ERLN
Economies of Regions
LEARNING NETWORK

CONCEPT REPORT
The South African energy landscape

This report has been commissioned by the ERLN via the Isandla Institute and compiled by Dirk de Vos. The views and opinions expressed in this report are those of the author and do not necessarily reflect those of the ERLN or the Isandla Institute.

ERLN is an initiative of
GTAC government technical advisory centre
National Treasury
REPUBLIC OF SOUTH AFRICA

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Introduction

This ERLN concept note has been compiled as an input to the ERLN event titled, “Local and sub-national renewable energy and energy efficiency: Challenges and opportunities for economic development”.

The event sets out to explore the question: “Can we stimulate renewable energy (RE) and energy efficiency (EE) markets in a manner that is developmental and equitable whilst being sustainable for municipalities?”

The just-released Bloomberg New Energy Outlook of 2015[1] highlights five shifts that will disrupt the global electricity system going forward. These can be summarised as:

1. **Solar, solar everywhere**. The further decline in the cost of photovoltaic technology will drive a $3.7 trillion surge in investment in solar, both large-scale and small-scale.

2. **Power to the people**. Some $2.2 trillion of this will go on rooftop and other local PV systems, handing consumers and businesses the ability to generate their own electricity, to store it using batteries and – in parts of the developing world – to access power for the first time.

3. **Demand undershoots**. The march of energy efficient technologies in areas such as lighting and air conditioning will help to limit growth in global power demand to 1.8% per year, down from 3% per year in 1990-2012. In OECD countries, power demand will be lower in 2040 than in 2014.

4. **Gas flares only briefly**. Natural gas will not be the “transition fuel” to wean the world off coal. North American shale will change the gas market, but coal-to-gas switching will be mainly a US story. Many developing nations will opt for a twin-track of coal and renewables.

5. **Climate peril.** Despite investment of $8 trillion in renewables, there will be enough legacy fossil-fuel plants and enough investment in new coal-fired capacity in developing countries to ensure global CO^2 emissions rise all the way to 2029, and will still be 13% above 2014 levels in 2040.

Aside perhaps from the gas power dynamic (although here SA's trajectory may have elements similar to the US depending on how this unfolds) these all have direct implications for municipalities and new economic opportunities.

This report outlines the overall energy landscape in South Africa and explores some of the conundrums and challenges we face.

Policy making & solving our electricity conundrum

At a national level, official energy policy remains the 1998 White Paper setting out a progressive vision for our electricity sector, with a substantial restructuring of our electricity sector separating generation, transmission and distribution, the extensive use of markets to regulate price, promoting energy efficiency and environmental sustainability. Extracts from the 1998 White Paper (page 43) include:

> *"To ensure the success of the electricity supply industry as a whole, various developments will have to be considered by government over time, namely:*
> - *giving customers the right to choose their electricity supplier;*
> - *introducing competition into the industry, especially the generation sector;*
> - *permitting open, non-discriminatory access to the transmission system; and*
> - *encouraging private sector participation in the industry."*

On industry finances, the White Paper reads as follows (p46):

> *"The entire industry (generation, transmission and distribution) must move to cost-reflective tariffs with separate, transparent funding for electrification and other municipal services."*

This has not been comprehensively followed. We have to work with what we have. In this context, there are challenges in how to engage with energy:

- Energy is subject to many pressures and claims - decision making is not straightforward and is subject to a wide range of interests;
- At this stage, there are no clear “win-wins”;
- There many players in the field with strong statutory, economic and/or other interests. These range from Eskom, Nersa (the regulator), industry, mining, the Intensive Energy User’s Group (IEUG), agriculture, the different spheres of government, residential customers, Independent Power Producers and others. These have established positions. As such, any policy intervention will be subject to extensive scrutiny;
- As far as government is concerned, there needs be clarity in roles and interests in order to bring certainty and predicatibility, as well unlock economic potential;
- Solutions will need to evolve from these players (from the existing ecosystem); and
- Economics and politics will continue to challenge evidence-based policy;

In terms of regional/sub-national economic development, a central challenge to unlocking the economic potential lies in the challenge facing local government:

- Electricity sales by municipalities are an important source of their income;
- Municipalities as the most direct link to consumers/users of electricity are in the best position to implement policies and strategies that will make South Africa energy efficient and energy secure; and
- Efforts to achieve energy efficiency and local generation will potentially reduce municipal income. Conversely, the benefits of efficiency and local generation of renewable energy (economic growth and therefore increased tax receipts) accrue only indirectly to municipalities.

Why we are where we are

Eskom ought to be understood in its historical context. It was first established to provide cheap electricity to the mining sector. In late Apartheid years, Eskom, like Sasol had a role in securing South Africa’s energy security in an increasingly hostile world. However, it is important to understand that Eskom has never been a particularly efficient utility. Perhaps part of the reason why the 1998 White Paper on Energy Policy was not implemented was that the apparent low prices and exemplary electrification performance created the impression that Eskom was highly efficient and in no need of reform.

A closer look shows that Eskom’s ability to undertake its electrification programme was as a result of other factors such as very low coal prices, exemption from taxation and dividends, financing subsidies and by the fact that consumers had largely amortised the loans required to fund the generation over-capacity built in the 1970s and 1980s. Eskom’s poor performance then was the subject of the De Villiers Commission set up in 1984[2] . Eskom did not invest in any new capacity from the 1980s and so a falling debt (via amortising older plant) was the most significant contributor to its ability to deliver cheap electricity through the 1990s and first decade of the 21st century. For two decades, Eskom’s electricity prices have been very low by international standards but critically, also below its own long-run marginal costs leading to an economy with excessive electricity consumption patterns - something that exacerbates the current shortage of capacity.

Eskom at a glance

Eskom has a total Generating Capacity: 41,194MW[3]. In the world of electricity utilities, Eskom is an extreme outlier. By generating capacity, it is the 5th or 6th biggest electricity utility[4] in the world[5] but operates in an economy that is only the 29th biggest by GDP[6].

Eskom's revenues for its 2014 financial year amounted to R139.5 billion which means that by revenues, Eskom is South Africa's fourth or fifth biggest company[7]. If only South African revenues were the measuring criteria, it would move higher up.[8]

Eskom is responsible for 95% of all electricity consumed in South Africa[9]. Other than the Koeberg nuclear power station and a small contribution from hydro, 95% of Eskom's electricity has been generated from coal-fired power stations. An overview of Eskom's Coal Fired Generators (as set out in Eskom 's presentation to Parliament 29 July 2014) is set out below. The capacity of coal fired Power Stations is as follows:

Station	Location	Nominal Capacity (MW)	Age in 2014 (design life 30 years)
Arnot	Middleburg, MP	2 232	38
Camden	Ermelo	1 480	42
Duhva	Witbank	3 450	34
Grootvlei	Balfour	1 090	44
Hendrina	MP	1 865	43
Kendal	Witbank	3 840	25
Komati	Middelburg MP	791	52
Kriel	Bethal	2 850	34
Lethabo	Viljoensdrif	3 558	28
Majuba	Volksrust	3 843	17
Matimba	Lephalale	3 690	27
Matla	Bethal	3 450	34
Tutuka	Standerton	3 510	28

Recently, the performance of Eskom's plant has fallen dramatically. Although poor maintenance is a factor in all this, the age of Eskom's generating plant is also a factor. The fall-off in plant availability is now rather deep. In 2010 plant availability stood at 85%, but by 2014 it had fallen to 75%[10]. This is important, Eskom's own reserve margin requirement (the margin required to prevent unplanned outages is at 15-20% of generating capacity[11].

The under-investment is not only in the generating capacity. The South African Grid is also in trouble. It is estimated that as much as R163 billion will be needed to get the South African grid to Grid Code Standard. As South Africa cannot rely on other utilities in neighbouring countries to kick start a national black-out, our grid ought to be extremely robust. It is not only the robustness of the grid which is important. If the grid is going to be able to evacuate new generating capacity, it will need to be strengthened[12].

Staffing

Eskom's staff complement in 2013, stood at 46 000 – 47,000 employees[13]. Of these, about 15 000 are involved in Eskom's own distribution/retail activities. On the face of it, Eskom seems over-staffed. Depending on available plant or full (theoretical) capacity, Eskom employs more than 1 person per KW capacity. By way of comparison, Iberdrola, a Spanish utility with a capacity of 45GW, a little bigger than Eskom's 41GW employs 30,678 people or 1 employee per 1.4KW while Duke Energy, the US's largest electricity utility with 57GW of capacity, employs just 27,948 people or 1 employee per 2kW[14]. Poor productivity is less of a problem if employers are paid less than Eskom's peers but this is not the case, the average salary per Eskom employee stands at more than R600,000/annum.

Prices

For the present, South Africa's electricity price is still amongst the cheapest in the world[15]. For industrial users, it is amongst the cheapest anywhere in the world[16]. According to 2014 figures, Eskom's average selling price was 71c/kwh[17] but this tariff is likely to go up dramatically. The average cost of running the Ankerlig Open Cycle Gas Turbines is R3/kwh and Nersa calculated in 2012 that Medupi will, on a stand-alone basis need to have a tariff of 97c/kWh, a figure which has since increased. Once Medupi and Kusile come on line, they will represent between 20-25% of Eskom's total generating capacity. At present, Eskom's estimation of revenue shortfall in MYDP3 period[18] is R225 billion (Eskom presentation to Parliament 29 July 2014).

Sales

The table below sets out Eskom's sales of electricity.

	2013/14	2012/13	2011/12	2010/11	2009/10	2008/09	2007/08	2006/07
Total sold, GWh	217 903	216 561	224 785	224 446	218 591	214 850	224 366	218 120
Growth/ (reduction)	0.6	(3.7)	0.2	2.7	1.7	(4.2)	2.9	4.9

Eskom does not disclose the sectors to which it sold its electricity but using a 2004 Treasury study, the splits across the different sectors are as follows:

Category	Percentage of Total
Domestic	17.9%
Agriculture	2.7%
Mining	17.6%
Manufacturing	39.8%
Commercial	11%
Transport	2.9%
General	8%

Renewables

Moves to bring in Independent Power Producers commenced in 2011 in renewables – under the Renewable Energy Independent Power Producer programme (REIPPP). This was as a consequence of our commitments to the Conference of the Parties (COP) processes under the Kyoto Protocol. The renewables programme operates via an Independent Power Programme (IPP) office run from the Department of Energy. Every renewable plant supplies its power to Eskom in terms of a Power Purchase Agreement that is guaranteed by the state. Already, via four bidding rounds, 5 243 MW has been procured amounting to investments totalling R200 billion. Another 1 084 MW will be added shortly as an extension to the fourth bidding round and an expedited fifth round may add another 1 800 MW of renewable energy. The Department of Energy has sought to secure an additional 6 300 MW of renewable energy.

Cogeneration

Beyond renewables, the IPP programme has recently issued a request for bids under the cogeneration independent power producer (IPP) procurement programme and the deadline for 1 600MW of

Baseload Coal IPP bids (spread over different bids of no larger than 600MW each) are expected in August 2015. Of interest is that the baseload coal IPPs will need to bid in their projects with a tariff of less than 82c/kWh.

Gas

In May 2015 the Department of Energy issued a request for information (RFI) for gas-fired electricity generation and this will help with the development of a 3 126 MW Gas to Power Procurement Programme.

South Africa's electricity intensity & increasing energy efficiency (EE)

South Africa's economy is one of the most electricity intensive (kWh required to produce a unit of GDP). Despite the movement towards a bigger services sector, inherently less energy intensive than mining or manufacturing, our economy's energy intensity has grown. Figures show that South Africa's energy (and with it electricity), intensity doubled over the period 1990 to 2007[19]. In large part this was due to increases in energy intensive manufacturing activities in the 1990s, particularly in the area of aluminium smelting (the non-ferrous metals sector).

Our economy is also characterised by a small number of industrial concerns consuming almost half of our electricity. Most of them are members of The Energy Intensive Users Group (EIUG)[20]. Its 31 members account for 44% of all electricity consumed in South Africa but, collectively, they also have a collective annual turnover of R741 billion, more than 20% of South Africa's GDP and employ nearly 600 000 South Africans.

Almost half the EIUG's members are in mining and a third are manufacturing concerns. Of importance here is that across the EIUG's membership, a significant component of their annual expenditure, nearly 20%, is made up of electricity. This would indicate that they are both heavily dependent on electricity but are also very exposed to increases in the price of electricity. It would be a mistake to understate the importance of most of the EIUG membership. The EIUG membership represents much of what South Africa exports to the rest of the world. These exports finance our dependence on imports of industrial equipment, a necessary input if this economy is to grow[21]. Moreover, many of them form an important base upon which the economy rests.

Another way of looking at things is to compare South Africa to its peers. The table below lists the 25th – 37th biggest economies in the world in US dollar terms, South Africa, being the 35th biggest. It then sets out population size and electricity production:

Country	GDP (Nominal in US Dollars) World Bank 2013	Population in millions	GDP/ Capita World Bank US dollars Nominal World Bank 2013	Electricity Production TWh BP Statistical Review of World Energy	Electricity Intensity ratio (Elec prod/ GDP)	Electricity Intensity per Population) (Elec prod/ Pop ratio)
Nigeria	$522 638	178.9	$3 010	24 827	47	139
Poland	$517 543	38.5	$13 342	164 800	318	4 280
Norway	$512 580	5.1	$100 819	134 200	261	26 313
Belgium	$508 116	11.1	$45 387	85 100	168	7 666
Venezuela	$438 284	28.9	$14 415	131 700	300	4 557
Austria	$415 844	8.5	$49 074	67 700	163	7 964
Thailand	$387 252	64.4	$5 779	164 800	426	2 559
UAE	$383 799	9.0	$41 692	111 300	290	12 366
Colombia	$378 148	47.7	$7 829	62 200	165	1 303
Iran	$368 904	77.6	$4 763	263 400	714	3 394
South Africa	**$350 630**	**52.9**	**$6 618**	**256 100**	**730**	**4 841**
Denmark	$330 814	5.6	$58 930	30 402	92	5 428
Malaysia	$312 435	30.4	$10 514	131 600	421	4 328

South Africa is an outlier being the most electricity intense economy.

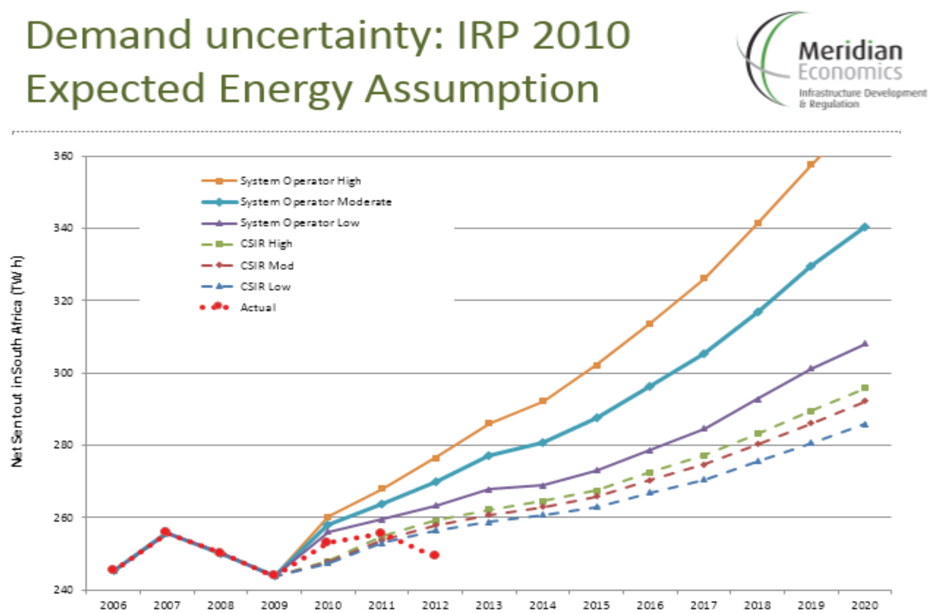
One of the more interesting documents submitted by Eskom in support of a 16% year-on-year tariff increase was a report produced by Deloitte entitled “The Economic Impact of Electricity Price Increases on Various Sectors of the South African Economy”[22]. In it, the work of University of Pretoria academics Roula Inglesi-Lotz and Professor Blignaut studying price elasticity of demand by different sectors of the economy is extensively cited. One of the important findings by these academics is that as electricity prices declined from the 1980s, South Africa’s electricity intensity has increased dramatically. So while in 1990 South Africa had roughly the same electricity intensity as the OECD (a group of developed industrialised countries), by 2006 it had almost doubled. These academics were also able to show that when South Africa experienced its last big electricity price increases in the early 1980s when Eskom’s build programme was at its height, the price elasticity of electricity demand in South Africa was significantly negative. We are likely already in this position once again.

This has important implications for the procurement of generating capacity. At present, our current planning is set out in the Integrated Resource Plan of 2010 (IRP2010). It provides the basis for the procurement of new generating capacity. In general terms, it projects that economic growth requires a growth of generating capacity. But some of the assumptions are based on a price compact to which Eskom committed itself in 1991 which brought prices of electricity progressively lower[23]. The compact was broken in 2006 and from then, prices have increased significantly as seen from the table below:

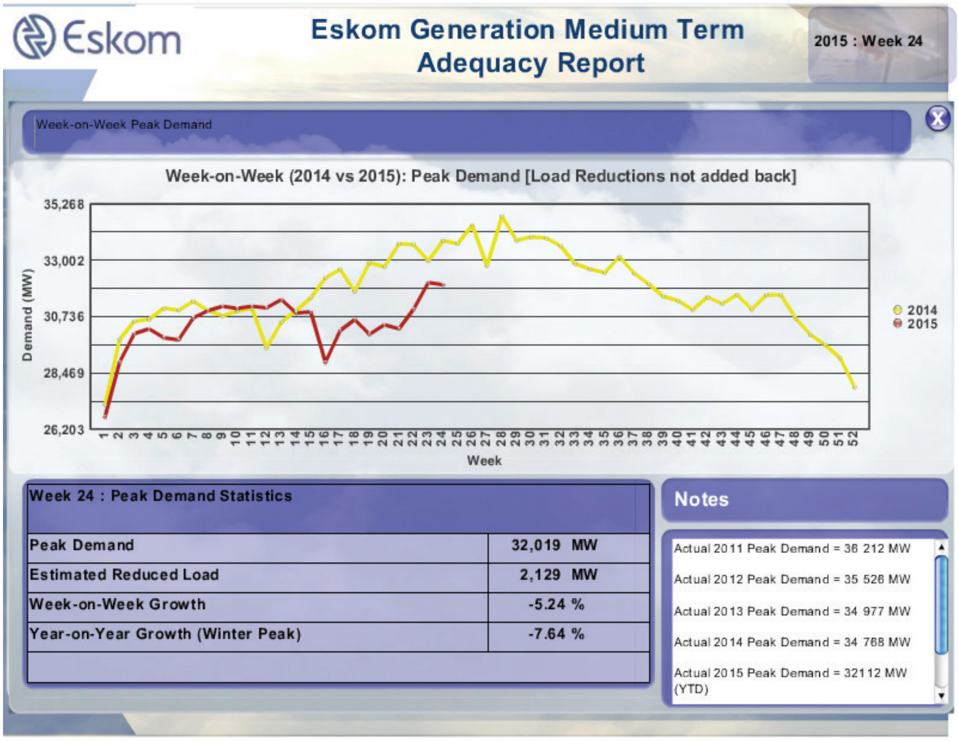
Comparison of approached tariff increases with rate of inflation

Year	Average approved tariff increase %	Average yearly inflation %
2008	27.5	11.5
2009	31.3	7.1
2010	24.8	4.3
2011	25.8	5.0
2012	16.0	5.7
2013	8.0	5.7
2014	8.0	6.1

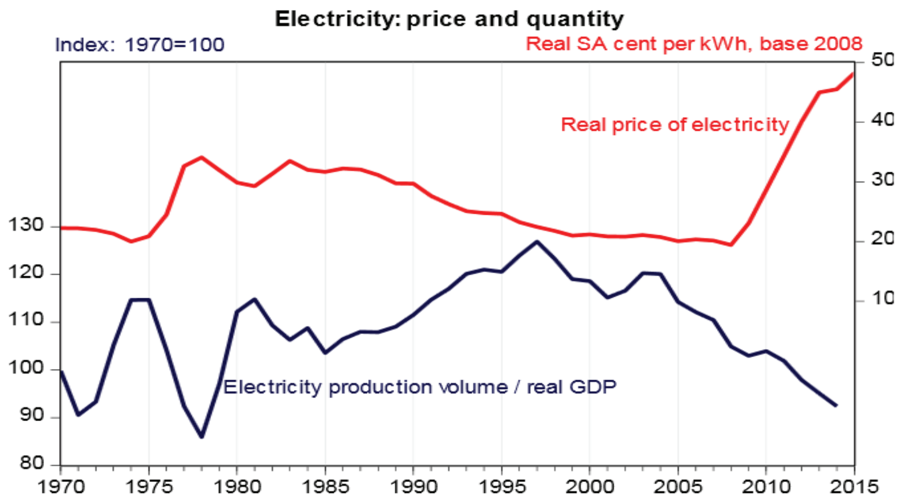
The five years since the publication of the IRP2010 has shown that assumptions around electricity demand are incorrect. Given the economy's extreme electricity intensity, this is not surprising. South Africa has grown (very modestly) but as the chart below shows, it has actually reduced the amount of electricity it uses.



More recent figures from Eskom show that South Africans are using progressively less electricity, even at peak times[24]:



Energy efficiency will increasingly become an integral part of our economy. The graphic below shows how in response to increased electricity prices, the output from a unit of electricity has increased. This trend is set to continue:



Considerably more work on energy efficiency has been done elsewhere than here. While a number of energy efficiency measures are in place, very little has been done about its implementation[25]. Where incentives such as section 12L of the Income Tax Act exist they are limited in their ambit[26].

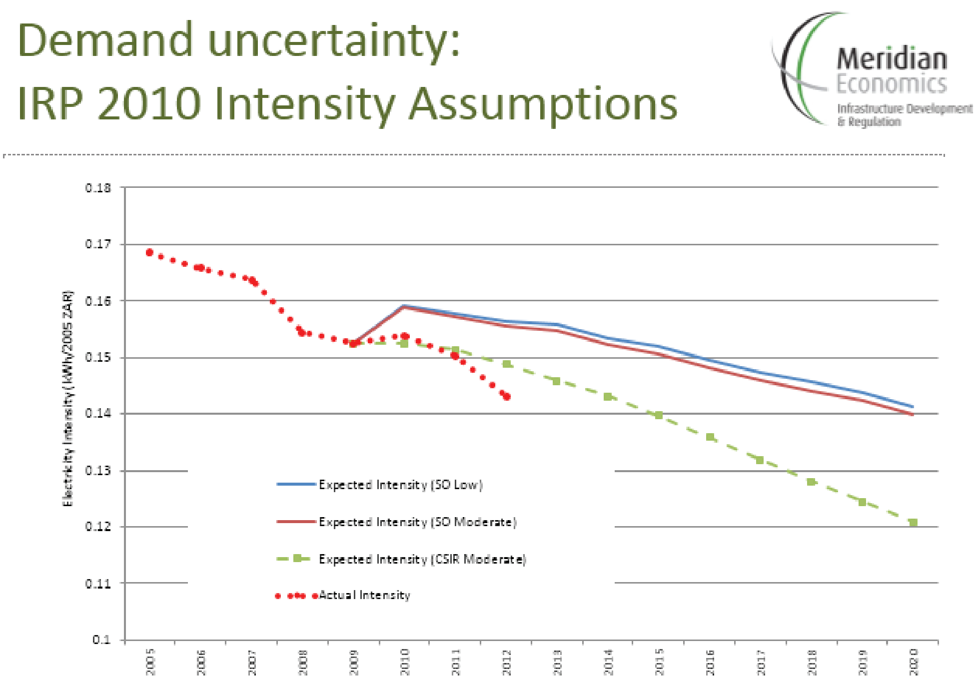
Energy efficiency, research from the International Energy Agency (IEA) suggests, is routinely and significantly undervalued. Their research shows that under existing policies of their member countries (the OECD), two-thirds of the economically viable energy efficiency potential available to 2035 will remain unrealised[27].

The problem is that energy not used, and costs not incurred, are hard to measure hence the description of energy efficiency as the “hidden fuel”. Nevertheless, the benefits of energy efficiency are huge[28]. Amongst the IEA member countries, energy use avoided in 2010 was bigger than the demand met by any other single energy supply including oil, coal or gas. To demonstrate the effectiveness of these measures, the research also showed that the total amount invested in energy efficiency across those countries as of 2011 was an estimated $300 billion, which equalled their aggregate investments in non-renewable conventional energy sources.

There are other benefits, energy efficiency can provide health benefits and improve industrial productivity by lowering the costs of energy in the supply chain. Greater energy efficiency can improve national budgets by lowering the cost of energy used in the government’s infrastructure which could be directed to say, increasing access to electricity for low-income populations. The report also dealt with the rebound effect where efficiency gains are lost when people respond by buying more energy. This is not a bad thing as people improve their well-being with the *same amount* of energy. Some developed countries such as the USA has seen a divergence between energy consumption and economic growth since the 1970’s[29]. This is also happening on a global level[30].

We need to understand the scope for greater efficiencies in our economy. If South Africa is to grow, it will need to delink economic growth from greater electricity consumption. Energy efficiency and the revenue models of municipalities must be changed. Energy efficiency programmes run by municipalities run contrary to their revenue models.

Nevertheless, there is now evidence that South Africa is becoming less electricity intense as seen from the chart below:



We need a more thorough understanding of demand elasticity for electricity across and within various sectors. Very little research exists. We need to understand to what extent our balance of payments or our ability to fund imports of capital equipment depends on certain electricity price levels in the important mining and parts of the manufacturing (ferro-chrome processing) sectors. In doing so, we need to identify those sectors that look the most vulnerable to increases in price and to what extent can these industries become less energy intensive[31].

All the above is very important to understand as South Africa embarks on a build programme. How much generating capacity does South Africa need at different price points? Beginning to understand this is key to breaking the generation long cycle of over investment and under investment. It will also help answer what type of generating capacity we ought to consider.

The economic cost of load shedding

Most reliable observers say that load shedding will remain with us for at least another five years. It obliges us to answer the question of the economic cost of unserved electricity to the South African economy. It can be a tricky question to address. Different businesses will have vastly different costs. Some businesses can manage a work-around, while others are less able to do so.

The calculations currently used by the revised Integrated Resource Plan 2010 (2013) provide one basis and was the basis of a study published by the CSIR on the financial benefits of the renewable power projects that have already been commissioned[32]. Even at the very high tariffs (compared to subsequent renewable projects under construction, the paper calculated that South Africa's net benefit amounted to R800 million. Demonstrating that the renewable projects under consideration had delivered 2.2 terawatt hours to the grid, they could derive the savings on diesel not burnt but then went on to show that the 2.2 terawatt hours avoided 120 hours of unserved electricity. Avoiding unserved energy amounted to a "benefit" of R1.6 billion. How is this derived? The number comes from a worksheet for the current revised Integrated Resource Plan[33] found on the Department of Energy's website[34].

The basis for the cost of unserved electricity is derived from surveys done by Eskom at its largest customers. These suggested that the cost of unserved electricity was 150 times larger than the cost of supplying electricity. Using the average tariff at the time, the cost of unserved electricity was deemed to be R75/kwh. The CSIR updated this to R87/kwh based on the average selling tariff at the time. The Department of Public Enterprises, in its own calculations, uses a figure of R100/kwh[35].

It ought to be remembered that the original Eskom survey was not undertaken to calculate the actual cost to the economy of unserved electricity, its purpose was to determine the size of the reserve margin that Eskom ought to maintain (i.e. the size of mostly idle capacity). Intuitively, it does not make sense. If it were a reliable measure then any increase in the tariff would result in an increase in the costs of loadshedding to the economy. Very little research has been done on the impact of loadshedding and many numbers are mere speculation[36].

More work needs to be done. The economy is not only represented by a sample of Eskom's largest customers. The services sector, which does not use much electricity, would have a far greater cost where electricity is a small but essential part of the services business concerned. Being unable to have a hot shower or eat a hot meal at home is a horrible inconvenience but probably does not generate much of a cost to the economy. Deriving a figure for the costs of load shedding to our economy would be a very difficult task. Many of the costs are not direct costs but would include issues like investor sentiment and confidence in the future of the country, social stability issues, opportunity costs and so on.

Perhaps better numbers could be derived from undertaking a sectoral analysis or undertaking a study on a regional or local level. Expanding the requirements of local government's mandated Integrated Development Plans to include issues around electricity and the costs of loadshedding to local economies could one way to achieve this.

The distribution sector and local government

There are over 170 licensed electricity distributors in South Africa. Eskom serves 48% of customers in the country and municipalities serve 52%. The current position in the electricity distribution industry is the result of its historical development. Before 1994, municipalities distributed electricity in historically white areas, while Eskom covered historically black townships and some of the former so-called homelands. The table below sets out the position.

Category	Estimated number of Customers			Estimated Sales Per Category MWh		
	Eskom	Municipalities	Total	Eskom	Municipalities	Total
Domestic	3 376 276	3 470 054	6 846 330	7 965 000	26 109 593	34 074 593
Agriculture	78 433	20 621	99 054	4 358 000	784 918	5 142 918
Mining	1 180	823	2 003	33 372 000	26 774 133	33 639 741
Manufacturing	2 988	40 964	43 952	53 715 000	22 234 526	75 949 526
Commercial	43 880	199 332	243 212	6 936 000	14 135 177	21 071 177
Transport	511	1 642	2 153	3 182 000	2 383 011	5 565 011
General	1 771	34 334	36 105	1 429 628	13 916 728	15 346 356
Total*	**3 505 039**	3 767 770	**7 272 809**	**110 957 628**	**79 831 694**	**190 789 322**

**An increase of 13% to each category would be a reasonably accurate update to 2015*

The municipalities do not only have residential customers, they also service industrial/manufacturing, commercial and even mining companies but Eskom itself, measured on capacity, distributes significantly more electricity to customers directly than all the municipalities put together. Twelve of the largest municipalities account for about 80% of electricity distributed by all municipalities. The remainder are small and mostly uneconomic.

We have come to see dependence of local government on electricity (and more particularly the surpluses it generates) puts local government in a bind. We saw this with the collapse of a programme to rationalise distribution into a number of Regional Electricity Distributors (REDs) in 2009[37]. There are several reasons why the REDs initiative was not successful but the unresolved financial implications on local government's finances was amongst the primary reasons.

To a very large extent, the question of what to do in place of having REDs has not been adequately resolved and this is becoming a critical issue. Nersa, which in terms of the Electricity Regulation Act undertakes audits of distributors, shows up a progressive deterioration of plant amongst many of the distributors, particularly the smaller municipalities. The audits verify whether the planned network maintenance and inspections are conducted as planned and assessments are conducted on electrical assets in substations, mini-substations, pole mounted transformers, switching stations of secondary substations and overhead lines to gain an understanding of the condition of the electrical network.

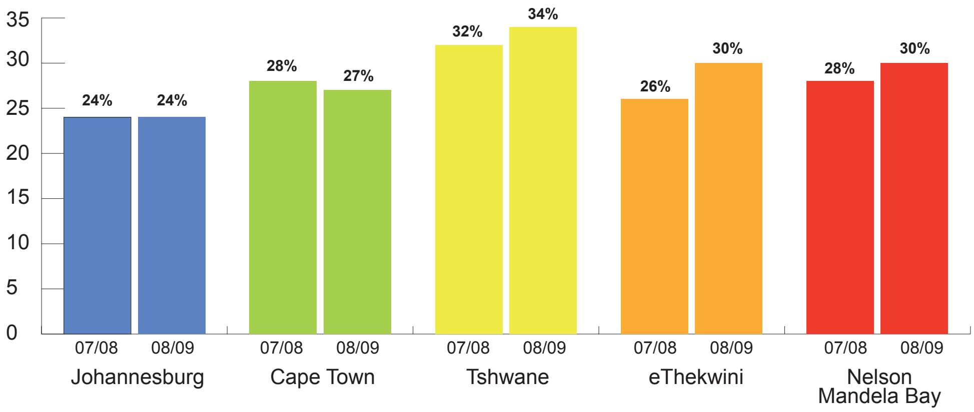
The poor state of many local networks has been known for a long time. More recently, the amount of money owed to Eskom by certain municipalities has brought the matter of failing small local municipalities back into focus.

Other than the abandoned REDs initiative. There was a plan to turn this around called the "approach to distribution asset management (ADAM), a comprehensive, multi-year initiative targeted at addressing maintenance, refurbishment and strengthening shortcomings. Other initiatives included a master plan for standardisation and centralised purchasing of equipment for upgrades.

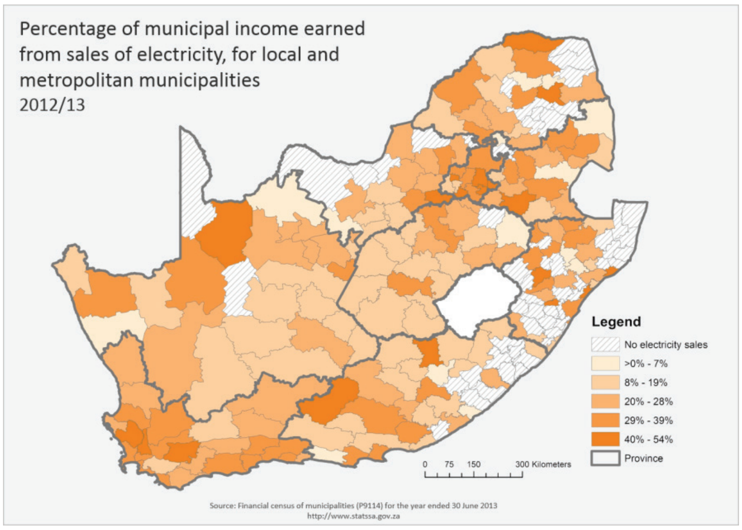
Given the financial benefit of being able to distribute electricity, one suggestion has been to allow local distributors in small municipalities to retain their electricity businesses and to provide them with intensive and sustained support. To do this, however, it would be necessary to develop ring-fenced, corporatised, effectively regulated and well-managed utilities, with adequate investment in physical and human capital. If this were to occur, large corporatised municipal distribution companies could play a much larger role in future.

Local government's revenue model and the role of electricity

Municipalities themselves use electricity as a tax to cross subsidise their other activities. In the large metro's, electricity sales make up as much as a third of total revenues[38]:



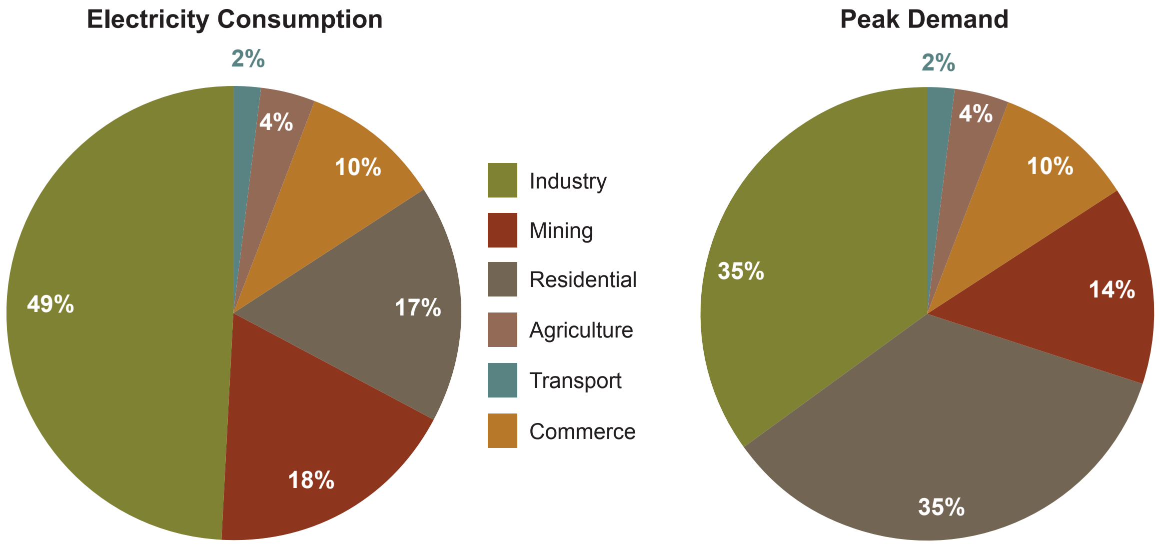
The amount of income earned by municipalities does, however, vary greatly. The figure below is from a June 2015 STATSSA report[39].



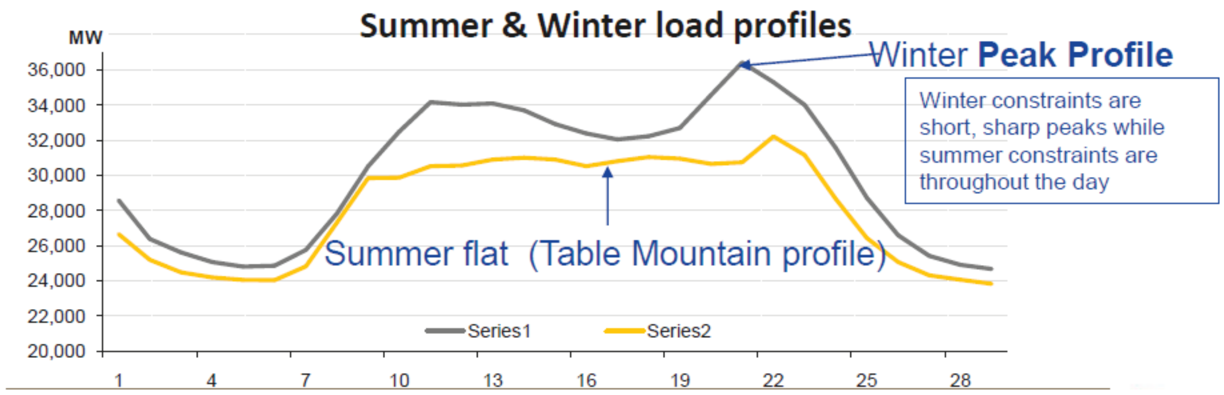
While electricity was as cheap as it has been, the local government has used the supply of electricity in a manner somewhat similar to an income tax. As seen from the tables above, the operational surpluses that electricity sales generate contribute as much as 15% of total municipal income (and in some cases much higher). It is the only local government service for which it charges consumers that makes any significant contribution to the general budget. Without the contribution of electricity "surpluses", local government budgets would be significantly affected.

As electricity becomes more expensive, the ability to subject its supply to a surcharge or tax becomes more difficult. It also puts local government, as least as far as its revenue model is concerned, on the wrong side of important efforts to reduce exposure to load shedding, get behind energy efficiency, deal with the introduction of embedded generation, undertake demand response efforts and commence with the development of local procurement. If the retention of surpluses from electricity remains an important source of funding for local government, none of these initiatives will succeed and local government will remain exposed to the necessary changes that will have to happen in our national electricity system.

As shown above, local government has a far greater exposure to residential consumers than Eskom itself. While the residential sector represents only about 17-18% of total electricity consumption, it is characterised by peaks in the early morning and the early part of the evening. During these peak times, the residential sector makes up 35% of Eskom's generating capacity[40].



As one would expect, these peaks become more pronounced in winter.



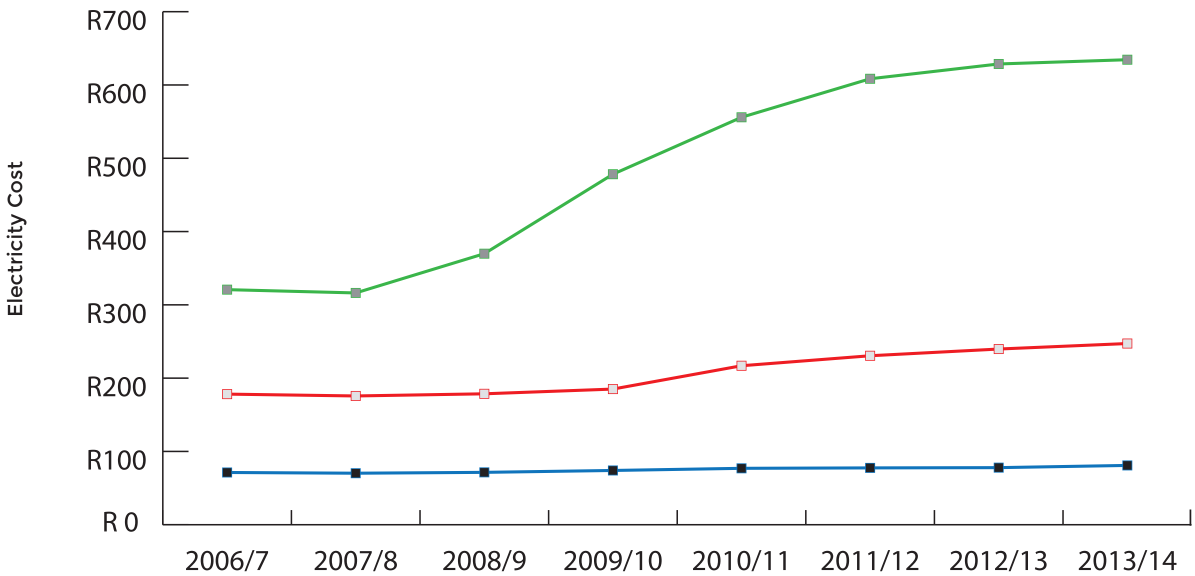
Eskom report to Parliament (p 25).

In terms of demand, there is the need for more than one full power station between daytime consumption and the evening peak in winter.

Residential pricing has become rather complicated. As one would predict in a progressive tax system, local government uses inclining block tariffs (IBT) in terms of which the more electricity that is consumed, the more one pays per kwh. This has important consequences. One study[41] showed that since the introduction of IBT, a municipality in Gauteng has lost R53 million and now owes Eskom R200 million while a Free State municipality lost R75 million.

Poorer customers using less than 350kwh per month are supplied electricity at below what it costs to provide it. This does not take into account illegal connections and the free allocation of 50kWh/month. That being said, poor customers are already stretched beyond breaking point[42]. The poorest households already spend 47.7% of household income on food and 32% on housing, water, electricity, gas and other fuels. While the national government provides some support to municipalities to fund free electricity, a good part of it is done through cross-subsidisation. The graph below[43] (using ERC-UCT[44] data) shows the impact of this for higher use customers:

Real Electricity Cost 2006/7 - 2013/14 (June 2013 Rands)



	2006/7	2007/8	2008/9	2009/10	2010/11	2011/12	2012/13	2013/14
Low (150kWh)	R71.28	R70.28	R71.45	R74.03	R76.95	R77.53	R77.88	R80.91
Medium (350kWh)	R178.19	R175.69	R178.62	R185.08	R216.91	R230.54	R239.71	R247.22
High (450kWh)	R320.74	R316.25	R369.81	R478.23	R555.92	R608.47	R628.66	R643.47

Source: ERC - UCT

As an aside, many poor households are charged using the highest tariffs. If a single electricity connection is shared between several households as is often the case in informal settlements, then that single connection would be charged on the highest tariff, losing out on the 50kwh free electricity allocation.

The cross-subsidy only works when there are sufficient high consumption users in the system. One calculation shows that it is only those residential customers that consume over 600kWh per month that generate surpluses[45].The commercial sector generates significant surpluses but high voltage (HV) industrial customers mostly have a neutral impact. If the type of customers that provide the cross subsidy are no longer in part of the system, it doesn't work. Cross-subsidies in electricity tariffs are inevitable in a country such as South Africa but these should be levied transparently. Local government should make the effort to establish and publicise the average level of cross-subsidy between customer categories so that customers are made aware of it.

Cheap electricity has become woven into our public finances. Cheap electricity has been used to fund other things. It is also embedded into the social welfare system. When electricity was cheap, it was easy to fund low-income users via a basic free allocation and the inclining black tariffs. When these assumptions change, as they must do, what are the implications? We have already seen the results of this with over-indebted municipalities.

Poorer or indigent households are in no position to pay more for their electricity consumption and already in large parts of those areas enjoying an electricity connection for the first time, electricity theft is becoming a bigger problem[46]. We should understand that electricity subsidies are becoming unsustainable. We need to quantify these at different electricity cost levels and move them to the social welfare budget. This has important consequences for our national budgeting processes. Our welfare budget has already grown substantially and there is a limit to how much further it can grow

The problem of data

There is very little data about patterns of electricity consumption and such data that does exist, exists in isolation and is not collated or combined. As such, it cannot be analysed to produce any valuable insights on a suburb-by-suburb scale. We can produce a macro picture but not with sufficient granularity.

The disciplines of ETL (Extract, Transform and Load) have not been implemented to any great degree. We need to get to the point where disparate data from several heterogeneous sources is transformed and stored in a common format that renders it usable by analysis tools.

For example, municipalities have SCADA systems (a supervisory control and data acquisition) on main transformers or injection points, but very few are metered. Very little data exists in real time. Far better informed decisions could be made if data about electricity consumption could be collected on a sub-station level, even before time-of-use metering is rolled out.

When Eskom provided a reliable, abundant and cheap source of electricity, it was not important to understand electricity consumption by consumers. Electricity utilities around the world are undergoing fundamental change[47]. Far more expensive electricity will drive changes to the traditional municipal electricity revenue models[48] in ways that are not yet clear to us[49]. Questions of how to maintain the grid will become important policy issues[50]

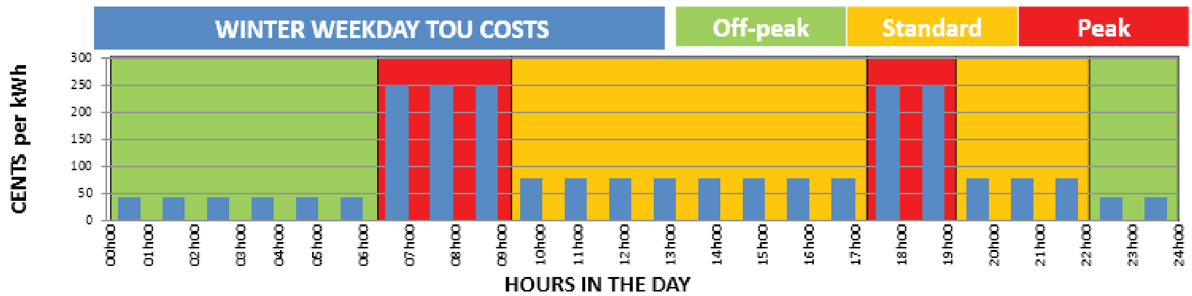
Change will be difficult at an institutional level within electricity departments but to help everyone understand what is at stake, better information will make the arguments for change clearer.

Smart-meters and smart grids – a key consideration for municipalities in unlocking the economic opportunities at sub-national level

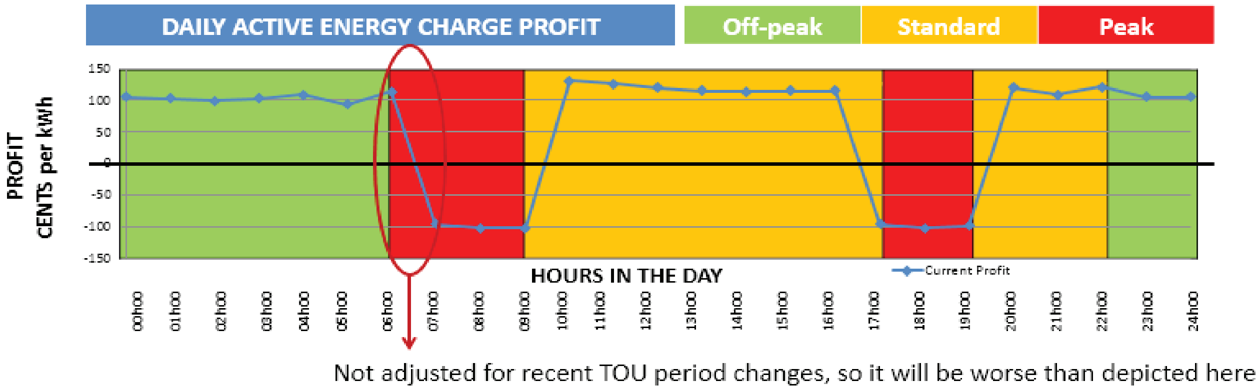
Most local governments are on Eskom's Megaflex package. This means that local government is subject to different time of-use-tariffs but residential consumers are not.

As electricity becomes more expensive, the response will be to conserve electricity but this is likely to make the difference between daytime usage and the peaks even greater. Those consumers who provide most of the cross subsidy (or the biggest contribution to the surpluses from electricity sales) are getting to the point where alternatives such as PV installations reach "socket parity". These customers don't leave the system entirely but remain grid tied – using municipal-supplied electricity at peak times alone. In this way, instead of being net contributors or "surplus generators", they will also be supplied at a loss. One study showed that the revenue impact of embedded generation can be as much as 60% of a municipality's electricity gross profits[51]. If this were to happen, the ability to cross-subsidise poor households, something already under pressure, would no longer exist.

At the same time, municipalities must encourage electricity savings, particularly during peak times and maintain a financially sustainable electricity supply to consumers, without cutting out cross-subsidies. Local government, as an electricity distributor, charge residential customers using a flat rate. The cost of supply to a local authority during winter might look something as follows:

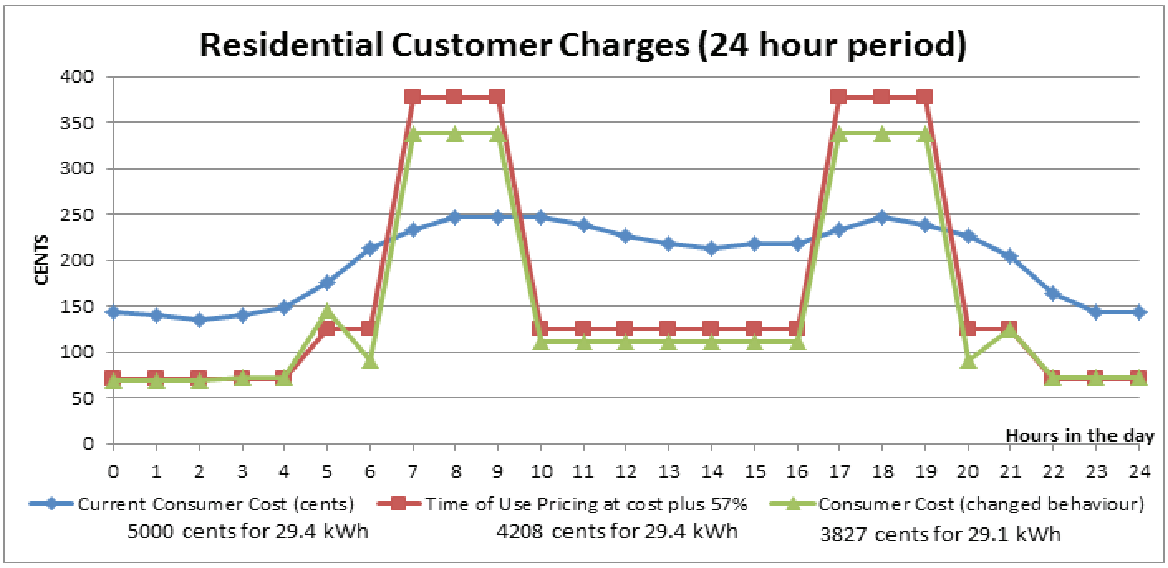


Difference between Eskom Peak Pricing and fixed Inclined Block Tariff means no incentive to save electricity during peak times. Increasing electricity prices mean consumers save more electricity but savings are mostly during off-peak times. This makes peaks more intense. During winter peaks, even some high tariff residential customers are supplied at a "loss" described in the graphic below:

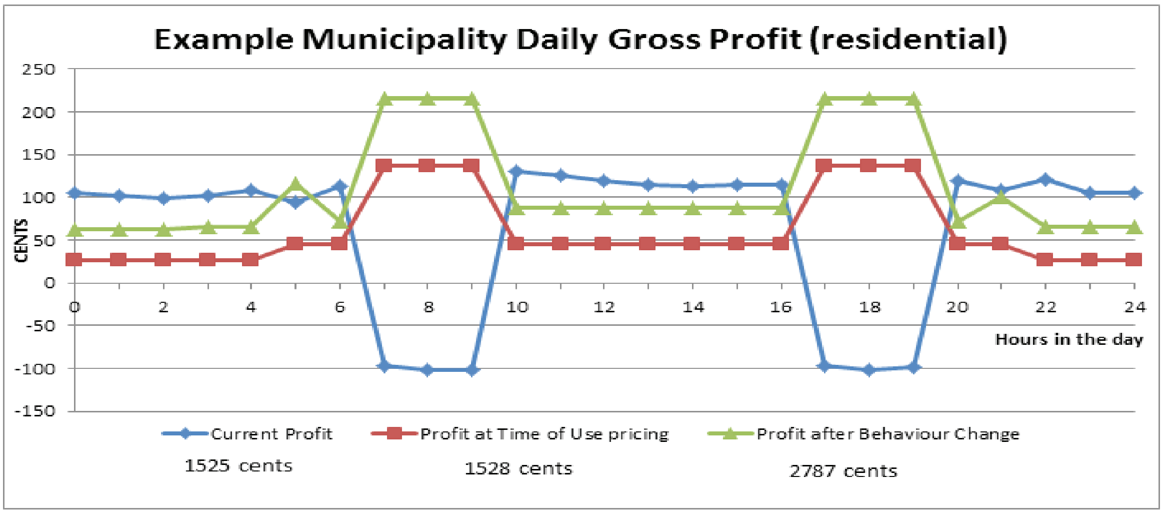


If local government/electricity distributors can encourage changes in residential customer behaviour change by moving to time-of-use pricing – (i.e. charging customers different rates for different times of the day), then municipal profitability increases even as less electricity is consumed. Customers are incentivised to reduce peak-time demand when rates are higher and defer usage for cheaper time slots instead. In essence, the cost of inefficient electricity usage shifts to the customer.

The graphic below shows the stylised position (spreadsheets generating graphics available) for high tariff users in the winter months and how, with time-of-use metering, this would change. Importantly, it also shows the position once changes in consumption habits are made. It is possible that under certain tariff structures the consumer might be able to reduce the electricity bill.



The graphic below shows the position from the distributor's/local government's point of view. While the consumer has reduced his/her bill, the gross profit margin and the cumulated net profit amount increases.



There are very few win/win opportunities in our electricity sector. Time-of-use metering is one of these.

The implementation of smart-metering programmes is something that requires special attention though. In this regard, we need to be sure to avoid single supplier lock-in. In this regard, standard specifications for Smart Meters are crucial before going down this road. Future-proofing metering solutions is best achieved by securing “optionality”, not vendor lock-in.

Any time-of-use metering programme must thus be guided by the requirement that the programme needs to produce a given ROI within a set period. Over-complicating the meters or insisting on “Smart Meters” could increase costs with marginal return. For example, simple time-of-use meters have 80% of the functionality of fully-fledged smart meters for less than 20% of the cost.

Options could include:

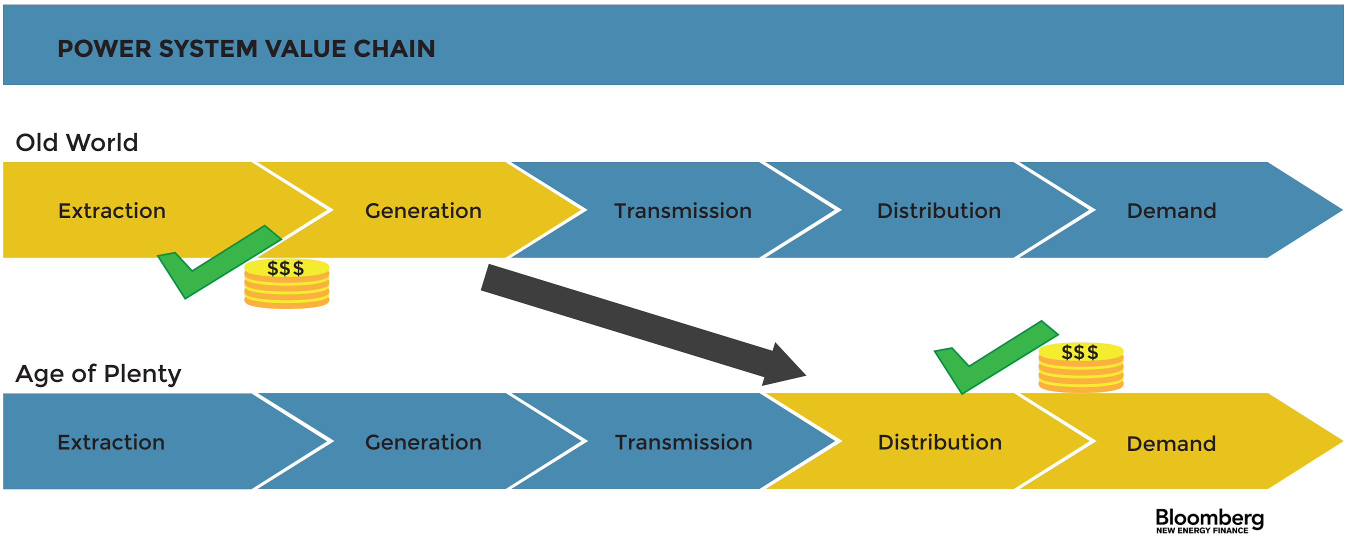
- An incremental implementation path where “learning” takes place within electricity departments should be undertaken.
- Maintaining control of the protocol to communicate to the time of use meters fitted/deployed.
- Other aspects than must be controlled include:
    - the management platform.
    - the ERP applications.
    - the access network (for security and liability) and the on-boarding process for meter manufacturers.
    - the manufacturing of the meters can be done locally provided that the local authority concerns provides a certification process to approve meters, management platforms and access networks.

The future

With the rapidly declining price of renewable energy (RE) – especially wind and solar PV – along with the massive increases in energy efficiency across all products (from lighting, to cars, to fridges and industrial machinery) the future landscape for energy is changing.

Michael Leibrech in his keynote address to the 2015 Bloomberg New Energy Future[52] conference notes that a shift is taking place in the power system value chain – a shift from an old world dominated by energy extraction and generation to a future where the key rests with responses to demand and managing distribution. It is also a shift from a centralised view of energy to a far more localised and distributed approach to managing and delivering energy. The challenges for municipalities in this space are only going to grow – as are the economic potentials and opportunities.

How we respond now will be critical to unlocking that value, build our energy security and contribute productively to our economic development.



ERLN Economies of Regions LEARNING NETWORK

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