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WORKING PAPER

THE CRISIS AT ESKOM AND INDUSTRIALISATION

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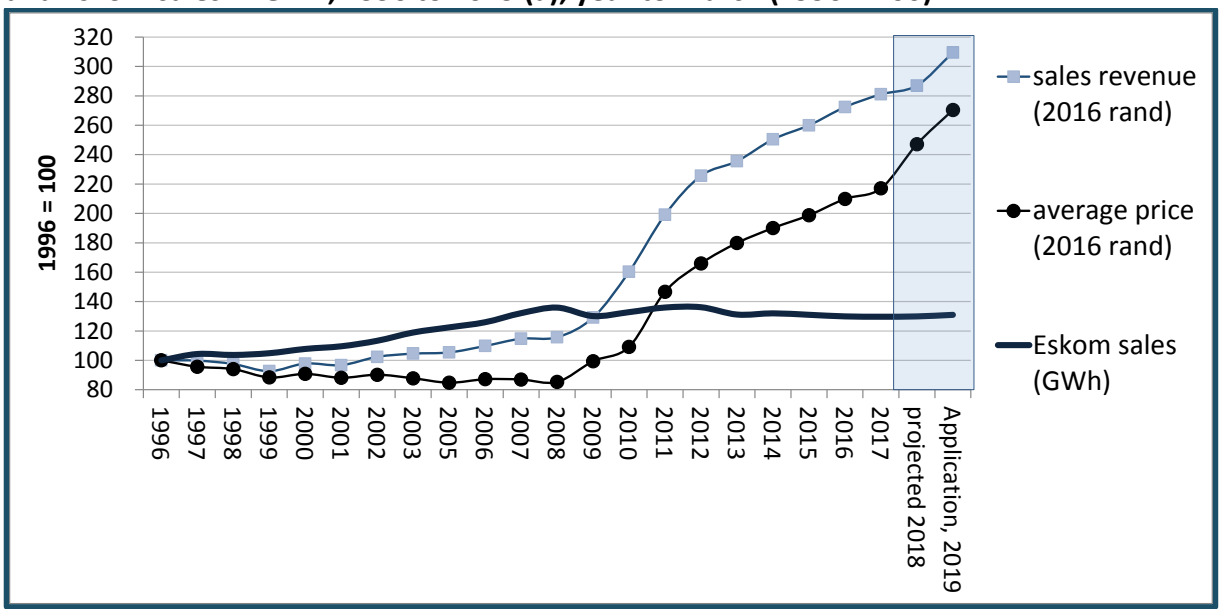
CONTENTS

1 THE PROBLEM: RISING ELECTRICITY PRICES WHILE DEMAND FALLS

In recent years, Eskom's business model has seemed increasingly delinked from, and indeed damaging to, the real economy. Its electricity sales have fallen 9% since 2011 while its prices have more than doubled since 2008. (See Graph 1). In August 2017, it applied for a 19,9% average increase in electricity prices for 2018/9. Its application would mean a 27% increase for municipal customers, which includes three quarters of manufacturing. Eskom's latest application largely results from its determination to maintain its older, more costly plants and to sustain very large investments in new capacity despite stagnating sales.

Graph 1. Indices of Eskom's average price per kWh and sales revenues in constant rand, and Eskom sales in GWh, 1996 to 2019 (a), year to March (1996 = 100)

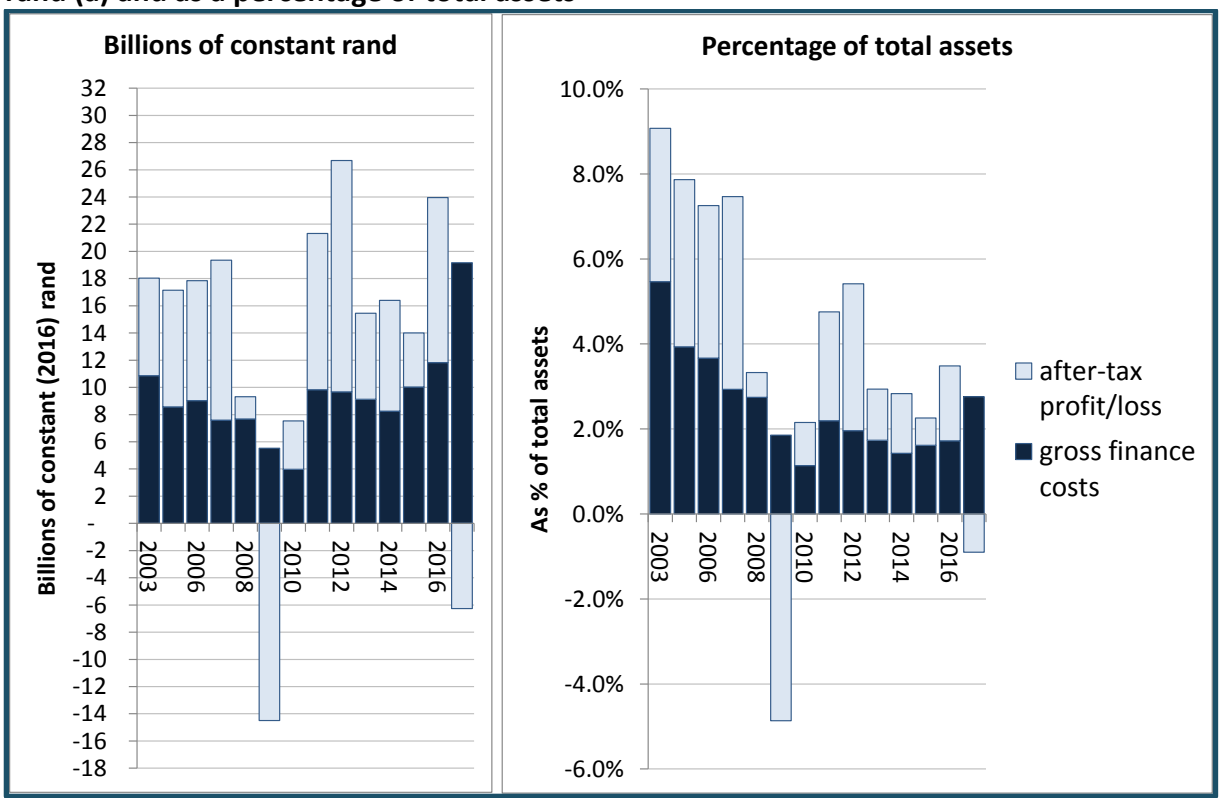


Notes: (a) Figures for 2017/8 and 2018/9 are Eskom projections. Average price is deflated using CPI for March.
Source: Average price calculated from figures for revenue and sales. For 1996 to 2016, Eskom Annual Reports for relevant years. 2004/5 figures estimated from Eskom figures for 15 months. For 2018 and 2019, Eskom. 2017. *Revenue Application 2018/19.* Johannesburg. Pages 14 and 36.

Since 2012, the largest cost driver for Eskom has been high levels of investment. This has led to higher financing costs from 2014 principally because of significant borrowing to pay for massive investments since 2008. It has also boosted depreciation and operating costs. As a result, although rising prices for electricity increased Eskom's revenue despite falling sales in volume terms, its profits have become increasingly unstable. As Graph 2 shows, in 2017 Eskom made a loss.

Eskom's investment and pricing strategy makes sense if demand for electricity were likely to strengthen greatly at least in the medium term. Otherwise, there is little promise of benefits down the road to offset the damage done to the economy, and specifically to manufacturing, by its high tariffs and investment.

Graph 2. Eskom finance costs and after-tax profits/losses in billions of constant (2016) rand (a) and as a percentage of total assets



Notes: (a) Deflated using CPI for March. *Source:* Calculated from Eskom Annual Reports for relevant years. Information on finance costs, after-tax profit or loss and total assets.

It follows that the first step toward a rational strategy on electricity pricing for industrialisation is to establish an evidence-based understanding of the drivers of electricity demand. To achieve that end, this working paper note first reviews the factors behind stagnant Eskom sales. The two main factors have been the rapid increase in electricity tariffs from 2008 and the end of the metals price boom that lasted from 2003 to 2011.

In response to escalating electricity prices, energy-intensive producers introduced new sources of energy and more efficient technologies. That means they permanently shifted down their demand curve for electricity. The trend away from Eskom has been accelerated by concerns about climate change, which fostered a move toward renewable energy and gas. At the same time, the sharp fall in metals prices from 2011 led to downsizing along the mining value chain – a key source of demand for Eskom. IMF forecasts, and a review of commodity cycles over the past century, suggest that these markets are not likely to recover soon.

Section 2 analyses why Eskom's response to these changing conditions has become so paradoxical. It finds that Eskom's path dependency is generated by the current regulatory framework for electricity prices combined with Eskom's attachment to an outdated business model.

The regulated pricing system for electricity effectively rewards falling sales with higher tariff increases, without encouraging Eskom to manage down its fixed costs. Eskom's tariff applications are based on estimates for its own costs, including a percentage return on its

existing capital base plus depreciation. The National Energy Regulator (Nersa) can cut Eskom's claims, but it cannot easily enforce efficient production or a more realistic approach to asset management. Moreover, Eskom has substantial power to back up its demands for higher tariffs. Historically, it has consistently argued that inadequate revenues risk destabilising the grid, load-shedding, and loan defaults. Ultimately, this pricing system undermines effective cost controls, opening the door to corruption and waste as well as enabling Eskom's failure to adapt to new realities.

Eskom's business model has always centred on a continual increase in electricity production through large-scale projects especially in coal and nuclear. This model made sense when the economy was centred on expanding mining and first-stage beneficiation. It made Eskom a pillar of the minerals-energy complex. But it is less relevant as South Africa shifts toward more advanced industrialisation.

In the face of changing economic realities, Eskom justifies clinging to its old business model by developing persistently unrealistic demand projections and trying to limit independent renewable producers. In the most recent tariff application, for instance, Eskom's sales forecasts rely principally on optimistic internal estimates for GDP growth while ignoring the National Treasury's more moderate expectations. Moreover, it has pressured government to limit independent generation, including for producers' own use, even where it would reduce costs for manufacturing.

The third section of this paper provides a systematic assessment of the costs, benefits and risks of three options for responding to the new conditions. The first is the *status quo*, which is effectively to continue to increase tariffs and investments and try to keep out other producers, and assume demand will recover in time. The second, which Eskom prefers, is for government to subsidise energy-intensive users to boost demand despite continuing large tariff increases for most users, including the bulk of manufacturing. The third option would require that government undertake a genuine turnaround strategy. It would entail holding down electricity prices especially for manufacturing while revising Eskom's investment plan to promote greater flexibility and lower costs. It would include accelerating the mothballing of older, less efficient Eskom plants, and facilitating renewable energy production for own use as well as the grid.

The evaluation of these options indicates the following key decision points.

First, Eskom's historic model was designed to support the mining value chain, in part by imposing higher costs on other industries. Historically, this approach was central to the growth of the minerals-energy complex. Reversing it will require the capacity to manage pressure from stakeholders that currently make a livelihood from mining and refining, including the provision of coal to Eskom.

Second, the decision will depend in part on how the country prioritises efforts to mitigate climate change and encourage renewables as an increasingly important source of innovation. In that context, South Africa needs a realistic understanding of the possibility of international action to promote reduced emissions, for instance through offshore carbon taxes.

Third, it is important to assess the actual economic feasibility of Eskom's preferred solution, irrespective of the impact on industrialisation. The core question is whether South Africa can in fact attract major electricity-intensive projects given the prospects of flat metals prices for the foreseeable future, relatively high baseline electricity prices, and declining overall domestic and foreign investment. If new refineries can only be attracted with substantial state subsidies, then the strategy would effectively squeeze support for other, more advanced, comparatively labour-intensive and cleaner industries.

Finally, any viable strategy has to take into account the state's limited capacity to redirect Eskom. In the past few years, efforts to discipline Eskom have generally led to pushback including through load shedding, arguments they will renege on debt, and demands for increased Treasury support.

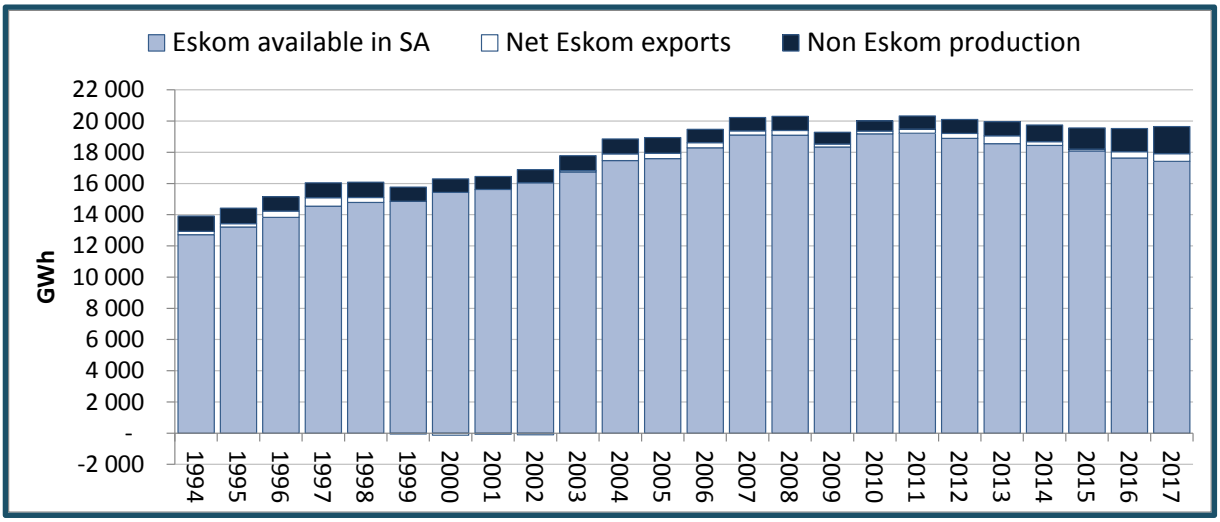
2 FALLING ESKOM SALES

Eskom argues that its prices must keep rising because it cannot reduce its fixed costs when its sales fall, leading to higher unit prices. This section first describes trends in sales in more detail. It then explores the rising unit costs and the end of the metals boom that underlie stagnant Eskom sales.

2.1 Trends in demand

Eskom's sales of electricity declined by 9% from 2011 to 2017, using the year to August (See Graph 3). The fall contrasted with growth of 26% from 2000 to 2007 as well as a strong recovery from the dip in the 2008/9 global financial crisis. Total electricity production, including non-Eskom sources (mostly renewables), fell more slowly, by 3% from 2011 to early 2017. Non-Eskom producers doubled their production, although they remained just 8% of the total.

Graph 3. Average monthly electricity used in South Africa by type and source, year to August

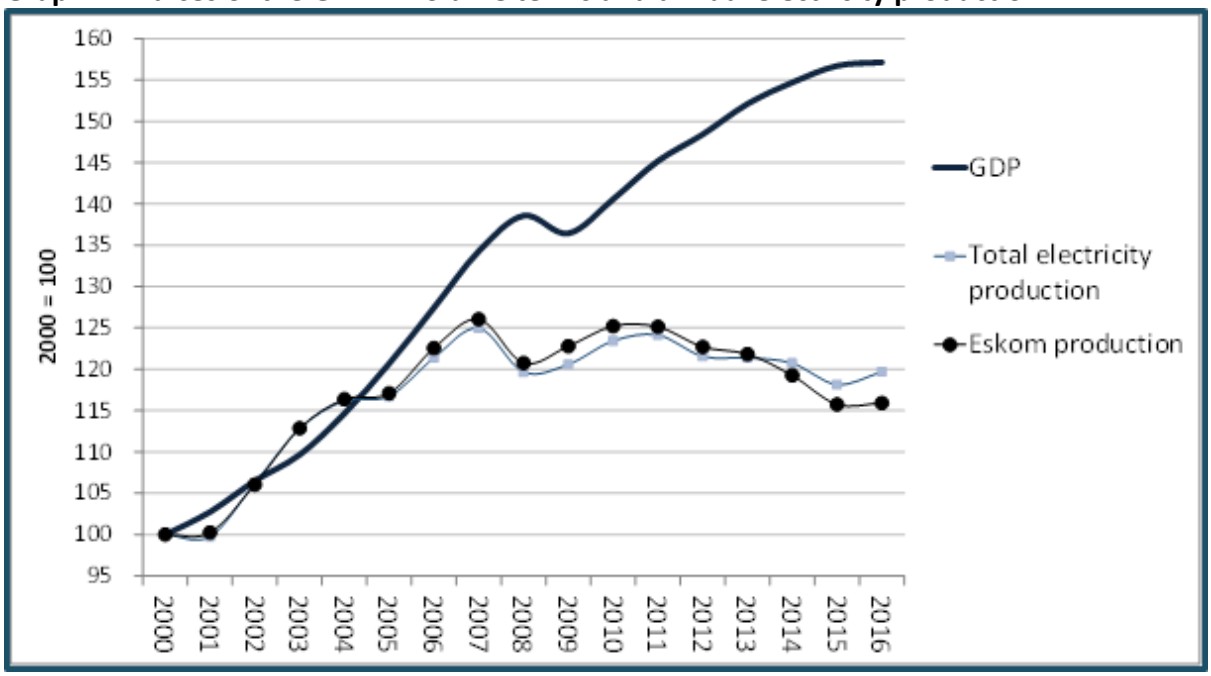


Source: Calculated from Statistics South Africa. Electricity generated and available for distribution. 201708. Excel spreadsheet. Series on monthly electricity generated and available for distribution, not seasonally adjusted. Downloaded from www.statssa.gov.za in October 2017.

As the price of electricity rose, consumers of all kinds reduced their usage. For instance, Sasol shifted to imported natural gas both to reduce costs and to generate its own cleaner electricity, replacing Eskom's coal-fired energy.

The result was that electricity sales fell even though the GDP was growing. As Graph 4 shows, through 2008 the GDP and electricity demand were closely correlated. From 2008, however, as electricity prices increased while metals production dropped, total electricity sales inched downward. In this period, Eskom demand dropped by 0,5% a year although the GDP grew annually by 1,6%.

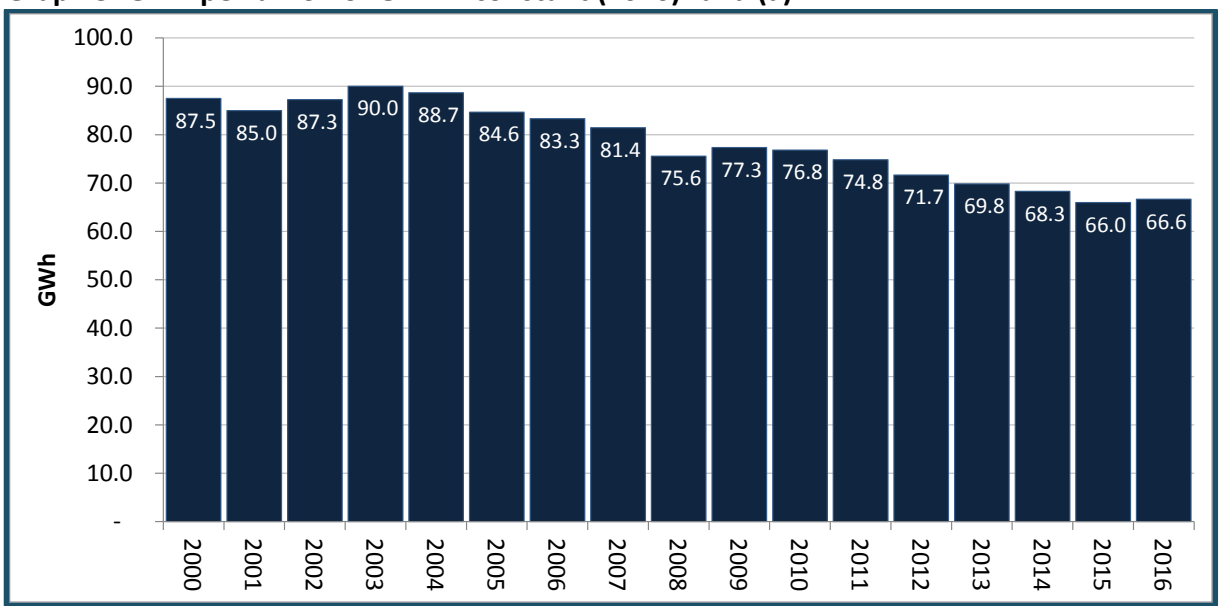
Graph 4. Indices of the GDP in volume terms and annual electricity production



Source: For GDP, calculated from South African Reserve Bank. Interactive dataset. Series on GDP in constant rand. Downloaded from www.resbank.co.za in May 2017. For electricity, calculated from Statistics South Africa. Electricity generated and available for distribution. 201703. Excel spreadsheet. Series on monthly electricity generated and available for distribution, not seasonally adjusted. Downloaded from www.statssa.gov.za in May 2017.

As a result of these trends, the energy intensity of the GDP fell markedly. From 2003 to 2016, the number of gigawatt hours required to produce a billion rand of the GDP (in constant 2016 terms) fell from 90 to 67. That represented a 26% fall over 13 years.

Graph 5. GWh per billion of GDP in constant (2016) rand (a)



Note: Deflated using GDP deflator rebased to 2016. *Source:* For GDP, calculated from South African Reserve Bank. Interactive dataset. Series on GDP in constant and current rand. Downloaded from www.resbank.co.za in May 2017. For electricity, calculated from Statistics South Africa. Electricity generated and available for distribution. 201703. Excel spreadsheet. Series on monthly electricity generated and available for distribution, not seasonally adjusted. Downloaded from www.statssa.gov.za in May 2017.

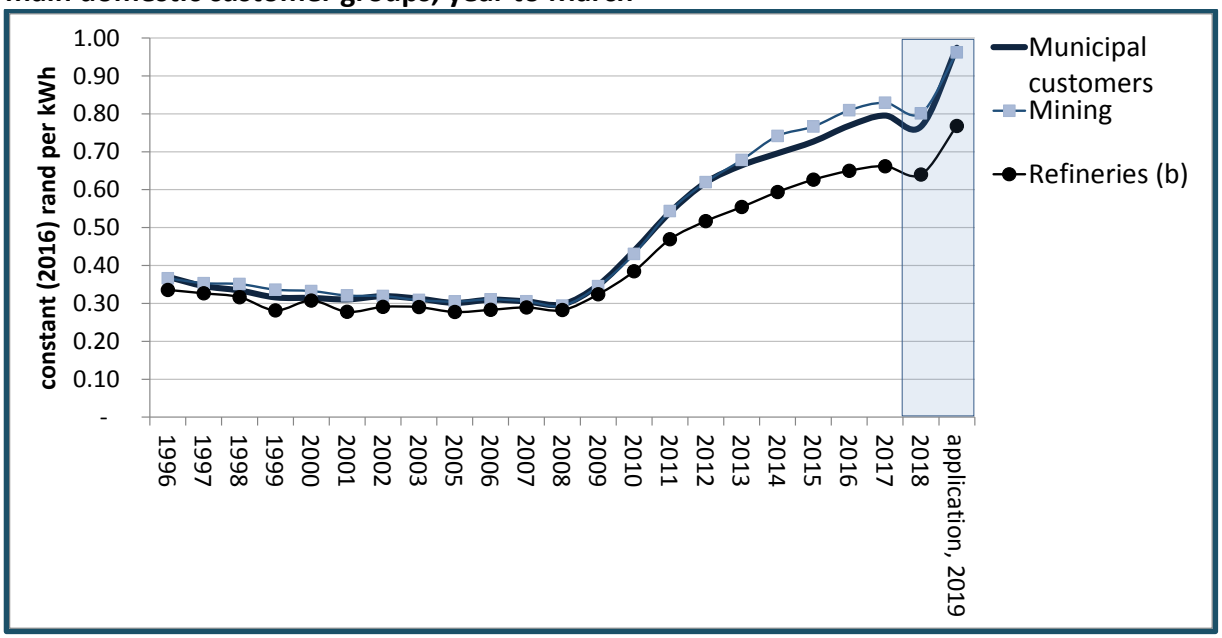
The relationship between GDP forecasts and electricity use is central to Eskom's demand forecasts. In its 2017/8 application for a tariff increase, Eskom argues that there is a near-unitary relationship between GDP growth and electricity demand, citing a correlation of between 0,93 and 1. (Eskom 2017a, p. 106) As Graph 5 shows, this relationship is changing rapidly, with growth becoming qualitatively less electricity intensive. By extension, Eskom's assumptions about future demand need to be revisited, as discussed in section 3.2.

The main factors behind falling electricity intensity have been the rapid increase in electricity prices, which over time encourages investment in more energy-efficient technologies and industries, combined with the fall in metals prices from 2012. The following sections consider each of these factors in turn.

2.2 Rising electricity prices

From 2008 to 2012, Eskom's prices doubled in real terms. From 2012 to 2016, they climbed another 25% above inflation (as measured by CPI). Nersa limited the 2017/8 price increase to 2,2%, nearly 4% below inflation. Eskom's proposed 19,9% increase for 2018/9 would effectively recoup the resulting fall in its sales revenue – but would likely lead to a further slowdown in sales.

Graph 6. Average Eskom revenue per kWh in constant (2016) rand, 1996 to 2019(a), for main domestic customer groups, year to March

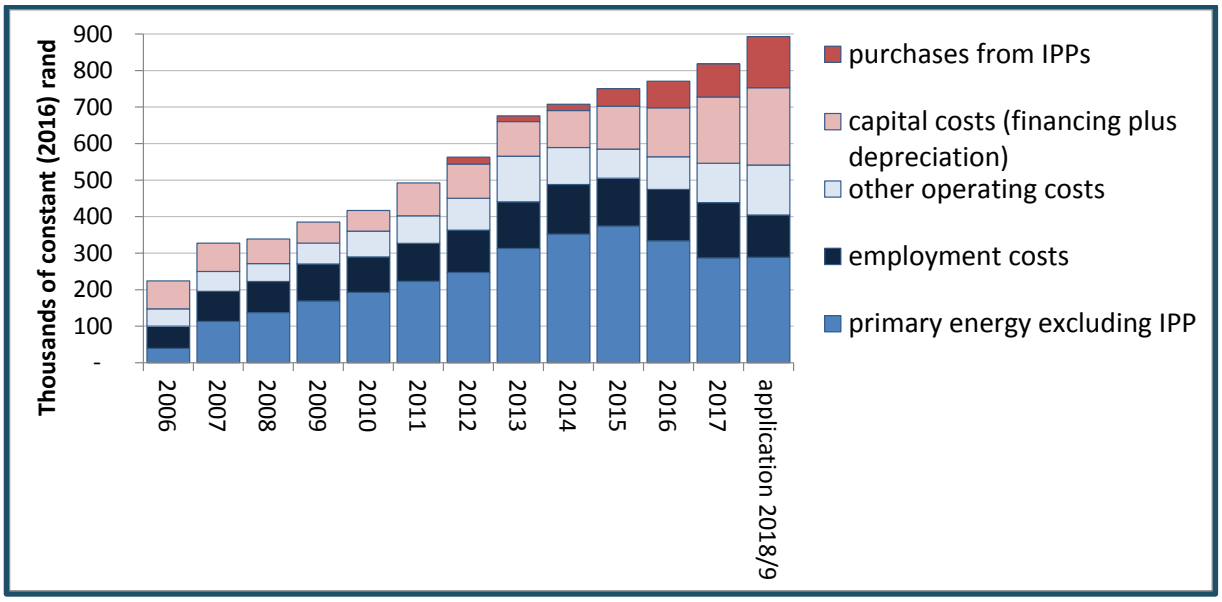


Notes: (a) Figures for 2017/8 are estimated using increases granted by Nersa for municipalities, and the average increase granted for refineries and mining. For 2018/9, the figures are increased at the rates in the Eskom application, which provides for a 27% increase for municipal customers and a 19,9% average increase overall. The average price from 1996 to 2016 is deflated using CPI for March; for 2018 and 2019, the figures are deflated using the National Treasury's forecasts for CPI in the 2017/8 Budget Review. (b) The price is charged to all industrial customers that Eskom supplies directly, of which the bulk are smelters and refineries. *Source:* for 1996 to 2016, average price calculated from figures for revenue and sales by customer category for 1996 to 2016, Eskom Annual Reports for relevant years. For 2018 and 2019, figures are increased at the rate granted by Nersa.

As Graph 7 shows, in the past five years the main cost drivers for Eskom have been capital costs, followed by purchases from independent power producers (IPPs), mostly of renewable energy. The third largest cost driver has been primary energy, mostly coal.

Eskom's cost drivers have shifted substantially over the past decade. From 2006 to the end of the commodity boom in 2012, coal accounted for most of the increase in costs per unit. From 2012 to 2017, the largest cost driver was capital spending, reflected in depreciation plus financing costs.

Graph 7. Thousands of constant (2016) rand (a) per GWh produced by Eskom (b), year to March



Notes: (a) Deflated with CPI. (b) The figures in the 2018/9 application for 2016/7 do not fully align with the figures from its Annual Report for that year. *Sources:* Eskom Annual Reports for relevant years, figures for primary energy spending, purchases from IPPs, gross payments on financing costs and depreciation, and other operating costs.

As costs other than primary energy increase, the share of fixed costs in Eskom's expenditure has risen. By definition, these charges cannot be changed quickly as output evolves. This trend means that when Eskom's sales decline, it cannot cut expenses easily. Instead, its unit costs increase. In the 2018/9 application, Eskom argues that its inability to reduce fixed costs accounts for over half of the total increase requested. Of course, in the medium term fixed costs can and should be managed down; a concern is that Eskom does not appear to have a defined strategy to achieve this end, other than to retrench workers.

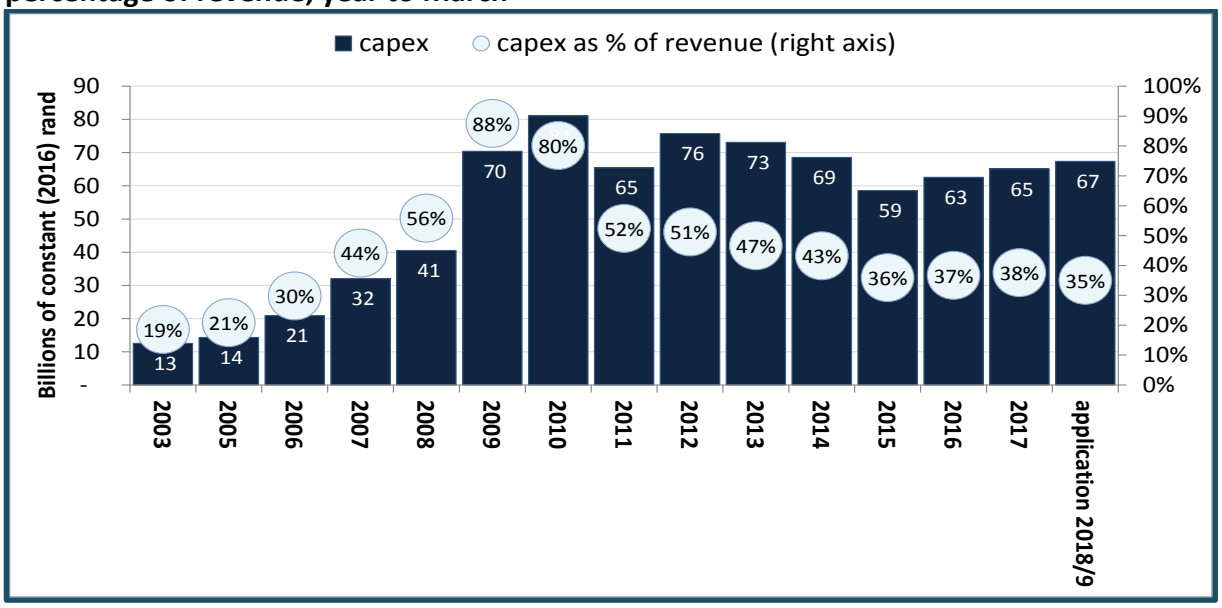
The rest of this section reviews the impact of Eskom's costs of capital investment, primary energy and purchases from IPPs.

2.2.1 Capital investment

Capital investment adds to Eskom's fixed costs in three ways. First, high levels of investment since 2003 are now feeding a rapid increase in finance payments. Second, as its capital base expands, Eskom's depreciation costs increase. Finally, as investment mushroomed from 2008, Eskom increased staffing levels, presumably in large part to support the build programme.

Eskom's capital investment climbed sharply from 2003, initially reflecting the metals price boom that boosted electricity demand. Eskom slowed its capital spending in real terms from 2010 to 2015, although it remained at an historically high level relative to national investment and Eskom's own revenues. From 2015 to 2017, despite the continued decline in electricity sales, Eskom again increased its investments in constant rand terms. According to its 2018/9 tariff application, it plans to raise capital spending by a further 3,5% above inflation in that year.

Graph 8. Eskom capital expenditure (capex) in billions of constant 2016 rand (a) and as a percentage of revenue, year to March

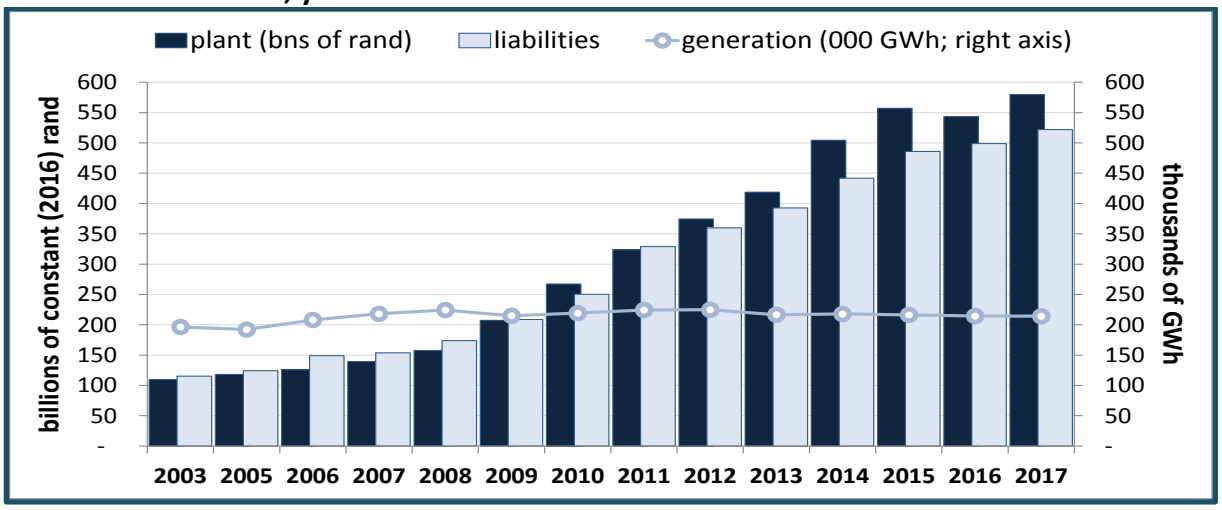


Note: (a) Deflated with CPI. For 2018/9, the forecast for CPI in the 2017 Budget Review is used. *Source:* Eskom Annual Reports, relevant years, figures for capital expenditure and revenue.

Eskom's large-scale capital investment from 2009 led to a massive increase in the value of its assets. Its debt also multiplied, as capital investment is generally funded by borrowing, to be repaid by future sales. The risk is that if its sales do not meet its expectations, Eskom will have to increase tariffs to pay for its new holdings.

As Graph 9 shows, from 2003 to 2017, in constant (2016) rand, the value of Eskom's plant and equipment climbed fourfold, while its liabilities rose 560%. In contrast, its generation rose just over 9% for the entire period, with a decline from 2011. In constant rand, Eskom had plant worth around R640 000 per GWH generated in 2007; ten years later, the figure has risen to R2,7 million.

Graph 9. Eskom's plant and liabilities in billions of constant (2016) rand (a) and its output in thousands of GWh, year to March



Note: (a) Deflated with CPI. *Source:* Calculated from Eskom Annual Reports, relevant years, data on plant and equipment, liabilities and sales in GWh. Figures for 2004/5 extrapolated from Eskom's 15-month figures.

Eskom's build programme meant that it assumed a central role in total investment in South Africa. As a percentage of national gross fixed capital formation, its capital expenditure climbed from 3% in 2003 to a high of 11% in 2010, then fell back to 7% in 2016. At the start of the Century, Eskom accounted for around 1,5% of South Africa's total fixed capital; by 2016, the figure had risen to over 5%.

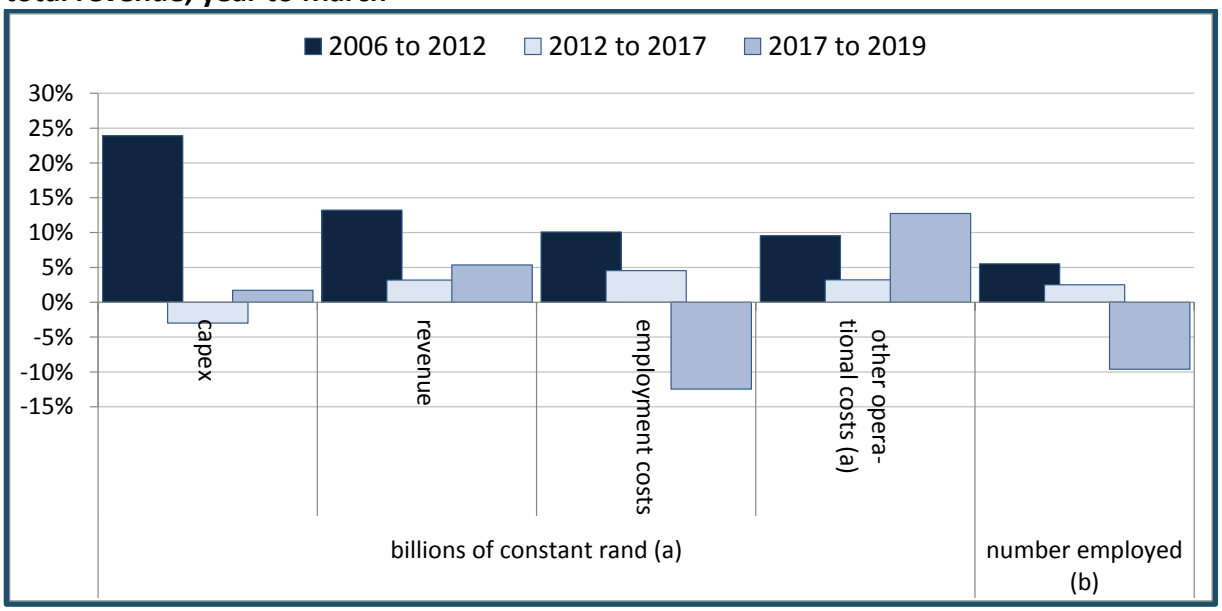
Eskom's debt costs have begun to climb as financing raised over the past decade comes due. As Graph 2 on page 4 shows, in nominal terms Eskom's finance payments bottomed out at R4 billion in the year to March 2010, but rose to R19 billion in 2017. As a result, these costs increased from 4% to 11% of Eskom's sales revenue over this period. In part, they rose because Eskom's higher debt with stagnant sales contributed to a credit downgrade. That in turn raised its cost for borrowing, including to rollover existing debt.

Eskom's capital expenditure feeds into its production costs in two ways. First, it has to meet the costs of financing. Second, it is allowed to claim a cost for depreciation based on a formula. It does not publish the figures per plant, however, making it difficult to check its depreciation estimates.

Eskom forecasts depreciation plus return on capital at around 23% of its total expenditure in 2018/9. Depreciation comes in at R29 billion and returns on capital at R23 billion. Eskom proposes to limit returns on capital in 2018/9 to debt repayment, providing neither savings nor a dividend to government. (Eskom 2017, p. 10)

Eskom's operational costs increased as its capital expenditure and revenues surged, especially from 2008 to 2012. The number employed climbed from just over 30 000 in 2006 to almost 45 000 in 2012, and reached 48 000 in 2016. In constant rand, other operating costs rose from R11 billion in 2006 to R23 billion in 2017. Eskom planned to slash jobs by 20% through 2018/9, but expected its other operating costs to continue to grow at around 13% a year above inflation from 2017 to 2019. Most of the increase was due to higher spending on maintenance.

Graph 10. Average annual change in operating costs compared to capital expenditure and total revenue, year to March



Notes: (a) Deflated with CPI. (b) Eskom's 2016/7 Annual Report does not appear to provide a figure for employment numbers, so the figures on employment numbers are for 2012 to 2016 and 2016 to 2019. *Source:* Eskom Annual and Integrated Reports for relevant years.

From the standpoint of industrialisation, two questions emerge around Eskom's investment programme.

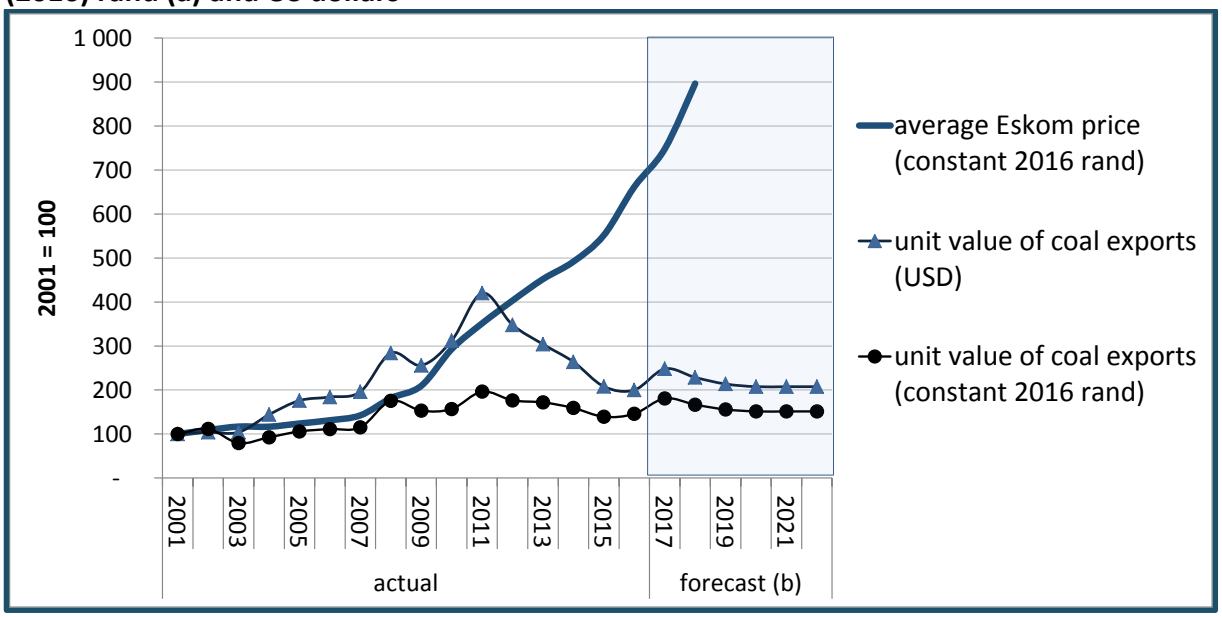
- Eskom argues that, despite current excess capacity, it has to sustain high levels of investment to meet future demand. If South Africa shifted instead to smaller-scale generation technologies, however, this kind of lumpy investment, with the associated cycle of over- and undersupply and high investment costs, could be avoided. Furthermore, as discussed in section 3.2, Eskom appears to exaggerate the likelihood of a significant increase in demand at least in the medium term.
- Eskom's investment programme has supported industrial deepening through substantial purchases of capital goods. The question is whether these benefits for industry outweigh the negative effects of rapidly rising electricity costs.

2.2.2 Primary energy

Coal accounts for four fifths of Eskom's purchases of primary energy (excluding IPPs, which are discussed in the next section). Most of the rest comes from gas, oil and diesel.

The increasing price of coal during the commodity boom from 2003 to 2012 certainly added to Eskom's price increase in this period. As Graph 11 shows, however, Eskom's prices continued to climb even after coal costs declined sharply in dollars from 2012. Rapid depreciation after the metal boom ended meant that coal prices only levelled out in rand terms.

Graph 11. Indices of Eskom's average price compared to export price of coal in constant (2016) rand (a) and US dollars



Notes: (a) Deflated with CPI. For 2017 to 2019, National Treasury forecasts for CPI from 2017 Budget Review. (b) For coal prices, IMF forecasts; for Eskom average price, based on tariff applications for 2017/8 and 2018/9. *Source:* Average prices for Eskom from 2011 to 2017 calculated from relevant Annual Reports, figures for sales revenue and amounts. For 2017/8 and 2018/9, figures are calculated using the percentage increase in tariff applications agreed by Nersa in 2017/8 and demanded by Eskom in 2018/9. For coal prices from 2001 to 2016, calculated from ITC, Trade Map. Electronic database. Series on unit price of South African coal exports in US dollars and South African rand. Downloaded from www.trademap.org in October 2017. For 2017 to 2022, calculated from IMF. Data projections actual prices through 07/13/17. Downloaded from www.imf.org in October 2017.

While coal has not been a key cost driver for Eskom since 2012, there is considerable evidence that it has not contained coal costs as well as it could. In its 2018/9 application, it anticipates that its total coal costs, including handling, will climb by 9%, or about 3% above inflation forecasts. Coal costs account for around a sixth of the total increase in unit costs that Eskom has claimed for 2018/9. Given the stagnant price of coal, there is no obvious legitimate reason for the rise in expenditure on coal.

2.2.3 Purchases from independent power producers

In 2010, government developed a programme to contract with private power producers to supply energy to the national grid. The aim was both to enhance the electricity supply at a time of shortages and to encourage generation from renewable sources (although some independent producers are engaged in co-generation rather than renewable production).

According to Eskom, its purchases of energy from independent producers will reach 18 GWh in 2018/9 at a cost of R34 billion. That amount equals around 8% of total electricity production in South Africa, up from 5% in 2017/8.

The initial unit cost of renewable energy was substantially higher than Eskom's tariff, but the unit costs of newer projects have sunk while Eskom's prices have risen. According to Eskom, the cheapest new independent producers will provide electricity at around three

quarters the price of Eskom's average tariff. (Eskom 2017b, p 27) In addition to lower direct costs, electricity from independent producers generates substantially less external costs from emissions and other pollution associated with coal generation. By extension, the actual cost for South Africa is lower than the tariffs alone indicate.

The IPP programme has provided a stimulus for manufacturing through the procurement of capital goods for the new plants. Many of the major inputs for renewable generation are designated for local procurement.

The current system, however, does not internalise any of these benefits to Eskom itself. Under the programme, Eskom is required to purchase electricity from independent producers and connect them to the grid. From its standpoint, the IPP programme imposes three new sets of costs:

- The expenses from extending the transmission network to often far-flung renewable projects.
- The required purchase of electricity from private partners. Eskom is paying substantially more than it recoups from selling this electricity, although that situation should reverse in the next few years as lower-cost projects come on line.
- An opportunity cost in terms of lost sales as private producers displace Eskom's own generation in a context of declining demand. As already noted, Eskom does not feel it can cut its costs proportionately to the decline in sales, so it sees these purchases as driving up its unit costs.

From a policy standpoint, the challenge with this situation is that the benefits of the IPP programme remain external to Eskom. Yet Eskom has a central role in making the programme work. In recent years, Eskom has explicitly opposed and delayed expansion of the programme because of concerns about its own falling sales.

2.2.4 Summary

Ultimately, both Eskom's own capital expenditure and the IPP programmes have become cost drivers because demand did not expand as expected from 2008. As a result, Eskom now faces an oversupply of electricity but feels it cannot take steps to reduce either its own capacity or that of contracted renewable producers.

From this standpoint, Eskom's tendency to prefer large-scale coal and nuclear plants imposes high costs on society. This approach made sense when the lion's share of South Africa's electricity went into very large energy-intensive projects in the mining value chain. As industrialisation progresses and consumers need smaller amounts of electricity, the dependence on mega-plants builds rigidities and difficulties in managing demand to meet supply into the process. Furthermore, the rapid evolution of generation technologies over the past 15 years or so makes smaller options more competitive.

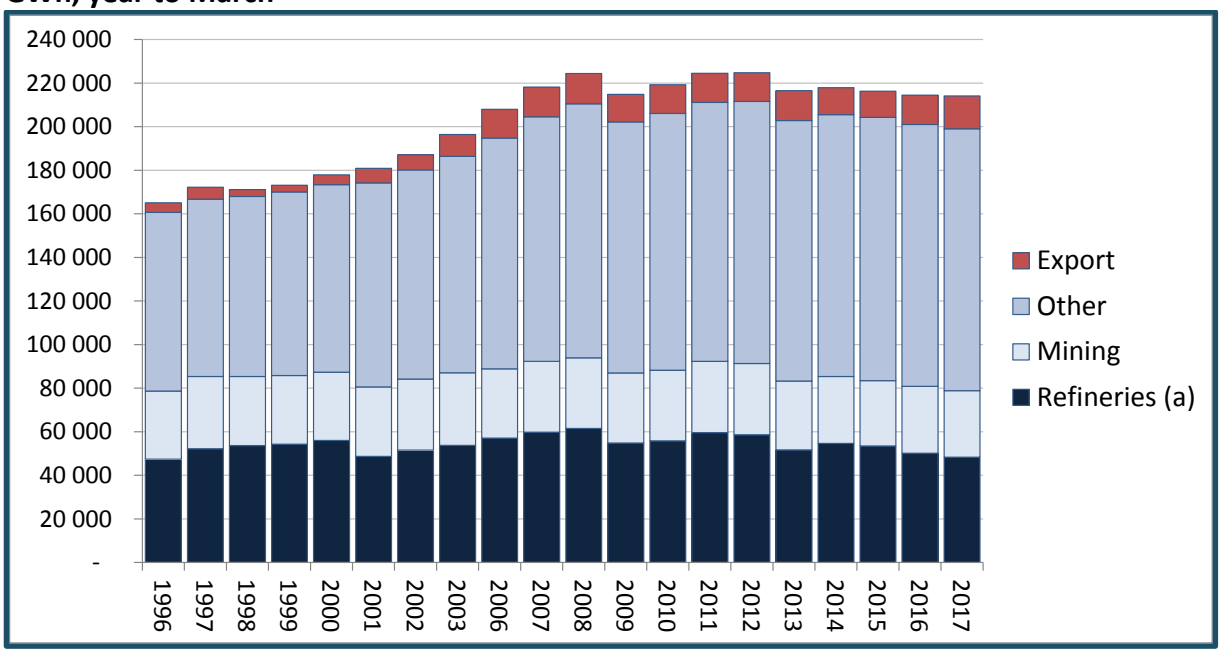
In these circumstances, exploration of smaller generation plants, agreement to close down some more expensive capacity, and some downsizing in the capital expenditure programme would help relieve the cost pressure on the national electricity system.

2.3 Economic trends and lower electricity demand

In addition to rising electricity tariffs, economic trends have also contributed to lower electricity demand. On the one hand, overall growth slowed significantly from 2012. On the other, demand from refineries and smelters has fallen particularly sharply as commodity prices have dropped and companies have sought less electricity intensive technologies.

From 2012 to 2017, the mining value chain, including Sasol, accounted for around a quarter of Eskom's electricity sales, but over 95% of the fall in domestic demand. The share of the mining value chain in Eskom's total production dropped from half in the 1990s to 37% in 2017.

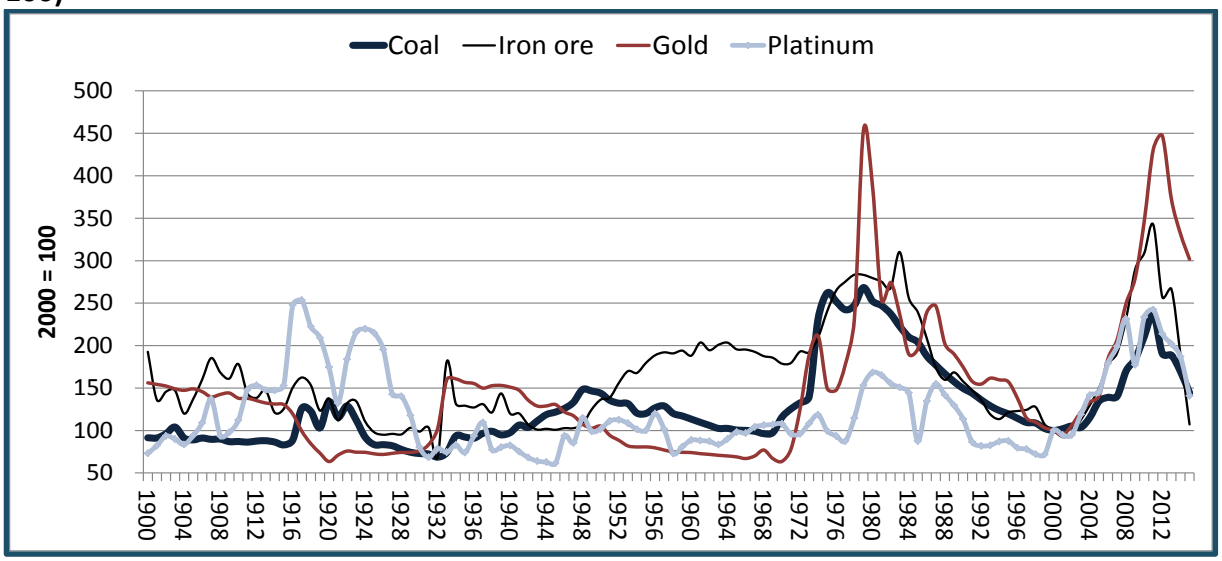
Graph 12. Eskom annual sales of electricity to refineries (a), mines and other users, in GWh, year to March



Notes: (a) "Refineries" here refers to large energy-intensive plants outside of the mines that Eskom supplies directly. Eskom refers to this group generally as "industrial" but it excludes the vast majority of manufacturers, who buy electricity through municipalities. Refineries and smelters account for most of the companies covered under Eskom's "industrial" category, but there are also some paper plants. Annual figures for 2004 and 2005 are not available because Eskom changed its financial year in that period. *Source:* Calculated from Eskom, Annual and Integrated Reports for relevant years. Figures on sales by type of consumer.

The end of the metals price boom was a central cause of the decline in the use of electricity for metals and coal refining. As Graph 13 shows, metals prices reached a 30-year high around 2011, then fell back to more normal levels.

Graph 13. Indices of major metals prices in constant U.S. dollars, 1900 to 2015 (2000 = 100)

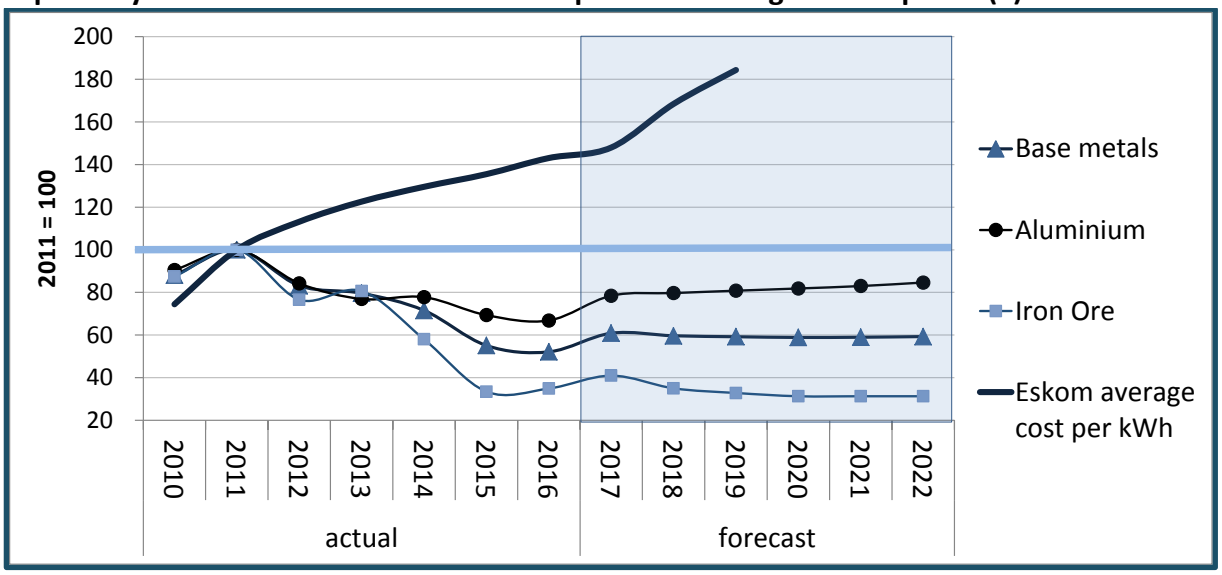


Source: Calculated from Jacks, D.S. 2016. Chartbook for "From Boom to Bust." February. Downloaded from www.sfu.jacks.ca in June 2016. Update of David S. Jacks. 2013. "From Boom to Bust: A Typology of Real Commodity Prices in the Long Run," NBER Working Paper 18874.

The future of metals prices is a critical element in evaluating whether the decline in energy intensity in the South African economy is likely to persist. In the event, as the historic trends depicted in Graph 13 suggest, it seems unlikely that a similar increase in prices will occur in the near to medium-term future. The 2003 to 2011 commodity boom appears to be part of a long, 30-year cycle combined with an international asset bubble.

The IMF projects essentially flat prices for base metals through 2022, as shown in Graph 14. It does not provide forecasts for precious metals, including gold and platinum.

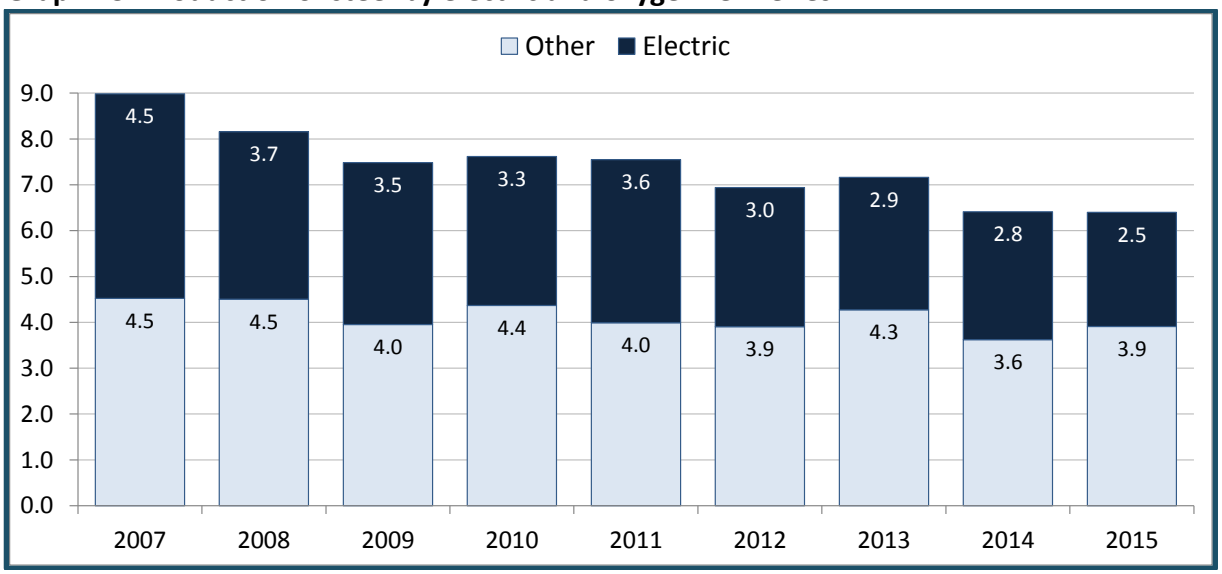
Graph 14. IMF medium-term projections in US dollars for base metals prices generally and separately for aluminium and iron ore compared to average Eskom prices (a)



Note: (a) 2019 figure based on Eskom 2018/9 application. *Source:* Metals prices calculated from IMF. Data projections and actual prices through 07/13/17. Downloaded from www.imf.org in October 2017. Eskom average price from relevant Integrated and Annual Reports, figures on revenue and sales GWh.

The combined effects of higher electricity tariffs and falling metals prices are particularly visible in the steel industry. Overall, as Graph 15 shows, steel production using electric furnaces fell by 50% from 2007 to 2015. In contrast, other kinds of steel production shrank relatively slowly, by 20%. As a result, electric steel production accounted for 75% of the total fall in steel output, although it made up just 40% of production in 2015. Among others, ArcelorMittal South Africa (AMSA) has closed down its electric-arc lines and the number of iron and steel foundries has fallen by around a third since 2008.

Graph 15. Production of steel by electric and oxygen refineries



Source: Calculated from, South African Iron and Steel Institute. Crude steel production. Data in Excel format. Downloaded from www.saisi.co.za in May 2016

2.4 Conclusions

The available evidence suggests that:

- Eskom's high prices in themselves have led to a structural shift away from electricity consumption, and
- The end of the commodity boom that lasted from 2003 to 2011 has caused additional downsizing along the mining value chain, which historically formed a key customer for Eskom.

These developments mean that the decline in demand for electricity is now rooted in changed technologies. By extension, even a reduction in tariffs would not see an immediate jump in demand.

In light of these realities, a central question becomes why Eskom has continued to pursue a strategy of claiming high tariff increases and expanding its generation capacity. The following section explores the systemic factors that underpin this counter-intuitive response.

3 SYSTEMIC FACTORS BEHIND ESKOM'S RESPONSE TO FALLING DEMAND

Two systemic factors promote Eskom's path dependence in the face of significant shifts in the economy over the past five years.

- The pricing system, which is regulated and managed by Nersa as an independent regulator, does not ensure effective interrogation of costs or manage Eskom's ability to use its control of the grid to counter efforts to induce greater efficiency and support additional producers.
- In this context, Eskom consistently overestimates demand and seeks to maintain its position as sole supplier in electricity, rather than managing down fixed costs other than employment and developing smaller-scale and cleaner technologies.

The rest of this section describes each of these systems in more detail.

3.1 The pricing system

The pricing system is managed by Nersa under the Electricity Regulation Act of 2006. The principles for regulating the price laid down in the Act are largely replicated from other countries that sought minimise rent-seeking by private oligopolistic utilities rather than a single state supplier. They centre on the idea that the regulator's job is to prevent monopoly rents by (a) promoting efficiency to hold down costs, and (b) on that basis, setting tariffs to enable a reasonable return on capital (See para 16(1) in the Act). The assumption at the time was that more private producers would be allowed to supply the grid.

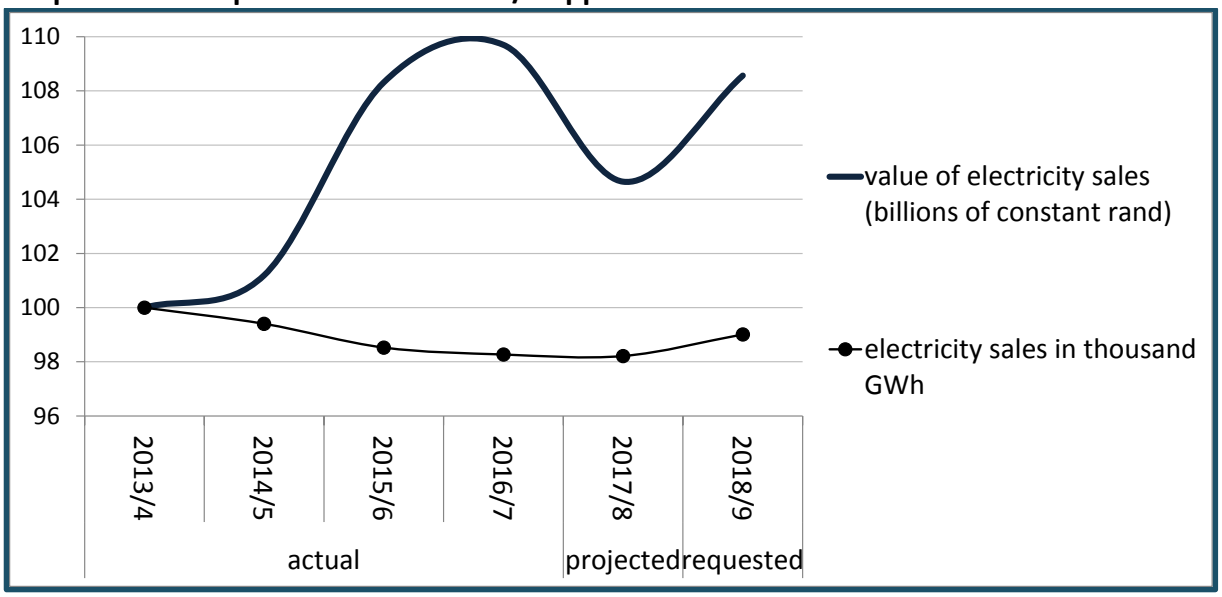
This model does not work if the regulator cannot ensure that utilities minimise costs. In the event, Nersa has neither the legal power nor the institutional capacity to challenge key cost drivers at Eskom. It can refuse to accept some of Eskom's cost claims, and on that basis set a lower increase than requested. But it cannot require action to reduce costs, change unrealistic strategies, or hold the Eskom board and executives responsible for cost overruns.

A particular challenge has been that Eskom has disproportionate power since it can inflict substantial economic and political pain on Nersa and on government. If the regulated system is analysed as a bargaining process, then the following balance of power emerges.

- The pricing system lets Eskom claim for its costs plus a return on capital. It is, however, difficult for Nersa to prove that Eskom is wasteful or inefficient, or that it overstates calculated costs such as the return on capital and depreciation. Moreover, Eskom can claim that its costs are fixed even when output is declining. In these circumstances, the pricing system effectively ends up facilitating the vicious cycle where Nersa approves increases in Eskom's prices precisely because its sales decline, in turn further depressing demand.
- As an independent regulator, Nersa has constrained scope for direct collaboration with government to secure a coordinated approach to Eskom. In practice, Eskom is able to forum shop, building alliances with Nersa or with officials in state departments (Energy, Public Enterprises and even the Presidency) to counter decisions that it opposes.

- Nersa does not control practical decisions about the electricity system. That means it cannot compel Eskom to respond as hoped to pricing decisions.
- In contrast, Eskom has considerable power due to its unparalleled knowledge of system requirements and its ability to make disruptive decisions on the electricity supply and its debt payments. Moreover, it can use its access to the media to blame perverse outcomes on the regulators and government. In meetings on pricing, investments and the regulatory framework, its representatives do not hesitate to argue that any decision with which it disagrees may lead to loadshedding, destabilise the national grid, or lead it to default on its massive debt. In 2008, Eskom successfully convinced most commentators that loadshedding resulted from government and Nersa efforts to restrict its prices and investments rather than its own poor management and planning.
- If Nersa does not meet Eskom's tariff claims in full, Eskom can build the unmet costs into subsequent bids. It can also demand that the state provide it with additional loans or investment to compensate for lower revenues. From this standpoint, as the following graph shows, Eskom's 2018/9 application represents an effort to recover from the low tariff approved by Nersa in the previous year.

Graph 16. The impact of Eskom's 2018/9 application on its revenue



Source: Calculated from Eskom Integrated and Annual reports through 2016/7 and from Eskom. 2017. *Revenue Application FY2018/19.* Johannesburg.

- Finally, Eskom routinely starts with a bid for a very high tariff increase. This appears to be a version of a stance in power negotiations that involves an exaggerated initial demand in order to push up the parties' expectations for settlement.

In short, the current price-setting system for electricity effectively rewards Eskom for high costs in most cases. Moreover, it leaves the regulator at a disadvantage in terms of both technical capacity and economic power. In these circumstances, Nersa has proven unable to moderate Eskom's prices substantially, or to ensure a rational investment strategy in light of rising electricity costs and falling demand.

3.2 Eskom's business model

Eskom's business model is rooted in its history as a core pillar of the minerals-energy complex. Historically, its role was to generate low-cost electricity based on South Africa's abundant coal reserves. That in turn led to a reliance on large coal plants to the near-exclusion of other technologies. This approach is linked to a cycle of oversupply when new plants are commissioned. In oversupply phases, Eskom has encouraged new energy-intensive projects, mostly refineries, above all by committing to supplying low-cost electricity.

From the standpoint of industrialisation, this strategy historically entailed significant opportunity costs. On the one hand, it effectively diverted investment into the mining value chain, typically only in the first stages of beneficiation. The major refineries have, however, not been required to provide inputs for downstream manufacturers at a competitive price. Instead, they have mostly exported basic metals. On the other hand, by subsidising electricity for energy-intensive, mining-based projects, the strategy effectively ended up imposing higher prices on more innovative and advanced manufacturing.

The metals price boom of the last decade began to undermine Eskom's long-standing business model. In response to soaring demand from the smelters and refineries, Eskom embarked on an accelerated build programme. At the same time, the commodity boom spiked primary energy prices, including coal. Given the opening of the economy with the end of apartheid, the result was rising coal exports, putting upward pressure on input costs for Eskom. Both these factors pushed up the price of electricity. Initially, however, high prices for metals compensated electricity-intensive producers for the resulting hike in production costs.

This model stopped working altogether when metals prices dropped. It left Eskom with high investment costs, excess capacity, and generally inflated operating costs. As a result, it had much less space than in the past to cut electricity costs to attract energy-intensive projects. Eskom itself argues that its electricity price is now at the norm for industrialised economies. (Eskom 2017a, pp. 108-9) In contrast, 15 years ago it was among the cheapest in the world.

In response to these conditions, Eskom has consistently counted on an uptick in electricity demand based on GDP growth, while ignoring the structural decline in electricity intensity over the past 15 years. It also hopes to return to the practice of subsidising electricity for large-scale users.

The 2017/8 application exemplifies Eskom's optimistic approach to GDP growth. It combined a high economic growth forecast with an assumption that electricity demand would recover almost as rapidly as the GDP. Specifically:

- The application incorporates a growth forecast of 2,7% for 2019. It derives this optimistic projection by combining a 3% prediction from the Eskom Treasury and Investec at the high end with an IMF figure of 2,4%. It simply leaves out the National Treasury's 2019 forecast of just 2,2% in the 2017 Budget, although it gives the figures for

2017 and 2018. (Eskom 2017a, p. 39) The IMF forecast was downgraded to 1,6% in October 2017.

- Eskom does not itself estimate the relationship between GDP growth and electricity demand. It cites consultants, however, to the effect that (a) average GDP growth through 2021 will equal 1,8% a year, and (b) electricity sales will therefore rise at an average of at most 1% a year. (Eskom 2017a, p. 107) This assessment simply ignores the fact that electricity use declined from 2011 despite growth in the GDP. From 2008 to 2016, the GDP expanded an average of 1,6% a year but electricity demand fell by 0,5% annually.
- Finally, Eskom argues explicitly that it cannot calculate the price elasticity of demand for electricity, and apparently concludes that it can therefore simply ignore it. (See Eskom 2017a, p. 41)

Taken together, these factors enable Eskom to assume that electricity demand will pick up when GDP growth accelerates, irrespective of soaring tariffs and stagnant metals markets.

Despite this apparent optimism, Eskom also calls for a return to its historic practice of promoting investment in energy-intensive projects. In its 2018/9 revenue application, it says "Eskom has developed a framework to stimulate local demand with four key elements geared to supporting existing customers to expediting projects in construction". In this context, it called for "incentives and support packages from SA Inc perspective" (Eskom 2017a, pp. 47-48).

This approach entails two risks.

First, the strategy seems unlikely to work in the context of higher electricity costs, especially given low metals prices. Existing subsidies for smelters already impose significant costs on Eskom, effectively raising electricity prices for producers and consumers outside the mining value chain. Thus, Eskom has contracts with Hillside and Bayside smelters that link the price of electricity to the aluminium price in London translated into rand. Since metal prices dropped from 2011, it has effectively subsidised the smelters to the tune of R10 billion a year.

Second, the strategy would effectively strengthen South Africa's dependence on exports of unfabricated metals. In contrast, the national industrial policy seeks to diversify the economy into more dynamic and value-adding industries. In an energy and climate constrained world, it seems undesirable to encourage relatively low-value-add electricity-intensive projects to prop up the national electricity utility. Ultimately, sustainable industrialisation requires diversification out of mining and by extension away from the main areas of energy-intensive growth.

In addition to seeking to bolster electricity demand while maintaining high prices overall, Eskom has begun to resist government support for renewable producers. In its 2017 Integrated Report (Eskom 2017b, p 27), for instance, it argues that increased renewable generation comes at the cost of coal miners and their communities, and potentially the

economy as a whole. In 2017, it publicly resisted providing transmission facilities to renewable projects.

In October 2017, the Minister of Energy sent a letter to businesses informing them that permits for own generation would be delayed in large part to protect demand for Eskom.[1] In effect, that approach requires industry to pay a higher price for electricity to sustain Eskom, rather than developing new technologies that would cut production costs.

In sum, Eskom's historic business model can be summarised as expanding the supply of electricity based on cheap coal, including by promoting new refineries and smelters. That model does not work once its electricity is no longer priced well below the global norm. Moreover, the model tends to reinforce dependence on the mining value chain while increasing costs for the rest of the economy as well as climate-changing emissions.

4 OPTIONS FOR CHANGE

This section uses the SEIAS (Socio-Economic Impact Assessment System) approach to evaluate the benefits, costs and risks of options for transforming Eskom's business model. In particular, the impact on different groups of stakeholders as well as the main threats to success are assessed.

The options considered are:

1. Eskom's existing strategy, which in effect seeks a continual increase in tariffs and investments while limiting access to other producers, on the assumption that electricity demand will recover in time.
2. Government subsidies for energy-intensive users to boost demand, while Eskom continues to raise tariffs well above inflation for the foreseeable future.
3. Government gets Eskom to undertake a genuine turnaround strategy that would entail moderating electricity price increases especially for manufacturing, and reviewing its investment plan to reduce costs and promote smaller-scale and more flexible plants. It would include accelerating the mothballing of older, less efficient Eskom plants, and facilitating independent renewables for own use as well as the grid.

The analysis considers the implications of each of these options for

- Manufacturers inside and outside of the mining value chain,
- Working people, through the impact on job creation and wages,
- Government, especially in terms of capacity requirements and funding, and
- Eskom.

As Table 1 shows, the assessment points to the following conclusions.

- The *status quo* option is best able to deal with a surge in demand, for instance if global growth picks up or metal prices spike again. The question thus becomes how much the

[1] Minister of Energy, Government of South Africa. "Response to request for approval for to [*sic*] deviate from the integrated resource plan 2010-30." Letter dated 3 October 2017.

country should pay to provide for a rapid increase in electricity demand, which currently seems highly improbable. That in turn raises the question of whether a less expensive way to mitigate this risk is viable, for instance by developing smaller-scale generation options that can be brought on line relatively quickly.

- As Eskom notes, providing subsidies for refineries seems unlikely to work on a large scale unless government provides substantial additional resources. In the absence of some kind of subsidy or equivalent protection, the combination of high electricity prices, depressed metals markets, and low overall investment would make new refineries excessively unattractive.
- If government subsidises refineries and smelters, the direct benefits for production and employment will be very limited, although there could be a boost for exports. Historically, however, South Africa has not been able to leverage the beneficiation of metals to support downstream manufacturing, in part because of monopoly pricing by the mines and refineries. If downstream multipliers were realised, the impact would be significantly improved.
- A shift in Eskom's business model to support broader industrialisation rather than focusing on support for the mining value chain would bring about higher job creation as well as more sustained growth. But this kind of strategic change entails considerable risks of instability as well as contestation.
- An assessment of the costs and benefits of the options requires a more detailed evaluation of the implications of high-emissions growth for climate change and, more immediately, international trade opportunities. If key trading partners were to impose sanctions on high-emissions products, then the cost of subsidising coal-based electricity would be higher.
- Any option that reduces demand for coal will affect livelihoods in Mpumalanga. Eskom and its suppliers have already begun to lobby to protect the coal value chain irrespective of the cost of its externalities for the country as a whole.

Table 1. Assessment of options

	Option 1: *Status quo*	**Option 2: Subsidies**	**Option 3: Turnaround**
Key elements	Continued high capex with price increases to offset lower demand, while waiting for GDP growth to recover and with it electricity demand	Continued high capex Subsidise refineries to promote higher demand, moderating increase in unit costs	Change Eskom's mandate to support industrialisation and renewables generation; shift to smaller more responsive plants; slow down capex

	Option 1: *Status quo*	**Option 2: Subsidies**	**Option 3: Turnaround**
Risks	GDP growth remains slow, in part due electricity pricing GDP recovers but electricity demand remains low due high prices	Unable to attract major projects at all given high baseline electricity cost and low metal prices Attract major projects only by providing massive subsidies plus cheap electricity	Eskom resists slower growth, lower capex, and possible downsizing GDP growth picks up unexpectedly, leading to electricity shortages
Mining value chain	Benefits: Electricity supply will be there if metal prices spike again Cost: High price of electricity leads to closure or requires high investments to increase electricity efficiency	Benefits: Subsidy for investments Cost: Risk that will lose subsidy and metal prices do not recover	Benefits: Moderate price increases in the longer run; greater scope to generate own electricity, e.g. as by-product Cost: Risk of undersupply when mining cycle turns
Other manufac-turers	Benefits: Electricity supply improves in quality as demand falls Cost: High price of electricity and cost of adapting to it	Benefits: Able to supply new projects especially with capital goods; may be able to use output if manage downstream pricing; some moderation in price hikes in unit costs as Eskom sales increase Cost: Less access to incentives and subsidies, as absorbed by new mining projects; high electricity prices due effective cross subsidy for energy-intensive producers; long run risk of trade sanctions due high emissions	Benefits: Moderation in electricity prices; able to supply alternative energy projects; reduced risk of trade sanctions due to high emissions Cost: Risk of electricity shortage if growth takes off unexpectedly; new systems are always less stable

	Option 1: *Status quo*	**Option 2: Subsidies**	**Option 3: Turnaround**
Working people	Benefits: Less risk of loadshedding due oversupply Costs: Slower growth and job creation; high electricity prices; job losses at Eskom and in coal as demand falls	Benefits: Limited jobs created in mining value chain but multipliers in communities and due to exports; sustain coal jobs Cost: Lessened support for labour-intensive industries in short run, and in long run slower industrialisation and job creation; pollution around mining communities leading to worse health outcomes	Benefits: Moderate electricity prices lead to greater growth and job creation; reduced risk of trade sanctions due high emissions Costs: Risk of electricity shortage in case of unexpected growth spurt or unstable systems as Eskom restructures; job losses at Eskom and in coal
Govern-ment depart-ments	Benefits: Continue with familiar approach Cost: Increasing subsidies to Eskom; slower growth brings various social problems and policy contestation	Benefits: Continue with known approach; visible, large-scale investments in mining value chain; do not need to confront Eskom over plans Cost: Slower and more unequal growth with resulting social problems and policy contestation; high cost to fiscus	Benefits: Stabilise the electricity industry at a reduced price and greater responsiveness Cost: Confrontation with Eskom and risk of perverse outcomes; risk of being blamed for shortages if growth picks up unexpectedly
Eskom	Benefits: Avoid disruption; continue to get high prices at least in short run; maintain investment programme Cost: Job losses; public anger; business model becomes increasingly unsustainable if growth and/or metal prices do not pick up soon	Benefits: Expand demand and therefore operations Cost: Need to maintain subsidies for new projects until higher metal prices kick in and possibly for longer, given higher baseline cost of electricity; slower growth in demand outside of mining value chain due continued high prices to sustain subsidies to mining value chain	Benefits: More sustainable model; stable growth in demand in long run due to industrialisation Cost: Reduced capex and need to redirect operations and investment toward smaller scale and renewable technologies; may have to cede market share to other producers; accepting change

5 CONCLUSIONS

The current electricity model incorporates a paradox in which continual increases in price contribute to falling demand, which in turn leads to higher unit costs and prices. In this context, high levels of capital expenditure by Eskom have become a critical cost driver.

The contradictory response of raising prices in the midst of declining sales results in part from weaknesses in the regulatory framework for electricity prices, and in part from Eskom's business model. In particular, Eskom has long functioned on the basis of:

- Large investments in low-cost coal-fired electricity, especially to facilitate investment in the mining value chain;
- As a result, alternating periods of over- and undersupply, with Eskom actively promoting investment in electricity-intensive refineries during periods of oversupply.

In line with this strategy, Eskom wants to sustain its capital programme despite low demand by subsidising investors in refineries and smelters. Given a relatively high baseline tariff for electricity and depressed metal prices, however, it seems likely that this approach will prove less successful than it has in the past. As a result, Eskom is requesting additional subsidies from the state for new energy-intensive projects.

This strategy risks countering the push for diversification away from the mining value chain. In effect, government has to decide between supporting refineries and assisting other kinds of manufacturing that are more labour intensive, sustainable and dynamic. If government were to subsidise metals refineries, as a minimum it should require a strategy to support downstream fabrication on a large scale.

Finally, given global concerns about climate change, the sustainability of a growth path based on subsidising electricity use seems dubious. Beyond the ethical issues, there is a risk that the international community will ultimately impose sanctions on energy-intensive economies or products.

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