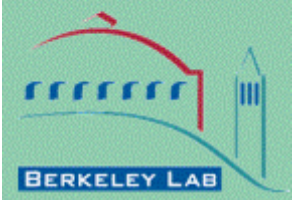


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# Energy Efficiency Country Study: Republic Of South Africa

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# Summary

Over the last few years, the Republic of South Africa's Government (RSA Gov) has been actively implementing policies to move Energy Efficiency forward. The trigger to this acceleration has been a series of widespread rolling blackouts in 2008 but deeper-rooted reasons have also contributed to this necessity, such as the significant saving potential and the desire to reduce South Africa's impact on climate change.

In its National Energy Efficiency Strategy, RSA Gov has identified the low price of energy in South Africa as one of the significant barriers to the investment in energy efficiency in the country. To remedy this specific market failure, the government has taken bold actions to increase the retail price of electricity with the goal to establish cost reflective electricity tariff by 2015. The government has also chosen to include an environmental levy in electricity tariff to fund the implementation of Energy Efficiency Demand-Side Management (EEDSM) programs. Energy efficiency is now included as a resource of choice in integrated planning for future energy resources. The phase of funding allowed in the three-year Multi-Year Price Determination (MYPD) 2 was R 5,445M (USD 674M[2]) with the goal of gross saving 1,037 MW and a cumulative annualized total of 4,055GWh (about 0.67% electricity savings relative to retail sales per year) from 2011 to 2013. The MYPD 2 ended this year in March with MYPD 3. A new funding of R 5,183M (USD 641M) for a period of 5 years, 2013 to 2018 has been approved in the MYPD 3; savings goal are yet to be decided. During the MYPD 2, tariff increase by an annual average of 22.1% and annual increases of 8% have been approved in the MYPD 3, from 65.5 c/Kwh (8.1 US cents) in 2013/14 to 89.13 (11.03 US cents) in 2018.

South Africa is one of the pioneering emerging economies to have set up a transparent and systematic mechanism to fund energy efficiency. There is a lot to be learned from both the regulations surrounding the new policy framework and from the programs' implementation. The National Energy Regulator (NERSA) is the regulatory authority in charge of determining electricity tariff increases and energy efficiency goals. Eskom, the national government-owned electricity utility, administers the energy savings programs.

According to Eskom's annual report, a total cumulative savings of 3,072 MW have been achieved through the establishment of its incentive programs in the past 10 years, representing an offset of 5 generators' worth of output. About 2/3 of these savings comes from lighting energy efficiency by replacing incandescent bulbs with efficient CFL bulbs. RSA has also developed solid metrics to support its savings accounting, following the International Performance Measurement and Verification Protocol (IPMVP).

However, the residential sector remains difficult to reach because of its diffuse nature and, setting appropriate prices for efficiency incentives to attract investment in that sector has also been perceived as challenging. Moreover, the current pursuit of energy efficiency in RSA has been mainly driven in responses to the electricity capacity shortage and the need to constraint demand in the medium term. Annual funding for energy efficiency

[2] A five years average exchange rate of 0.12 (2007-2012) was used to convert Rand to US dollars in this report, http://www.irs.gov/Individuals/International-Taxpayers/Yearly-Average-Currency-Exchange-Rates

under the new MPYD 3 has dropped compared to the MYPD 2. This raises concerns about the long term commitments of RSA on energy efficiency, especially after the additional capacity ramp up, and about the possible under-appreciation of energy efficiency as a way to meet future demand. A shift toward energy efficiency as a tool for longer range planning is needed. This may implies a change in the current business model restructured to conform and encourage better long range energy efficiency planning by Eskom.

This country study seeks to better understand how incentive programs are being implemented within South Africa. The goal is to provide details on both supporting policy frameworks and program implementation. The first section gives an overview of the energy sector in South Africa; the second section explains the general policy framework and the most important factors involved in energy efficiency in South Africa. The third section provides more insight on the policy framework governing incentive programs development. Finally, the last section offers a description of current programs implemented in the residential sector.

**TABLE OF CONTENT**

GLOSSARY

EEDSM – Energy Efficiency Demand Side Management

EM&V – Evaluation, Measurement and Verification

IDM – Integrated Demand Management

CFL – Compact Fluorescent Lamp

IMPVP – International Measurement and Verification Protocol

LBNL – Lawrence Berkeley National Laboratories

MTEF – Medium Term Expenditure Framework

MYPD – Multi-year Price Determination

NERSA – National Energy Regulator of South Africa

RMR – Residential Mass Rollout

SA – South Africa

SEAD – Super-efficient Equipment and Appliance Deployment initiative

SOP – Standard Offer Program

SWH – Solar Water Heater

**FIGURES**



**TABLES**



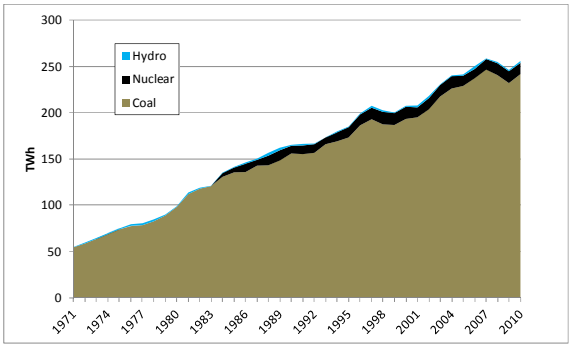
**ANNEXES**

# COUNTRY OVERVIEW

## ENERGY STATISTICS

### ENERGY SUPPLY: CURRENT STATUS AND OUTLOOK

**Figure 1. Electricity generation Mix**

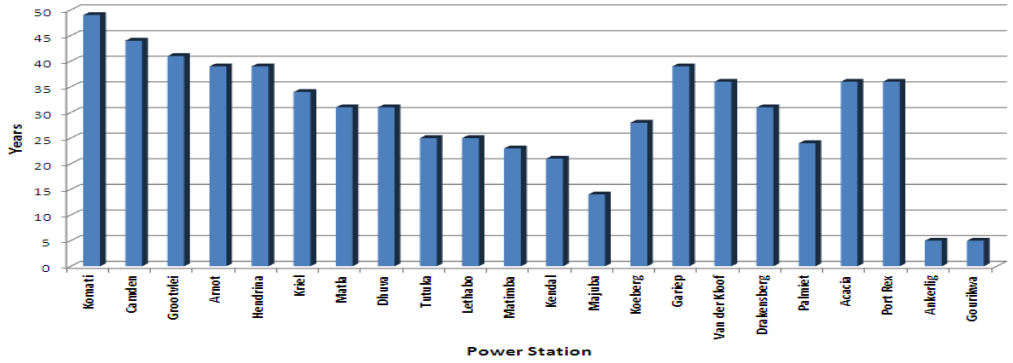



*Source: IEA, 2012*

Current electricity production in South Africa relies heavily on coal inputs with about 94% of South Africa's electricity generation comes from coal (Figure 1). It therefore has a very high Greenhouse Gas (GHG) emission factor. About 6% of production represents sales outside of South Africa. In January 2008, SA experienced widespread rolling electricity blackouts due to rapid growth in demand and insufficient investment in generation capacity. To remedy to the inadequacy of supply, load shedding was carried out and lasted until early May 2009. Many industries, notably in the mining sector, were badly hit by the power crisis.

One of the reasons for the underinvestment often cited was the failure by the government to bring independent power producers into the market and its decision to prevent Eskom from building any new power stations. (CDE, 2008). Since 2008, no major blackout has been experienced in South Africa. However, South Africa is again approaching a period in mid-2013 of limited capacity during a winter period of higher demands. Eskom reports that they are making effective use of public appeals known as Power Alert on cold days through television and radio. Real time information on the status of South Africa national grid is available at www.poweralert.co.za.

**Figure 2. Average Age of Eskom Generation Fleet**




**Source:** (Segole, November 2012)

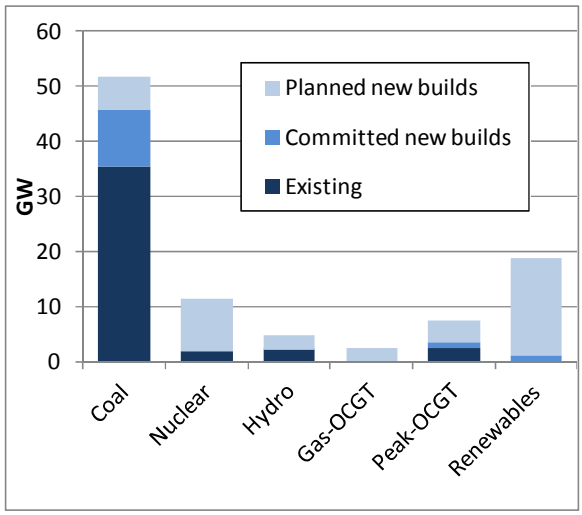
The current maximum capacity of Eskom power station is 41 GW (DBSA, 2012). Most of the power stations are approaching the end of their lifespan, resulting in substantial operational inefficiencies. About 85% of Eskom

generation fleet are 20 years old or older (Figure 2**Error! Reference source not found.** for more detail). Other challenges include the availability of coal supplies to power stations, as coal exports are financially attractive to the local coal mining industry (DBSA, 2012). SA good quality coal is exported and high ash content coal remains in the country for local generation. This also leads to unreliable generation.

Current new capacity addition are planned to start delivering electricity toward the end of 2013 from the Medupi plant first unit. However, the construction is currently experiencing delays that will probably defer production to 2014. Medupi plant will be one of the largest dry-cooled coal-fired power station in the world with six boiler units that will together generate 4,800 MW. The project cost is estimated R100bn (USD 12.4B) and is financed with loans from the African Development Bank (AFDB) and the World Bank (power-technology, 2011). Additional capacity is also planned from another coal-fired power plant being constructed. Kusile will be the first power station in South Africa to have a Flue Gas Desulphurization (FGD) to remove oxides of sulphur (SOx) from exhaust flue gases. The station will consist of six units, each rated at approximately 800 MW installed capacity, giving a total of 4800 MW. The first unit is planned for commercial operation in 2014, with other units commissioned every 8 month and the last unit expected to be in commercial operation by 2018. However, construction delays are also experienced in the Kusile construction that may postpone the initial planned dates of electricity generation.

Renewables are planned to be the largest addition in future planning. The Integrated Resource Plan (IRP 2010, 2011) lays out the proposed generation capacity to be built by Eskom and by IPP for South Africa for the period 2010 to 2030 (Figure 3). In addition to all existing and committed power plants (including 10 GW committed coal), the plan includes 17.8 GW of renewables, 9.6 GW of nuclear, 6.3 GW of coal, and 8.9 GW of other generation sources. Capacity targets for renewable energy up to 2030 are 8.4 GW for wind, 8.4 GW for solar PV and 1 GW for Concentrated Solar Power (CSP). However, Eskom projects that additional supply will not be sufficient to meet demand over the coming years unless active demand-side management continues to contain the growing electricity demand (Eskom, 2011).

**Figure 3. Planned Capacity**




Source: (DBSA, 2012).

Figure 3 provides planned capacity additions in the IRP for the period 2010 to 2030. However, it should be noted that expected electricity production from generation results from the application of operating capacity factors and that wind and solar resources generally have low operating capacity factors, in the order of between 13 and 30% while coal's are in the order of 90%. Therefore, given IRP planned capacity ahead, South Africa will continue to heavily rely on coal as the main source of electricity generation.

## ENERGY CONSUMPTION BY CONSUMER GROUP AND BY END USE

### Electrification

Electrification rate has increased radically since the implementation of the national electrification programme in the late 1980s (Bekker, Eberhard, Gaunt, & Marquard, 2008). However, a significant remaining share of households still lacks access to electricity. The 2012 Infrastructure report from the Development Bank of South Africa estimates electrification rate to be 73% with 3.4 million households remaining without electricity. The current Integrated National Electrification Programme (INEP) has been running since 2001 and aims to increase access to electricity to 92% by 2014 (Eskom, 2011). However, Statistics diverged across source. Eskom estimates a remaining backlog of 2.5 to 2.9 million connections in 2011, representing 19% to 22% of households in SA (Eskom, 2011).

### Equipment Penetration

South Africa has conducted three censuses (1996, 2001 and 2011). **Error! Reference source not found.** shows the proportion of households per energy type used for lighting, cooking and heating. Electricity is the primary energy source in households for lighting (84%), cooking (72%) and heating (59%). Use of gas for cooking is very small (4%) as the large majority of households use electricity for cooking in South Africa. A non negligible share of households is still using candles for lighting and wood and paraffin for heating and cooking. Figure 5 shows the evolution between 2001 and 2011 of ownership of selected appliances. The LSM (Living Standard Measure) divides the population into 10 LSM groups, 10 (highest) to 1 (lowest) according to the degree of urbanisation and ownership of cars and major appliances.

**Figure 4. Percentage of household by type of energy used for Lighting, Cooking and Heating**

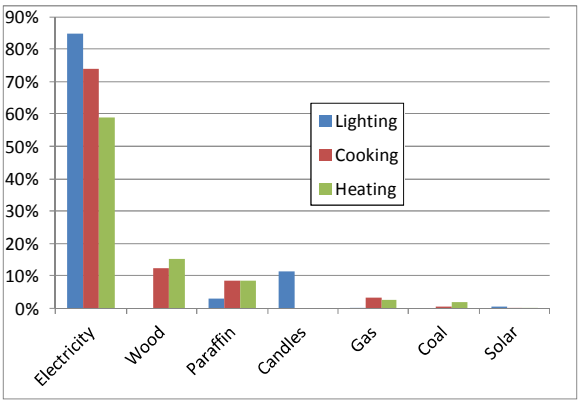



**Figure 5. Percentage of households**

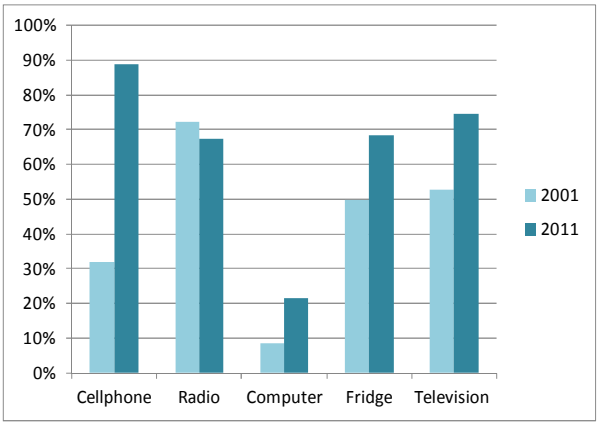
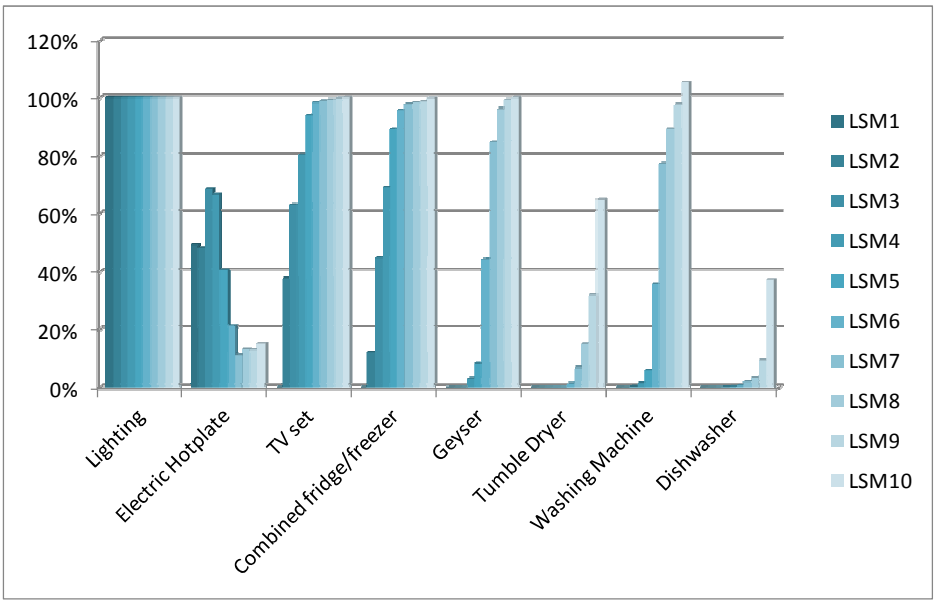


Figure 6. Penetration of Residential Equipments per LSM

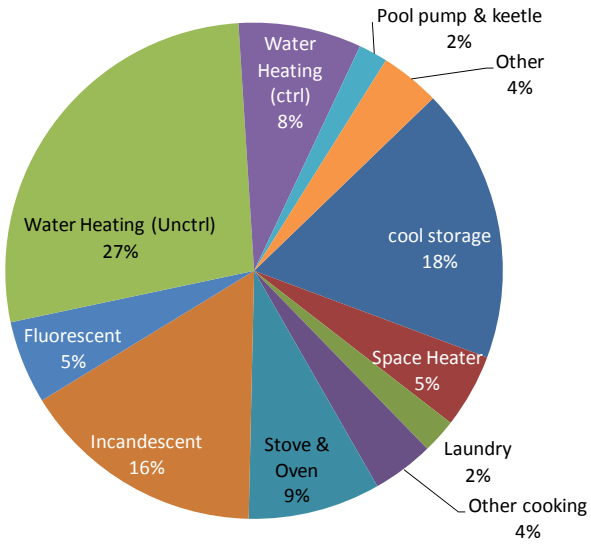



## Residential Energy per End Use

This pie chart provides an estimation of total household's electricity use by end use done by Eskom in 2007 and cited by (Covary, Appliance Retail Programme Feasibility Study, 2011) and (UNDP, 2011). Energy for water heating is the largest source of households energy use at 35%, followed by lighting at 21%. In this survey, incandescent bulbs still represents about three quarters of the energy use of lighting. Since then, Eskom has expanded its CFL program and so this share has most likely come down. Energy for refrigeration comes in third with 15% of energy used, followed by stove and oven electricity use at 7%.

It is important to understand that this end use breakdown is estimated over the total number of households and that consumption between categories of households varies widely.

Figure 7. 2007 Eskom Survey




A study from the Energy Research Centre, University of Cape Town as well as Eskom, estimate that about 56% of households in South Africa connected to the national grid consumed about 50 kWh of electricity per month (Makonese, Kimemia, & Annegarn, 2012). It is also argued that the 50 kWh per month is adequate electrical energy for a typical poor household to meet the needs for lighting, media access, limited water heating, basic ironing and cooking. However, this estimate is questioned by experts we interviewed. For example, it was found that in the CFL

mass rollout program, lower income households have an average of 6 lamps, mostly at 100W that consumed close to 50kWh per month. Experts also found that many low income households spend an additional 20 Rand on electricity on top of the first 50kWh given for free, meaning that an additional 40kWh per month is needed to meet their basic electricity needs.

The estimation of the basic needs for electricity for low income households is an important number as this represents the minimum amount of electricity given to qualifying low-income households for free if they apply and are willing to receive it in the form of pre-paid service monthly. This is part of the social welfare policy of South Africa and is called the Free Basic Electricity (FBE) program as explained in Section about Tariff per Customer category.

## ENERGY SAVINGS POTENTIAL (BUENAS RESULTS)

In this section, we present the results from the BUENAS "best available technology" (BAT) scenario which seeks to determine the maximum potential savings that would result from diffusion of the most efficient available technologies in South Africa, also referred to as technical potential (Letschert, 2012). Because of limited data availability, the scope of the study focuses on electricity consumption from a handful end uses in the residential sector[3] and motors in the industry sector.

The following table describes the technology options that have been evaluated in the study:

| End Use | Technology |
|---|---|
| General Lighting | LEDs |
| Refrigerators | Combination of most efficient components available on the market |
| Air Conditioners | Combination of most efficient components available on the market |
| Televisions | OLEDs |
| Water Heaters | Solar water heaters |
| Fans | Combination of most efficient components available on the market |
| Stand-by | Hard off switch with low reactivation mode |
| Motors | High efficiency motors |

(Letschert, 2012)

The following figures present the energy savings potential by end use for the residential and industry sector:

[3] In particular, we only focus on the losses from water heaters, not the total consumption. As a consequence, the foot print of water heaters is grossly underestimated.

Figure 8. Technical Potential in the Residential Sector

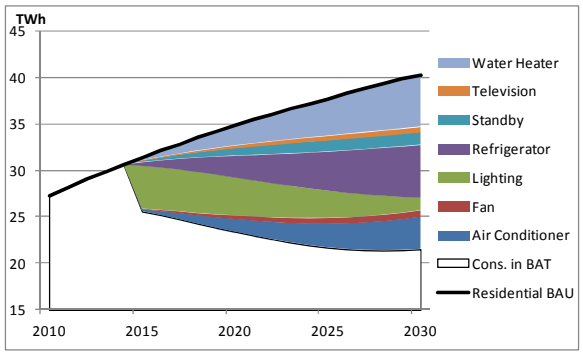
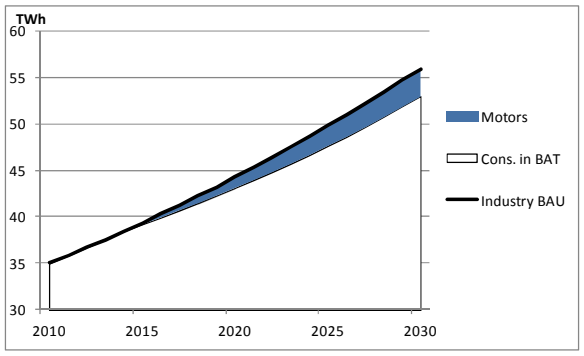



Figure 9. Technical Potential in the Industry Sector




Note: Please not that the "y" axis doesn't start at zero which results in the potential to looks large. This was done to give detail per end use

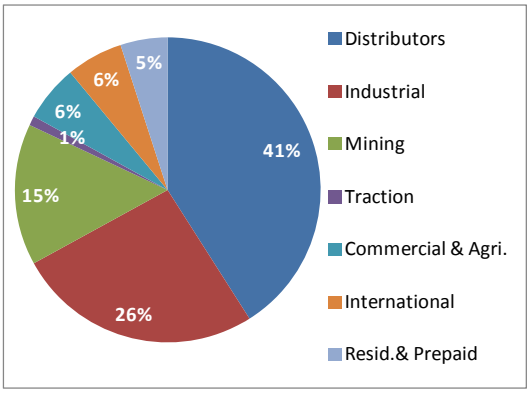
Despite the limited number of end uses analyzed, we identify over 22TWh of technically achievable energy savings. Even though the selected technologies would be deployable en masse in the next few years, they have not been proven cost-effective yet and a series policy instruments are deemed necessary in order to capture the saving opportunities identified in our study.

# ELECTRICITY MARKET AND POLICY

## MARKET STRUCTURE

The South African electricity industry is essentially vertically integrated with Eskom generating 96%, municipalities 1% and Independent Power Producers 3%. Eskom is wholly owned by the South African government and provides electricity directly to about 3,000 industrial customers 1,000 mining customers, 49,000 commercial customers, 84,000 agricultural customers and more than 4 million mostly prepaid residential customers, many of them in rural areas. It also sold electricity to 187 municipalities, which in turn redistributed it to businesses and households.

**Error! Reference source not found.** depicts the breakdown of Eskom's sales customers in 2012.




(Eskom, 2012a)

As the only transmission licensee Eskom is responsible for all transmitted electricity. The responsibility for distribution is shared between Eskom, the municipalities and other licensed distributors. About 180 municipalities distribute 41% of electricity sales to 60% of the customer base (DME, 2008). The government is studying the possibility of establishing an independent entity to be known as the System Operator. This entity would manage the prioritization of electrical energy generating capacity and purchase power from Independent Power Producers.

## ELECTRICITY PRICES AND PRICING STRUCTURE

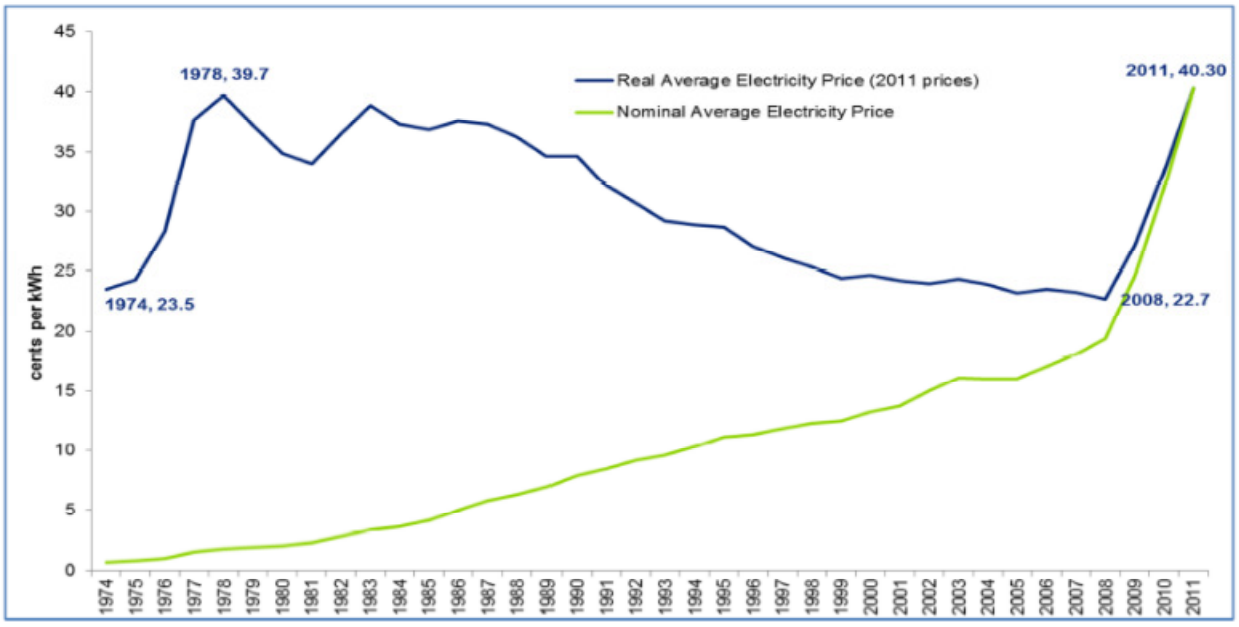
SA's electricity has been priced as if it were among the least expensive in the world. The artificially low price of retail electricity in South Africa has contributed to undervalue energy efficiency and is clearly identified as an important barrier to energy efficiency in South Africa in the National Energy Efficiency Strategy formulated by the government (DOE, 2012). The government is committed to see electricity prices increase to reflect the underlying costs given current and forward market conditions.

In 2006, the Electricity Regulation Act established the legal basis for the Multi-Year Price Determination (MYPD) methodology. Section 16(1)(a) recommends that the regulation of revenue enable licensee to recover the full cost, including a reasonable margin or return. Regulation of revenues is further defined by the Electricity Pricing Policy (EPP) published in 2008. EPP calls for revenue determination that also allow the utility to obtain reasonably priced funding on a forward looking basis (DME, 2008). Additionally, EPP calls for energy efficiency cost recovery from tariffs.

The National Energy Regulator of South Africa (NERSA) is in charge of developing the Multi-Year Price Determination methodology and process (NERSA, n.s.). Licensee's revenue are calculated based on the replacement cost of assets and includes a rate of return. The MYPD is also a process that is transparent and open process.

Figure 10 shows the evolution of the real and nominal electricity prices in South Africa during the period 1974 to 2011. Electricity prices increased 78% in real terms from 2008 to 2011 according to Eskom (Eskom, 2012a).

**Figure 10. Real and nominal electricity prices in South Africa (1974–2011)**




Source: (Eskom, 2012a)

The price spike reflects the strong desire to reach a cost reflective tariff. The MYPD-2, covering the period 2011 to 2013 (31 March 2013.), set an average increase of Eskom's nominal tariffs of 25.3% per year. However, the increase was lowered to 16% during the last year increase. In October 2012, Eskom sent its application for the

third MYPD (MYPD 3) for the period 2013/14 to 2017/18 and asked for an average increase of 16% for each of the five years of the MYPD 3 from 2013/14 to 2017/18 (Eskom, 2012a). In contrast to MYPD 1 and MYPD 2, both of which spanned three years, Eskom proposed a five-year determination for MYPD 3, running from 1 April 2013 to 31 March 2018. The Energy Regulator has scheduled a series of Public Hearings in all South African provinces, from January 15th to 30th and reached a decision on February 28$^{th}$ 2013 to approve increases of 8%/year over the 5 years period. The average electricity price will increase to 65.5 c/Kwh (8.1 US cents) in 2013/14 up to 89.13 (11.03 US cents) in 2018. However, in setting lower electricity tariff increases for MYPD 3, NERSA also reduced the allowed amount to be spent on EEDSM programs. In its initial application, Eskom had requested a total funding M of R 13.9 billion (USD 1.7 billion) but NERSA approved only R 5.2 billion (USD 0.67 billion) in its latest released. More detail on Financing is given in the Section about Financing.

For MYPD 2 NERSA determined that the correct rate of return for Eskom during this period was 8.16% (pre-tax, real). However the rates of return that NERSA allowed when setting the allowable revenue were 0.08% in 2010-11, 2.8% in 2011-12 and 4.2% in 2012-13 (Eskom, 2012b). In its MYPD-3 application, Eskom was asking for a rate of return of 7.8% (Eskom, 2012a).

It should be noted that these are Eskom's tariff and that municipalities then applied their tariff upon NERSA approval. The EPP (2008) notes that many municipalities recover some of their municipal services cost by applying a surcharge on the cost of electricity. Cost of streetlights are typically recover by this surcharge, but it can also include other municipality services. Cities receive about 30% of their revenue from the sale of electricity (Goldblatt & Palmer, 2011). However, this is rarely done in a transparent manner to the consumer. The EPP calls for the establishment of norms and standards for electricity surcharges and the regulation of the "base tariff" by NERSA. NERSA publishes percentage guideline increases for Municipalities based on the approved Eskom price and the increase on the municipalities' cost structures (NERSA, 2012b). Municipalities then submit proposals to NERSA for approval.

## TARIFF PER CONSUMER CATEGORY

The implementation of Incremental Block Tariffs (IBTs) was approved by the Energy Regulator on 24 February 2010. The objective was to cushion the effect of rising electricity prices for low income residential customers in accordance with the EPP (2008). The decision was taken in order to provide for cross-subsidies for low income domestic customers and was therefore applicable to both Eskom and municipalities.

**Table 1. 2012/13 revised Municipal Tariff Benchmarks and Revised Eskom Tariffs**

| | | DOMESTIC TARIFFS(IBTs) | | | | COMMERCIAL 2000 kWh | | INDUSTRIAL |
|---|---|---|---|---|---|---|---|---|
| | Unit: c/kWh | Block 1 0 – 50 kWh | Block 2 51 – 350 kWh | Block 3 351 – 600 kWh | Block 4 >600 kWh | Prepaid | Conventional | 43800 kWh |
| **Munies** | Rand | 61 – 66 | 77 – 82 | 104 - 109 | 124 – 129 | 130 – 135 | 130 – 135 | 132 – 137 |
| | *USD* | *7.3 - 7.9* | *9.2 - 9.8* | *12.5 - 13.1* | *14.9 - 15.5* | *15.6 - 16.2* | *15.6 - 16.2* | *15.8 - 16.4* |
| **Eskom** | Rand | 60.83 | 75.09 | 111.42 | 122.21 | | | |
| | *USD* | *7.3* | *9.0* | *13.4* | *14.7* | | | |

(NERSA, 2012c)

The existing benchmarks are based on five assumed tariff/customer categories and average consumption levels for these categories. Table 1 shows the municipal tariff benchmarks applicable for the 2012/13 financial year. Municipalities applying for tariffs that are outside the approved benchmarks must justify such increases

It should be noted that these are average consumption levels and that there may also be other tariff classes in various municipalities which will cater for other customer classes or consumption levels that are very different from the ones that are assumed by NERSA.

Inclining Block Tariffs have been fully implemented by Eskom for both its conventional and prepaid meter customers. According to NERSA, 76 out of 173 municipalities have fully implemented IBTs for both conventional and prepaid customers. NERSA is continuing to assist the remaining municipalities in effectively implementing IBTs (NERSA, 2012a).

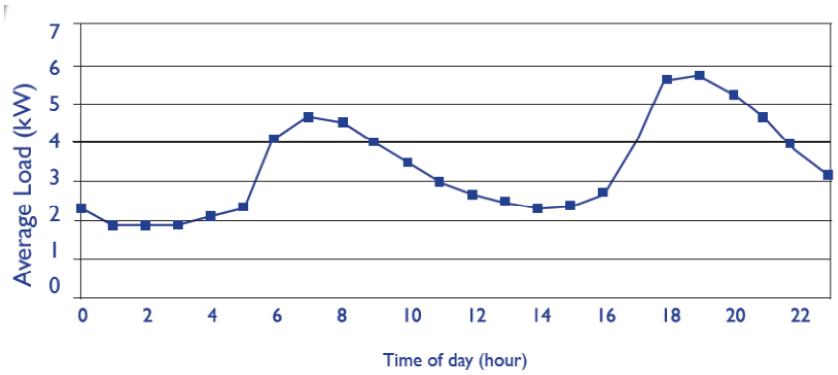
Based on the current Eskom MYPD3 application, NERSA has developed indicative guidelines to assist municipalities with their budgetary process. It is anticipated that municipalities will compile and submit draft tariff applications for NERSA's consideration from January 2013. NERSA will then determine and approve the final municipal tariff guideline on 28 February 2013. The approved guideline will be communicated to municipalities who will then adjust their budgets accordingly.

Low income households can also benefit from the Free Basic Electricity (FBE) program. FBE is part of a government social welfare policy that has for goal to ensure free access to basic services for low-income households through electricity basic and water services. Qualifying customers are eligible for 50kWh of free electricity per month. About 1.12 million households took advantage from this program in 2011 (Eskom, 2011). Eligible households have to agree to a pre-paid meter being installed. Although prepayment systems have been proposed as innovative solutions to the problem of non-payment and affordability in utility services, the use of such mechanisms is still controversial (Makonese, Kimemia, & Annegarn, 2012). As noted earlier, the 50 kWh allocated was regarded as sufficient electrical energy to facilitate access to the electronic media, lighting, and limited water heating, basic ironing and cooking services.

## TIME OF USE TARIFF

The highest peak load in South Africa is typically between 17:00 and 21:00 daily and also between 7:00 to 10:00, but to a lower extent. The peak season is the winter (June to August). The following graph shows a typical consumption residential customer's daily profile.

**Figure 11. Residential Load Profile**




(Eskom, n.s.)

Time of Use (TOU) tariffs were introduced during the early 1990s to reflect the increased production cost of electricity generation during daily peak hours and the high demand of the winter season. As a result customers on TOU tariffs currently pay more for electricity during winter and at different times of day. The charges for TOU tariffs differ from high-demand (June to August) to low-demand (September to May) seasons. These charges also differ by the time of day, with peak, standard and off-peak rates applying for different times of day.

The TOU tariffs offered by Eskom are only for commercial consumers: Megaflex (urban, >1 MVA), Miniflex (urban, >25 kVA and < 5MVA) and Ruraflex (rural, > 25kVA). Additionally, Eskom offers a seasonally differentiated tariff for urban and rural consumer with consumption above 25kVA. Variation between the differentiated tariffs are significant, with a ratio of 1:9.

NERSA has given permission for Eskom to implement its residential TOU tariff, called Homeflex, since 1 September 2009. This tariff will be implemented initially on a voluntary basis to 10 000 suburban residential customers, together with advanced metering infrastructure (smart metering technology).

## SUPPLY COST

In its MYPD application to NERSA, Eskom provides its assumption on capital and fuel cost to meet the IRP requirement. The Next table provides the detail by generation type.

**Figure 12. Eskom Assumptions on capital and fuel costs per technology**

| Technology | Capital costs $/kW | Fuel costs real R/MWh |
|---|---|---|
| Nuclear | **6,131** | **60** |
| Coal | **2,940** | **200** |
| Gas – OCGT | **1,029** | **2,772** |
| Gas – CCGT | **684** | **665** |
| Wind | **3,258** | **-** |

| | | |
|---|---|---|
| Solar Photovoltic | **2,750** | - |
| Concentrated solar power (CSP) | **5,802** | - |

(Eskom, 2012a)

# ENERGY EFFICIENCY IN SOUTH AFRICA

## GENERAL POLICY FRAMEWORK

RSA Gov has introduced various policies and other regulatory measures to ensure the efficient use of energy over the last decade, primarily driven by an economic need and secondly by an environmental concern. The 1998 White Paper on South Africa's Energy Policy is the first formulation from the government of the need to rationalize energy and gives a mandate to the DOE to promote EE through various means. In 2005, the DOE drafted the National Energy Efficiency Strategy (NEES) of South Africa to give effect to the provisions of the White Paper in respect of energy efficiency and sets a national aspirational target for an energy efficiency improvement of 12% by 2015. It was approved by Cabinet in March 2005 and reviewed in October 2008. Based on information provided recently at a workshop in Johannesburg, it appears that these targets are no longer achievable in full.

**Table 2. National Energy Efficiency Targets**

| **Sectors** | **Target by 2015** |
|---|---|
| Industry | 15% |
| Mining | 15% |
| Power Sector | 15% |
| Commercial & Public Buildings | 15% |
| Residential | 10% |
| Transport | 10% |

The NEES is a central document that outlines government objectives in term of EE and measures considered to achieve this objective. The target is further disaggregated for each economic sectors (see table). Its implementing instruments include legislation (Energy Act of 2008), regulations, standards and labeling, certification and accreditation, education, information and awareness, research and technology, energy management, financial instruments and incentives (including those by treasury).

The document is currently being revised for a second time and a draft was submitted to public comments due by end of January 2012 (DOE, 2012).

## MAIN ACTORS

Since 2008, major reorganizations have lead to new legislation and entities to govern and implement EE in SA. In 2009, South Africa's newly elected president, Jacob Zuma, announced the split of the Department of Minerals and

Energy into two separate departments: the Department of Mineral Resources and the Department of Energy (DOE). The 2008 National Energy Act gives authority to DOE to conduct the EE policy in South Africa. The Department of Trade and Industry (DTI) is also an important actor in the implementation for EE policy and especially standards and labeling (S&L), for two main reasons. First, the South African Bureau of Standards (SABS) and National Regulator for Compulsory Specifications (NRCS) falls under its authority, and second, the DTI's main goals are to enhance the competitiveness of South African industry and to advance international trade. SABS has signed a Memorandum of Understanding with DOE and as such has formed a working relationship with them which can be used for setting S&L (UNDP, 2011). The 2008 Energy Act established the South African National Energy Development Institute (SANEDI) to conduct public-interest energy research. SANEDI reports to the SA DOE and is a combination of the National Energy Efficiency Agency (NEEA) and the South African National Energy Research Institute (Pty) Ltd (SANERI) which have kept their structure at this point. The next figure summarizes the main stakeholders involved in the case of S&L program.

## STATUS OF RELEVANT EE PROGRAMS

### S&L

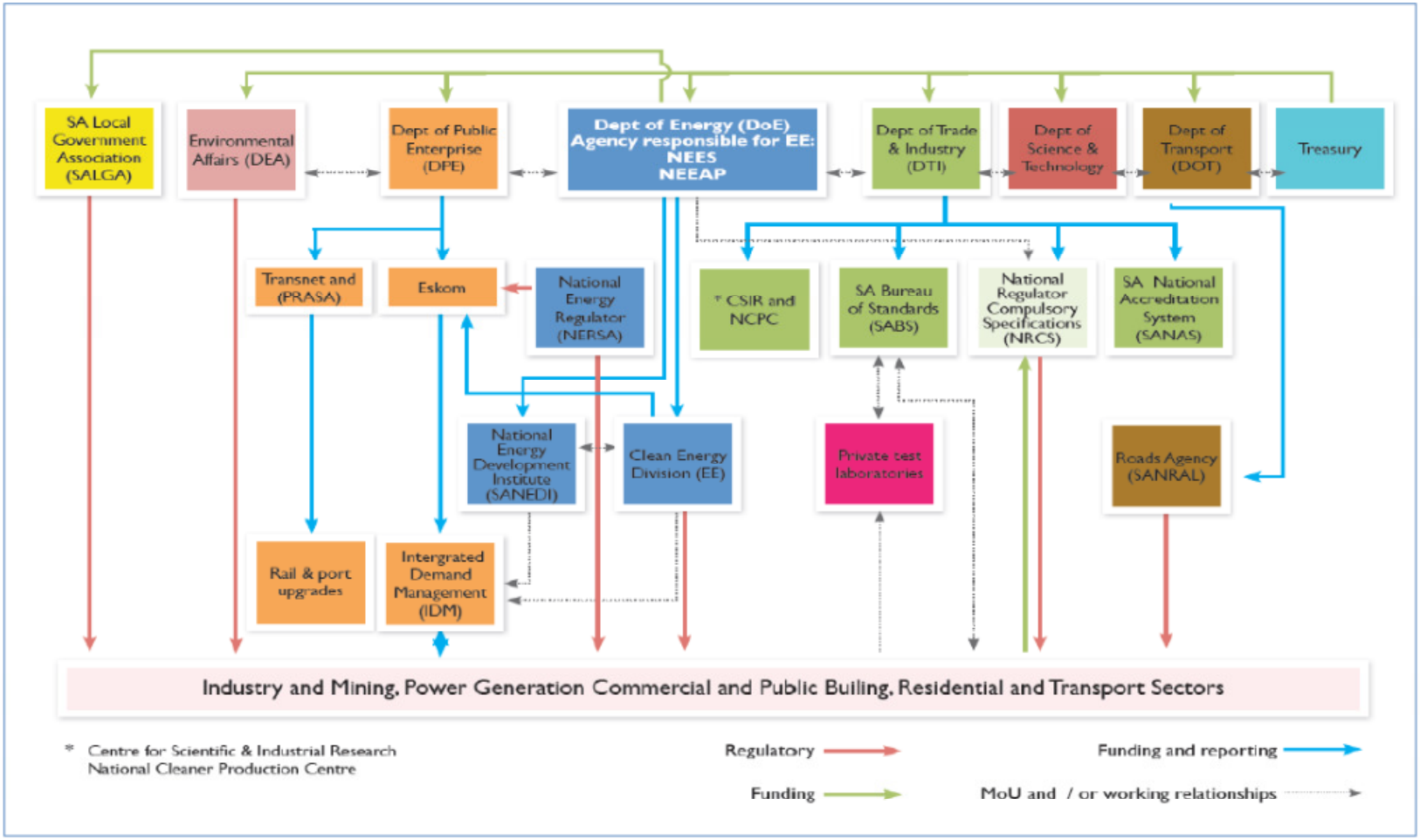
The government plans to introduce MEPS and labeling in 2013 and SABS has selected 10 products to be regulated under the mandatory S&L program, to be introduced through SANS 941 and labeling through SAS 60043. Technical assistance will be provided through a UNDP project of USD 13 million funded approximately equally between GEF, the Swiss aid agency and the SA Gov (GEF, 2011). The products selected are: residential refrigerators (fridges, freezers, and their combination), washing machines and dishwashers, room air conditioners, electric stoves, ovens, and hobs, and electric water heaters. At the moment there is no mandatory requirement for labeling or for standards in RSA. The government introduced a voluntary labeling program in 2005/6 for refrigerators/freezers but the rate of participation was very low.

### TAX ALLOWANCE

The Government has introduced allowances for energy efficiency via Section 12I and Section 12L of the Income Tax Act of 1962.

- The 12I Tax Incentive is designed to support cleaner production investment in manufacturing expansion or retrofit. Since the Section 12I Tax Allowance was announced in 2010 to date, the program has supported 13 projects with an investment value of R21.7 billion: eight of the projects are in the chemical sector; one within the agro processing sector, two are in the paper and pulp sector, and two in the bio-fuel sector (DTI, 2013).
- 12L provides is an allowance for energy savings achieved through energy efficiency in any activity from year to year. The energy savings according to 12L should be measured and verified by a SANS accredited M&V body using the methodology in SANS 50 010. Just note that this has not come into effect yet. We are hoping for later this year

**Figure 13. Current Broad Energy Efficiency Institutional Framework**




Source: (Covary, 2013)

## SOLAR WATER HEATING

The Solar Water Heating Program (SWH program) is a government initiative with an initial goal to install 1 million solar water heaters by 2014. The SWH program is expected to save approximately 650MW of electrical demand. The national Treasury has approved R4.7 billion in the current medium term expenditure framework (MTEF) for the installation of SWH in the residential sector (DOE, 2012)

## OTHER ENERGY EFFICIECNY RELEVANT REGULATIONS AND MEASURES

The next table summarizes some of the other key measures implemented by the government to support energy efficiency.

**Table 3. Other Key Measures Implemented by the Government to Support Energy Efficiency**

| | |
|---|---|
| **Public Sector Support** | The public sector implementation plan is intended to bring energy efficiency to the government infrastructure stock (including building stock and public lighting). The National treasury has approved R 600 million in the current MTEF for the implementation of energy efficiency measures in the Municipal Infrastructure. The allocation for 2011/12 was R 280 million. (DOE, 2012) |
| **Manufacturing Upgrade Support** | The DTI R 5.75 billion Manufacturing Competitive Enhancement Program (MCEP) aims to support manufacturing enterprises to upgrade their plant, create jobs, increase their competitiveness and support the value-add process as well as help companies invest in "Green Technology". This program started accepting applications as of the 4$^{th}$ of June 2012. (DOE, 2012) |
| **Building Code** | The National Building Regulations have been amended to include a specific requirement for energy efficiency in new buildings (SANS 10400XA). The Building control officers at each municipality are responsible for its application (they must ensure that before they approve plans they comply with the regulation) and the National regulator for Compulsory Specification (NRCS) is responsible for its enforcement. |
| **Energy Efficiency Management** | In 2011 the SABS adopted the International Standards Organization Energy Management System standard (ISO 50 001) as a national standard (SANS 50 001) followed by a national standard for Measurement and Verification of Energy Savings (SANS 50 010). |
| **Carbon Tax** | SA Gov has included a carbon tax of approximately R120 (US$ 1.3) per ton of $CO_2$ in the federal budget to be instituted in 2015. More details is to come in a carbon tax policy paper that is expected to be published by the end of March 2013. (SA Gov, 2013) |

## POLICY FRAMEWORKS FOR DEVELOPMENT OF INCENTIVE PROGRAMS

### LEGISLATION

Since 2010, energy efficiency is considered a resource as integrated resource for planning (IRP) new capacity (Government Gazette, 2010), (IRP, 2010) and is recognized as the cheapest and quickest way to reduce demand in order to avoid electricity shortages (SA DOE, 2010). The Electricity Regulation Act of 2006 introduced a regulatory framework with Energy Efficiency Demand-Side Management (EEDSM) obligations to electricity producer licensees. The Act also empowers the NERSA to implement DOE energy policy. In May 2010, DOE published a policy framework document to support the EEDSM for the electricity sector (SA DOE, 2010). The document empowers NERSA to regulate and set the funding level for EEDSM. The document also introduces the Standard Offer scheme. The next table outlines the role of each of the stakeholders.

**Table 4. stakeholder roles in EEDSM**

| | |
|---|---|
| **Minister of Energy** | Sets EEDSM targets |
| **Eskom (Purchaser of energy savings achieved)** | • Applies for EEDSM funding in its multi year price increase application to NERSA.<br>• Collects the EEDSM funding through its tariffs.<br>• Releases EEDSM funding to the SOP Administrator upon NERSA instruction. |
| **Department of Energy** | • Develops policy on the Standard Offer. Provides for the required long term funding for EEDSM in the IRP.<br>• Develops criteria for "Request for Offers" in the MYPD cycle. |
| **NERSA** | • Approves EEDSM allowance in MYPD.<br>• Develop rules to enable the Standard Offer.<br>• Instruct the release of funding by Eskom.<br>• Determines SOP rebate levels.<br>• Approve verification protocol.<br>• Accredit independent M&V teams.<br>• Implement financial reconciliation of EEDSM funds in relation to target savings. |
| **NEEA (in the interim DBSA)** | • Receive verification reports for each EEDSM initiative under the SOP.<br>• Advise the Development Bank of South Africa (DBSA) and NERSA of verified savings per initiative.<br>• Collate reports and produce EEDSM performance reporting for the electricity industry. |
| **DBSA** | • Serve as single point of contact for project developers wishing to develop initiatives under the SOP.<br>• Serve as single point of contact for entities wanting to claim for electricity |

| | |
|---|---|
| | savings against the EEDSM fund.<br>• Perform NEEA functions until NEEA is able to take over the function.<br>• Advice market when DoE makes criteria available for the next "Request for Offers".<br>• Receive and manage the EEDSM funds in accordance with the SO policy and NERSA rules.<br>• Pay verified claims. |
| **ESCO/ Utility/**<br>**Consumer**<br>**(Project Developer)** | • Initiate interventions that comply with the Standard Offer and NERSA rules.<br>• Source the required capital expenditure, at risk, to implement the EEDSM intervention.<br>• Submit claims to DBSA to redeem the capital investment over the life of the investment. |

Source: (SA DOE, 2010)

## FINANCING

Funding for the implementation of energy efficiency is obtained through electricity tariffs. Eskom provides an EEDSM project plan in its MYPD application to NERSA to obtain funding to purchase energy savings and recover the reasonable costs. NERSA makes a final determination of the EEDSM costs that Eskom provides for the MYPD application.

As part of the MYPD2, NERSA approved a total of R 5,445m (USD 651M) for Energy Efficiency and DSM. "These funds will be applied for project implementation and administrative costs for DSM, energy efficiency and demand-reduction programmes, including a portion of the solar water heating (SWH) initiated by the Department of Energy (DoE)." The savings requirement is for 1,037MW savings over the 3 years, which is the equivalent of a cumulative 4,055GWh annualized reduction in energy consumption with a load factor of 45%.

In its application to the new MYPD3, Eskom had requested a total funding for EEDSM of R 13.9 billion (USD 1.7 billion) to cover for Integrated Demand Management (IDM) costs. The peak saving target proposed was 1,730 MW and the energy savings is 7,731GWh for a 5 year period 2013-14 to 2017-18. However, NERSA approved only R 5.2 billion (USD 0.67billion) in its latest released Table 5. New savings target have yet been released.

**Table 5. NERSA Approved IDM Program Cost**

| R'm | 2013/14 | 2014/15 | 2015/16 | 2016/17 | 2017/18 | MYPD3 Total |
|---|---|---|---|---|---|---|
| Return | 23 477 | 26 511 | 26 436 | 27 657 | 33 667 | 137 748 |
| Primary Energy Costs | 51 067 | 54 966 | 56 779 | 62 060 | 68 620 | 293 492 |
| Independent Power Producers | 2 686 | 5 108 | 14 826 | 19 269 | 23 018 | 64 907 |
| Depreciation | 25 733 | 27 481 | 28 564 | 28 911 | 29 197 | 139 886 |
| Integrated Demand Management | 1 455 | 953 | 819 | 712 | 1 244 | 5 183 |
| Operating costs | 45 519 | 48 565 | 52 908 | 57 769 | 60 576 | 265 337 |
| Total Allowed Revenues | 149 937 | 163 584 | 180 332 | 196 378 | 216 322 | 906 553 |

## STANDARD OFFER (SO)

The Standard Offer scheme was introduced in the Policy document published by DOE in 2010 (SA DOE, 2008). It is a mechanism that establishes a predetermined rate (e.g., R/kWh or R/kW) for demand-side resources (energy

efficiency/load reduction). Purchase rates are determined by NERSA either based on the long-run marginal cost of supply or estimated subsidies necessary to attract commercial bids. The Standard Offer is the mirror image of a renewable feed-in-tariff mechanism, whereby a price for energy savings is offered (ESMAP, 2011).

In June 2010, NERSA published a document that outlines the regulatory rules for implementation of the SOP for DSM and EE projects. NERSA calculates the incentives based on the avoided cost of electricity supply resulting from the EEDSM intervention. The avoided capacity cost is based on the estimated capital cost of a new pulverized fuel coal fired plant with fuel gas desulphurization, the average fuel and operation costs of the plant (NERSA, 2010).

**Table 6. SOP determination**

| **Year in which EEDSM project start delivering savings** | **2010** | **2011** | **2012** |
|---|---|---|---|
| Avoided cost due to deferment of installed capital cost by 3 years, R/kWh (proxy plant – PF FGD) | 0.3985 | 0.3211 | 0.3318 |
| Avoided operating cost based on average annual Eskom operating costs, R/kWh | 0.1594 | 0.1652 | 0.1716 |
| Avoided primary energy cost based on average annual Eskom primary energy cost, R/kWh | 0.1783 | 0.1926 | 0.2112 |
| **Avoided Generation cost (proxy plant method) at the projected EEDSM Load Factor** | **0.7362** | **0.6789** | **0.7146** |
| Eskom's M&V, management & marketing costs included in the MYPD2, R/kWh | 0.1958 | 0.1620 | 0.1351 |
| **REBATE (R/kWh) excluding the cost of M&V and marketing** | **0.5404** | **0.5168** | **0.5795** |

Source: (NERSA, 2010)

## ADMINISTRATION

Eskom is the main administrator and implementer of NERSA funded demand-management program and has set up an entire division, Integrated Demand Management (IDM), dedicated to EEDSM implementation. According to Eskom, IDM plays a significant part in mitigating energy shortage risk. Eskom runs several demand-reduction programs to encourage industrial customers, municipalities and households to reduce their energy consumption.

Eskom will continue to be the main administrator and implementer of NERSA -funded demand-management initiatives in South Africa for the next MYPD. However, it is uncertain whether Eskom will continue to carry out this role in the future.

During MYPD public hearings, stakeholders have raised concerns over whether Eskom is the ideal choice as the administrator of EEDSM programs and suggested that an independent agency administer the programs. However,

the establishment of such an agency would require significant endeavor and the development of new capacity (NERSA, 2010).

## REGULATORY SUPPORT OR OBSTACLES

In case of non performance the penalty is calculated as follows

Penalty(R/MW) = total allowed revenue ÷ proposed MW =R/MW x MW (unsaved MW)

(NERSA, 2010)

Non performance in this case means that the utility do not reach the goal in term of savings in MW and GWh set by NERSA in the MYPD. No other regulation such as decoupling of sales or utility incentives have been established to support and encourage the out performance of EE goals by Eskom.

## EM&V

The South Africa government recognizes the importance of EM&V as a key factor of success to EEDSM programs. According to NERSA rules, M&V cost are allowed up to 8% of the total EEDSM project costs (NERSA, 2010). During the MYPD 2, Eskom was allowed R 128 million for the measurement and verification (M&V) costs of programs (NERSA, 2010). However, discussions with experts estimate that about 3% in average are spent on M&V.

Eskom administrates M&V process and its Energy Audit Division contracts with universities across South Africa to conduct independent M&V assessments. In an initiative led by the University of Pretoria, an informative book gathers 32 papers on various energy efficiency M&V projects in different sectors (Xia & Zhang, 2012).

Standard guidelines of measurement and verification of energy savings are given by SANS 50010, which was developed by SABS based on the International Performance Measurement and Verification Protocol (IPMVP) documentation developed by EVO (www.evo-world.org). SANS 50010 is intended to provide a standard approach to measurement and verification of energy savings and energy efficiency for use in voluntary and regulatory process in South Africa (SABS, 2011). More specific guidelines are also developed per programs type or for specific measures. South Africa has also an independent professional body called the Council of Measurement and Verification Professionals of South Africa (CMVPSA) which offers training and certification of professionals.

South Africa has a well implemented business model for M&V and are now exploring ways to improve its process. One example is to introduce a bidding process in allocating M&V projects to an M&V inspection body, where M&V project will directly be offered to the Escos and Project Developers.

According to Eskom, demand-side management has reduced peak electricity demand by 3,072 MW for the combined years 2005 to 2012. A single power station unit contributes about 600MW to national electricity supply, so demand-side management has conserved more than four generators' worth of output (a typical power station has six) in the past four years. These savings are expected to continue into the MYPD 3 period (Eskom, 2012a).

# INCENTIVE PROGRAMS IMPLEMENTATION

## ESKOM FUNDING OPPORTUNITIES

Eskom's IDM business unit has developed several funding opportunities to attract business owners, ESCOs, project developers and others to develop energy efficiency improvement programs. The figure on the right shows the different funding models according to the size of savings they are targeting. The table below provides details about each funding program. All models are designed to promote energy efficiency in the industrial, commercial or agriculture sectors. Only, the Residential Mass Rollout target energy savings from the residential sector. However, another type of program directed to the residential sector also exists. It is called the rebate model and is explained in the following sections.

The last row of the table below provides the level of funding per kwh or MW offered in each funding model type.

Figure 14. Eskom Funding Models


Table 7. Eskom Energy Efficiency Funding Opportunities

| | Description | Applications | Size of Projects | Market Focus | Payment |
|---|---|---|---|---|---|
| **Performance Contracting** | Bulk buying of energy savings from project developers for multiple projects. | Compressed Air, Ventilation, Lighting, Shower Heads, Heat pumps, SWH | >30 GWh for 3 yrs | Large capital intensive industrial projects | Peak savings: R0.55 / kWh<br>Other savings: R0.10 / kWh |
| | **Description** | **Applications** | **Size of Projects** | **Market Focus** | **Payment** |
| **ESCO Model** | Demand-based payments for verified savings | Lighting, Heat Pumps, HVAC, Process optim | > 500 kW | Industrial | Load Shifting: R3.5m/MW<br>Peak clipping: R 3.5m/MW<br>Energy efficiency: R5.25m/MW |

| | | | | | |
|---|---|---|---|---|---|
| **Standard Offer** | Energy efficiency and Small-scale RE at a fix rate | Lighting, LEDs, Hot Water Systems, Solar, Industrial Process Optimization | 50 kW – 5 MW<br>Mon-Fri 6h – 22h | Industrial, Commercial | R0.42 – 1.20 / kWh (Peak Hrs)<br>See Annex 1 for more detail |
| **Residential Mass Rollout** | Demand-based payments for verified savings | Lighting (CFLs, LEDs), Showerheads, Geyser Controllers and blankets | 1 MW – 5 MW | Residential | Fixed Rate per technology |
| **Standard Product** | Pre-approved rebates for deemed energy savings (24/7) | Lighting, shower heads, industrial heat pumps | < 250 kW savings<br>Small to medium projects | Small Industrial Commercial Agriculture | Fixed Rate per technology |

## RESIDENTIAL PROGRAMS

### RESIDENTIAL MASS ROLLOUT

Eskom is currently launching the Residential Mass Roll-out (RMR) programme to stimulate bulk replacement of inefficient lighting, implementation of energy saving technologies and load control devices in the residential sector. The allowable technology mix is as follows:

- Energy Efficient CFL replacing Incandescent lighting
- Energy Efficient LED Downlighters replacing Halogen Downlighters
- Geyser Timers
- Geyser Blankets
- Pool Timers
- Low Flow Showerheads

The RMR is a replacement program offered free of charge to the consumer. The implementation of the Residential Mass Roll-Out (RMR) program is intended to start at the beginning of 2013 and operate until March 2014, with the 3 year sustainability period not extending beyond March 2017. The RMR is implemented by ESCO or Project Developers and must be between 1MW and 5MW. Eskom has defined the monetary rebate & deemed energy savings per unit of technology installed, and audited. This program is targeted at the middle income sector (LSM 4 to 10). All removed inefficient equipment should be disposed in independent recycling companies which will provide Eskom with disposal certificates (Eskom, 2012). The RFP was issued in late December 2012 and closed in January 2013.

### SOLAR WATER HEATING

The financial incentive program for Solar Water Heaters (SWH) is described below. Specifics about the program are given in Annex 2. Eskom has had a financial incentive program for SWH since 2008. The program was put into motion in response to black outs that the country experienced in 2008. The aim of the program is to promote the uptake of 1 million units by 2015. To date the program has fallen short of that goal. In 2011, approximately 60,000 claims for rebate were made – this was an accelerated pace of uptake as compared to previous years (Eskom 2011).

To take advantage of the rebate, consumers can go to one of a number of participating retailers – lists of participants are posted on Eskom's website – buy an accredited SWH unit to replace their electric geyser and then apply to receive a rebate. Participants must use a registered installer. Retailers register the installers and are responsible for the installations that they carry out. The program is meant to save energy, save on peak demand and nurture a domestic solar water heater production industry.

Solar water heating systems included in the solar program have a "SABS efficiency rating (Q factor), which indicates the kilowatt-hours (kWh) of electricity it is expected to save on a typical day" (Eskom 2013). Based on the test result, a system will qualify for a rebate. Currently the maximum rebate on the programme is R8,964 ($1,065)[4]. The program has largely been directed towards low-pressure models but, to capture more of the market, has also begun to focus more on high-pressure SWH as well.

The process of claiming a solar rebate has been streamlined and is facilitated by an independent auditing firm, with buyers receiving their rebates within 8 weeks of receipt of a complete application. Options such as leasing or paying off solar systems are now also available in the South African market.

Originally, funding was directed from the Government of South Africa, through NERSA, to Eskom who implements the program. Municipalities have recently directly applied to the government to receive funds in order to carry out the program themselves for low pressure SWH.

### HEAT PUMP SYSTEMS

As with the SWH program, program specifics for the heat pump financial incentive scheme are given in Annex 3. In November 2010, Eskom began a program that offers rebates on heat pumps for retrofit or replacement of electric geysers. Both residential and commercial customers with 100 liters to 500 liters electric geysers, either split or integrated type systems, are eligible for the rebates. Customers must go to a participating retailer to buy their heat pump. Unlike the SWH rebates, heat pump rebates are offered up front to buyers; suppliers take on the responsibility of claiming the rebates. From each qualifying unit purchased, they receive a voucher for rebate. They then claim these rebate in batches from Eskom.

In August 2012, Eskom announced that the Heat Pump program would be expanded to include new builds (buildings in process of being built or having just been built, known as 'greenfields'). Developers can qualify for units that are already occupied. Rebate amounts are the same as for the exisiting heat pump program.

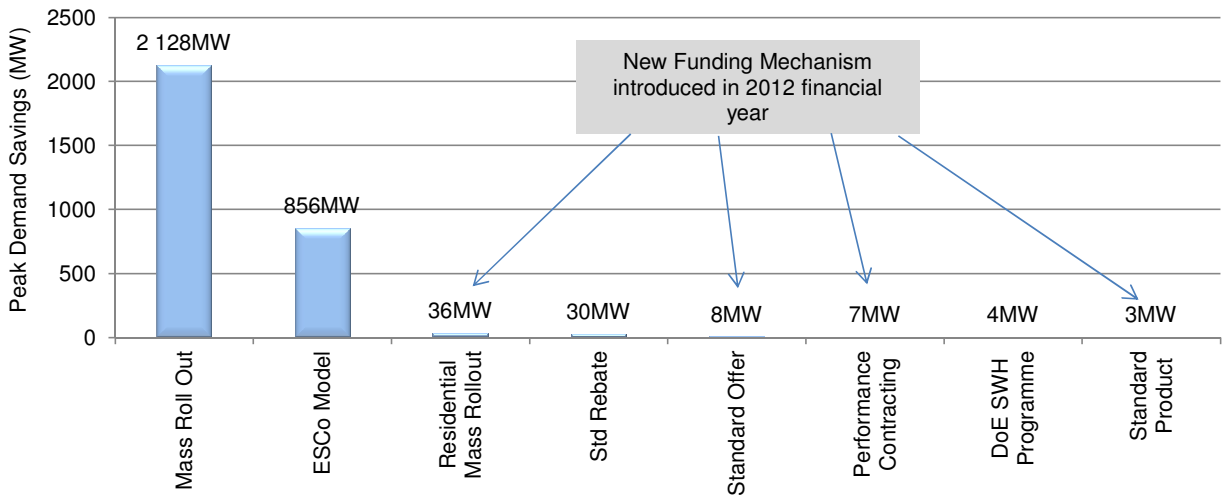
The plan is to distrbute 65,500 units over the course of the program (approximately 26,200 per year). Heat Pump Systems that qualify for the rebate program are quality tested by the Eskom Quality department. It is envisaged that soon these systems will have a test facility at SABS and will be able to get SABS test reports or a SABS mark of approval. The SABS report will supersede all previous approvals. To qualify for the program, the average integrated system COP achieved over the six temperature points must be no less than 2.8. Rebates on heat pumps range from from R3,668 ($435) for models with storage capacities between 100 L and 300 L, and R4,320 ($513) for models with capacities between 301 L and 500 L.

## PROGRAM PERFORMANCE

According to Eskom, a total of 3,072 MW have been saved since the implementation of their Integrated Demand Management (IDM) programs. The next figure shows the breakdown of performed savings per funding model until end of 2012.

[4] 8.41Rs for 1$

Figure 15. IDM Demand Savings Split By Funding Mechanism




The largest savings comes from the first Mass Roll out program which consisted in distributing CFL in exchange of incandescent bulb. A total of 2,137MW has been saved by replacing over 53 million incandescent bulbs with efficient CFL bulbs. Savings from this program have contributed to 70% of all savings claimed by Eskom IDM unit. The CFL Mass Roll Out and the ESCO model are the oldest Eskom programs. Several new, more flexible funding mechanisms were introduced in the past 18 months which targets mainly the commercial and small Industrial sectors. Savings from these initiatives are only now being realised

Figure 16 shows cumulative savings per type of customers and Figure 17 shows cumulative savings per technology. The Residential Sector has delivered 76% (2,333MW) of all savings previously claimed by IDM. This was mainly from CFL mass rollouts.

Figure 16. Cumulative Savings per Consumers

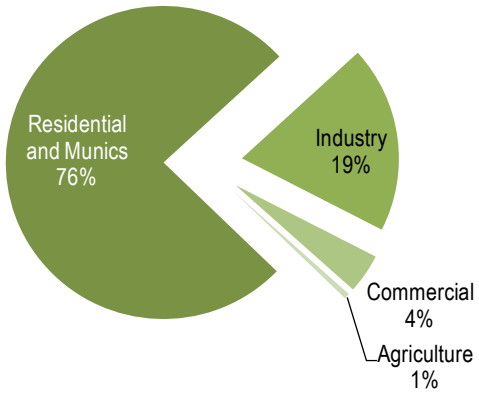
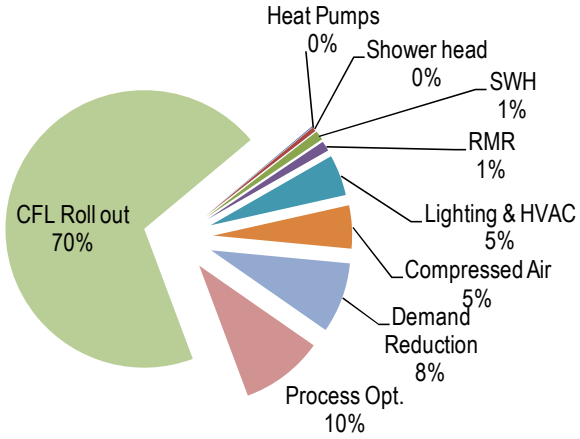



Figure 17. Cumulative Savings per Technologies



## OPPORTUNITIES AND BARRIERS TO INCENTIVE PROGRAM DEVELOPMENT

In just a few years, since the launch of NERSA funded EEDSM programs, Eskom has implemented a great number of funding models and has begun to meaningfully incorporate energy efficiency as an integrated resource for future planning. As reported in the evaluation section, through the establishment of these programs Eskom has been able to report a total cumulative savings of 3,072 MW, representing an offset of five generators' worth of output[5] in the past 10 years. This is the result of combined efforts from Eskom, NERSA and many South African ESCOs.

The establishment of energy efficiency goals and funding capabilities is making South Africa one of the few emerging economies with experience in integrating energy efficiency in its future capacity planning. South Africa effectively modified its rate making practices to provide sufficient, timely, and stable program funding to deliver energy efficiency where cost-effective. In addition, these efforts aim to ensure that South Africa has developed the necessary on-the-ground expertise and funding capabilities to roll out additional future energy efficiency programs.

So far, energy savings have focused on savings from lighting, industrial process optimization, compressed air and industrial and commercial HVAC systems. Little has been done in terms of technologies in the residential sector. Eskom's new residential program, RMR, will continue to target energy savings from lighting by replacing Incandescent lamps with CFLs and Halogens with LED downlighters. It will also target water heating by adding water tank blankets and replacing showerheads with low flow showerheads. The program also targets load shifting by adding water tanks and pool timers. In addition to the RMR, Eskom has developed two other residential programs: the SWH and heat pump rebate programs. However, these have experienced slow uptake even though the rebate distributed covers 20-25% of the purchasing cost. The residential sector is a difficult sector to reach due to its diffuse nature. The new RMR program from Eskom tends to fill in this gap by developing a large scale energy efficiency improvement program in the residential sector. Lessons from this experience will be instructive for the development of similar projects in other countries or for expanding this program to more appliances.

However, so far, much remains to be done in improving the use of energy efficiency in the residential sector. Other appliances with significant cost effective potential could be considered. For example, energy use from refrigerators represents about 15% of residential use and SEAD analysis has demonstrated that significant cost effective energy efficiency potential exists for that segment. Other equipment that may be of interest for the residential sector are TVs, fans, ACs and additional measures for water heating. There is still a need to identify priority areas where savings are large and most cost effective. There are also challenges to implementing programs that can produce profound market transformation.

Moreover, energy efficiency efforts and commitments are centered on the medium term and around managing loads until new capacities come online. There is a need for a shift over time toward energy efficiency as a tool for longer range planning. This may imply a change in the business model restructured to conform and encourage better long range energy efficiency planning by Eskom. The recent reduction in the proposed budget for EEDSM by NERSA also raised the question about the level of funding allocated to

[5] A single power station unit contributes about 600MW to national electricity supply (Eskom, 2012a).

energy efficiency and the possibly under-appreciation of energy efficiency as a way to meet future demand.

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## WORKS CITED


Bekker, B., Eberhard, A., Gaunt, T., & Marquard, A. (2008). South Africa's rapid electrification programme: Policy, institutional, planning, financing and technical innovations. *Energy Policy*, 3115– 3127.

CDE. (2008 July 2008 Number 10). South Africa's electricity crisis - how did we get here? And how do we put things right? Centre for Development and Enterprise. From http://www.academia.edu/1217303/South_Africas_Electricity_Crisis_How_did_we_get_here_And_how_do_we_put_things_right

Covary, T. (2011). *Appliance Retail Programme Feasibility Study.* South Africa.

Covary, T. (2012 4-Jan). Personal Communication.

Covary, T. (2013). *Development of 1st Draft of a National Energy Efficiency Action Plan (NEEAP) for the Republic of South Africa.* GIZ.

DBSA. (2012). DBSA State of SAs Economic Infrastructure Report 2012. The Development Bank of Southern Africa . From http://www.dbsa.org/Research/Documents/DBSA State of SAs Economic Infrastructure Report 2012.pdf

DME. (2008). *Electricity Pricing Policy of the South African Electricity Supply Industry.* Department of Minerals and Energy. From http://www.eskom.co.za/content/18671_not1398~1.pdf?Src=Item+2255

DOE. (2012 July). *National Energy Efficiency Strategy - Second Review.* From http://www.info.gov.za/view/DownloadFileAction?id=179403

DTI. (2013). *Section 12I Tax Allowance Incentive (12I TAI).* Retrieved 2013 9-Jan from http://www.thedti.gov.za/financial_assistance/financial_incentive.jsp?id=45&subthemeid=26

Eskom . (2011 8-April). Media Statement - 8 April 2011. http://www.eskom.co.za/c/article/580/media-statement2-8-april-2011/.

Eskom. (2011). Annual Report.

Eskom. (2011). *Eskom's Electrification Programme.* From http://www.pmg.org.za/report/20110614-salga-implementation-intergrated-national-electrification-programme-p

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

Eskom. (2012a 17-October). Part 1 Revenue Application: Multi-Year Price Determination 2013/14 to 2017/18 (MYPD 3). From http://www.nersa.org.za/

Eskom. (2012b 12-November). Eskom Multi-Year Price Determination Methodology. Presentation to NERSA Public Hearing.

Eskom. (n.s.). Homeflex Booklet.

ESMAP. (2011). *The Standard Offer Model - An Improved Scheme For Implementing Demand Side Management.* Briefing Note 007/11.

GEF. (2011 June). REQUEST FOR CEO ENDORSEMENT/APPROVAL: UNDP Project: Market Transformation Through the Introduction of Energy Efficiency Standards and the Labelling of Appliances in South Africa. http://www.thegef.org/gef/sites/thegef.org/files/documents/document/06-24-2011%20Council%20document.pdf.

Goldblatt, M., & Palmer, I. (2011). *Demand Side Management for Electricity and Water and Financial Implications for Local Authorities.* PDG. Employment Promotion Programme. Retrieved from http://www.bkcob.co.za/media/files/RCI%20Final%20report%20v2%202%2020111208%20ip.pdf

Government Gazette. (2010 *йил* January). *535(No. 32898)*. Pretoria. From http://www.energy.gov.za/files/irp_frame.html

IEA. (2011). *Energy Balances of Non-OECD Countries (2011 Edition).* Paris: International Energy Agency.

IRP 2010. (2011 March). Integrated Resource Plan (IRP) for Electricity. South Africa: Department of Energy. From http://www.energy.gov.za/IRP/irp%20files/IRP2010_2030_Final_Report_20110325.pdf

IRP. (2010). *Executive Summary of the Draft Integrated Electricity Resource Plan for South Africa - 2010 to 2030 -IRP.* From South Africa Department of Energy: http://www.energy.gov.za/files/irp_frame.html

Letschert, V. D.-B. (2012). *Technical Potential of Minimum Efficiency Performance Standards: A Global Analysis of Best Available Technology.*

Makonese, T., Kimemia, D., & Annegarn, H. (2012). Assessment of Free Basic Electricity And Use of Pre-Paid Meters In South Africa. *Domestic Use of Energy Conference (DUE), 2012 Proceedings of the 20th, IEEE Conference Publications .*

NERSA. (2010). *Eskom Holdings Limited: Revenue Application - Multi Year Price Determination 2010/11 to 2012/13 (MYPD2).* NERSA.

NERSA. (2010). *Revenue Application - MultiYear Price Determination 2010/11 to 2012/13 (MYPD2).* Energy Regulator Meeting No. 49 of 24 February 2010.

NERSA. (2010 June). *Revision of Regulatory Rules for Energy Efficiency and Demand Side Management (EEDSM) including Standard Offer Programme (SOP).* From http://www.idasa.org/media/uploads/outputs/files/eedsm_consultation_paper_including_the_rules_-_nersa_june2010.pdf

NERSA. (2012a 4-June). Media Statement - Impact of Inclining Block Tariffs. NERSA.

NERSA. (2012b 19-November). MUNICIPAL TARIFF GUIDELINE, BENCHMARKS AND PROPOSED TIMELINES FOR MUNICIPAL TARIFF APPROVAL PROCESS FOR THE 2013/14 FINANCIAL YEAR. *Consultation Paper*. NERSA. From http://www.nersa.org.za/Admin/Document/Editor/file/Electricity/Revised%20Consultation%20paper%20on%20%20Guideline%20and%20Benchmarks%202013-14%20final%20%282%29.pdf

NERSA. (2012c March). NERSA Review Eskom's Tariffs for the Period 01 April 2012 to 31 March 2013. From http://www.eskom.co.za/content/NERSAreviewEskomtariffs1Apr2012-31Mar2013.pdf

NERSA. (n.s.). *Multi-Year Price Determination (MYPD) Methodology.*

SA DOE. (2008). *ELECTRICITYPRICING POLICY (EPP) OF THE SOUTH AFRICAN ELECTRICITY SUPPLY INDUSTRY.* From http://us-cdn.creamermedia.co.za/assets/articles/attachments/18671_not1398.pdf

SA DOE. (2010). *Policy to support the Energy Efficiency and Demand Side Management, Program for the Electricity Sector through the Standard Offer Incentive Scheme.* From http://www.energy.gov.za/files/policies/Standard_Offer_Policy.pdf

SA Gov. (2013). *South African Government Information. "Minister of Finance Pravin Gorhan presents the 2013 Budget Speech.".* Retrieved 2013 *йил* 27-February from http://www.info.gov.za/speech/DynamicAction?pageid=461&sid=34533&tid=99785

SABS. (2011). *SANS 50010:2011: Measurement and verification of energy savings.* Pretoria: SABS.

Segole, F. (November 2012). IDM & Energy Efficiency - an Update. *Southern African Energy Efficiency Convention, 2012SAEEC.*

UNDP. (2011). *Market Transformation Through the Introduction of Energy Efficiecny Standards and the labeling of Appliances in South africa.*

Xia, X., & Zhang, J. (2012). *Energy Efficiency Measurement and Verification Practices in South Africa.* Pretoria: University of Pretoria.

## ANNEXES

### Annex 1. Published Standard Offer technology category rates in Rm/MW and c/kWh

| Target technologies | Rm/MW | c/kWh |
|---|---|---|
| Energy efficient lighting systems | 5.25 | 42 |
| LED lighting technologies | 6.86 | 55 |
| Building management systems | 5.25 | 42 |
| Hot water systems | 5.25 | 42 |
| Process optimisation | 5.25 | 42 |
| Industrial and commercial solar water systems | 8.736 | 70 |
| Renewable energy | 14.5(average) | 120 |

Please note: Eskom reserves the right to change these rates at any time.

**Annex 2. Information on SWH Rebate program details.**

| TARGET APPLIANCE | **Solar Water Heater (low and high pressure)** |
|---|---|
| PROGRAM TYPE | downstream |
| NAME | Eskom's Integrated Demand Management (IDM) Rebate Model for SWH |
| GEOGRAPHIC FOCUS | South Africa (entire country) |
| TIMELINE | 2008-2014 |
| ADMINISTRATING BODY | Eskom with ESCos |
| ADMINISTRATING BODY TYPE | Eskom, government-owned utility |
| TARGET EFFICIENCY SPECIFICATION | incentive depends on SABS efficiency rating (Q factor) |
| REFERENCE TEST PROCEDURE/S&L PROGRAM USED | (South African National Standard (SANS)), SANS 151 (hot water storage tank), SANS 6211 |
| INCENTIVE PER UNIT | R3,280 - R8,969 (US$364 - US$994) |
| INCENTIVE BENEFICIARY | residential electricity consumer |
| TARGET SECTOR | residential |
| EXPECTED PAYBACK PERIOD | ~3 years |
| BUDGET (MILLIONS) | R2000 (US$222) |
| EXPENDITURE (MILLIONS) | R225 (US$25) (2011;high & low pressure) |
| BUDGET PER YEAR (MILLIONS) | R 333 (US$37) (high & low pressure) |
| BUDGET PROVENANCE | Eskom's DemnAd Side Management (DSM) funds |
| ENERGY SAVINGS [GOALS] | 2300 GWh by 2013 |
| POWER SAVINGS PER YEAR [GOALS] | |

| | |
|---|---|
| **POWER SAVINGS [EVALUATED]** | 5.9 MW (2011;high & low pressure) |
| **NUMBER OF IMPACTED UNITS [GOALS]** | 1M units by 2014 (both high and low pressure) |
| **NUMBER OF IMPACTED UNITS [EVALUATED]** | 41,690 (2011;high & low pressure) |
| **EM&V TYPE** | 97 randomly chosen site inspections annually |
| **EM&V BUDGET** | 8% of budget |
| **COLLABORATION** | International Carbon Ltd. Coordinated by the Low E Solutions (established for this purpose). |
| **ELIGIBILITY REQUIREMENTS** | Must buy registered system from a registered supplier. |
| **NOTES** | May be eligible for CDM credit. Voluntary initiative. Leasing and paying off units is possible under the program. Customers apply individually for their rebate. |
| **BACKGROUND SOURCES** | UNFCCC/CCNUCC Programme of Activities Design Document. http://www.eskomidm.co.za/funding-options; "SAEEC Conference IDM & Energy Efficiency – an Update" Fikile Segole, 14 November 2012.; http://www.eskomidm.co.za/residential/residential-technologies/solar-water-heating-supplier-list; http://www.energy.gov.za/files/swh_frame.html; https://cdm.unfccc.int/ProgrammeOfActivities/poa_db/IAC8FW3TU7SZKRE2P9OVY6HB0LQNM1/view; http://www.erc.uct.ac.za/jesa/volume22/22-3change-etal.pdf; http://www.solarthermalworld.org/content/solar-water-heaters-save-electricity-south-africa |

**Annex 3. Information on Heat Pump rebate program details.**

| TARGET APPLIANCE | **Heat Pump** |
|---|---|
| PROGRAM TYPE | mid-stream |
| NAME | Eskom's Integrated Demand Management (IDM) Rebate Model for Heat Pump |
| GEOGRAPHIC FOCUS | South Africa (entire country) |
| TIMELINE | Nov 2010-March 2013 |
| ADMINISTRATING BODY | Eskom with ESCos |
| ADMINISTRATING BODY TYPE | Eskom, government-owned utility |
| TARGET EFFICIENCY SPECIFICATION | average COP $\geq$ 2.8 |
| REFERENCE TEST PROCEDURE/S&L PROGRAM USED | SANS 151 (hot water storage tank) |
| INCENTIVE PER UNIT | R3,668 - R4,320 (US$407 - US$479) |
| INCENTIVE BENEFICIARY | residential, commercial and municipal electricity consumer |
| TARGET SECTOR | residential, commrcial, municipal |
| EXPECTED PAYBACK PERIOD | ~3 years |
| BUDGET (MILLIONS) | |
| EXPENDITURE (MILLIONS) | R40 (US$4) (2011) |
| BUDGET PER YEAR (MILLIONS) | |
| BUDGET PROVENANCE | Eskom's DemnAd Side Management (DSM) funds |
| ENERGY SAVINGS [GOALS] | 4288 kWh/yr per 150L unit; 80.66 GWh for residential @ load factor of 16% |
| POWER SAVINGS PER YEAR [GOALS] | 54.16 MW |
| POWER SAVINGS [EVALUATED] | 0.3 MW (2011) |
| NUMBER OF IMPACTED UNITS [GOALS] | 65,000 (total program residential), 51,100 low p, 14,400 high p |

| | |
|---|---|
| **NUMBER OF IMPACTED UNITS [EVALUATED]** | 5475 |
| **EM&V TYPE** | 97 randomly chosen site inspections annually |
| **EM&V BUDGET** | 8% of budget |
| **COLLABORATION** | International Carbon Ltd. Coordinated by the Low E Solutions (established for this purpose). |
| **ELIGIBILITY REQUIREMENTS** | For split and integrated systems of between 100 and 500L. Average COP over 6 temperature points must be ≥2.8. Must buy from a registered supplier. |
| **NOTES** | Retailers give rebate and then collect reimbursements in batches from Eskom. |
| **BACKGROUND SOURCES** | http://www.eskomidm.co.za/funding-options; "SAEEC Conference IDM & Energy Efficiency – an Update" Fikile Segole, 14 November 2012.; Xia, Xiaohua, Jiangfeng Zhang, editors. "Energy Efficiency Measurement & Verification Practices: Demystifying M&V through South African Case Studies." Chapter 14. 'Residential Heat Pump Rebate Programme.' Media in Africa, 2012. |