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Understanding the current energy crisis in South Africa

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This is a guest article by Simon Ratcliffe and Jeremy Wakeford. Simon is an energy and sustainability consultant and is the Chairperson of the Association for the Study of Peak Oil South Africa (ASPO South Africa). Jeremy is an economist specializing in energy and sustainable development and is Research Director of ASPO South Africa.

South Africa has been experiencing blackouts over the last three weeks or so, and is forecast to have electricty shortages until at least 2013, see S Africa eyes rationing to end power cuts (Financial Times, 24 Jan.) for a brief overview. Here Simon and Jeremy discuss the issues in more detail.

Let us venture into a political no-go zone and say that at some point in the not too distant future there is a bitter pill that we will need to swallow and we are getting just a foretaste with the current energy crisis. In a nutshell, our global growth based economic model is fundamentally unsustainable.

This is not a new idea, but one that dates back to the early 1970s. At that time there was much debate around energy and sustainability coupled with a search for alternatives. One seminal work published in 1972 was The Limits to Growth commissioned by The Club of Rome. It was a prophetic piece which was based on some early computer modeling which linked population growth, energy consumption, natural resource usage, food production, industrial output and life expectancy. The authors, an eminent group of highly respected scientists, from the Systems Analysis Lab at Massachusetts Institute of Technology, developed a number of future scenarios based on optimistic as well as pessimistic assumptions. The work was a warning to governments and decision makers to start changing course because the earth's resources could not sustain indefinitely the patterns of growth that are a consequence of our current economic paradigm. The report has been dismissed by mainstream economists because some of its predictions did not occur in the timeframe they were predicted and because of its Malthusian undertone which modern agriculture had "disproved". However, it is the underlying logic of the report that ought to give us much to contemplate in a sober and rational manner.

Understanding the consequences of a growth-based model holds the key to our understanding of the current energy crisis. How did we go from a situation of having a huge surplus of electricity to the current situation where the entire country faces regular blackouts and some of our key economic sectors are threatened with an unpredictable and rocky road ahead? Mines have been forced to shut down as their electricity supplies cannot be guaranteed, while energy-hungry aluminum smelters continue to operate so that we can have our beer dispensed in cans. Worldwide, aluminum smelters consume 2% of the world's electricity.

There are many factors that contribute to the current crisis. We are familiar with the fact that Eskom, the state-owned electricity utility, has been warning of a power crunch for some 10 years now, of the fact that government wouldn't invest in new power plants, of denial by ministers and other government officials, of hemorrhaging of skills from Eskom, of rain-soaked coal, of

allegations of bad planning and incompetence. But while all of these factors may contribute to the problem, they don't give us a picture of the systemic issues. They are all indicators of how complex the whole system is and consequently how difficult it is to predict how this will play itself out. Perhaps the scale of the electricity issue can best be explained by understanding exponential growth and its implications.

Exponential growth refers to a situation where there is compound growth. For example, our current economic strategy is aimed at achieving an average 6% growth rate over a long period of time. This has been determined by looking at the rate at which we need to be creating employment, by our increase in population, by levels of poverty and the need to alleviate it and a range of other factors. A constant 6% growth rate means that we will be doubling the size of our economy in roughly the next 11 years. Yes, at this rate of growth we will double our economy. What is it we will be doubling? We will double our GDP. This means we will double what we produce. In order to double what we produce we will need to double what goes into what we produce. This includes raw materials and crucially, energy. Yes. Roughly speaking, on this growth path, in the next 11 years we are going to need to double the amount of energy we are currently consuming. The doubling time of anything that is growing constantly can be determined mathematically. (Doubling time = 100 x ln(2) / Growth Rate). This means dividing 70 by that rate of growth. This basic calculation is used constantly with respect to calculating financial returns, but rarely to calculating the rate at which we are growing our need for electricity or the rate at which we are depleting resources. In fact, it can be applied to anything that involves constant growth; population, the rate at which a disease is spreading and so on.

Let's go into this in a little more depth. Each doubling cycle (11 years, in our case, at 6% growth) is greater than the sum of all previous doubling cycles combined. Let us put this another way. In the next 11 years we will consume more than we have in our entire history. So in order to double the size of our economy, which we will do at 6% growth in 11 years, we will require more resources than we have required during our entire history, including electricity.

Every time we double, that is, when we go from 1 to 2, from 2 to 4, from 4 to 8, from 8 to 16 and so forth, the last doubling cycle is greater than the sum of all the previous cycles. Thus, 16 is greater than 8+4+2+1 which is equal to 15. This is an irrefutable mathematical calculation. This is how very large quantities can be generated in relatively short periods of time from relatively low rates of growth. This is not a fantasy.

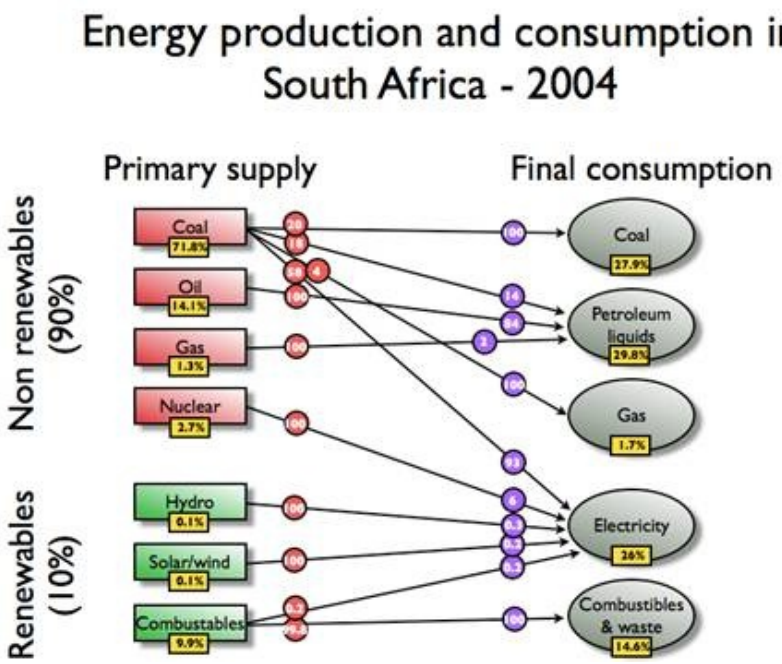
This might come some way to explaining why it is that Eskom has been unable to keep up with electricity demand on our current growth path and why we keep experiencing power cuts on such a wide scale and why the scale of the cuts is likely to widen. It also gives us a clue to the scale of the issue we face. So let's get this right. If Eskom is going to meet demand, it is going to have to generate more electricity than it has in our entire history during the course of the next 11 years in order to maintain our current growth path. What is it going to take to achieve this and is this a path we want to go down? Where will the resources come from? Where is the coal, the uranium, the skilled and unskilled labour going to come from? Who is going to be training the engineers and the artisans required? According to its 2007 Annual Report, Eskom's timeframe for new capacity shows that it plans to double its capacity to 80 000 MW by 2024, in other words in 16 years time. This assumes an annual growth rate of 3.64%. To do this Eskom is going to have to burn nearly as much coal as we have burned in our entire history. This is a frightening thought, given that per capita, we are among the world's worst polluters. Hopefully this is beginning to paint a picture of the challenges we face that are consequences of our growth path.

The current blackouts provide us with unique opportunities. Firstly, it is a huge wake-up call. We are being offered a glimpse of the limits of our current models and an opportunity to change course to a more sustainable path. We are seeing too, the consequences of these limits. Mines and factories are being forced to shut down during outages. The cost to the economy is huge. Costs to industry of the blackouts vary, with some estimates in the order of R1 billion (£70m) a day. Large

numbers of people have their livelihoods threatened and confidence in the country's economy as an investment destination is being questioned. The upside is that it provides Eskom and the government with the opportunity to take energy conservation and efficiency, as well as renewable energy sources, more seriously. We have for decades been very wasteful with our energy resources and this must change, for reasons of depletion as well as carbon emissions and climate change mitigation.

The era of very cheap electricity in South Africa is now over. Consumers will face price hikes of between 14 and 20% per annum for at least the next few years. This will encourage necessary conservation and efficiency measures, but will be especially hard on poorer consumers. Thus the government will come under pressure to increase its expenditure on social support programmes and grants. What has happened, has happened, and cannot be changed. We are here, now, in the present situation and faced with the choices of which route to follow going forward. The question we need to ask is, "Will our solutions make us more or less dependent on fossil fuels? Will they take us closer to sustainability or further from it? Are we seeking long-term solutions or short-term quick fixes? What price will we pay in the future if we make the wrong choices now?"

What does our current energy mix look like?



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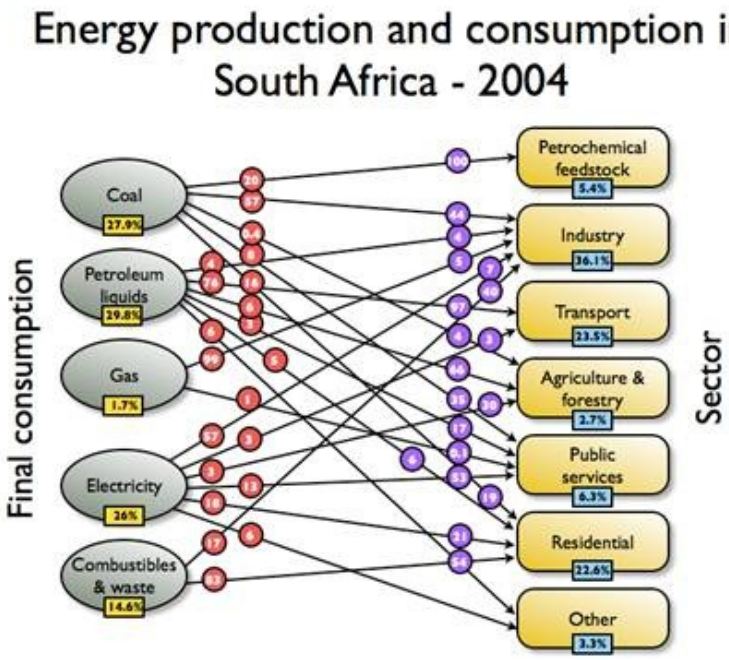

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Eskom provides 95% of the country's electricity. Of this, some 90% is generated in coal-fired power stations, and another 6% is generated by two pressurised water reactors at the Koeberg nuclear power station near Cape Town. There is a small contribution from hydroelectricity and a negligible contribution from solar and wind power.

As we look out into the future from where we are now, do we aim to centralize our energy production or do we create the mechanisms for decentralizing it? Centralising the provision of our electrical power in the hands of one utility makes us very vulnerable to its weaknesses. This is a classic case of poor national risk management. Hopefully we can see what the consequences of this are. Centralising the production of electricity means that solutions will inevitably have long timelines. Many people have started to make their own arrangements anyway and are buying generators, and their own solar water heaters and so forth. The problem is that there are no national guidelines, no goal to which we are aiming, no incentives or dis-incentives and so we could be creating other problems. Installing an emergency generator which uses either diesel or petrol only creates further dependence on another equally vulnerable fossil fuel and is likely to exacerbate our increasingly fragile liquid fuels situation. Decentralising the production of power reduces dependency and enables many people to find solutions to their own energy needs. Do we build more power stations fired by “dirty” finite resources (coal), or do we begin to use the clean solar or wind energy supply that we have in abundance and channel our investment and research resources into harnessing it? Coal fired power stations have high capital costs, long planning and construction timelines and ongoing running costs as its feedstock is continuously required. Coal is a finite resource and could according to the German based research unit, the Energy Watch Group, reach its global production peak by 2025. As we approach that point and go beyond it, coal will begin its production decline and its price will rise dramatically. Is this a resource we want to become further reliant on, even though we do have large reserves in South Africa? Solar and wind power stations also have high capital costs but once complete, their energy feedstock is free. Eskom is planning the construction of a 100MW solar power station in order to reduce our “dependency” on fossil fuels. This represents 0.3% of our current usage.

It is time, too, that we settle the score with the bean counters that tell us that the unit cost of solar and wind powered electricity is higher than the unit cost of electricity derived from coal fired power. Doing a financial analysis of pure costs in this respect is insufficient for making crucial long-term strategic decisions. The financial analysis needs a comparative analysis of the full life-cycle costs, the environmental costs and crucially a vulnerability risk analysis. This would provide

us with a more complete picture and allow better decision making. It will provide us with a holistic picture of which path to take as we take this journey from the current crisis we find ourselves in.

Finally, putting growth and sustainability into a global context, let's look at China and India both of which are growing at a rate of about 10% per year. So, their economies are doubling every 7 years (70/10). Some might argue that this is growth off a low base, but each of these countries has a population of over a billion people, so absolutely their consumption is enormous, even if per capita it is less than ours right now. Both of them will in the next 7 years consume more than they have during their entire histories. Is it any wonder that most of the world's steel, coal, cement and other critical resources are on ships heading east? China is currently experiencing both electricity and fuel shortages as it begins to experience the limits of its growth. As long as it keeps on its current growth path its energy problems will continue and so will the rest of the world's. Exponential growth is assured to bring with it exponential resource depletion, the effects of which will look a lot like we are experiencing now. Continued exponential growth will ensure that the experience is long lasting. It will last until we understand that long-term sustainability and growth are mutually exclusive.