SOUTH AFRICA: ENERGY EFFICIENCY DEMAND SIDE MANAGEMENT EXPERIENCE (2004–2022)

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LIST OF ACRONYMS

DFFE	Department of Forestry, Fisheries and the Environment
DG	Distributed Generation
DMRE	Department of Mineral Resource and Energy
DR	Demand Response
DSM	Demand Side Management
EE	Energy Efficiency
EEDSM	Energy Efficiency and Demand Side Management
ESCO	Energy Service Company
GHG	Greenhouse gas
IDM	Integrated Demand Management
IEA	International Energy Agency
NDC	Nationally Determined Contribution
MYPD	Multi-Year Price determination
NEES	National Energy Efficiency Strategy
NERSA	National Energy Regulator of South Africa
SANEDI	South African National Energy Development Institute

Executive Summary

Overview

In July 2022, President Cyril Ramaphosa announced an emergency response plan to address the growing electricity crisis in South Africa, which included the necessity for customers of Eskom, South Africa's primary electricity supplier, to implement demand-side energy efficiency measures. This report is the first of two reports that provides the foundation for a strategic Demand-Side Management (DSM) approach to reduce load shedding and maximize energy savings in South Africa, through inter-governmental collaboration and increased coordination of energy efficiency activities. This first report focuses on the experience of Eskom's rate-funded Integrated Demand Management (IDM) programme, from its beginning in 2004 to today, highlighting the factors that led to failed support for the programme, and emphasising the measures that will need to be addressed to meet the government's energy efficiency (EE) goals, as well as other socio-economic and environmental priorities, such as job creation, affordability and greenhouse gas (GHG) emission reduction goals.

South Africa's Electricity Sector

South Africa's electricity sector was built almost exclusively around its abundant coal resources which were used, in conjunction with cheap labour, to industrialise its economy. Consequently, the country's - minerals based, energy intensive economy continues to have high social and environmental costs. The vertically integrated utility (Eskom) supplied cheap and reliable electricity but more recently has encountered significant challenges which are placing the entire economy at risk, these include:

- A structural electricity crisis, where demand periodically exceeded supply from 2007, but which has worsened significantly from 2021 with almost daily outages lasting up to twelve hours
- Eskom's debt crisis and dependency on government bailouts
- Coal-based electricity production which represents 80% of electricity generation

Methodology

The analysis undertaken in this study is based on two primary information sources. The first, is official and publicly available research, reports and documentation issued by Eskom, the DMRE, the National Energy Regulator of South Africa (NERSA) and others. The report especially relied on the documentation surrounding the Multi-Year Price determination (MYPD) process, Eskom's revenue applications to NERSA for a predetermined period and the Regulator's responses which includes the rationale for its decisions and includes the allowed revenue to fund Eskom's Energy Efficiency and Demand Side Management (EEDSM) programme. The second, was interviews conducted with key stakeholders.

Eskom's Integrated Demand Management Programme

Eskom initiated its DSM programme in 2004 (renamed IDM in 2010), and became the primary administrator and implementer of the NERSA-approved rate-funded DSM programme. During the 2007 electricity crisis, Eskom established a dedicated DSM division which was well funded and enjoyed political and regulatory support. Between 2011 and 2013, and as part of the MYPD- 2, NERSA approved a total budget of R5.4 billion (USD 674 million[1]) with the goal of saving 1 037 MW and 4 055 GWh for three years. Eskom achieved a saving of 1 216 MW, exceeding the initial target set by NERSA with 179 MW.

From 2010, the DSM programme evolved from an awareness-focused programme to a multi-project programme, across all sectors (mining, industrial, commercial and residential) with measurable energy savings. A comprehensive set of interventions were deployed by Eskom to deliver the targeted energy and demand savings, ranging from large-scale efficiency projects mainly implemented by Energy Service Companies (ESCOs) to customer's rebates based on deemed savings for standard efficient technologies. Different financing incentives were designed offering varying levels of funding to motivate investment in energy efficiency. By 2013, the IDM programme had saved 3.9GW, equivalent to a full year's electricity consumption by the City of Tshwane. The Mass Roll-Out programme was the most successful, saving 2.1GW by 2012 by replacing incandescent with CFL bulbs. The program also created local jobs and contributed to grow a nascent ESCO industry.

During the period 2013-2018, NERSA cut the IDM programme funding in half, primarily due to the perception that saving energy was less of a priority since a better balance of supply and demand had been achieved. It was intended that Eskom and NERSA would engage to identify an alternate funding model and implementing agency, and in the interim, the IDM programme was transferred to the distribution division at Eskom, creating an internal disincentive and decline in performance. The programme still resides in Eskom's distribution unit.

From 2019, the DSM levy, which was paid by electricity users on a per kWh basis, was stopped. The IDM programme was gradually reduced from a holistic demand management programme, which sought to reduce total demand and electricity consumption to only demand response for a selected number of large users.

Reason for the Decline of Eskom's IDM Programme

The four primary reasons identified for the decline of Eskom's IDM programme include: 1) the lack of consideration of EEDSM as a least cost energy resource, 2) the muted policy support, from 2015, for EE from national government, 3) the misbelief that EEDSM is only valuable during energy crises, and 4) concerns over Eskom's ability to administer EE programmes, due to the inherent conflict of interest this creates.

[1] A five-year average exchange rate of 0.12 (2007–2012) was used to convert rand to US dollars.

While the first 2010 Integrated Resource Plan (IRP) established DSM as an energy resource required to meet South Africa's future electricity demand, DSM was not considered as a resource in the subsequent IRP and no EE assessments were conducted to inform the report.

Additionally, the EE policy signals from South Africa's Department of Mineral Resource and Energy (DMRE) began to wane in 2013, demonstrated by multiple efforts that either did not secure funding, lacked management support, or were not ratified by the cabinet.

Summary and Findings

The potential for vast energy savings and GHG reductions available from EE in South Africa remains largely untapped. In addition, South Africa has yet to successfully mitigate the ongoing energy crisis and electricity supply shortages—energy shortages which could partially be met by reducing energy use and demand through DSM programmes. Despite the nascent attempts to establish a conducive policy and regulatory environment in 2007, most of the EE and DSM programmes have not been established or embedded sufficiently in regular government and utility practices for them to be institutionalised. The approach initiated by the government in 2007 after the country's electricity supply shortages lacked political support in the longer term.

Re-establishing EE as a political priority will increase the effectiveness of the work being undertaken by the Department of Mineral Resources (DMRE) EE unit. South Africa has a tremendous opportunity to reduce total electricity demand, which in turn will lower consumer energy bills, reduce GHG emissions and create jobs. This will deliver a more equitable energy system. However, to tap this potential EEDSM must be elevated as a political priority.

1. Introduction

In recent years, the electricity crisis in South Africa has significantly worsened, with widespread load shedding[2] and nationwide rolling blackouts affecting millions of people and hindering economic progress. As a result, President Cyril Ramaphosa announced an emergency response plan to address the nation's energy crisis in July 2022. One of the measures included in the plan is the requirement for Eskom to implement a programme that promotes energy efficiency (EE) among consumers, with the goal of reducing demand during peak hours (Ramaphosa, 2022).

The development of South Africa's energy sector has relied heavily on the country's plentiful and affordable coal resources, leading to the widespread use of coal in various economic sectors, particularly for electricity generation. Until the democratic elections in 1994, energy policy was designed to drive the growth of a minerals-based, energy intensive economy — the 'minerals energy complex' (Fine et al, 1996). This policy emphasized electricity as the primary energy carrier, but at great social and environmental costs that persist in 2022.

In the recent years, the electricity sector has experienced the following significant challenges that has limited the role that can play electricity access in social, economic and environment progress:

- **A structural electricity supply crisis:** Since 2006, the country has experienced several periods of load shedding when the country's demand for electricity has exceeded its ability to supply it. This structural electricity supply crisis has worsened over recent years, with 2022 recording 208 days of load shedding (55% of total days), which is the greatest number of days affected by power cuts to date, and Eskom warning about potential worsening levels of involuntary curtailment if the same electricity demand profile is observed in 2023. From the start of the year up to and including 1 February, 2023, load shedding has occurred every day, totalling 765 hours (Eskom, Transmission, 2023).
- **Eskom's debt crisis:** Eskom, South Africa's primary electricity supplier, has been embroiled in a financial crisis for years and relies on government bailouts to stay afloat. This tenuous financial situation contributed to question Eskom's ability to administer and lead South Africa's demand side management (DSM) programme in 2015.
- **Coal based electricity generation:** Coal-fired power plants dominate installed capacity with 39.8 GW, or 73% of total capacity in 2020, contributing 80% to the electrical energy mix in 2020 (Pierce & Le Roux, 2023). This makes the emissions intensity of the South African power grid one of the highest in the world with 1.05 kgCO2e/kWh in 2021 (Eskom, 2023a). Meeting the GHG reduction targets outlined in the national determined contribution (NDC) for the period up to 2030 is therefore a significant challenge and depends on an accelerated transition to renewable energy, the decommissioning of coal plants, and achieving the energy saving targets of the post-2015 National Energy Efficiency Strategy (RSA, 2021).

This report is one of a two-part series that provides the groundwork for creating a DSM approach in South Africa that expands beyond current EE and DR initiatives in order to enhance coordination and inter-

[2] Load shedding is the deliberate shutdown of electric power in a part or parts of a power-distribution system to relieve stress on the electric system when demand for electricity is greater than supply.

governmental collaboration, with the aim of decreasing load shedding and maximizing energy conservation. This first report focuses on the experience of Eskom's rate-funded IDM programme, spanning from its inception in 2004, to today. At its height, this programme was a multi-million-rand initiative that delivered 4 gigawatts (GW) of energy savings between 2004 and 2013 (Eskom, 2018). Nevertheless, support for this programme dwindled over time, and Eskom announced that no new programmes would be initiated from 2014 due to a lack of funding — a result of the national regulator's (NERSA) rejection of Eskom's complete annual tariff increase application. This left a void that has only been partially filled to date.

This report traces the sequence of events and analyses the reasons that led to the discontinuation of the programme, shedding light on the challenges that arose from the decisions that led to its suspension. It begins by describing the national EE policy framework, followed by an evaluation of the past and present status of South Africa's EEDSM policy and implementation, as well as a broad overview of EE programmes implemented to date. The report concludes by summarising these findings and drawing conclusions.

2. Policy Context

The 1998 White Paper of Energy Policy (Paper) is the primary policy framework for the energy sector in South Africa (DMRE, 1998). It sets the foundation to make energy accessible and affordable to all South Africans and underlines the environmental impacts of coal usage and the need to reduce carbon emissions through a more diverse energy supply, EE, and DSM. The Paper is the precursor to the development and promulgation of bills and regulations, making it an essential reference document for ministries to execute their mandate confidently and unambiguously, as it carries Cabinet approval. Several key policies, strategies, and regulations with a focus on a clean energy transition, economic development, and a climate change perspective have been developed from the Paper, including the following:

- **Free Basic Electricity (FBE) Policy (2003):** Emanating from the Paper, Government's FBE policy provides qualifying indigent households with 50 kilowatt-hours (kWh) of free electricity per month. This came into effect in 2003.

- **The White Paper on Renewable Energy (RE) (2003):** The RE paper recognised that South Africa had to establish a RE industry — setting a 10-year 10 000 gigawatt-hour (GWh) target. This paper has not been updated despite the substantial techno-economic changes in the industry over the past decade.

- **National Energy Efficiency Strategy (NEES) (2005 and post-2015):** Both NEES strategies set ambitious voluntary targets to deliver affordable energy across all economic sectors and to limit the negative environmental and health impacts of energy usage. The 2005 target of a 12% energy reduction for the overall economy was met, and a 16% reduction has now been set for 2030. However, the post-2015 NEES is still to be endorsed by Cabinet(DMRE, n.d., 2016).

- **Electricity Regulation Act (2006):** The Act established a national regulatory framework for the electricity supply industry, making NERSA the custodian and enforcer of national energy policy. The Act also created the legal basis for the Multi-Year Price Determination (MYPD) methodology, which permits licensees to recover full costs, including a reasonable margin / return, and incorporates EEDSM obligations.

- **The National Energy Act (2008):** The Act provides the mandate for the Department of Minerals Resources and Energy (DMRE) to: diversify supply, pursue environmental sustainability, deliver affordable energy prices to grow the economy and tackle unemployment, and perform energy planning. Importantly, it established the South African National Development Institute (SANEDI) and National Energy Efficiency Agency (NEEA) *inter alia* to '*increase EE throughout the economy*' (Chapter 4, 40), which was absorbed into SANEDI.

- **Integrated Resource Plan (IRP) (2010 and 2019):** The IRP is the country's formal electricity resource plan, which seeks to ensure that supply is sufficient to meet demand by determining the least-cost mix of resource investment in generation and DSM. EE featured prominently in the 2010 version, which noted that "~35% energy efficiency improvement is built into this IRP" (DoE, 2010a). There it forecast 242 megawatts (MW) of savings in 2010, increasing to 4.2 GW by 2017, which were achieved by Eskom's IDM programme (see next section). Most surprisingly, however, is that EE and DSM are absent in the current IRP (2019), and the reasons for this are unclear. It signals a change of policy, albeit this may be unintended (DMRE, 2019).

- **National Determined Contribution (NDC) (2021):** The updated NDC was submitted to the UNFCCC in 2021 by the Department of Forestry, Fisheries and Environment (DFFE). The revised, and more ambitious, mitigation targets represented a narrowing of the older 'peak plateau and decline' trajectory range for 2025, with a lower bound level for 2030 (see Table 1). Important to note is that the DFFE's revised NDC targets are based on the successful implementation of existing national policy and plans, *including the IRP and post-2015 NEES* (RSA, 2021). A carefully considered and programmatic approach to implementing identified NEES interventions will increase the probability of achieving the targeted and forecast NDC emission reductions.

- **Integrated Energy Plan (IEP) (unpublished):** The IEP was initially proposed in the Paper and its creation and release is the responsibility of the DMRE Minister. In 2007, a preliminary draft of the IEP assessed current energy consumption across various sectors of the economy and projected future energy demands based on several scenarios (DoE, 2016). However, the DMRE has yet to produce a final version of the IEP.

Table 1: South Africa's revised NDC mitigation targets for 2025 and 2030

Corresponding Period of Implementation	Target
2021–2025	South Africa's annual GHG emissions will be in range from **398–510 Mt CO_2**
2026–2030	South Africa's annual GHG emissions will be in range from **350–420 Mt CO_2**

3. Methodology

This study is based on two main data sources, as has been detailed in the executive summary. The first, reviews all relevant official documentation, and specifically that of two MYPD cycles. The MYPD forms the

basis on which NERSA determines electricity tariff adjustments and allowable revenue for Eskom over a multi-year period. The process requires Eskom to submit a revenue application to NERSA for the period considered, once assessed NERSA announces Eskom's allowable revenue based on a cost-of-service methodology. NERSA then publishes a document called "Reasons for Decision" which describes the assessment for each revenue category. The cost of EEDSM is included in the revenue application, which NERSA assesses. Under the methodology, EEDSM revenue requirement is defined as project cost or programme cost, plus operating cost and measurement and verification (M&V) cost (NERSA, 2006, 2016). The second source of information was semi-structured interviews with key government stakeholders.

4. Eskom's Integrated Demand Management Programme

In 2004 Eskom launched its DSM programme (renamed IDM in 2010) and as a result became the primary administrator and implementer of the NERSA-approved, rate-funded, DSM programme. In 2006, the electricity crisis necessitated immediate energy savings, prompting Eskom to establish a dedicated DSM division as part of the transmission division. During this period, the policies that were developed and adopted created a supportive environment for a well-funded DSM programme, with political and regulatory backing. A crucial factor was the cost recovery mechanism approved by NERSA, which provided the DSM programme a multi-billion-rand budget at its peak from 2011 to 2013. However, during the MYPD 3 period from 2015 to 2018, funding was reduced by over 60%, leading to the suspension of additional activities and gradual phase-out of existing IDM initiatives. This series of events is analysed in greater detail below.

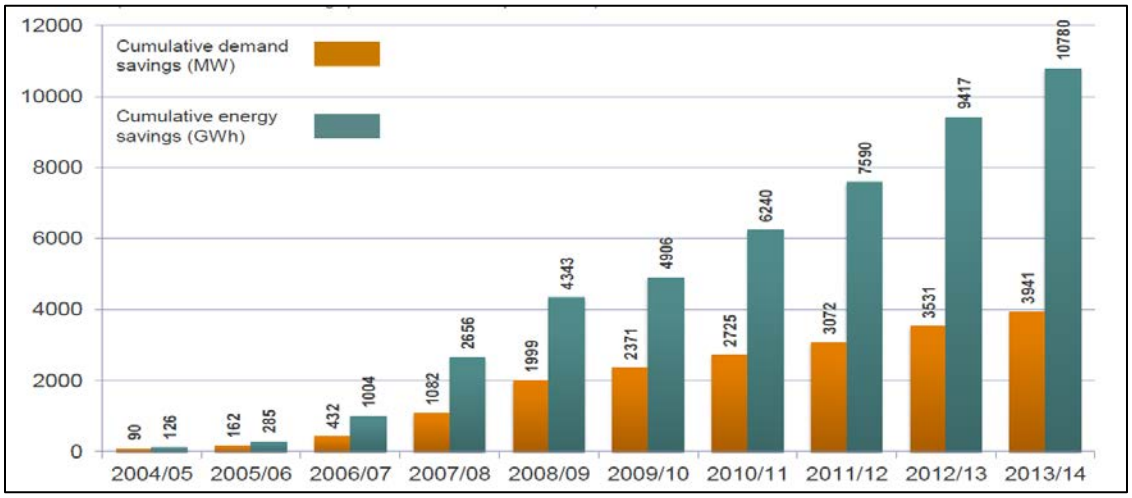
3.1 2004 to 2013

Eskom's IDM programme transformed from an awareness campaign-focused initiative into a measurable energy savings programme with multiple objectives. As part of the MYPD 2 revenue application process covering the period of April 2010 to March 2013, Eskom was approved a budget of R 5.4 billion (USD 653M)[3] by NERSA to achieve 4 055 GWh of energy savings and 1 037 MW of demand reduction (NERSA, 2010). The costs of administration, interventions, and verified measurements were included in the approved budget and recovered from electricity sales, via a DSM levy making it ratepayer funded.

At the end of the MYPD period, Eskom achieved a saving of 1 216 MW, exceeding the initial target set by NERSA with 179 MW. By 2013, IDM had achieved significant results, saving cumulatively 3.9 GW, which is equivalent to the capacity of a large power station with six generators of 600 MW (Eskom, 2015). It had also saved 10,780 GWh, an amount of energy equal to the total annual electricity consumption of the City of Tshwane, the country's capital city (Figure 1).

[3] A five-year average exchange rate of 0.12 (2007–2012) was used to convert rand to US dollars.

Figure 1: IDM cumulative capacity performance over time (MW)



Source: (Eskom, 2015)

Over this period, a comprehensive and integrated set of solutions were deployed by Eskom to deliver the targeted energy savings and demand reduction. These solutions ranged from large-scale efficiency projects mainly implemented by Energy Service Companies (ESCOs) to small projects based on the implementation of standard efficient technologies. Table 2 summaries these interventions which were designed to cover all sector of the economy. They proposed different financing incentives to attract a maximum of investment in energy efficiency technology and behaviour change. These solutions evolved over time to address the changing needs of the market and changing conditions of supply outlook. Table 2 provides a snapshot of programs available in 2013.

The residential mass roll-out and standard products were designed to target single technologies spread out across many users and for which standard efficient technologies are recognized. In these cases, validated estimates of energy and peak demand savings were attributed to specific technology energy efficiency measures and a rebate was offered to consumers for the deemed savings.

The performance contracting, the ESCO model and the standard offer programs offered pre-determined price for every kWh or MW saved. In these cases, Eskom purchased energy savings and demand reductions from energy users or project developers using a predetermined rate based on verified delivered savings. In some case these saving needed to be preapproved by Eskom and in other case they were independently verified by third parties. The verification process had to follow the Measurement and Verification Guideline for Energy Efficiency and Demand-Side Management (EEDSM) projects, based on the International Performance Measurement and Verification Protocol (IPMVP) and SABS: SANS 50010 standard, Measurement and verification of energy savings (Eskom, 2011; EVO, 2012; SABS, 2011).

Eskom's IDM programme contributed to the development of an ESCO industry in South Africa. By 2012, 613 ESCO's projects were completed or were being verified and a further 312 were in the implementation phase (IDC, 2018). The total savings from the ESCO model were 769 MW of demand savings and 2,327 GWh of energy savings (Skinner, 2012). As the majority of ESCOs and solar water heater installers developed their business models around these IDM incentives, the suspension and subsequent termination of the IDM programmes had a significant impact on many businesses.

Table 2: Eskom EE funding programs

Program	Size	Description	Market Focus	Funding per kWh or MW offered
Performance Contracting	>5 MW	Bulk purchasing of energy savings from project developers	Large capital intensive industrial projects	Peak savings: R 0.55/kWh Other savings: R 0.10/kWh
ESCO Model	> 500 kW	Demand-based payments for verified savings	Industrial	Load Shifting: R 3.5M/MW Peak clipping: R 3.5M/MW Energy efficiency: R 5.25M/MW
Standard Offer	50 kW – 5 MW	EE and small-scale RE at a fixed rate	Industrial, Commercial	R 0.42–1.20/kWh (Peak Hrs)
Residential Mass Rollout	1 MW – 5 MW	Demand-based payments for verified savings	Residential	Fixed Rate per technology
Standard Product	< 250 kW	Pre-approved rebates for deemed energy savings (24/7)	Small Industrial Commercial Agriculture	Fixed Rate per technology

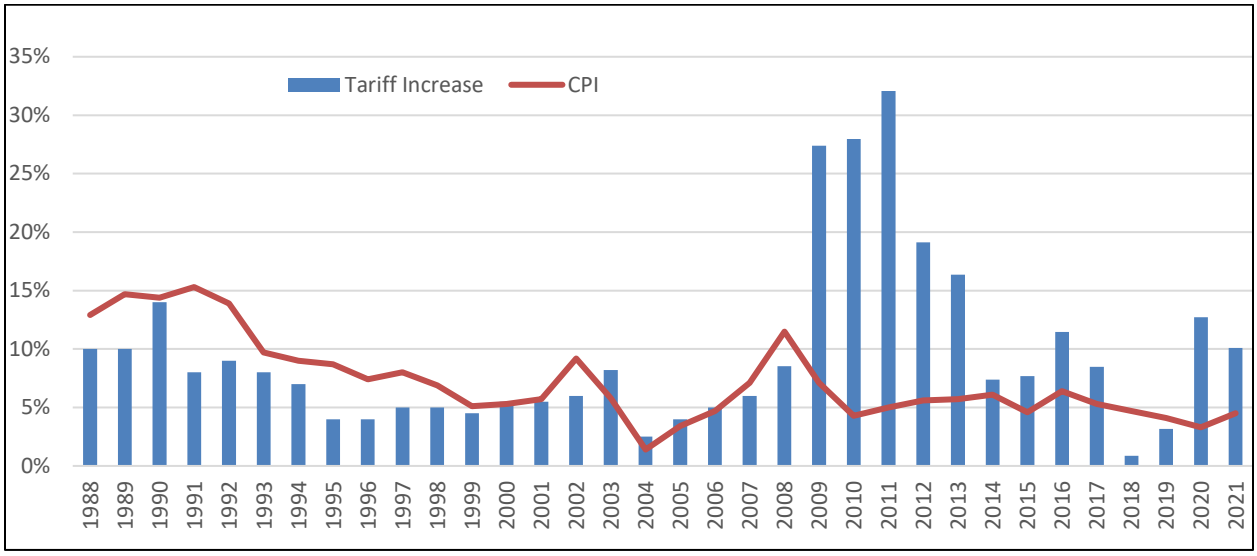
Source: (de la Rue du Can et al., 2013)

The majority of the achieved energy savings came from the residential mass roll-out (RMR) programme. This programme consisted of several interventions of which the replacement of incandescent lightbulbs (destroyed) with compact fluorescents (CFLs) was by far the most effective. By 2012, a total of 2 137 MW of savings was achieved with the replacement over 53 million bulbs and the savings from this programme made up 70% of all savings claimed by the unit. The RMR was implemented by approved project developers, with energy saving targets between 1 and 5 MW with the aim to stimulate uptake, accelerate implementation, and create new job opportunities (Eskom, 2012).

3.2 2013 to 2018

Eskom's MYPD 3 application, which covered the period from 2013 to 2017, included R13.9 billion (USD 1.7 billion) to target energy savings of 1 730 MW and 7 731 GWh. However, NERSA only approved R5.2 billion (USD 641 million); less than 60% of what Eskom requested. During that period, the electricity reserve margins indicated a stabilisation around 15%, suggesting that the electricity supply would soon be sufficient to meet the demand and thereby bring an end to the crisis. On this basis, NERSA decided to reduce the allocation — and with it, the savings. NERSA viewed the IDM programme as one of the measures aimed at achieving a balance between the supply and demand of electricity, which appeared to be nearly accomplished. NERSA prioritised cost containment to reduce the annual increases as electricity tariffs had increased by up to three times the inflation rate. See Figure 2.

Figure 2: Eskom electricity increases compared to consumer price inflation (1998 – 2020)



Source: (Karin Kritzinger, 2022)

During the public consultation, NERSA acknowledged the concerns raised about the inherent conflict and long-term disincentive for utilities to manage and operate a sustainable DSM programme, and agreed with them. In NERSA's decision on the MYPD 3 Eskom application, the agency explained that the *The long term view of the Energy Regulator is that all IDM programmes with the exception of system operator tools (such as demand management) should be implemented by a suitable agency. The management of IDM funds by Eskom creates a conflict of interest, as Eskom is then required to encourage its customers not to purchase its generated electricity. IDM funds shall therefore be ring-fenced within Eskom to enable transfer of the funds to a suitable agency* (NERSA, 2013).

In response to the insufficient funding provided for its aggressive energy savings initiatives, Eskom stated that it would engage the government to explore alternate funding models (Eskom, 2014). Nonetheless, Eskom pledged to continue as the main administrator and implementer of the NERSA approved DSM programme during the MYPD 3 cycle, with an obligation to meet predetermined targets even though the approved tariff allocated significantly less funding to the IDM programme.

In 2014 Eskom publicly stated that it was not certain whether it would initiate new IDM projects once its MYPD 3 obligations were achieved, and indeed even if the existing obligations under MYPD3 were not met.

In September 2018, Eskom's MYPD 3: Regulatory Clearing Account Submission (Eskom, 2018) to NERSA reported that 41.87 MW of peak demand savings had been achieved for FY2018 against the NERSA determination of 415 MW. This was estimated to result in Eskom incurring a penalty of R1 118 million.

In 2018 Eskom confirmed that it had not secured any alternate funding for its IDM programme. Consequently, the programme, excluding demand response (DR), was transferred to Eskom Distribution (Dx), which prioritises electricity sales. This move heightened the conflict of interest with energy savings

and led to a decline in performance. Nevertheless, Eskom recognised the crucial role that EE measures played in alleviating pressure on the power system.

On this basis, the focus of the Eskom IDM programme shifted towards optimising the load profile and boosting baseload sales by targeting the following:

- System load optimization (load shifting):
    - Shift load to off-peak.
    - Reduce customer bills for using electricity in cheaper periods.
    - Optimise the long-term system profile to reduce the long-term cost of generation.
- Increase sales:
    - Use the space created from load optimisation to increase high load factor (24/7) sales.
    - Additional sales result in recovering fixed cost and reduced cost per unit.
- Demand response:
    - Incentivise customers to reduce demand when system is constrained.
    - Economic dispatch to reduce open cycle gas turbine (OCGT) costs.
    - Fast frequency response to protect the system in coping with increased renewables

3.3 2019 to 2021

Between 2018 and 2021, during MYPD 4, NERSA reduced the funding for the IDM programme to zero. NERSA argued that 'the IDM programmes that Eskom applied for in the MYPD 4 application was costly while they will have a little contribution to the demand savings' (NERSA, 2019). Eskom had proposed a goal of 75 MW for a budget of R583 million (USD 34 million[4]), a cost of R7.7 million per MW (USD 450,000/MW), significantly lower than the costs for new generation sited in the 2018 IRP, ranging from R16.5 million/MW for solar photovoltaic to R98.1 million/MW for nuclear (Engineering News, 2018).

Eskom responded that this decision was contrary to the requirements contained in the MYPD methodology and that the decision from NERSA was determined by NERSA's belief that the IDM programme is unnecessary during availability of '*excess capacity*' (Eskom, 2021). Eskom further explained '*firstly, such programmes are not dependent on the existence of capacity but are meant to advance energy efficiency, and secondly, Eskom did not have excess capacity at the time which undermines the very basis for the disallowance of these costs*.'

Eskom requested R1.079 billion for the Instantaneous and Supplemental Demand Management Participation (DMP) programme aiming to achieve demand reductions of 600 MW and 105 GWh through voluntary customer load curtailment. NERSA granted approval for R967 million.

The Eskom IDM team remained acutely aware that even with an improved energy availability factor (EAF) servicing peak electricity demand would remain challenging, especially during the three-month winter

[4] USD 0.058 /Rand (1/18/2023 exchange rate)

period (June to August) when demand can increase by an additional 3 GW[5]. 'Since the EEDSM programme cost was disallowed in the NERSA MYPD 4 determination, Eskom could not continue with any EEDSM programmes despite the requirement in the MYPD methodology. This becomes a significant risk.'(Eskom, 2021).

3.4 2022

In 2022, Eskom's demand management programmes focussed primarily on load shifting (LS). It is worth noting that the responsibility for LS still lies with the Eskom transmission (Tx) unit. The supplemental (DR and LS) programme protects the integrity of the system in the following two ways:

- Via the fast frequency response initiative, where heavy users (such as smelters and furnaces) adjust their demand instantaneously to ensure the system retains a 50 hertz frequency. This accounts for approximately 1 GW of usage.
- Via a price incentive for customers not participating in the frequency response initiative to shift load, where the shorter the notice period, the higher the price paid by Eskom. An additional benefit for customers participating in this programme is that they are excluded from Stage 1 and 2 load shedding. Currently, the programme has access to ~400 MW of load.

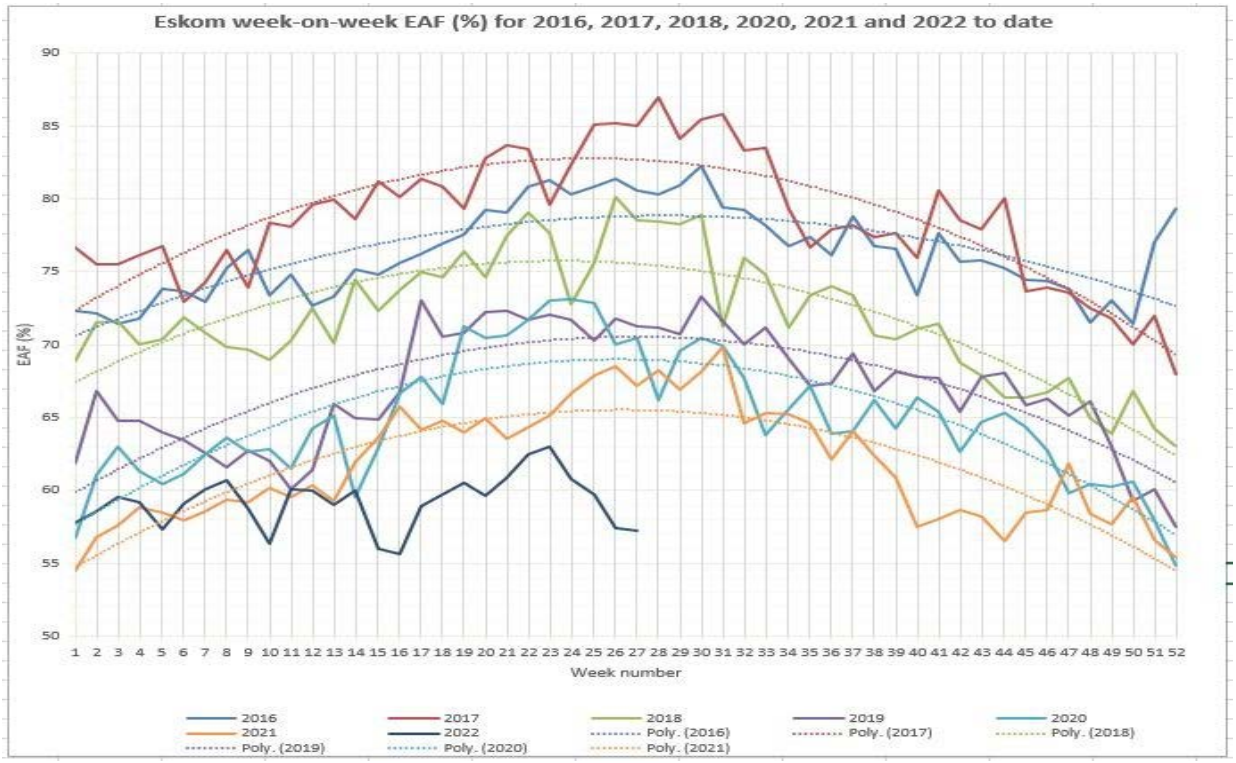
Eskom Tx is currently in the process of expanding its programme to target the remaining DR and LS potential, estimated at ~4 GW — i.e., the identified 8–9 GW base, less the already accessed 1.4 GW from above, and excluding non-flexible load (~3 GW). The set of consumers who can provide meaningful DR and LS volumes is estimated at 150, and thus the opportunities are limited.

According to Eskom Tx, there is limited potential and high complexity in actively targeting DR and LS in the commercial sector. The residential sector, which is part of Dx's IDM programme, faces similar challenges.

Eskom acknowledges the urgent need to reduce total and peak electricity demand in light of its declining EAF (Figure 3), limited new generation capacity, and increased post-COVID electricity demand. These factors have resulted in the most extensive load shedding in the country in 2022. The Eskom Dx EE unit has taken several actions, such as reintroducing the successful 'Power Alert' updates on national television (Figure 4), issuing tenders for project developers to submit proposals for "the reduction in electrical consumption by implementing energy efficiency measures, during specific Eskom defined periods", providing Energy Advisory Services (Eskom, 2023b), which includes electricity tariff analysis, energy audits for qualifying customers, optimization of usage profile, sector-specific advice (such as agri-processing and residential), and reliable EE literature to inform, educate and guide their electricity customers.

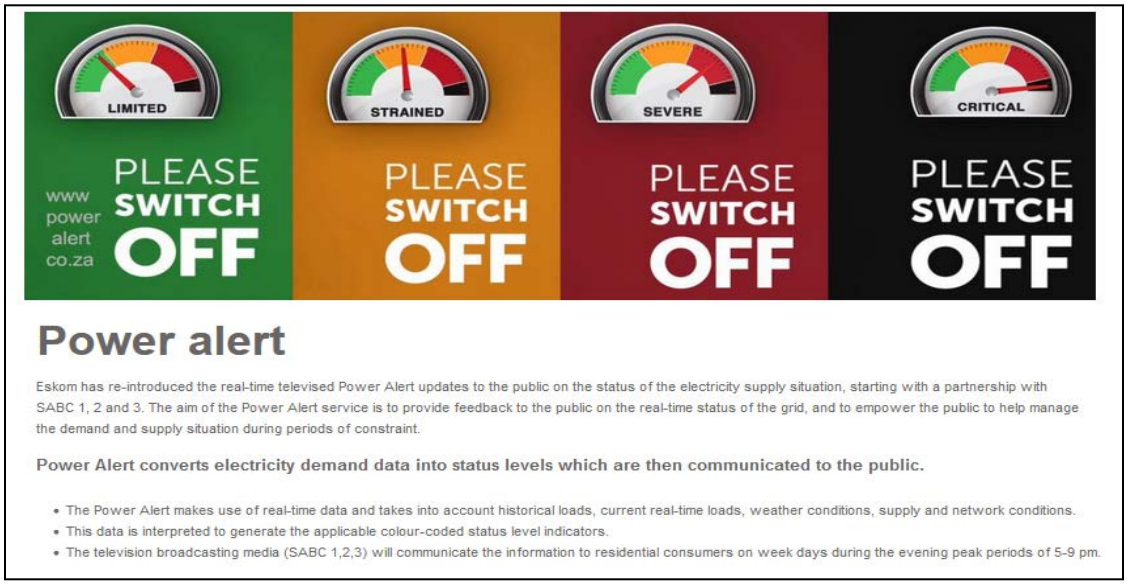
[5] Interviews with Eskom were used to inform this section.

Figure 3: Eskom EAF (2016 to 2022)



Source: (EE Business Intelligence, 2022)

Figure 4: Eskom power alert



Source: (Eskom, 2022)

5. Reasons for the Decline of Eskom's IDM Programme

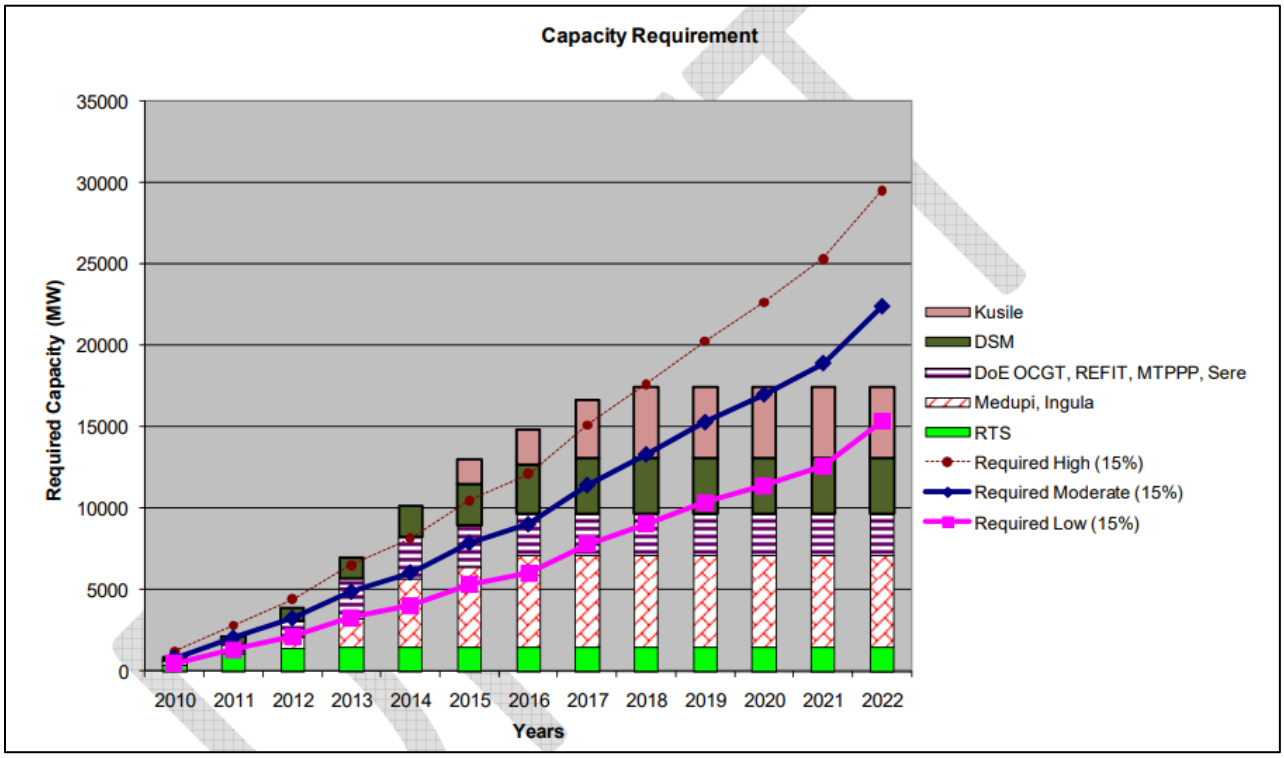
The defunding of Eskom's IDM programme can be attributed to four primary reasons, namely: (1) the failure to acknowledge EEDSM as an energy resource, (2) weak policy signals from national government regarding EE, (3) a lack of transparent metrics for prioritizing cost-effective investment at the regulatory level, and (4) doubts about Eskom's capacity to implement EE programmes. We explore these four factors in more detail below.

4.1 Lack of integration of EEDSM in energy resource planning

South Africa's 2010 IRP recognises DSM as an energy resource necessary to meet future electricity demand, as indicted in Figure 5. The incorporation of DSM as an energy resource was based on an evaluation of the country's EE potential, which was estimated at 12 933 MW (DoE, 2010b). The analysis informed DSM investment decisions, with Eskom charged with delivering 3 420 MW. Investing in DSM initiatives to enhance EE was viewed as a least-cost alternative to meet demand.

This perception changed with the release of the subsequent IRP 2019, which excluded DSM as a potential energy resource. While EE is referenced, it is only cited to explain why electricity demand was lower than anticipated in the 2010 IRP. The implication is that EE has already been accomplished and no further investment is necessary. However, no EE assessments were conducted to inform the IRP stance, and it is unclear why continued investment was terminated.

Figure 5: System capacity requirement in the 2010 IRP



Source: (DOE, 2010)

4.2 Muted EE policy signals from national government

The intensity of EE actions and policy signals from the DMRE began to decline starting in 2013, as evidenced by the various attempts to establish new programmes and carry out EE activities:

- In 2013, the National Energy Efficiency Action Plan was developed by the EE directorate of the then Department of Energy. However, due to the inability to secure the necessary funding for its implementation, the plan was ultimately shelved.
- The plans for an EE and RE retrofit of the DoE building, so as 'to lead by example' failed to receive management support.
- The post-2015 NEES was completed, but is yet to be ratified by Cabinet.
- The most recent Cabinet-approved IRP (2019) does not include EEDSM.
- The 2016 amendment to the Electricity Regulations include EEDSM as a source of potential new Generation Capacity (Government Gazette, 2016), which implies that any EEDSM project over 100 MW will require a Section 34 Determination and Regulatory approval. This threshold was 1 MW in 2016, but this has been increased to 100 MW in 2021.

4.3 Lack of transparent metrics to prioritize least cost investment

NERSA disallowed funding for the IDM programme proposed by Eskom during the MYPD 4 process, because it judged the funding application 'costly'. However, the cost per MW saved proposed was much lower than the cost of new generation at the time. Based on their actions and reports, NERSA seemingly has a limited perception of the benefits of EEDSM, viewing the programme only as useful during energy crises and unnecessary when there is excess capacity. To date the agency has not acknowledged EEDSM as a least-cost clean energy resource for long-term energy planning.

4.4 Concerns over Eskom's ability to administer EE programmes

One of the main reasons NERSA reduced Eskom's IDM programme funding was that it and other stakeholders expressed concern about Eskom's ability to effectively administer EE programmes. During NERSA's MYPD4 public hearings, it was feared that Eskom's motivation for energy savings would decline once the electricity supply shortage improved, with its interest shifting towards increasing electricity sales. Utilites can have a disincentive to invest in energy efficiency since such programs will reduce sales volume nd therefore their revenue. Some stakeholders argued that an independent agency would be more suitable for achieving long-term sustainability. However, the development of such an agency would require significant effort and new human resource capacity. Ultimately, the combination of an improving EAF and reduced budget allocation from NERSA led to Eskom's decision to abandon the IDM programme and pursue sales.

Eskom's decision to transfer the IDM programme from Tx to Dx deepened the conflict, as these units have very different mandates. The former must balance and provide a reliable and continuous electricity supply

and during shortages will drive DSM. The latter 'chases sales'[6] and has no influence or even access to the state of generation, or lack thereof. The view of a senior Eskom manager is that IDM should reside with the unit paying the open cycle gas turbine (OCGT) diesel bills for emergency power. This would create the required urgency to maximize performance, as these peaking plants generate power at more than twice the retail tariff, resulting in significant losses for the utility. Moreover, the Tx mandate has a lesser conflict with energy efficiency. While this may be true at present, it is not a sustainable solution in the long term, as evidenced by the utility's lack of progress towards meeting international benchmarks for its energy availability factor (EAF).

6. Eskom's current position on EEDSM programmes

Today, Eskom senior management: (1) recognises the urgent need to escalate its EE activities, evidenced by the recent tenders (Annex 1), but concedes that these efforts are still insufficient to meet the supply deficit and will need to be increased considerably; and (2) 'opened' the discussion regarding where EE should reside — i.e., revert to Tx with LS and DR or to strengthen activities within Dx. Here it is important to note that no decision has been taken, and the current structure should not in any way be undermined, nor should any expectations / assumptions be made.

Reflecting on the barriers impacting the acceleration of EE investment, and more specifically Eskom as an administrator of the IDM programme, Eskom executives identified the following:

1. Eskom accepts and supports the national benefits of DSM, beyond the narrow viewpoint of focusing solely on DR and SL to reduce peak demand. Given the national context (supply deficit, national institutional capacity, financial resources, technical skills) Eskom believes that DSM is once again a national imperative and that it is best placed to implement a holistic "additional capacity programme".

2. To date, NERSA has not approved funding for an aggressive programme (the application for cost DSM recovery in the MYPD 4 application was rejected by NERSA). The Regulator's support and urgency relies on EE policy direction from the DMRE, such as being included in the IRP.

3. The 2016 amendment to the definition of the New Generation Regulations has created uncertainty for Eskom. The DMRE should provide written clarity of what is intended by this sub-clause, confirming that DSM programmes greater than the licensing threshold are not in contravention of the Regulations.

4. Large scale energy savings from an effective DSM programme (4.5 GW), as delivered by Eskom's IDM programme, requires an enabling policy environment, which is currently lacking.

In conclusion, the responsible unit within Eskom current DR program is considering acceleration of its programme (additional capacity programme). It believes it has the experience, technical skills, and under current conditions, the necessary motivation and internal commitment for a medium-term programme.

[6] Eskom interview

A suggested time period of ten years would align with the estimated period required for new generation to become reliable and more flexible to operate. However, its success will rely heavily on clear policy signals to develop supportive regulations and programme rules. The unit recognises the importance of working closely with national government to achieve holistic and sustainable objectives.

7. Summary and findings

Eskom's IDM programme was delivering large energy savings, which could have resulted in lower levels of load shedding in 2023. The decision making by Eskom and NERSA is viewed by the authors as reckless, as they failed to take responsibility and seek an alternative. The DMRE, as the policy owner, had a responsibility to take a leadership role in resolving the impasse between the utility and the Regulator

Eskom's IDM programme up to 2014 demonstrated the availability of and ability of Eskom to capture significant energy savings and GHG reductions. These savings have not been exhausted (GreenCape, 2023). Notwithstanding the development of a conducive policy and regulatory environment underpin the programme's success as demonstrated during the period when the electricity crisis started in 2006 to 2014 when interest in DSM waned. This was further complicated by subsequent and contradictory policy and regulatory actions. With the benefit of hindsight, the Eskom officials that were interviewed felt that its highly effective IDM programme was prematurely curtailed. The improved EAF in 2016 could not be sustained and from 2018 plant breakdowns mounted and load shedding returned. Had IDM continued at the pace and scale of 2013, it is highly probable that the severity of the supply shortages from 2018 would have been mitigated, benefiting the national economy.

While large business and affluent citizens are able to respond to the energy crisis by investing in embedded generation and distributed generation, small businesses and the majority of households are directly impacted by electricity crisis. Improving energy efficiency is one of the most constructive, cost-effective ways to address the challenges of constrained energy availability, high energy prices and global climate change. Energy efficiency is also an important source of local job creation as demonstrated by the vibrant ESCOs industry, notably during the peak period of the IDM program and it contributes to reduce energy poverty by lowering energy bills. A coordinated DSM programme contribute to reduce the costs of integrating variable renewable energy.

Despite these benefits and the previous success of Eskom's IDM program, energy efficiency remains critically underutilized in the South Africa's energy portfolio. It is time to take advantage of the past experience within Eskom and as well as within more recent programs, to capture the savings that energy efficiency offers for the benefits of the citizens.

This combination of decisions from NERSA and Eskom ignored the least cost energy resource investment and missed an opportunity to reduce the impact of the current electricity crisis resulting in acute power outages. To increase the effectiveness of the DMRE IEE unit, South Africa's government must re-prioritize energy efficiency. The subsequent report focuses on addressing the challenges identified in this first report and describes the elements of policy framework to develop a sustained DSM program to meet the government's energy efficiency goals in terms of greenhouse gas emissions reduction and social equity and inclusion to achieve a just transition.

References

de la Rue du Can, S., Letschert, V., Leventis, G., Covary, T., & Xia, X. (2013). Energy Efficiency country study : Republic of South Africa. In *Ernest Orlando Lawrence Berkeley National Laboratory*. https://doi.org/S1356689X03000080 [pii]

DMRE. (n.d.). *Policy Brief: Post-2015 National Energy Efficiency Strategy*.

DMRE. (1998). *White paper on the energy policy of the Republic of South Africa*. Dept. of Minerals and Energy. https://www.energy.gov.za/files/policies/whitepaper_energypolicy_1998.pdf

DMRE. (2016). *Post-2015 National Energy Efficiency Strategy*. https://www.gov.za/sites/default/files/gcis_document/201612/40515gen948.pdf

DMRE. (2019). *Integrated Resource Plan (IRP2019)*. https://www.energy.gov.za/files/docs/IRP 2019.pdf

DoE. (2010a). *Executive Summary of the Draft Integrated Electricity Resource Plan for South Africa - 2010 to 2030*. https://www.cityenergy.org.za/wp-content/uploads/2021/02/resource_81.pdf

DOE. (2010). *Integrated Resource Plan for Electricity* (Issue October). https://www.energy.gov.za/irp/irp%20files/INTEGRATED_RESOURCE_PLAN_ELECTRICITY_2010_v8.pdf

DoE. (2010b). *Integrated Resource Plan for Electricity*. https://www.energy.gov.za/irp/irp%20files/INTEGRATED_RESOURCE_PLAN_ELECTRICITY_2010_v8.pdf

DoE. (2016). *Integrated Energy Plan Overview.* https://www.energy.gov.za/files/iep_frame.html

EE Business Intelligence. (2022, July 20). *Why is the Eskom Energy Availability Factor (EAF) getting lower and lower each year?* Eskom Data.

Engineering News. (2018). *Technology cost assumptions used to produce IRP explained*. https://www.engineeringnews.co.za/article/technology-cost-assumptions-used-to-produce-irp-explained-2018-10-09/rep_id:4136

Eskom. (2011). *The measurement and verification guideline for demand-side management proejcts*.

Eskom. (2012). *MEGA Tranche Residential Mass Roll Out (RMR) RFP*. http://mp2mas17.eskom.co.za/tenderbulletin/details.asp?id=3946

Eskom. (2014). *Integrated Report*. https://www.eskom.co.za/wp-content/uploads/2022/01/full-integrated2014.pdf

Eskom. (2015). Eskom Integrated Demand Management Update Background- Presentation. In Wayne Fortuin (Ed.), *Energy Efficient Buildings Forum*.

Eskom. (2018). *FY2017/18, Year 5 of MYPD 3 Period MYPD 3: Regulatory Clearing Account Submission to NERSA*.

Eskom. (2021). *Regulatory Clearing Account (RCA) - Submission to NERSA*.

Eskom. (2022). *Eskom Power Alert* . https://www.eskom.co.za/eas/power-alert/

Eskom. (2023a). *2021 Carbon Footprint Report*. https://www.eskom.co.za/wp-content/uploads/2022/09/2021-Carbon-Footprint-Report.pdf

Eskom. (2023b). *Advisory Service*. https://www.eskom.co.za/eas/about-us/

EVO. (2012). *"International performance measurement and verification protocol: concepts and options for determining energy and water savings" Volume 1, Technical Report*.

Fine, B. and R. Z. (1996). *The Political Economy of South Africa: From Minerals-Energy Complex to Industrialization*. Routledge.

Government Gazette, Government of South Africa (2016). www.gpwonline.co.za

GreenCape. (2023). *2023 ENERGY SERVICES MARKET INTELLIGENCE REPORT*. https://greencape.co.za/wp-content/uploads/2023/04/ES_MIR_2023_DIGITAL_SINGLES.pdf

IDC. (2018). *Developing a vibrant ESCO Market-Prospects for South Africa's energy efficiency future*. https://www.idc.co.za/wp-content/uploads/2018/11/ESCO_Market_Study_Report-Developing_a_vibrant_ESCO_Market.pdf

Karin Kritzinger. (2022). *Eskom electricity increases compared to consumer price inflation (1998 – 2020)*.

NERSA. (2006). *Multi-Year Price Determination (MYPD) Methodology*. https://www.nersa.org.za/wp-content/uploads/2021/01/Multi-Year-Price-Determination-Methodology.pdf

NERSA. (2010). *NATIONAL ENERGY REGULATOR OF SOUTH AFRICA REASONS FOR DECISION Subject Eskom Holdings Limited: Revenue Application-Multi Year*. https://www.nersa.org.za/wp-content/uploads/bsk-pdf-manager/2020/10/RfD-Eskom-MYPD-2-application-2010-20133536172010093621.pdf

NERSA. (2013). *The Decision - Revenue Application - Multi Year Price Determination 2013/14 to 2017/18.* https://rise.esmap.org/data/files/library/south-africa/Documents/Energy%20Access/South%20Africa_NERSA%20reasons%20for%20decision%20MYPD3.pdf.

NERSA. (2016). *Multi-Year Price Determination (MYPD) Draft Methodology*. https://static.pmg.org.za/160915MYPDDraftMethodologyPublishedon08September2016.pdf

NERSA. (2019). *Eskom's MYPD4 Revenue Application tor the 2019/20 – 2021/22 Financial Year Reasons For Decision*. https://www.nersa.org.za/wp-content/uploads/bsk-pdf-manager/2020/10/Reason-for-Decision-Eskoms-Fourth-Multi-Year-Price-Determination-MYPD4-Revenue-for-2019-20-2021-22-23809152019020929.pdf

Pierce, W., & Le Roux, M. (2023). *Statistics of Utility-scale Power Generation in South Africa - February 2023*.

https://www.csir.co.za/sites/default/files/Documents/Statistics%20of%20power%20in%20SA%202022-CSIR-%5BFINAL%5D.pdf

Ramaphosa. (2022, July 25). *President Cyril Ramaphosa: Address to the nation on energy crisis*. https://www.gov.za/speeches/president-cyril-ramaphosa-address-nation-energy-crisis-25-jul-2022-0000

RSA. (2021). *South Africa First Nationally Determined Contribution Under the Paris Agreement*. https://unfccc.int/sites/default/files/NDC/2022-06/South%20Africa%20updated%20first%20NDC%20September%202021.pdf

SABS. (2011). *"SANS 50010: Measurement and verification of energy saving,."*

Skinner, T. (2012). *An overview of energy efficiency and demand side management in South Africa - Presentation*.