Development of municipal electricity generation and distribution in South Africa and its impact on electricity conservation

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Abstract

Eskom, the national electricity utility, generates >95 % of the country's electricity and is the sole custodian of high voltage (>66 kV) power transmission in South Africa. Transmission at lower voltages is jointly undertaken by Eskom and the municipalities, with Eskom distributing 40 % and municipalities 60 %.

Municipalities are self-financing and generate revenue from three sources: 1) Property taxes; 2) Transfers from national Government; and 3) Provision of services, for which they are entitled to charge a surcharge. This practise is guaranteed under the Constitution, which is the supreme law in the country. The proceeds from the provision of services is used to cross-subsidize other activities and Municipalities have become increasingly reliant on the revenue derived from the sale of services, such as electricity and water. Under this context they have a strong incentive not to encourage electricity conservation measures as this may impact negatively on their revenue model. This arrangement is not recent and has been in practise since the time Municipalities started distributing electricity in 1890. The practise was formally endorsed by enshrining it in the Constitution by the African National Congress (ANC) when it was elected in 1994.

This study tracks why and how the institutional arrangements for Municipalities to become so reliant on the revenue from electricity sales have evolved in South Africa over time, notwithstanding numerous national Government commissions of inquiry which have warned against this practise. The impact and potential consequences are also explored to highlight that this outdated, and arguably, inappropriate revenue source is having a negative impact on the country's economy. Reverting to the original model of Muncipal generation to complement the electricity supply from the country's sole utility may hold the key to a more reliable electricity supply and spur economic growth.

Introduction and contextual background

COUNTRY FACT

South Africa is a middle-income, emerging market with an abundant supply of natural resources; well-developed financial, legal, communications, energy, and transport sectors and a stock exchange that is the 15th largest in the world. Even though the country possesses modern infrastructure that support a relatively efficient distribution of goods to major urban centres throughout the region, some components retard growth. These include a low skilled labour force, deteriorating infrastructure, high unemployment rate, poverty and inequality.

Country data from the International Monetary Fund (IMF) [1] stated that for the period 1980 until 1995 the population grew at an annual rate of between 2 % to 2.5 %. From 1996 the growth rate dropped to below 2 % and has remained between 1 % and 2 %. The 2010 figure was 1.07 %. A country census [2] undertaken in 2011 counted 51.7 million people living in the country. The same census report also highlighted the sharp increase in population numbers for provinces where the country's large metropolitan cities are located.

ROLE AND STRUCTURE OF ELECTRICITY SECTOR IN THE SOUTH AFRICAN ECONOMY

High level energy statistics are provided in the graphs below to provide an overview of the country's energy profile.

Mining, and the industries associated to mining, have been the driving force behind the country's development. With the discovery of some of the world's biggest gold deposits, diamonds, platinum, manganese, iron ore and many other minerals – South Africa remains one of the world's leading mining and mineral-processing countries.

With small deposits of natural gas and oil but very large coal deposits the country relies heavily on coal for most of its energy needs. The South African electricity system was built and relies almost exclusively on the country's coal reserves.

Eskom, the state owned utility which generates in excess of 95 % of the country's electricity [4] reported electricity sales of 224,785 GWh in 2012 (2011: 224,446 GWh). Eskom's generation is dominated by coal – the breakdown is shown in Figure 1 [5]. In 2011 the Eskom Generation Division operated 13 coal-fired power stations with an installed capacity of 37,755 MW. 64 % of Eskom's current installed base load capacity plants are past their midlife. The utility also operates one nuclear power station which has a net output of 1,800 MW [6], and several peaking plants with an output of approximately 4,400 MW. Eskom's maximum generating capacity in 2012 was 41,647 MW [5] (Figure 1). Eskom is also the sole custodian of high voltage power transmission in South Africa, while Eskom and the municipalities jointly undertake power distribution at lower voltages. In this context, high voltage is considered anything higher than 66 kV. Eskom distributes roughly 60 % of the electricity to 40 % of the customers and Municipalities supply 40 % of the electricity to 60 % of the customers. The distribution of electricity by the Municipalities is a major funding source. On average 25 % of municipal budgets is financed from the surplus from electricity sales. A recent study conducted found that between 24–34 % of the metros' revenue is derived from the electricity [27]. Under this arrangement Municipalities have a strong incentive not to encourage electricity conservation measures as this may impact negatively on their revenue model.

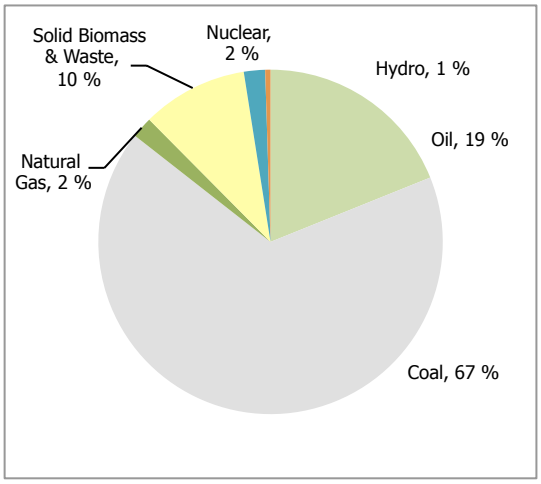

Figure 1. SA Total Primary Energy Supply (2012). Source: EIA.

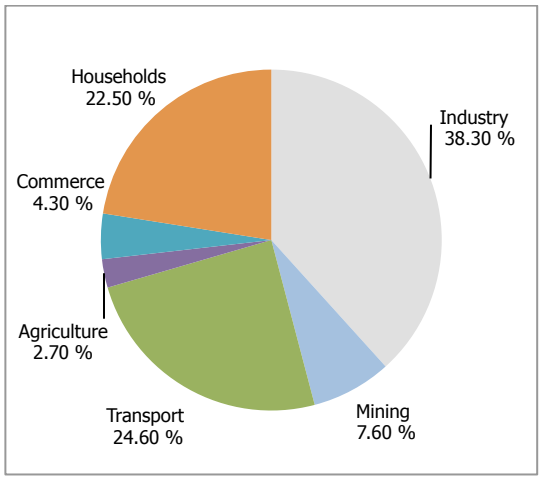

Figure 2. Energy Consumption by Sector (2012). Source: DOE.

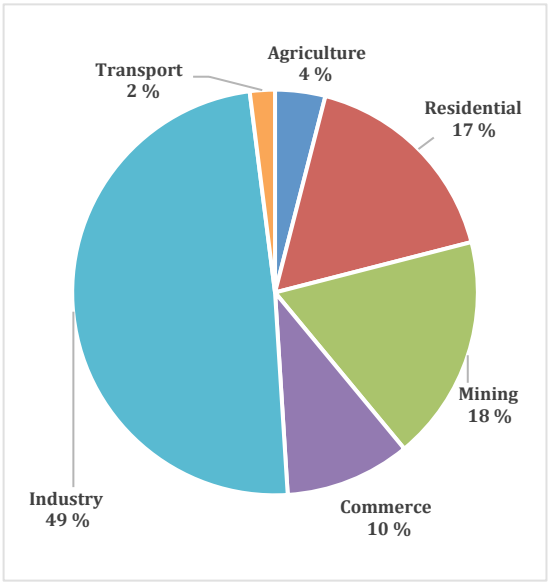

Figure 3. Electricity Consumption by Sector. Source: Eskom.

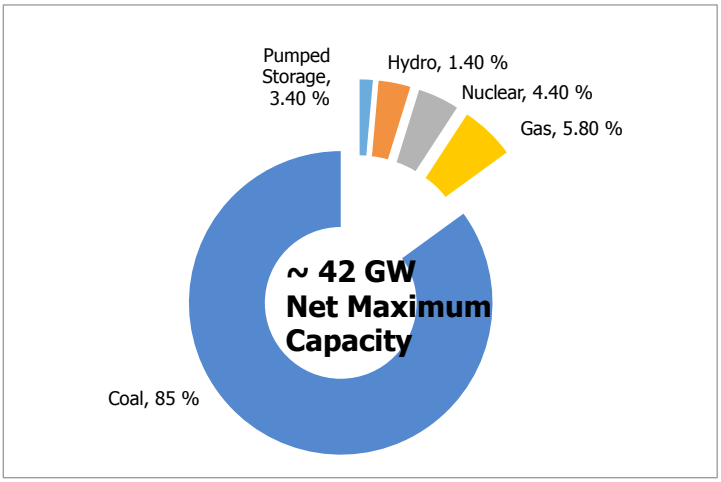

Figure 4. Eskom net capacity mix (2012). Source: Eskom.

The above mentioned institutional arrangements developed over a long period and Eskom was only assured its generation and transmission monopoly in the late 1960's. Three distinct periods can be identified in the formulation of electricity policy in South Africa: 1) The period up until 1970 when Government succeeded in implementing its policy of developing a large, single supplier of electricity; 2) 1970 to 1994 the Eskom dominated period up until the first democratic elections; and 3) 1994 until the present day.

SOUTH AFRICA'S ELECTRICITY CRISIS

The new democratically elected Government had the objective of reforming the electricity industry and in 1998 published the White Paper on Energy Policy. During this period it placed a moratorium on the building of any new power plants in the expectation that the new policies would attract independent producers. However, for a variety of reasons this did not materialise. When it became evident that demand would overtake supply by no later than 2008 Eskom was given the go ahead to embark on the re-commissioning of mothballed power stations and to build new power plants. A build programme was developed to add new generation capacity of 17,082 MW during the period 2005–2016, of which 5,756 MW was installed and commissioned as at March 2012 [5]. Figure 5 shows Eskom's historic power capacity starting from 1969 and its new build plan up to 2025 [7]. Eskom's prediction of supply shortages was correct and the country experienced large scale rolling blackouts in early 2008 which lasted for a month. The utility managed to stabilise the grid for the next four years but the power stations being built have experienced extensive delays and cost overruns and are still to be commissioned. Thus the post 2012 numbers shown in Figure 5 were not achieved and the country entered a new period of uncertainty in 2014 where power cuts became regular. In a press conference held on the 15 January, 2015 the Eskom CEO stated that the crisis will persist until 2018 at a minimum. Tariffs are also likely to be revised upwards of the already approved 12 % annual increases up to 2017.

In 2005 when Eskom realised that demand would overtake supply it implement a Demand Side Management Programme which was funded by a mandatory levy charged to all consumers. The Integrated Demand Management (IDM) as it was known, started slowly but reported in its annual financial results in 2013 that the programme had delivered in excess of 3,500 MW in savings. The programme was suspended in 2013 due to insufficient funding and no replacement DSM programme has been implemented by the Government. In 2015 there are a few energy conservation programmes but these are not coordinated and insufficient to address the challenges being faced. For example, the 12L EE Tax incentive offers a tax rebate to all energy efficiency projects that reduce energy consumption and is claimable until 2020. However, the effective kWh rate after tax is R0.126 (<0.01 Euro) so financially unattractive for many companies. The M&V requirements are also onerous making them time consuming and expensive.

In this context the importance of energy conservation is a national imperative and if available opportunities are realised it could solve many of the immediate problems being faced by the country in the short to medium term. The paper looks at the development of the electricity industry in South Africa and the events that have resulted in the current institutional arrangements which are seemingly working against the widespread implementation of electricity conservation by consumers supplied by municipal distributors.

Local government and electricity

1890 TO 1950

The second Anglo Boer war ended in 1902 and Under the Treaty of Vereeniging, the Boer states of Transvaal and Orange River Colony (Orange Free State), lost their autonomy and

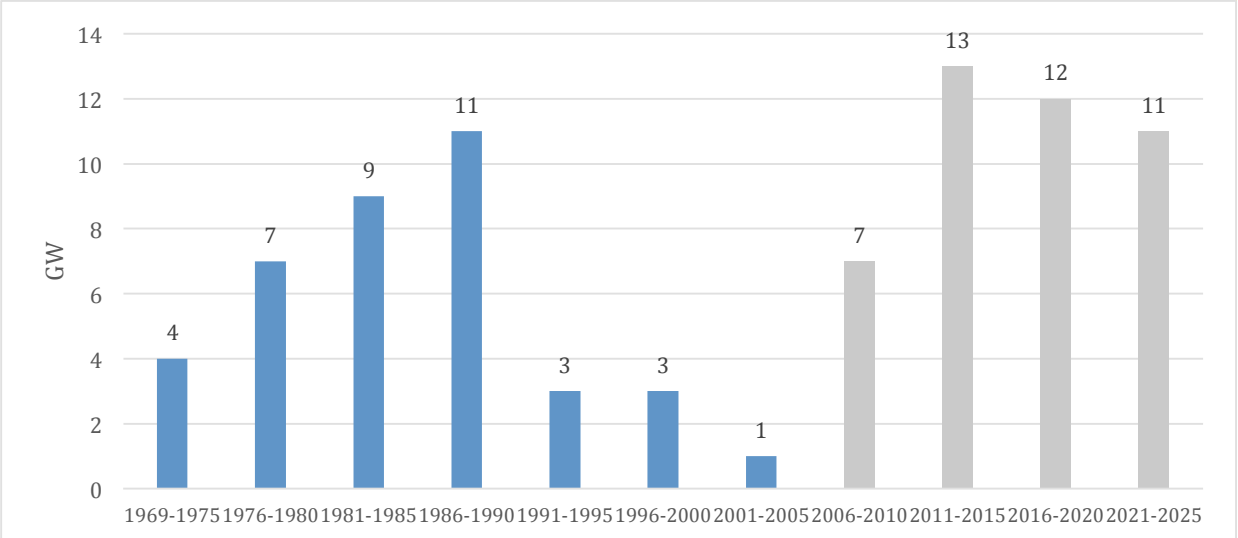

Figure 5. Eskom build programme (1969–2025). Source: Eskom.
1969–1990: Eskom developed skills and world class performance in construction and contract management.
1991–2005: Eskom was instructed not to build as Indepdented Power Producers were expected to enter the market.
2006–2025: Eskom was instructed to build in 2005 with a very steep ramp-up.

agreed to come under the sovereignty of the British Empire on the understanding that they would be given self-government in the future. The origins of local government, with an elected council, go back as far as 1836 but the form for each of the four states had evolved differently as a result of the British and Dutch influences [8]. Under the British, municipalities were formally established across the Transvaal, most of which came into existence in 1903. The town engineer was responsible for all public works under municipal governance. Depending on the size of the town electrical, water and sewerage engineers would be appointed who would report to the municipal engineer [9]. Most of the early engineers were trained via the apprenticeship system.

The Cape Electric Light and Telephone Company was formed in 1879 and the country's first electric lighting appeared in Cape Town railway station in 1881 and extended to Table Bay Harbour by 1882. From there the demand for electricity grew across the country. By the turn of the century most independent electricity generation plants, for one reason or another, had been taken over by the local municipalities. The result was that municipalities generated most of their electricity. A practise which endured for many years.

The mines, however needed power. Siemens and Halske won the first concession in 1894 to build a commercial power station to supply Johannesburg and Pretoria but this was ceded to the Rand Central Electric Works Company a year later. Rand Central's interest was in supplying the mines and a power station was built in 1897. Simmer and Jack mines was another example and when it was awarded the rights to supply five nearby mines it set up the General Electric Power Company which started producing power in 1899. The practise of mines building their own power stations continued for the next two decades [10]. The Victoria Falls Power Company (VFPC) was formed in 1906 with the original intention of supplying Transvaal and Rhodesia with hydro-electric power. A combination of concerns that hydro-electric supply may have on the coal mining industry and the state railways that transported the coal as well as the urgency for power after the Anglo-Boer war delayed the project. In the interim it was decided to supply the Witwatersrand from steam plants using local coal. Ultimately it was accepted that transmitting power from Victoria Falls was not viable. The VFPC purchased Rand Central Electric Works and the General Electric Power Company in 1907. By 1915, VFPC had four thermal power plants with an installed capacity of more than 160 MW. The rapid growth and success of the VFPC, which changed its name to VFTPC in 1909 (Victoria Falls and Transvaal Power Company), to supply power to the mines was creating a single supplier which 'might perpetuate a powerful monopoly' [11a]. This threatened the interests of a number of important groups in the Transvaal [12a] and led to the appointment of a Power Companies Commission in 1909. The Commission findings can be summarised as follows: [13a] 1) There being significant advantages to the large scale production of electricity; 2) Private investment could facilitate this; and 3) Supply by the private sector would lead to a 'virtual monopoly in a commodity which has become practically a necessity of modern civilisation'. To manage this it was concluded that although it was desirable to leave this undertaking to the private sector, Government would need to control and regulate the sector in the interest of equitable supply, the public and public safety. Thus, the Transvaal Power Act (Act 15 of 1910) was passed three days before the Province was amalgamated into the Union of South Africa, and thus became the cornerstone for future development of the electricity-generating industry in the new Union of South Africa [11b]. The main provisions of the Act provided for the establishment of a Power Undertakings Board, which had the authority to license public power undertakings and their supply area. Public roads could be used for electricity reticulation and licensees had to charge uniform rates [11b]. Uniform rates meant regulated prices according to a supervised rebate system of annual 'surplus' profits. Surpluses were re-distributed to consumers on a prorated basis of their consumption [14a]. Most contentiously the Act made provision for the expropriation of undertakings by the State after 42 years [12b]. The Act did not require local authorities to apply for a license in their areas of jurisdiction, however other parties could subject to a veto from the local authority. But, Section 5 of the Power Act excluded certain types of customers from the local authority's area of jurisdiction, such as mines, railways and Government operations. This provision meant the local authority could not veto such undertakings being supplied by other power generators which gave VFPTC, and later Eskom, access to its primary consumer base [13b]. The Transvaal Power Act was responsible for regulation until it was superseded by the Electricity Act of 1922. With regards to licenses and the attached conditions, the Transvaal Power Act effectively remained in force until 1995 as new legislation recognised the existing licensing conditions between Eskom and local authorities. All electricity infrastructure was required to relicense in 1995 by the National Energy Regulator [13b].

In 1910 the Union of South Africa was formed under British dominion, which was made up of the four British colonies. A strong Union rather than a Federalist State was deemed necessary to promote nation building between the two older British colonies (Cape and Natal) and the two Boer Republics. A three-tier system of Government was formed – national or central, provincial and local. As a gesture to Federalist sentiments an upper house was created to represent local interests but national Government had a legislative override, so in effect they had no protected or residual powers [15]. Municipal affairs were made the responsibility of the provincial authorities with central government showing little interest in municipal affairs and did not contribute to their development or their administrative capacity [16]. The structure of local Government was similar to the British system with the major difference being that local Government provided few social services such as education and social welfare. These were administered by provincial or national Government. The major functions of authorities was the provision of trading services such as electricity, water and gas supply. These trading services along with rates on fixed property accounted for almost all the revenue generated by each local authority [17]. The principal of financial self-sufficiency applied to local authorities with grants only providing only about 4 % of total expenditure [18]. Local authorities continued developing their electricity supply infrastructure in order to supply their residents with power and generate revenue. Up until 1922 the electricity supply industry was made up of private and municipal enterprises [14a].

Unsurprisingly the large number of power suppliers resulted in chaotic conditions as there was little legislation, regulations and standardisation. Different supply voltages were used across the country and many consumers were supplied with direct current [19a]. In an attempt to address this 22 engineers from 17 municipalities came together to form an association (Association of Municipal Electricity Undertakings or AMEU) to cater for the needs of municipal electrical engineers. Right from the start electrical engineers objected to the Municipal practise of using revenue from electricity sales to subsidise other activities. The electrical engineers referred to revenue from electricity sales being used for the so called 'contribution to the relief of rates' as licensed robbery [19b]. This practise continues until the present day.

From the turn of the 20th century the railways had considered different schemes to electrify the railroad. These were not implemented due to technology deficiencies, lack of large scale generation and the outbreak of World War I. By 1916 all railway lines from the four provinces and the harbours had been incorporated into one entity, the South African Railways (SAR). A report was commissioned by the SAR in 1917 on the possibility of railway electrification in South Africa [13b]. Key routes were identified but the study raised the broader question of electrification in South Africa and the economies of scale that could be achieved by supplying both the railways and industry. This led to a second report being commissioned by Prime Minister Jan Smuts in 1919 on the electricity industry. The Merz report, as it was known, warned against a fractured electricity supply which was believed to have constrained economic growth in England [14b] and recommended a centralised approach to regulate and unify electricity supply in the country. The Government appointed a committee to review the findings and propose what action should be taken. The committee supported the Merz findings and recommended an even more ambitious programme. For example, Merz followed the English model whose aim was to control and regulate the electricity industry. The Committee drafted legislation which recommended that a Commission be set up to not oversee but run the electricity industry. Persistent mining and municipal power-worker strikes as a result of working conditions, racial policies being implemented and the effects of the Great War played their part in convincing the Prime Minister to implement the recommendations of the committee. The Electricity Act of 1922 thus reflected the call to secure reliable and cheap electricity supply, particularly for mining and for the electrification of the railways [14b]. This would be achieved by the creation of an Electricity Supply Commission, whose mandate was to supply electricity to 'Government departments, the South African Railways and Harbours Administration, local authorities, companies and other persons carrying on industrial undertakings or to any persons whatsoever in the Union' (Act 42 of 1922, Section 3:476). In addition to creating a utility, the Electricity Supply Commission (Eskom[1]), the Act also created the Electricity Control Board (ECB) to license and regulate electricity undertakings. In future, all electricity undertakings would require a license in order to supply electricity. Exempted from obtaining a supply license were any government departments and local authorities supplying within their area of jurisdiction. Finally, the Act established the general principle that Eskom's undertakings 'be carried on neither at a profit not at a loss' (Act 42 of 1922). The Act thus set up the institutional structure for the creation of a large, single supplier of electricity for large industry and rural areas but had to recognise the existing municipal producers who would retain the right to decide on urban generation and distribution. In this way municipalities were able to protect the profits from their electricity undertaking activities but could also choose to enter into pooling or other agreements with Eskom, which many did.

Over the next thirty years municipalities expanded their electricity generation in parallel with the VFPTC and Eskom. The former was expropriated by the state in 1948 and taken over by Eskom. The mining industry exerted pressure on the Government for the supply of cheap power to expand both horizontally, by exploring and opening up new mines in the Free State, and vertically as deep-level mining became viable. This ever-increasing demand for power resulted in blackouts and it was necessary for Eskom to work closely with the gold mining and other energy intensive sectors to manage the electricity system and to assist with planning. Eskom embarked on a massive new-build programme in the late 1960s, taking its existing output of 6,500 MW with a further 3,500 MW under construction, by commissioning a capacity expansion programme of 36,000 MW. Eskom and the municipalities which generated power increasingly found themselves competing for consumers as both required scale. National Government sided with Eskom by delaying approvals for new power stations being submitted by Municipalities or making approval subject to them guaranteeing that the generation price would be lower than that of Eskom. Under these conditions they were forced to sign supply contracts with Eskom and new build programmes were abandoned (AMEU archives). The game changer was when Eskom succeeded in connecting the individual grids into one national grid. This meant that large coal power stations could be built next to large coal mines and the power, not the coal feed stock, would be distributed to all parts of the country. This reduced generation costs and Municipalities could no longer compete. Subsequent to this event, Eskom and the municipalities entered into an agreement whereby all generation and transmission would lie with Eskom and distribution with the municipalities, unless a municipality opted to cede this activity to Eskom.

1970 TO 1994

Eskom was now firmly entrenched into a culture of continuous expansion and its mandate to operate at *neither a profit nor a loss* created a perverse incentive whereby it chose to invest profits into new plants rather than return it to the consumer in the form of lower tariffs. This funding was not sufficient and rates were increased 16 % in 1975 and 30 % in 1976. The response from consumers was immediate and the Government set up an inquiry undertaken by the Board of Trade and Industries (BTI) [20]. During the inquiry tariffs were increased by 48 % (1977). The BTI inquiry made multiple pro-reform recommendations. Key amongst these were: 1) Abolishing the Capital Development Fund, a system which allowed Eskom to allocate fund-

1. Escom underwent a name change in 1986 when the English and Afrikaans acronyms were combined to form its new name – ESKOM.

ing as a cost; 2) Eskom's accounting procedures needed urgent review; 3) A general lack of planning existed; and 4) Future capital projects should be postponed or cancelled. Eskom responded by adopting some management changes and was able to convince the Government not to adopt the reforms. Artificially low tariff increases (1979–1982), delay in commissioning the nuclear power plant (Koeberg), teething problems with the new 'six-pack' power plants, loss of supply from Mozambique's Cahora Bassa hydro-electric plant resulted in some sporadic power outages during the late 1970s to mid-1980s. Eskom was quick to point out the need for additional expansion and to respond harshly to concerns raised about its planning process.

By early 1980 Eskom had lost 3–4 years of generation expansion which did not sit well in an entrenched organizational culture of continuous expansion. Eskom management opted to stick with its assumption of 7 % demand growth even though multiple external and internal studies suggested otherwise. A tariff increase of 14.5 % in 1983 prompted P W Botha to unilaterally announce a lower increase and appoint the De Villiers Commission of Inquiry [21]. The findings once again recommended reform, and included: 1) Organization restructure; 2) Electricity conservation should be prioritised; 3) Investigate cost-cutting measures; 4) Abandon the 'neither loss nor profit' principle under which Eskom had operated; 5) The adoption of orthodox accounting principles. The inquiry resulted in much needed reform but the call to promote electricity conservation was ignored as Eskom moved into a situation of over-supply. The Inquiry's estimate of the country's total required capacity was significantly lower than Eskom's forecast but still well above the actual demand (see Figure 6).

1990 TO PRESENT DAY

On the 2nd of February 1990 the president announced the unbanning of all political parties and a transition period which would lead to the country's first democratic elections. During this period a Constitution was written which was to be accepted by all political parties. The Constitution is the supreme law of the Republic and any law inconsistent with it is invalid, and the obligations imposed by it must be fulfilled (Constitution of South Africa, Founding Provisions). The Constitution (1996) guaranteed Municipalities certain functions, this was a fundamental shift away from the inter-governmental system which had been in place since 1910 [22]. Five reasons drove [23] the promotion and elevation of local Government: 1) To remove any remaining vestiges of apartheid; 2) In addition to service delivery, cities must be globally competitive if they are to prosper; 3) Strong local Government allows for greater public participation and seen as a way of empowering people; 4) The African National Congress (ANC) viewed it as a mechanism to strengthen its political power, by upgrading local rather than provincial Government; and 5) Many provinces were entirely new creations with limited or no capacity. Local Government was therefore in a better state than provincial administrations. Protected by Section 151 (4) of the Constitution, which states that national or provincial Government may not compromise or impede a Municipality's right or ability to exercise its powers or perform its functions, Municipalities became a sphere of Government in their own right. Municipalities are also self-financing and this is guaranteed by the Constitution (Section 229 [1]) – 'may impose rates on property and surcharges on fees for services provided by or on behalf of the municipality'.

Thus, the existing practise of local Government levying fees and using the proceeds from the provision of services (such as electricity) to cross-subsidize other activities was enshrined and strengthened in the Constitution. The objective of this institutional arrangement was to provide Municipalities with a reliable funding mechanism and reduce their reliance on grants from National Treasury. The profits from electricity sales could be significant and would assist Municipalities to fund projects to upgrade areas which were neglected under the apartheid system. Under this structure it was rational for Municipalities to seek to constantly increase sales and profit margins in order to maximise profits which would allow them to fund other activities. The consequence of this practise is that it is contrary to national electricity conservation objectives, as Municipalities have a strong incentive not to encourage and promote any practises

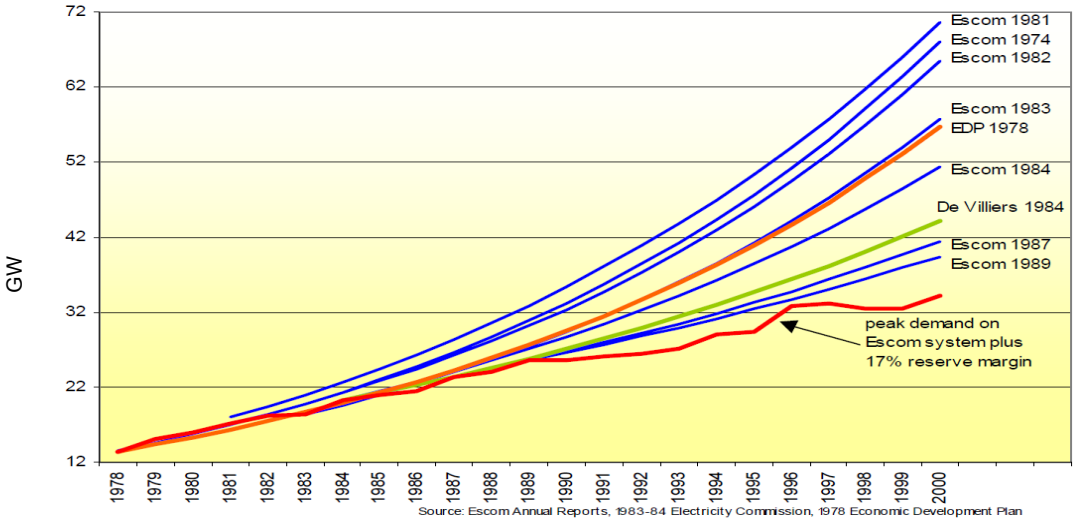

Figure 6. Actual versus Forecast Electricity Consumption. Source: Marquard (2004).

which may adversely affect their revenue model. This was not an issue in the 1990s as Eskom had an over-supply; electricity was cheap so large margins could be levied; an electrification programme was being implemented to increase penetration rates from 35 % in the 1980s (in 2011 83 % of households in South Africa had access to electricity); and environmental issues were paid little attention. In recent years things have changed. Exogenous and endogenous factors are placing this revenue model under pressure and in so doing, the co-ordination mechanisms that sustain equilibrium are being threatened. Climate change concerns and non-binding international Government commitments to reduce greenhouse gas (GHG) emissions; a national energy efficiency strategy (2005) which set voluntary energy savings targets; consistent annual electricity tariff increases of the magnitude of 15–25 % to fund new generation plants; electricity supply shortages culminating in national rolling blackouts (2008 and 2014); delays and cost overruns of new coal generation power plants; are all classified as exogenous shocks. Endogenously the maintenance and refurbishment backlog of ~R35 billion (€2.3 billion) by Municipalities in the distribution network [24] is compromising the network's performance. Endogenous activities fall under the Municipalities direct control and influence, whereas other spheres of Government or private sector instigate exogenous shocks.

In 1999 national Government commenced with its plans to reform the electricity sector by consolidating distribution from the approximately 180 registered municipal distributors and Eskom into six distribution centres, with each one anchored by a major metropolitan city – Figure 3 (REDs in colour with black outline depicting the nine provinces). The Regional Electricity Distribution, or RED's initiative as it was commonly known, aimed to address the issues being experienced, the key ones being [24]: 1) Fragmentation and inefficiencies due to a lack of economies of scale; 2) Inequitable treatment of customers; 3) Financial crisis as many distributors were bankrupt; 4) Inadequate investment in refurbishment and backlog; 5) Loss of experience and skill; and 6) Accelerated need for electrification. The consultation process between national and local Government was long, difficult and acrimonious as the latter were reluctant to lose this primary revenue source but more importantly this service was their primary credit control instrument. – Municipalities disconnect households who are in arrears with all municipal bills such as water, rates, sewerage and waste. In 2010 the programme was abandoned by national Government and demonstrated the extent to which Municipal distribution is safeguarded by the Constitution.

Current status quo and recommendations

South Africa is entrenched in the current operating model of a single utility supplying cheap and reliable power. This contractual arrangement is now under threat due to Eskom's inability to deliver on these two requirements and its position is being challenged. However the transformation process is slow as the momentum of over fifty years of being a monopoly combined with developmental and interventionist state policy continues to frustrate efforts to find practical and cost effective solutions to address the current power crisis. The energy regulator (NERSA) is also failing to provide the required leadership. Delays or even outright failure to make pronouncements and rulings where uncertainty exists due to conflicting Government policies and regulations is common. For example, the energy security issues, steep increase in electricity tariffs and drop in global photovoltaic prices has resulted in much interest from small electricity users for small scale embedded generation (SSEG), the majority of whom are supplied by the municipalities. The potential to create a sizable SSEG market which could provide much needed economic activity and provide additional generation is real. But this opportunity is not being exploited as under existing legislation and policy pronouncements the role that municipalities may play is unclear and as a result almost

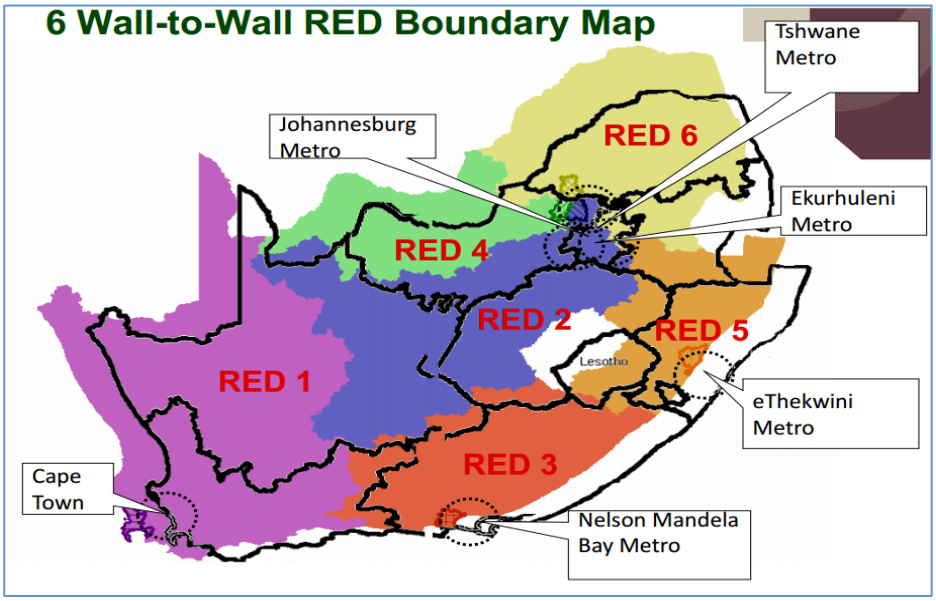

Figure 7. Proposed Boundaries of REDs. Source: Eberhard, 2013.

all have adopted a very conservative approach and discouraged uptake. In the words of one municipal manager of a major metro interviewed in December 2014, 'if the department of energy is five steps behind the game, then NERSA are fifteen'.

Similarly the Department of Energy (DOE) has also been slow to act. The country's electricity road map is the Integrated Resource Plan (IRP) which is the master plan for all electricity capacity development, distributed and non-Eskom generation (including cogeneration) and Energy Efficiency Demand Side Management (EEDSM) in the country. The 2010 IRP was promulgated in March 2011 with a revision scheduled for 2013 and set a target of 3,420 MW of final electricity consumption for EEDSM by 2017, equating to 7 % of forecast peak electricity demand. The updated draft of the IRP was released for public comment at the end of 2013 with the consultation process completed early in 2014. This draft proposed noteworthy and sensible changes: 1) Formalised (approved by the Regulator) funding for EEDSM programmes and to secure the appropriate mandate for the national entity to facilitate these programmes. The IRP noted that due to the uncoordinated nature of DSM projects in the country the plan can only rely on projects undertaken by Eskom. And that the recommendation of the 2010 IRP for additional work to be done by the DOE or one of its agencies to ascertain the per unit costs of DSM, needed to allocate funding, had not been done and thus the IRP once again can only rely on Eskom data; 2) A downward revision in the expected GDP growth of the country which would significantly reduce the proposed new build programme; and 3) Recommended a delay in the country's nuclear programme. The updated plan was due to be submitted to Cabinet in March 2014, but this process was not concluded and the IRP 2010 still holds as the only valid IRP. Communications from the DOE indicated that the stakeholder consultation process has resulted in further, unspecified revisions to the updated IRP. The IRP is a component (sector plan) of the Integrated Energy Plan (IEP), the overall master plan for energy in the country. Completion of the IRP is reportedly pending the publication of the long awaited IEP; previously planned for promulgation in June 2014, now expected in the first quarter 2015[2]. In its current form the IRP 2010 forecast has proven to be woefully inaccurate and a revision incorporating the events of the past five years is urgent.

Since its inception funding for the Eskom EEDSM programme was obtained through electricity tariffs. Eskom would submit a project plan to the National Regulator in its Multi-Pear Price Determination (MYPD) submission for tariffs, which included an application for funding to purchase energy savings and recover the reasonable cost. MYPD3, for the five year period 2014 to 2018 Eskom requested funding of R13,9 billion (€1 billion) for a peak saving target of 1,730 MW and energy savings of 7,731 GWh. The Regulator only approved R5.2 billion (€375 million). The EEDSM programme continued for a year and in October 2013 the programme was suspended due to lack of funding [28]. No other EEDSM programme was introduced by the Government and just a few initiatives are in place, which are not coordinated. An example is the Private Sector Energy Efficiency (PSEE) funded by the UK Government which offers discounted energy audits and advice to large, medium and small enterprises. There is also the previously mentioned 12L Tax Incentive but these are inadequate given the requirements of the country.

The failure of the REDs programme exacerbated already problematic local Government administration (Auditor General, 2013) and the problems that the REDs were meant to address have worsened. The surplus from electricity sales that municipalities used to rely upon has now been transformed into a deficit for many and since 2006 the aggregate surplus of R5.6 billion (€400 million) has turned to a loss of R1.4 billion (R100 million) [25].

The steep electricity tariffs users have experienced since 2007 has had an impact on consumption. By way of illustration, electricity tariffs for households and small users in Johannesburg have gone from R0.31/kWh (€0.03) [26] in 2007 to over R1.40/kWh (€0.12) [26]. Research undertaken by the University of Pretoria (2010) [29] found that internationally the price elasticity of electricity is -0.52. This implies that a price increase of 10 % will decrease demand by 5 %. Modelling the SA situation estimated a price elasticity -0.56 (4 % GDP growth rate, tariffs doubling from 2008–2011 and then remaining constant to 2025). In this outcome demand reaches a low point in 2018. South Africa's growth rate is much below 4 % and still above inflation. Tariff increases will continue until at least 2017, so it is likely that the low point will exceed 2018. The high tariffs will also make SSEG more attractive for large users. The consequence of these two events will result in reduced electricity demand and the surplus earned by Municipalities for the distribution of electricity on which they rely heavily to subsidise other functions, specifically in low income areas will decrease significantly or even become a loss as it has for Category B Municipalities (Table 1). Lower revenues will lead to higher tariff increases to recoup the losses and the cycle will perpetuate. This does not bode well for political stability or economic growth.

Municipal electricity distributors are experiencing the same challenges from disruptive forces being felt by international utilities, where lower revenues are forcing utilities to increase their tariffs resulting in more consumers opting out of the system or using less electricity and thus perpetuating the vicious cycle [30], shown in Figure 8. However the problem is more acute in South Africa for the reasons outlined in this paper.

In conclusion, South Africa's electricity sector is in crisis and requires an urgent and detailed review. The economy was built on energy intensive industries, and although this has reduced in recent years, it remains the cornerstone of the economy. The current model which has served the country in the past may no longer be relevant. The decades old institutional framework designed to provide cheap and abundant electricity from coal, which in the modern context of climate change, environmental degradation and diminishing resources needs to be reconsidered. Political interference in state owned entities and municipal operations only serves to exacerbate the problems. The following suggestions are put forward:

- **The Municipal funding model needs to be reviewed:** The sale of services is the major source of revenue and thus they have an inherent incentive to increase sales. This is in direct conflict with national policies which aim to decrease the use of natural resources (water), waste to landfill and of

2. The second IEP is currently underway and government has repeatedly stated that the next iteration of Integrated Resource Planning for the electricity supply industry (subsequent to IRP2010) will be based on the IEP, in which officials have promised an energy development road map.

Table 1. Local government electricity distributors financial viability under threat – net surpluses on electricity sales (South African National Treasury 2013).

	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13
R Million					**Medium term estimates**		
Category A (Metros)	2,888	3,211	3,350	2,454	2,945	2,168	1,151
Category B (Locals)	1,487	1,473	1,251	795	608	-331	-1,281
Secondary cities	815	618	577	341	339	-87	-785
Large Towns	310	406	374	151	214	-92	-285
Small Towns	304	372	253	252	37	-80	-205
Mostly Rural	58	77	46	50	17	-72	-7
Category C (Districts)	-21	-28	-48	-25	4	-4	-7
Total	**5,840**	**6,129**	**5,803**	**4,018**	**4,165**	**1,500**	**-1,421**

Source: Energy Security in South Africa MAPS (2014).

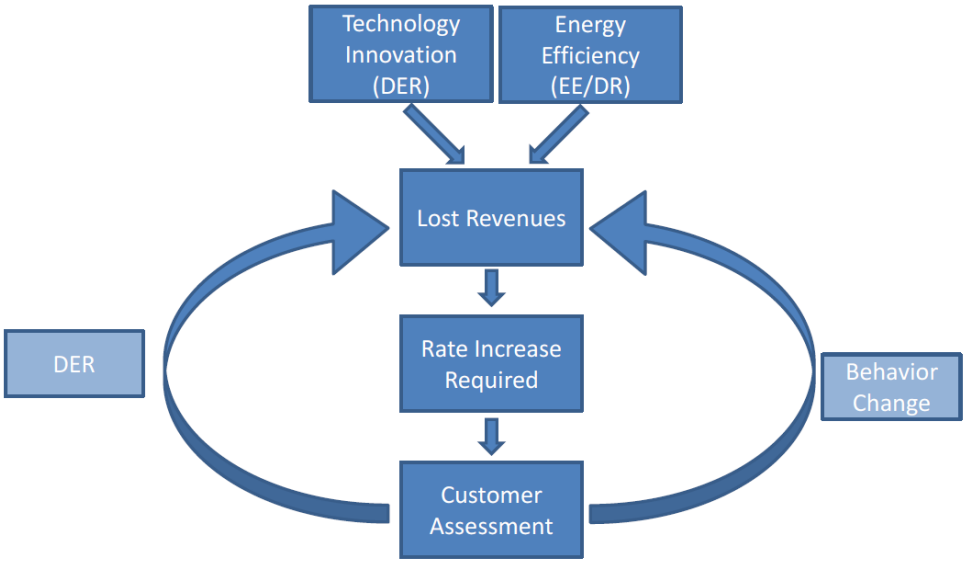

Figure 8. Vicious Cycle from Disruptive Challenges.

course non-renewable electricity consumption. An attempt to address the revenue issue through the REDs failed and it would be worthwhile to understand why this happened and how it could be repeated to ensure a favourable outcome. Decoupling revenue from sales is worth considering and there may be merit in reverting to the principle of undertakings operating 'neither at a profit or a loss'. The loss in surplus to the Municipality would have to be addressed through an increase in national grants, increasing property taxes or charging a developmental levy. Theoretically the consumer should be in the same position as what is lost in higher taxes is recovered in lower electricity tariffs. Lower electricity tariffs could also stimulate economic activity;

- **Municipal generation:** Until recently, Municipalities generated a significant percentage of the country's electricity. If Municipalities are to continue distributing electricity in the new paradigm of SSEG, distributed generation and suppressed demand they will require additional revenue streams. Municipal generation, using appropriate technology, should be encouraged and re-established. These operations can be undertaken by the Municipality, the private sector or in partnership. A further spin off would be to reduce the city's reliance on Eskom;
- **Clear policy signals**: Timeous delivery of policy documents such as the IRP and IEP. The DOE must take cognisance of the fact that the GDP growth figures in the IRP 2010 have not and will not be achieved in the medium term and must revise the build plan accordingly. New generation plants are expensive and it is unwise to enter into a new period of excessive over supply as was the case in the 1990's. The implementation of a comprehensive EEDSM programme which is properly funded and administered can yield large energy savings which will further reduce the need for new generation and capital funding;
- **Strong and independent Regulator:** NERSA should be adequately resourced and its decisions must be autonomous and binding. They have been overruled by national Government in the past and this has created doubt about their independence;

- **New Technology:** The renewables programme should be extended. The existing Government programme has proved that the private sector can deliver on time and within budget; and
- **Eskom**: The utility appears to have lost its way and requires an overhaul to once again operate efficiently and effectively. Political interference is rife and counter-productive.

The study has shown that the electricity supply issues being faced in 2014 are not new. Vested interests from different stakeholders are strong and may result in decisions being taken which will be to the detriment of the people of South Africa for many decades to come. At the very least mistakes made in the past should not be repeated.

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