South Africa's Electricity Crisis

PSA
The Union Of Choice

SOUTH AFRICA'S ELECTRICITY CRISIS

Public Servants Association

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Contents

Executive summary

South Africa's national electricity grid has inadequate capacity to operate within reasonable operating buffers. The overworking of aging power stations has triggered failures, and sparked load-shedding. The roots of the crisis lie in inadequate investment in new generation capacity. Investment has been stifled by an energy monopoly, Eskom, which does not generate enough revenue to cover its capital costs.

There has also been the problem of slow response to the impending crisis by a government unwilling to bear the financial burden of expanding the national grid. An expansion plan is currently underway, but the priority projects (Medupi and Kusile) have been struck by major delays that have prolonged the crisis. The longer the crisis

continues, the more severe will be its impact on economic growth and workers. This monograph is the contribution of the Public Servants Association (PSA) to assisting workers and the wider society make sense of the intricacies of South Africa's national electricity crisis.

Introduction

South Africa is in the grips of an unprecedented energy crisis. Electricity supply has been erratic since the second wave of load-shedding engulfed the country in 2014. This followed a few years of respite after the first wave hit the nation in 2007. In 2015, whispers have occasionally been heard in the public domain suggesting that a total collapse of the national grid is not an unimaginable possibility. Indeed, such an eventuality would exert long-term adverse effects on the economy.

However you look at it, load-shedding has become a new normal in South Africa. The government has confirmed that, in the short-term, the idea of an uninterrupted supply of energy would be an unreasonable expectation. This is despite the fact that the White Paper on Energy

underscores energy security for low-income households as a means to "reduce poverty, increase livelihood, and improve living standards."[1] In other words, the new situation of energy scarcity puts a damper on the country's efforts to alleviate poverty.

Hope is placed on government's new build programmes – Medupi, Kusile and Ingula – as an escape route from our energy crisis. But these projects have been bogged down by multifarious factors. Medupi, for example, should have been completed in 2013. It is now estimated to be completed 8 years later – in 2021. Kusile was due for completion in 2014, and it, too, has been postponed to 2021.

Communication from Eskom about these delays and their concomitant costs has been patchy. The irony, though, is that the White Paper on Energy laments lack of unaccountability under the apartheid system as part of what has held back investment in generation capacity expansion.

At a time when our country disparately needs a sound power utility that inspires confidence, Eskom is trapped in a bog of financial and corporate governance problems. It is facing a funding shortfall of R225bn. As if to rub salt in the wound, the credit rating agency Standards and Poor has downgraded Eskom's credit rating from BBB to junk status, following a poorly explained decision to suspend senior executives. "Execution risk" in government's support plan was also cited as part of the reasons behind the downgrade. This makes it even harder for the utility to raise debt in capital markets to make-up for its funding short-fall, and therefore to ensure operational viability.

This, without a doubt, compounds the country's energy crunch.

The question is: How did we get here, and what are the implications for the country? More importantly: What is to be done? This monograph is an attempt to answer these critical questions and to untangle other related conundrums of South Africa's debilitating energy crisis.

Coal-fired monopoly vs. global sentiment

South Africa has a mixed-energy economy that is largely dominated by a state-owned energy utility company, Eskom, which is vertically integrated. Evidence of Eskom's monopoly across the value chain is manifest in its disproportionate share of energy production: 96 percent. Coal accounts for 70 percent of primary energy, and generates more than almost 90 percent of electricity. It also makes up a third of liquid fuels. The energy that is generated by the state utility monopoly gets transported over a transmission network controlled by Eskom to distributors countrywide. There are more than 400 distributors, comprising of municipal electricity divisions that supply

energy to households. There has been a threat by Eskom to cut off electricity from non-paying municipalities. Were this move to be carried out, it would adversely affect many households, including those that have paid municipalities that did not pass on the money to Eskom.

There are also macro questions relating to the environmental sustainability of coal-dependent energy generation. This is particularly important for South Africa, as it is an active participant in such important global forums as the United Nations Framework Convention on Climate Change (UNFCCC). The current pattern of energy production lends our country the character of a significant emitter of carbon dioxide. South Africa is a high-energy intensive economy, with the major users of energy being mining and manufacturing companies that are beneficiaries of the country's old mineral-energy complex. Like many other countries that are confronted with the challenge of shifting production patterns towards a greener path, South Africa has to manage the developmental tensions entailed in such choices. Over the past decade, however, two problems have emerged which have made it imperative for South Africa to diversify its energy mix and open up the energy sector.

Firstly, the national grid has been overwhelmed by demand side factors. The demand surged as many households that were previously unconnected under apartheid gained access to electricity under the new democratic dispensation. The positive political changes that have taken place in South Africa since 1994 have also spurned the kind of economic growth that had not been witnessed since the mid-1970s. Between 2004 and 2007,

the economy grew at an annual average rate of above 4 percent, a development that drew on an already strained national electricity grid.

Second, the world has become more and more obsessed with cleaner, less carbon intensive ways of producing energy. South Africa's situation has thus become more complicated. On the one hand, there is a need to grow the economy and to create jobs, an objective that relies on the abundance of energy resources that are optimized from coal. On the other hand, the country had to demonstrate a move towards greener or alternative energies that would bring it in line with ongoing global shifts away from reliance on fossil fuels. For example, in line with the Copenhagen Accord of 2010, South Africa developed an indicative strategy geared towards reducing emissions by 34% below the "business as usual" level by 2020 and 42% by 2025. This was based on the assumption that emissions would peak between 2020 and 2025, followed by significant reduction.

According to the National Planning Commission (NPC), South Africa's energy intensity is one-and-a-half to four times higher than the Organisation for Economic Cooperation and Development (OECD) average, depending on whether Gross Domestic Product (GDP) is measured in nominal or purchasing power terms. In mapping out future energy scenarios, the NPC notes that, if the sector follows the proposed carbon-emission scenario of peak, plateau and decline, in line with the Department of Energy's long-term mitigation strategy, the balance of new capacity will need to come from gas, wind, solar, hydroelectricity, and possibly a nuclear programme from about 2023.

Envisaged policy solutions contained both in the country's Integrated Resource Plan 2010 – 2030 (IRP 2010) and the National Planning Commission's flagship report setting out vision 2030, includes: exploring gas alternatives to coal; use of cleaner coal technologies; greater mix of energy resources; and a diversity of independent power producers (IPPs) in the energy industry. In the draft revised IRP 2010, there is a commitment to a nuclear fleet of 9 600MW, justified on the basis of its base-load capacity to offer security of supply.

The Integrated Resource Plan initially required 21 500MW of new renewable energy capacity to come on stream by 2030 to meet demand. This has recently been revised upwardly to 29 000MW. In total, 40 000MW of new power capacity would, according to government, need to be built to provide for this demand. It should be noted that, currently, the country is battling to maintain a grid of about 45 000MW. In other words, the idea is almost to double current national capacity. There are certainly good intentions behind this idea. What remains unproven is government's capability to bridge the gap between intentions and deeds. Only time will tell.

Reality trumps ideology

In 2007, failure to plan properly for increased demand resulted in severe problems and near collapse of the national grid, triggering intermittent power outages that introduced the detested term of "load-shedding" into the lexicon of South Africa's public discourse. Eskom's technical managers had informed government as far back as 1998 of the diminishing reserve capacity and the need to plan for increased demand as a result of economic growth. They had requested government to commit to a new build programme, a request government turned down. Later in 2007 the then President Thabo Mbeki apologized publicly for his government's grave dereliction of responsibility,

stating what had become obvious: "Eskom was right, government was wrong." Subsequently, two new large coal-fired power plants were planned – Kusile and Medupi.

In April 2010, Eskom received a loan of US$3.75bn from the World Bank. This was the first of such significant loans from the World Bank to South Africa since the end of apartheid in 1994. The ideological debate that had taken place in the early years of the democratic dispensation, leading to the adoption of the Growth, Employment and Redistribution policy by the ANC-led government, had in part been motivated by political intentions for South Africa not to run to international finance institutions with a begging bowl. But the energy crisis poured cold water on this ideological fire – Eskom ran to the World Bank for a much-needed loan. Of the secured loan, US$3bn would go towards capital expenditure in Medupi, and the remainder (US$750mn) was to be utilised in emission reduction programmes.

These developments generated much impetus to think seriously about the need for encouraging the development of independent power producers to complement and compete with Eskom. Given Eskom's position as a state monopoly, government's volte-face to allow independent power producers to compete with Eskom essentially represented the admission that state monopolies are as inefficient as private ones are throttling to economies. It was this startling admission that made it all appear like a devastating defeat of ideology in its duel with reality.

Expanding access without more capacity

A major priority after 1994 was the expansion of the supply of essential utilities, including energy, to the segment of the population that was excluded under apartheid. Thus, the Department of Minerals and Energy prioritized "the promotion of access to affordable and sustainable energy services for small businesses, disadvantaged households, small farms, schools, clinics, in our rural areas and a wide range of other community establishments".[2]

While progress was initially slow, with access to energy increasing from 65% to 66.1% of the population between 1990 and 2000, progress was accelerated dramatically in the following decade.[3] Between 2000 and 2010, access

to energy grew from 66.1% of the population, to 82.7% of the population, with the addition of over 13 million people to the grid.[4] Government often alludes to this factor in trying to ward off criticism about the current wave of load-shedding. The retort is that this should be viewed as a consequence of government's positive delivery record.

It must be noted that there are 8 million South Africans who still have no access to electricity, despite the remarkable progress that has been achieved thus far. The situation is worse in the rural areas: 18% of the population in rural areas have no access to electricity, compared to 12% in urban areas.[5] There is also the problem of unbearable costs – 43% of South Africans spend more than 10% of their net income on energy.[6] These challenges notwithstanding, the progress made in expanding electricity access to the majority of the population is commendable. But, as pointed out above, the post-1994 government committed a serious blunder by not heeding Eskom's advice in 1998 that the country needed to build more power stations to prepare for future economic growth and to mitigate anticipated demand-side pressure.

A healthy grid

Developing a healthy energy grid is a crucial part of building an efficient modern economy. If the grid is deficient, especially on the maintenance side, it is impossible to have reliable supply of energy. Six factors are important when considering the adequacy of a grid:

1. *Inclusion:* Households that are not connected to the grid face increased costs and risks associated with basic daily chores like cooking and lighting, while unconnected businesses face the high costs associated with expensive off-grid sources of power.
2. *Meeting demand:* Once connected, the grid must have adequate capacity to meet the demands of the population. Failure to do so can trigger costly blackouts.

3. *Creating buffers:* An efficient grid should be able to supply more electricity than is demanded at peak times. This allows power stations to run below maximum capacity, which reduces the risk of failure and extends the life of the station. These buffers also ensure that failures in one station do not lead to blackouts in the broader system.
4. *Managing distribution:* Demand for energy fluctuates over the course of a day. Moving from periods of low demand to periods of high demand ("ramping up") puts extra strain on power stations. The grid needs to be able to manage these fluctuations.
5. *Keeping costs low:* Energy is an essential and costly input for almost every company and every household. Keeping energy costs low helps improve the productivity of companies and the welfare of families, while also stimulating the economy by keeping more money in the hands of households.
6. *Security and sustainability*: Energy grids may also aim for more subjective outcomes, like environmental sustainability and domestic energy security.

The South African energy grid is often characterised as being in a general state of crisis. For instance, one of the reasons why renewable energy projects have yet to come fully on stream is Eskom's inability to provide transmission grid access. For the energy grid to be reasonably functional, it should balance the six factors highlighted above. This should enable it to identify failures before they emerge, and manage trade-offs involved in improving the grid. The question is: How is the South African grid doing in relation to the above factors? There are clearly weaknesses

in the grid. This has prompted Eskom to close a $339m financing deal with kfw (a German development finance institution) to upgrade its transmission network.

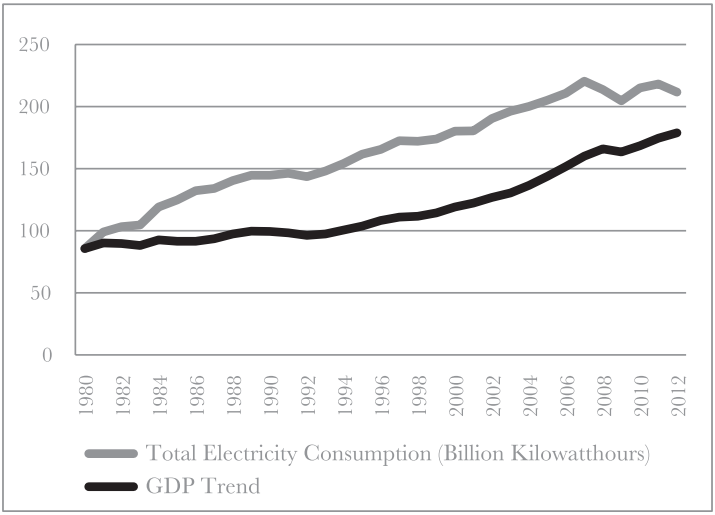
Inclusion

As indicated above, 82.7% of the South African population was already on the grid by 2010, while 8 million people were still without electricity. Impressive as this may appear, from the standpoint of inclusion, the blackouts the country has been experiencing since 2007 are an indication of a national grid that is in serious trouble.

Meeting demand

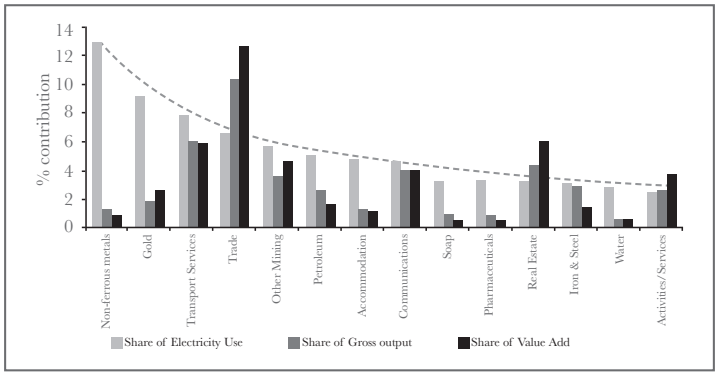
The rapid expansion of access to the electricity grid, combined with structural changes in the economy and high growth rates, resulted in spiraling demand for electricity since 1994, at a time when supply was largely stagnant. Between 1994 and 2007, demand for electricity grew by 43%. There was no provision made for this growth. This growth has pushed demand increasingly close to South Africa's total energy production, and is a core underlying driver of the current crisis. Figure 1 shows the growth of electricity demand in South Africa in compared to GDP growth.

Figure 1: Electricity consumption vs. GDP growth in South Africa: 1980-2012[7]



Households account for 17.9% of total electricity consumption, while industry accounts for the remainder.[8] Within industry, 33 firms account for 44% of total electricity demand. These firms are known as the Energy Intensive Users Group of Southern Africa (or EIUG).[9] The EIUG is dominated by mining and industrial metal processing firms, but also includes large manufacturers (such as SAB Miller) and some services firms (such as Transnet).

Figure 2: Industry energy usage vs. contribution to GDP[10]



Supply of electricity to the South African grid surged in the 1980s. Previously, investment in energy infrastructure upgrade was linked to the growth of economic activities in the railways, harbour and the mining sector. At that time Eskom (then Escom) had received a US$90 million loan from the World Bank to be carved equally into the three economic sectors. In the 1980s Eskom undertook an ambitious development programme that resulted in a significant excess of production capacity.

Prior to the current round of infrastructure construction, there has not been a significant infrastructure programme since 1990. Currently, South Africa's electricity is produced by 25 power installations: 13 coal-fired power plants, 1 nuclear power plant, 2 pumped-storage schemes, 4 gas-fired plants, 2 hydro-electrical plants on the Orange River, and 1 wind farm in the Western Cape.[11] Coal-fired plants account for 85% of total generating capacity in South

Africa, while gas, hydro and nuclear account for 6%, 5% and 4% respectively.[12]

Maintaining buffers

The energy crisis is often framed as South Africa having inadequate capacity to meet energy demand. However, this is not the case. The maximum capacity of the current grid is adequate to meet peak energy demand. The real problem is that capacity is not adequate to maintain prudential buffers, which should ideally be between 15% to 20% of grid capacity by international standards.

Power stations are not built to run at full capacity, but ideally to produce a maximum of 80% to 85% of their potential output. The 15-20% buffer prevents the equipment from excessive wear and tear, which reduces maintenance costs, decreases the time stations are offline, and extends the life of the station. Beyond having buffers at single power installations, the entire power grid should have adequate buffers to ensure that when some generation capacity is offline for repair or maintenance, the grid is still able to meet energy demand.

The current buffer between total electricity generating capacity and annualized peak demand is estimated between 6.7% and 12.7%.[13] This buffer is too low to cope with scheduled maintenance and other unforeseen failures. The low buffer has necessitated power stations to run over their ideal capacity, and has led to increased failure rates at many power installations. And because of the lack of sufficient system-wide buffer, these failures have resulted

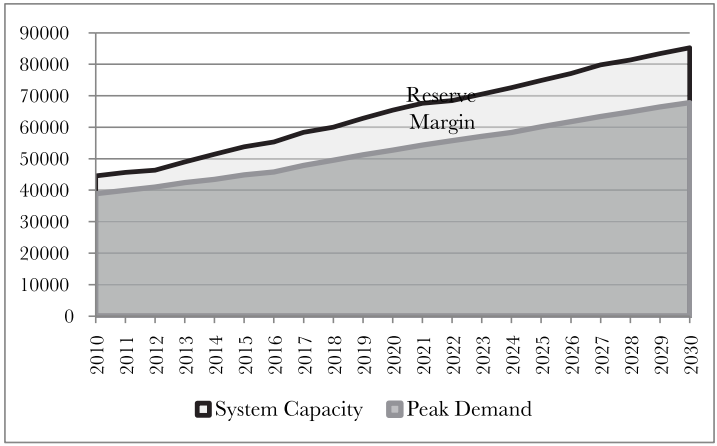
in Eskom being unable to meet demand, and therefore triggered load-shedding.

Eskom does not systematically release information on the causes of load-shedding, but some examples can be drawn from media reports. Load-shedding in early 2008 was triggered by maintenance and repairs taking 20% of the grid offline.[14] The November 2014 load-shedding was due to the complete collapse of a coal silo at the Majuba plant in Mpumalanga, despite the plant being amongst the newest in the Eskom fleet.[15]

Other incidences of load-shedding have been driven by problems in the supply of raw materials. The latest cycle of load-shedding kicked off in 2014, due to coal being excessively damp, and thus not generating as much power as it should.[16] Load-shedding in April 2015 was attributed to problems in the supply of diesel to open-cycle gas generators, combined with various other installations being out of service.[17] The April load-shedding incidence was reported to have reduced Eskom to 51% of its total generation capacity, an all-time low.

Load-shedding does not occur when demand exceeds supply, rather it occurs when buffers are extremely critical, and the risk of the grid going offline (tripping) is significant. If the grid were to go offline, the process of turning it back on would require more energy than is available – requiring a long, slow restart. Figure 3 shows changes in the buffers planned under the Integrated Resource Plan's envisaged expansion of the grid.

Figure 3: Reserve margin of South Africa's national electricity grid, 2010-2030[18]



Managing distribution

Demand for energy fluctuates considerably throughout the day, featuring numerous 'ramps', or large upswings in energy demand. South Africa experiences two ramps in the course of a day: a morning ramp between 6:00 and 8:30, which requires power output to be increased by 38%, and an evening ramp between 16:00 and 19:00, which requires power output to be increased by 50%.

Ramping up output puts additional strain on power installations, most of which require more energy in the process of increasing their output than they do in maintaining the new, higher level of output. Eskom distinguishes between base-load power stations and a

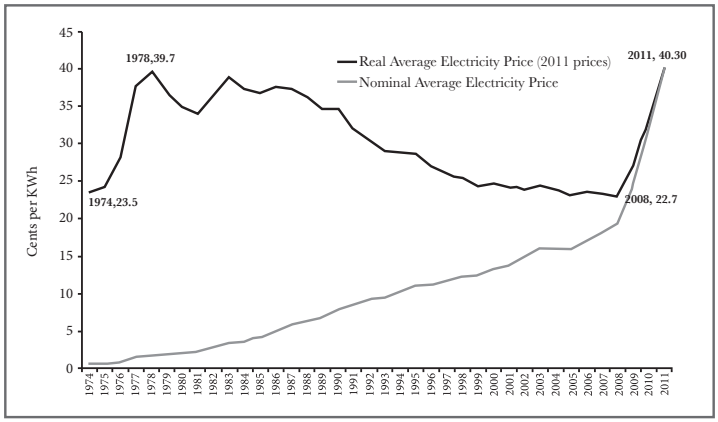
special peaking fleet, which is only used during ramps and periods of high demand. The peaking fleet primarily consists of pumped-storage facilities and diesel-powered open-cycle turbine generators, and boosts power supply by approximately 12%.[19]

Keeping costs low

Energy costs are a primary input for almost every modern business, and are major costs for the vast majority of South African families. Maintaining low energy costs can have a powerful stimulus effect on the economy, making companies more competitive and giving households greater disposable income to save or spend. These economy-wide energy effects have been demonstrated recently in the case of the United States, which has used low energy costs from its shale gas boom to close productivity gap with its economic rival, China.

The cost of electricity in South Africa peaked in 1978 and has declined steadily for the next 30 years, until the start of unusually high tariffs in 2008.[20] In response to the onset of the electricity crisis, tariffs doubled between 2008 and 2012, surpassing the previous 1978 high in 2011.[21] Figure 4 shows the evolution of electrical tariffs since the 1970s.

Figure 4: Nominal and real electricity prices in South Africa[22]



Despite this, South Africa still has amongst the lowest energy prices in the world. Prior to the 2008 price surge, South African industrial energy tariffs were approximately a fifth of the cost of those faced by European OECD countries, and were lower than major energy producing countries like Russia and Norway.[23] This gap has significantly eroded after the recent price increases; but, as recently as 2011, South African electricity was still marginally cheaper than most developed European countries, and roughly on par with the United States.[24]

Two factors have traditionally driven the low energy price in South Africa. The first is action by the National Energy Regulator of South Africa (NERSA), which sets energy tariffs. NERSA has consistently resisted calls from power utility Eskom to balloon prices. Second is the availability of large quantities of cheap coal in the country, and the subsequent use of cheap coal-fired plants.

Other factors also play a role, arguably including the monopoly status of Eskom. Electricity grids are considered by some to be a natural monopoly, in which a single provider is able to generate power at a lower cost than in a competitive market. This area lends itself to contentious ideological debates that are difficult to settle.

Sustainability and security

Beyond the core issues necessary to create and deliver stable energy, various other considerations enter the debate. Environmental considerations have been particularly prominent in recent years, driven by the rise of concerns over global warming, and the growth of highly polluted areas in countries like China. South Africa ranks very poorly in terms of the production of CO2, due to the prominent role of coal-fired power plants in the energy mix, and the old age of these plants. Despite having the 33rd largest economy in the world, South Africa is the 12th largest producer of carbon dioxide.[25] The country ranks 12th in the world for producing CO2 per capita, and 3rd for producing CO2 in relation to GDP size, behind only Kazakhstan and the Ukraine.[26] South Africa's current energy plan aims to limit carbon emission to less than 275 million tons per year from 2025.

Essentially, energy security refers to the likelihood that energy supply will be interrupted by external factors such as political instability, and is often understood as the fraction of energy produced domestically. South Africa's energy grid is almost entirely powered by domestic supply,

with only 15.5% of energy imported. These imports are entirely made up of oil and diesel. South Africa exports as much energy as it imports, and (depending on the prevailing price of oil) is generally a net energy exporter.

Figure 5: State of South Africa's energy grid at a glance

Category	Description	Rating
Inclusion	82.7% of population on grid	**Good**
Meeting demand	Supply meets demand when grid is fully online	**Mixed**
Maintaining buffers	Inadequate buffers	**Poor**
Managing distribution	Ramps covered but with strain	**Mixed**
Keeping costs low	Costs remain low, but are rising fast	**Mixed**
Sustainability	Very high CO2 emissions	**Poor**
Security	Net exporter of energy	**Good**

Behind the current energy crisis

The key to the South African energy crisis is therefore inadequate energy supply to maintain sound prudential buffers. A number of factors have contributed to the current crisis.

The hand of apartheid

Under apartheid, public utilities like clean water energy were produced primarily for the white minority. Energy was seen narrowly in terms of supporting a system of accumulation referred to as the mineral-energy complex.

This was essentially made up of conglomerate industries, primarily in mining, but also in manufacturing. The shift to democratic rule therefore required a massive shift in the burden facing government, from providing for 9% of the population, to providing for the entire country. The positive story of growing inclusion identified above has also meant growing demand for power.

This growing demand was also reflected in the private sector. South African firms under apartheid were particularly labor-intensive, in part because the denial of rights to black South Africans created a pool of disenfranchised, and therefore, low-cost labour. The transition from apartheid has been accompanied by rising wages, combined with various structural changes and increased international competition resulting from a more open economy, the combination of which sparked a shift in parts of South African business from labor-intensive production to capital-intensive production. More capital-intensive productive processes generally use more energy, exerting a heavier burden on the grid. In particular, the growth of the energy-intensive Iron, Steel and Non-Ferrous Metals sectors have played a significant role in the growth of electricity consumption.[27] As Figure 1 above shows, electricity consumption has grown more rapidly than the economy, indicating the presence of structural shifts beyond traditional economic growth.[28]

Under-investment in infrastructure

Growing demand for energy was not met by investment in expanding the capacity of the grid, despite clear signs that this was necessary, and warnings in 1998 from Eskom. There are many explanations for the government's failure to respond to calls for investment in the grid, including basic criticism of the competency of government decision-making. Nevertheless, three important factors beyond competency should be considered.

First, at the time the government faced an array of pressing priorities, as it attempted to manage the country's transition from apartheid. Aside from the vast structural change this required, urgent matters like the 1998 currency crisis and the looming election in 1999 may have acted as a significant distraction from appreciating the urgency of the White Paper's warnings.

Second, economic policy at the time was guided by GEAR, which prioritised fiscal responsibility as a means to win private sector confidence and encourage growth. Between 1996 and 2002 South Africa's budget deficit shrunk progressively.[29] Large scale investment in energy infrastructure would have complicated these efforts, and made such investment unpalatable.

Third, despite the warnings, there was an engrained belief within the electricity sector that South Africa did not require significant investment. This belief stemmed from Eskom's vast overinvestment during the 1980s. At the time, Eskom's reputation deteriorated as rapidly as it has recently, but the primary complaint was the company's

overambitious attempt to expand supply. The 1988 De Villiers Commission heavily criticized the focus on expanding supply, and warned against the risk of further increases in capacity.[30] The experience of this backlash is an important part of the institutional memory of the energy sector in South Africa.

Nevertheless, some critics lay the blame on incompetent and under-skilled ministerial appointments in the Departments of Energy and Public Enterprises, and to the political cronyism that lies behind these appointments. Evidence seems to suggest that individual ministers may have struggled to overcome the entrenched beliefs that underpinned government policy at the time. Evidence of looming energy problems did not seem adequate to overcome government's low prioritization of expanding electricity supply.

Historic underpricing

Underinvestment in more generation capacity has been driven by political decisions, but this situation only exists because the national energy utility Eskom has weak capacity to invest without government support. This is largely driven by energy tariffs being inadequate to cover the costs of capital expansion. As pointed out above, tariffs have been decreasing since the late 1980s. Relatively high rates were faced-in in the late 1970s and early 1980s in an effort to fund Eskom's huge investment during the period. Once higher tariffs had covered these costs, the company found itself with little need for capital-generating tariff

levels, as the grid had an oversupply of capacity. After the National Energy Regulator was established in 1995, tariff increases were kept below inflation and thus allowed to gradually decline in real terms.

Political pressure has also played a large role in depressing prices. While NERSA is ostensibly an independent body, government still exercises significant influence on pricing, most noticeably through the Minister of Public Enterprises, who represents the government on NERSA's board. Government has generally sought to keep electricity tariffs low, in an attempt to boost economic growth, and to lighten the burden on citizens.

Underpriced electricity may also have contributed to an increase in demand for power, as customers had weak cost incentives to improve their energy efficiency and avoid unnecessary uses of power. Most studies, however, have found that the price of electricity has little impact on the behavior of consumers, with price being mostly insignificant to consumption.[31] This is largely because some form of energy is essential to consumers, and substitutes (like gas or solar panels) are significantly more expensive to install.

A problematic monopoly

As already pointed out, Eskom produces 96% of total power in South Africa.[32] Traditionally, this dominance has been maintained because of arguments that electrical supply is a natural monopoly. A natural monopoly is a market in which one large firm is more efficient than competition between various smaller firms. This situation is driven by numerous factors, including the presence of large economies of scale and difficulties in building infrastructure that allows for competition.

The downside of these monopoly structures is two-fold. First, problems in a monopoly utility have a disproportionately large impact on the entire power

network, because electricity consumers cannot shift to other sources when there is a problem in the monopoly. Second, the lack of competition inherent to this relationship can make firms inefficient.

Some efforts have been made to dilute Eskom's monopoly, most notably in the renewable energy sector, where a comprehensive Independent Power Producer programme is expected to see the introduction of numerous new electricity firms. A more comprehensive effort towards the breaking of Eskom's monopoly was proposed in the Independent System and Market Operator (ISMO) Bill. This Bill was aimed at creating a new state-owned enterprise that would purchase power from both Eskom and independent power producers. The new entity would essentially own the country's transmission network. It would sell electricity to distributors and buyers at a wholesale price. In this case, Eskom would focus only on power generation. This idea has since been abandoned. The ANC expressed unease about breaking up Eskom and exposing it to private competition as envisaged in the ISMO Bill. For the ANC, this was largely an ideological standpoint.

Governance crisis at Eskom

Eskom's corporate leadership has been characterized by a revolving door at top-management level. Figure 6 shows the rapid change of leadership over the past ten years, which have seen 6 Chairpersons, 5 Chief Executives and 7 Finance Directors pass through Eskom.

Figure 6: Senior management positions at Eskom: 2004 – 2014

	Chairperson	Chief Executive	Finance Director
Present	Baldwin Sipho Ngubane	Brian Molefe	Nonkululeko Veleti
2014	Zola Tsotsi	Tshediso Matona	Tsholofelo Molefe
		Collin Matjila	
2013	Zola Tsotsi	Brian Dames	Caroline Henry
2012	Zola Tsotsi	Brian Dames	Paul O'Flaherty
2011	Mpho Makwana	Brian Dames	Paul O'Flaherty
2010	Mpho Makwana	Brian Dames	Paul O'Flaherty
2009	Bobby Godsell	Jacob Maroga	Izak du Plessis
2008	Valli Moosa	Jacob Maroga	Bongani Nqwababa
2007	Valli Moosa	Jacob Maroga	Bongani Nqwababa
2006	Valli Moosa	Thulani Gcabashe	Bongani Nqwababa
2005	Reuel Khoza	Thulani Gcabashe	Bongani Nqwababa
2004	Reuel Khoza	Thulani Gcabashe	Willem Kok

Eskom went through its most serious leadership crisis during the height of load-shedding in 2008/2009. The Eskom board, led by Chairperson Bobby Godsell, terminated Chief Executive Jacob Maroga's contract, amidst a dispute over whether Mr Maroga would resign over the load-shedding crisis. Mr Maroga denied these accusations, claiming that his dismissal was unlawful (a claim later supported by the courts), and accused board members of promoting a culture that did not accept black leadership at Eskom. The fallout from the conflict saw Mr Godsell resign, and Mr Maroga's termination maintained,

on the basis that his relationship with the board was irreparably damaged.

Since then, the role of Chief Executive received some stability under Brian Dames, who served four years before resigning in 2013, citing "personal reasons", but reportedly exhausted by Eskom's continuing crisis. Interim Chief Executive Collin Matjila replaced Dames, but did not last in the position, due to relentless criticism from the National Union of Metalworkers over his alleged previous mismanagement of COSATU's investment arm. He was succeeded by Tshediso Matona, who was suspended after less than a year, under charges of underperformance from Chairperson Zola Tsotsi, which would eventually see Mr Tsotsi himself tendering his resignation. While Mr Matona remains suspended, Eskom has since appointed Transnet CEO Brian Molefe to the position of acting Chief Executive.

The role of Chairperson has been similarly turbulent. Mpho Makwana replaced Bobby Godsell in the wake of the fallout over Jacob Maroga's termination. However, he was removed in 2011, in a purge of the Eskom board that saw 8 of the 10 non-executive directors removed. Zola Tsotsi replaced Mr Makwana, but resigned in the face of a pending vote of no-confidence in 2011, after facing allegations of overreach in his power, most notably in the suspension of CE Tshediso Matona. Ben Ngubane assumed the role of acting Chairperson in March 2015, following on a controversial stint on the board of the SABC.

Beyond the in-fighting and instability, senior Eskom officials have generally been criticized for their role in the energy crisis, including general mismanagement and poor decision-making. Others note the highly politicized nature of the positions, which has seen numerous politically-connected officials with limited experience in the energy sector rise to senior positions in Eskom. The irony of Eskom's governance crisis lies in the fact that the Energy White Paper 1998 go into some lengths on the imperatives of governance, especially accountability and transparency, as well as the need for better coordination across the range of government entities responsible for energy.

Diversifying energy sources

The South African government drafted an energy master plan, which includes the Renewable Energy Independent Power Producer Procurement Programme (REIPPP), as part of its mitigation strategies to reduce greenhouse gas emissions. This strategic plan was drafted during 2010-2013. The key objective of the plan was to move away from fossil fuels and push for the diversification of the energy mix, with emphasis on solar, wind, biomass and biogas – without compromising security of supply.

The core focus of energy planners was on ensuring uninterrupted and secure energy supply for the nation.[33] The goals of the master plan can be summed up as:

addressing energy requirements of the poor; enhancing competitiveness of the economy by providing low cost, high quality energy inputs to sectors such as mining and others; and to achieve environmental sustainability of natural resources.[34]

The REIPPP is a practical policy programme intended to mitigate the effects of climate change while increasing certainty in energy supply. What motivated the shift towards diversification was South Africa's unsustainable growth path that relied largely on coal-fired power stations. In 2010, a new policy framework, the Integrated Resource Plan (IRP 2010), was formulated, and approved by Cabinet in March 2011. This framework set out indicative goals for the next 20 years on how South Africa was to diversify its energy mix. The country made a commitment to diversify its mix, with renewables producing 42% of additional new capacity by 2030. The REIPPP, which had a target of 3 725MW to be produced from renewable energy sources, was allocated as follows:

- Wind: 1 850MW
- Solar PV: 1 450MW
- Concentrated solar power: 200MW
- Biomass: 12MW
- Biogas: 12.5MW
- Landfill gas: 25MW
- Small hydro: 75MW

From the outset, the Independent Power Producer programme recognises the importance of the private sector playing a role in the energy sector and in addressing

the country's electricity needs, which helps government to reduce the funding burden on Eskom. To date, there have been 4 rounds of bidding for the different allocations, beginning in August 2011. From the first round of bidding, 28 bidders were selected and agreements concluded in 2012 to yield a total of 1 416MW.

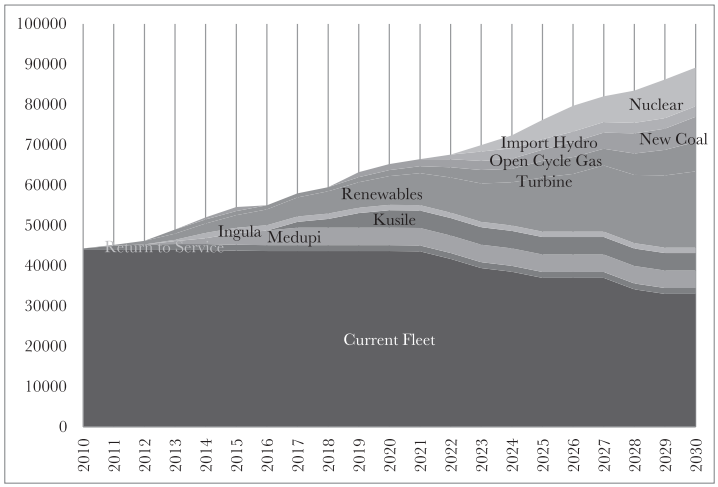
In the second round, which was concluded in 2013, 19 bidders were selected for a total allocation of 1 044MW. The third round was concluded in 2014, with 17 bidders preferred to produce a total of 1 456MW. The fourth round of bidding was concluded in April 2015, with 13 bidders selected for an allocated 1 121MW. This brings the total number of projects across all the different rounds to 79, with a combined capacity of 5, 243MW. This is a significant investment by the private sector in energy infrastructure, worth R168bn. Because of the success of this programme, and the urgency to add capacity to the grid, there will be an expedited process of procuring energy from independent producers, including through co-generation, over and above the planned fifth round, which will be announced in 2016.

Beginning in 2006, the South African government began planning to rapidly expand the capacity of the electricity grid. This culminated in the release of the Integrated Resource Plan in 2010, which lays out expansion plans for electricity infrastructure up until 2030. The build programme is the key avenue by which South Africa's energy crisis will end, but as indicated above,it has experienced serious delays.

The expansion plan aims to both grow the energy grid and shift the mix of energy inputs, moving away from

overreliance on coal. Figure 7 presents an overview of the changes in the grid under the Integrated Resource Plan.

Figure 7: Integrated Resource Plan growth in total electrical capacity, MW



Coal

The core of South Africa's short term resolution to the energy crisis is the building of two large coal-fired plants, Medupi and Kusile. Kusile is being constructed next to Kendal Power Station in the Witbank area of Mpumalanga. The station has six stacks, the first of which was scheduled to come online in June 2013, and the last of which was scheduled to be completed in 2017.[35] When completed, Kusile should be able to produce 4 338MW

of power, equivalent to just under 10% of the current capacity of the grid.[36]

Under a significantly revised timeline, Kusile's first stack is now expected to come online in the first half of 2017, four years late.[37] These delays have been compounded by construction delays at Medupi, which has encouraged a shift in resources from Kusile to the Medupi project.[38] Medupi is being constructed near Lephalale in Limpopo. The station is similar to Kusile, also having six stacks, and projected to produce 4 332MW.[39] The first unit should have been completed in 2012, with the final unit being completed in 2015.[40]

Executives at Eskom blame the largest component of Medupi's delays on major contractors: Hitachi Power Africa and Alstrom. Hitachi Power was accused of making numerous changes to their designs, and of poor workmanship in the building of boilers, requiring numerous repairs and reworking.[41] Alstrom was blamed for problems in the design of its complex boiler management system.[42] Others claim the root of these problems lie with Eskom's decisions to pursue an unusual design at Medupi, which is larger than the industry standard of 4 000MW power stations, generally regarded as much easier to build. Local content requirements have also been blamed for problems in sourcing adequate skills in the construction.

Industrial action has also been a major cause of the delays at Medupi. A 2013 strike lasted five months, over disagreements on workers receiving differentiated pay for similar work. A further strike broke out in April 2015, in which Numsa and NUM demanded the payment of exit bonuses to workers once the project is completed. Some

experts have estimated that the construction of Medupi's second units could take two and half years, five times longer than the planned 6 months.[43]

Beyond Medupi and Kusile, Eskom has two other coal-based projects. First is the Return to Service (RTS) programme, which aimed to reopen three closed power stations, namely Camden, Grootvlei and Komati. All three are coal-fired plants. The Camden plant was the first under the RTS programme, and came back online in 2010, followed by Grootvlei and Komati in 2013. The RTS programme should produce between 1 463MW and 3 800MW (or between 3.3% and 8.6% of current capacity).[44]

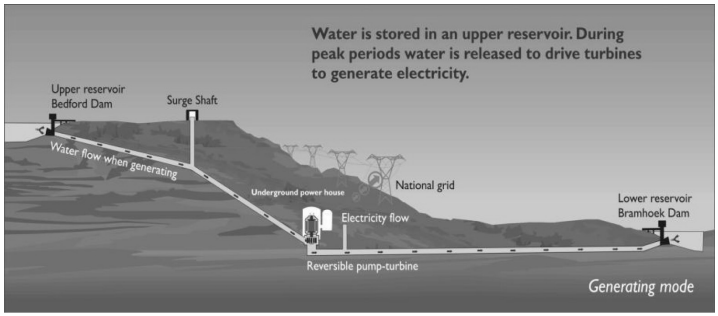
Second are a range of potential new build coal plants. It is difficult to gauge the extent of this potential expansion, as increasing the grid's reliance on coal has proved controversial in the light of serious environmental concerns. Nevertheless, the Integrated Resource Plan has scope for new coal power builds providing output from 2019, and completing its ramp-up in 2030. New build coal plants have the potential to produce up to 6 250 MW of power, or 14% of current grid capacity.[45] While coal is expected to be less important to the South African electricity mix in the future, it is nevertheless projected to remain the backbone of the grid, accounting for approximately 65% of total output in 2030.[46]

Hydro

Hydro-electric power will be rolled out in two forms: pumped-storage schemes and true hydro-electric. Pumped storage schemes involve the pumping of water from a lower to an upper dam, with flow from the upper to lower dam then used to generate power. Because the process of pumping the water uphill is energy-intensive, the pumped storage schemes are primarily useful in managing peaks in demand for energy. During periods of low demand, water is pumped to the upper dam; while during periods of peak demand, the station generates electricity.

Eskom is currently in the advanced stages of constructing a pumped storage scheme, Ingula, located in the Drakensberg Mountains. Ingula is scheduled for completion in 2016, and will have generating capacity of 1 332MW, approximately 3% of current total grid capacity. While this is not on the same scale as other projects, it is aimed primarily at reliving stress during peak times, and thus could make a major contribution to offset the impact of load-shedding.

Figure 8: Diagram of Ingula Pumped Storage Scheme[47]



South Africa maintains two traditional hydropower installations, the Gariep and Vanderkloof Power Stations on the Orange River, but as a water-scarce country there is limited scope for further development. Nevertheless, there is great potential to import energy from regional neighbours, notably the Democratic Republic of the Congo (DRC). The DRC's Grand Inga Dam project has the potential to generate up to 42 000MW, almost equivalent to South Africa's total electricity capacity, and twice the output of the world's current largest dam project. The project has remained stalled for years, facing serious problems of inadequate finance, opposition from environmentalists and political instability.

There is a possibility that the DRC's Inga project could be financed jointly by China and the U.S. to the tune of $12bn, with Eskom as a major off-taker. Eskom's potential supply from Grand Inga, though, is still subject to contract negotiations. Nevertheless, the Inga project holds immense potential in the long-term, and may form the core of a rapid expansion of regional generation capacity. During his

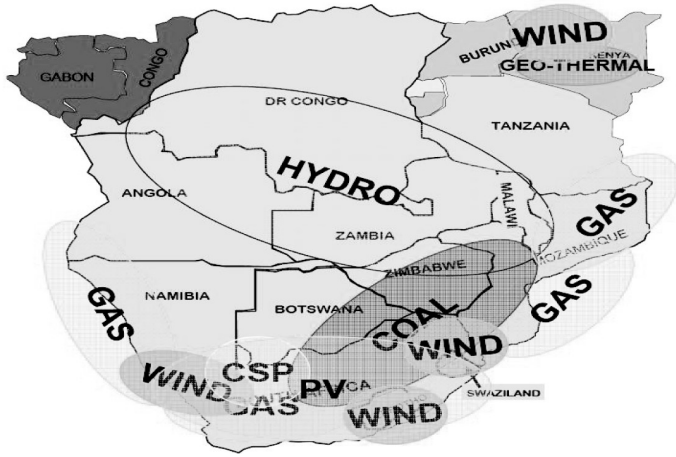
2015 State of the Nation Address, President Jacob Zuma announced that South Africa would source 15 000MW from Grand Inga, although he attached no time frame to this. Indeed, details could not be confirmed before Eskom finalises its contract negotiations with the DRC authorities, which may be a long way from now.

Solar and wind

Renewable energy sources play a negligible role in power generation currently, but are especially prominent in the IRP, which aims to have over 20% of total capacity provided by renewables by 2030. Eskom is in the process of directly constructing some renewable electricity generating capacity, notably the Sere Wind Farm in the Western Cape, which began generating at its full capacity of 100MW as of January 2015.[48] However, as indicated above, the bulk of the renewable energy infrastructure will be driven by the Renewable Energy Independent Power Producers Procurement (REIPPP) programme.

The REIPPP proceeds in numerous rounds of bidding by private firms aiming to supply a given target of power from renewable sources. The programme is notable not only for its role in expanding renewable energy, but also as the first major example of independent generation and a diversification of the sector away from Eskom's monopoly. Figure 9 shows the potential for various types of renewable energy generation across Southern Africa.

Figure 9: Areas in southern Africa by energy generation potential[49]



While the IREPPP has been hailed as a major success, and renewables are primed to make an important contribution to the South African electricity grid, there are numerous limitations on what they can offer. First, supply from renewables is dependent on weather conditions and is generally unpredictable, and thus requires Eskom to develop adequate capacity for periods in which they are not producing. Second, they have weak capacity to help the grid cope with times of peak demand, since these peaks happen in the early morning and late afternoon, when solar energy is not optimal. Third, renewable energy poses numerous technical challenges by exacerbating ramps. Input into the grid from renewable power would be at its highest during the day, but tapers off in the evenings,

around the same time that the evening ramp must be managed. With significant renewable power, other power stations would have to increase their output to account for both falling renewable generation and increased demand, which could put strain on older stations.

Nuclear

South Africa currently has only one nuclear plant – Koeberg in the Western Cape – but has plans to considerably expand the fleet. The development of nuclear power plants is a slow, expensive process, and for this reason the nuclear component is a long-term prospect. The IRP makes provision for the new build nuclear plants to begin delivering energy in 2023, with the plant(s) fully operational by 2029. At full capacity, the aim is for nuclear to produce 9 600MW, or just under 22% of current grid capacity.[50]

Plans to expand nuclear energy have met with mixed responses from the public. Proponents point to the fact that nuclear energy is the best way to reduce carbon emissions while maintaining high levels of scalable energy generation. Critics argue that nuclear is expensive and dangerous.

Particular criticism has been leveled at the procurement process for future nuclear plants. Nuclear plants are amongst the most complicated and expensive to construct, and are incredibly valuable to potential bidders. Concerns were sparked by media reports on a purported deal struck by the South African government that offers assurances that new nuclear equipment would be sourced from Russia's

Rosatom State Nuclear Energy Company.[51] The concerns have been exacerbated by the problematic sourcing of new steam generators at Koeberg, in which media reports have suggested that Eskom went against recommendations in the awarding of the bid.[52]

Gas

Open cycle gas turbine (OCGT) plants, which run on either natural gas or diesel, play an important role in both short- and long-term planning. In the short-term, OCGT plants were some of the most effective responses in helping the country deal with the 2008 load-shedding crisis. Two plants were commissioned in 2004, with a view to meeting the looming energy deficit, and were completed in 2009. Ankerling in the Western Cape has a total capacity of 1 338MW; while Gourikwa in Mossel Bay has a total capacity of 746MW. Both run on diesel, which is amongst the most expensive forms of generation, and for this reason they are only used to manage peak-load demand, usually running from 6:00 to 8:00, and from 17:00 to 20:00.[53]

Sustainable integration of OCGT plants into the grid requires a shift from diesel to cheaper and cleaner-burning natural gas. South Africa does have the potential to produce natural gas, but this would involve controversial fracking of the Karoo. Other countries in the region, notably Mozambique, are experiencing a natural gas boom, which may drive further OCGT development in South Africa. Eskom aims to produce 7 300MW, or 16% of current generation capacity, from its new build OCGT fleet.[54]

Implications for the economy and workers

The electricity crisis imposes a number of costs on firms, workers, and the general population. Of these, three are particularly important. The first is the direct cost of lost output resulting from disruptions in the operations of companies as a result of load-shedding or related restrictions on electricity availability.

The second is the loss of competitiveness, including foregone expansion and investment opportunities. These costs tend to reduce the competitiveness of local firms, by imposing additional costs (such as running generators) or by affecting their service delivery by, for instance, delaying the delivery of orders. This loss of competitiveness prevents

firms from expanding as they otherwise would. Similarly, foreign firms that might otherwise have considered South Africa as an investment destination may be discouraged from doing so at the same rate, for fear of these costs. The net result is slower growth and weaker job creation. Because this cost is based on foregone growth, it is difficult to quantify. It requires a great deal of abstraction in estimates. But it is not farfetched to postulate potential losses as a matter of principle.

The third is related to the build programme itself. While investment in the grid is clearly essential, and would likely pay for itself with the economic growth it encourages, investment in a rushed manner is likely to have costs. With the new build plants, these include the additional costs of urgent construction, and the long-term costs of any design flaws. The greatest cost, however, may be that imposed on the older fleet of stations. Many of the current fleet of power stations have been run over capacity, have had inadequate maintenance, and have been extended beyond the lifetime they were designed for. While these efforts have helped cover electricity demand in the short term, in the long-term they could leave the backbone of the South African grid facing serious technical problems.

While these economic costs are certain, the spillover effects on workers are less clear. Protection in South African labour law, combined with the role of unions in protecting workers' rights, make it difficult and costly to fire workers. While some firms may have no choice but to downsize, many others may recognize the energy problem as short-term. If this is the case, and firms have faith that electricity supply will return to normal soon, then they are

more likely to avoid substantial changes to their workforce, which in the long-run would impose serious administrative and training costs. To limit job losses, it is essential that Eskom, the Departments of Energy and Public Works, and all interested parties assist in facilitating the rapid development of new power stations – foremost amongst these being Medupi and Kusile. Industrial action at these build sites may protect the workers involved in the projects, but it puts workers in the rest of the country at risk.

Numerical estimates of the cost of load-shedding should be approached with caution. It is extremely challenging to correctly isolate the cost of load-shedding, and estimates must be considered only as educated guesses. Media reports claim that the Department of Public Works estimates the cost of load-shedding between $1.7 billion (R20 billion) and $6.8 billion (R80.1 billion) a month.[55] Energy expert Chris Yelland estimates the cost of unserved energy at R100 per kW, meaning that Stage 1 load shedding for 10 hours per day for 20 days results in losses of R20 billion per month.[56] Economist Dawie Roodt has claimed that, in total, load-shedding has cost the economy R300 billion rand and a million job opportunities, however the methodology used to calculate these figures is problematic,[57]and the estimates themselves should be treated more as guide to the pitfalls of costing load-shedding than as accurate projections.[58]

Conclusion

There is still a long way before energy supply is stabilised. There are too many problems that plague the state utility, from those related to corporate governance, skills challenges to the absence of strategic guidance from the shareholder – government. There are severe implications for poor planning for both workers and the general public. Economic and social costs will, in the end, be borne by ordinary citizens. Any growth projections will be meaningless in the absence of consistent power supply. Without a clear indicative roadmap on tackling the energy challenges, it is inconceivable that the country would attract the required levels of investment. A corollary factor is that without major investment flows, it is difficult to imagine economic dynamism and jobs created in the real

sectors of the economy.

The Eskom problems have an impact, even indirectly, on public service workers. Consider, for example, a scenario where Eskom was properly managed and the energy crisis had been forestalled, there would not be a need for government to transfer over R20bn to mitigate the utility's funding short-fall. A chunk of this amount could very well go towards improving the standard of living, including remuneration increases, for workers who serve the public.

On energy procurement, one avenue that could be of use is through a regional integration strategy on energy to build transmission grid infrastructure linking the DRC, Angola, Namibia, and other countries in the region, including South Africa. Various other possibilities that are mooted by government include gas exploration, biomass, importation of hydroelectricity, and nuclear. The monopoly that Eskom has on the electricity market has meant that smaller would-be independent producers find it impossible to gain worthwhile market share.

The foremost expert on energy Chris Yelland has made a number of proposals on short- to medium-term steps that government can take to ensure energy security, including:

- stopping further increase in unplanned generator outages, and introducing better planning for maintanance;
- pressing aggressively towards earlier completion of Medupi and Kusile;
- promulgating the Independent System and Market Operator Bill and remove barriers to entry for independent power producers of all technologies;

- removing all unnecessary barriers to entry for industrial, commercial and domestic co-generation across various technologies; and
- facilitating the private sector to build liquified natural gas terminals.

These measures are generally sound, and require flexibility of mind and pragmatism on the part of policy-makers. If anything, the current electricity crisis has exposed the perils of tenacious faith in monopolies. The idea of a natural monopoly that possesses an inherently faultless capacity to manage mega projects in the best interests of the state has been debunked. In the modern world, the best of policy makers maintain an open mind about the challenges that confront the state. South Africa's energy crisis also calls for an open mind.

In most cases, it is not that government is not aware of what needs to be done, but there is less than optimal political will at the moment. There are also too many lines of authority that seem to direct activities at Eskom, including the conflicting or overlapping mandates of the Departments of Public Enterprises and Energy; the Inter-ministerial Committee on Energy; and the War Room that is anchored by Deputy President Cyril Ramaphosa. The failure of corporate governance at the Board of Eskom has also compounded the problems at the state utility. The absence of clear policy and strategic oversight is a major source of paralysis. Hopefully these problems will be resolved soonest – for the sake of our country.

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PSA
The Union Of Choice

The Public Servants Association of South Africa is the largest, politically non-affi liated, fully-representative union in the public service. It represents more than 225 000 public servants, and has for more than 90 years been championing the interests of workers. The PSA has a proud track record of presenting well-researched ideas on matters affecting government employees and society at large.