

In early February, Grattan Institute released the first of a two-part report on the technology choices that will frame Australia's energy future. *No easy choices: Which way to Australia's energy future?* explores in detail the seven technologies that might enable Australia to achieve the targets set out in the Federal Government's Clean Energy Legislation for reducing greenhouse gas emissions. It also considers the case for government intervention beyond the carbon tax and R&D support.

Andrew Charlton, a former senior economic adviser to Prime Minister Kevin Rudd, an Australian representative at the 2009 UN climate change conference in Copenhagen and the author of the November 2011 Quarterly Essay, *Man Made World: Choosing between Progress and Planet*, discussed the conclusions and recommendations of the report with Tony Wood, Grattan's Energy Program Director.

Speakers: **Tony Wood, Energy Program Director, Grattan Institute**
 Andrew Charlton

AUDIO: This is a podcast from Grattan Institute, www.grattan.edu.au.

ANDREW CHARLTON: Ladies and gentlemen, it's a great pleasure to be here with Tony Wood to discuss his new report from the Grattan Institute, entitled *No Easy Choices – Which Way to Australia's Energy Future?* Tony's report is excellent. It's a refreshingly frank appraisal of where we are and a practical approach to our future challenges. Those of you who have read it will agree it makes a nice change from the often fractious and difficult politics of Australian climate and energy.

In Australia we seem to be caught between the Cassandras, on one side, who tell us that it's too hard and too expensive to move away from coal towards a renewable energy future, and the Pollyannas, on the other side, who say that it's easy and all we need is a little more political will from Canberra. So can Pollyanna and Cassandra be married? In a literal sense that would require an act of Parliament. But in a metaphorical sense, Tony Wood is here to perform the ceremony tonight. Tony, with your background in the energy business and the policy world, you are well placed to turn discord into harmony.

Our discussion tonight will take about 20-30 minutes and then we'll take questions from the audience. Let me begin with the first question. I was interested to read in the report that you say that Australia's energy sector will require a transformation to achieve our emissions targets. You say that we will need both a market solution and direct action from government. These are two very different camps in the Australian political debate and you have a foot in each. Are you having a bet each way, and isn't that Greg Hunt's job?

TONY WOOD: This journey started when we looked at the numbers that were put out by the government last year in their climate change policy package. People who look at the projections of economic models tend to either believe them as forecasts of the future or, if they're economic modellers, they have their own version. You need to understand that economic modellers are like parents: they prefer their own children. And so you have the debate about which economic model is better than the other. But when I looked at the numbers in this report the first thing that struck me, as someone who has background in business, was that these numbers were quite extraordinary. Within forty years, we're going to produce more energy from renewables than we do currently from coal, which has been our major source of energy for over a hundred years. And secondly, according to those numbers, within the same period of time, the majority of our energy is going to come from two major sources that we don't yet produce any electricity from today, which are carbon capture and storage and geo-thermal. That sounds to me like a total transformation. Now can policy drive that or does it need other

engines? From my background, I conclude that the only way we're going to achieve the challenge that we in Australia and the world have to climate change, is to harness the engines of commerce. And how do we do that? By creating some market drivers to cause industry to invest in the way we need it to. When we start that, we begin to uncover some of the challenges which result from fuelling a market. This is not a simple market. It's created by government and people. Steve Jobs did a great job convincing people to get an iPad, but I'm not sure everybody is convinced they need a different sort of electricity. It becomes quite an interesting challenge when you start to unpick what is necessary to cause this sort of transformation.

ANDREW: Just unpick what that challenge really looks like for us. Australia has targets to reduce our emissions by 80% by 2050. Can you paint a picture of what that looks like in terms of an energy transformation? How is the energy sector going to be different after we've been through the transformation?

TONY: I guess that's part of the journey. People talk about 80% by 2050 or 5% by 2020, but the environment doesn't care when precisely that happens. What's important is that we don't build up a stock of greenhouse gases in the atmosphere which ultimately cause the temperature to increase and all the consequences that come with that. Australia, unusually for a developed country, has very high level of emissions, particularly coming from stationary energy, more particularly from coal. That gives us a challenge that many other parts of the world don't have. In many parts of the world, the biggest problem is transport. In New Zealand they have a problem with sheep and cows. We have been blessed in one sense with our resources, the main one being coal, which has been so successful in delivering competitive energy. We have no problem digging coal out of the ground, producing electricity, driving industry, driving manufacturing, and delivering jobs off the back of that. If it wasn't for climate change we'd keep doing it! We're not going to run out of coal any time soon. The only thing that has changed recently is technologies that could follow peak demands (i.e. gas). But if you look at the history of people's forecasts of what we produce from gas, they've always been way out. People thought we'd produce a lot of electricity from gas but most of the time we haven't because coal has been so successful. Why would we change? The underlying issue is climate change. People have been aware for many years that Australia has been one of the world leaders in wind turbines for pumping water or for remote solar power. But to really start to drive high volumes has become a challenge. With a shift to gas, that we're already seeing to some extent, and a switch from wind and solar, that's already been built as a result of existing government policies, along with the capacity for companies to buy permits (under the emissions trading scheme) we could get to 2020 without too much trouble. The challenge starts to emerge after that. If we've got to get 80% reductions by 2050, we've got to decarbonize the electricity industry. That means much bigger change occurring in the second half of the period ahead of us. What we don't want to do is get to 2040 and then say we should have done something different in 2012, 2013, because this is not the place we wanted to end up!

So whether it's the forecasts of the Treasury modelling, which have very big components of geo-thermal and carbon capture and storage, or whether you look at other versions of modelling which have more solar or thermal or even whether we have nuclear in the mix – it doesn't matter as much as acknowledging this is a big change. The fix will be determined by the policy settings that we have. What you don't want to do is find that as a result of policy choices we make today, we start driving down in a direction from which we have to turn around and come back again. A lot of what we said in the report was about the uncertainty: how do we keep our options open?

ANDREW: Treasury is more pessimistic about the 2020 numbers than you've just described. In their modelling they talk about reaching the 5% target by 2020, but reaching that target involves purchasing a very significant number of permits from abroad (around 2/3 of all the abatement to achieve the 5% target occurs abroad). The implication is that, at the prospective price, it isn't enough to drive the abatement required to meet the 2020 targets domestically. Are they being too pessimistic?

TONY: I'll stand corrected, but I don't think too many people in Treasury have ever run a business. The evidence is that if you can use a market structure to drive people to change their

behaviour in a positive way, industry will always find cheaper ways of achieving the outcome than anyone in Treasury or their economic modellers would have ever forecast. A year or so ago, Grattan Institute looked at market mechanisms around the world to address environmental issues, particularly around climate change, but also to address acid rain and so forth. They concluded overwhelmingly that markets not only meet the target earlier and cheaper but they're doing it in ways that modellers could never forecast. People are now worried that Australia's carbon price might be quite high. Currently, if the carbon price starts at \$23 then effectively from the middle of this year we've got \$23 a tonne, \$24 and \$25 a tonne. Then we go into a situation where the global market sets the price and there will be a floor on our price for a while of say 15. Let's assume that it drops to the floor and then it escalates to 16 or 17. You do a simple calculation and it's worth spending something like \$80 to save a tonne with capital investment over that period of time because you'd save that every year. There are lots of things industry can do for \$80 of investment to reduce emissions. And it is absolutely in industry's best interest not to tell government these things because they have to negotiate the best deal they can get! As soon as the umpire says the game is on, people will get out and play their best game. You don't give out your secrets before the game starts because you'll be buggered by the rule makers! The ways in which industry will find to reduce their emissions at prices that will be below those market numbers are much lower than people think. Will that mean we get to 2020 easily? No. I think it's still quite a challenge because we are a country in which peak demand is continuing to grow. I think Treasury in that sense is being quite pessimistic. They may be optimistic however, on what international permits will be sold for.

ANDREW: So if you're more optimistic about the ability to achieve the 2020 target that implies that the price at 2020 will be reasonably low and that most of that target from your perspective could be achieved by efficiencies rather than shifts in the energy mix.

TONY: There are other things I'd mentioned before, which are already, to some extent, locked in from previous policies. We've already got, courtesy of a whole lot of feed-in towers designed at mostly state levels and rebates federally (over a thousand Megawatts of solar) which will add to that equation. That is also part of the engine that will drive where we'll end up by 2020 and beyond. The problem is when people start looking at the longer term. Does industry really believe that the governments will stick to this and therefore make a longer term investment, because in the short term a shift of fuels between coal and gas, for example, will make a big difference? There are quite a number of gas-fired generators that could run more hours of the year and coal generators might run less but that has consequences. That can be done physically without a big drama. The question is when you've got to build not only new generation, but also think about shutting down existing generation you probably need emissions prices that are higher than you would expect under current forecasts.

ANDREW: If businesses are successful, in the short term, in achieving emissions reductions in a range of ways, does that mean that good news becomes bad news because we're not making the shifts towards renewable energy over than those ancillary policies that you described. We're locking in a trajectory that actually makes it a steeper curve to achieve the energy mix that we're going to need to achieve the 2020 and 2050 targets.

TONY: I'm not an economist, but I did some work with Ross Garnaut and the way he explained it to me was that if you had certainty around what the forward emissions constraint was going to be, then the market would be very efficient in taking that, discounting that back to today and saying that's the price we should have. To some extent that's what Nick Stern did. He looked at the real social cost of climate change and came up with a number which is significantly in advance to what we're talking about today. The problem is that in the short term, an emissions trading scheme as does our renewable energy target drives investment in what's the cheapest technology today, it does not necessarily drive people to invest in the technologies of the future, because partly they don't have that credibility around future policy. So what could happen is the market will discount the carbon price and you end up with the low price. If you accept that we will stick to our emissions constraint then later on the price will inevitably get much higher and that gets quite nasty, from an economic perspective.

One of two things can happen: either we achieve our emissions target, but the cost of doing so is much higher than it should be, because we should have been investing today in technologies

with a lower cost in the future. Or the cost goes up and our political leaders, struggling with the implications in prices of electricity, abandon the constraint. This is precisely why people don't want to invest today - because they're worried that might happen. So you end up with a really horrible combination in terms of policy credibility. And the question we raise to government in our report is what do you do about that, because either of those outcomes is not where anyone wants to be!

ANDREW: So policy credibility is one risk. But in the report you also talk about technology risk. You describe seven technologies and you say it is possible that none of these technologies can replace current electricity production. Explain the gap and how should we respond to the uncertainty?

TONY: The one caveat I put on that statement would be "at affordable cost". It's not difficult to demonstrate that technically we could achieve the abatement reductions we're talking about. The question is how do we do this in a way that is the lowest cost over time? The economists talk about this as "inter-temporal optimisation of abatement", which is a beautiful term. This means we don't want to do too much too early or too much too late. How do we optimise our time? We're trying to get a handle on the way in which these technologies might shift over time. We looked at seven technologies that we thought were most prospective in terms of having the material contribution to Australia's energy mix in the foreseeable future: wind, solar PV, solar thermal, geo-thermal, bio-energy, nuclear and carbon capture and storage. There are others. We didn't look in detail at electricity storage because there seems to be a long way to go, but we do recognise there has been a lot of change going on in that sector. We looked at storing of heat because solar thermal has a particular advantage which is, potentially, very exciting. But when you start to try and scale up from 10, 20, 30% of the energy mix to 30, 40 and 50%, it gets very challenging indeed. It's not at all difficult to see us getting to 20% of wind and similar numbers for solar. The challenge is when you have to have effectively no emissions, people start to talk about gas-fired generation with carbon capture and storage or other combinations like that. But how do you design a policy outcome that will keep the options open?

These technologies are more or less grouped in cost – around the same range. Depending on what numbers you're looking at today, in terms of the wholesale price of electricity, it's generally between \$100-150 of megawatt hours, so there is no obvious winner. If there is no *obvious* winner why would you back one? Companies might, but the community and government shouldn't. So the issue becomes how do you keep your options open and what sort of policy would give the greatest opportunity for those options to emerge? Recognising that there may very well be within 30 – 40 years a clear winner. It may be that geo-thermal turns out to be absolutely fantastic and can supply all of our energy for less than \$100 per megawatt hour. I'd only be prepared to put on a small wager. We don't know yet. How do you design policy mix that causes people to react to market signals now, but keeps those options in the future open because the technology uncertainty is very high.

ANDREW: If we're seeking to create policy that promotes technological development that can deliver – we back a lot of horses and hopefully one of those horses comes in and delivers the solution we're looking for. How do we, in Australia, design policy when the reality is that a lot of that technology will not come from Australia? A lot of it will come from abroad. How do we factor that in to our policies around supporting technology development, providing a flexible scheme which allows for a range of technologies to come in and be supported by market and direct approach? How do we think about the reality that we're a small part in the global economy and a small part of the global technology work?

TONY: One side of that is to what extent do we want to be altruistic and think about some of this as our contribution of the global climate change challenge? The other is do we have to be a lot more selfish about this and say how can we get the best outcome for Australia? In our work, we've said that there is a role for government to support technologies. What we've been a bit more cautious about is Australian governments, partly for the reason you've just implied. Australia has had a very strong track record in R&D, in the solar PV space and that has resulted in a number of companies taking that technology offshore. We are a small market and inevitably the monetisation of the investment in R&D is going to end up hopefully in global markets and we'll create some wonderfully successful companies.

The way we do that is to break it into two pieces. At the R&D end of the spectrum, the costs tend to be lower but the risk is higher. There is less money but you're taking some significant technology risks. That's an appropriate role for government research facilities. And in that context you would ask where are the things that we think we might have either a strategic interest in or a natural competitive advantage? For example, it seems to me, that doing research into wind technology or nuclear technology would be inappropriate for Australia either at the R&D end or at the commercialisation end. On the other hand, when you look at where our interests might lie, I think we should look at solar thermal. And the reason I say that is when you look around the world, solar thermal can be very effective. Australia is one of those countries that look particularly prospective for solar energy. Secondly solar thermal has the advantage in that not only can you store the heat, but also you can combine solar thermal with gas to have quite low emissions and you can use the gas to combine with the solar thermal to overcome the degree to which you're concerned about the intermittency. And there are already a couple of those plants here. And in Australia we have a really unusual combination of gas resources and solar resources together. In geo-thermal we have some particularly interesting prospects and I don't claim to be an expert. As I said before I couldn't say that was going to be the winner. And the other one which we have a high interest in would be certain aspects of carbon capture and storage. Not only do we have a very high dependence on coal fired power ourselves, but we are a major exporter of coal. And from a coal perspective, if there is going to be a future for coal it has got to be coal that doesn't produce emissions. We would have an interest, you would think, in ensuring those technologies get developed.

ANDREW: Let me ask you specifically about carbon capture and storage. You are at pains in the report to point out that we should be not backing any individual horse, that we should be neutral in regards to technology when we're applying government effort at least, but is carbon capture and storage an exception? In the report you cite figures that it is doing 30% of the work. Would it be extremely hard to achieve Australia's long term targets to effectively decarbonise the electricity sector without carbon capture and storage? Is that one essential technology?

TONY: If you're doing it physically I think the answer is yes. In the longer term you can reasonably say other things will emerge, but in the timeframe we're talking about I think it's difficult to maintain affordability and security of supply of electricity and meet your emissions target at the same time without carbon capture and storage. I'm assuming that in making that either the cost or the acceptability of nuclear energy would remain a challenge in Australia, which it may not be in other parts of the world. The International Energy Agency said that not only would carbon capture and storage contribute something like 25% to the abatement that it has to be achieved globally to reduce emissions, but also that if carbon capture and storage was simply eliminated from the equation, you could do it, but the cost would be 70% higher. I don't think it's just technical issues; it's a matter of affordable, secure energy that is also low on emissions. It's solving the equation for those three constraints that I conclude that pursuing carbon capture and storage is worth doing in Australia.

ANDREW: Let me ask you about the ever expanding suite of government policy in this area. In recent years there has been a blizzard of initiatives: we have the Global Carbon Capture and Storage Institute, the Flagship Programme, a range of solar programmes including Solar Cities, Solar Schools, and Solar Communities. We've had the RET both small and large and a raft of new agencies created under the recent bill. Two questions: first of all how do we know whether these are working – how do we monitor these? And what do you think we've learnt from our recent experience?

TONY: In answer to the first one, I guess you never do. Somewhat cynically I'd suggest that there are many people who have a vested interest in ensuring we never know what they've actually achieved. Some of you may have seen the report on "7:30" last night that talked about the Global CCS Institute that was created by Prime Minister Rudd in early 2008. In some ways the easy argument is that it's too early to know. That's the comment that the Chinese leaders said about western civilisation. The question is what is it contributing and how is it changing the game. The evidence from a carbon capture and storage perspective is the \$2.5 billion Flagship programme that the government announced to go with the CCS Institute (one being domestic and one being global) is that two-thirds of stuff all has been achieved! In a report that we did

last year looking at capital grant programmes our conclusion was that the bad news was they don't achieve very much; the good news is that they don't waste too much money because most of the projects never get built. This means the politicians can announce it again! Which again is a very cynical approach to the way politicians work. I have admiration for the politician's capacity to do that! But from a business perspective I struggle with it.

The question is what are these things designed to achieve? One of the challenges in this area of climate change policy is to be clear on what the objective is. There are numbers of programmes which were designed specifically to get more renewable energy. The renewable energy target was designed to try and do that at lowest cost. It wasn't designed to reduce emissions at lowest cost. If that's your objective you'd ask how you measure that, rather than ask what's the broader objective? Other policies have been introduced specifically to try and create jobs in regional Australia. You could measure that. For me, as I said in the beginning, the fundamental issue is that we need to achieve a reduction in emissions in Australia and the world (and in Australia is a significant part of that contribution) and we need to do that in a way that keeps electricity affordable and secure and reliable.

We have a really unusual combination in Australia for the number of alternatives we have. If your objective is to reduce emissions at lowest cost, then that should become the measure, not whether or not we've got more renewables or less renewables or more jobs or fewer jobs. They will be very strong political drivers. You mentioned quite a few – and there are literally hundreds of – programmes that have at least part of their objective to achieve reduced emissions and they fight against each other. So what you need to do is think about how you design a policy mix that doesn't do that. That's difficult politically. If you ask a political leader whether this policy is to reduce emissions, to encourage particular technology development, to create more R&D, to get jobs in regional and rural Australia, the answer would be yes. It's very difficult to design a policy mix that achieves all of those. And after the event if they're asked "well did they achieve their objectives?", you could almost always say that one of them had been achieved, but almost never the fundamental one. And that's where the challenge is with many of the policy instruments you were talking about before. They've really struggled to deliver the sort of outcomes that we should be talking about when we think about complementing the core policy instrument which is the emissions trading scheme.

ANDREW: We might throw it open to questions. Please introduce yourselves, please keep your questions short and please keep your questions, questions.

AUDIENCE: Gareth Lloyd, eWATER: You touched on CCS and it's absolutely pivotal role going into the future in the interest of this country and this country's interest long term. It's a bit hard to ask you to wave a technology magic wand, but you've talked about its central importance so what would you be doing now, if you were in government, to create not the technology of the future, but the conditions to bring it about?

TONY: The way I'd respond here is with regard to which technology you ask me about. What are the risks faced by the people who may want to develop these technologies and how do you then design policies to help reduce and better manage those risks. In the case of of CCS, one of my first jobs in industry a long time ago was working on the ammonia urea plant in Brisbane where the technology used to capture CO₂ was well and truly known. There is no question that it works. It works and it has done for a very long time! We know how to sequester CO₂ safely and securely. There is a long way to go in certain geological structures but in other cases no. The second question is what would cause this to change? At the moment there is no CCS integrated from power stations anywhere because we don't have the policy instruments that your question leads to. You've got to do a couple of things and part of our work is looking into this. The next piece of work will look at it in more detail. You've got to get a better understanding of the geological structures for storage because that's the uncertain part. The government announced last Friday that they're going to put some money into a project in Victoria, called Carbon Net, and a lot of that money is going to be spent on better understanding of those geological structures for sequestering the CO₂. That's the first thing you'd do. You do the things in the CCS world that would be the equivalent of the sorts of policies that we've had in Australia and other parts of the world to drive renewable energy technologies to help underpin the first of those projects. It seems to me that I'd be completely technology agnostic because I

just want to get the emissions out of the environment. Why would I care whether it comes from renewables or CCS? What I'm interested in is how to do that. I would, for example, criticise the Clean Energy Finance Corporation because they explicitly excluded CCS from the mix of technologies that organisation could support. Find the mechanisms that would be, in many ways, the equivalent of the ones that have supported the renewables and apply them into the CCS world. You'd get similar responses and similar deployment. But at the moment we don't have those and that's where I think we need to intervene.

AUDIENCE: Geoff Cameron, BZE: You said that you think we will reach our 20% target for renewables by 2020, but, as that's just eight years away, I'd be interested to hear how you think we might get there. Particularly in the light of recent legislation in NSW and Victoria which makes it near enough to impossible to build any more wind; the Solar Flagships Programme at the federal level seems to have come to a halt mainly it appears because the flood of RETs has been picked up by the utilities and they don't need any more renewables for a number of years; and also the rooftop PV industry in NSW seems to have come to a complete stop. Is that target by 2020 at all realistic and how?

TONY: It largely depends upon in the renewable energy target space to the same comment I made in relation to the broader climate change space and that is to what extent the governments want this to happen. The renewable energy target is designed to say "we will meet this target and the market will work out what the price has to be". In theory, the price should rise in line with the marginal cost of the next technology that will meet the target. Companies who have the liability – the major retailers – should be looking forward to how they're going to buy those. There are two alternatives: one is the renewable energy does get built and we meet the target; whatever the price turns out to be. Or the price starts going up for reasons you just mentioned – the cost of the next technology (if it's not wind it starts to get pretty expensive) - and the price starts going up. That flows through to electricity prices, people get very uncomfortable and then we squib on the target. But my simple answer, in terms of the mechanics of this, is that if governments stick to that target the price will rise and rise and it will cause the investment we need. There are some elements of the renewable energy targets that are a cliff face, but it has been a very effective programme in doing what it was designed to do. In some ways not what the designers intended, but it's been very effective. If we stick to that, from my understanding, it should still effectively produce the investment we need, even though we have some of the challenges you mentioned. I think the game is still there. But it could get nasty! I'd be more concerned about it getting nasty in a price sense than nasty in a "can we meet the target" sense, unless government is (unclear).

AUDIENCE: Ben Windsor. The Clean Energy Finance Corporation and Arena – are they the sorts of direct-action things you're talking about? If not, what's wrong with them?

TONY: They may be. What we did in the report is we've taken a diagnostic. We said we think there's a problem that many people haven't confessed to, and this is the nature of the problem. This is why it's occurring and this is where governments need to think about intervening to address this problem. We're going to be doing a separate piece of work so in some ways we're going to fudge the answer to the question but it's like a separate piece of work to say "How should governments intervene?".

If you look at the things you just mentioned – Arena and CFC - Arena potentially could be. But Arena, in some ways, is hoovering up a whole lot of other programmes. For example, with Round-1 of the Solar Flagships money: if it doesn't get spent in Round-1 it will get transferred into Arena, as far as I'm aware. So Arena has got a fair bit of money to play with. It depends on what it does with it. I'd be very confident that given what's happened with Solar Flagships that Arena wouldn't do the same thing again. How does it do that? Potentially Arena's more the R&D end of the spectrum. Clean Energy Finance Corporation is a much more interesting beast in a way. I'm pretty sure that Jillian Broadband and her team have been appointed to set this up are being bombarded with people who are giving them all sorts of advice as to what they should and shouldn't do with the \$10 billion fund. My only worry is it looks like a solution looking for a problem (to some extent). The intention is not to compete with the private sector. The intention is to try and use that fund to do things that the private sector might struggle with. For example, it might be that creating a liquid market in green energy bonds might be a good idea. They

could just be a buyer and seller and create the market and get out. That could be a good thing to do. Some people suggest they should just lend money to projects at the government's borrowing rate. Well that's just competing with the private sector, that's not adding anything to the equation. So it's an interesting challenge. And their job is to report back to government next month as to how they're approaching that problem. I'm more optimistic that maybe they will be part of the policy mix that gets it right.

AUDIENCE: ??(unclear) University of NSW, First of all, Tony, I'd like to congratulate you and team that have worked on the report. I think it's a really excellent piece of work and it will be a very useful resource for years to come. And I hope that you'll find the opportunity to update it regularly as well. The question I'd like to ask really relates to a lot of the discussion today and a point you allude to in the report: I think what we're seeing in all countries is a problem of policy complexity – each of these technologies has different policy requirements behind them. The ideal of having a level playing field is very hard to produce because different technologies need different policies. So how might we lift the way in which we produce policy here in Australia to deal with the complexity of the problem, and also deal with the problem that we might create imbalances between the technologies through the policies that we create?

TONY: We've got an incredibly complex set of policies already and in addition to that, one of the points we make in the report is that we've got an incredible range of subsidies (some we know about and some we don't know about) that are embedded in all sorts of things: the tax systems, credits for exploration and production for gas, oil and coal, mining... a whole range of things. Every time you subsidise one thing, it becomes a barrier to something else that would otherwise have got up. You could be somewhat trite and say "get rid of all that" but that's not going to happen. So how do you address that in a sensible way, let alone some of the specific policies that we have, which are there to address climate change. We said ourselves that we're still unclear about whether or not some of those existing mechanisms, like the renewable energy target or like Arena and the CFC, ideally are part of the mix. But if you conclude that they should not be, even unwinding those or moving back from them is tricky because in many cases companies have invested in technologies on the basis of that policy. To simply abandon it is completely inappropriate. So if you decide one of those instruments is no longer relevant, not only will you have screams from those who would have been benefiting from it, but you'd also have a real sovereign risk problem. You've got to ask are there investment contracts that you've got to unwind? Or would you not unwind but let play out. What's the core of this?

I'd say there are two things you'd have to do. You'd start at the beginning. And the emissions trading scheme is front and centre as far as we're concerned. What won't this do and what would you do about addressing those fundamental market failures or barriers? The market failure issue we've talked about a lot already: there are some barriers that governments have to directly address in respect of certain technologies. For example, this is not a comment about good or bad or pro or against coal or gas. This is a comment about the way reality emerges. Most of our regulatory structure has been very well designed around our existing physical structure. If we start producing a lot of energy that is not close to the current grid, it could become problematic. What do you do about that? What do you do about the subsidies, and so forth?

There are things that you have to start to do to create this level playing field. In addition to that, you will have to go back and look at some of the subsidies that exist. Remember you've got to do all of them – not just the ones that favour the incumbent technologies. There are also those that we've already put in place that may need to be restructured around some of the new technologies. You've got to start with the renewable energy trading scheme. Look at the market failures and gradually put that together. Secondly, you ask how politically feasible these things are, because having the perfect theoretical model that isn't able to be implemented because of political constraint isn't much good either. In the Australian context, with our tax system, with our existing regulatory structure, the physical structure – what do we do? We're not going to produce nuclear energy and then import it all from New Zealand because it doesn't seem possible at the moment. But some countries in Europe do that. So we've got to do both: have a robust theoretical model, but also a robust practical model. We're going to be working on this.

We know many people have come to the conclusion that, for the reasons we've discussed already this evening, the emissions trading scheme isn't enough. It's a bit harder to see what happens next because, as Andrew implied in some of his questions, there are some significantly difficult trade-offs here. On the one hand, we could leave it to the market. Well the market isn't going to deliver. On the other hand, just pick the winner? Well picking winners doesn't work either. So getting the balance right is going to be a challenge in terms of good policy design. Don't pretend that's easy. We're going to get into a lot of discussion ourselves with both governments and market participants in this country before we get anywhere near going public on what we think might be the appropriate way forward.

AUDIENCE: Stuart Bolton, BZE: One thing that puzzles me about CCS is the question of insurance. How do you insure a repository in perpetuity against leaks or a background of future unknown carbon price? And in particular, isn't there a great danger that a government seeking to support this technology will legislate a liability cap (as has been done with nuclear all over the world), thereby creating a subsidy of unknown magnitude for one particular technology.

TONY: A couple of things: one is physical and one is more to do with policy. The physical one is that CO₂, when it's injected into these geological structures doesn't remain liquid CO₂ forever. It mineralises over time. And there are lots of people who are developing technologies that they believe will hasten that process and even produce useable materials from CO₂. For those of you who remember high school chemistry, you can turn CO₂ into CO₃ and make some solid materials. And in the long term the CO₂ gets more secure rather than less. The second thing is that there is clearly a liability being created. So who carries that liability? You very quickly come to the conclusion that the government ends up carrying that liability. So the implications of that are very important for policy and I think it needs to be aired and discussed. It's no different to other long term liabilities that governments take on our behalf. But understanding what we're doing there, in a very visible way, is critically important.

There are parts of the world now where they've been sequestering CO₂ for many years already and they know where the CO₂ is going, what it's doing, they can track it quite easily and be confident that there is no leakage. But geological structures are tricky beasts. There is still a lot of work to be done. You don't want to find that you've got an uncoded liability in the future. Ensuring that you've got a robust regime around that is part of the regulatory policy structure that has to be in place for CCS.

ANDREW: Last question please?

AUDIENCE: John Bleakwell, Blue Global – Hi Tony, looking internationally, in a post-Kyoto world and considering the impact on Australia, it seems that multi-lateral, broad action on countries de-carbonising using whatever mechanisms available, is still somewhat into the future. In that context, does Australia taking unilateral action to de-carbonise over the foreseeable future mean de-industrialisation for Australia?

TONY: One word that we might take exception to (though not personally) is "unilateral". The Koreans are about to introduce an emissions trading scheme, the Chinese are. I'm not sure where the Japanese have finally got to with their scheme, the Canadians are looking at it again, and Mexico is looking at it. Ours is a more comprehensive programme than other countries. The European scheme is much narrower. What does this mean in terms of this global trading regime? If there's not going to be a global one, then are we going to see a whole lot of bi-lateral and multi-lateral trading arrangements in place? Would Australia link with the European scheme? Would we link with a Korean or a Chinese scheme, and if so, where would our prices go? I think that's what Minister Combet said when he went to Durban, South Africa in December: his primary focus was to get some of these multilateral trading mechanisms in place. Whether that's done through links to schemes similar to ours or whether it's through the Kyoto arrangement called the Clean Development Mechanism, I guess remains to be seen.

Given what Andrew said before about people's assumptions relative to the acquittal of international permits against our domestic scheme, that becomes a really important aspect, not so much for reducing our emissions target, but how much is it going to cost? And the last point I'd make on that is the role of the Productivity Commission in the way it provides assistance to

countries to avoid what's called carbon leakage (we published a separate report on that last year). What we want to ensure doesn't happen is that we just export the emissions somewhere else.

The big topic of the week has been around aluminium. Now if aluminium goes to the Congo and produces electricity where electricity may have been produced from hydro, you could argue that it's not carbon leakage because the emissions aren't being produced. But if steel manufacturing goes to a country that is not imposing any form of carbon constraint and the emissions go up, that is a problem. So the role of the Productivity Commission as part of the core governance structure associated with the legislation, is front and centre, to avoid exactly the sort of problem that you're talking about – that we have no environmental benefit but we have a horribly negative outcome. And that would be the wrong outcome completely from where we want to be.

ANDREW: Tony, congratulations on the report. It's received a lot of attention and deservedly so. Thanks very much for sharing your time with us.

AUDIO: This has been a podcast from Grattan Institute. Want to hear more? Check out our website, www.grattan.edu.au.

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