GRATTAN Institute

Carbon Pricing: Is a Tax Better than Emissions Trading?
- Dr Cameron Hepburn

25 March 2010

Transcript

On 25 March 2010, Grattan Institute hosted a seminar on energy policy, with special guest Dr Cameron Hepburn. This seminar provided an opportunity for detailed discussion about climate change policy around the world, and what it means for Australia. We discussed the economics of various options for designing carbon pricing schemes.

Speaker: Dr Cameron Hepburn (CH)

Moderator: John Daley (JD)

(Music being played)

JD: Ladies and gentlemen, good afternoon. Thank you very, very much for coming this afternoon. My name is John Daley, I'm the Chief Executive of Grattan Institute. I'd like to begin by acknowledging the traditional owners of the land on which we are sitting today and also to thank Price Waterhouse Coopers for hosting this event tonight which promises to be very interesting.

We have with us tonight Cameron Hepburn. Cameron has many things. He pointed out earlier today that he and I have a past that goes back to some work we did at McKinsey together about ... a long time ... I won't embarrass myself about how long ago it was and since then Cameron has gone on to do some very impressive things. He wrote a thesis for his doctoral thesis in Oxford on why you should use a very low discount rate for environmental costs. That work was then the subject of a paper that he co-wrote with Nicholas Stern and for those of you familiar with the greenhouse debate, that choice of a low discount rate was in fact one of the key intellectual moves that the Stern Report made in arguing its case for shifting as rapidly as possible towards a low carbon economy.

Since that work Cameron has continued to work in Oxford where he's a Fellow as one of ... practically becoming one of the world's leading environmental economists. We will be talking a little bit later tonight about some of the work he has done on the differences between trading schemes and taxes and other things you can do in terms of carbon. He has also, as I said, done work on discount rates as well as a huge number of other economic issues that are raised by environmental questions. And I think one of things that's terrific about Cameron's work is that he's very much applying a hard, rigorous economic analysis to these environmental problems which is exactly what they need.

Cameron has a number of other strings to his bow. He's part of Vivid Economics which has done some tremendous work on various economic issues particularly around carbon pricing and environmental issues. He is also a director of an organisation called Climate Bridge which is essentially in the business of taking western technology, applying it in China, reducing carbon emissions as a result and then selling those credits back into Europe and as ex-McKinseyites as we both are, it's the kind of business model that one can only dream about and it's a terrific initiative.

So that's Cameron's background. It's an extremely impressive background and as you'll see someone who's done a lot of very deep thinking about the economics that lies behind many of the issues, environmental issues particularly, probably one of ... well what has been described as a defining issue for our age, that of reducing carbon emissions. So with that introduction, Cameron, thank you very much for being here. Welcome back to Melbourne. Cameron is indeed a graduate of the University of Melbourne in both Law and Chemical Engineering which is probably not the most common combination at Melbourne let alone any other university and has also, as I said, done his doctorate at Oxford. So, welcome.

CH: Thank you, John.

JD: It's lovely to have you here.

CH: It's an embarrassing introduction.

JD: Cameron, we've set up this talk today as being about the differences between taxes and cap and trade as schemes for reducing carbon emissions. What are the economic differences between them?

CH: Great. Well that's actually rather a big question and we could spend an hour and a half talking about it as I do with some of my students at Oxford and what I thought I would like to do with you all today is to take you through ... not an hour and a half, not even 15 minutes but at least a brief summary of the economic analysis of the difference between choosing carbon trading schemes and carbon taxation schemes. And it's a little bit technical so I'm warning you ahead of time. If you nod off I will ask you a question, check whether you've understood, but let me explain it in plain English first and then I've even brought some charts along with me. So the way economists think about this choice is to say our objective here is to make sure that there is a price on emitting carbon dioxide. We want to do that because we want to provide an incentive for people to stop emitting carbon dioxide and the two simple ways of doing it is to stick a price on directly by putting on a carbon tax which creates a carbon dioxide price or you can put a cap on emissions and fix a quantity and from that trading scheme emerges a price which fluctuates and moves around.

So there's a basic duality between fixing a quantity, putting a cap on emissions and then watching the price fluctuate around or you can fix the price so fix a carbon tax rate and then you don't necessarily know what the quantity's going to be. You can't guarantee that you're going to deliver a certain quantity of emission reductions with a given carbon tax. So that's kind of the fundamental duality of the problem. You can pick prices and watch quantities vary or you can pick quantities and you can watch prices vary. But you can't do what some governments think they would like to do and choose both at the same time. We call that communism and it tends not to work.

But let me now translate some of that into a basic undergraduate style analysis of how we think about the choice between taxes and trading when you're not certain about what the costs are going to be. And one of the pervasive features of climate change is that we know that it's a big problem, we know that it's enormously challenging, it's going to be costly but we don't know exactly how costly and we don't know what the critical limits are. You know scientists tell us that we're creating risks in the environment and in the economy and I for one believe them. I think there are some fairly serious risks in the system, but I don't think anyone knows exactly where they are.

So dealing with this uncertainty is a critical part of the policy choice and it's also relevant to us in thinking about whether we choose a tax or a trading scheme. And the first way in which uncertainty is relevant is that if we knew for sure that we were going to head off a cliff at 500 parts per million of CO_2 so currently we are at 390 parts per million of CO_2 and prior to the industrial revolution we were at 275 parts per million. If we knew for sure that we were going to head off a cliff at 500 then you'd want to stick quantity regimes in place to prevent us from falling off a cliff at 500. But if you're not sure, and we're not sure, then you might look at it another way and say well what we do know is that the damage being done by climate change is a function of the stock of greenhouse gases up in the atmosphere and the additional damage done by a ton that we put up now isn't perhaps all that different from a ton we put up last year or a ton in a month's time or a ton over in Brazil or something so roughly the pricing for each ton should be the same so what matters is fixing a relatively constant price. And that's what you're trying to balance up, those stories.

So I'm going to try and make that a little bit analytical and I hope you're going to bear with me and not fall asleep. I'm going to get up and use a white board and give the video a hernia, but anyway... So economists love to start with charts. Artesian Plain. I'm going to put price up here, I'm going to have Aussie dollars here and the quantity of emissions on this axis. And I'm interested in two things. What we're trying to do when we're making climate change policy is balancing the damages that climate change is going to do with the costs of doing something about it 'cause I'm an economist so I think in this you know naïve way that we should try and make sure that we don't pay more than we're going to get back and we get back what we're going to pay.

So we can think about the damage from emissions as likely to be probably rising so the more you put up into the atmosphere the more damage each additional future ton does. So I'm going to draw what we call a marginal damage curve that looks something like this so by marginal damage I mean the damage from each incremental ton of CO_2. How am I doing so far? Let's hear some noise. Great.

I'm also going to draw a curve that describes the abatement cost so the cleanup cost of taking a ton out of the atmosphere. Now I could draw that any way I liked. I'm going to draw it downward sloping on the basis that it's probably easier to reduce emissions now when there's a lot of them out there than it's going to be to get to zero emissions. I'm saying well another way to think about it is if you spill something and it's probably easier to pick up the first bit of rubbish or the first crumb of your chips packet if you dropped it on the floor than the very last crumb so the costs are going to be low when there's a lot of emissions around and high when there's few emissions around so it's the marginal abatement cost. So far so good? Yeah.

So what we want to do when we make our climate policy is think about the intersection between these two curves because if we have this many emissions in the system the marginal damage each additional ton of greenhouse gas emissions might be doing 30 Aussie dollars per ton of damage but it would only cost us 10 Aussie dollars to clean it up so we should clean it up. And over here we've got too few emissions – environmentalists don't tend to like this idea sometimes, that you can have too little emissions, but you can. What we mean is that the damage from additional ton is a lot lower than the cleanup costs so we should emit some more. And so there's a sweet spot somewhere here where you've got the appropriate cap on emissions and some appropriate carbon price. And that's the kind of starting framework.

Now we think about taxes and trading in the context of that framework, using some PowerPoint. I hope so far so good and I hope this works. Right, so I'm going to make it a little bit more complex. I told John this was going to be slightly ambitious but I think you're with me so far, it seems. I don't see anyone asleep so that's good.

JD: You've just disappeared from out the back so ...

CH: Oh. You're with me but this isn't. Has that come out?

JD: No, I don't think so, yes. I think you might have to go back to the board.

CH: Luckily I can go back to the board. Right so if we suppose ... so let's start from the situation where we know exactly what's going on, highly questionable assumption, in fact patently false but let's start with that. So we know exactly what it costs us to reduce a ton of emissions and we know exactly what damage it's doing, then we won't know for certain that this is our cap. We know for certain that this is our carbon price you know 20 odd Aussie dollars a ton and what your economics tells you in that circumstances it doesn't matter. Stick on a carbon price, do a trading scheme, it's all roughly the same. Huge, huge oversimplification, but that's a starting point.

Let's suppose now that we don't know exactly how much it's going to cost us to cleanup. So suppose we anticipate that our costs are going to look like this one but in fact it's going to be a whole lot more expensive than we thought so here's our true monitor [unclear 13:21] cost curve. Now if we think we're here then we're going to put a carbon tax of, let's make it 20 Aussie dollars for sake of argument, and in actual fact ... just draw these ... adjust these a little bit real time. If companies look at that tax of $20 and their abatement costs are quite expensive then they won't clean up as much as you might have hoped they would. You're looking at the market saying if I put on a tax at $20 then companies with their abatement costs, they will clean up when their abatement costs are lower than the tax ... they're not dumb ... and they'll keep emitting if their abatement costs are higher than the tax so if it's you know $30 a ton to clean up then they'll pay the tax instead of cleaning up.

In actual fact it's more expensive and so rather than the emissions in the system being here the emissions are going to be way out here and so you've screwed up ... excuse my French ... and you've ended up with you know a whole lot more emissions than you wanted to. But you've locked in your price at $20 so the merit of a carbon tax, you're fixing the price, you can't guarantee the quantity of emissions.

Now let's have a think about what a trading scheme would look like in this setting. We think we're here again so we think this is our target, we think this is the optimal cap so we set a cap at that point. So fine, we cap emissions at that point. What happens to the price? Well we thought given this cap, the price of a carbon permit or whatever would be $20 but in actual fact it's been more expensive for companies to clean up than what we anticipated so the true cost, and the cost that the emissions trading scheme would tell us, would spit out is maybe 40 Aussie dollars a ton. And so you've got certainty over your quantity but you've got uncertainty over your price.

Now the question from a policymaker's point of view is which of those two uncertainties is worse? And that's where economics can give you a little bit of a hand in thinking about the question because you can actually look at these charts and start to calculate what we call the efficiency loss from different instruments. Now this is really technical, I'm about to stop so for those of you whose heads are starting to hurt or you're finding me just intensely boring it won't be much longer.

So if we think about the efficiency losses the true target we should have been aiming for is here. Now with a trading scheme we've ended up here and we have lost money because our marginal damage curve which I'm going to draw off the scale here now. Think ahead. At this point here our marginal damage is 15 ... sorry no, it's $20 a ton and our cleanup cost was $40 a ton so we're emitting too little. We should emit some more, do some more damage, cleanup a little bit less until we get to this ideal point. Is that making sense? Yeah? So we've lost 20 bucks' worth of value here, we've lost maybe 19 bucks worth of value there and so on, and so the total efficiency loss is that shaded area. So that's the efficiency loss from a trading scheme. We can do the same thing for a tax so remember we set the tax at 20 Australian dollars. We're going to get a whole lot more emissions than we thought and we'll have too much emissions now 'cause the tax is too low and we're losing here too because we're doing damage to the environment that we don't have to be doing so we're maybe ... I don't know, might even be $60 for damage per ton up here when we could have cleaned it up for 20 so we're wasting $40 a ton there and 39 and so on. And this area here is your tax efficiency loss: tax being lost.

So now the way I've drawn it here it looks like ... well it's a bit of a no brainer, right? Your dead weight loss, the wasted money, the money they're leaving on the table with a trading scheme is a lot lower than a tax scheme, but the nice thing about economic analysis is that you can vary things around and what I would have done if the computer had worked is shown you that these losses vary as the relative slope of the damage curve varies. So if you imagine yanking on this end of the curve and kind of pulling it down, flattening it out, this area gets depressed and that area does too a little bit but not as much and so the conclusion you end up with is the flatter the marginal damage cost the more likely you want to have a tax. The steeper the marginal damage the more likely you want to have a trading scheme. So if we apply that to climate change the key question is are we really worried about a tipping point where the marginal damage cost could be really steep? Because the additional tons send us off the edge of a cliff and do a lot of damage in which case we want to have a trading scheme with a cap just before that steep point, or is it a pretty kind of consistently damaging problem? It's fairly linear, each additional ton does an additional amount of damage.

And by and large, the economists who've looked at the kind of science and pulled it all together say, and here's the big answer, it's what you've been waiting for, the marginal damage curve we think of climate change is fairly flat, relatively flat and so a carbon tax is the more efficient answer. Now whoa you think, we don't have carbon taxes and I hear economists talking about trading schemes all the time so what's going on? Well the short answer is that this is a very important piece of analysis but it's one of several issues that we need to bear in mind. Efficiency under uncertainty is one issue. There's a range of other political economy issues, issues about getting buy-in from industries, issues about getting buy-in from green groups, and general

concerns that maybe we've got this wrong you know we think the marginal damage curve is fairly flat but maybe we are about to hit a tipping point so general prudence might suggest that we should be thinking more about sticking a firm cap on emissions.

JD: So, Cameron, how do those political economy considerations play out? What is it that makes it easier to get a cap and trade scheme up? Well certainly if you look around the world there's an awful lot more cap and trade schemes in operation than there are taxes.

CH: Yeah and it certainly was an easy case to make, that cap and trade was more politically acceptable up until very recently. I mean the key political considerations are that ... I mean certainly about five, 10 years ago when these types of issues were really live there was a bit of a pincer movement so the Greens were saying we've got to have a firm cap on emissions and remember in Europe Germany's kind of in the middle and in the middle of Germany, at least from a voter point of view, are the Greens so the Greens had some power and that political power translated into a strong lobby and a strong voice for caps, and cap and trade schemes. But the flip side is that industry looked at cap and trade versus taxes and said well you know what we like about cap and trade is that we might be given some of these permits to begin with, maybe we might be able to be given quite a lot of these permits. Maybe we don't really need them or shouldn't deserve them but we're going to get them anyway.

JD: In Australia they're of course called free permits. Are they free?

CH: Well in the sense that they're not sold but someone's paying for them, someone's always paying, and the point here is that it's a transfer from the taxpayer effectively to the regulated firms because depending on where you start if you're the CEO of an oil conglomerate you probably say well no, no, they're my permits because I've been emitting for years now and I have a right to continue to do so and what you're doing in government is unfairly and without due consultation damaging the equity value of my company by not giving me free permits. Another way of looking at it is that the atmosphere is a common good owned by all of us collectively and, hence, most appropriately owned by the state in its role as collective representative of all of us and, hence, if we give away the free permits we're transferring money from taxpayers to companies, shareholders.

JD: Yeah. We've spoken so far, Cameron, about a very pure sort of tax versus cap and trade. And only one of the interesting things in the piece that you wrote was about the way that in fact you can wind up with hybrid schemes, which have elements of both, and indeed whether you start with a tax or whether you start with a cap and trade scheme you know you can modify both so that they wind up looking more like , something halfway in between. I mean how does that work? How can you modify one so that one ends up looking a bit more like the other?

CH: Yeah. So there are two kind of effects to think about. One is who's getting all the money? Which is always a good question to ask. And the other one is what are the incentives at the margin, and both questions are important. But what are the incentives at the margin question is important to actually solve the problem because you need to have the right incentives for people to invest and to clean up but the who's getting all the money question is the important political question. And you can make a tax look like a trading scheme and vice versa by changing the way either the permits are allocated or by the way tax exemptions are given. So if you sell off all of the permits through an auction or some other process then the who's getting all the money effect looks you know pretty similar between a tax and a trading scheme because companies have to pay for each permit they acquire, it's much the same as if they're paying a tax per ton. So you can make them look the same and broadly speaking you know couple of decades of economic research says that you should auction ... the starting point should be that you should be auctioning all of your permits. That's the right thing to do for efficiency of the scheme and the right thing to do possibly for kind of equity principles but you may wish to scale that back for international competitiveness and other political considerations which are real.

And then on the margin, your question is how do you make them look similar to one another and can you blend them in a hybrid sense? If you take a trading scheme and you put in a floor price ... I can definitely see someone nodding off there ... and a ceiling price then you start to make the trading scheme look a little bit more like a tax and indeed if you set the floor price and the ceiling price at the same point then you basically have a tax, yeah? But most hybrid schemes don't propose to do that. So the way you implement a floor price is that you can say the government will buy back any permit from anyone who's participating at a price of 10 Australian dollars. Now if you're a market participant and you've got a permit you're not going to sell it on the market at eight if the government's going to buy it from you for 10 so what that means is that the market price won't fall below 10 because the government will buy back all of the permits.

Now governments tend not to like that way of implementing floor prices because they don't really like the idea of having a big contingent liability on the balance sheet to be buying back permits. Kind of a response to that from academics has been well if you auction them off in the first place you've got the money, just keep some in reserve so that you can finance the floor. But there are other ways of implementing a floor. One way is to when you're doing an auction set a reserve price so if you say we're going to auction off these permits at regular intervals but we're going to set a reserve price of 10 Aussie dollars. Then if the traded price of the permits goes down to five then you're not going to release any further liquidity onto the market and so you're going to continually be holding back permits from the market until the price edges back up to 10 so it's not a hard floor but it's a kind of what we call a soft floor.

And the other way of implementing a floor to go to your point about combining instruments is that you can actually use a tax to fix a floor price so you say companies have to pay the 10 Aussie dollars a ton and they'll get a rebate of that $10 if they bought permits above that price so if you've paid 20 then you get the 10 off so you pay the tax but you get a rebate on the permit so you end up paying 20 anyway so the floor effectively doesn't kick in but if you paid zero for your permits because the market's crashed and indeed it did crash to zero in Europe in phase 1 then you're left paying the tax of 10 and that's your floor price.

And you can do the same thing the other end and create a ceiling and this is a little bit more palatable to government because there if prices get too high you can just print some more money effectively. You create a few more permits and you sell them onto the market at the ceiling price and you get some more money into the public coffers and industry is happy with you because you've got a safety valve that means the costs are not going to be punitively high. Of course the flip side is as soon as you start doing that you've no longer got the guarantee that your cap is going to constrain emissions to a certain amount.

JD: One of the reasons I guess that this plays in Australia, and it's certainly one of the things that's been talked about a lot, is around the uncertainty that a carbon price creates. Particularly for those people who are in the business of building new electricity generation; their concern is if they don't know what the carbon price floor or cap will be either they're dealing with a very large range of carbon prices and that can make them very wary about building a new supply of electricity and needless to say all of us get very upset if the lights go out. Is that something that's been playing out elsewhere and how is it being resolved?

CH: Yeah, I think the uncertainty in trading regimes has been problematic for investment in the UK, in green power. I guess as I was saying at lunch, probably helpful to divide that uncertainty into two types crudely. There's good uncertainty or good volatility in your system and there's bad uncertainty, bad volatility. And the division is that you shouldn't expect a market to give you a constant price all the time. The point of a market is that it aggregates information so when new things change, or when someone develops a new technology that reduces the costs of emissions, you would expect that to be reflected in the price and that's how a market ought to work. And that creates the price that moves around, it creates uncertainty for bankers and maybe they're less likely to bankroll large investment in power stations and the lights go out but there you go. I mean that's what we call good volatility and the reason it's called good volatility, or I'm calling it good volatility in a crude way, is because parts of the banking community are used to this, it's something that you're you know you can have a think about technological development, you can have a think about whether the winter's going to be cold

and whether we're going to use more power and you can use different instruments to try and hedge that volatility out and to allow for it.

But the other type of uncertainty, slash volatility, is the bad one and that's the one that's created by less than perfect government intervention, would be one way of putting it, and the point here is that if you know we know that these are long-lived assets. Power stations don't you know you don't put them up for a year and then take them down again. They tend to be there for a while, for a few decades, and if you're going to put up the power station then you'd like to have some kind of confidence that the system that is incentivising you to make it a wind turbine, a wind farm rather than a coal-fired power plant, that that system is going to stay in place for some time. And the problem so far in environmental policy all around the world has been that the interventions have not been very consistent nor credible and they've been rather short-term so you know the European scheme, the first phase went for three years. Three years is not 30 years and it's not really enough to incentivise someone to do a big wind farm unless they're prepared to take a punt that the next phase is going to be around. And indeed the next phase was around, it's five years and the phase after that is eight years so the Europeans are kind of gradually getting the message here.

But the Americans have had a bit of trouble too. They have these renewable energy tax credits, they get it come into force for a few years and then they're suddenly withdrawn because they run out of money and so you go from boom to bust and boom to bust again and it's not very conducive for investment. And one of the problems about this is that ... John, as you rightly say, when a banker looks at an investment and says what's the cost of the debt that I'm going to give you, the cost of the capital, if it's a very uncertain policy regime they'll put the interest rates up because you know someone has to pay for the uncertainty. And as I was saying earlier if we have 50 billion Aussie dollars' worth of transmission and distribution investment to do or investment in generation for that matter then you know 1% increase in the cost of capital means that all of us as taxpayers are paying an extra 500 million Aussie dollars a year in interest that actually really needn't be paid. It's a cost that's being borne by the system because policy isn't credible, reliable, certain enough and bankable enough and so you know one of the conclusions is it's probably worth paying a few smart people in government to get rid of that 500 million dollar a year loss to all of us that could be spent on other things.

JD: One of the things you talked about was this idea of good volatility and I want to think just very briefly about well how good is it really? In particular because one of the kind of very peculiar features of a carbon trading market, which is of course an entirely artificial market to start with, is it has a completely vertical supply curve as the economists would say or to translate it into English if demand falls below the fixed number of permits that you said are on offer in any particular year then rationally the price crashes very quickly and indeed that's been one of the features of carbon markets overseas, demand for permits has been very slightly less than people thought it would be and as soon as it you know drops under that number the price falls very, very quickly and of course that might be good volatility for economists but as someone who used to work in a bank, it's very, very bad volatility for a bank in the sense that one of the things you really don't like is projects in which there's a distinct possibility that the return won't just be you know 5 or 10% less than you thought it would be but it would be a lot less.

CH: Yeah, I mean it is ... it's a good question and of course you know in Europe prices have ranged from over 30 Euros a ton to you know well below 10 Euros a ton and in the current phase, in the previous phase they went to zero so you know if you're a slightly sceptical banker there's evidence for you that prices do go to zero because there've been too many permits put out there so I could jump up again and draw it on the chart if you'd like ...

JD: We've probably seen enough curves.

CH: Yeah, enough charts, okay, alright. That's a good steer.

JD: That's been a fascinating discussion already and I wondered if we could throw it open to the audience. We do have a microphone wandering around if you could just wait 'til it gets to you because until the microphone gets to you we won't be able to hear your question on the recording. If I could ask you if you're happy to do so just to state your name and where you're from in introduction to your question. Thank you.

Audience: Good evening, John Egan from John Egan Strategic Consulting. Critical to the choice there is the gradient of the marginal damage curve. One of the big arguments against Australia taking any action actually is that whatever we do makes minimal difference on a global scale so implied in that is that the marginal damage curve is very shallow yet if you believe the tipping point analysis of environmental ... of our environmental future say on a global basis, the marginal damage curve potentially is quite steep. I just wondered if you'd done any analysis on how you deal with these two contradictory gradients.

CH: Sure, I mean the first thing is that the marginal damage is the damage of an additional ton so while Australia's impact as a whole isn't high the impact of one ton in Australia is probably the same as the impact of a ton in China or a ton in America so you know the word marginal helps us to focus in on the extra ton and in this context it means that actually the marginal damage in Australia is the same as the marginal damage anywhere else but your point, which is a good one, is that the total damage of Australians on the climate isn't actually that great and that's obviously ... that obviously is true. So why should Australia do anything given that its total damage isn't great? Well there are 192 countries and none of them have a particularly great total damage. The essence of these types of commons problems, which is what it is, it's a kind of tragedy of the commons, is that you know the nasty effects happen because of the collective result of all of us doing the wrong thing and it adds up.

Now it's not to say that there aren't big emitters you know obviously there are, China and the US are the big players, but even then I mean they're not absolutely dominating. It's very clear that we need you know a lot of the big players to be on board, but even more to the point I think is the argument, and in fact it's not even just an argument, it's the accepted guiding principle of the United Nations Framework Convention on Climate Change to which we've signed up and to which every country pretty much has signed up including the US. It's not Kyoto, this is the thing that came well before in 1992, and the guiding principle of that was that countries should reduce their emissions as a function of their responsibility and their capability of doing so and you may know that Australians are responsible per capita for more tons going up there than pretty much any other or indeed any other industrialised nation so in terms of your individual responsibility or my individual ... I don't live here at the moment, but someone who lives in Australia's individual responsibility it's you know possibly even double that of a European in terms of damaging the climate.

And then when we think about capability. Well we're a rich and prosperous nation. We've got money to spend on all sorts of frivolities. It's not as if we can't afford a per cent or two to sort out a problem that could wipe all of us out, so I don't think it's good enough to say Australia is a small country, why do we have to think about this? It misses the point. Our marginal damage is the same as everywhere else, our responsibility is high, our capability is high and frankly the rest of the world expects countries like Australia to be taking action and we're giving ourselves a bad name when we don't.

JD: Thank you. There's a question just here in the aisle if we can ...

Audience: David Campbell from the Office of Knowledge Capital here in Melbourne but I'm also a Director of Animal Health Australia in the Sugar R&D Corporation. My question's on agriculture which has always been a vexed issue in this whole discussion. Where does agriculture fit into this? You mentioned CO_2 initially and then you talked about greenhouse gases, and we know agriculture's contribution to that, and I'll put it in the context of the challenge we're facing this century is to probably double world food production if we're to support nine billion people on the planet so where does agriculture fit into the scheme? How do we argue that in or out?

CH: Correct. Well agriculture has to be in, that's the first point as does broader land use changes and forestry and deforestation issues which are obviously all connected. They have to be in because of two reasons. It's big so as a proportion of emissions ... there is some dispute actually about precisely what the contribution is but collectively all of the areas I've just mentioned could be up to 20% of global emissions so they have to be in because they're a big bit of it. And they also have to be in because they may well be one of the cheapest ways of getting the problem under control and you don't start with the most expensive ways, you start with the cheapest ways so clearly in is the first answer.

The second point you made quite rightly is that agriculture's contribution comes through ... as much through non-carbon dioxide gases as it does through CO_2 so particularly methane and you know the nitrous oxides and so on. I mean nitrous oxide, yeah not the nitrous oxides. Anyway and so getting the science right about the relationship between those gases and carbon dioxide is difficult and important and you know the IPCC gives us equivalence factors between them but there is some ongoing scientific debate about exactly what those equivalence factors ought to be so that's an important part as well because you've got to compare like for like which means you have to apply these equivalence factors. Then I guess the real question underlying all of this is so what the hell do we do about agriculture and forestry and deforestation land use in a context where you know we do you know we've got a population going to nine billion, people are consuming more calories every year which is by and large a good thing in ... for most of the world's population. It's probably not a very good thing for the people in this country. We're consuming more calories year on year, but anyway, it's partly because the price of calories is going down and when prices go down people buy more of the stuff.

So what do we do about it? The big debate here is do you put it into a carbon market? Or do you use kind of separate funding-type mechanisms and support? And it does I guess vary between different categories so agriculture's one thing, deforestation's another. The reason there's a debate here in a way that there isn't so much for point sources of pollution like big coal-fired power plants is that you know your pollution for agriculture is diffuse, it's over a wide scale, it's difficult but not impossible to monitor and verify or at least it was hard, it's getting a lot easier and so building in the MRV, the monitoring, recording and verification that we need to have those sectors within ... fully fledged and within a trading scheme's a bit more difficult but not impossible and we've seen success in building them in offset programs here and in the US although the US programs are a criticised a little bit but it's a big bit of the US bills that are on the table and that's because the US are taking you know they've heard the first two points I made. It's a big issue and it's cheap so you know that's probably a good point to end on.

JD: Thank you. One up the back here. Thank you.

M: I'm Amit Golder, from the Department of Premier and Cabinet here. You mentioned that the damage costs of carbon emissions are generally considered to be fairly flat on each additional ton emitted [unclear]. Does that change if you consider non-financial costs as well like cost to the environment [unclear] costs to human beings?

CH: No so it doesn't change. The analysis I was giving you and the kind of comments I was making were based on a pretty comprehensive assessment of the damage cost so it's not just the narrow damage to economic assets but it's also including attempts to price damage to biodiversity and other natural capital although of course it's you know fraught with enormous difficulty getting those numbers right. It doesn't ... but actually even if you got the numbers wrong it may not necessarily affect the slope you know you might be slightly wrong on where the curve is but the slope may not be different you know so it's already built in.

JD: There's one just here, I think. Thank you.

Audience: Bruce Nicholls, Capital Holdings and I'm also a Director of Goulburn Valley Water. Just to come back to a very simple crude model again. If what we really want to do is tax people to disincent them in the carbon sector then we also want to incentivate investment in the non-carbon sector and the thing that I'm interested in is how the investment curve's affected by the pricing and how you lock in the long-term security. And is there a mechanism for revenues from the tax to flow into the non-carbon sector as incentives?

CH: You know it's a good question. I mean the analysis I've put up here is static so it's not over time, it's just a snapshot chart and it's also marginal so it's not thinking about how you translate that into lumpy ... supporting lumpy capital decisions although I made some comments about that later so the critical ... I mean the first point is that if you got this right and if things were certain and if the prices were credible and long-term and they lasted over 30 years and everyone knew what they were and if, if, if, if, if then you would have appropriate incentives for people to go to banks and get their finance and be confident in investing over the longer term. But as I was saying you know more than one of those ifs is a bit iffy and where that leaves us is for the need for other ... I mean we should obviously improve the systems that we do have but it also leaves us needing other incentives as you've rightly suggested to support the investments that's required.

And these can take a, you know, a large variety of different forms. One of the perhaps most interesting things I've been working on recently, or at least I find most interesting, is work with some of the biggest global pension funds to work out you know what it would take them to invest big time in shifting the capital stock of the world from dirty to clean because you know, as ever, you should follow the money and the money often ends up in these big pools of capital of a couple hundred billion at a time. And it's all our money at the end of the day, it's our pensions that's being invested but it's one person or a group of people who are making those investment decisions so you go and find them and work out what does it take that investment committee to shift?

And you know at the end of the day perhaps unsurprisingly it's a capital market, they're unsentimental. They need an appropriate risk-adjusted return on their investment and so you think about that. Well how do we get the right risk-adjusted return so that they go for renewables and etc instead of coal? And the answer is you can either take some of the money that you generate from the trading scheme and plug it into pushing up their return but ... and it's not to say that won't do any good, but actually returns are already fairly high, the problem is that there's a lot of risk and so the question is how can you think cleverly about policy to push down the risk of those investments or to take some of the risk away from them so instead of requiring a 30% hurdle rate of return on ... for a Swedish pension fund to invest in a wind farm in South Africa, they might say okay well we're getting comfortable with a lot of these risks, we understand the policy, we understand the market, let's make it ... well we feel that the appropriate hurdle rate here is now 15% and so the capital can start flowing even though you haven't necessarily changed the return.

So that's by way of saying that you can do some fairly clever things by taking the money that's generated here and rather than just handing it out thinking about how it can be used to provide guarantees to take risk away from the private sector and you may never have to pay out on those guarantees. I mean one of the benefits that the government has is that until recently they had decently strong balance sheets but they've still got relatively strong balance sheets and ...

JD: More so here than where you've just come from.

CH: Right, that's right. And apart from anything else if you think about good risk management you want risks to be lying with the entities that are in the best position to bear those risks and a lot of the risks here are policy risks so that's you know load them onto the government and say well if you renege you're responsible, you've got to pay out and if you provide us with that insurance our hurdle rate goes down and the money starts flowing.

JD: Thank you. There's a question up the front here.

Audience: John White from Sustainable Soils and Farms. There are a lot of really low cost ways of capturing CO_2 through biological means including better farming and sequestering it in soils or oceans. Now that's taking CO_2 out of the atmosphere using it and creating fertility. You're talking about emissions being avoided. What is the best way to bring CO_2 sequestration, particularly via biological activity, into this trading scheme? The second part of the question is the whole world is waiting for geological capture and storage, which is another way of

sequestering CO_2, which may or may not be secure and permanent, and how should that be dealt with in such a scheme? Tax or trade.

CH: Yeah and there's a fabulous report I commend to all of you that deals with some of these issues in a wider sense by The Royal Society and The Science of Geoengineering is what it's called and the large scale sucking of CO_2 out of the atmosphere whether it's through biological methods or through CCS is effectively a kind of planetary engineering method and they also consider the slightly more wacky stuff about managing solar radiation and so ... which is not your question, but is in the broad area of geoengineering. Anyway so it's a great report. In terms of how we think about incorporating biological or even ocean sequestration or geological sequestration into these schemes the short kind of factual answer is at the moment they're not really in there in any big way. The reasons are several. I think the reasons are ... an important reason is that you know policymakers have been focusing on preventing the problem rather than curing it in a sense. Prevention's better than cure. Stopping emissions before they get up there so if you think about the artificial trees idea of Klaus Lackner in Colombia University.

It's ... actually in the same way that I drew this marginal abatement cost curve as sloping down it makes sense that ... it's a lot harder to extract your CO_2 out of the atmosphere once it's already mixed than it is to collect it and put it underground prior to it mixing with the general atmosphere which is what you do at the end of pipe in a coal plant. So the first point, and I'm rambling a little bit here, is that policy is focused on prevention rather than cure, but to get to your question which is well what do we do about building these biological, geological and other forms of sequestration into this scheme? I mean you obviously can't regulate them in exactly the same way because there aren't ... except with CCS on coal, there aren't emissions in the first place so if you're doing a separate piece of biological sequestration or ocean sequestration then you need a separate scheme. So you're then taken towards offset mechanisms and you know offset mechanisms can work rather well provided you have very careful monitoring and enforcement, clear standards and the rest of it, and the challenge with them is inevitably to ... unlike a trading scheme where you know what allowance you have and whether you've used it up or not, in an offset mechanism you have to describe a counterfactual so what would have happened if I hadn't have done this thing that I've done? And you're in the realms of speculation.

Now it's not impossible to create a system around that and DEEP is a fantastically functioning system created around that but it is relatively expensive to go and specify all of the counterfactuals and then do all of the crosschecking. And then when you add the fact that in biological sequestration you've got the diffuseness problem that I mentioned before as well it does make it a bit of a… it's a much more challenging issue to address through trading and so that has taken policymakers and some academics to start thinking about non-trading and kind of non-tax routes where you're thinking more in ways of regulation, direct funds and subsidy support and direct investment, but it's a complicated and slightly rambling answer, but it's a difficult question.

JD: Thank you.

Audience: Hi Cameron. Tristan Edis here from Grattan Institute. The one question I had for you with the studies in the marginal damage curves and their slopes, I would have thought that based on my limited reading of the climate science literature that you may have some kind of kink. It may be flat for a period and then a kink or a rapid rise up. What's the literature say on that? Besides perhaps flat for a period but then there's a kink or ..?

CH: If I could just jump up again. If you say that the problem here is that the marginal damage curve itself isn't quite clear and so it might be that there is this nasty kink going up there, or it might be that the real curve's there, or the kink could happen here, or the kink could happen there, and the job of the analyst is to take all of those curves and say well what is kind of the average? So if you've got a kink at 450, and one at ... parts per million, and one at 460, and another one at 470, and another one at 480, and so on, and there could be a kink anywhere here and you average them all out well what you get is something that isn't very kinky. I don't think I meant to say that. So I mean the ... I go back to the point I made before, if we knew exactly where the kink was and if we knew that there was a bit where it definitely got

steep then we'd be sticking in your trading scheme somewhere prior to that. Until we really have confidence about where that's going to happen and I'm sure ... I mean if there were some climate scientists in the room they would say well you know Cameron, you haven't been reading the recent literature enough, we know where it's going to happen and it's here but the problem is that another climate scientist in the room would say you know Cameron, you haven't been reading the literature well enough. We know where it's going to happen and it's somewhere else and so as the economist your job is simply to try and pull all those views together and represent them appropriately and I'm afraid it doesn't solve the ... marginal damage curve isn't as steep as we would have liked to justify trading schemes-type problem.

JD: Thank you. You may have just heard that our greenhouse emissions dropped about 30 seconds ago as we hit 7:00 and the air-conditioning went off so it's probably time that we wrapped things up. Cameron, can I thank you very much? It's a deeply technical subject. It's nevertheless an issue which Australia is facing. The reality is that we have a trading scheme in draft legislation but legislation that has failed to pass in the words of the constitution, and we have a party which may well hold the balance of power after the next election with a tax back on the table, and so I think it's a debate which may well come back into Australia and therefore it's been tremendous having your thoughts about how to think about it and what are some of the tradeoffs involved and what are the key considerations in thinking about one rather than the other. So can I thank you very, very much for coming? Can I thank everyone here and the questions we've had. Thank again our hosts, Price Waterhouse Coopers, for their facilities and encourage you all to attend the next event. In terms of this event we hope to have podcasts up within the next day or so on the website. That's now becoming standard practice for Grattan events. We also hope to have the transcript up within the next week or so depending on just how fast we can get to editing it, but those things are all available on the website and for those of you who know friends who couldn't make it here but you wish they had, please do let them know and we look forward to seeing all of you at the next Grattan event. Thank you very much.

End of recording