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WILL THE COAL INDUSTRY SURVIVE TO 2050

GUEST SPEAKER - MR D COLLINS

I'm conscious that in 2007 the "C" word came up – Climate Change. We were spared it in 2008 but it came back in 2009 again and has even crept into what I'm supposed to be talking about today. I just want to assure you that I'm not going to talk about Climate Change as such. It will be a factor in what I talk about and with the coal industry being an outcome of what I talk about.

There's an elephant in the room. We all get excited about Eskom prices and about traffic and water heaters and poverty. That's what I would call Level 3 problems. Then we've got Level 2 problems like climate change and the future of coal, but we're still missing the Level 1 and the Level 1 problem I'd like to talk to you about is sustainability of civilisation as we know it. By the way, Gandhi was once asked what did he think of Western civilisation and he said it would be quite a good idea!

I was in the States a couple of months ago and picked up a very nice book by a woman called Vries?? And I'd like to read you a couple of quick things that she said: She said, "*We've made a lot of mistakes over the centuries as we've struggled to understand the nature and impact of coal and its smoke.*" She notes that: "*Some people thought that coal grew underground from seeds, or in mines guarded by demons or dragons. Some credited coal with protecting people from the plague and (now it gets more interesting) others accused it of promoting baldness, tooth decay, caustic speech and fuzzy thinking.*" I think I can believe some of that. Then she said more significantly: "*More recently many of us believed we could burn vast amounts of coal indefinitely, without disturbing the natural balance of the planet*".

Just before I start, those of you who don't know me – which is quite a lot of people, although there are people who do know me from the past – I worked as a coal preparation engineer in the late 1970's with Wally Lurie.

Can I just say before I start, my mission is to give you the overview. I'm not pushing any particular viewpoint. I'm not trying to sell solar water heaters. I'm not a rabid tree-hugger. I want to give you a condensation of what has been said out there. I'm the man in the middle and there are three sets of groupings: Exxon-Mobil for example is still denying that global warming is occurring, although they are making roads into renewable energy strangely enough. You've got people like Greenpeace who are putting out highly emotive messages about the scale of the threat. And then you've got people like BP and Shell who claim to be green – you've probably heard that BP, which used to be British Petroleum – have branded themselves as beyond petroleum and are now into sun and solar, but some people say they're now called "Back to Petroleum" because both BP and Shell have backed off their green credentials.

So with everything I say, if it's an opinion I will say so, otherwise you can take it that it's a statement of collective wisdom of what's going on out there. Could we please hold questions to the end?

So to understand the sustainability crisis, to understand that, let's go back in time a bit for a couple of minutes. 200 000 years ago we evolved in Africa. About 70 000 years ago, after a very severe drying out of the world – it's reckoned only 2000 of 5 000 people survived. The about 60 000 year ago (before present (BP)), only about 150 people moved out to colonise the world. The world was colonised by black people from Africa. Those of us who are Europeans, our skins went white to enable us to absorb Vitamin D. So all that happened during the last ice age, which ended 10 000 years ago, with more than a kilometre of ice over the top of the northern hemisphere. Africa was colder and dryer than today and we survived as hunter/gatherers. 10 000 years ago there were a million people, there are now 6 800 million people, 6.8 billion.

It's important to note that during that last ice age, temperatures were very erratic. We are now fortunate to be living in a very stable climatic period and that has facilitated the development of agriculture and civilisation. Consequently population has gone from about 1 million 10 000 years ago to about 230 million at the time of Christ; at the time of the Industrial Revolution, 900 million; and then that seminal event of the 1940's – McDonalds – 2.2 million – many of us born just after that and the population of the world is three times as many since we were born. Projections by the UN on the middle scenario, world population should go to 9.1 billion people. The highest scenario is 12 billion.

Why the explosion? First of all stable climate – very important – stable climate, reasonably warm. The second

reason was energy use. Look what happened to energy. I've expressed that in exojoules – for those of you who have forgotten, an exojoule is 10 to the 18^{th} joules – it's a standard way to express all energy these days. But look at the projection for the next forty odd years; doubling. And how? The energy came from fossil fuels. First coal, followed by oil, followed by gas. Of course that has put huge emissions of CO_2 and other gases into the air.

So civilisation as we know it is built on two pillars: stable climate and cheap energy from fossil fuel. And there are three factors that are threatening this. The first one is just the sheer number of people that's growing rapidly and those people want their share of water, energy, space, food. The second one is the depleting reserves of fossil fuels – I'm not talking about next week or next year, I'm talking about decades. And the third one is climate change and let's look at these.

The first one is population. If everyone lived like an American, we'd need five planets. If everyone lived like a South African we'd still need 1.5 planets. It just goes to show, we think we have lots of problems with poverty here and of course we do, but it's still a pretty affluent country. The world average is 1.4. So right now, we need 1.4 planet's worth of resources. That's fishing, cheap fuels – there are a whole lot of things that go into that calculation. It's not just something I've dreamt up; it is a published calculation, with a very rigorous, well-founded, scientific basis.

The world average is 1.4 at present and that number of 1.4 today is growing. In the 1960's just about all countries could meet their own demands for resources. By 2005 many countries has to import and they had to use the global atmosphere to dump their emissions. The famous example is the fishing areas off north-east Canada and Newfoundland – all just about fished out. There are a lot of examples like that.

So that was the first problem – too many people demanding too much. The second one is depleting reserves. Now if you take the BP 2008 statements of world primary energy, you'll see that 88% of the world's primary energy comes from fossil fuels. And then if you look at the reserves in terms of 2008 consumption rates – oil 42 and coal looking pretty cool at 122 and gas at 60. Now of course as consumption goes up, the number of years of reserves will drop, but then, at the same time, there will be discovery of new reserves won't there? Will there? Just to substantiate that number of 122 from BP, the World Coal Institute publishes a number of 130, so it's the same number.

You may be confused about peak oil. What's that all about? On the one hand we're hearing it's the end of cheap oil. On the other hand we're hearing squeezing more oil from the ground. The statements are actually compatible. We will be able to squeeze more from the ground at increased cost. It is the end of cheap oil. But if you ask when will conventional oil production peak – now conventional oil production means what it says; the standard wells. You're not getting into things like tar sands in Canada. Exxon Mobil will tell you no problem. These are the guys that funded organisation to deny global warming. Exxon Mobil will tell you 2050. The US Department of Energy will tell you 2037. Shell will tell you 2015. So where is it? The point is it's going to be reasonably soon that conventional oil will peak and then we'll be into much more difficult oil to extract at higher costs.

If you think of the concept of energy return and energy invested, when oil was first discovered in the late 1800's or early 1900's, to get 100 barrels out you had to expend a barrel of energy. Today that number's about 10 - and the picture is of an open cast tar/oil sands in Canada – is about 3 to 5. I don't have to tell you what that means for costs.

So there is no doubt some more reserves will be found, or resources will be turned into reserves, but at what cost to extract? Fossil fuels have got us to where we are today.

I believe - this is an opinion, but it's based on a lot of fact – history will show that fossil fuel use was just a blip. If you go back to 1000 BC and forward to 4000 AD it was just a blip. It'll be gone. Equally the emissions from burning fossil fuels – that's in gigatonnes, billions of tons – of carbon, but that blip is enough to cause global warming and climate change.

Let's talk about climate change. One thing we must understand is the difference between weather and climate. Weather is what is happening today and climate is typically averaged over 30 years if not longer. So you a hot summer's day in not necessarily climate change.

Johannesburg's climate could be described as sub-tropical, warm and sunny with mild winters. The average temperature here is 16° over the year. However, the climate can vary. The weather can vary on a daily basis. There were two days at the end of last year that went from 32° and dry to 17° and wet. So when we talk about global climate change of one or two degrees, we're not talking about the difference between one day and

another. Weather is very different from climate. Weather swings tens of degrees on a daily basis, whereas climate is about decades and about things that might only be one or two degrees.

As you know climate change has been caused by all the gasses that we're putting up there. It leads to global warming, global warming leads to climate change – unequally all over the earth – e.g. the north and south poles and Africa will warm up a bit more than on average. But the very important one that everyone misses is that it'll mean a less stable climate. The climate is not going to go up one or two degrees. It could actually go quite haywire.

This is the evidence for the CO₂ in the atmosphere and that's when the various fossil fuels were introduced. It fits like a glove. Just as a matter of interest, the greenhouse gas occurs naturally anyway. Earth is 15° on average. If we didn't have an atmosphere of greenhouse gasses it would be -18° so let's not knock the greenhouse effect, but we just don't want too much of it. It's human activities that's causing the increase in the greenhouse gasses which will raise the temperature.

I'm going to mention sceptics and denialists in a moment and if you're interested in that subject, it's important to understand this next slide. It's the causes of ice age and global warming. We've just discussed more greenhouse gasses will cause more warming. More dust could mean more cooling.

Probably the most important one is something called the Milankovitch Cycles, where the distance of the earth from the sun varies, which causes the temperature of the earth to change over a regular pattern of 100 000 years. Also the earth's axis wobbles a bit. All these cycles cause changes in temperature. Also you get sun spots – some people call it cosmic rays, it's all basically the same thing – and of course you get volcanic eruptions and if they get up into the upper atmosphere, they really cause havoc. So there are four main causes of changes in temperature, sometimes warming, sometimes cooling.

You've probably heard of the IPCC (Intergovernmental Panel on Climate Change). It's important that they've allowed for all of those things and still there's something missing in the explanation. They've quantified changes in the earth's orbit. They've quantified solar flaring and sun spots and allowed for volcanoes. Still there's something and it must be human emissions. They say that more than 90% is the cause of the increase in global temperatures in the last sixty years and likely that 65% has contributed to wind patterns affecting tropical storm tracks.

Let's take Hurricane Katrina in New Orleans. I saw for myself and talked to a lot of people. As you know hurricanes are caused in the Gulf of Mexico by the sea warming up. What happened was there were four hot spots in the Gulf of Mexico and Katrina just happened to pass over them, picked up so much energy and then zapped New Orleans. What we can state from that it is very likely that the warming of the gulf was caused by global warming. The track of the actual hurricane is of course left much more to chance, but the actual warming of the gulf, which resulted in Katrina, was a result of global warming. You can't make a direct connection, but there's a very strong probability.

Temperature in the last 130 years has gone at about .7° on average. The scary thing is that even if we stopped today with our emissions, there'd be another .6° to come because of time lags in the system. So we're in for 1.3° already. It's in the pipeline. To put that in perspective, the last time earth was 5° warmer was 50 million years ago and there were crocodiles within 1000km of the north pole. The world was warm. So at 1.3° we are 25% of the way today to crocodiles near the north pole.

If we do nothing, we're headed for 4° and maybe as much as 6° by 20100, with all these consequences of extreme storms, sea level rise, distribution of rainfall and human settlement being re-distributed. It's reckoned that the rain that now falls in the Western Cape will fall out to sea and be lost. The glaciers of the Himalayas, which are the huge reservoirs of water for the summer to provide water for something like one third of humanity, will disappear as there won't be any snow in the winter.

Sub-Saharan Africa is looking at a 15% drop in agricultural yields. We all know that while the world may get wetter in many places, there's evaporation and a drought condition is caused by increased temperature and rainfall. It may rain a bit more, but if it evaporates immediately, you're worse off and it will fall in different places.

We must remember that South Africa is already living on the edge climate-wise. Much of it is arid or semi-arid. The whole place is subject to droughts and floods and just a little more stress is going to throw a lot of areas out. The poor will be hit hardest.

We must not just think about climate change being a slow, gentle thing over the next couple of decades. There

are things called tipping points. For example between 11000 and 13000 years ago, the whole place warmed up 5° in ten years and then dropped again 5° in ten years. There were less than a million people around so it's not recorded and didn't have such a huge effect, but can you imagine with 6.8 billion people, if something like this is triggered, what could happen.

You may have heard about the concerns about the permafrost loss in Siberia, where methane – which is a much worse global warming gas than CO₂ – could be given off. The rain forests could die back or ice sheets collapsing – these are all trigger points that will suddenly happen and cause havoc.

The third factor then in climate change is the burning of fossil fuels, especially coal, contributes about two thirds of the total warming effect and this is likely to lead to a reduced ability to use them. Before we discuss this further, we need to cover a popular subject in South Africa (it's become quite passé in Europe, but is also popular in the States), one I'm going to call denialism.

There's a lot of confusion out there. I think this is something people would like to understand. It results from too much information, misinformation, and simplistic analyses of complex problems. Let's talk about sceptics and denialists. To be sceptical about something means you challenge it, you keep an open mind. Denialism is another story. You simply deny that something is happening. The denialists either deny that global temperatures are rising, or they argue that it's rising but it's not caused by us. To try to be fair, I've listed the most recent 10 denialists – not sceptics – denialists. There is no single umbrella counter to the view of the denialists. You can't say they're all wrong, because each one has a different perspective. They're all denying in different ways. I've analysed all these arguments and every one of them has a problem.

If you had a brain problem you wouldn't go to a nuclear physicist or an estate agent, or a farmer for advice on what to do. So I think part of the problem is there are a lot of self-appointed experts out there who are talking about things they don't really understand in depth. You need deep expertise to be able to talk about anything.

Nicholas Stern of the Stern Review said: "It's remarkable how many people have set themselves up as experts. I'm trying to illustrate for you the silly things that happen e.g. Exxon Mobil funds organisations to put out learned papers denying climate change to give the impression that there's a debate. Our own Financial Mail came up with a comment that "greater sun spot activity reduces the cosmic rays, hence reducing cloud formation and raising surface temperatures". Let's say maybe that's right – it's only part of the explanation. Remember I said the IPCC has looked at the total explanation and there's still something missing, but yet this is presented as true and therefore we cannot be causing climate change.

The famous statement: "Man is not capable of damaging earth's systems". Well what about the ozone layer which we nearly lost in 2001? It's now recovering nicely because of all the action taken under the Montreal Protocol.

So I would suggest to you that since it looks like we are causing climate change, even if it is only probably rather than certain, since the consequences are so horrific we'd better take out an insurance policy against this catastrophe that may never happen. So we need to adjust our behaviour and we need to start developing sources of energy for the day that fossil fuels run out. So for all those reasons, it's something we should take seriously. The one that I've not put up formally is this slide is to say I'm sure you've all noticed, even in the last year, the sheer momentum that's building up – the public awareness overseas and here – on this issue. It's gaining a momentum of its own. And if you have any doubt whatsoever, there is the final truth. I could probably give you a very good scientific argument for that.

Let's talk about the way forward.

There are three obvious things to do: reduce energy consumption, start moving away from fossil fuels to clean energy and to help facilitate that, put a price on carbon emissions, which is beginning to happen. At the United Nations meeting in Copenhagen last December, the one thing they did agree was that 2° is the maximum that we can allow the temperature to rise. Remember 5° is crocodiles near the north pole. Why 2°? Well I guess it's manageable. Some countries lose some benefit. If you think about most of the developing countries are hot and most of the developed countries are cold, so the cynical view might be that 2° suits the developed countries. Certainly not in South Africa. It's also been said that the probability of having some catastrophic tipping point increases significantly above 2°. Then the other cynical explanation is that it's already 1.3° so it's inevitable that we're going to get to 2° anyway. To do that we have to reduce our emissions on this planet by 70 billion tons per year by 2050. That means if we do nothing, we're up at low 80's of emissions by 2050, we have to get to about 10-12 billion tons. We have to cut out 70 billion tons we have to cut out from the "business as usual" scenario.

How are we going to do that?

There's no single big solution. It's going to be a set of solutions. First of all lifestyle. The roses the girls got for St Valentine's Day were flown in from Kenya probably. Gautrain will make a big difference to emissions by bringing in decent public transport. Anybody in the UK has the great privilege these days of jumping in an aeroplane and flying to the sun. What's that doing for emissions? So lifestyle is going to take some cramps.

As a result of SA's new carbon tax, the Hummer will cost an extra R21 000 because of its consumption. It's 405 grams of emissions per kilometre. The limit now is 120. That legislation is being introduced here and is already happening in Europe. But the really good news about the Hummer is that Hummer was hoping to sell out to a Chinese company and the Chinese government has blocked it. So it looks like Hummer is dead!

Energy efficiency: simple things like low-energy globes, consuming 20% of the normal incandescent globe and buildings. There's an ex parastatal building in Pretoria, where on a winter morning the south side of the building is cold so they turn the heating on. ON the north side as the sun comes up it gets hot, so they turn the air-conditioning on. So the front side of the building uses 3 megawatts and the south side has heating of 3 megawatts. Net consumption – 6 megawatts. Now in an efficient building, they'll be able to transfer heat between the sides. So it's reckoned that just by getting more efficient, we could cut 25-35% of the energy off the world's consumption.

Nuclear is another solution. South Africa plans to build multiple nuclear plants to solve the country's power deficit and reduce its carbon footprint.

Renewables: I'll mention hydro in passing. It's about 16% of the world's electricity, but it's limited geographically.

The big ones are wind and solar. Wind is becoming a very mature technology with 2% of the world's electricity and it's growing. Thomas Edison said about 100 years ago: "I put my money on the sun and solar energy. What a source of power! I hope we don't have to wait till oil and coal are out before we tackle that." He was right. We are about to run out in the next couple of decades. Of course SA is in the pound seats with all the solar radiation available.

The Europeans are putting together a proposal to have solar plants all over North Africa, wind up and down the west of the Atlantic. That's all going to be linked together in one big grid. So it means if the wind isn't blowing in Belfast, Ireland will get solar electricity from the sun coming off the grid. You may have heard about the smart grid. This will control all these new sources of energy. It'll turn appliances on and off to match supply. Johannesburg was talking about doing this recently, but I don't think it's happened yet. If you have an electric car you would charge it up at night.

Biomass: Ethanol in the States. There are lots of problems with Biomass. It needs a lot of water. It's also being accused of displacing food etc, but it will play a role.

We've got greenhouse gasses other than CO₂. We've got methane and nitrous oxide – 14% of all emissions.

Land Use: We're burning forests instead of growing them – that's 12%. So there are several things that we can do something about.

Of course the last one is fossil fuel use which is currently causing 67% of all emissions. If we look at the numbers again and if you look at the tons of CO₂ you generate when you generate a megawatt hour of electricity – coal has the highest reserves and secondly it has the highest emissions per megawatt hour. As a result of that there's a lot of effort going into improving combustion efficiencies from today's 35% to near 50%. And of course carbon capture and storage. I think the Fossil Fuel Foundation needs to do a lot more work in publicising its efforts. The average person hasn't a clue what's going on. I was at a talk given by Mervyn King the other night and an obviously intelligent and well-educated person asked why can't we stop Madupi and these other plants? We have a role to educate people.

There are two conferences coming up – one in conjunction with the IEA at Eskom in Woodmead in April and another which I'll talk about later. This one will focus on what we can do with clean coal technology.

So that's the eight things we have to do. As I said this requires 70 billion tons a year reduction. Let's look at what that means.

If you look at the world's emissions in terms per person, the USA is up there; hot on the heels is Australia because of their coal. We aren't as bad as we might be, but mostly because a lot of our people are poor. The people in this room are 20 plus. IN 2006 every person on this planet was responsible on average for 6.7 tons of emissions. In order to achieve the emission goal that has to drop to 1.5 tons. To put that in perspective, 1.5 tons is like driving 7 500km a year in an average car. It's also the same as a return flight to Cairo. If you fly to Cairo and back, that's your emissions for the year. That's how serious it is.

Let's look at South Africa now. If you split the country up into 500 000 rich people – we're more than 20 tons of emissions and then with poor people at less than 1, the average is maybe around 9. We, as the rich, this is where your emissions come from. Just heating water is going to take you 3 tons. Lighting is four, appliances 4 and your car, if you do 12 000 is 3, one flight to Europe is 2, to Cape Town and back is 1 and there's your 20 tons.

What does South Africa as a country do? The rich people are about 2% of the total emissions and the poor people only 5%. There are many of them, but they don't have anything to emit. Transport 9, Sasol 18, Lime 20, agricultural waste 20 and industry 10. You might ask where is Eskom. I've built the Eskom numbers in there because although Eskom deserves a lot of flak for bad management, but it is government policy to fire Eskom with coal. So if you mine deep gold, you are using Eskom electricity which is fired by coal, so you must carry the emission. That's the way the world is going. It's going to be costing of emissions into every product. So if you mine deep gold somewhere on the Reef, with a lot of energy consumption, it's going to have a lot of emissions factored into it – unlike something that's open-pit in Australia.

South Africa is the world's 13th largest emitter and that's the result of what has been a very successful strategy, which is based on high energy-intensive sectors such as coal to liquids, deep mining, smelting, aluminium oxide that gets shipped in from Australia, smelted to aluminium here with cheap electricity and shipped off again, creating a couple of jobs on the way. That's not an opinion, it's a fact. The heavy reliance on coal will have to be re-assessed. It was the appropriate strategy at the time but is no longer appropriate.

If you think about the measure of carbon intensity, this is a parameter that's being used throughout the world now, how many kilograms do you emit to generate a dollar of GDP. It gives you a measure of how intensive your economy is in terms of your emissions. The developing countries are typically 2kg per dollar of GDP, South Africa at 2 and then developed countries about a half or less. France is very low because of nuclear. So we have an issue that we're going to have to re-think. As the 13th largest emitter, we are going to be obliged by the international community to place our part. You may have heard of the Long Term Mitigation Scenarios (LTMS) brought out about two years ago – that's the number that we have to follow. That gap that we have to drop – if we do nothing 1600 million tons to about 280 million tons – is going to cause a major disruption to South Africa's economy, particularly for energy and emission intensive industries. They're going to suffer and of course there will be lots of new industries that thrive. Those of you who are following it, you can see it on a weekly basis.

If you now look at our electrical energy and the costs of the alternatives, these numbers are averages of ranges that are published overseas. You can see that our coal-fired electricity was very competitive two years ago, with all the alternatives. Our coal-fired electricity in 2013 will be 55c. I've discounted that at 6% per annum from the recently agreed NERSA prices. But if you add to this the cost of carbon capture and storage, suddenly our electricity is no longer that exciting. This won't happen overnight, but our industrial strategy based on cheap electricity is not going to work. Energy across the world is entering an era of high energy costs, because fossil fuels will start becoming expensive as they start to run out and as they are taxed or have to carry carbon capture costs – one or the other or both. Renewable sources require heavy investment. So perhaps costs will go up again as renewables become of age and technology improves them, but I think we can expect turmoil in the transition period.

Let's talk about energy demand scenarios. The eight scenarios being published is a Norwegian NGO, Trefolka, is a loaner with a very interesting viewpoint, US Department of Energy, IEA and the European Commission. So overall quite a reliable bunch of people. They show for primary energy, if we do nothing, we will grow up to about 930 exojoules by 2050. You can see the coal going. However, the same people publish a "business as usual" scenario and then an "action taken" scenario. Then it's a different story. Firstly the total energy demand drops by 27% because of energy efficiency and energy cutting measures. But coal does not do anything very exciting. So it's the average of eight scenarios, showing growth in coal if we do nothing about climate change. And if we take action it stays more or less the same. Only two projections satisfy the need to reduce emissions. I would be the first to agree that there could be a peak between today and 2030.

There's a train coming down the track. If you keep your ears to the ground and your eyes open you can hear it and see it coming. We got all these government plans beginning to happen. Carbon taxes – Treasurer is going to issue a discussion paper on carbon tax. Emissions Accounting legislation has been promised for over a year. It will happen. That means that every company will be legally bound to account for its emissions. Many of you representing big companies are already involved in the Carbon Disclosure Project, where you voluntarily disclose your emissions, but this is going to go right down through the whole country. Everyone will have to start measuring. What about your insurance risks against extreme weather events. If you're a wonderfully green coal producer, typically your emissions in mining and production are only 4% of what that coal yields when it's burnt – and it's the burning that going to give coal the bad image. You're going to worry about physical risks and risks to your work force. Wal-Mart, the biggest store in the world is beginning to put carbon footprints on their products.

So the way forward is to reduce consumption, start pricing carbon emissions. But all this is going to happen with uncertainty in the background of how nature will react to the damage done so far. If you look at the problems with municipalities not delivering – can you imagine if people don't get access to energy, or if energy prices get too high what will happen. Social unrest, wars over water and energy resources is what life will be all about. Protectionism measures are already being talked about in Europe. The Europeans and Americans get lots of their goods made in China, so China has high emissions. There are lots of uncertainties ahead.

Will the coal industry survive? I hope that you've seen and understand some of the issues that will affect the answer to that question. I think the opportunity for the Fossil Fuel Foundation is we should be out there helping to share public opinion. We should be educating people, telling them that the reasons we're in the situation we're in, is what got South Africa to where it is today. We need time to change things. We can become known as a centre for excellence for clean coal technology, which I think we are. But what about legislation and best practice and response? We should be doing the whole gambit of the future of coal through conferences and our website. On 28 July the conference referred to is Part 2 of the successful we had in November. Part 2 will be in July and it will be precisely talking about the bigger picture on the future of coal, particularly in South Africa.

Thank you.

A question and answer session with general discussion followed this address.

A. I agree it's not sustainable, but at what point does it blow up.

Q. Again I congratulate you on your presentation – probably the best one I've seen on this topic – but the thing that concerns me is that it's all negative. There's no positive that comes out of this. Having lived in Northern Canada I know that a 2° change in the climate in Canada would do wonders for the agricultural community by extending growing seasons by two or three weeks on either side. That in itself could become a solution to feeding a growing world population. I have problems looking at 2°. Why not 1° or 3°? The other problem I have is capping at 500 parts per million. To me that is .05%. I have some problems with the science although I don't disagree that we are polluting our environment and this needs to stop, but there are some figures that come out of the scientific community that I don't understand. The third thing is having been in advanced years and living in this country for a long time, I don't see any change in sea level or temperature, but for most of us who do not understand the science etc. my environment has not changed all that much with the exception that Gauteng is probably getting more and more sustained rainfall than we had 20 or 30 years ago.

A. 2° in Canada – a survey was done about six months ago and they reckoned that the two countries that would score most would be Canada and Ireland. Some countries will score, but Africa is going to be a big loser, along with India and a lot of China. China is ahead of everyone else in the world on developing renewable technology like solar, part of the reason being they realise they have a big problem ahead of them. The 500 ppm is a very small number, but then if I give you a drop of poison and it kills you it's also a very small number. CO₂ is a very toxic substance – a very small amount can have a very big effect. In terms of local conditions I said you have to average climate change over decades and Paul is saying he's seen nothing. Possibly you haven't seen that much where you've been but there are many parts of the world – around the Sahara, parts of China, the Himalayas with less runoff – there's a lot of evidence for climate change and for local conditions changing. Part of the problem is because we don't see it happening, we don't take it seriously.

Q. We lived in a house for 26 years till recently and I noticed over that period of time frosts became a lot less prevalent. In fact at the end of those 26 years we didn't get frost at all, but that was because the trees grew up and sheltered the place. It wasn't anything to do with climate change. You mentioned the Himalayas and the melting of the snow, but the IPCC has given incorrect information. That being wrong and calls for the Chairman to resign, puts the whole issue of the scientific aspects of climate change into jeopardy.

A. Fair comment. Everyone probably heard that they got it wrong when they said that the ice in the Himalayas would be gone by 2035 when what they should have said was 2350. That does affect their credibility negatively, but it was one mistake in a body of people that presents a huge volume of evidence and while it was inexcusable, the analogy I use is if a pilot makes an error in a plane and crashes, are you going to stop flying? Does it mean that flying is unsafe? Things break down.

Q. The message I got was that we need to look at the demand for coal into the future. Maybe it won't expand as some of the predictions say. Is there not therefore a reason to consider how the development of coal mines in this country is going to happen over time, because at the moment it seems to be business as usual? Is there not room to use as much of our resources that we're already exploiting, rather than opening up new areas such as the Kabela mining operation?

A. Part of the problem is that a lot of CEO's will say is it legislated? Answer: No. Not interested! That's the way people proceed and until that legislation comes in you cannot necessarily rely on the CEO to make the right decision.

Q. What I hear is that the FFF is active in developing that policy and is this not something you could build into your best practice.

A. The Coal Roadmap. Ian would you like to comment on that?

A. I'm not too sure I understand the question.

DC Well every day you open Engineering News some new coal mine has been opened or some new venture has been formed and I guess the question is: Is that being done in the context of the greater scheme of where the coal industry might be going long term.

A. Correct. We don't want to have a whole lot of mines half exploited in your 2030 scenario, when in actual fact the existing mines in operation could have fulfilled that function. At the moment I know it's probably very subjective, but we seem to have a rush of coal mines starting up now, when in fact we're not even sure there'll be a market.

DC I think it's something that will have to be considered by everybody.

TS What happened to competition? If a mine starts up and it's not viable, it closes down. There are environmental controls on mines.

DC But in a country like South Africa that is constrained for capital, the question should be raised as to whether money should be put into a coal mine that could close down in ten years time, or should we rather use that scarce capital to invest in carbon capture or solar. Those are the kind of questions that must be asked.

A Dave, you quoted that number that says there's a possibility that overall coal demand will be flat between now and 2050, but what's not shown there is the regional fluctuations, because it's widely believed that the Indian market is going to demand huge quantities of coal and also the shorter term – and it's quite possible that the scenario you've outlined is realistic, I don't agree with it, but it's possible – but that doesn't reflect short-term changes or regional changes. So the reasons mines are opening is that right now there's a huge demand for coal in southern Africa, in India and in China, but there's a reduction in demand in Europe. Overall and over time – in the next 40 years – we might well see the overall picture changing like that, but within that overall picture there are regional and short-term fluctuations and that's why mines are opening right now.

DC There's no scenario for 2020. You say you don't agree with the numbers, but I must then challenge you to give me a scenario that will satisfy the way the world is looking at its emissions restraints that satisfies that and shows a growth in coal, because I haven't found one.

Q To the gentleman who questioned whether we should open new mines or not, we are actually trying to open new mines because our production is increasing year after year and our consumption remains if not the same, then bigger. So in this country alone, looking not at the environmental issues, at the carbon emission or what Europeans are doing, in general we need to have more coal to keep our industry running the way it's running now. Not that we want to increase the production, we just want to keep up, because remember a large number of mines by 2020 will close down and there will be a gap between production and demand. So we need to fill that gap and probably won't, but we'll do our best to do that. We cannot stop opening coal mines. It's not a question of likes or dislikes or politics. If we don't open new mines we're going to have serious problems. I'm not talking about environmental issues, just about realities in this country.

DC That's the point I made, that there's going to be some serious readjustments.

Q. A comment on the lifestyle changes. Just about the mini drought down in Knysna. Friends were saying they see the rain over the sea, which is exactly what you were saying about rainfall going south. On the lifestyle – take light bulbs – it seems to me they're all making use of smarter materials like carbon fibre, aluminium and all these things that are very energy intensive to produce. Are we all meant to be going back to being peasant farmers? I can't work out this dichotomy – if I start cycling to work, I'll want the latest carbon fibre light thing which has used a lot of energy to manufacture. I don't know if that equation is better or if I should just continue with the car.

A. I worked in Holland and every morning there's a fleet of kids on bicycles who cycle 10km to work through rain. It'll come to that probably. I don't have all the answers. All I'm saying is that for us to achieve what all governments have agreed – which is 2^o - we have to get from 6.7 tons today to 1.5 tons by 2050 and that's going to have implications for aluminium (which is highly energy intensive, but with a very high recycle rate). There are going to be lots of drama ahead.

Q. My name is Rob de Jong and I live in Australia and I've been coming backwards and forwards to SA over the last year. The first time I came back was last year in June. I hadn't been here for 15 years and I must say that compared with Australia which is a fairly clean climate you can take it from me that the pollution here is extremely high, especially in the winter months and a lot of that is produced from coal and charcoal in the various townships. It normally takes me a week to recover from my asthma attacks that I get coming to SA. I'd like to add that one of things we've done is to study the future here over the next 10 to 20 years of the requirements of coal. There's one fact and that is if you take Eskom – they currently produce 20 000 megawatts per year of electricity. By the year 2030 that has to be doubled to 40 000 megawatts per year and as everyone knows, Eskom relies on coal and it's a fact that if the economy is to keep growing that will be happening. So pollution is a real problem.

DC We've all be told that when you talk about things you have to have the opportunity as well as the risk. It sounds as if there's a lot more risks here than there are opportunities and a lot of problems ahead. Let's understand and not deny.

Q. I don't understand why the nuclear plants are not developing quicker. You say there is talk about building new nuclear plants, but they stopped all nuclear plant development a couple of years ago because there was no money. There is no longer any expertise and so I don't understand why there is not a lot more emphasis on nuclear plants. All attention should be put on nuclear plants in my opinion.

DC That is certainly one of the answers and nuclear now seems to be being considered quite seriously again. The problem with nuclear is that even though a levelised cost of 70c, a lot of that money is up front money and a relatively low operating cost and the problem is to find the finance. What discount rate do you use to justify it? There're a lot of scorpions in that particular decision, but nuclear would appear to be on the way in again – all over the world including the States.

Q. There's one comment I always have a problem with concerning nuclear plants. If you see the trucks in South Africa with the smoke that comes out of them – is that causing a lot of pollution? I thought it was legalised that this should be diminished, but I think this is very bad in South Africa.

A. I think transport is about 10% of emissions on the planet. I think it's probably higher here and it's not controlled.

Q Another thing is if you develop biomass plants then I think the price of the biomass will increase out of certain states and that is another big problem.

A The price of energy is going to go up.