

Planning for low-carbon development: the twin challenge of poverty eradication and emissions reductions

In developing countries, where most of the world's population lives, the daunting challenge for governments and policy makers is to reduce both poverty and greenhouse gas emissions. Professor Harald Winkler from the University of Cape Town's Energy Research Centre offered his perspective on how this challenge might be tackled in South Africa, a country that, like Australia, has a heavy dependence on coal-based electricity generation. Prof Winkler argues that taking more ambitious action to reduce emissions can result in socio-economic advantages, or 'co-benefits', which should be considered primary rather than secondary benefits.

Speaker: Prof Harald Winkler – University of Cape Town, Energy Research Centre
Chair: David Green – Chief Executive, Clean Energy Council
Panel: Tony Wood – Energy Program Director, Grattan Institute
Dr Malte Meinshausen – Honorary Senior Fellow, School of Earth Sciences, University of Melbourne (Potsdam Institute of Climate Impact Research)

AUDIO: This is a podcast from [Grattan Institute](#).

SUSANNAH: I would like to acknowledge the traditional owners of the land, the Wurundjeri people, of Elders past and present on which this meeting takes place. Welcome to the University of Melbourne and the first Energy Futures seminar for 2013. I'm Susannah Powell, I manage the Energy Institute. For the new faces here, this series is a partnership between [Grattan Institute](#) and the [Melbourne Energy Institute](#). Tonight we are delighted to be joined by the [Department of Climate Change and Energy Efficiency](#). We hope you enjoy the seminar and that you can join us for our next seminar in April. It will have more of a domestic focus looking at Australia's energy market and network investment issues. This event will be held in Sydney so if you can't make it to Sydney, please watch it online. We will be streaming it.

It is now my pleasure to introduce David Green, the CEO of the Clean Energy Council, who'll be chairing tonight's events. David is very experienced in sustainable energy with numerous advisory roles in government and business. He is an executive director of the International Council for Sustainable Energy and was the founding chief executive of UK Business Council for Sustainable Energy. We are very lucky to have you here tonight, David, thank you.

DAVID: Thank you very much. Can I add to the organisers, welcome to you all this evening, both on behalf of the organisers, the Department of Climate Change and Energy Efficiency here in Australia and also obviously to all the other people representing various organisations here. I'm actually delighted that we've got this really interesting seminar to kick off the season, as it were. It's from a country, and a field, that many of us have had quite an interest in for many years, trying to think about the balances between how do you develop an economy into an advanced industrial nation, how do you balance that with decarbonisation, and how do you take into account the need to lift many millions of people across Africa, but particularly in this context in South Africa, out of poverty? How do you increase the access to the social welfare that good electricity supply, good energy supply can bring to households?

What it doesn't say on my CV is I had the honour of being a member 12 years ago of the UK government's delegation to the World Summit on Sustainable Development. I spent a very surreal week in what I describe as an armed camp in Johannesburg as they protected us all from whatever while we debated the world's problems on sustainable development. One thing that really came home to me there, we were having this very intense debate about the minutiae of the text, where the commas should go, what it really meant when we said something, how far the American delegation would agree to something, etc., and then within a few kilometres of that site there were people who had absolutely no electricity whatsoever. There have been a number of people thinking since that time about developments of how you can empower economic

development through bringing solar access to remote communities, people can charge up their mobile phones and engage in trading of their agricultural products, a lot of interesting developments taking place in South Africa. I think the speech tonight is on an incredibly relevant subject, that is, how do you plan for low carbon development and meet the twin challenges of poverty eradication and emissions reductions?

It's an issue not only in a developing country like South Africa, but it's an issue across the world, how do you actually decarbonise without putting undue costs on consumers which will inevitably be an additional burden on poor and vulnerable households, and indeed businesses, particularly if they're trade exposed or if they're low income households who very often don't have the choices of building or energy supply that are available to many of the rest of us, particularly if they live in remote rural areas, and in Australia the main source of supply is probably a diesel system. These are very real issues not only in South Africa, but with much broader policy implications across the world.

Once we've heard Professor Winkler's presentation, we will have a panel discussion which Professor Winkler will join. Tony Wood will be joining us as well. Many of you probably know Tony. When I first met Tony many years ago he worked for Origin. I was actually working in the field of developing co-generation at the time, so we had quite a lot of contact. Then more recently he's been working with the Clinton Foundation, and is now with Grattan Institute.

I'm also delighted that we're able to be joined by Dr Malte Meinshausen who's an honorary Senior Fellow at the Potsdam Institute for Climate Impact Research and also here at the University of Melbourne. I know, having had the opportunity on other occasions to talk with him, he brings an immense amount of experience, both academically and practically, to this field. So I'm sure we're in for a very interesting discussion.

HARALD: Thank you very much for that introduction and for the warm welcome. It's really a pleasure to be here and thanks also to the Department for inviting me here. It's been a very interesting first few days. I really want to talk to you today about planning for low carbon development. I'm particularly going to focus on coal and renewable energy in South Africa and the co-benefits of that. Because the challenge of moving away, both in energy policy terms in South Africa and in terms of climate policy, really is going to entail a move away from coal.

But before digging into that, as I was coming here I was asking myself how do South Africa and Australia really compare? I hope you can see that while your population is a little bit less than half of ours, your GDP is not quite double. You'll have very quickly calculated that income is about three and a half times on a power purchasing parity basis of the average Australian. Certainly the problems that we're talking about apply across the world, and I'm very interested how these problems apply in Australia. But I think a key difference is that South Africa has a very high degree of inequality represented by a Gini coefficient of 63 and a much lower human development index.

In terms of greenhouse gas emissions, you can't really compare these numbers. I really shouldn't put them up here as they're my cheat sheet that I'm sharing with you. Because they're not in the same years, our best estimate is that in 2010, we are at about 510 megatons: so fairly comparable just counting three gases. Our emissions projections are higher than yours. Of course we know that projections are a matter of great uncertainty. It depends what you stick into them. We've actually published these in a white paper as well and interestingly, an upper and a lower bond has been put around these.

I don't often get to say this but Australia's per capita emissions are higher than ours. South Africa thinks of itself as a high per capita emission country, but Australia's are particularly high, given the relatively high emissions and relatively small population. But, if you look across the economy, or whether you specifically look at the carbon intensity or electricity use the emissions intensity. They are pretty comparable in a similar kind of range. Quite a lot of this is explained by the predominance of coal in the energy system. Though our share is 73 and yours is 57%, so overall it's significantly higher. One of the success stories of post-apartheid South Africa, is that

in terms of access to electricity, we've gone from about one-third in 1990 of people's access to grid electricity to the high 70 per cents. It's now closing in on 80%, but that last 20% is much harder to get to. So that's really just by way of background.

We've had a National Planning Commission for all of two years. This is not the national development plan but a diagnostic report. I'm not going to take you through all of it other than to say that really, and you'll see why I'm saying this in a moment, the key policy priorities, and they had many that they looked at across the Commission, are eliminating what's in the middle. Eliminating poverty and reducing inequality are absolutely crucial. The two elements that are in the circles here, the two ways of addressing that are really around job creation and improving education. So that's the context in which I'm going to address the issue of how we look at two of our big energy resources, from coal and renewable energy in South Africa. I'm going to give you a little bit of national context and a little bit of global context. That top one is supposed to show you coal and I've already mentioned that number of 73% of primary energy. We've also used coal to produce about 30% of our liquid fuel. The rest is in the refineries that input oil, but we take oil and through a Fischer-Tropsch process, turn it into liquid fuel, a highly emissions intensive process of a single facility generating 71 megatons of CO₂ each year. And 93% of our electricity comes from coal. So we have a highly coal dependent economy.

Comparatively, South Africa has a particularly high share of coal of total primary energy supply, as does Australia, so we really are amongst those countries together with China, and to a lesser extent India. We have these very high components. Comparing South Africa and Australia both in terms of production and exports, you can see the numbers there. Coal is pretty dirty stuff overall, but in our situation a lot of what happens is that we keep the really nasty low calorific value, high ash content stuff, 20 megajoules per kilogram on average, and we export some of the hard coal. We export significantly less and you can see the statistics there. What's really changing in South Africa is what we do with this coal. I couldn't unfortunately find a more recent one, but the really big change, and I think I highlighted this, that is 2007. That arrow over there, what's going over to the east, and I think particularly to India, I don't know this data particularly well, but I certainly know that that would be a significantly larger arrow these days. To the extent that just recently, Eskom a national utility, persuaded government to declare coal a strategic resource, in other words don't send all of it to India. That is actually my interpretation, I'm sure that's not an official interpretation.

Richards Bay is our main export terminal built for coal, and the real thing that I want to point out here is the downward trend in the top line which is Europe, and the upward trend in Asia. This was only up until 2008 I think, again if I found more recent data you would see that gap probably narrowing. So there are important changes happening in that regard and that's a little bit of background in terms of coal.

Renewables, the story will be rather different. The main reason being that we have had almost none in South Africa; a few wind turbines here and there, but it has changed. So I start with studies, some of my colleagues looked at the questions that often get asked. If we're going to use renewables for mitigation what is it going to cost? They costed in this particular case a target of 15% of renewable energy. Interesting question: what exactly does 15% mean? I understand that's an issue in Australia. In this case it was just a study. They found that in fact the electricity costs are slightly higher, the same number than the base line, but that is in the context of doubling of electricity prices, and I'll show you more of that due to a bold program. If you combine renewables with efficiency, the average electricity costs are actually lower than baseline, so how you combine policies is obviously a really important thing and then you can also add carbon finance to the same and you can see the number on the slide there. Really importantly in terms of the way in which different policy interventions are combined, mitigation costs can turn from added costs, and a Rand is roughly nine Australian dollars. You can do the conversions from positive costs to negative costs. That's significant. I'm not going to go into other cost parameters that were used in that study but really what I want to say is that the key policy question that gets asked in this context is what are the co-benefits? Does it deliver access for everybody but in particular to the poor? Quite a range of work that has been done in South Africa suggests that there are really critical benefits.

The really top one, as I tried to explain in one of those early slides, is around job creation. If you ask a policy maker in South Africa what the top priorities are, it will be jobs, jobs and jobs. That's not necessarily different to Australia, as I'm hearing. We have an official unemployment rate of 25%, and unofficially it's much more likely to be 40%. So it's hard to over-emphasise how high a priority this is. We spend a lot of time trying to understand our different interventions in our political economy, in a society at large, and what it will do for employment and job creation.

The relative water uses of different kinds of energy technologies are important. It's not necessarily unique that renewables use less water. There's been a lot of effort in coal-fired electricity generation to move from originally wet core to the cooling towers that I showed you, having dry cool coal-fired power station, there's an energy penalty about one percentage point, our subcritical pulverised fuel power stations that have gotten to 34.5% efficiency and it's not going up from that. If you're dry core they're about 33.5%, and that is what is largely being built. As I will show you in some other slides, key considerations of the benefits are about how local communities participate, how much local content there is has a direct relationship back to the issue of job creation. And in fact who owns, controls and manages these technologies. And those can be quite different.

As I said earlier, we had virtually no renewables and a few years ago, the Department of Energy introduced a feed-in-tariff with pretty high guaranteed returns to investors. In particular, I remember the number for concentrating solar power. It stuck in my head because when the first design came up they said they would pay 90 South African cents per kilowatt hour. There are a whole lot of tariffs in South Africa but roughly you were talking about an average, if there is such a thing, around 45 cents. So it was already high. The actual tariff offered was very high: 220 cents, 220 per kilowatt hour. The really surprising result for me as an energy researcher was virtually no uptake. The key barrier being power purchase agreement and standard contracts with Eskom in the vertically integrated monopoly and large monopoly it is. There is this a little bit of other power generation but Eskom certainly controls the wires and is not very interested in giving contracts to others. What really changed is that government decided to actually procure renewable energy from independent power producers. The political policy decision that Eskom would not build renewables is something I actually don't particularly agree with. An implication of this is that it would be private sector, which means not Eskom as it is 100% publicly owned. And so there are five rounds adding up to a total of 3,725 megawatts. And crucially also this was going to be run institutionally, not by the Department of Energy, but together with Treasury. And I think the procurement unit in Treasury had made a big difference.

In the first round there were quite a few bids but actually there wasn't a conclusion to this but there was a conclusion to the second round. What's in the yellow and red over there is really crucial. There were 47 projects selected in July 2012. Financial closure was reached on 28 of those. And 1400 megawatts is at least two orders of magnitude bigger than we've had in the past of renewable energy. So, a large investment by South African standards of 47 billion Rand, roughly 9 billion Australian dollars, and the context of a build program that's going to spend 500 billion Rand over the next five years mainly on coal-fired plant. Given that we have 93% coal and virtually zero renewables, this is a significant change. What's also been very interesting to watch, and this is a slide I got from some of my colleagues who are looking at precisely this, and the next slide will show how these co-benefits that I've outlined in this procurement program have given real content to them. They've studied and said okay, so what does it mean to have job creation. And we'll just pick on that one given the emphasis.

They're looking at the number of citizens from local communities that have been employed, and what percentage of those within the range that you see there of the total number are South African based employees. Now you can argue with that metric. But the point really being, and I'm going to flip between slides here if I can a little bit, is that this template that you can't really read is really in the procurement program, the IPPs are complaining because they have to produce volumes of things, they have to fill out on job creation, local content ownership – there's a description, there's measurement, there's a threshold over which you don't get into the next round, in other words you won't become a preferred bidder, and this needs to be completed not only for job creation, as I pointed out, but also ownership, also to what extent is this creating

enterprises. It is certainly something that we haven't seen before in South Africa. On the 19th of December last year, the government issued a Gazette. They seem to pick December and around about Christmas time when nobody's paying attention to issue some of these determinations, because I only discovered this when we came back from leave. There's now also going to be a base load IPP program. And the question that many of us in the research community are asking are these same socioeconomic indicators that are really aimed at addressing these key policy priorities of eliminating poverty and reducing inequality going to be applied equally across the board? I hope they will be. There's no reason to believe they shouldn't be if it's also an IPP program, but they haven't been applied in the way things were done previously. So this is quite a significant change.

The co-benefits of coal are usually articulated in economic terms, how much is produced, how much is exported. One can probably add to that the amount of foreign exchange earned and what that production looks like. Of course there is employment in the coal industry as well. Historically we've seen from coal mining through to electricity generation and coal to liquids, declining numbers of people employed overall. When we do economy wide modelling trying to understand if you shift it from the situation of putting most of your investment into new coal-fired powers, and the way that requires you obviously to buy coal, to buy a whole range of inputs that will build that coal-fired power plant that clearly differs from building a wind farm or concentrating solar power. If you put that into an economy wide model that basically incorporates in its matrix the forward and backwards linkages through the economy, we see clearly how employment multiplies for pretty much the full range of renewables that are relevant to South Africa, which are really wind and solar, different solar technologies. So they're the job numbers, the direct contribution to GDP and with the forward and backward linkages, 3% indirect.

So how has this been put together in South Africa? The preface that I need to give here, having learnt a little bit about Australia, is that our electricity planning is a national central process, we have an integrated resource plan, so called IRP, that is put together formally by the Department of Energy but with strong participation by Eskom and a range of stakeholders. What really changed from this last IRP, it was called the IRP 2010 even though it actually came out in 2011, is that it moved from its analytical base, previous IRPs were based on one criterion, least cost, and the models that were used were least cost optimising models. And so you had a demand projection and then the model would tell you this is the least cost mix of plants to build. Then of course the model results are not the plan. Government then uses that information to have discussions and make some decisions. The point I make is the criterion was one. We've clearly gone to not multiple, that's an error there, in this type of multiple criteria decision making. So clearly not only access to electricity but also the affordability of that access is a key social issue. Cost always remains an issue. But externalities are critically carbon, by far the biggest externality in our electricity sector, has been integrated so that you certainly need to ensure security of supply. You need to provide access to energy and services create those jobs, and achieve the emissions targets that South Africa committed to in Copenhagen which were that our emissions would produce 34% against the business as usual projection by 2020.

Before I come back to some of those emissions implications I want to show you some of the demand for cost, because if you thought that from the previous slide that all is hunky-dory in the IRP process, that's not my view. Demand projections, any projections really depend on what you assume goes into them. What is really striking in this was a report before the final plan. Really the demand is driven by aluminium, iron and steel and ferrochrome. Energy intensive industries that clearly made sure that in the projection of this demand there are a lot of questions where the best demand projection is too high, which of course has a huge effect. We have seen this in South Africa not only in modelling terms, but we've seen it in very real terms. During the 1970s and '80s we massively over-built power stations. We had, by 1990, a 40% reserve margin, had 40% more to the extent that we actually mothballed coal-fired power stations, three of them. We managed to get ourselves down to a reserve margin that was so tight that we've actually had outages. Both the over-investment and the under-investment are hugely expensive to the economy. So getting these demand projections right, and in fact how you meet those demands, whether in big increments, we are right now building a four and a half

thousand megawatt size coal-fired power plant. If you were to build wind farms within individual turbines at a couple of megawatts a time, then there are big differences in this regard as well.

Certainly the final IRP case that was chosen is called the policy adjusted case. The critical line isn't really on here but I think you'll see it in the next slide. You need to imagine a line around 275 megatons of CO₂. South Africa's political decision was that our emissions would peak plateau at 550 megatons. And so the electricity planning too, and said we will take 50% of that. Now whether it should be 50 or not, some other major which is in South Africa might have something to say about. But take 50, it does mean that in much of the modelling that was done for the IRP, a limit of 275 megatons was assumed to be improved and the policy adjusted case gets there not in 2020 but slightly later. And it can actually achieve the 42% reduction by 2025, at least as far as Eskom is concerned they think the earlier reduction of 34% is actually the more difficult one even though the number is lower.

This is a slide that I really found fascinating and there are a couple of things about it. Our electricity price has been somewhere around 40 cents per kilowatt hour, as said, the actual tariffs, but a long run margin of cost kind of calculation would give you that. With the build program that we're entering, we're coming to a phase where many of our mostly coal-fired plants are getting really old. With that large build program our electricity price, whichever scenario you take, any of these lines, will more than double from 40 to 100 cents or one Rand per kilowatt hour. You can see here what I was saying before, these were emissions cases, one, two and three, and a carbon tax case. So integrated into the modelling is something we never saw before. You might have seen a sensitivity analysis on carbon. Apart from one that brought in a carbon constraint really unrealistically which really did drive up the price, you can see that our electricity price is going to rise not due primarily to carbon. So the additional cost of doing emissions one and emissions two, you can hardly spot the difference. It's not that there isn't an incremental cost, there is. But compared to the price rise and that goes two ways. The message that I tell from that is the one in the headline. So the electricity price is going to rise not due to carbon.

The question that's been asked in South Africa as well, if the electricity price is going to rise that much anyway, do we still need a carbon price? That's the other way of thinking about it. In terms of the demand response, that is a legitimate question. Just to give you a sense of the scale here of what this might mean in terms of existing and planned coal plants, these numbers are deliberately general, but they're not without thinking. In terms of the trajectory that the South African Cabinet actually set out in 2008, and that's in our national policy, the area below that peak plateau and decline curve, you have to take the middle between the upper and the lower band, which is roughly 19 gigatons of CO₂ over that period. Now that isn't in our policy, that number, but the calculation is simple. So 20 is 19, 20, what's a gigaton between friends, is roughly what South Africa gets from its own target. If we take a global carbon budget, citing 9000 at 2009, and 1440 gigatons of CO₂ over the first half of this century which accepts roughly 50% probability of exceeding two degrees. If we take that and we allocate it on a per capita basis, remember we are South African, not Australian, right, we get something like, according to our Chinese and Indian colleagues, six or seven gigatons of CO₂ allocated to South Africa under those schemes. What you can see is that even under these lines would be basically the resulting trajectories that you would need to follow. This is the end of life of existing coal-fired power plants. These are planned power plants that we're already building. Under some of the allocations we're certainly on a moral, philosophical basis, I can't argue with per capita and equity principle, I think it's fair. But if you actually accepted a line like this, you would have to actually take this, a large part of existing power plant out of operation. That's the implication. That's not something that I think in the political economy of South Africa is likely to happen.

Here is the last slide and my concluding remarks. From the previous slide, it is going to take significant effort to reduce South Africa's emissions in terms of our Copenhagen pledge under our business as usual projection of emissions, our per capita emissions actually would increase significantly to be more like 25 or 27 tons per capita. To actually get them down, the electricity sector is going to be key, which is why I focused on coal and renewables, those two energy resources are both extremely large in South Africa. Both are available in the long term – long

term by human standards. I'm very interested and I hope we can discuss how this might play out in South Africa because we use and export significant amounts of coal and we have significant sources of renewable energy.

For us in South Africa really shifting away from coal is a major part of the transition to low carbon development. We really can't do it without making that move. But we have to achieve it at the same time as eliminating poverty and reducing inequality. The approach that we try to take, both in the research work that we do and I think in the approach that is taken in our international negotiations, is to start from developmental considerations to address mitigation. That's why these considerations of how we assess not just the economic costs, not just the financial costs, but the broader social costs and the broader social benefits in terms of employment creation, jobs, water, all of those I mentioned and I won't read out again. It's really for us a full consideration of what is needed to actually achieve something that will work in our system. At least the electricity plan has started to balance these considerations at our economic, social and environmental level. I'll leave it there. Thank you very much.

DAVID: Thank you very much indeed for a fascinating presentation. I can see why our colleagues in Canberra thought it was a good idea to get you over because there's a lot of resonance and similarities with some of the challenges that Australia is facing, particularly when you look at the balance between what you can earn by your exports, the implications of that for domestic prices, if you want domestic use, is it coal, is it gas, where are you going to earn your money from overseas and how does that balance with how you're going to use your renewable assets. Also I think it's fascinating the way in which your government was using renewables as it were to bring in new entrants to the market, and that play off as well on price, where the demands had a really important role to play. I think there are some very fertile areas there. Before we open up for discussion perhaps I could just invite our panellists to make a few remarks. Tony, would you like to kick off?

TONY: I guess there are some areas and lead tables that you don't necessarily want to be the top of. Australia is at the top of a couple of those, and South Africa is not. I don't suggest you join us at the top, by the way.

One of the things about this, of course, is that the number of per capita matters in some of this stuff. If you think about what's happening in Australia where we have a growing population relative to some parts of the world where they don't, the international debate tends to be going towards more about absolute emissions. We have a very strong interest in having the per capita debate because we're going to have more capita. We think we'll end up with a better outcome internationally. So that's an issue where we probably have some similarities.

We also have, and David referred to it if only obliquely, this poverty eradication question. There are a lot of people in this country who don't have access to electricity and what they do is very poor quality, it's often provided by diesel and it's expensive. The way we respond to that in our Indigenous communities is going to be one of the tests for us. We also, in Australia, have a lot of proximity to the small island developing nations in the Pacific who have a similar challenge and they are the canary in the coal mine in respect to the greenhouse gas emissions in climate change because they're the ones who are seeing rising sea levels. How we respond to that is going to be one of our challenges and maybe you don't have that challenge.

Coming to the things where we might have some common issues and questions, you mentioned 220 South African cents as a feed-in tariff. We had – if I'm right the Rand's about 11 Australian cents, you convert that, 220 is about 24 cents Australian per kilowatt hour – feed-in tariffs in this country with three and four times that. We did get a response. Many people in this country, if they didn't put solar PV on their roofs, missed a wonderful opportunity to make a lot of money for a little while. Now unfortunately government's walking away from those policies and I want to come back to that in raising maybe somewhat provocatively, a couple of questions. I think the feed-in tariff's a good idea. The second question relates to a debate which is happening in Australia, maybe similar to your debate about coal, and that is what's called the domestic gas reservation policy. Those of us in this room from Australia who managed to relax over the

holidays might not have been following this debate, but it is hotting up. The argument is following what's going on in the United States, which is, we've got all this gas, we should keep it for ourselves, we should add value to this gas and see the renaissance of manufacturing in this country. From what you were saying about coal, the same argument seems to be applying. In your view, is that sort of policy a good way to think about the use of the resource?

The third one is much more, for me, directly related to the centre issue about the way in which we make this transition, because in Australia we have a combination of policies which don't necessarily work together all that well. We've got an emissions trading scheme, at least we have for some little while yet, and we have a renewable energy target. I'm interested in the point you made about a 15% renewable energy target. Would a renewable energy target in South Africa make sense as part of your policy mix? I think you are introducing a carbon tax, and I wondered how you would make those work together. We have a challenge in this country of how we make our renewable energy target and our emissions trading scheme work together. That would be my initial thoughts.

DAVID: Please, Malte, do come in.

MALTE: The basic question is, is there a balance between poverty eradication and climate change mitigation? Or are there at least some problems that we can't meet together? In the very long term it's very easy. Climate change is going to hit the poorest who can't protect themselves the hardest. So the climate change mitigation and protection of the poor goes hand in hand. In the near term, the question is do we have trade-offs? You outlined some of the issues like how job intensive renewable energies are compared to coal, and there's a benefit of going more into renewable energies. This might be similarly important for Australia and South Africa. Australia moving more to manufacturing rather than the resource based industry in terms of coal. In lifting that from the national level to the international level, you indicated that South Africa has a problem with, for example, the per capital approach of the basic group because South Africa's emissions are already pretty high. Of course my implication is that Australia will have even more of an issue with per capita emissions. In the real world where we won't have trillion dollar transfer payments neither from South Africa to other countries, nor from the developed world to other countries, to compensate that imbalance in per capita emissions, how are we going to move forward? How do we have a coalition of the willing, of those countries who want to move forward and have the equity in mind but have the equity not as a stumbling block for progress?

DAVID: There's some challenging initial thoughts there. Do you want to respond at all at this stage, or would you like time to mull it over? Well let's open up to the audience for questions.

AUDIENCE: Hi, Harald. I really enjoyed your presentation. My name's Monica Sada, I'm from the Economic Student Society of Australia. I was really interested in your comment when you said that the IPP was now going to look at renewables for base load energy. You'd be aware that in Australia for various reasons renewables is still very much a supplementary energy. So two questions, at what scale do you envisage base load? Is that potentially a capacity that will limit the ability for those communities to have future investment from energy intensive industries? My second question is in order for it to be base load, do you have step change, technology that's going to provide renewable energies for everyone, at scale. Do you think that economic forecasting ignores the possibility of such a step change technology? For example you said mineral commodities is maybe grossly overestimated. Do you think that that's a problem in the way that economics approaches the issue?

HARALD: Let me clarify. The base load IPP program is a separate program to the renewable one that I described in some detail there. It was recently announced that it will be coal and gas. I'm not quite sure where the gas will come from precisely, that's a big question and I think the interesting question is about reservation that Tony has raised. The other quick think I want to add in relation to your question, there was a lot of consideration particularly of concentrating solar thermal with storage. Without storage the assumptions and the modelling were you had capacity factors in the 30%, maybe 30%, with storage 60%. It becomes a different kind of plant actually in the mix. Maybe not quite base load but certainly with merit. That's important. What

was really surprising to me was that right in the end of that planning process I would have always assumed that in so far as solar comes in, and our biggest renewable resource by far is solar, in fact our biggest energy resource by far is solar, but it would be CSP, concentrating solar thermal with storage. But a lot was put into photovoltaics right at the end and really on the basis of assuming that, on reports, that costs of PV were coming down significantly faster than expected. Now whether that's a real breakthrough and the kind of breakthrough we really need is yet another question, but I have no crystal ball to answer that one. So I think I'll leave it there.

TONY: On the question about base load versus peak. One way to think about it is don't use those terms and use something else. We want energy at certain times. We want it when we demand it. The problem is that some energy sources want to give it to you when they supply it. Coal is probably the best example because coal-fired power stations run like this. One could say that if you value the energy that was available when you needed it more highly, you value the energy which was there when it wanted to turn up, then you change the dynamics of the value of the costs. What that would mean, for example, is solar and solar thermal were more likely to be available when you really needed them which is in the day time and late afternoons, you'd actually value them quite highly. You would also, by the way, at certain times value wind very lowly because it's running at three o'clock in the morning unless you want to get up or pre-set your washing machine or something, then you've got a problem. You just change the equation to think about these things differently, because I think this base load versus peak isn't necessarily the right way we should be valuing energy in the future. We should be thinking about it in the way of how we want to use energy, and then the various forms of supply should be what we need rather than us having to do what the energy wants.

AUDIENCE: Hi, my name is Chris and I'm from Perth, Western Australia. I was just enquiring on two elements of your talk. One element is what role do you think foreign aid has to redistribute where money is being spent in foreign aid in countries like South Africa? Rather than all the money going to other programs, putting instead 10 to 20% to energy, for lower carbon emissions? Two, what roles in South Africa – I know in Western Australia and Fremantle they're very passionate about making themselves carbon neutral – is there a role for councils and local regions to do the same thing? And is that happening?

HARALD: For the first part I think my short answer would be no, not in the form of foreign aid. I think South Africa's made it clear in terms of when it made this commitment in Copenhagen that some levels of support would be needed to implement this. Now, I think realistically we're not talking about the full capital expenditures, understood that that's financed from domestic sources. I do think that international climate finance to distinguish from development aid, can make differences in key places, it can bring things in that might not come in if you only looked at the South African domestic economy. Certainly I mean the situation in South Africa is different. The real loci of power at the national level in city governments provinces don't have the same kind of powers that seems to me Australian states have. Certainly cities are very active. The City of Cape Town where I live has a climate action plan. What's also quite interesting is that different cities will position themselves in terms of saying let's attract investment, what resources do we have locally? Can we build the wind industry? For example, the region around Cape Town's got good wind resources. There is potential and certainly there is activity in all the bigger South African cities.

AUDIENCE: My name's Alistair Mailor. I come from East Gippsland. My question is in relation to the additional social benefits from the move to renewables from coal, particularly in terms of health and safety, both in coal mining and also in the reduced emissions from power generation, not just CO₂, but the other nasties that come out of power generation. You didn't mention those in terms of benefits, and I would argue they're quite significant. Thank you.

HARALD: It's a good point and it was an omission. I mean certainly there is significant sulphur, coal is quite high, to the extent that we have some acid rain problems along the eastern, north-eastern part of South Africa, a lot of particulate matter. The local air pollution is a big issue. Most of the health problems come from indoor use of coal. In the areas where there's coal, so not in Cape Town, but further north in the country the health effects are not so much from the ambient

increase in particulate matter, although that does happen. There was a really seminal study in this regard on counting the social costs of power. Kliefen Heeren wrote it I think back in '94 and he did some environmental economics. This is a very inexact science, but I think an important one, even though the ranges of figures are large. He tried to value those impacts. The one very simple message from a complex piece of work – it was his PhD thesis – was that if you value, and you assumed at that time a very low carbon price, I can't remember what it was, but the external costs from greenhouse gas emissions far outweigh the ones of the local health effects from power stations. If you start looking at other fuel use then, as I say, things like dwelling biomass or coal indoors, that's another question. In terms of power stations, if you value the externalities in monetary terms, the big impact is by about a factor of six on greenhouse gases.

AUDIENCE: My name's Joel Kennedy and I am just an interested local. My question is with regards to fossil fuels versus renewable energies. It's been said many times that perhaps we have reached peak oil per capita at least, and that's been reflected in the price of oil and a lot of other fossil fuels. What I'm interested in is whether you can foresee that the increased price of fossil fuels coupled with increases in technology and economies of scale will see us reach at some point in the next few decades where the two prices meet and using renewable energies will actually be more economic than using fossil fuels?

TONY: One of the biggest game changers that's going on in the world, and I referred to it slightly before in relation to my comment about gas, is that the world isn't going to run out of fossil fuels any time soon. If anything, the world's reserves of fossil fuels have been upgraded dramatically in the last three or four years as a result of non-conventional oil and gas. Now there are some really nasty consequences that emerged from this interesting equation for climate change. The concept that we're about to reach peak oil and peak gas has just about been pushed back quite a lot, I suspect. In Australia we are facing an interesting question on the east coast where the gas prices may move up somewhat and that's causing the debate about domestic gas reservation policy. In other parts of the world gas prices are coming down. That has interesting implications because in the short term, it could mean a reduction in greenhouse gases of some significance for those countries that are burning coal versus gas. However in the longer term it creates a far more interesting conundrum, and that is that you've now made a transition to a fossil fuel of lower carbon intensity but it's still a fossil fuel, and what you may have done is put off a move to low, really low emission technologies for some time. This is a debate that's going to play out very intensively over the next little while, and Australia is right at the middle of this debate, because we're about to turn into the world's largest exporter of LNG and we're probably still going to stay at the top of the league table in terms of the largest couple of exporters of coal. This is really significant. That makes it a really challenging proposal to think about how you can really achieve high levels of penetration of renewable energy when you've got that sort of prospect.

DAVID: Is there a case for saying you want more renewables so you can earn more foreign currency from the exports? I'm presuming it is foreign currency that is earned from the exports that enables us all to live a very affluent lifestyle in Australia.

TONY: Well we can't export our wind energy, we can't export our solar energy, but we can export our coal and gas.

DAVID: Absolutely. So you could argue that in broad economic terms, it's probably really good being able to export your LNG, export your coal, etc, etc. It may not be good in climate terms but you could argue it's good economically. Therefore the more renewables you have in Australia, the better because you can export more to keep the Australian economy going and keep us all in nice university theatres and having great schools and hospitals. It could be a virtuous circle there.

MALTE: Harald, one of your last slides was very nice telling the whole story about what is the existing coal power plant stock, if you run that to an imaginary end of the lifetime, what are the planned new coal power plants and what would actually be the carbon budget for South Africa. We saw that South Africa has way more infrastructure than needed to bust its carbon budget to

emit more than what you would allocate. The world has at the moment that infrastructure in order to emit all the carbon that we can possibly want to emit, if not creating global warming beyond two degrees. So coming from the other side, we can't possibly want climate to warm more than two degrees or even one and a half if we talk about Pacific Island states, so somehow we can't accept that reality that just because there's infrastructure standing there, we have to run it to the end of the lifetime. We have to think about decommissioning it before the normal end of the lifetime. What does need to happen in South Africa for that to become a politically feasible option?

HARALD: Malte, I think you really articulate the problem very well because there's a clash of realities. There's the reality of climate change and, I completely agree with you, we're heading for three and a half, four degree worldwide and we don't want to contemplate that. The impacts and the damage costs of that are enormous. What we know from the Stern review is that those costs are greater than the costs of mitigation and we don't know precisely what the costs of those damages might be, but we seem to know which ones are bigger than the other ones. At the same time, turning around what you're describing, premature retirement of capital, coal-fired power plants, right, is the exact opposite of where South Africa is going right now. We're building two, four and a half thousand megawatts each coal-fired plants right now, with a World Bank loan. Three and a half billion dollars plus half a billion for renewable energy. The latter isn't really being taken up. You've got to turn around the economy and you have to persuade the South Africans, including the elite and the poor that, you're going to have to make do with less power. It's a big turnaround. While I agree with you that that's what has happened, if you really prioritise the two degree goal, those are not the top priorities of South Africa at this point. So for me it's a clash of realities. We're not there yet, and what is going to turn that around? Who knows? Maybe the climate impacts themselves? I don't know how many droughts in the Darling-Murray Basin it will take to convince Australians.

AUDIENCE: Fiona Haines, University of Melbourne. I just have a question about the politics of coal in South Africa. If you could tell us a little bit about things like the level of royalties going to government, the subsidies to coal, and the politics associated with that. What does that look like? And the politics around climate change and the carbon price itself. Perhaps you could flesh out the political context that you're trying to put these policies through.

HARALD: You clearly took up Malte's invitation to grill. That's a big question, and a good one. There are major interests in coal mining, which is a significant part of our mining sector. Eskom, which is a publicly owned company as I said earlier, and there is an energy intensive users group, the large customers of Eskom who consist of again the mines and also large smelters. Those are some of the major players that really benefit. Eskom used to pride itself on being the lowest cost producer of electricity in the world. True or not, it was extremely cheap precisely because we weren't paying for the external costs. The question of royalties that you touched on is a very important one. The ANC, the ruling party in South Africa, at the policy conference last year very firmly put on the table a document which was titled State Intervention in the Mining Sector. Essentially it is a proposal which seems now to have political support to be implemented that mines would get costs but at a reasonable return, perhaps 15% or some percentage picked. Anything above that half would go the state. That's got a fair chance of being implemented.

In terms of putting a price on carbon, I spoke about this at ANU yesterday and if you're interested in details, that presentation's going to be on their [website](#). The short version of that is that there's been a long process of discussion now at Treasury. There's been political support again in the ANC and a policy resolution to put a price on carbon. The most interesting thing really is that the Finance Minister announced in his budget speech last year that after long discussions since 2004, a carbon tax of 120 Rand, about 13 Australian dollars per ton of CO₂ with other things around it, it's not quite as simple as that, was proposed for the next financial year which starts this March. It was a proposal so whether at the end of February it is going to go through is not certain. It will be subject to further discussion and no doubt to intense further lobbying from some of the players, and also the environmental NGOs and many others involved. I think in the long run we will get a price on carbon, so whether this March or later. It

seems to me that even some of those big players like Eskom and CESO do understand that it needs to happen.

AUDIENCE: My name is Ian Mackillop. I am international student from the Philippines. My question is we know that investment in renewable energy is high, so how could it be incentivised both in general and specific terms so that renewable energy will have a strong presence in South-East Africa and other developing economies?

DAVID: So the question, incentives in developing economies for renewables, and lessons from South Africa?

HARALD: I think there was an earlier question about the costs of renewables and certainly what we're seeing in South Africa that wind, for example, is becoming pretty close to competitive with coal, which is really kind of a default, or business as usual. I think that in itself reflects that investment elsewhere, to do with new technologies drives down the unit costs. Being here I've been struck by how much PV is installed in households, it wasn't something I knew about. We look at solar water heaters in South Africa, there are huge effects from those who can afford to essentially buy down the costs of technology. That's not a direct incentive, but if, as we were talking earlier this afternoon, if somewhere, say in Australia the breakthrough to ultra low cost PV was made, well you'd find more uptake in South Africa. I don't think it has to be, as Malte said, if you do a calculation of a carbon budget and do a financial transfer, you get massive financial transfer. There's no sign of that happening in the real world.

DAVID: Thank you. Do you want to give any final reflections at this stage on the discussion points that have occurred to you?

TONY: I had one question. That is, my understanding in some ways is quite limited on South Africa, but the nuclear question, it's almost he who shall not be named in this country. For a whole range of reasons, none of which are superficial, we don't have that debate in Australia, and we are, at least for a while, going to struggle with how do we reduce our greenhouse gas emissions without either nuclear or carbon capture and storage CCS. How do you see the role for nuclear CCS as being part of South Africa's future?

HARALD: Certainly CCS is something we looked at, we being so coal dependent we have to. Let me start with this, that in terms of the urgency of the climate problem I think Malte has kind of posed very clearly, we've got to look at a range of options that in an ideal world we wouldn't look at. And CCS I would count amongst those. It has an energy penalty, for all kinds of reasons, but certainly you would start with coal to liquids. You'd start at CESS where they're already 35 megatons of concentrated, you. I think it should be tried out there to see if the technology really works and if it does, then it certainly changes that. Another positive aspect of that is if you think that's part of the solution, which I tend to agree with, at least a solution that needs to be tried in real life for beyond enhanced oil recovery. There are requirements now that new coal-fired power stations be built carbon capture ready. We're not actually doing it, but at least they should be designed in such a way that if it proves to be viable, the storage and everything else. South Africa's taken a very clear view, only geological sequestration. Nuclear, again, one of those technologies that has the nasty stuff, the radioactive waste of course. We have one existing nuclear power plant but the policy is very clearly that nuclear is part of the mix. Our electricity plan includes 9,600 megawatts of additional coming in from about 2023, quite late. I think a lot of things could happen. Interestingly, apart from all of the safety and security issues about nuclear, which are a whole topic in themselves, it is simple financial considerations. We had a so-called nuclear one. We basically couldn't, as I understood, the cost estimates when they really came in were way above what we could plan and basically South Africa couldn't get the order. So whether this actually happens, our national planning commission that I've already mentioned are asking some pretty hard financial questions about nuclear. As a matter of policy, South Africa would have no qualms, so the government would have no qualms.

DAVID: Malte, do you want to make a final point then we'll draw it to a close?

MALTE: My last question ended up in a pretty dark tunnel there when Harald basically said well, it can't be done. There's the one side, yes we see the urgency but the political reality is something different. Actually, I'm more hopeful. We have the infrastructure to burn all the carbon, and the normal life time of a coal power plant is 30 to 40 years, but the return on investment is only, I don't know, 10 years. So afterwards it's a decision whether it's profitable to drive your coal power plant further or not. And if we then have initiatives like you say, for South Africa introducing a \$30 carbon price, in Europe you need a \$40 carbon price and all the coal power plants are kind of out of the window. So we are going to have cheap technologies and we are going to have carbon prices and they are going to force premature retirement of the existing heavy carbon infrastructure stock, whether we like it or not. And this is our hope, and therefore I think in the longer term, once the dynamics kick in, I'm still hopeful for that going to happen.

DAVID: Well thank you very much. For those of you who don't follow Eurocentric politics of energy, you may all not be aware that Britain's biggest gas and electricity supplier two days ago announced they were withdrawing completely from the nuclear race in the UK, leaving it down to one French player and possibly one Chinese player, on the grounds it was going to be too expensive and too costly. Instead they're going to be developing wind farms in the North Sea, because they feel that's more secure for their shareholder base, which is an interesting story. That's probably a subject for another debate in the future. Could I ask you all to join with me in thanking not only our main speaker, but also the panel and thank you all very much for being here. And in not only thanking Professor Winkler for coming, can I also again thank the Department of Climate Change, Energy Efficiency in Canberra for bringing you over, and thank the team at the Melbourne Energy Institute and Grattan Institute for organising this evening. Thank you all very much.

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