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TRANSCRIPT OF PROCEEDINGS

LAND COURT OF QUEENSLAND

MRS C.A.C. MacDONALD (PRESIDENT)

EPA431-14
EPA433-14
MLA 70441
MLA 70505
MLA 70506
MRA428-14
MRA429-14
MRA430-14

ADANI MINING PTY LTD **Applicant**

and

LAND SERVICES OF COAST AND COUNTRY INC and OTHERS **Respondents**

BRISBANE

10.45 AM, TUESDAY, 7 APRIL 2015

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OVE HOEGH-GULDBERG, AFFIRMED [10.45 am]

EXAMINATION-IN-CHIEF BY DR McGRATH

PRESIDENT: Yes. Thank you.

DR McGRATH: Professor Hoegh-Guldberg, I'll just spell your name for the transcript. Your surname is spelt H-o-e-g-h-hyphen-G-u-l-d-b-e-r-g; that's correct?---That's correct.

And you're a professor of marine science at the University of Queensland?---That's correct.

And the director of the Global Change Institute at the University of Queensland?---That's correct.

I can tell you that your report is exhibit 12 before the court, document OL014, and you can see just the front page of it on the screen in front of you. Are the facts stated in your report true and correct to the best of your knowledge and belief?---They are.

And are the opinions stated in your report your own?---They are.

And do you continue to hold the opinions that are stated in it?---Yes, I do.

Are there any corrections or additions that you wish to make to your report?---No.

Your Honour, I understand the practice is we're not formally tendering it. It's the – the documents have been tendered.

PRESIDENT: Yes.

DR McGRATH: Subject to the witness who's being called.

PRESIDENT: Actually, which exhibit is it, did you say, Mr - - -

DR McGRATH: It's exhibit 12.

PRESIDENT: Thank you. That's all right. I've got the rest of it. Thanks.

DR McGRATH: Yes.

Professor Hoegh-Guldberg, your report is your evidence, and I don't need to take you through it, but I just wanted to get your responses to some of the evidence of Dr Chris Taylor, who is the climate expert called by the applicant for the mine. His report is document AA007, exhibit 34. It's tab 31 in your Honour's bundle.

PRESIDENT: Yes. Thank you.

DR McGRATH: And if we could go to page 13, paragraphs 4.13 – particularly paragraph 4.1.3.2, and you can see that on the screen in front of you?---I can.

Dr Taylor – you've read the joint climate expert report, haven't you?---I have. Yeah.

And you refer to that in your report?---I do.

And the climate change experts refer to the global goal of stabilising mean global temperatures at beneath two degrees Celsius?---That's correct. That's the international agreement across 200 counties.

Yes. And Mr Taylor goes on here to state that the two-degree target is highly unrealistic and that based on the climate action tracker, the emissions, commitments and actions of countries suggest at the time of writing, that global mean temperatures will increase above pre-industrial levels by about 3.1 degrees Celsius by 2100. I'm going to ask you some question that I'm going to take Mr Taylor to in a moment about that, but can I just take you over to paragraph 5.1.1.5, paragraph – soft page 15, paragraph 5.1.15. This is Mr Taylor's summary of conclusions, and he repeats the point that the two-degree warming target is highly unrealistic, because, as noted in the joint report, international pledges are insufficient to achieve it. I'm going to ask Mr Taylor to assist the court in understanding what a two-degree mean temperature rise means in terms of the temperature distribution, and I'm going to take him to a figure in the Intergovernmental Panel on Climate Change reports, and I'd just like to get your – to tie in with the evidence that he will give, your link to what that means for coral reefs, and could I hand up, your Honour, an extract from – I'll hand up two copies for the court and one for the witness.

Professor Hoegh-Guldberg, this is just a short extract from the latest report from the Intergovernmental Panel on Climate Change which is referred to in the joint expert report and your report. The Intergovernmental Panel on Climate Change works in three working groups, doesn't it?---That's correct.

And it publishes its reports in three volumes?---That's correct. After extensive review, I should say. Yes.

And in the latest report, which was issued in 2013 over to 2014, you were the coordinating lead author for one of the chapters – or, the chapter on oceans in Working Group II report, weren't you?---That's correct.

So this extract is from Working Group I?---That's correct.

And you weren't a co-author those this part of the report, were you?---No, I wasn't.

But is this – this is the physical science basis that underpins the other two working groups?---That's correct.

And so Working Group II, where you were a coordinating lead author, do you essentially take what's in Working Group I's report and then Working Group II is looking at impacts, is it?---That's correct. So the working groups are staggered, so that the physical science is done first, and then Working Group II, which looks at issues, impacts and adaptation, draws on that, and then the final report is about mitigation. So they're nicely configured in that sense. So what we're looking at here is the conclusions of the physical science.

Okay. Thank you. And the total report is about – it's over – each report – each of the working reports is about 1000 pages, isn't it?---It's at least that, yeah.

Yes. And so in total 3000 pages, was it? It was a - - -?---It's well in advance of that when you start to consider the online material which is also part of the process. So there's an extensive literature there.

Your Honour, we don't intend to – the document is referred to by all the experts. We don't intend to tender it. I've just pulled out this one graph because I've been asking Dr Taylor about it and this is the extent that we intend to specifically refer to it.

Can I just take you, Professor Hoegh-Guldberg, to the extract – page 134 and to figure 1.8?---Yes.

And the first – it's explained in the figure beneath it but the (a) part of the figure represents an increase in the mean temperature and what that does to the temperature distribution. Is that your understanding?---That's my understanding.

And then the (b) part of the figure looks at the effect to the temperature distribution in the increase in the variance of temperature?---That's correct.

And then the (c) part of the figure combines the increase in the mean and the increase in the variance?---That's correct.

Now, we can effectively ignore part (d) before that's referring to participate – sorry, precipitation, which isn't particularly relevant to coral reefs, is it? It's - - -?---No, not at this point.

All right. So - - -?---I mean, it has some relevance but - - -

Okay. So I'm going to ask Mr – Dr Taylor about that report and just to explain the effect of increasing the mean by two degrees – it's also accepted, isn't it, that there will also be an increase in the variance due to climate change?---That's correct.

And so effectively figure (c) is a diagrammatic representation of the - - -

MR AMBROSE: I object to that. Accepted by whom?

DR McGRATH: I'll rephrase it, your Honour.

Looking at part (c) of the figure - - -?---Yep.

- - - can you explain the scientific basis for that and its - - -?---I think the take-home message here is that small shifts in temperature can result in large changes in the distribution of extreme events and that's really important for coral reefs because that's what's causing the damage. It's the warmer than normal summer that we have because the background temperature has increased. You've got changes to do with the variance and so what you're seeing is a disproportionate impact for what might seem a small change in temperature. And that's certainly being borne out by the science around bleaching and a whole range of other impacts on coral reefs.

Okay?---Like the Great Barrier Reef.

Okay. So looing at part (c) of that figure for coral reefs, what's the significant part of that shift in the distribution for impacts like coral bleaching?---Well, I think if you look at the pink and the red bits, they are the part that really matters when it comes to coral reefs exceeding their tolerance – the extreme events. And you can see that the area under the curve of the red patch is a lot greater than the salmon colour. And that's the difference between a small shift in mean and variance. So it's making the point that that aspect of climate is very important responds nonlinearly – i.e. it's not a simple relationship to the shifting mean or variance.

Thank you. You can put that document to one side. Those are all the questions I have for you in relation to it. One part of Dr Taylor's report which he doesn't refer to is in terms of impacts that you've looked at for impacts in coral reefs is ocean acidification. Could I just take you back to your report to figure 4 on page 11. And I'll be asking Dr Taylor if his statements there – he – that assumes also ocean acidification. Can you just explain for the court the relationship between temperature and ocean acidification as shown in – perhaps with reference to this figure?---Ocean acidification is the second effect of CO2 on the ocean. The primary effect is the change in the absorptivity of the earth in terms of infrared – that's heating up oceans and that's one effect. But CO2 – by going into the ocean – and about 30 per cent of the anthropogenic emissions have already gone into the ocean – you're changing the chemistry in a fundamental way. This is causing an acidification of what is a basic ocean. As well as that, it's changing the concentration of carbonate irons, which are very important to the formation of coral skeletons. So just that alone has dropped around 26 per cent since the industrial revolution. Now, I make the point – is that when you take those two effects and you combine them, you get a synergistic effect. So the sensitivity of corals to temperature goes up. Also, their ability to bounce back from disturbances such as coral reef – so when we talk about 850 gigatonnes of CO2 left to emit to the atmosphere before we exceed the two-degree Celsius threshold, that's probably conservative. Especially when you take into account these other factors that are influencing the responsivation systems.

Okay. When you talk about the effect of CO2 there, are you referring – the climate experts and you in your report – you're specifically referring to carbon dioxide

emissions from the burning of fossil fuels. Is that?---That's correct. That's the major signature in the ocean from isotopes studies.

Thank you. There's a significant reference in your report that I just want you to identify and so it can be before the court. At paragraph 29 of your report, you refer to a report by the Great Barrier Reef Marine Park Authority from 2014 and if one looks at your references, that's a reference to the recent strategic assessment report from the Great Barrier Reef Marine Park Authority. I just wanted to confirm – it's a significant reference and I just wanted to provide that to the court and have you identify it. Your Honour, could the – can I hand up one copy for the court and one copy for the witness, your Honour? We'll providing the – the whole report is 650 pages in colour. We haven't printed it all out. Professor Hoegh-Guldberg refers to two particular passages and I'm just going to take him to those to confirm what he's referenced. We'll be tendering the whole report simply for – I'm very conscious about needing to show the context and – but I could assure my learned friends that we don't intend to refer to any other parts of the report in closing submissions; it's really just for context. And the particular parts that I'll take Professor Hoegh-Guldberg to are the relevant parts, we say, for – in terms of climate change impacts in the Great Barrier Reef.

PRESIDENT: Dr McGrath, have you got a spare copy? Could the court have another copy, please, if you've got one?

DR McGRATH: Yes, your Honour. I thank my - - -

PRESIDENT: All right. I understand that Mr Hobson's getting it electronically and can put it on the website so - - -

DR McGRATH: Yes. We'll - - -

PRESIDENT: Well, in that case, I just want to be able to write on this.

DR McGRATH: Yes. Can I hand up, your Honour, a copy of the extract for the – perhaps if there's going to be an exhibit bundle that's in hard copy – and I'm unsure but we can provide a second copy and I thank my learned friend from the Department.

PRESIDENT: Yes. All right.

DR McGRATH: Thank you, your Honour.

PRESIDENT: So are you – are you tendering it or not, Dr McGrath?

DR McGRATH: I will, your Honour.

PRESIDENT: Yes.

DR McGRATH: I was just going to get him to identify it first.

PRESIDENT: All right.

DR McGRATH: Sorry, have the witness identify.

Professor Hoegh-Guldberg, the extract that you've been handed is – has on the cover Strategic Assessment Report and it's got on the cover Australian Government Great Barrier Reef Marine Park Authority. Is this the report that you're referring to in paragraph 29 of your report?---That's correct.

And the Great Barrier Reef Marine Park Authority probably needs no introduction but it's the - - -?---It's the peak Australian Government organisation for looking after the Great Barrier Reef marine park. It has scientist. I understand this was drawn from the primary literature and put together to advise the authority about going forward as part of recent government policy.

Thank you. And in the extract [indistinct] included the table of contents just to show that it's a very long report and then the first part of chapter 5, if you turn over, "drivers and activities". And on page 5-2 there's a little schematic of how the report was put together and so this chapter, "drivers and activities", then feeds into a chapter on impacts etcetera. If I take you over to page 5-4 there's a heading "implications for the region's values". And that first paragraph:

> *Climate change is a direct and indirect driver for coral reef ecosystems such as a Great Barrier Reef and there have already been serious effects on the region's biodiversity values for example coral bleaching in 1998 and 2002.*

And that that goes on. Over the page, I understand, is the relevant part that you've referred to. On page 5-5, the second paragraph:

> *Implications for the region's values at different concentrations of atmospheric carbon dioxide can be summarised as:*

And then the first dot point.

> *350 parts per million. Optimum limits for coral reef ecosystems are at or below this concentration and this would require a lowering of global carbon dioxide concentrations.*

And you've said the same thing in your report, haven't you?---That's correct.

And then the second dot point:

> *450 parts per million.*

And then in brackets:

(close to the current concentration); the frequency of severe bleaching is likely to increase with rising summer temperatures leading to the dominance of thermally tolerant species.

And that paragraph goes on. At the end it refer to declining calcification rates caused by temperature stress and ocean acidification. So that's current levels?---That's current levels. We're at 400 million parts per million CO2 and we're seeing pretty much what was being predicted or at least being ascertained.

And you refer in your report to we're increasing global emissions from fossil fuels and other anthropogenic causes are increasing global carbon dioxide by about two parts per million a year; is that - - -?---That's correct.

Then if – the third dot point:

450 parts per million it is predicted that the diversity of corals on reefs will decline under the combined effects of elevated temperatures and ocean acidity. And ocean acidification is likely to further affect the growth of most calcifying organisms. This level of atmospheric carbon dioxide poses and extreme risk for coral reef ecosystems and tropical costal habitats.

And that's what you've said in your report?---That's correct. And this is based on a very broad source of information from our understanding of reefs in the geological past where they disappear at certain amounts of CO2 to the physiology, to the ecology. So when you look at it and you look at, for example, the latest assessment by the IPCC they come out with a very strong statement about these general phenomenon being rooted in extremely solid science. So this is what is happening and I think we can take a lot of guidance from it. It's essentially saying that if we continue on our current track within 20 years we won't have a Great Barrier Reef with corals on it anymore. Now, we'll have a reef off there but will it attract the tourists that bring in the enormous amounts of income, does it support the fisheries; I think that's extremely questionable.

Going over the page to figure 5.2 there's a diagram showing – is it across the top there's atmospheric carbon dioxide concentrations in parts per million and then the first part of it, in pink, is sea temperature increases in degrees Celsius and then there's the ocean pH change in green, going down. It's a little bit difficult to tell from that figure but is your understand of the science that at about 450 parts per million that's equivalent to about a two degree mean global temperature rise?---That's generally accepted, I think, if you look at the [indistinct] Five archive of models it's taking a very broad number of models and I understand Malte Meinschausen is giving evidence on this, I understand. That's correct. So it's 450 parts per million you start to push average global temperature to two degrees above the pre-industrial period.

Okay. And it goes over on the page, 5-7, is just a summary of the science of carbon dioxide concentrations in coral reefs?---That's correct.

And again there's the reiteration in paragraph 4:

> *If carbon dioxide concentrations reach 450 parts per million scientists predict reefs will be in rapid and terminal decline world wide as a result of multiple synergies arising from mass bleaching, ocean acidification and other environmental impacts.*

?---That's correct.

And that's reflected in your report?---That is. I think that we need to emphasise that we have only known of these impacts on coral reefs for about 15 to 20 years. So the amount of science that's required, that is needed to be done to properly nail down all of the impacts, is quite large in itself. So I would be very cautious about what we're seeing because I think a lot more is changing. For example, recently scientists have found that the neural systems of fish – which may not sound very important but are essential to the ecology of fish – are now varying with ocean pH. That fish are no longer being able to navigate properly; this just being one tiny part of a problem. We know from ocean acidification overseas with aquaculture industries that it's causing hundreds of millions of dollars of impact on things like oyster cultivation. Those same effects are happening on the Great Barrier Reef but we probably haven't actually uncovered them or described them.

Okay?---So I think we have to be very cautious with what we're doing with the ocean.

So just tying that back to Dr Taylor's evidence and the climate scientists where they talk about stabilising at two degrees your report and this report from the Great Barrier Reef Marine Part Authority are really summarising the impacts that we expect to see on the Great Barrier Reef at that level?---That's correct.

Just going over to paragraph - - -?---Can I just make one small point about the - - -

Yes?--- - - - 3.1 degrees Celsius number. We are in a year of international negotiations over the targets. I don't think that those negotiations have been completed. The Cop 21 at the end of the year is going to be where those targets will ultimately be set. So I think to accept fait accompli that 3 degrees Celsius, which would be disastrous for the Great Barrier Reef and for many other ecosystems – to accept that as a fait accompli would be unwise.

Okay. When you refer to Cop 21 are you referring to the conference of the parties of the United Nations Framework Convention on Climate Change, the twenty-first - - -?---Meeting of.

- - - meeting of the conference of the parties is going to be Paris at the end of this year; is that correct?---That's correct.

At paragraph 47 of your report – if we could just bring that up, Mr Deputy Registrar – you refer again to the Great Barrier Reef Marine Park Authority report 2014 and it's the strategic assessment that you're referring to there, isn't it?---That's correct.

You reference page 11-6 and if I could just take you over in the extract you'll see chapter 11 with a turtle - - -?---Yes.

- - - image. And then – on the cover. And then the next page, 11-2, is again showing where chapter 11 is in the scheme of this large report; it's on projected condition into the future. And then page 11-3 has a heading "current condition and trend values". And then if you go over to 11-5 there's a section "11.5 projected condition" and a section "11.5.1 the future of the Great Barrier Reef" and the final paragraph on that page states:

> *The declining condition of the Great Barrier Reef and its loss of resilience cannot be attributed to any single cause – it is almost certainly the result of cumulative impacts.*

And then if – that's just the context. If you go over the page to 11-6, which is what you were referring to in your report, the second and third paragraphs is that the relevant parts that you're referring to? The second paragraph states:

> *Climate change remains the most serious long term risk facing the reef the is likely to have far reaching consequences for the region's environment. Future climate change predictions - - -*

PRESIDENT: We can read it.

DR McGRATH: Yes?---That's correct.

That's the section that you're referring to?---Yes. That's correct.

And then particularly in that second paragraph it refers to the international negotiations and two degrees and the final sentence I'd just draw your attention to:

> *To ensure the reef remains a coral dominated system later science indicates global average temperature rise would have to be limited to 1.2 degrees Celsius.*

?---Correct.

And that's reflected in your report?---That's correct.

And on page 18 of your report – Mr Deputy Registrar if you can just go up slightly – that figure 6 – just the actual image – that image is – that comes from one of your publications in 2007 in the Journal of Science, doesn't it?---That's correct.

And Science is a leading scientific peer review journal?---It's the leading American science journal and I should point out that I was one of, I think, 20 authors on this particular paper.

And you've got the three panels there. Just with reference to Dr Taylor's – the two degrees and the 3.1 degrees can you just relate his statements to this diagram; just explain it to the court?---So if you progress from left to right this is really to enable people to know what we're talking about when we talk about the Great Barrier Reef declining. And so on the left-hand side we have – when this paper was written there were 375 parts per million CO2 in the atmosphere. So we've, since the publication, added another 25. You've got rare systems which are impacted by bleaching which is not a natural thing; it's an actual disturbance to coral reefs. But reefs are able to bounce back because the acidity is low. If you treat reefs right you'll still have a Great Barrier Reef that looks like that one outside my lab on Heron Island. If you then go upward in terms of CO2 and average global temperature – which is approximately the same as tropical sea temperature – you get to a point where corals – only the toughest survive. Other less appealing organisms like seaweeds and sponges tend to take over reef systems. But as you keep pushing up that CO2 in the atmosphere, increasing that temperature, that acidification, you get to the right-hand panel where very few multi-cellular organisms are able to survive and you get that – a system that's dominated by bacteria and so on. And of course the big concern is whether people can still earn livelihoods off the right-hand panel if that's the world – if that's where we're headed. Now, we don't have to go there. If we do take steps to deal with this issue we can stabilise and potentially go back to the left-hand panel over some time. And I think given the value of the reef to our nation, to our state, I think this is highly desirable.

So just a final question: where Dr Taylor refers to increasing to 3.1 degrees Celsius, the mean global temperature rise, is your evidence that that panel on the right is effectively what the consequence would be for coral reefs?---More or less, yes.

Your Honour, that's the evidence-in-chief. Those two documents – could I tender those two documents? I think – I understand we're up to exhibit numbers 50 and 51.

PRESIDENT: Yes. So the - - -

DR McGRATH: Extract.

PRESIDENT: The report on the Intergovernmental – by the Intergovernmental Panel on Climate Change will be exhibit 50, or the extracts from that report.

EXHIBIT #50 ADMITTED AND MARKED

DR McGRATH: And I'll just confirm, your Honour, we'll provide a PDF of exactly what your Honour has in your hand to the registry for the e-trial system. It's all

available on the internet. We don't intend to put in the thousands of pages or refer to it in submissions.

PRESIDENT: Yes. All right. Thank you. And then the Great Barrier Reef strategic assessment report is exhibit 51.

EXHIBIT #51 ADMITTED AND MARKED

DR McGRATH: And on that, your Honour, I confirm we will provide the whole report electronically, but we don't intend to refer to anything further than is in the extracts.

PRESIDENT: Thank you.

DR McGRATH: That's the evidence-in-chief of this witness, your Honour.

PRESIDENT: Thank you. Thank you.

MR AMBROSE: I think we go down the table.

PRESIDENT: I beg your pardon?

MR AMBROSE: I think we go down the table for cross-examination.

PRESIDENT: I see.

MS CLAYTON: We have no questions for this witness, your Honour.

PRESIDENT: Thank you.

CROSS-EXAMINATION BY MR AMBROSE [11.20 am]

MR AMBROSE: The Marine Park Authority has found that even if the global average temperature rise was about 1.2 degrees Celsius, there would still be an adverse impact on the reef?---That's correct.

So even if the internationally targeted two-degree increase was to occur, that wouldn't protect the reefs of the world?---Not in the short term. I think there's a very important part of the future scenarios, and that is whether or not we stabilise ocean temperature or not. When you go to three degrees, you're getting into pathways which don't stabilise for hundreds of years.

I understand that?---So there's a value in that from two degrees - - -

I understand that, but my point is even a targeted two-degree increase limit wouldn't protect the Great Barrier Reef, whether or not the Carmichael Mine was approved or not?---The Great Barrier Reef would be protected to some extent, relative to unfettered emission increase, but it would lose some of its quality, no doubt.

What if the Carmichael Mine didn't go ahead but a hundred others did? The Great Barrier Reef would still be adversely impacted, would it not?---That's correct.

So even if the targeted two-degree limit to increase of temperature were to occur, it wouldn't protect the Great Barrier Reef, whether or not the Carmichael Mine was approved or not?---Well, I think if we're talking about sources of emissions and their impacts, there's plenty of cases, I guess, where you have sources of pollution which cause the impact that need to be regulated, and I'd say with this type of direct impact of CO2 on this wonderful system, there's more than a good reason to regulate its activity internationally.

Well, we'll come to that. You say that enterprises such as the Carmichael Mine will directly damage the Great Barrier Reef, and you've just repeated that, that there's a direct impact to the Carmichael Mine?---By emitting or leading to emissions of CO2 – very significant emissions of CO2, it will damage coral reefs here, there and everywhere.

You're talking about the combustion of the coal, aren't you?---Mmm.

So if a coal fire power station presently operating buys thermal coal from coal mine A and Carmichael Mine comes on line and, instead of coal mine A, supplies the same amount of coal to the power station, there's no net increase in CO2 emissions; do you accept that?---I accept that.

So if there are no net increases in CO2 emissions as a result of the Carmichael Mine going ahead, where is the direct impact to the Barrier Reef?---CO2, wherever it comes from, is going to be damaging to the Great Barrier Reef. We know that. It's already damaging the reef. So I think this issue is about the broader issue about how much CO2 we should be emitting to the atmosphere if we care a damn about ecosystems like the Great Barrier Reef or, indeed, our agricultural systems and so on. So I think that's the issue. It's the CO2.

I understand that. If the Carmichael Mine doesn't go ahead but the power stations still take the same amount of coal from another coal mine, the Barrier Reef is still, on your evidence, at risk, and it will remain at risk until that coal mine stops supplying coal to the power stations?---With all respect, it's not my field of expertise in terms of international trade in emissions, but I would imagine that you're talking about actions that go beyond the current one.

I'll put it to you this way: if someone drives a motor vehicle which causes CO2 emissions, is that person directly or indirectly causing harm to the Great Barrier

Reef?---That person plus other emitters are jointly responsible. Right. The CO2 has the impact.

That's not what I asked you. It wasn't what I asked you. I'll ask you again?---Okay.

If someone drives a car causing CO2 emissions, is that person directly causing harm to the Great Barrier Reef or indirectly causing harm to the Great Barrier Reef?---I suppose philosophically speaking you'd have to say that their CO2 to some extent has an impact on the Great Barrier Reef.

Direct impact?---Direct.

Thank you very much. So that person is directly causing an impact to the Great Barrier Reef?---But you'd have to sum up the cars, the other sources and so on.

I understand that. I'm trying to make it simple?---Yeah. I know. Sorry.

It's for my benefit, really?---I'm a scientist. I'm trying to make it more - - -

Now, if we accept that the person who drives the car, causes CO2 emissions, directly contributes to an impact on the Great Barrier Reef, if someone is the maker of the car, does that maker directly or indirectly, because that car might be driven and cause CO2 emissions, impact adversely on the Barrier Reef?

DR McGRATH: Well, your Honour, I'm not certain to what – Professor Hoegh-Guldberg can assist with this line of questioning. It's really his – he's a coral reef scientist, not a philosopher and not – if this is meant to be about legal tests for causation or responsibility – but it may be – I ask my learned friend to consider the – where within his area of expertise this is directed.

MR AMBROSE: Well, is that an objection? If it is, I'd like to hear the basis for it, but I would assume that it is, and Dr – Professor Guldberg has said in paragraph 3 and in evidence that enterprises such as the Carmichael Mine will directly damage the Great Barrier Reef. I'm questioning him and challenging him on that statement.

PRESIDENT: Yes. I'll allow you to continue.

MR AMBROSE: So my question is - - -?---And I've answered that - - -

No. No. No. No. My question is – just so that we're back on track, we've established that someone who drives a car and the result of that driving causes CO2 emissions, that person has directly, on your evidence, adversely – or, caused harm to the Great Barrier Reef. My question is if someone is the maker of the car that someone else drives, does that person, that maker, directly or indirectly cause harm to the Great Barrier Reef?---Well, I was thinking of the analogy from the tobacco industry. I suppose you can have a pipe maker who by implication would be helping people to consume a dangerous product, and thereby you could make an argument,

and, again, this is not my field, I'm a humble biologist, but you could make an argument that that's aiding and abetting the distribution of the dangerous substance. Right.

My question is - - -?---And I think if you then take cigarette manufacturers, they don't grow the tobacco, but they package it up nicely, and clearly they're being regulated. So I imagine that you could get caught, if we are dealing with a very dangerous substance, caught in a situation where the manufacturer of the machine to burn the coal to provide the transport or whatever it is could be also implicated.

The question is does the maker of a car directly - - -?---Not until - - -

Excuse me. Wait until I finish my question, please?---Sorry. Yep. Sure.

That way you might be able to focus your answer. Does the maker of the car directly impact on the Barrier Reef or does the maker of the car indirectly impact on the Great Barrier Reef?---I would say directly when burning substances in the car, right. But when the car is not burning substances then I don't think you could say there's an impact.

Well, let me give you another: if live cattle are exported and eventually they're going to be burnt to be consumed, the person who consumes the live cattle – does that person directly harm the Great Barrier Reef or indirectly?---Probably directly.

Okay. Does the grazier - - -?---Can I - - -

Just please – please. Does the grazier who breeds the cattle that is put on ships and sent overseas to be consumed directly or indirectly harm the Great Barrier Reef?---Well, can I suggest another analogy?

No, you can. You can in re-examination?---Okay.

In cross-examination - - -?---Sorry.

- - - I'd be pleased if you answered my question?---Sure. Okay. So - - -

Do you want me to repeat it?---Yes, please.

We've established that the person who consumes the live cattle that are exported by the burning of it has directly, on your evidence, impacted upon the Great Barrier Reef. My question is to you is is the grazier who bred the cattle that was transported directly or indirectly impacted upon the Great Barrier Reef?---I would say that it's very similar to the other example of the cars where it is a direct – but you have to add the joint activities of many to properly track that. Now, so – could I - - -

No, no, no, no. Your answer is that he's directly impacted on the Great Barrier Reef and the person who supplies the grazier with food and sustenance – they also have

directly, on your evidence, adversely affected the Barrier Reef?---In a chain of different activities, yes.

Right. So how does the extraction of coal itself directly impact on the Great Barrier Reef? Forget about its burning. How does its mere extraction contribute to the adverse impact on the Great Barrier Reef? It's just like the example of the car - - -?---Yep. Sure.

- - - that is built - - -?---Yep.

- - - but not driven?---Right. So could I possibly redirect the discussion here to say - - -

Well, you can redirect in re-examination. You can redirect in re-examination?---If I knew that - - -

You can answer my question?---Sure.

How does the mere extraction of coal - - -?---I - - -

- - - impact on the Great Barrier Reef? It's just – I put it to you it was just like the manufacturer of the car that's not driven?---So we're extracting a substance which we know, if burnt, will significantly impact CO2 concentrations in the atmosphere and we know that those CO2 concentrations, when they get to a certain point, are having impacts – direct impacts on the Great Barrier Reef. There's nothing indirect about it. Now, if you don't dig up the coal and you don't burn it, yes, other countries may contribute coal in the lieu of that extraction in Australia, right? But if we continue to take this issue seriously then eventually those activities will be curtailed as well. Now, I see - - -

I'm not asking you – I'm not ask you about that?---Can I just see – can I - - -

I'm asking you about your - - -?---If I'm extracting coal from the landscape - - -

Yeah?--- - - - it's a dangerous substance. It's just like a toxin. And if I know that I am sending that overseas and I'm not sure that those toxins are going to be properly handled, as we are sure the coal will be burnt, then I think we're contributing to something that's not in our interest.

A direct impact. Is that – you understand my questioning - - -?---Yeah.

- - - is focused on your evidence that enterprises such as the Carmichael Mine will directly impact on the Great Barrier Reef. Will damage the Great Barrier Reef?---By - - -

It's not possible, is it?---Well - - -

That the mere extraction itself can damage the Great Barrier Reef?---Well, of course, that's associated with some CO2 emissions on its – it's got a carbon footprint and of course - - -

Sure?--- - - - responsible mining companies are taking care of that; I agree with that.

Excuse me. That's precisely the same as the argument you put up in the first instance. If one person drives a car, it might have an impact but it will be very, very minor but if you take the cumulative effect that's a different story. We've established that?---Sure.

Again, come back to the question. How does the mere extraction alone – leave aside the [indistinct] 1 and 2 emissions caused in that enterprise. How does the mere extraction, rather than the combustion, directly impact and harm the Great Barrier Reef?---So the mere extraction – digging up the coal, putting it into a boat – doesn't have an impact.

I've got no further questions.

RE-EXAMINATION BY DR McGRATH [11.34 am]

DR McGRATH: Thank you, Professor Hoegh-Guldberg. Just on that final point, is your understanding of this project that it's intended to produce thermal coal to be sold for export?---I understand that, yes.

And if it's sold for export, what's your understanding of what's intended to be done with it?

MR AMBROSE: Well, I object to that. This witness is not an expert in anything other than marine biology.

DR McGRATH: Your Honour, my learned friend can't have his cake and eat it too. He's - - -

PRESIDENT: Well, nor can you, Dr McGrath.

DR McGRATH: Well, he's put to him that the project is the mere extraction of coal. Of course, the project is to dig it up, sell it so it can be burnt. So Professor Hoegh-Guldberg is responding to the project that's actually proposed, not the hypothetical, "We're going to dig it up and leave it in a pile beside the mine" that my learned friend put to him.

So I just want to ask Professor Hoegh-Guldberg in – if I could take you to your report – page 19 of your report, paragraphs 48 to 52, which is, I understand, what my learned friend was asking you about. Can you explain to me – sorry, can you explain

to the court what you understand the project is – the Carmichael Coal Mine – what it is that you are talking about in that just so – just your understanding. Whether it's right or wrong but just what you envisage when you wrote paragraphs 48 to 52?---My understanding was that the extraction of coal from the Carmichael Mine site was to be shipped overseas – a lot to India – to be burnt for power production. Black thermal coal being burnt to provide – and, of course, given that sequestration of CO2 emissions doesn't seem to be in place anywhere – or very few places – it's assumed that that CO2 that's burnt to provide that energy would go to the atmosphere. And I understand that to be somewhere in the vicinity of 4.5 gigatonnes of CO2 over the life of the mine.

Okay. So that's the project that you're writing about in paragraph 48 to 52?---That's correct.

Not merely the extraction of the coal?---No.

Okay. You were asked about a driver of a car and a maker of a car and a live cattle export consumer and a grazier. In terms of the scale of carbon dioxide emissions from those activities, how do they compare to the project that's before the court?---Well, as I understand it, the project will produce far more than those sources of greenhouse gases.

In terms of orders of magnitude, the – you've taken from the joint report that this mine will produce 4.49 gigatonnes, which is a billion tonnes of carbon dioxide. Is – you've set that out in paragraph 50 of your report. Can you give a comparison to – like, how big that is for the court to – in comparison to the emissions from a driver of a car or a live cattle export? Is there some analogy you can give in terms of size?---It's very hard to do that, I think, on short notice but it's very large. The difference is very large. We're talking about .5 per cent of the total emissions left. If we look at them as a conservative 850 gigatonnes left before we push the climate into a very dangerous state, that's an enormous amount of CO2 over the life of the mine.

Just finally, you were asked about a grazier who bred cattle and whether that was a direct impact and you said that you wanted to give a different example for that. You might not remember but if you do remember, can you explain what that different example is?---I did manage to suggest that I think we need to think about the responsibility of this chain of being that was so much in focus during that question. Yes, digging up itself is not going to add emission of CO2 to the atmosphere if the footprint of those operations has been taken care of in terms of, you know, what it cost to extract them. But I think if we do know that we are exporting thermal coal where the emissions are not going to be sequestered or taken up and those emissions come back to bite us in terms of the ecosystems that we know and love and depend on then I think we need to think beyond the digging and the shipping to think about what the ultimate use of these substances is and what they do to concentration of CO2 in the atmosphere. I'm not sure everyone is aware that the current rate of change in CO2 in the atmosphere is the highest in the last 65 million years. This is an extremely extraordinary concept that came out of the IPCC - - -

MR AMBROSE: I object to this. It doesn't arise out of cross-examination at all.

DR McGRATH: I can – if I can stop you there. I don't need to take you any further on that. Professor Hoegh-Guldberg, you were asked about net impacts of coal coming from other mines. In paragraphs 48 to 52, is it effective – are you – is net impact part of your reasoning in 48 to 52 or are you simply looking at a sort of chain of custody cause and effect – "Dig up this coal, burn it, it has an impact"?---I'm really referring to the latter – the chain of custody of the emissions and the – yeah.

And in terms of whether the coal will come from somewhere else or other mines – that's not an area that you're expert in, is it?---Not at all.

That's the re-examination of this witness, your Honour. May he be excused?

PRESIDENT: Yes. Yes, you're excused. Thank you, Professor?---Thank you, your Honour.

WITNESS EXCUSED **[11.41 am]**