7TH ANNUAL COMPETITION AND ECONOMIC REGULATION (ACER) WEEK

Analysing South Africa's energy policy and regulatory reform: the case for promoting climate and competition considerations in policy formulation

Nonhlanhla Msimango[1], Carla Orffer[2]

Abstract

Affordable, reliable, and renewable power supply is not only essential for economic recovery but to ensure the economy reaches its potential output over the long term. However, the policy framework has lagged the market's need for (i) competition to address increasing tariffs and the widening capacity shortfall and (ii) the increased role of renewable energy to facilitate the country's energy transition. The study reviews the historical context and the current regulatory framework of the South African energy sector to assess the extent to which competition and climate change have been key considerations in driving policy reform and implementation. Furthermore, the study assesses the cost of neglecting these objectives in policy formation by assessing the impact on the energy system, the economy and the environment. The energy sector has undergone rapid reform in the past three years, largely as a response to the energy crisis, however, competition and climate benefits are expected. The lifting of the embedded generation threshold policy reform, which will support climate and competition objectives, albeit after the fact, is expected to yield economic, social and environmental benefits. This paper will empirically demonstrate this utilising the E3ME model developed by Cambridge Econometrics to support the case for ex-ante prioritising of climate and competition considerations in energy policy. While energy security should remain the primary objective, energy policy can be leveraged to promote other government objectives such as increased market participation and decarbonisation.[3]

Keywords: Climate change, competition, energy policy, policy reform

---

[1] Senior Economist, National Treasury of South Africa

[2] Economist, National Treasury of South Africa

[3] The views expressed in this paper are the personal views of the authors and do not represent those of the National Treasury. While every precaution is taken to ensure the accuracy of information, the National Treasury shall not be liable to any person for inaccurate information, omissions or opinions contained herein.

1. Introduction

Traditionally, electricity supply industries have been characterised by vertically integrated monopolies, as this structure was positioned to efficiently supply markets (Minnie, 2018). This required investments to be undertaken with the state's support; enabled governments to drive public service and social objectives; and ensure efficiencies and security of supply from coordination of generation and transmission. However, the period over the 1980s and 1990s was characterised by the liberalisation of electricity markets worldwide, as the standard model of vertically integrated state-owned monopoly utilities was no longer suitable (ERSA, 2020; das Nair et al., 2014; Eberhard, 2004). There were many drivers for these reforms – with international trends in reforming the electricity markets placing greater emphasis on "competitiveness, efficiency and environmental sustainability" (Kessides et al., 2007).

South Africa's reform agenda is largely reflected in three main developments: the establishment of an independent regulator, the National Electricity Regulator of South Africa (NERSA) in 1995; the corporatisation of Eskom (2001); and the introduction of independent power producers into generation (2011). However, despite these interventions, the more radical market reforms outlined in the 1998 White Paper on Energy Policy have not been implemented, including the restructuring of Eskom (Clark et al., 2005). It is not until recently that this reform has been introduced and is underway. Government's explicit commitment to prioritise security of supply has insulated Eskom's dominant position, having no real impact on competition, and limiting the role of Independent Power Producers (IPPs) to government-run procurement programmes (Clark et al., 2005; das Nair et al., 2014).

The challenge is that entities under the current market arrangement of a vertically integrated monopoly are often prone to abuse of monopoly power and inefficient performance from lack of competition (Mondi, 2018). The failure to implement policy reform as outlined in the 1998 White Paper on Energy Policy has meant that Eskom's performance from a financial, operational and environmental perspective has been dire. Not only has this had implications for the fiscus but further costs have been imposed on the economy in the form of ongoing emissions and severe load shedding which continues to intensify.

The recent lifting of the embedded generation licensing threshold will not only support decarbonisation efforts, but it promotes competition in generation and is expected to yield economic, social and environmental benefits. This paper will empirically demonstrate these benefits, utilising the E3ME model developed by Cambridge Econometrics, by analysing the impact of adding more renewable energy over and above what the national energy mix would be as outlined in the Integrated Resource Plan (IRP) 2019. This demonstrates the benefits that ex-ante prioritisation of climate and competition considerations in energy policy, which are aligned to the 1998 White Paper, could have yielded.

2. Review of energy policy drivers – The historical context and the current regulatory framework of the South African energy sector

Rationale for traditional monopoly market structure

Historically, the global consensus on the supply of electricity was that vertically integrated monopolies could efficiently supply markets (Minnie, 2018). Under such a consensus, governments sought to address three market failures. First, the high capital cost associated with achieving scale economies in generation, including tariffs that do not reflect operating and capital investment costs and the required sunk costs to establish distribution networks. Second, and more applicable to South Africa, government sought to drive public service and social objectives by increasing the electrification of households from as early as 1922 and more recently during the post-apartheid era. Third, to ensure efficiency and security of supply, coordination between generation and transmission is necessitated to equate demand and supply – which governments enabled through vertically integrated state monopolies (Minnie, 2018).

Standard model of energy sector reform

However, the period over the 1980s and 1990s was characterised by the liberalisation of electricity markets worldwide, as the standard model of vertically integrated state-owned monopoly utilities was no longer suitable (ERSA, 2020; Des Nair et al., 2014; Eberhard, 2004). The drivers behind the reform agenda over this period derive from several factors including the need to correct for the inadequate performance of state-owned utilities (both operational and financial); the need to expand investments and capacity; and the restructuring of utilities to ensure efficient operation and reduction of fiscal impact (Eberhard, 2004). More generally, these international trends in reforming the electricity markets were placing greater emphasis on "competitiveness, efficiency and environmental sustainability" (Kessides et al., 2007). These reforms enabled the gradual reduction in the dominance of vertically integrated utilities by allowing for private sector participation. Kessides et al. (2007) note that while the common denominator in the transition has been the increased participation of private players, this has varied across countries.

Some countries have unbundled vertically integrated utilities with partial privatisation, while some have introduced private participation in generation. Other countries have undertaken full privatisation and the introduction of private participation in generation. These reform responses reflect a variation of the "standard model" for electricity sector reform recommended by institutions such as the World Bank. Geddes et al. (2020) and Minnie (2018) categorise these reforms into the following main broad categories: (i) creation of a system of independent regulation; (ii) promoting competition across the sector, while recognising that transmission is likely to remain monopolised; (iii) restructuring the utilities by vertically and horizontally unbundling into independent corporatised entities; and (iv) encouraging private sector investment in new infrastructure and privatisation of existing assets. While the effectiveness of the standard model in developing and emerging economies remains a subject of debate, the World Bank finds a positive correlation between private sector participation and economic efficiency improvement (Geddes et al., 2020). Furthermore, since the development of the prescripts of the standard model, many economies have had to place social and environmental impacts alongside economic considerations, therefore extending the reform response. (Geddes et al., 2020).

South African historical context

Prior to 1994, South Africa's public energy policy was largely aimed at achieving adequate supply of cheap electricity for industry and mid- and high-income households (Kessides et al., 2007). The underlying principle of "separate" development meant that the majority of the population was excluded from access to electricity. Therefore, a large focus in the early 1990s was, among other things, the electrification of previously excluded households, which was also facilitated by the consolidation of electricity distributors to enhance their financial and operational performance (Eberhard, 2004). In 1995, the National Energy Regulator was established to, among other things, issue licenses to electricity suppliers, approve tariffs, monitor the quality of supply and settle disputes (Clark et al., 2005).

However, the need for reform of the South African electricity sector was (formally) recognised in the 1998 White Paper on Energy Policy (White Paper) (Teljeur et al., 2016). In particular, the objectives of the White Paper were: (i) increasing access to affordable energy services, (ii) improving energy governance, (iii) stimulating economic development, (iv) managing energy-related environmental and health impacts, (v) improving energy governance, and (vi) stimulating economic development (DME, 1998). This created the foundation to prioritise environmental sustainability and ensure security of supply through diversity in generation. In particular, the policy pronounced on government's support for a competitive electricity market, with a restructured Eskom. Renewable energy was also recognised for its role in remote areas and how it could be the least cost energy service, particularly when social and environmental costs are included (DME, 1998). The vision for the electricity sector espoused in the policy was for the vertical and horizontal unbundling of the sector to enable the separation of competitive and natural monopoly components of the industry; introduction of competition; non-discrimination and open access to transmission and the introduction of independent regulation (Eberhard, 2004). Therefore, from a policy perspective, South Africa has always been positioned to transition the electricity sector and attain efficiency, increase competition (resulting in increased investment and capacity), and realise benefits related to climate change (environmental sustainability).

Many of the reform proposals in line with the White Paper faced resistance and were never implemented (Eberhard, 2004; Teljeur et al., 2016). Those that were implemented are:

- **1995: Establishment of an independent regulator**. The National Energy Regulatory (NER) (and later the National Energy Regulator of South Africa (NERSA)) was established in terms of the Electricity Act of 1995, to among other things grant licenses and determine tariffs (Teljeur et al., 2016).

- **2001: Corporatisation of Eskom**. Eskom corporatisation sought to reform the entity's governance and create greater emphasis on its commercial imperatives (Clark et al., 2005). As a result, Eskom would be subject to taxes and dividends to the government as the sole shareholder (Teljeur et al., 2016).
- **2011: Introduction of independent power producers**. The competitive bidding process for renewable energy projects was developed in 2011 by the Department of Energy. The programme has gone through four major bidding rounds and 6 323 MW of electricity has been contracted from 92 IPPs (IPP Office, 2021).

Despite these interventions, the more radical market reforms outlined in the White Paper had not been implemented, including the restructuring of Eskom and permitting open nondiscriminatory access to the transmission system (Clark et al., 2005). First, the corporatisation of Eskom was not the result of policy developments in the energy sector but rather of a broad agenda by the Department of Public Enterprises (DPE) to restructure state-owned enterprises (SOEs) (Eberhard, 2004). The introduction of independent power producers (IPPs) through the Renewable Energy Independent Power Producer (REIPPP) programme has also not come without its own challenges. In 2007, Eskom was designated the single buyer of power from both public and private producers which led to the holdup in the programme when Eskom refused to sign power purchase agreements from the programme (das Nair et al., 2014; Minnie, 2018). Thus, despite the implementation of the programme (which some may argue has been successful), the role of IPPs has been limited and this has had no real impact on competition (das Nair et al., 2014).

In 2001, Cabinet approved a set of proposals for the managed liberalisation of the electricity supply industry, including (i) Eskom retaining a market share of no less than 70 per cent, with vertical unbundling to ensure nondiscriminatory and open access to the transmission lines, (ii) the introduction of a multi-market model electricity market framework; and (iii) regulation that will enable participation of IPPs and diversify the energy mix (Clark et al., 2005). The decision to pre-determine Eskom's market share was the result of Eskom's disapproval of the proposals to reduce its market share to around 35 per cent (Ebherhard, 2004). In the years following this, the energy mix remained coal dominated and the role of IPPs was limited.

Several other White Paper-aligned reforms went through phases of proposal and resistance – in some cases going as far as the development of required legislation – ultimately failing to be adopted. These include the development of six Regional Electricity Distributors (REDs) in 2001 to rationalise distribution and separate it from Eskom; the introduction of a multi-market model for electricity trading proposed by DME in 2003 and the unbundling of Eskom which was to be facilitated by the Independent System and Market Operator (ISMO) Bill in 2011 (Teljeur et al., 2016a). The Bill was centred around the removal of the operation of the electricity grid from Eskom into an independent, state-owned entity (National Treasury, 2020).

The challenge with South Africa's electricity reform is that government has traditionally prioritised security of supply over other objectives. In 2004, a period in which the White Paper proposals should have been implemented, the Minerals and Energy Minister stated in parliament that "the state has to put security of supply above all and above competition especially." (Clark et al., 2005). While this core objective is important, energy policy can be mobilised to achieve secondary objectives. The lack of ex-ante prioritisation of other policies in the South African market has meant policy reform is driven by a response to crisis as opposed to international precedence to a phased approach to reform, recognising the failures of the traditional model of vertically integrated state monopolies.

Climate change considerations in the course of policy development and reform

South Africa's national climate change governance has been cross-cutting across all sectors and more specific to sectors such as energy, industry, agriculture and waste. The cross-cutting and energy policies are summarised in the figure below. According to Averchenkova et al. (2019), the foundation for South Africa's climate policy is found in the 2004 National Climate Change Response Strategy and the 2011 National Climate Change Response White Paper (NCCRWP). The NCCRWP sets out guiding principles for climate change, outlining priorities for adaptation and mitigation for a long-term transition to a climate-resilient low carbon economy and society (Kiss-Dobronyi et al., 2021).

Table 1: Summary of climate change policy – cross-cutting and at the energy level

	2004	2008	2009	2011	2012	2015	2018	2019
Cross-cutting	National Climate Change Response Strategy			National Climate Change Response White Paper	National Development Plan	Nationally Determined Contribution to Paris Agreement	National Climate Change Bill	Carbon Tax Bill
Energy		National Energy Act	Non-renewable electricity levy	SANS 204: Energy Efficiency in Buildings Integrated Resource Plan for Energy (2010-30)	Section 12L of Income Tax Act			Integrated Resource Plan for Energy

Source: Averchenkova et al., 2019

Climate change policy reform in the energy sector has experienced similar challenges with regards to policy design, priority challenges and delays in adoption In terms of the sector-specific interventions, we highlight some challenges:

- Government's flagship programme for adaptation and mitigation, the REIPPP programme, was successfully implemented at a small scale relative to the overall energy mix, which has not materially changed the share of renewable energy in the overall energy-mix. The programme also faced delays when Eskom delayed the signing of PPAs as the designated buyer pf privately generated electricity (Averchenkova et al., 2019).

- Since the introduction of Minimum Emissions Standards to be effective in 2015 by the Department of Environmental Affairs (DEA), Eskom has applied for two 5-year postponements and has not fully complied with the regulations since their inception (Euripidou et al., 2022). Furthermore, the programme has faced an approximate 5-year interruption between bid window 4 and bid window 5 that the DMRE launched in 2021.
- The introduction of the Carbon Tax has also allowed for deductions in the rates and a phased implementation of the tax. Under the first phase of the tax (1 June 2019 to 31 December 2021), transitional support measures were put in place, such as the electricity price neutrality commitment enabled through the environmental levy offset (National Treasury, 2022; KPMG, 2022). Phase 1 measures will be extended to 31 December 2025.
- South Africa's updated Nationally Determined Contribution (NDC) approved by Cabinet in 2021 implies that most of the mitigation in the economy will come from the electricity sector, with an almost linear relationship between national greenhouse gas emissions and electricity sector emissions (Steyn & Tyler, 2021). The challenge is this will require an accelerated decommissioning of coal plants, low utilisation of the coal fleet and substantial renewable energy (Steyn & Tyler, 2021). This will require an update to the IRP, particularly to reflect the required renewable energy.

Recent reforms

In the State of the Nation Address of 2019, President Cyril Ramaphosa announced that "*To bring credibility to the turnaround and to position South Africa's power sector for the future, we shall immediately embark on a process of establishing three separate entities – Generation, Transmission and Distribution – under Eskom Holdings"* (SONA, 2019). Government formally re-introduced the policy of unbundling Eskom, to facilitate the 9-point plan the entity had introduced to address its challenges. The Department of Public Enterprises (DPE) then published a roadmap (Eskom Roadmap) outlining Eskom's restructuring and role in a reformed electricity supply industry. In presenting this plan, the DPE acknowledged, among other things, the risk that was presented by the lack of diversification in generation (DPE, 2019). Moreover, in as far as the structure of the sector was concerned, the DPE noted that (i) Eskom's business model was outdated and (ii) Eskom's monopoly prevented innovation and the ability of Eskom to embrace technology disruptions (DPE, 2019). DPE (2019) has further recognised the following benefits from the electricity supply industry restructuring: increased competition in generation and drive compliance with environmental legislation and policy.[4] Subsequent to the Eskom Roadmap, the DMRE has published draft amendments to the Electricity Regulation Act (ERA) – which will enable a competitive electricity market, alongside unbundling of Eskom and the establishment of an independent transmission company (Operation Vulindlela, 2022).

[4] In line with the Roadmap, Eskom has completed the (i) divisionalisation and appointment of divisional boards and heads and (ii) functional separation within three divisions. Eskom is currently in the process of legally separating Transmission into a wholly-owned subsidiary of Eskom.

Amendment of Schedule 2 of the ERA introduced a higher licensing threshold, 100MW, which would facilitate private investment at scale and increase the role of IPPs outside government's procurement programmes. Furthermore, the DMRE issued New Generation Capacity Regulations in terms of the ERA, to enable municipalities (in good financial standing) to procure power directly from IPPs. These two reforms are aimed at facilitating greater private sector investment in electricity generation. Draft amendments to Electricity Pricing Policy and NERSA's electricity pricing framework have been proposed and form part of the suite of regulations that require alignment with a reformed electricity supply industry. In relation to climate policy, South Africa revised its Nationally Determined Contribution (NDC) in 2019. Cabinet approved South Africa's updated climate change mitigation up to 2030 (Steyn & Tyler, 2021). Furthermore, Eskom has developed its Just Energy Transition (JET) plan, and the plan's strategic objectives include accelerating the repurposing and repowering of power stations; fast-tracking execution of renewable energy; and ensuring a positive social impact through local manufacturing and job creation (Eskom, 2021d).

Finally (and more recently), the President announced a suite of interventions aimed at addressing the current energy crisis (Ramaphosa, 2022). While the measures are aimed at arresting load shedding and resolving the immediate capacity shortfall, some will have implications for the structure of the electricity supply industry. This includes the removal of a licensing threshold for embedded generation projects and passing legislation for the streamlining of relevant processes and required exemptions for renewable energy projects (Ramaphosa, 2022). While it should be noted that there are challenges with implementing the standard reform model, as models of wholesale and retail competition are extremely difficult and complex to implement, and circumstances and constraints faced by developing countries are fundamentally different (Teljeur et al., 2016b). South Africa is recognised as a laggard in the electricity sector reform, and policy efforts over the past three years are characterised by a response to the crisis – largely deriving from the failure of Eskom.

3. Costs of neglecting climate and competition objectives in energy policy

3.1 Financial failure

South Africa's dominant governance paradigm in which the vertically integrated, state-owned monopoly Eskom was positioned to realise scale economies and drive industrial policy suffered from monopoly failure. Entities under such a paradigm are often prone to abuse of monopoly power and inefficient performance from lack of competition (Mondi, 2018). This is evident in the performance of Eskom from a financial, operational and environmental perspective. According to the Parliamentary Budget Office's (2017) report on Eskom's financial position, profitability has been declining since 2007/08 – with profit margins averaging 4 per cent relative to highs of 15 per cent in 1994/95. This was not the result of declining revenues, which despite slowing economic growth and the introduction of load shedding, continued to increase (PBO, 2017). Over this period, Eskom reversed the trend of low electricity tariffs that fell in real terms (PBO, 2017).

The price of electricity before the onset of load shedding, pre-2007, did not reflect the actual cost of generating, transmitting, and distributing power and reached an all-time low by 2007 (Nova Economics, 2020). Eskom heavily subsidised electricity, therefore, crowding out the private sector investment for electricity generation. Two key changes in the electricity landscape facilitated the reversal in the tariff trajectory: a change in the tariff setting methodology and the timing of Eskom's investment in the new build programme. The cost of electricity has since risen substantially, with the average electricity price increasing by approximately 400 per cent since 2008.[5] Despite the allowance for the return of tariffs to cost reflectivity by 2013, this has not been the case (PBO, 2017). More recently this has been evidenced by a consistent divergence in the tariff applied for by Eskom and approved by the regulator Nersa (Eskom, 2021d). These inadequate tariff increases add to Eskom's under-recovery in costs, which is also largely driven by rising municipal debt, loss of revenue and high-cost structure.

While it can be argued that the municipal debt and level of approved tariffs are driven by external dependencies, other factors have contributed to the entity's financial liquidity constraints. These include Eskom's cost structure (driven by among other things primary energy contracts, labour costs, etc) and the ballooning costs for the new build programme. This has necessitated government support to ensure the entity's going concern status and its ability to service its debt (Eskom, 2021a). In their interim results for the six months ended September 2021, Eskom reported a 15 per cent reduction in debt, facilitated by government support of R31.7 billion (Eskom, 2021c). This leaves approximately R392 billion of the remaining debt to be restructured by the state in facilitating the unbundling (Business Tech, 2022).

3.2 Energy system failure

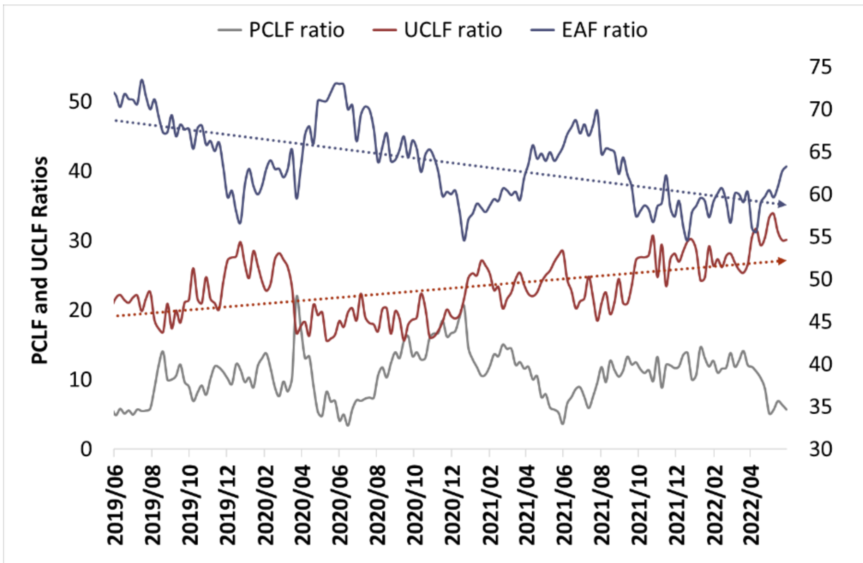
The South African energy system is constrained with intermittent power outages crippling the economy since 2007. The market structure of a coal-dominated energy-mix, with a vertically integrated, state-owned monopoly has resulted not only in unsustainable energy but also inadequate and unreliable electricity supply. The steady downward trend of the energy availability factor (EAF), measuring the difference between the maximum energy available and unavailable due to outages expressed as a percentage, reflects the worsening plant performance over time. The EAF decreased from 78 per cent in 2017 to 59 per cent in 2022, well below the 74 per cent target (Eskom, 2018, 2022). The declining EAF has been predominantly a result of an ageing and deteriorating coal fleet and subsequent unplanned outages. Eskom (2022) attributes the causes of deterioration in fleet's performance to a lack of sufficient generation capacity, aggravated by equipment age, insufficient funds for maintenance and additional system space. The average age of the coal fleet, excluding Medupi and Kusile, is 42 years across Eskom's 15 power stations of which many have become unreliable due to age and lack of maintenance. Furthermore, the construction of Medupi and Kusile, which started in 2007 was expected to add almost 10 GW to the grid however construction has

[5] Data source: Statssa (The average price of electricity, c/kWh)

been significantly delayed and design defects result in sub-optimal performance, exacerbating the constraints to the system.

Figure 1 depicts the ratio of unplanned outages over time; it is evident that unplanned outages have been trending upwards, signaling the deterioration of plant performance and Eskom's inability to meet demand. Eskom has been faced with severe operational challenges and quality concerns and a shortage of resources to undertake planned capital spending and maintenance resulting in worsening unplanned outages (Nova Economics, 2020; Eskom, 2019). Eskom (2022), furthermore, reported that the electricity supply shortfall is at approximately 6 GW which is likely to persist over the next five years if action is not taken to add new capacity onto the grid. Similarly, Meridian Economics (2022) empirically shows that 5 GW of additional renewable capacity would have reduced load shedding by 96.5 per cent in 2021.

Figure 1: Planned and unplanned outages and energy availability factor ratios



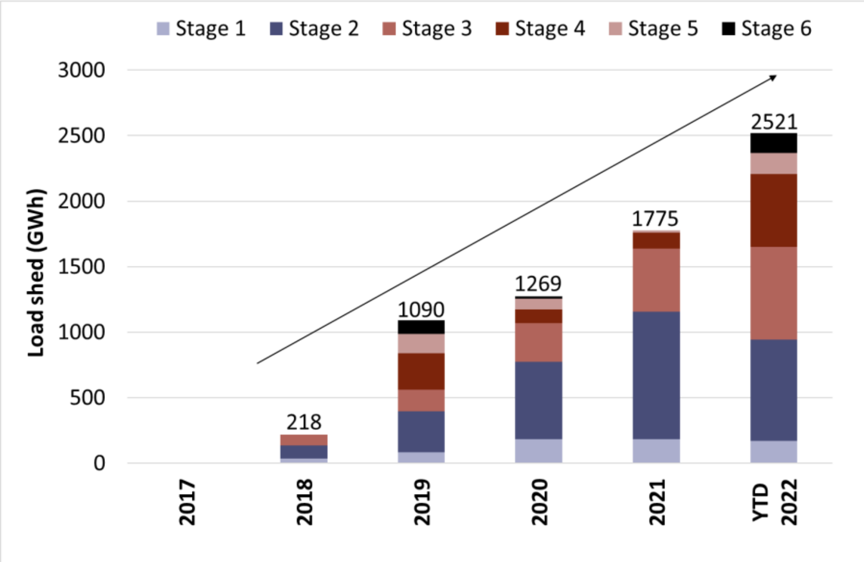
Source: Eskom data from the weekly Eskom system status reports
Notes: UCLF refers to the unplanned capacity loss factor; PCLF refers to the planned capacity loss factor

The worsening outages and limited new generation capacity added to the grid have culminated in a vulnerable energy system with persistent load shedding paralysing the economy. The 2021 load shedding capacity amounted to 1775 GWh, approximately 40 per cent above the 2020 capacity. By July 2022, the 2022 load shedding has surpassed the 2021 levels and will be the worst year on record. This translates into 1276 hours of load shedding compared with 871 and 1165 hours in 2020 and 2021 respectively.[6] Around 10 GW of Eskom's base-load capacity will be decommissioned in the next decade adding additional strain to the already vulnerable energy system and exacerbating the need for new generating capacity (Eskom, 2021). Failing to sufficiently and timeously ramp up renewables in the energy mix and introducing competition in the market has led to an over reliance on ageing large-scale coal-fired power plants and

[6] See Appendix, data source: Eskom (Manual Load Reduction (MLR), GW/h).

ultimately reducing the energy security of South Africa at a significant cost to the country. The current IRP 2019 does not sufficiently consider other government objectives such as increased market participation and the energy transition, calling for an urgent revision.

Figure 2: Load shedding (GWh) by stage of load shedding



Source: Authors calculations, based on Eskom hourly data
Note: Calculations are based on hourly data, load shedding as such is assumed to have taken place for the full hour in which load shedding was implemented and reported. Each stage represents 1000MWh lost, ex. Stage 1= 1000, Stage 2=2000MW etc., similar to the CSIR methodology (CSIR, 2021). Data included up until 26 July 2022

Nova Economics (2020) was commissioned by Eskom to conduct a study to determine the impact of load shedding on the economy. The study estimates that 1 per cent load shedding as a percentage of electricity sales leads to a 0.4 per cent decrease in GDP. It is furthermore inferred that a full day of stage 1 load shedding would cost the economy around R235 million while the cost of stage 4 is almost a billion. In total, the study estimates that the cost of load shedding to the South African economy over the 12 years between 2007 and 2019 was nearly R35 billion. The cost of load shedding for 2020 and 2021 is estimated at R12 billion and R18 billion respectively (Creamer, 2022). The cost of load shedding for 2022 is expected to exceed the historical record reached in 2021.[7]

3.3 Environmental failure

South Africa's economy continues to be reliant on fossil fuels as a source of energy – with 90 per cent derived from fossil fuels (DEA, 2017). This is because coal remains a primary source for our electricity generation mix, providing around 80 per cent of generation capacity (Pierce & Ferreira, 2022). In 2018, the

[7] The CSIR calculates the cost of unserved energy to be between R163 billion- R326 billion. While Eskom calculates the cost of load shedding the CSIR calculates the cost of unserved energy. Cost of Load shedding (COLS) calculates the cost when the timing and duration of outage is known; the Cost of Unserved Energy (COUE) calculates the cost when no warning of load shedding is provided. Nova Economic (2020) argues that the COUE methodology is not appropriate for planned and longer duration interruptions to calculate the impact of loadshedding on the economy.

electricity (and heat) sector contributed over 50 per cent of the carbon dioxide (CO_2) emissions in South Africa, and therefore remains an important industry for targeting decarbonisation (Kiss-Dobronyi et al., 2021). Pretorius et al. (2015) find that during the earliest period of South Africa's energy crisis, emissions increased as energy demand was met by delayed maintenance resulting in increased utilisation of the generation fleet. In particular, over the period 2007 and 2010 particulate matter almost doubled and over 2006 and 2012, CO_2 emissions increased by 15 per cent, reflecting the impact of the energy crisis.

Despite the promulgation of the Minimum Emissions Standards (MES) by the DEA for effect in 2015, Eskom continues to struggle with containing and meeting emissions standards. While emissions have fallen by over 92 per cent between 1982 and 2021, emissions levels increased at the onset of the energy crisis and have remained fairly stable since then (Eskom, 2021). These levels, albeit low by historical terms, are a significant contributor to the country's overall emissions. Following the promulgation of the Minimum Emissions Standards, Eskom applied for its first postponement to comply with the emissions standards Eskom noted that they would adopt a phased approach to compliance due to a number of factors including the remaining life of plants, excessive financial, outage, and resource requirements for 100 per cent compliance (Eskom, 2016).

Ahead of the 2020 compliance deadline, Eskom further applied for a combination of postponements, suspensions of compliance, and alternative (weaker) limits in relation to emissions standards (Euripidou et al., 2022). This included an exemption application for compliance with MES. Six power stations were granted suspensions, while another three granted 5-year postponements and no alternative limits were approved (Euripidou et al., 2022). In its decision, the National Air Quality Officer noted that "*Eskom has made minimal effort to fully comply with the standards", and "[t]he NAQO does not have the prerogative to issue decisions that are outside the current legal provisions or are in non-compliance with the law"* (Euripidou et al., 2022). In appealing the decision, Eskom has indicated that the cost of full compliance is estimated to be around R300 billion and approximately 16 000MW of nominal generation capacity will be at risk if alternative limits are not granted (Eskom, 2021a). The extent of Eskom's non-compliance may be exacerbated by the current energy crisis. Eskom's average plant energy utilisation factor (EUF) – which measures the extent to which a plant is run when it is available – has been increasing and has now breached 90 per cent relative to 85 per cent in 2010 and 80 per cent in 2000 (Eskom, 2021b, 2022).

Maintaining a market structure that limits private participation and renewable energy has resulted in inadequate, unsustainable, and unaffordable electricity supply. The persistent and worsening power outages call for not only an expansion in electricity capacity but a decarbonisation of the sector. Security of electricity supply is the cornerstone of economic growth and accelerating the decarbonisation of the electricity sector that supports a just transition is paramount to the country's climate and social objectives. The electricity landscape envisioned would embody an environmentally sustainable electricity structure that encourages private participation and strengthens competition in the sector and is supported by a sound policy framework and an efficient administrative system.

4. Benefits of prioritising competition and climate considerations: An Impact Analysis

Affordable, reliable, and renewable power supply underpins efficient operations and sustained economic growth. It also contributes to the country's international competitiveness and cushions the effect of potential trade pressure such as the Carbon Border Adjustment Mechanism (CBAM) under the European Green Deal in which emissions and carbon tax exposure may be assessed across the entire supply chain. The South African energy sector is undergoing significant transformation by introducing competition to the energy market (Operation Vulindela, 2022). In August 2021, Schedule 2 of the Electricity Regulations Act (ERA) was amended raising the licensing threshold for embedded generation from 1 to 100 MW. During the announcement of the energy reform, President Cyril Ramaphosa noted that "*this decision reflects our determination to take the necessary action to achieve energy security and reduce the impact of load shedding on businesses and households across the country*." More recently, the President announced that the licencing threshold will be removed altogether and once the ERA has been amended accordingly, projects will only need to register with the regulator irrespective of the size of the project.

The energy sector has undergone rapid reform in the past three years, and although ex-ante climate and competition considerations do not seem to have been the key drivers of this energy policy reform, but rather a response to the energy crisis, ex-post competition and climate benefits are expected. The amendments to Schedule 2 of the ERA will unlock private participation in energy generation, encourage renewable energy projects and contribute to broader efforts in ensuring energy security in light of the intensifying energy crisis. The policy reform, which supports climate and competition objectives, albeit after the fact, is expected to yield economic, social and environmental benefits which this paper will empirically demonstrate.

This study presents the potential impact of the embedded generation energy policy reform through scenario-based analysis, utilising the E3ME model developed by Cambridge Econometrics. Specifically, we determine the impact of additional renewable capacity as a result of the energy policy change. This widely used dynamic, structural, global macroeconomic model is well suited for analysing the impacts of Energy-Environment-Economy (E3) policies by allowing two-way linkages between the energy system, environment, and economy, the three components of the model. The modelling approach is based on the national accounting framework disaggregated to 43 industries as well as 29 stochastic equation sets by employing cointegration and error-correction methodology. This allows for the analysis of interactions between the components, investigation of short-term dynamics and the assessment of longer-term impacts of policies.[8] The main difference between E3ME and Computable General Equilibrium (CGE) models is the assumptions about optimisation. While generally with CGE models, behaviour is determined through

[8] The E3ME model manual provides a detailed description of the model, data sources and inputs, software, econometric specifications and modelling approaches. The manual and additional information pertaining the model is available from: www.e3me.com.

an optimising framework, E3ME determines behavioural factors empirically (Cambridge Econometrics, 2019).

The baseline in the E3ME model is reflective of the latest official energy policy, the IRP 2019. To determine the impact of the energy policy change, a scenario is constructed that adds embedded generation renewable energy capacity to the baseline after which the impact on various economic, social, and environmental indicators is determined. To create the EG (Embedded Generation) scenario, the expected additional capacity as a result of the energy policy change needs to be determined. A survey based on 239 industry players indicated that an estimated 5 GW of additional capacity could be added over 5 years in the residential, commercial, industrial, and agricultural sectors (Steyn & Renaud, 2021). Furthermore, the most recent 2Q2022 Operation Vulindela progress report reports that more than 80 projects are in development representing a combined capacity of over 6 GW. Considering the approximate timelines for obtaining approvals in order to register a project as well as the construction time, this additional capacity is expected to be added incrementally over the medium term.

Most of the investment in embedded generation is likely to be a combination of investment in solar PV and wind due to their cost advantages (Meridian, 2022). The cost of renewables has fallen significantly in the past decade supported by improving technologies, economies of scale, competitive supply chains, and improving developer experience and is likely to continue to decrease over time as technology improves (Irena, 2021; Hartley et al., 2019). Renewables have become more cost competitive, not only compared with new coal but also to the operating cost of existing coal plants (Merven, Burton & Lehmann-Grube, 2021).

The scenario assumes that embedded generation capacity is added incrementally over time reaching around 6 GW over the medium term in line with Operation Vulindela projections and project announcements. The scenario assumes that the capacity is a combination of wind and solar and that there is some initial lumpiness in response to the policy change and normalisation in additional capacity added thereafter. An additional 6 GW is expected to be added between 2022 to 2026, such that in total, the scenario assumes 12 GW of renewable capacity over and above the level outlined in the IRP 2019 is added by 2030. This is depicted in Figure 3 which indicates the expected additional renewable- solar and wind- embedded generation capacity to the baseline as a result of the energy policy reform.

Figure 3: Electricity capacity (GW)

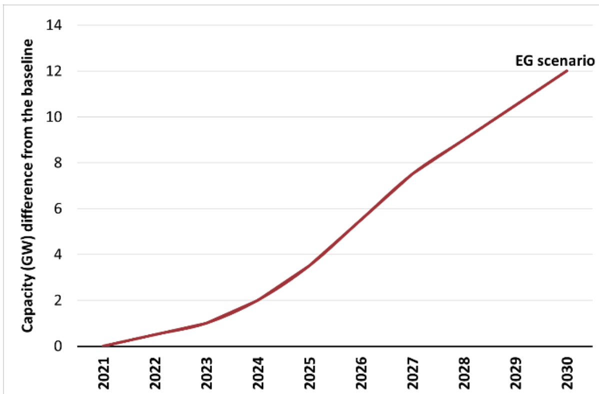
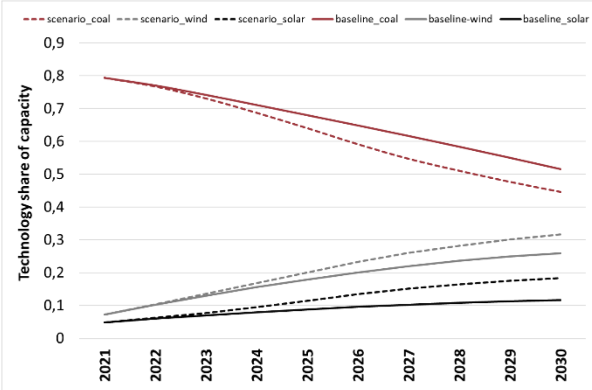


Figure 4: Electricity technology share of capacity



Source: E3ME modelling

In 2021, coal-fired power generation dominated the electricity mix and accounted for around 80 per cent of electricity generated while renewable sources accounted for approximately 12 per cent (Pierce & Ferreira, 2022). Figure 4 illustrates the share of capacity of coal, solar PV, and wind of the baseline compared to the EG scenario over time. The share of coal decreases in both the baseline and the policy scenario but to a greater extent in the EG scenario. Similarly, the share of solar PV and wind capacity increases incrementally in both the baseline and the scenario with the share of solar PV capacity reaching 18 per cent compared with 11 per cent in the baseline by 2030. The share of wind capacity reaches 31 per cent by 2030 under the scenario compared with approximately 25 per cent in the baseline.

It should be noted that the projections and simulation results are quantified estimates of the impact of the policy reform on the various indicators and should not be interpreted as predictions. As such, the generally accepted method of reporting the impact of the policy change on economic, social, and environmental indicators is the difference from the baseline (Cambridge Econometrics, 2019).

Figure 5: Economic Activity (GDP)

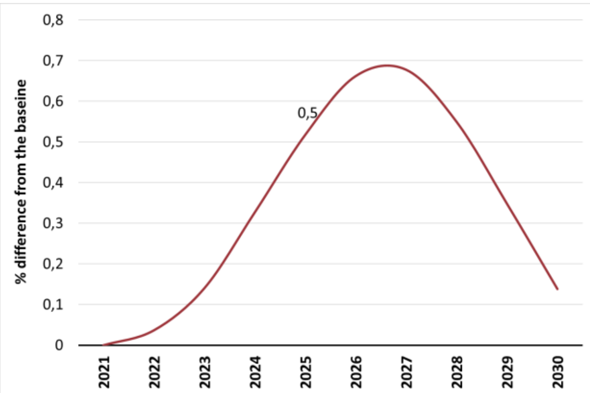
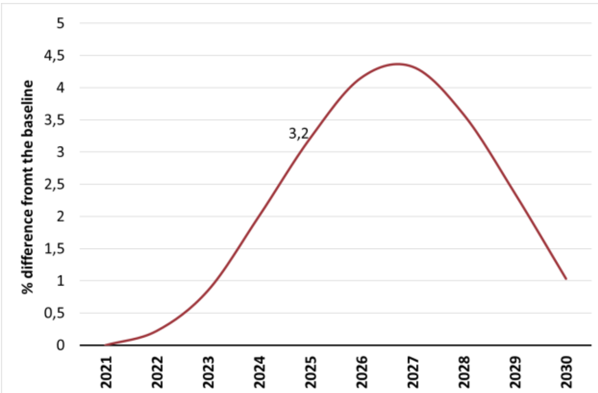


Figure 6: Investment (GFCF)



Source: E3ME modelling

Hartley et al. (2019) employ the SATIMGE model, a combination of the South African TIMES (SATIM) model (integrated energy systems model) and the eSAGE model (CGE model) to illustrate the impact of renewable energy on growth and employment. The study shows that a shift to renewable energy generation has a positive impact on growth as a result of lower electricity investment requirements that limit the crowding out of investments in the economy, as well as lower electricity prices. Figure 5 illustrates the impact of the policy reform on economic activity and can be interpreted as the percentage difference from the baseline. By 2025, GDP is expected to be 0.5 per cent higher compared with the baseline. The smaller impact in the outer years reflects the relatively higher initial investment in response to the policy but also a higher baseline in outer years based on the current energy planning.

The energy policy reform will support investment in renewable energy. The Minerals Council (2021) expects investment of around R60 billion and 3.9 GW of additional privately funded, renewable energy capacity from the mining sector alone in the short to medium term. Figure 6 depicts the impact of the embedded generation scenario on investment. From Figure 6 it can be deduced that, as a result of the expected additional embedded generation capacity, investment is 3.2 per cent higher compared to the baseline by 2025.

The National Business Initiative (NBI) studied the least-cost power system and finds that a least-cost pathway will consist of a renewables-dominated power system by 2050 (NBI, 2021). The study estimates that at least 4 GW of renewables will need to be installed each year for South Africa to reach net-zero by 2050. The current IRP 2019 reflects only approximately 2.3 GW of additional capacity on average per year between 2022 and 2030. The NBI study recommends that by 2030, additional renewable capacity should be increased from 20 GW to at least 30 GW in order to achieve net zero by 2050. The scenario adds an additional 12 GW of renewable energy through embedded generation which is in line with the NBI (2021) recommendation. From Figure 7 below it can be inferred that CO_2 emissions may decrease by 3.5 per cent by 2030 compared with the baseline as a result of the policy change. Increased renewable capacity through embedded generation has the potential to contribute notably to the energy transition.

Not only is the expansion of renewable energy capacity expected to contribute to the energy transition, but also the just transition and yield social benefits. A phase-out of coal power generation threatens the livelihoods of thousands of individuals in the coal mining value chain specifically. Renewable energy technologies have the potential to improve the resilience of vulnerable groups and diversify and bolster the economy (TIPS, 2020). Studies have shown that renewable energy has a net positive impact on employment (Hartley et al., 2019; Merven, et al., 2021). Although employment benefits are likely skewed towards individuals with secondary and tertiary education, lower educated workers are also expected to benefit. Furthermore, employment gains are expected predominantly in the electricity, manufacturing, and service sectors (TIPS, 2020; Hartley et al., 2019).

Figure 8 shows the potential employment benefits of lifting the licensing threshold for embedded generation and can be interpreted that by 2025, at least 15 000 additional jobs are added compared to the baseline. Although an energy transition is expected to have a net positive effect on employment, the decommissioning of coal power stations and shift to greener energy both domestically and globally will have disruptive effects on the coal value chain in particular. Given these realities, strategies on the coal value chain and energy transition, such as the Eskom JET strategy, are crucial to ensure that the transition is just and will not negatively impact society or livelihoods. Future research can potentially study the distribution of these employment gains to determine who will be benefitting from the transition and assess whether it can be considered a just transition.

Figure 7: CO_2 emissions

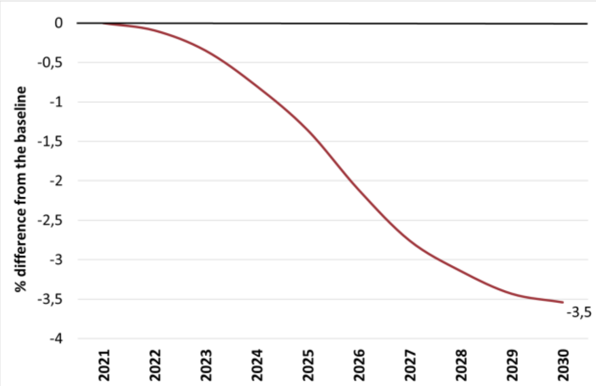
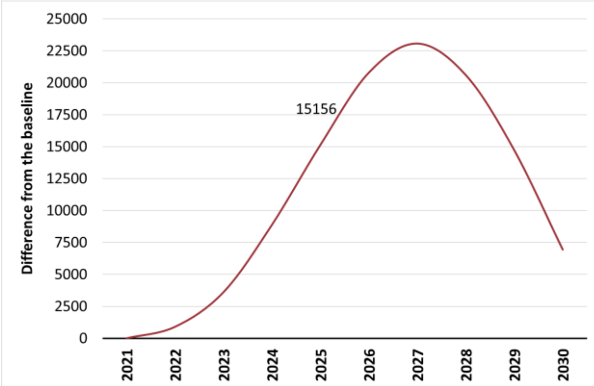


Figure 8: Employment



Source: E3ME modelling

5. Conclusion

Overall, the policy framework has lagged the market's need for (i) competition to address increasing tariffs and the widening capacity shortfall and (ii) the increased role of renewable energy to facilitate the country's energy transition and climate objectives. Failing to sufficiently and timeously ramp up renewables in the energy mix and introducing competition in the market has led to an over reliance on ageing large-scale coal-fired power plants and ultimately reducing the energy security of South Africa at a significant cost to the country. The energy sector has undergone rapid reform in the past couple of years, and although ex-ante climate and competition considerations do not seem to have been the key drivers of this energy policy reform, but rather a response to the energy crisis, ex-post competition and climate benefits are expected. The empirical results demonstrate the benefits of climate and competition considerations, albeit de facto ex-post in this case, as illustrated through the lifting of the embedded generation threshold and support the case for ex-ante prioritising of climate and competition considerations in energy policy. While energy security should remain the primary objective, considering and leveraging other government objectives, such as increased market participation and the energy transition, while formulating policy is crucial.

Reference list

Averchenkova, A., Gannon, K.E. & Curran, P., 2019. *Governance of climate change policy: A case study of South Africa.* Grantham Research Institute on Climate Change and the Environment Policy Report, pp.1-39.

Business Tech, 2022. *Government set to take over portion of Eskom's R396 billion debt*. Business Tech. Available at: https://businesstech.co.za/news/energy/611710/government-set-to-take-over-portion-of-eskoms-r396-billion-debt/ (Accessed: 08 August 2022)

Cambridge Econometrics, C., 2019. *E3ME technical manual v6. 1.* Version March.

Creamer, T., 2022. *Eskom seeks to show prudency of running diesel plants as its pegs cost of load-shedding at R9.53/kWh,* Engineering News. Available at: https://www.engineeringnews.co.za/article/eskom-seeks-to-show-prudency-of-running-diesel-plants-as-its-pegs-cost-of-load-shedding-at-r953kwh-2022-01-20/rep_id:4136 (Accessed: 12 July 2022)

Loewald, C., Makrelov, K. & Wörgötter, A., 2020. *Electricity Reforms: Experience and Approach.* ERSA Policy Bulletin, 4, pp.1-6.

Clark, A., Davis, M., Eberhard, A., Gratwick, K. & Wamukonya, N., 2005. *Power sector reform in Africa: assessing the impact on poor people.* University of Cape Town Graduate School of Business/ESMAP.

Department of Environmental Affairs (DEA), 2017. *South Africa's 3rd Climate Change Report*

Department of Mineral Resources and Energy (DMRE). 2019. *Integrated Resource Plan (IRP2019).*

Department of Minerals and Energy (DME), 1998. *White Paper on the Energy Policy of the Republic of South Africa*, Department of Minerals and Energy, Pretoria, December 1998.

Das Nair, R., Montmasson-Clair, G. & Ryan, G., 2014. *Review of Regulators Orientation and Performance: Review of Regulation in the Electricity Supply Industry.* Available at SSRN 2747923.

Eberhard, A., 2004. *The Political Economy of Power Sector Reform in South Africa.* Working Paper WP-06 Programme on Energy and Sustainable Development, Stanford University.

Eskom,2016. *Integrated Report*

Eskom, 2018. *Eskom Integrated Report*

Eskom, 2019. *Eskom Integrated Report*

Eskom, 2021. *Eskom Integrated Report*

Eskom, 2021a. *Group Annual Results for the Year Ended 31 March 2021, Results Presentation.*

Eskom, 2021b. *System Status and Outlook Briefing. Presentation*

Eskom, 2021c. *Group Interim Results for the Six Months Ended 30 September 2021. Results Presentation*

Eskom, 2021d. *Eskom Integrated Report*

Eskom, 2022. *System Status and Outlook Briefing.*

Euripidou, R., Irlam, J., Hallowes, D., Lloyd, T., & Loser, N., 2022. The Minimum Emission Standards (MES) and the sabotage of public health. *Clean Air Journal*, *32*(1). Available at: https://doi.org/10.17159/caj/2022/32/1.14026

Geddes, A., Bridle, R., Mostafa, M., Roth, J., Sanchez, L., Garg, V., Scholtz, L. & Fakir, S., 2020. *Rethinking Eskom: Lessons from electricity sector reform in India and Mexico.*

IRENA, 2021. *Renewable Power Generation Costs in 2020*, International Renewable Energy Agency.

Hartley, F., Burton, J., Cunliffe, G., McCall, B., Caetano, T., Ntuli, N., Fourie, R. & Chiloane, L., 2019. *Future skills and job creation through renewable energy in South Africa–Assessing the co-benefits of decarbonising the power sector*. Energy Research Centre, University of Cape Town (UCT), and Council for Scientific and Industrial Research (CSIR), Pretoria.

Hartley, F., Merven, B., Arndt, C. & Ireland, G., 2019. *Quantifying the macro-and socio-economic benefits of a transition to renewable energy in South Africa*. Working Paper 26, Southern Africa–Towards Inclusive Economic Development (SA-TIED). Helsinki, Finland.

IPP Office, 2021. Independent Power Producers Procurement Programme (IPPPP). An Overview as at 31 December 2021.

Kessides, I., Bogetic, Z. & Maurer, L., 2007. *Current and forthcoming issues in the South African electricity sector*. World Bank policy research working paper, (4197)

Kiss-Dobronyi, B., Barbieri, L., Van Hummelen, S. & Lewney, R., 2021. *Modelling an Inclusive Green Economy COVID-19 Recovery Programme for South Africa Modelling an inclusive green recovery*. Cambridge Econometrics.

KPMG, 2022. Carbon Tax - a surprise extension to Phase 1. *Tax and Legal News*

Minnie, R., 2018. *Competition as a means to reform the South African electricity sector.*

Mondi, L., 2018. *State, Market and Competition-Can Eskom be rescued?*

Brand, C.R., Mgoduso, L. & Steyn, G., 2022. *Resolving the power crisis Part A: insights from 2021 - SA's worst load shedding year so far*. Meridian Economics.

Merven, B., Burton, J. & Lehmann-Grube, P., 2021. *Assessment of new coal generation capacity targets in South Africa's 2019 Integrated Resource Plan for Electricity,* ESGR.

Minerals Council, 2021. *The Minerals Council South Africa supports recently announced electricity market reforms as Eskom opens access to renewable energy projects.*

National Business Initiative, 2021. *Just transition and climate pathways study for South Africa: Decarbonising South Africa's power system.*

National Treasury (South Africa), 2022. Budget Review. Budget 2022

National Treasury (South Africa). Economic Policy Division, 2019. *Economic Transformation, Inclusive Growth, and Competitiveness: A Contribution Towards a Growth Agenda for the South African Economy.* National Treasury.

Operation Vulindela, 2022. *Operation Vulindela progress update 2022 Q2*, Presidency & National Treasury

Parliamentary Budget Office (PBO), 2017. *Analysis of Eskom's financial position Full report*

Pierce, W. & Ferreira, F., 2022. *Statistics of utility-scale power generation in South Africa in 2021*, CSIR.

Pretorius, I., Piketh, S., Burger, R. & Neomagus, H., 2015. A perspective on South African coal fired power station emissions. *Journal of Energy in Southern Africa*, 26(3), pp.27-40.

Ramaphosa, C, 2022. *Address to the nation on energy crisis. 25 June 2022,* Pretoria.

Ramaphosa, C., 2019. *State of the Nation Address. 7 February 2019*, Pretoria.

Steyn, G. & Tyler, E., 2021. *What does South Africa's updated Nationally Determined Contribution imply for its coal fleet?*, Meridian Economics

Steyn, G. & Renaud, C., 2021. *Survey results: Scoping interest in the South African distributed energy generation sector,* Meridian Economics.

Sustainable Energy Africa (SEA), (n.d.). *Local Government Energy Efficiency and Renewable Energy Strategy: Status Quo Report.* South African Local Government Association (SALGA)

Teljeur, E., Sheik Dasarath, F., Kolobe, T., Da Costa, D., 2016. *Electricity Supply Industry Restructuring: Options for the Organisation of Government Assets,* Pretoria and Johannesburg: Trade & Industrial Policy Strategies and Business Leadership South Africa (2016a)

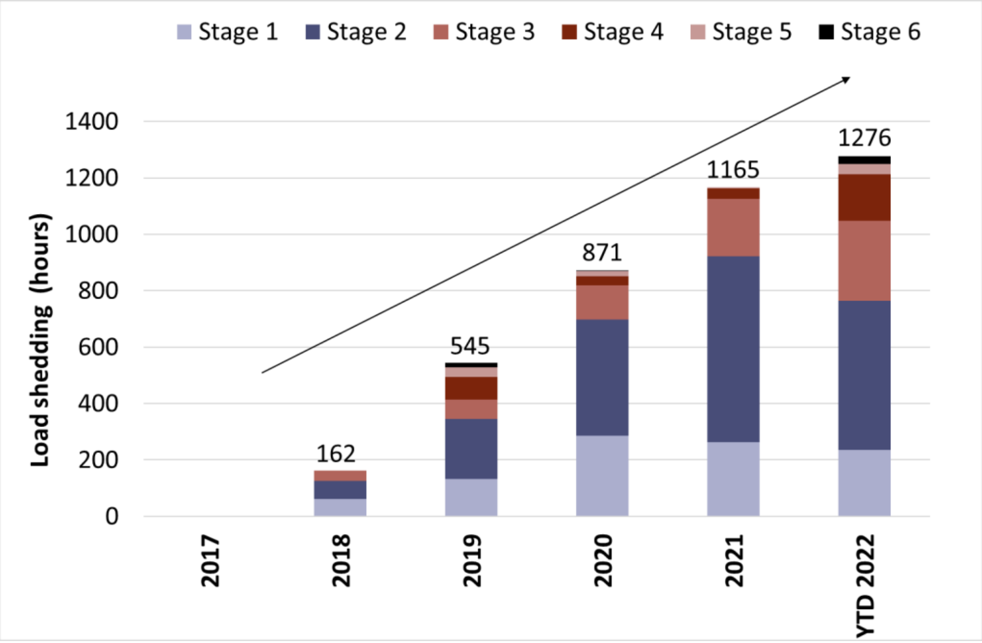
Teljeur, E., van der Hoven & Kagee, S. (2016). *The Electricity Retail Competition Unicorn: Why we need alternative ESI Structures.* 2nd Annual Competition and Economic Regulation (ACER) Conference, Livingstone, Zambia. (2016b)

Walsh, K., Theron, R., Seedat, A. & Reeders, C. (2020) *Estimating the economic cost of load shedding in South Africa.* Nova Economics

Wright, J. & Calitz, J., 2019. *Brief Analysis of Variable Renewable Energy Contribution during Loadshedding (Q1-2019).* CSIR

Appendix

Figure A1: Hours of load shedding by stage



Source: Authors calculations, based on Eskom hourly data
Note: Calculations are based on hourly data, load shedding as such is assumed to have taken place for the full hour in which load shedding was implemented and reported. Each stage represents 1000MWh lost, ex. Stage 1= 1000, Stage 2=2000MW etc., similar to the CSIR methodology (CSIR, 2021). Data included up until 26 July 2022