Australia probably has a very well-developed one. They do get very extreme temperatures in the summer. They have information messages that go out throughout summer. They advise people how to manage the heat. I think they have fairly proactive management of the elderly.

**Dr Firman:** I am not as familiar with the South Australian plan. However, all states and territories would be aware of the issues of heat because it does place increased loads on their hospitals. If you look across the age ranges, the groups that are most affected by heat stress are children and the elderly, and then you will have people who have other medical conditions who may be particularly stressed by heat as well. So that will cover a full range. The elderly and children would be the most affected. If you look at who is admitted to hospital in heatwaves, it is often predominantly the elderly or those with underlying medical conditions.

**Senator BILYK:** Is it the role of the department to oversee or implement any plans with regard to children and extreme weather conditions? I am thinking more of the psychological issues that happen. The reason I ask is that, once again referring to the Tasmanian fires in the south-east earlier in the year, the school burned down while it was school holidays, and a really big issue was that the kids wanted to have a school. That seemed to focus the whole of the community. So many different people and organisations came together—not just the governments but individuals—and they managed to find moveable classrooms and other things and actually get the school up and going. There was a new school uniform and things like that. It seemed to bring them all together. So many people have said to me that not only was that good for the whole of the community but the psychology behind all of that for the kids was really important. I am not sure if the department has any sort of role in helping develop whatever might be needed. It might not be a school; it might be something completely different.

**Ms Morris:** I will give a very bureaucratic answer to that; I apologise. Something to do with a school burning down would primarily be a state government responsibility. If the Commonwealth were to be involved, it would be the department of education.

**Senator BILYK:** Sure; I was just using the school as an example of bringing everyone together and giving the kids hope—that was the issue—and some sense of normality. How do we deal with the psychology of extreme weather events, as to the mental health for the kids in the areas?

**Ms Morris:** I think both my colleagues have something to contribute on that topic.

**Mr Cameron:** Ms Morris is exactly right: very local incidents, like the one you are using to make the point, really belong to the state to manage. But, on a broader level, if we were to see a widespread need for assistance in mental health and related issues—I am using that as a very broad label—the national-level committee that Ms Morris referred to earlier, the health protection principal committee of AHMAC, specifically for this very reason, has a very senior mental health representative on it in Professor Beverley Raphael. So those issues are picked up at a national level and considered in the broad discussion around what might be appropriate responses and what are the sorts of things that other parts of the broader response might need to keep in mind as they go about prosecuting their particular part of the agenda.

**Senator BILYK:** Yes, that is good.

**Mr Cameron:** I might just add: she is pretty expert and a pretty forceful character, so we are under no illusions that these are important issues.

**Senator BILYK:** Very good. I am pleased to hear that.

**Ms Morris:** She is a good advocate for mental health.

**Mr Cameron:** Yes, she is.

**Ms Morris:** Jenny, did you want to add something?

**Dr Firman:** I was going to add: along with AHPPC, one of its roles, too, is to communicate with primary care and general practice, because in any disaster the people on the ground are dealing with the communities and supporting those communities. So those important messages coming through on disaster mental health from the committee are then communicated through the peak bodies in general practice, so that, we hope, all general practitioners are aware of it. That sort of issue you are referring to is all to do with the resilience of communities after disasters.

**Senator BILYK:** That is good to hear. Are the national health arrangements able to be used for international emergencies involving Australian citizens?

**Mr Cameron:** Yes.

**Ms Morris:** Yes, and have been.

**Senator BILYK:** Can you just expand on that for me?

**Mr Cameron:** I will just quickly make the distinction between an incident involving Australians overseas and an incident overseas which we might project, in any other context, would be considered to be aid.

**Senator BILYK:** I meant the first.

**Mr Cameron:** So this is about Australians overseas.

**Senator BILYK:** That is right.

**Mr Cameron:** All that activity is coordinated through the Department of Foreign Affairs and Trade, obviously, who have that core responsibility, and Australian Emergency Management, part of the Attorney-General's Department—and I am assuming that you have spoken to them as well—have a plan that deals with mass casualties of Australians overseas. It is under review, but I think it currently rejoices in that wonderful acronym of OSMASSCASPLAN—which I can actually take some credit for, I might add.

**Senator BILYK:** I do not know if I would be admitting that, Mr Cameron!

**Mr Cameron:** Can I ask for Hansard to strike that bit, then! The plan outlines roles, responsibilities and processes of how we deal with injuries and fatalities and, essentially, repatriating injuries and fatalities back into Australia to get them back into the domestic arrangements. Having a much stronger planning framework around that was one of the salient lessons learnt after the pretty tragic events of the first Bali bombings offshore. That is what prompted the development of a specific plan for that. That is the general framework.

The Department of Health's part in that is, through the AHPPC and the National Incident Room in our department, the coordination of health assets around the country to be able to accommodate a peak. That is the point I was making before. I will make something up just to illustrate the point. Say we had 30 serious trauma cases come back into Australia from an incident offshore. There is capacity, through those arrangements, to ascertain what trauma facilities and staff—so, the required medical and support staff—are available in Australian hospitals to take those and to then coordinate the transport of the injured people to those places and feed them into the domestic scene, taking account of where people's home base is, where family support might be and those sorts of things.

**Ms Morris:** I remember, during the second Bali bombing, the AHPPC convened almost immediately. I cannot remember what sorts of specialists and trained nurses were needed, but they were identified within the Queensland public health system in the course of the phone conference and were on the plane and on their way to Darwin before the conference even finished.

**Senator BILYK:** That is wonderful.

**Ms Morris:** Yes. It is actually a very cooperative, very supportive working arrangement we have. And I will just go back to one question. You will be pleased to know there was only one question that I really had no idea about; whether I answered the other ones correctly will be up to you to judge when you read the transcript! That was a question about mental health services. I was saying that, in a natural disaster, there are often a lot of people of goodwill who want to help but are not necessarily trained in the area, and I remember that was an issue in the Victorian bushfires. I think your question—

**Senator BILYK:** I think it was Senator Waters, actually. But they linked in.

**Ms Morris:** That is right. Senator Waters asked if there was any way to use those resources and turn them into a positive, and I said I really did not know. Are you aware of anything, Jenny?

**Dr Firman:** There are different types of help, and I will leave it to my colleague Rob Cameron to talk about AusMATs, Australian Medical Assistance Teams, which are a more organised form of support, volunteer medical support, organised through each jurisdiction that can be brought together nationally—

**Ms Morris:** And based on a roster too, so there is always one state on standby.

**Dr Firman:** Yes. They are teams of health professionals who not only are expert in their own profession but also have been given training in disasters, and are able to support themselves if they are away for two weeks from a normal base. That is because we found that when people volunteer—and we are usually inundated with health professionals who wish to volunteer—their effectiveness is limited if they do not have a support structure around them, some sort of infrastructure. No matter how skilled you are, if you turn up as an extra body but you do not have the equipment and the right setting, that actually places a burden on the organisers following a disaster. So it is a case of being aware that those people are there but also recognising that you need to have people who are organised and supported to do that job effectively in the community—hence the development of the AusMATs.

The period after the disaster is often when we need extra volunteers. For instance, with the Queensland floods, they really needed people to provide locums a bit further down the track because the local practices were overworked to the extreme in the immediate period after the disaster, and then they needed a break themselves. Often their homes are affected; their families are affected. So getting suitable volunteers who can go and work in that style of practice in another state is very useful. That is often coordinated through the medical colleges, such as the AMA and the College of GPs. It is that delayed support that is extremely important but does not get the same notice as turning up to help at the point of the disaster.

**Mr Cameron:** I will just add a couple of things to that. One of the core functions of the National Incident Room in the Office of Health Protection is to provide assistance with the management of spontaneous volunteers. It is actually quite a challenge. In the broader emergency management arena, this issue of convergence—everyone putting up their hands and wanting to do something valuable now—is a major challenge. So most agencies or most non-government organisations have a capacity to register and absorb a number of spontaneous volunteers. It depends what it is; some sorts of incidents attract more volunteers than others. But the management and harnessing of them, getting them into something of an organised structure as Dr Firman has described, is quite a task. It is easy to get flooded. Sorry, I did not mean to say that. It is easy to get—I was going to say 'swamped', but that is even worse.

**Senator BILYK:** Overloaded.

**Mr Cameron:** Yes. I am sure you know what I mean.

**Senator BILYK:** Yes. They are all my questions. Thanks for the work you have done in this area, because I have seen some real positives come out—certainly, from the Tassie government, that the issues down there were resolved.

**Ms Morris:** I cannot remember if there was anything else that you asked earlier that I could not answer.

**Senator BILYK:** I do not think there was. Thanks.

**Senator WATERS:** I have just a few follow-up questions, if Dr Firman or Mr Cameron could shed some light on those. On page 1 of your submission you talk about the lessons that you learnt from the Queensland floods and the Victorian fires, and perhaps also the Tassie fires, about the need for further development in planning and preparedness. Could you please elaborate a little on what you have learnt; and do you have the additional resources, if any are required, to implement those lessons? Also, what time frame are you thinking of, given we know the increased likelihood of these events over time?

**Mr Cameron:** I can certainly talk about lessons learnt about the supply chain for pharmaceuticals. That is one of the points we make there. That is related to some other work we have been doing as well, and I think we are starting to get a much better handle on the challenges around that. We are becoming increasingly involved in the challenges, as far as government has a role in it, around maintaining the supply of essential pharmaceuticals. This is normally done in the context of our national medical stockpile, which we would typically activate on request for big outbreaks of infectious diseases such as an influenza pandemic. We have been faced with a couple of challenges around the timely supply, at the right price, of the right drugs to have in the stockpile. This has prompted an exploration of recent trends in pharmaceutical manufacturing and getting us a much better understanding of that. It is a rapidly moving, rapidly developing and fluid industry that is seeing quite a bit of concentration of manufacturing sites in fewer places around the world. So supply chains are becoming much more critical.

**Ms Morris:** You could say that the supply of pharmaceuticals is becoming part of critical infrastructure.

**Mr Cameron:** Yes, it is much more along the lines of just-in-time supply, throughout the supply chain, rather than big stockpiles in warehouses. That is what we are focused on so that we have a contingency plan ready to go. Those lessons are much more at the forefront of our minds. If we have an incident that destroys a pharmaceutical warehouse, which might be a regional hub for the distribution of a whole lot of things—a flood is a good example of how that can happen over a broad area—then not only do we have a challenge with distribution from an alternative point but the receiving points are also impacted. So the whole supply chain network is damaged. There is a role then for us to assist industry and to understand what capacity there is elsewhere in the broader industry to combat that. That is very much at the forefront of our minds in terms of lessons learnt.

**Senator WATERS:** I would like you to take on notice a few questions on some of the other lessons beyond the pharmaceutical supply chain issues that you have identified. Could you talk about the question of whether additional resourcing is planned to be allocated to this area of your department given that, as we know, we are likely to have more and more intense natural disasters.

**Ms Morris:** I can answer that. At present the answer is no. We were asked a similar question at estimates yesterday and we said we are well resourced for preparedness, and what we have found previously is that, if a pandemic hits, extra resources arrive. If you would like to recommend extra resourcing—

**Senator WATERS:** Yes, I do; and hopefully the report from this inquiry will turn its mind to that very issue. I am also interested in whether there is any regular review of the Emergency Response Plan for Communicable Diseases and Environmental Health Threats of National Significance. Could you flesh out how often that happens, whether there is public consultation and expert consultation, and what the review looks like. Likewise, for the Commonwealth funded mental health programs that you list in your submission, are there any plans to extend those out given we know that, with increased natural disasters, there will be increased mental health impacts.

**Ms Morris:** I can answer that. The answer would be no. But they are considered on a case-by-case basis. At the time of the Victorian fires, there was additional funding.

**Senator WATERS:** Lastly, can you take it on notice to tell us the timelines for the survey based assessment you are doing on the Climate Change Adaptation Framework, who is being consulted, whether there are any plans for public consultation and when that will be completed. Thank you. That would be really helpful information. Sorry for the extra work; you have had a busy few weeks already.

**Ms Morris:** That is fine. We are quite proud of the work we do and we are happy to give you more information.

**Senator WATERS:** Thank you. It is a vital role and much appreciated by all.

**STEFFEN, Professor Will, Commissioner, Climate Commission**

[09:46]

**CHAIR:** Welcome. The committee has not received a submission from the Climate Commission but we have of course noted the various publications of the Climate Commission in this area. Do you wish to make a brief opening statement or table any information before we go to questions?

**Prof. Steffen:** Yes, I will make a brief statement. One of the things that the Climate Commission has worked on in the publications you have referred to and in the public forums and media events that we have had is to recast the relationship between longer term climate change and these extreme weather events. I think there was a lot of misunderstanding in the general community but also somewhat in the scientific community. The point I am making is that it was originally cast as 'Does climate change cause extreme weather events?'—it was an attribution problem. Of course, the answer is no. Natural disasters, climate events and extreme weather are a natural part of the climate system, and we know that. So we recast this really carefully as 'How does climate change influence these events that are already with us?' I think that had a very positive effect in turning the discourse away from the rather negative 'Is this climate change?'. This is a very ill-posed question. We deal with these things anyway. We already know from our natural record back through time that Australia is a land of extremes. So we recast the question to 'How is climate change influencing or affecting what are already extreme events? How does this change our need for preparedness to deal with them and what might happen in the future?'

**CHAIR:** For some of the key extreme climate events that Australia deals with—cyclones, bushfires, heatwaves—could you summarise what trends the commission and scientific research through the IPCC and elsewhere have identified and what confidence you have in those trends?

**Prof. Steffen:** We have drawn heavily from the IPCC, and I think the committee would be aware that the IPCC published a special report last year on extremes. We have also drawn from research from the Australian community and internationally which has come out since that time. So those are our sources of information. We have looked at six extreme events that are important for Australia. We have looked at series of very hot days, normally known as heatwaves. We have looked at bushfires—mainly bushfire weather, not the longer term condition of the vegetation and so on, which we also recognise is important. But that is a very thorny issue scientifically; it brings in ecology as well as climate and weather. We have looked at extreme rainfall events such as the one that triggered flooding in Queensland fairly recently. We have looked at the opposite of that—longer term drought or drying trends. We have looked at cyclones. We have looked at high sea level events—coastal flooding—and there is an influence of climate change there with sea level rise. We have looked at each of those. We start with heatwaves because that is the clearest one. We have a climate system now that has much more energy in it. There is much more heat in the atmosphere; we can measure that. I am talking about the last 50 or 60 years, when there has been a strong trend. There is much more heat in the oceans, too. That means that the probability of having high-temperature events—hot days and series of hot days—goes up. It is simple statistics: if you put more heat in the atmosphere, you load the dice toward those sort of events and away from cold weather events. The data is very clear. We use the Bureau of Meteorology data, which is consistent with what is happening in other parts of the world, and that shows that over the last five decades we have had a doubling of record-high temperatures and we have had a corresponding drop in record-low temperatures.

What is intriguing about this in terms of the health impact is that this trend is actually skewed more toward the night-time minimum temperatures; we are seeing more record-high minimum temperatures during the night. This is really what affects people's health, because it is that recovery period of cool weather during the night which helps people get through heatwaves. When you cannot get rid of the excess heat through the night because the temperature is rising, that is when you tend to get higher fatalities—at least, that is certainly what the medical professions tell us.

We have gone back and interrogated the data with the bureau, and it is quite clear that across Australia the high-temperature events are being skewed more toward the night-time—the minimum events that are rising—more than the daytime. There is a factor of about 5.2 to one for night-time, whereas it is about 2.8 to one for daytime. That is the change of ratio of record high versus record low. It is fairly complex science, but the data is clear, it is statistically significant—we have checked that out—and there is no doubt in our mind that that is a signal of climate change, simply because you have more heat in the atmosphere. I would say that is the clearest one where you have a climate change signal influence. I think all scientists would agree we are seeing the evidence of that.

A related one, of course, is bushfire weather. What we are looking at there are extreme fire weather days—in other words, days like Black Saturday, where you have exceptionally high temperatures, low humidity and high

winds. Those are the days when fires tend to break out. If any of you were in Canberra in January 2003, that is exactly what that day looked like here when those fires broke out. What we do is again interrogate the data. The basic, fundamental climate science, the physics, are quite clear: the risk will increase as you have hotter days, all other things being equal. If you have the same low humidity of 50 years ago and the same wind speed of 50 years ago, but you have much higher temperatures, the fire risk actually goes up. The bureau does calculate a fire danger index. It actually calculates two: one for forests and one for grasslands. In the south-east, the forest one is the more relevant one because that is the one that endangers property and endangers the lives of people who are in risk-prone areas.

If we look from 1973, we see that there have been 38 stations around Australia that have collected this data and calculated the fire index. We see that 16 out of those 38 have seen statistically significant increases in forest fire danger weather; none of the 38 has seen a decrease. They have either stayed steady or gone up. There is a strong geographical skewedness to that: most of those 16 stations are in the south-east. So we are now getting a fairly clear picture that fire danger weather is increasing in the south-east of the continent and staying the same in many other parts of the continent.

To give you an idea of what the numbers look like on that index: like a lot of these indices, scientists like to set the worst value at 100 and the low value at zero so that people can intuitively understand what those numbers are saying. Back in the 1970s, when that fire index was set up, the worst conditions were thought to be the 1939 fires that affected Victoria. I think they were called the Black Friday fires. The meteorological records for that day were set at 100 for the index. Then you scale up as you go forward in time—whether it is a day with 95, 65 or whatever. The familiar sign that you see along the roadside indicating the fire danger is low, medium or extreme is based on those numbers.

What we saw in the Black Saturday fires in 2009 is that, right throughout Victoria, the numbers were ranging from 120 to 190. In other words, they were off the record at the high end. That triggered a new category called 'catastrophic', which are the really high values that, I think, are well above 100—I think it is above 140. In this past summer of 2013, we saw that big swathes of New South Wales had catastrophic fire danger weather for a day or two. Fortunately, nothing broke out, which was a relief, but I have been talking to some of the fire management authorities and they said that they were extremely worried on that day that, if a fire broke out, they would not be able to control it. So again, because of the very clear temperature trend upwards and because that is related to climate change, we see an influence of climate change. We have always had extreme fire danger weather in Australia—Australians know that very well—but that has increased over the past three decades or so. So those two are pretty clear.

It gets trickier with things related to rainfall and drought. What we can see is that the basic physics of the climate system tells us that extreme rainfall should increase. The argument goes like this. Again you have a more energetic climate system. We know that there is more energy in the surface waters of the ocean, because we can measure that. That means that there is more evaporation. It is just like putting more heat to your kettle on the stove: evaporation is going to go up. A warmer atmosphere can hold more water vapour; that is a basic physical equation that has been known for 100 years. So that means you are getting more evaporation from the ocean and more water vapour in the atmosphere. The physics tells us that on average that is going to come down as heavier rainfall; there is some complicated atmospheric physics in that.

What does the data show? We now have enough globally that we see a trend toward heavier rainfall in many parts of the world. The best way I can say that to make it clear is that those areas of the world that have seen an increase in heavy rainfall events—that is the top five per cent in terms of rainfall intensity—are much greater than the areas that have experienced decreases, so we see an overall trend toward heavier rainfall. Australia is a very mixed picture, and that has to do with drought. In areas of Australia that have become drier overall—the south-west of Western Australia is a classic example, but the far south-east and Tassie are also becoming drier—you see a slight drop in heavy rainfall, which is consistent with the fact that you have a drying climate. In north-west Australia, we have seen a statistically significant increase in heavy rainfall, and rainfall overall has increased in north-west Australia. So we have a complex pattern of rainfall change around the continent.

This is where it gets tricky, because Australia's rainfall has always been very variable—the most variable of any inhabited continent on the planet—so teasing out the climate change influence is more difficult for rainfall than it is for temperature. There are two areas where we think we have good enough data and understanding of the climate system to say that we see a climate change influence. One is the south-west of WA, where there has been a quite pronounced rainfall drop since the mid-1970s. The physical reason for that is that the rain-bearing fronts off the Southern Ocean that give south-west WA its rainfall—that is cool season rainfall; it is basically wintertime rainfall—have slipped southward by a degree or two in latitude, and that is because of the warming of the climate

system; it pushes the mid-latitude jet streams toward the poles on both sides of the equator. It is the same phenomenon which is now affecting the south-east of Australia—Tasmania, Victoria and the southern part of Australia; there is still debate about what is happening to southern New South Wales. So those are the two parts of Australia where we can say that there is evidence that there is a climate change signal or influence on the drying trend.

A lot of people would like us to say something about most of New South Wales and Queensland, which have seen this roller-coaster ride of a post-1970s drying trend but extreme rainfall in 2010 and 2011. The only thing I would say there is that the extreme rainfall that we saw was associated with an exceptionally strong La Nina event. Most people are familiar with ENSO, El Nino and La Nina. Where El Nino brings dry and hot weather to eastern Australia, La Nina brings the opposite. That is a natural phenomenon. What we saw, though, is that in association with that La Nina event we had record high sea surface temperatures along the east coast of Australia and around the Top End. La Nina does bring high sea surface temperatures, but we think they got an extra kick from the longer term warming trend. So that is where the influence would come in there. That is a trickier one to pin down and there is more uncertainty, to be honest, around that one. That is basically the story on drought in the south-west and the south-east and on heavy rainfall.

In terms of the coastal flooding, there we do see a signal of climate change, and that one is pretty clear. Sea level has risen since the late 1800s, when we had enough tide gauges around the world to give a sensible figure. It has risen about 20 centimetres since that time. It does not seem like very much, but what it means is that when you get the conditions for flooding—which, again, are natural events—they almost always occur with a high tide. That makes obvious sense, but it is also when that is coupled with a storm surge—when you have an east coast low off New South Wales or Queensland or a west coast low off WA or, obviously, when you have a tropical cyclone.

These systems tend to push water in front of them from the seaside toward the land. So, basically, you have the water level raised by two aspects, and one is the storm shoving water in through its winds and the other is a high tide. When you get a very intense low, that is when you get the so-called one in 10 or one in 20 or one in 100 year events that does cause damage. Most people engineer for those. We are prepared for those. We mop up after them and so on.

What is happening is that this little bit of additional water has raised the whole system up, and so that gives you a reasonable multiplication effect of about a factor of three. So where we have long-term records in Australia, and in the two places that we do have really reliable records are Fremantle and Fort Denison in Sydney, we have seen an increase post 1950 of about threefold in flooding events compared to pre 1950. We think it is the signal that we see. The issue there is: what is going to happen in the future? Because one of the most certain aspects of climate change is that sea levels are going to continue to rise. This is because there is already a lot of heat in the ocean that has not worked its way through the system yet. The water is still expanding in response to that. And then on top of that is we are starting now to get additional water flowing into the ocean from melting glaciers and ice caps.

Over the last couple of decades, I think the statistics show, the measurements show, that that second phenomenon of additional water coming in, particularly from the big polar ice sheets in Greenland and Antarctica, is now becoming significant, and probably in the next couple of decades it will overtake the expansion of the ocean water as the major factor in sea level rise.

There is a lot of uncertainty about how much sea level is going to rise. The IPCC projections are for about two-tenths of a meter to eight-tenths of a meter by the end of the century, and that is based on a 1990 baseline. So that is roughly where we were a couple of decades ago. But they cannot rule out larger ones, because we simply do not know how stable those big ice sheets are. That is an area that requires more scientific research, and we are working on that.

One of the most controversial areas when this comes out into the real world of legal issues and planning issues is how coastal councils are going to deal with that. I spent a fair bit of time recently talking to councils in Sydney and councils down here close to Canberra, Eurobodalla. We have also talked to people in Tasmania, the Clarence council and so on. We are trying to point them to our expert base on sea level rise, which is based in Tasmania in the ACRC and in the University of Tasmania. These people have the expertise to really look at a location and take the sort of general stuff we say in the Climate Commission and say, 'How does that matter for your location?'

There are variations geographically. Around the Top End, the rate of sea level rise in Australia is about three times the global average. The Southern Ocean, along the southern coast of Australia, is less than the global average. Around the east coast, it is about the global average. So there are regional variations, which are actually important when you look at an individual council. Also, the topography is hugely important, or what the scientists

call the 'geomorphology'—the dune systems, the cliff lines, the angle of the beaches and so on. This is all important for what is actually going to happen, and it brings in other areas of science when you look at what the impacts of these high sea level events are. Our job is to look at how the climate system is changing and how it influences, if you like, upstream: what are the risks from these high sea level events occurring?

The last one that I will give you a brief on is cyclones, because that is a really interesting one. In principle, we are going to see a change in cyclone behaviour, and that is pretty obvious because the sea surface temperature is rising. This means there is more energy in those surface waters, and that is where cyclones draw their energy from. However, the interesting thing is that it looks like we will not have more cyclones—in fact, we will either have about the same or perhaps a little fewer. This involves some very complicated physics that is related to the gradient of temperature change from the surface ocean to the top of the atmosphere. Stronger gradients promote the formation of cyclones—in other words, it is the difference between the water temperature and the temperature at the top of the atmosphere. When you look at these big systems, you can clearly see the top of those cyclonic systems. A large difference tends to promote formation, but as that difference decreases—and it is actually decreasing as the climate warms—they tend not to form so often; but, when they do, they have got more energy to draw from.

So the bottom line is that we probably will not see any more cyclones, perhaps fewer of them; but, on balance, they are going to be more intense when they do occur. Again, that changes the risk profile in that Queensland, the Top End and WA; they may not see as many as they have in the past, but when they come the dice will be loaded towards the heavy ones, the extreme ones—and by 'extreme' I mean higher wind speed and more rainfall. That is where the science is on extreme weather events.

Again, all six of these are well known to Australians. They occur naturally. What we are trying to do is to ask how they are changing and how they are being influenced. We believe it is really important that this information is out there for the preparedness that we need to undertake in the health communities and in the emergency management communities and so on, and obviously to inform the debate about in the longer term getting emissions down, trying to prevent the worst of our projections happening.

**ACTING CHAIR (Senator Cameron):** Thank you, Professor Steffen, for your detailed analysis of the issues. One of the reports I read—12 January 2013—was in the *Murdoch* press, a headline in *The Australian* 'Climate results validates sceptics'. It is a report about Britain's Met Office that there is a pause in the heating and that this is being used by the sceptics to say that people like you should now have a great dose of humility because you have been proved wrong. Are you familiar with that?

**Prof. Steffen:** Yes.

**ACTING CHAIR:** Could you give us your take on this?

**Prof. Steffen:** Yes. That article is referring to the fact that the surface air temperature record—that is, the long-term global average—has a plateau in it of about 10 to 12 years. So from about 1999-2000 through to 2012 it remains very much above the long-term average, but the upwards trend appears to go like this. It appears to be a plateau or a hiatus in the warming. There are a couple of ways to answer that. One is that that is a misquote of the meteorology bureau in the UK. If you look at their statements after that they will say that they have been misquoted. However, the plateau is a real and observed phenomenon.

There are two things going on here. One is you have to take one step backwards and look at the more fundamental question: where is the extra energy from the greenhouse gases going? If you do that, you will find that only three per cent is going into the atmosphere. So although we spend a lot of time looking at the atmospheric record, it is actually not scientifically a good record to look at. Ninety per cent goes into the ocean and that is because there is a huge heat capacity of water, much more than air, and two-thirds of the surface of the planet is ocean. When you look at the ocean heat content record, you see no plateau. The rising trend is strong and it continues unabated through 2010, which is the last year we have records. We now have records down to 2,000 metres, which is much more comprehensive than the earlier 700 metres. We have better instrumentation and that is telling us that the heat is now penetrating further down into the ocean. In fact, we know there is some below 2,000 metres that we cannot account for yet because we do not have the instruments. So we are probably underestimating how fast the planet is warming—because we cannot get at the really deep oceans. There has been no plateau or hiatus, or slowing, or stopping, or stalling of the heating of the planet as a whole. There has been of the air but that is only three per cent of the total energy that comes into the system.

The second thing scientists have done is to say that that plateau is real. What is causing it? The answer is that there is interaction between the air and the ocean, obviously—they exchange heat all the time. So when you have

one that has 90 per cent of the heat and one that has three per cent, small changes in the 90 per cent give you big percentage changes in the three per cent compartment.

More specifically, the feature of that interchange we know best as what I referred to earlier, ENSO—El Niño—southern oscillation. El Niño, La Niña is in fact an interaction between the ocean and the atmosphere. What scientists have done is to say that we know that La Niña years are cool and El Niño years are warmer than average. We know that the incoming solar radiation varies a little bit from year to year and we know how much that is. When you put those correction factors onto the plateau, the plateau disappears and the trend goes straight up. The point is: the underlying warming trend in the atmosphere is still there; it is being masked by things that happen on shorter time periods.

This gets back to the met bureau projections. The projections, which in fact were not very good, were for shorter periods of time—the next five years; the next decade. In my view—and perhaps I should put this off the record, because I do not want to get in trouble with my colleagues—it is dangerous for climate modellers to put much weight on shorter-term projections. We do not have a good handle on how these natural modes like ENSO operate on shorter time periods. The climate models are much better on longer time periods.

So I think it is an interesting phenomenon, this plateau. And it has triggered a lot of interesting research in science, but I think we can explain it pretty well. The bottom line is: the heating of the whole planet has not stopped. It has continued as we have expected.

**ACTING CHAIR:** So have there been any peer-reviewed scientific papers that have a different view from what you have just explained on this specific issue?

**Prof. Steffen:** Yes. I will just quote two of them. There is a paper by Foster and Rahmstorf that was published in 2011 that examines this correction issue, taking the plateau and correcting that record for ENSO; for volcanic eruptions, which affect short-term climate; and for solar intensity. And they get the trend continuing.

The second is some really nice work by two groups. One is the group of Sydney Levitus, an American oceanographer. His group is one of the three in the world that track the long-term ocean temperature. He published in 2012 the latest record, and it shows the heating of the ocean continuing unabated. John Church down in Hobart has done similar work on ocean using what he calls thermosteric sea level rise, which is the expansion of the ocean. Again, you see absolutely no abatement of sea level rise over this period. So, yes, all of that is documented.

We will be publishing, as a climate commission, on 17 June—so, in a bit over a week—an update to the science: the basic science, not just extreme events. Both of these issues are dealt with, with the peer-reviewed literature, in that document. We will make sure that this committee gets a copy—in fact, I will see if you can get an advance copy, because it should be ready next week sometime—so that you can incorporate that in your report.

**ACTING CHAIR:** That is good. So, if you are tabling this, would that be within the period to table documents? So if you are going to table that in a week, we need somebody to move that we act accept the document as a tabled document.

**Prof. Steffen:** Thank you. We could table it by Tuesday or Wednesday next week if that would suit the committee.

**ACTING CHAIR:** That is good. So it has been accepted, thanks.

**Senator WATERS:** Thank you very much for your time, Professor Steffen, and for that excellent overview of the problems that the planet and humanity itself are facing. I have a few broader questions and a few nitty-gritty questions. First of all, I am interested in the mechanics of whether the climate commission is having any role in land-use planning. You mentioned that you are speaking with coastal councils, particularly, and I am from Queensland where our Gold Coast council was in fact the first council to adopt a sea-level building line, which I was very pleased about. Are you having ongoing talks with councils about that issue? I am also interested in whether you are having any input into any Building Code of Australia reviews, given the extreme weather intensity that you have outlined, and of course the impact on our built infrastructure.

**Prof. Steffen:** Thanks very much for those questions. Before I answer them directly I would just note that we are going to have a forum in the next few weeks up on the Gold Coast; I think it is the week of the 17th, and I think it is Wednesday, the 19th, but I will have to double-check that. That gets me to the substantive answer to your question: the remit of the Climate Commission is to communicate with and engage the Australian public on climate change, on three broad issues: on the science, which is my main role; on international action—what other countries as well as Australia are doing to deal with the problem; and on various mechanisms for getting emissions down—in other words, various economic tools, technology tools and so on; renewable energy; trading schemes; whatever. Our role is not to comment either on government policy or on opposition policy, or on state

government or local government policies. So we stay out of the policy advice on climate arena, and that is because of our legislation. We are pretty clear on that.

What I really try to do is make the science as clear as I can and invite local councils who are interested in pursuing that to get specific scientific advice from the experts on geomorphology, on sea level rise, for their particular location, because it varies, of course, from location to location. I know, for example that Eurobodalla shire, which is the one just down here from Canberra, is having some discussions next week with legal people on what all this means for zoning, for legal liability of councils and so on. All of this is informed by what we do at the commission but it is beyond our remit to take an active role in giving policy advice or getting into those discussions.

**Senator WATERS:** Okay, so you make that scientific advice available—

**Prof. Steffen:** Absolutely.

**Senator WATERS:** and hopefully councils can see the wisdom both from a legal and a risk management perspective of taking that advice. So the same goes wrong building code input, Professor?

**Prof. Steffen:** Exactly.

**Senator WATERS:** Again, I hope relevant folk are paying good attention. Can you make any comments about the recent Carbon Tracker Grantham institute report, which found that if the world is to stay within two degrees of warming, that between 60 and 80 per cent of our coal reserves need to stay in the ground?

**Prof. Steffen:** Yes, I can comment on that, because it will be in our report, this being released on 17th. What we do there is look at what the science says in terms of its relation to policy, without, again, making a policy recommendation.

Here is the way the scientific argument goes. Most countries around the world, including Australia—and it is a bipartisan approach in most countries, including Australia—has agreed to the two degree guardrail that you refer to. In other words, countries around the world want to take actions to limit the temperature rise to no more than two degrees above preindustrial. All major countries have said that—China has said it, the US has said it, the EU was the first one to say it. Australia has also agreed to that. That is right across politics; it does not matter what side of politics it is, that is agreed. So what scientists do then is say, 'We will take an agreed policy like that and work backwards and say, "What is required with our scientific knowledge to actually meet that policy objective?"' The best way to do that, because of uncertainties in our understanding of the systems, is to take a probabilistic approach. In our report we say, 'If you want a good chance'—and we define that as 75 per cent probability; in other words, a three out of four chance and not just a flip of the coin—'to meet the two degree guardrail then there is a certain amount of carbon dioxide that can be emitted between 2000 and later this century. 2050 is the normal year that is given.' That turns out to be about one trillion tonnes—1,000 billion tonnes—of carbon dioxide.

That calculation was done by scientists starting at the year 2000. Obviously we are in 2013. If you start with 2000 we have had 13 years through 2012 and we know how much the world has admitted—391 billion tonnes of carbon dioxide from fossil fuels. It is a fossil fuel calculation. That by far is the biggest emitter. That is 39 per cent of the budget. We have 61 per cent of the budget left: we can emit 609 billion tonnes if we want to have that 75 per cent chance of meeting our policy objective. That then tells you how much fossil fuels that you can emit.

If you look at the fossil fuel reserves, which are listed on the stock markets by the companies that own these reserves—here it is not just coal, Senator; it is the range of coal, gas, oil and non-conventional fossil fuels, there is a whole range—the science does agree with your numbers. Basically we can only burn about 25 per cent of the known reserves to meet that policy target. Can you extend that a bit? That is that uncertainty range that you quoted. Yes, you can, you can do that by more vigorous reduction of non-CO<sub>2</sub> greenhouse gases—and by that I mean methane, nitrous oxide and others, which will certainly help the cause; and carbon capture and storage. The analysis done by the Grantham Institute has taken some estimates of what that might mean, including the most optimistic projection of how much CCS can be deployed in time. That increases the budget but it still only means that about 35 per cent of the known reserves could be burnt.

So the bottom line is most of the fossil fuel reserves have to be left in the ground if the world wants to meet that policy objective. Now, that is what the science says, and we are pretty careful in our report to say, 'This is our line of argument: we are starting from an agreed policy objective and then working backwards.' So the number-crunching is pretty clear and it will be on record on 17 June, when this report comes out.

**Senator WATERS:** Thanks, Professor. If we take that 20 to 25 per cent, leaving out the carbon capture and storage—or even if, for completeness's sake, we take the remaining 35 per cent of fossil fuel reserves that are burnable to stay within two degrees—according to those reports and your summary, at current rates of extraction how many years is that?

**Prof. Steffen:** Okay. At the rate we are going now, the budget will be totally consumed in 28 years, so that will be about 2027 or 2028. That is at current rates of extraction, use and combustion of fossil fuels. That has, I think, a two per cent rise factor per year—over the last decade it has been rising—or a little bit more than that. Last year, we rose 2.6 per cent in emissions. Basically, the story is quite clear. If we do not start turning those emissions down really fast, we do not have any hope of meeting that policy target, and that is another point we make very clearly in the report. This is why, by the way, we use the mantra 'the critical decade' in our commission work. It is not just about turning the emissions down; it is about the investment decisions that have to be made this decade. We have to make the appropriate ones—again, if we want to meet that policy target.

**Senator WATERS:** Okay. That is not a long time. I am going to be asking our next witness about alternatives and whether we are going to be able to meet that time frame and still meet our energy needs. My view is yes, we can, overwhelmingly, but I will leave that for the next witness—unless, Professor Steffen, it is within your purview to comment on that?

**Prof. Steffen:** No. I would certainly defer to my colleague to answer questions about the energy system and what is possible and what is not.

**Senator WATERS:** Okay. I will ask, then, about the feedback mechanisms of those extreme weather events. I do not know if that is much of a proportion, really.

**Prof. Steffen:** The feedback mechanisms are normally not connected to the extreme weather events; they are connected to the broader climate system. I think what you are referring to in terms of feedback effects are, for example, an outburst of methane from permafrost, a weakening of the land and ocean sinks and so on. There has been a lot of work done on those feedback mechanisms which do accelerate climate change beyond our own emissions. The best advice I could give there is that, if we do meet this policy target of two degrees, there is very little likelihood that we will trigger those feedback effects. Above two degrees, the odds increase, sometimes quite sharply.

We think the most vulnerable areas may be things like the Greenland ice sheet, which could be committed to losing a lot more of its mass with a 2½ or three degree temperature rise. We do not have a good handle yet on the methane up in Siberia, Canada and Alaska, but there are some indications that the emissions are increasing, although somewhat sporadically. This is an area of active research, and I have to admit there is still a lot of uncertainty. Other than that broad statement that I think we are relatively safe when most of these are below two degrees—and that is another very good rationale for that policy objective—I would say that, although that level of two degrees was a politically negotiated policy objective, there is quite a bit of scientific support that it is a reasonable objective.

**Senator WATERS:** Okay. So, if we constrain warming to two degrees, then we can avoid runaway climate change?

**Prof. Steffen:** Yes. I think the overwhelming evidence is you will avoid runaway climate change at two degrees or less.

**Senator WATERS:** Professor Steffen, can you make any remarks about the impacts of a two-degree rise on some of our sensitive ecosystems? I am thinking in particular of the Great Barrier Reef. Is it safe for the reef?

**Prof. Steffen:** I want to make it clear that the two-degree rise has serious impacts. It does in extreme weather events, and I think we can point to that. In terms of natural ecosystems, the Great Barrier Reef is in serious trouble with a warming of two degrees, for a couple of reasons. One is the underwater heatwaves, if I can put it like that—the high-temperature events, the surface water, bleaching events. But, simultaneously, a world that is warmer by two degrees, with hundreds of millions of tonnes of CO<sub>2</sub> being emitted, means that the ocean acidity is going to continue to increase, and that erodes the resilience of the reefs. Coral organisms have trouble calcifying as the ocean acidity increases.

The Kakadu wetlands will also, I think, be in serious trouble, mainly because of saltwater intrusion into the freshwater lagoons. That is starting to happen now but, with sea level rise, it is going to happen even more. The snowfields and the alpine ecosystems will certainly shrink and how fast we can get emissions down will determine whether they almost completely disappear or whether we have remnant ecosystems left. Those are the high profile ones but many other ecosystems will struggle simply because the rate of change is so high.

Ecosystems are adaptable. They have adapted to the swings between ice ages and warm periods but they have had 5,000 years to do so, not a century. It is really the rate of change which is causing the problems for many ecosystems.

**ACTING CHAIR:** One of the arguments says, no matter what we do now, we are going to have these effects because of the latent nature of climate change, the existing heat in the ocean, changes to the atmosphere for many

years to come. Some of the sceptics use that as an argument to say, 'Look, this is a natural phenomenon, it is not the physics of climate change. No matter what Australia does now it is not going to have any effect.' Have you heard these sorts of arguments?

**Prof. Steffen:** Absolutely.

**ACTING CHAIR:** I suppose that is a political challenge for us as much as a scientific challenge for education. How do you feel the education process is? If you read Mr Dunlop's paper and the work that you guys are doing, there is obviously a need for clear action on this. But it is so easy to be a sceptic and the science is complex. To explain the science in the way that the ordinary public understands is very difficult. That is the strategy and the key issue for me. How do you politically and scientifically explain the challenge?

**Prof. Steffen:** There are a lot of good questions in there. Our job as a commission is to try to do that through these reports. First of all, the evidence is overwhelming that this is not a natural swing in climate and we have put that forward many times. You will see it again in the report that is coming out on 17 June: that the evidence is even stronger than it was five years ago, that the emission of greenhouse gases is the primary cause of the changes we are seeing.

We talk about this rate of change issue. Yes, there have been natural swings. The only times you have seen swings anywhere close to the ones we have seen now are when you have had mass extinction events—when a meteorite has hit the earth, the big one that wiped out the dinosaurs. Even with that the climate response was slower than what is happening now. Again, it is this rate of change. You cannot see this in nature. There is a wonderful paper published about a month ago which goes back 2,000 years and shows the natural swings, continent by continent. It shows one of the big arguments of the sceptics is rubbish: the fact that the medieval warm period was as warm as today.

The medieval warm period was but only in the northern hemisphere and only in the North Atlantic. It was not global. What is happening now is the first time in 2,000 years we see a sharp globally synchronous spike coming up in the temperature. It looks different from anything else in that record and it is different because it has a different cause. I could go on and on. That is one thing.

The second thing is there is huge value in stabilising the climate at around two degrees. It does have impacts and I have gone over that with Senator Waters, but it is hugely different world from a four degree world, particularly in terms of human wellbeing. We can cope with a two degree world. It is not going to be easy but we are a wealthy, resourceful species. We can probably do it. My considered opinion is contemporary society will really struggle at four degrees just to survive.

For our grandchildren it makes a huge difference what we do now. The last part of that is Australia. We are one of the 15 biggest emitters out of 200 countries on earth. We are certainly not as big as China and the US, they are the big guys, but we are in the next tier. Our emissions are as big as those of Italy and France and not much less than those of the UK. Everyone around the world expects those countries to take action and they expect us to as well and to play a role as a leader in that group of 15 countries that are the major emitters around the planet.

I still do a lot of work internationally. Our sense is the action that Australia has already taken has been extremely well received around the world. Australia is getting serious about playing its role. We have done a very thorough analysis of what other countries are doing and I would say Australia is well placed. Other countries are doing more but we are doing as much and more than many other countries. We are in the middle of the pack and I think I can rightly and reasonably proudly say when I go overseas that we are starting to pull our weight.

**ACTING CHAIR:** Thanks very much. That has again been very helpful and we are always appreciative of the skill that you can argue these points before the committees that you appear before.

**DUNLOP, Mr Ian Thomas, Private Capacity**

[10:30]

**ACTING CHAIR:** Welcome, Mr Dunlop. Do you have an opening statement you would like to make?

**Mr Dunlop:** Yes, I would. Just as a bit of background to the submission I have lodged, I am an engineer by training. I spent most of my career in the energy industry, initially in oil and gas exploration around the world and in the 1980s and the early 1990s here in Australia in coal developments. I have always had a very close interest in long-term energy planning. I have been involved in climate change issues since the 1960s because it was on the agenda in those days as something which the fossil fuel industries were going to have to contend with at some point, not necessarily in the short term but in due course.

In terms of relevant experience I chaired the Australian and the New South Wales coal associations in the late 1980s. I was the CEO of the Institute of Company Directors in Australia from 1997 to 2001. During that time I chaired the Australian Greenhouse Office's experts group on emissions trading which developed the first emissions trading proposal for Australia under the Howard government as part of our obligations under the Kyoto protocol. Since 2001 I have been working in a voluntary independent capacity to really improve the awareness of what I term the climate and energy dilemma because the two issues are inextricably linked. You really cannot address climate change without also addressing out future energy requirements.

What I really have been keen to do is to, one, improve awareness of that dilemma and, two, to advocate realistic solutions. I work with various think tanks in Australia such as Australia 21 here in Canberra and the Centre for Policy Development in Sydney. I am also a member of the Club of Rome internationally which has been heavily involved in this type of work for a long time.

I requested an opportunity to speak to the committee because I believe that the leaders in Australia, as with others around the world, have very badly underestimated both the extent and speed of climate change. Further, they are almost in total denial of the other major resource limits that are now impacting upon the world at a global level but also which are being translated into a national context, particularly with Australia. The issues are absolutely critical to any balanced assessment of the matters before this committee. I think it is critical that, if we are going to have sensible developments of risk management—and risk has been one of the major interests of mine over many years, particularly in relation to major industrial ventures like offshore oil and gas—you have to have really an honest definition of what the problem is. Our difficulty is that we really have not been honest, either in Australia or here, whether in business or politics, about what exactly is the problem we are confronting. Until we get to that point, we are never going to have realistic solutions.

Unfortunately, the current policies and attitudes that we are operating under almost guarantee catastrophic outcomes for the Australian community. This climate and energy dilemma is probably the most important issue that confronts this country and yet it just does not appear in the national debate. It is important because it affects every other policy consideration that we are putting in place at this point.

What I would urge the committee to do is initiate a major reconsideration of the Australian parliament's approach to these issues, before it is too late. I believe that if you look at the solutions that have been proposed and you look at the speed of change that has been going on we have little option—if we are serious about addressing climate change and the extreme implications of that in terms of weather—than to move to an emergency response, a completely different approach to the management of catastrophic risk from the ones which are typically talked about within business and the insurance industry and so on. My rationale and the risk-management approach I would advocate is set out in the submission, so I would be very pleased to answer any questions essentially on that.

**ACTING CHAIR:** Thank you Mr Dunlop and thank you very much for the detailed submission that you have provided to the committee. I was interested that you twice quoted Winston Churchill. You stated that Winston Churchill said:

Want of foresight, unwillingness to act when action would be simple and effective, lack of clear thinking, confusion of counsel until the emergency comes, until self-preservation strikes its jarring gong—these are the features which constitute the endless repetition of history.

When I read that I immediately thought of another quotation that is used extensively. It is not a Churchill quotation but one of Otto von Bismarck: 'Politics is the art of the possible.'

I thought, how do you get the Bismarck quote and the Churchill quote to deal with the issues that we are facing? I say because you are an engineer; you have worked in the industry. I am a fitter. I have worked in the power industry. I was a union official for the coal industry. I see all of these communities that rely on fossil fuel

for their livelihoods. My kids were brought up off the back of the steaming coal at Liddell Power Station. There are many people out there who go, 'What happens if we stop this?'

How do you balance, if there is such a balance, the community's fear, that is being pushed by some politicians and climate-change deniers, with the science and the anthropogenic outcomes that you are talking about in here? How do you feel you can deal with that? On the one hand I have heard that we should completely decarbonise the economy—I do not think that is possible and I am certainly not a climate sceptic by any stretch of the imagination; I do not think you can decarbonise, as you have to try to maintain some kind of industrial base—and on the other hand you have to deal with the technology. As you are an engineer, I would like your views on this.

The international energy agencies say that carbon capture and storage should account for 15 per cent of the decline in CO<sub>2</sub> emissions over the forthcoming period. This can be done, in my view, but it has to be at a cost. A lot of people simply look at putting solar panels on their roofs and they feel good about it and think 'This is great' but the real challenge is the industrial challenge. It is the industrial challenge of decarbonising or reducing carbon emissions in steel, concrete—the things that build our communities—and fuel. How do we do that?

**Mr Dunlop:** That is the crux of the problem. To answer your comment on Bismarck to begin with, the issue we now have is something that humanity has never faced before. We have historically experienced limits in the growth of the world economy since the Industrial Revolution. There is no question that fossil fuels have been the main factor in the generation of the wealth we now enjoy. But as John Maynard Keynes said: 'When the facts change, I change my mind. What do you do, sir? The facts have changed for fossil fuels. It is very clear that we cannot continue burning fuels in the way we have done historically. On the point raised earlier by Senator Waters on unburnable carbon, the 20 per cent limit is probably a bit much in relation to what is now happening around the world, so we are going to have to completely rethink the entire industrial system.

This is not something we have ever had to grapple with, because the limits we have hit historically have always been at a regional level in some way or technological limits which we could somehow get around. We have managed to avoid any real constraint. The problem we now have is that the limits today are global. The biggest one is storage capacity for CO<sub>2</sub> in the atmosphere. You cannot do it anymore; the capacity is used up. Now you have to do something else about it, either stop pushing it into the atmosphere or bury it somewhere. But others are equally important. You are now hitting the limits of conventional oil supply, for example; things like phosphorous we are hitting limits on. If you look at what is happening within the agricultural arena, the availability of arable land and fresh water are starting to move in ways that have been talked about for some time, particularly back to the 1972 Limits to Growth work that the Club of Rome did, but these are now becoming real.

The concepts we have lived with in terms of what is politically realistic are no longer relevant. As Milton Friedman said—and he is not exactly a left-wing socialist—we really have to prepare options and be ready for the time when the politically impossible becomes politically inevitable. That is what we are now facing. The transformation away from carbon has to move at emergency speed. We need to continue an industrial base, clearly, but that can be done without carbon. It will take some time to make the transition, but we have to start moving down that path. On the concepts of the conventional solution, such as carbon capture and storage, I know the IEA's work well and that is what they would like to target under their new policy scenarios for 50 degrees Celsius, which is the two-degree C temperature scenario. But the simple facts are that this is not working. Wherever you look at the world, we are not moving at anywhere near the speed that the IEA want. We have to see 3½ thousand major CCS operations running by 2015, and we are light years away from even the low-development stage of that.

The other problem is the cost one you mentioned, which is that to create that sort of carbon storage system you have to create something that is bigger than the world oil industry. And to have any serious effect on the climate, given what we see happening now in areas like the Arctic and the Antarctic and the Amazon, you have to do that very quickly. It is completely incompatible with the scientific evidence we see.

I believe there are solutions to this. We can maintain an industrial base. We can develop new sources of energy. There is no silver bullet; there are a whole lot of silver buckshot, and we have to start down that path. But it will not happen with conventional reform processes. If you look at what has happened since World War II, you look at the way we think and the way in which we are conditioned to operate, it is really incremental change. That is the way business think, it is the way the political work think, but this is not an issue you can handle that way. We have to face up to the fact that that is where we have got to.

**ACTING CHAIR:** You raised the issue of business, and this was my next question. I have been really disappointed that there has not been—apart from you—any leadership from the business community. I do not know if you know where leadership is, but I have not seen it. About nine years ago when I was a union official I met with the President of Ford Europe. They gave us a presentation about the implications of climate change for

Ford—what they needed to do in terms of diesel, aerodynamics, magnesium, making the cars lighter and all of these issues. That was nearly a decade ago. I am not trying to have a whinge here; I am just trying to put the facts on the table. When you deal with it as a politician then the business community desert the field and the business community see it simply in the context of returns on investment and profit to shareholders. They take the short-term view. Short-termism is a huge problem in Australia, particularly in the business sector. Where are the business champions? You are from the business area. Where are the business champions who are providing the backbone to some politicians to deal with this issue?

**Mr Dunlop:** I would agree with you that there is a complete absence of leadership in Australian business on this. Some of the reasons for that I have set out in the submission. In the way the business and the political systems have evolved over the last 20 years they have become more and more short-term focused. A large part related to the way we actually pay people, remuneration and the quantum of remuneration, and the fact that that depends on what has happened in the last three or six months and what might happen in the next six months. That has meant you have moved from a world in, say, the 1960s and 1970s where you had genuine statesmen in both business and politics who were prepared to take a broader view than their immediate short-term business interest to one where today it is almost totally dominated by short-term thinking, so getting anybody to actually focus on the implications of the climate issues and energy resource security issues is extremely hard. I guess it is particularly a problem in this country because of the fact we have grown up based on the mining industry and it has formed such an important part of our history and our wealth generation. If you have people who have worked in those industries for decades and risen to leadership positions and you then propose that the entire business model is, unfortunately, going to be completely turned on its head, they do not view that terribly favourably. If you have a situation where the power systems in the country have essentially accrued to that community, which is what has happened in Australia I would argue, then it becomes extremely hard to actually reverse that.

If you look internationally, you would have a little bit the same problem but there are signs now that some of the very big companies around the world are starting to acknowledge that you cannot do business in a four-degree world and that the proposals that are currently on the table in terms of the sorts of solutions I talked about, plus I suppose the emphasis on market forces and isolation, are not going to deliver the sort of change we need. Therefore, we have to start a different sort of conversation. I think that is actually very encouraging. It is only a glimmer at this point in time. You still have people going to the Davos meetings every January and agonising over the fact that climate change is now the biggest risk on the agenda, which it is in their risk reports, yet go away and do nothing about it.

So there is a complete disconnect both internationally and in this country for people who accept that climate change is a serious problem but then do nothing about it. I think that is why you have to start a completely different approach to this. You have to be very honest about the problem. One of the biggest challenges we have got is that there has not been a preparedness to put the facts on the table for fear of scaring the horses, as the psychologists would tell us. Unless you are honest then you can never come up with the right answers. You will not get community support for the change.

**ACTING CHAIR:** I have had the view that business need to take leadership in this now for some time. I think you said that businesses are doing nothing about it. I think it is worse than that; I think they are exacerbating the problem because for them 'business as usual' means more carbon pollution and it is simply about the bottom line. You have laid a challenge out for the politicians. I think the only thing you have not laid out in here as well is the real challenge for the business community.

**Mr Dunlop:** I thought I had got that in to some extent. Not perhaps to the same extent as the political world, but that is something I do a lot on and I have done for years: trying to encourage business to start to get into this space and take a leadership position, because in the end it is business that is actually going to have to implement all of this.

**ACTING CHAIR:** There must be business opportunities in this, surely.

**Mr Dunlop:** This is the biggest business opportunity the world has ever seen. People say that if you read the submission it is a doom-and-gloom story. The doom-and-gloom story is not this; it is what we are currently doing. What we are on is a completely suicidal path if you take a sensible objective look at the science.

On the other hand, the opportunities we now have are absolutely enormous. The world, I would argue, is in the beginnings of the evolution of a steady state economy in the developed world. If you look at the US and Europe, the problems that people have been having are actually getting out of recession. To a large extent I would argue it is because of the fact that these resource biophysical limits are now hitting. And they are going to hit us too.

There is a tremendous financial stimulus available by investing in the new lower carbon opportunities we now have. Instead of printing money to try and reboot the old economy, which is basically what the US is trying to do, and if you started that money going into low-carbon investments with a really strong push from both business and government, then I think you have an absolutely phenomenal growth development opportunity. But it is a different sort of growth from the one we have had.

**Senator WATERS:** Thank you very much, Mr Dunlop, for your inspiration as well as your very clear outlining of the extent of the problem. In your excellent detailed submission you talk about the difference between a two-degree and a four-degree world. You quote a chap from the Potsdam Institute for Climate Impact Research as saying the difference between two and four degrees is simply human civilisation.

We heard from the previous witness, Professor Steffen, his concerns about a four-degree world—I think you were in the room at the time, Mr Dunlop—but he said he thinks that we will struggle to survive at four degrees and what we do now makes a huge difference to our grandchildren. Do you share those views about the difference between a two- and a four-degree rise?

**Mr Dunlop:** Yes, absolutely. If you talk to any of the experts who have really looked at this seriously, like Hans Schellnhuber, from Potsdam, Kevin Anderson from the Tyndall Centre in the UK and the UK Royal Society generally, all of these views are saying that at four degrees Celsius we will probably move from a world at the present time of seven billion people to a population reduction of about six billion or more. So you would end up with a world of one billion, half a billion or so on. That may not all happen overnight, but that is what you are locking in by not taking action today.

In an Australian context, we will be more severely hit than most people. We are already a hot dry country, and therefore you are looking at a very severe reduction in the Australian population. I think we should face up to that fact and not sweep it under the carpet, because that is what you are dealing with and why you have to move to an emergency response.

**Senator WATERS:** If we are to constrain global warming to two degrees—we have talked about the Grantham Institute report and Carbon Tracker saying we need to keep 60 to 80 per cent of fossil fuel reserves on the ground. You go into that in your submission. If we did in fact burn all of those fossil fuel reserves, what sort of temperature increase would we see?

**Mr Dunlop:** You are heading up to six degrees or eight degrees on average globally. That would be the implication of that.

**Senator WATERS:** I recall John Howard in a Kerry O'Brien *7.30 Report* interview—several years ago now—when Kerry O'Brien asked him what six degrees would mean and he said it would make it 'more uncomfortable for some.' I have never forgotten that. What is your view on a six degree increase?

**Mr Dunlop:** This is the problem: people do not understand what an average temperature increase of two, four or six degrees really means. It means a completely different world from the one we have inhabited for the last 11,000 years. Just to add to the point that Professor Steffen made: if you look at the speed with which we are pushing carbon dioxide into the atmosphere today, it is 10 or 15 times faster than occurred at the last major extinction event we had, 55 million years ago at the Palaeocene–Eocene Thermal Maximum, which is why we are getting the spike up in temperature which we have seen since the end of World War II. We know that it is due, to a large extent, to human induced CO<sub>2</sub> because we can determine which of the carbon types is causing the problem. The context in which this is all happening is completely different from anything that we have previously experienced.

**Senator WATERS:** I note that, in response to Senator Cameron's statement that we cannot decarbonise because we need an industrial base, you said, 'We do need to continue an industrial base, but we can do that without carbon,' and I welcome your statement in that respect. Can you talk to us a bit more about how we can decarbonise, how quickly those cleaner energy alternatives can come online and whether they can fulfil all of our industrial and maintenance needs.

**Mr Dunlop:** As I said, there is no single solution to this. The most critical issue is that we have to stop wasting energy, so energy efficiency and conservation have to be top of the list. There is a tremendous amount that can be done within the developed world to achieve that. You then have all of the renewable technologies that are now starting to emerge, and the costs of a lot of those are dropping extremely quickly—for example, solar, wind, a lot of the concepts of tidal energy and what have you. That has been extremely encouraging, and obviously we have seen a big take-up in solar PV and so on in Australia. But that is all coming off a very small base, and the reality is that fossil fuel is still 85 per cent of the total energy provision and is forecast to stay fairly high. You are going to have to seriously look at issues like nuclear. As far as I see it, you cannot, given the size of

the problem, ignore the possibility of new technologies emerging with nuclear which make it safer than traditional technologies and also possibly quite smaller scale. The Chinese are doing a tremendous amount of work on that. It may be that nuclear rules itself out on a cost basis, but you have to keep the research running. There is a lot of work going on in biofuels, which you have to be very careful about because not all of that is automatically environmentally beneficial.

**Senator WATERS:** Nor is nuclear, I might add.

**Mr Dunlop:** You have to be very cautious about where that works. You can look at a lot of new technologies, such as fuel cells and different combinations of things. On some of the traditional issues like carbon capture and storage, it may be a contributor to solving some of the problem because you can store carbon in, for example, exhausted oil and gas reservoirs. We know that. We have been doing it for years in areas like the North Sea and so on. The problem is the volume that you are now talking about, so it is never going to be a major component of the solution—but it may help. When you look across the board, it is not going to be an easy task. You are not going to see fossil fuels disappear instantly, but they do have to be phased down very quickly.

The other dimension you also have to think about is the budget we have for fossil fuels. The world budget in the figures that Professor Steffen talked about would run out in about 20 years at current consumption rates. Australia's budget would run out in about five to eight years. So no more carbon after 2020.

It also means that you have to use that carbon budget that we do have very carefully in terms of handling the development of the new energy technologies because we need that energy actually to construct the newer technologies that are coming through and the facilities to do that.

**Senator WATERS:** That is a good point.

**Mr Dunlop:** None of this is going to be easy, but I think that through a combination of these things there are pathways through where we could achieve them. It is what the IEA has indicated in one of their scenarios. But I think you have to go a good bit further than the IEA have proposed, actually.

**Senator WATERS:** If we are to take our share of that fossil fuel reduction to stay below two degrees and, as you say, our proportion of that means that we would run out of fossil fuel reserves in five to eight years—well, not run out, but our quota for a safe climate would run out in five to eight years—what does that mean for new coal mines? I am thinking particularly of the Galilee Basin in Queensland, where I am from and which is the new mega coal proposal for 30- and 40-megaton mines. Can any of those proceed if we are to stay under two degrees?

**Mr Dunlop:** I think that what has to happen is we must stop new high-carbon development straight away. So really, none of those should proceed, in my view—the new coal mines as such. I also believe that coal seam gas is extremely damaging. So the big projects that we are trying to set up out of Gladstone really ought not to proceed.

The expansions of the coal industry ought to stop, and we are proposing in the context of the science I talked about to double coal exports and quadruple gas exports by 2025. That is completely inconsistent with what we have to do in addressing the climate problem. The danger is that if we do proceed, what we are doing is then creating a whole lot of investment in assets which will become stranded because the Chinese and Indians are moving away from all of that much quicker than I think is generally anticipated here. And so you are spending scarce money that should be spent on developing the new low-carbon alternatives.

I think the other issue that is important is like that with any major industrial change. For example, in the coal industry: there is an enormous amount of expertise in coal which is really going to be needed in this low-carbon world. The leaders of the coal industry should have been looking at ways and means of redirecting their workforces and their investments into these low-carbon alternatives, rather than locking people into a world which is going to become unsustainable. So there is a whole combination of technological investment and social issues that need much wider thinking that we are currently seeing.

**Senator WATERS:** As a former Australian Coal Association chair, you are now saying that we cannot afford any new coal or coal seam gas. That is a pretty bold statement from someone with your background. Are any such statements being made by current Australian Coal Association chairs or members? Do you have any support in the industry for your views currently?

**Mr Dunlop:** Very few at this point in time. I think the CEO of the Australian Coal Association is on record a couple of weeks ago as really brushing aside all of these concerns about climate change and what have you, and really not prepared, I think, to accept the fundamental science. I think this is extremely sad, because it is potentially catastrophic for the Australian community. I think what it indicates is that the power of the mining industry, particularly the coal industry, has really got completely out of kilter with the reality of what we now have to deal with.

**Senator WATERS:** Why in your view are the current Australian Coal Association folk and coal miners so blind to the catastrophic effects of continued expansion of their industry?

**Mr Dunlop:** In part it is to do with the fact that they have now accrued the power that they have within the community. Obviously, the Chinese opportunities have been an enormous bonanza for the coal industry and many companies consider that that will continue. They are also locked into a remuneration reward structure which is extremely short term.

This is an absolutely fundamental issue, because it is not just a question of how you pay people; it is a question of the whole ethics under which society operates, because, if you are not in the position to take a long-term view because of the framework under which you are operating, then I would argue that you are no longer acting in the interests of society. The power that accrues to the coal industry is no longer being used responsibly, so the licence to operate, for coal—unless the leadership can change—really has to be withdrawn.

**Senator WATERS:** Indeed. I do not have any particular questions. You have already touched on your view about coal seam gas and said that you thought it was dangerous. If you will indulge me, Chair, I will pursue that line of thinking. What about the contentions that coal seam gas burns cleaner than coal and therefore it is somehow some great climate saviour? Can you talk about whether you think that holds water?

**Mr Dunlop:** The argument is that gas has roughly half the emissions of coal, and therefore, if we move to gas, we end up solving the emissions problem to a significant extent. The problem with that argument is that, when you burn coal, you emit aerosols which float in the atmosphere—they do not stay there for terribly long but, if you keep on burning it, they keep on being pushed up—and the result of that is to actually cool the world relative to what might happen if they were not there. If you move, to a major extent, from coal to gas, you essentially get rid of those aerosols, because they are not produced when gas is burned, so the cooling effect is taken away. The result of that will be that, if you have a major change from coal to gas, over the next probably 20 to 30 years you are going to see an acceleration in warming relative to what we have currently seen because of that effect. The other component of coal seam gas, or gas generally, is that, if you leak methane into the atmosphere before it is burnt, methane has a warming potential of something like 70 times worse than CO<sub>2</sub> over a 20-year period, or about 25 times worse over a 100-year period. The effect of that is that, if you move to something like a three per cent leakage rate in a gas operation, you virtually negate the benefit of gas relative to coal because of the methane component you are adding into the atmosphere.

One of the problems of coal seam gas is that we just do not have the baseline information to know what the leakage rates actually are and the way they have changed as you develop this industry. This is not something that the industry itself—particularly in the US, for example, where coal seam gas started—has ever thought was particularly important. Governments in those areas did not either, so the base information was never actually measured. Now, when you go into those areas, you suddenly discover the methane levels are considerably higher than people expected. We may be completely fooling ourselves—and I think the chances are that we are—by assuming that we are going to have a great benefit from coal seam gas.

Then you have the other issues of what happens to water aquifers and so on. In a time when we are going to be critically dependent on agricultural productivity, what we are talking of doing is spreading gas wells across the countryside relatively closely spaced together because you have to keep on doing that to maintain the level of production to justify the investment in plants such as are being built in Gladstone. The reason for that is that the decline rates of those gas wells are actually far higher after you frack them, or even if you do not frack them, than you find in conventional gas fields. The rates drop something like 50 or 60 per cent per annum for the first few years, which means that you have got to keep on drilling across countryside to be able to maintain the production level. This is a completely different industry from the conventional LNG gas, such as the North West Shelf.

**ACTING CHAIR:** The argument I have heard from the proponents of coal seam gas is that it is transitional. It is not replacement; it is transitional until we move to wind power, solar power and thermal—the other, more sustainable approaches. Is that not an argument you would support?

**Mr Dunlop:** With the use of gas from, say, the North West Shelf, in a major conventional gas field, you could argue that. I think there is a degree of justification for doing it, because of the transition you have to make and the fact that it is not going to be simple. But coal seam gas is a completely different issue. The problem is, you have to have an enormous number of these wells spatially and if you look at what is going on in the western US you can see the evidence of what occurs. What you are doing is disrupting valuable arable land. Inevitably, you are going to interfere with water aquifers.

We are in a situation in this country where water is absolutely critical and it has become even more so. We consider that we are going to be one of the bread baskets of Asia, with the increasing population, and therefore

agriculture is critical in terms of our future, not just for domestic consumption. What we are about is essentially setting in place mechanisms to destroy that productivity. Why are we doing it? Some of the leaders of the gas industry have said that gas is, in fact, no longer transitional. This is something that is here to stay. That is in relation to coal seam gas.

You just have to stand back and take a hard look at what we are doing, because it is completely inconsistent. What is the point of spending a vast amount of money to put major impediments on agricultural productivity and then find that within 10 years that money becomes stranded assets and, at the end of it, you have severely degraded our agricultural potential? It seems to me to be quite crazy stuff.

**ACTING CHAIR:** As a business prominent business person, how are these arguments being either adopted or rejected by business people you have talked to? How do you justify their silence? That is the question.

**Mr Dunlop:** How do they justify their stand?

**ACTING CHAIR:** Their silence, yes.

**Mr Dunlop:** I find it very difficult. If you know what the science is saying, and I have been involved in it for a long time, we have seen over 40 years that the evidence has become clearer and clearer, the science has got better and better and there is virtually no doubt whatsoever that human-induced CO<sub>2</sub> is causing the problem, and you have to move to do something about it. It is a bit like the *Titanic*. The economies of the developed world have worked on a completely different premise and getting people to change off that is extremely hard. There are major ethical and moral issues in this, in the sense of: what are we doing to our children and grandchildren? This is starting to get increasing consideration in business circles but I do not think it has progressed very far in this country; it is progressing much faster internationally.

The bottom line is that you cannot do business in a four-degree world. If we keep going down that track, these businesses will not have a future, whether it be mining or anything else. We have to move away from it. People say that is an extreme view but, frankly, that is what the science is telling us and we need to be honest and face up to those facts.

**ACTING CHAIR:** You have been very helpful and very frank, Mr Dunlop. Your submission is extremely well prepared and very forceful. We thank you for your contribution and the effort you have made to come and put that to the committee. We have had a long two weeks in estimates, so some of our committee members had to go and they send their apologies. Thank you very much for your contribution and we look forward to a continued contribution into this very important debate.

**Mr Dunlop:** Thank you very much.

**ACTING CHAIR:** That concludes the proceedings for the inquiry into the recent trends and preparedness for extreme weather events. I thank all witnesses for their informative presentations. Thanks also to Hansard, Broadcasting and the secretariat. The committee has resolved that answers to questions on notice be returned by close of business, Friday, 14 June 2013. I think there has been only one tabled document and we have carried a resolution on that.

**Committee adjourned at 11:14**