Briefing Paper 1

Understanding Electricity Demand Patterns in South Africa's cities

Draft, 4 December 2015

Contents

1 Purpose 1
2 National context 1
2.1 Historical electricity prices in South Africa 1
2.2 Energy intensity, price and electricity demand over the long run 2
2.3 Understanding the recent decline in demand 6
2.4 Implications for future demand 10
3 Metropolitan electricity sales and average prices 10
3.1 The distribution business 11
3.2 The significance of the metros 12
3.3 Metropolitan electricity sales 12
3.4 Real changes in average effective prices 13
3.5 Impact on municipal distribution business and municipal finances 14
3.6 Changes in consumption patterns 16
3.7 Higher prices associated with increased business stress 18
3.8 Cross-subsidies under threat 20
4 Energy efficiency and demand effects 20

1 Purpose

This paper briefly outlines the patterns of demand in the electricity industry, looking at the national context initially but focusing on electricity demand in the metropolitan municipalities. The focus is on the period since 2007. Changes in real prices are tracked and the effect of price increases in municipal finances are analysed.

A companion paper examines the main dynamics in on the supply side, also focusing on actual trends and dynamics observed in the last few years (Briefing Paper 2). A third paper looks at the implications of both demand patterns and supply trends for the future of the electricity industry at the city level in South Africa. A fourth paper takes a step back to discuss the critical issues facing cities with respect to electricity in the light of these dynamics.

2 National context

2.1 Historical electricity prices in South Africa

The recent steep increases in Eskom's electricity prices are not unprecedented. In the mid to late 1970s prices increased steeply to recover the costs of rapid expansion in generation capacity that coincided with depressed demand (economic recession).

In the context of shortages in the 1970s, and driven by a policy to become energy independent and to grow a mining sector characterised by large but deep and poor yielding ores, Escom (sic), then a government department, embarked on a power plant building spree[1]. Then, as now, it built bigger plants using unproven technologies and like at present, these new builds experienced huge cost overruns. By 1983, Escom had over 22 GW (more than twice Eskom's current build programme) under construction or on order. Spiralling electricity price increases resulted in the government of the time setting up the De Villiers Commission to investigate. Among the findings was the problem of a looming supply surplus. Escom was building far too much generating capacity for the economy to absorb, more particularly at the prices required to fund this over-investment.[2] The large Majuba power station was eventually completed way over budget and years behind schedule. Then, as now, the state was responsible for the debt incurred by that build programme. Eskom's reserve margin in 1990 was 55%.[3]

The over-supply of generation capacity together with the initial steep increases in prices allowed Eskom to sustain a period of reducing prices (in real terms) and to enter into pricing compacts with the government to formalise this (Figure 1)[4]

[1] Steyn, Grové: Administered Prices Electricity – A report to Treasury
http://www.treasury.gov.za/publications/other/epir/Electricity.pdf
[2] Steyn, Grové: Eskom - Are we missing the opportunity to learn from history?
http://www.gsb.uct.ac.za/files/BusinessDay_newspaper_article.pdf
[3] http://www.gsb.uct.ac.za/files/SAElectrificationworkingpaperfinal.pdf
[4] Gaylor Montmasson-Clair and Georgina Ryan of Trade & Industrial Policy Strategies (TIPS) For the National Economic Development and Labour Council (Nedlac): Repositioning electricity planning at the core: An evaluation of South Africa's Integrated Resource Plan 2014: http://electricitygovernance.wri.org/files/egi/TIPS%20%20NEDLAC%20-%20Review%20of%20SA%20IRP%20-%20Final%20Report%202014.pdf

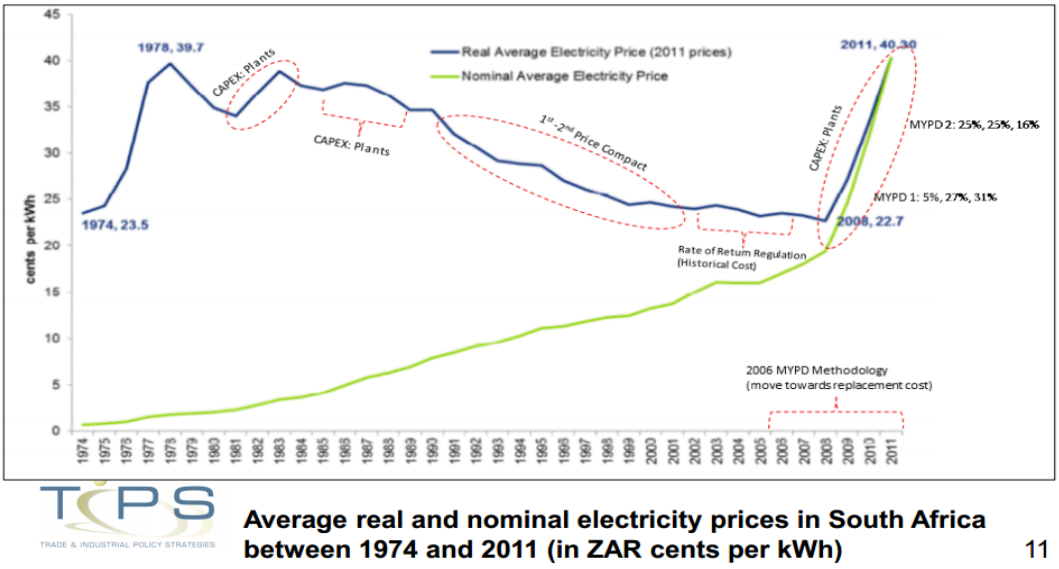


Figure 1: Average real and nominal electricity prices in South Africa: 1974 to 2011

An unintended bonus: financing the electrification program

The high reserve margin and low electricity prices facilitated a major drive to extend electrification in the new democratic dispensation after 1994. The Reconstruction and Development Programme targeted 2.4 million new electricity connections between 1994 and 1998. A target was set to connect 450,000 households annually with Eskom connecting 300,000 of these and local municipalities the balance of 150,000. The target was exceeded: in the period between 1994 and 1999, more than 2.5 million households were electrified. Many of the first connections undertaken to reach the RDP targets were completed by Eskom itself. Eskom was able to fund these connections through cross-subsidies from industrial users and bulk sales to local authorities. It was only from 2001 that the state funded the capital cost of electrification through the Integrated National Electrification Programme (INEP) which from 2005, was permanently established in the Department of Energy and Minerals (Department of Energy since 2009). Just above 5.8 million households were connected to the grid between 1994 and 2014.[5]

In effect, the electrification program could be said to have been partly financed and paid for by the electricity users in the mid to late 1970s and 1980s. It was the over-build, and resultant high prices, in the 1970s and 1980s that allowed Eskom to finance a large share of the electrification program in subsequent years.

2.2 Energy intensity, price and electricity demand over the long run

In the context of over-supply and cheap prices (once the debt had been reduced), Eskom was able to attract energy-intensive industries and deliver low-priced electricity to the 25+ major users which have become an important cornerstone in South Africa's industrial strategy, one which relies on a

[5] Department of Energy Presentation – Integrated National Electrification Programme March 2014: http://mfma.treasury.gov.za/Media_Releases/ReviewOfLGInfrastructureGrants/Documents/Review%20of%20Infrastructure%20Grants%20-%2019th%20March%20Sector%20Workshop/Presentations/DoE%20-%20INEP.pdf

continued ability to generate large volumes of cheap electricity. Some of these have included long-term contracts linked to commodity prices such as those signed with the aluminium smelters.[6]

As a result of these events, South Africa is an outlier among its peers with economies of similar size with respect to electricity-intensity (Figure 2).[7]

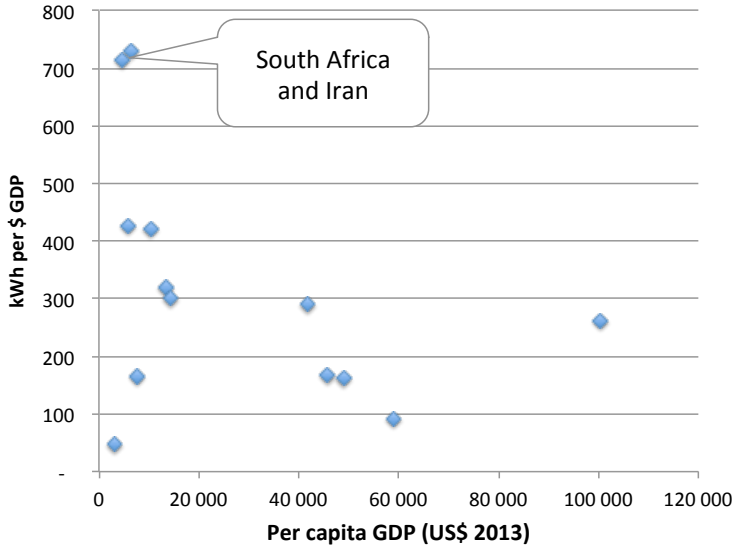


Figure 2: Electricity intensity of countries with similar size GDP to South Africa

Relationship between price and energy intensity

As electricity prices decreased in real terms in the period after 1980, South Africa's electricity intensity increased, particularly in the period 1985 to 1997 (Figure 3).[8] However, since the peak in 1997, electricity intensity has declined. This trend started as the services sector increased its share of the economy and before the very rapid increase in electricity prices from 2008 onwards.

[6] Yelland, Chris - Eskom's special electricity pricing deals with BHP Billiton http://www.dailymaverick.co.za/article/2013-03-25-analysis-eskoms-special-electricity-pricing-deals-with-bhp-billiton/#.VjnyESvvPLU

[7] World Bank GDP data for 2013. Countries are Nigeria, Poland, Norway, Belgium, Venezuela, Austria, Thailand, UAE, Colombia, Iran, South Africa, Denmark, Malaysia. Countries are ranked 25th to 37th in terms of the size of their economy.

[8] http://www.ee.co.za/wp-content/uploads/2015/06/NWU-submission-to-NERSA.pdf. Access November 2015.

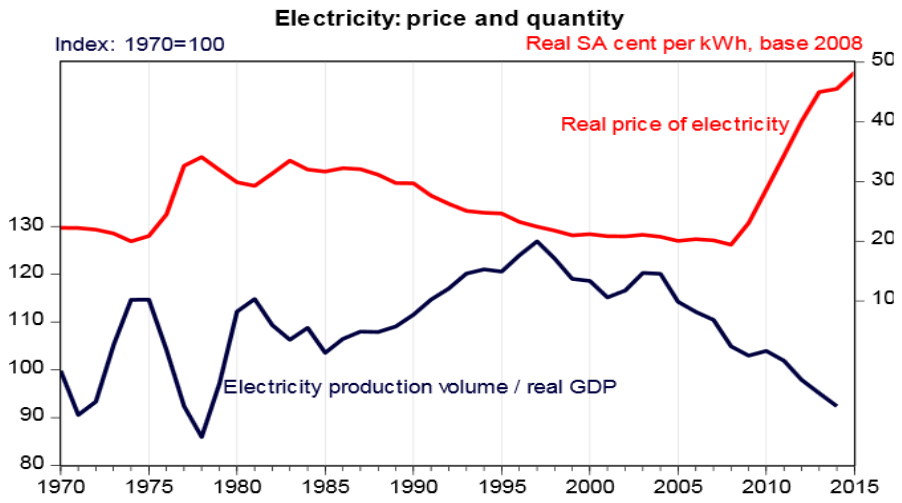


Figure 3: Electricity intensity versus electricity price

Low prices and high electricity-intensity were associated primarily with mining activities and minerals processing as well as other energy-intensive industries. In 2014, the 31 companies comprising the Energy Intensive User Group accounted for 44% of the electricity purchased from Eskom, with one company accounting for 6% of total Eskom sales.[9] The relationship between the commodity price index and total electricity sales is evident in Figure 4. There is a strongly held view that South Africa missed out on the commodity boom in the period 2003 to 2008 and that electricity sales over the last 4 years in particular have been affected by a combination of electricity price increases, a global downturn in the commodity market and weak economic growth.[10]

[9] http://www.eiug.org.za/about/ (accessed 5 November 2015). EIUG report total electricity usage by their members at 78 637 GWh in 2014. TIPS report BHP usage at 6% of total Eskom supply (http://www.tips.org.za/files/presentation_-_development_dialogue_seminar-_options_for_managing_electricity_supply_to_aluminum_plants.pdf) (accessed 5 November 2015).

[10] http://www.miningweekly.com/article/sa-missed-out-on-51-000-mining-jobs-in-2003-2008-boom-2011-02-23. EIUG personal communication (November 2015).

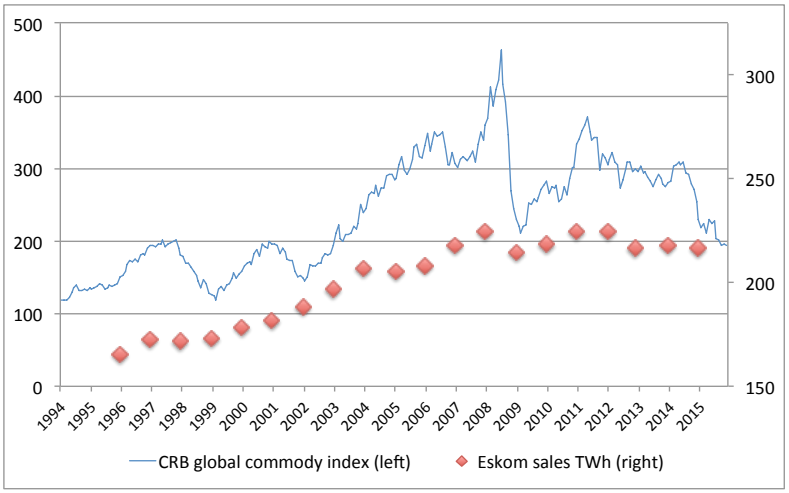


Figure 4: Global commodity price index (CRB) and total Eskom electricity sales

Consequently, over the last 8 years (2007 to 2015), while GDP has grown by 13% in real terms, electricity sales were slightly lower in 2015 than they were in 2007 (Figure 5).

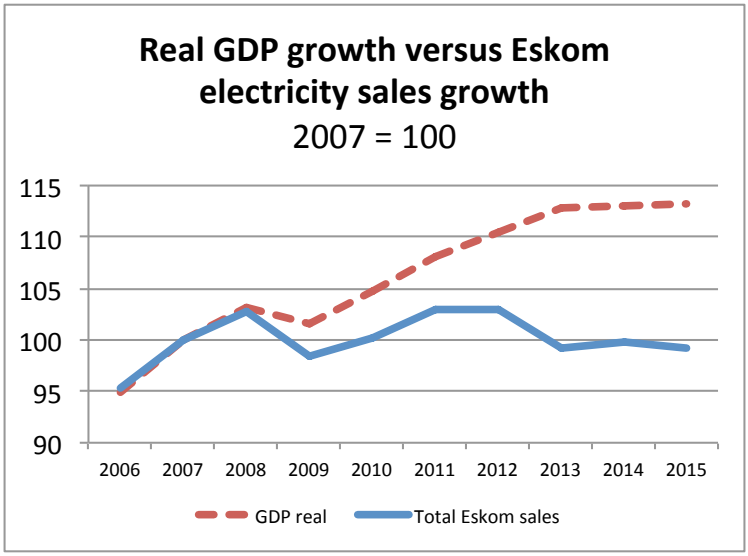


Figure 5: Change in real GDP versus change in Eskom electricity sales

A similar pattern of demand has been found in Australia, another economy with a significant mining sector (Figure 6).

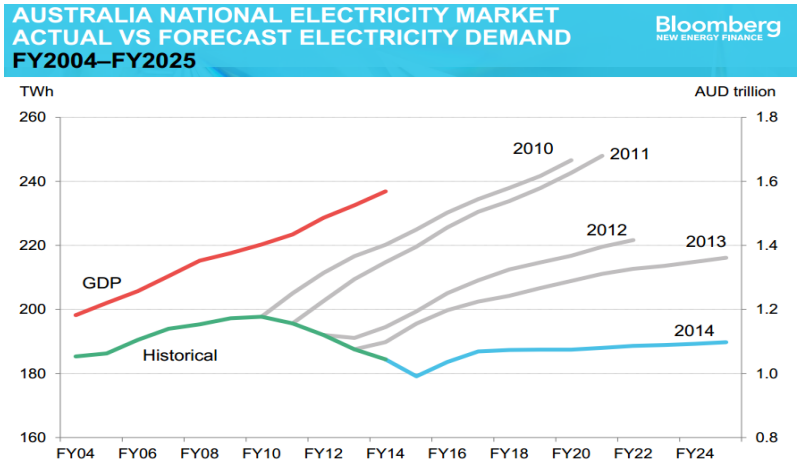


Figure 6: Divergence between economic growth and electricity usage - Australia

An energy-intensive beneficiation strategy rests on cheap energy and growing demand for beneficiated minerals. Electricity in South Africa is no longer cheap and future demand for mining-based commodities is uncertain. Hausmann, for example, has argued that this is the wrong economic strategy.[11] So structural changes in future electricity demand are quite possible, with lower electricity intensity going into the future a strong likelihood.

2.3 Understanding the recent decline in demand

Electricity usage and load shedding

A screenshot taken from Eskom's system adequacy report (Figure 7) shows that the decline in demand is not related to problems associated with load shedding. In periods where loadshedding has not taken place, demand has continued to fall.[12]

[11] "Mineral beneficiation has long been considered by many in government and the ANC as the panacea for South Africa's woes, but focussing on this relatively difficult to achieve economic outcome is unnecessarily costly while preventing policy makers from seeing other opportunities for economic development."

[12] http://www.eskom.co.za/Whatweredoing/SupplyStatus/SupplyStatus/AdeqRep2015w44.swf.

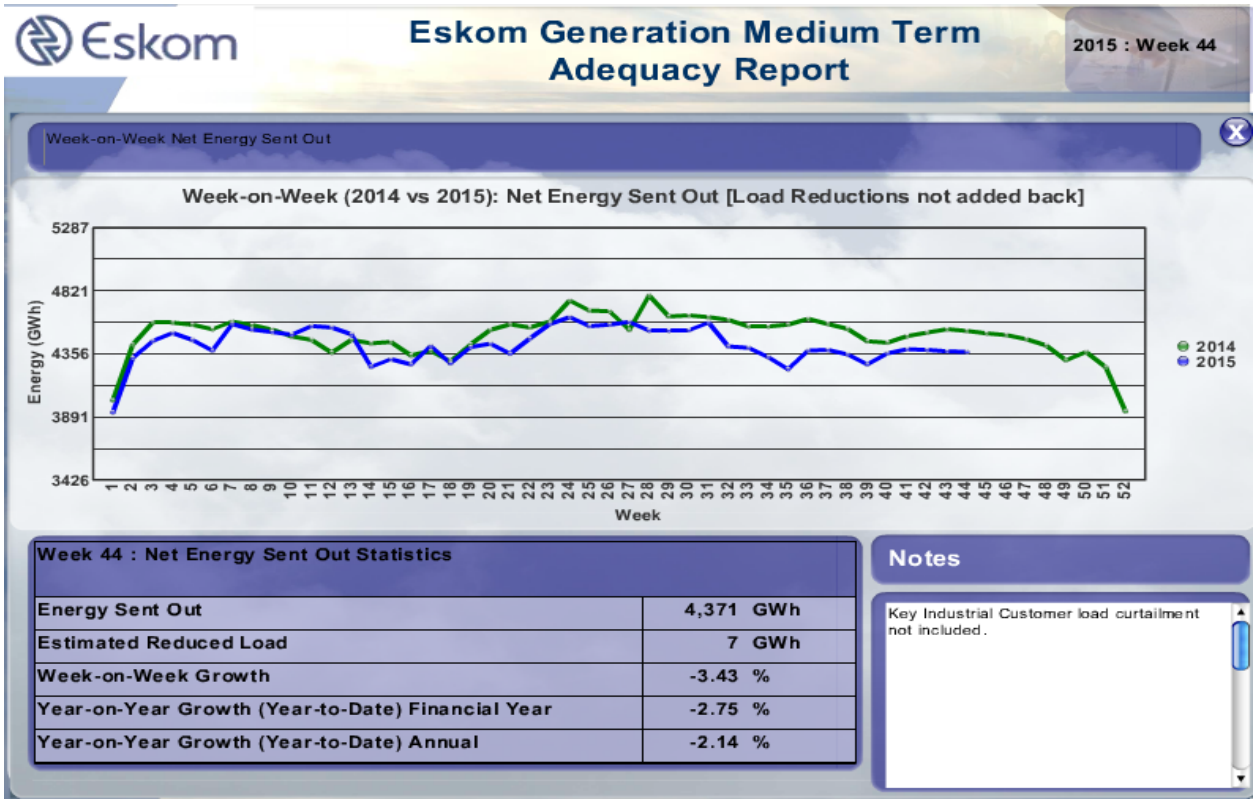


Figure 7: Electricity usage in 2014 and 2015

Eskom sales by customer category

Municipalities make up the largest customer category for Eskom, accounting for 42% of total Eskom sales in 2015, followed by industrial consumers (25%) and mining (14%). The other categories (including agriculture, and Eskom's direct commercial and rural customers, as well as international sales) make up the rest (19%).

The drop in Eskom sales arises mainly from a drop in industrial purchases (6100 GWh below peak in 2011, -10.5%) and mining (2640 GWh below peak in 2011, -8.1%). Sales to municipalities have also declined since 2012 (470 GWh below peak in 2012, -0.5%) – see Figures 8 and 9.

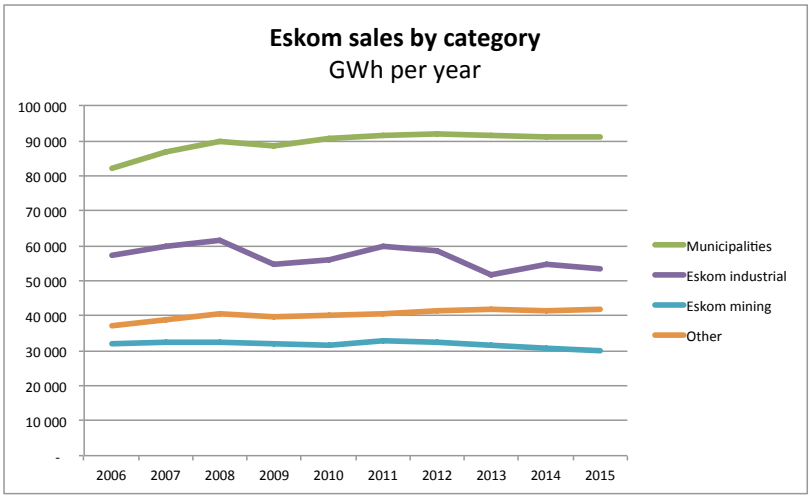


Figure 8: Eskom's sales by main customer category

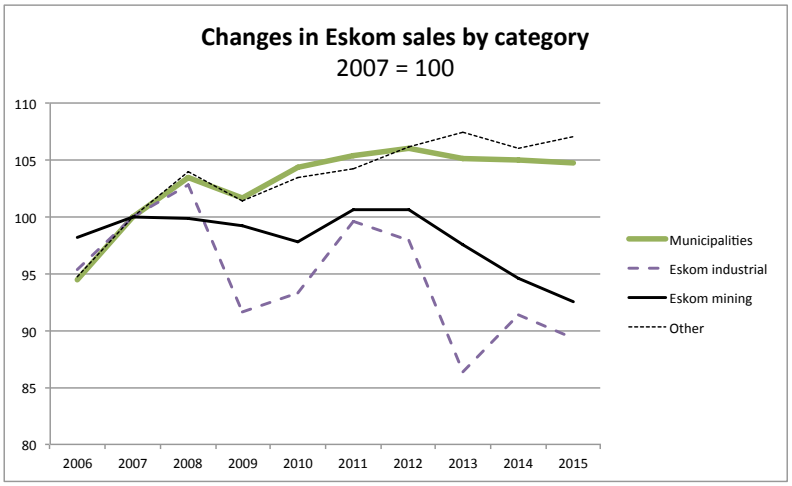


Figure 9: Changes in Eskom sales by customer category

Price changes

The very significant price changes charged by Eskom to their customers is show in Figures 10 and 11.

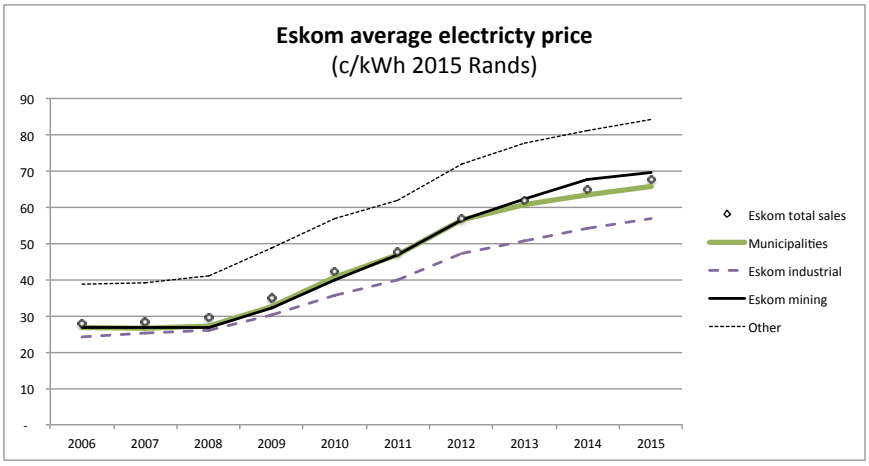


Figure 10: Changes in average electricity prices by customer (2015 Rands)

The relative changes between categories is show in Figure 11 below.

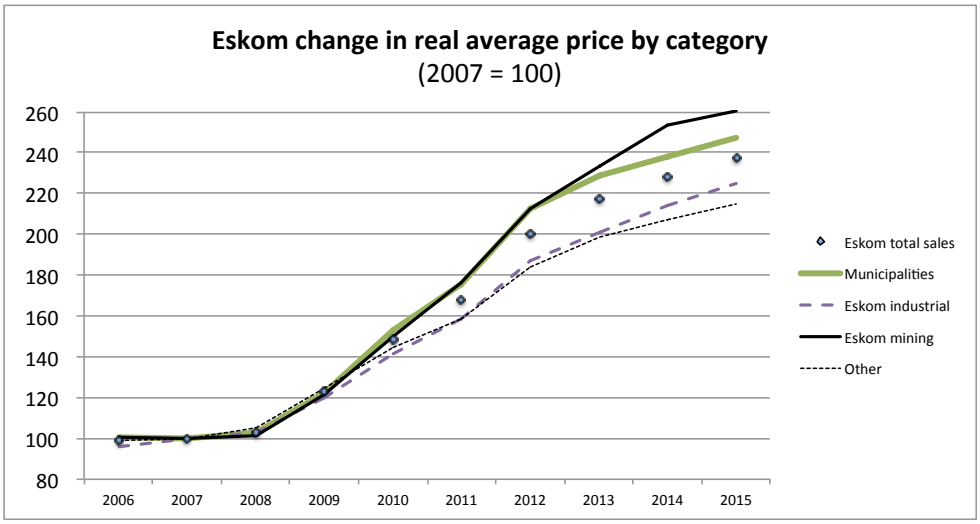


Figure 11: Change in Eskom's real average price of electricity by customer category

Average prices for mining customers have gone up by a factor of 2.6, municipalities by 2.5, and industrial customers by 2.25 over a period of 7 years.

The Energy Intensive User Group

One of the key pillars of South Africa's industrial policies has been to promote industrialisation based on mineral beneficiation and manufacturing sector output. So, any reduction in energy intensity is expected to be off-set by expected increases in industrial and mining activity including the expansion of platinum, manganese mines and chrome smelters in which, in terms of reserves, South Africa has comparative advantages. Smelters in South Africa have been less efficient and there is therefore scope for improving efficiency. It is hard to predict the price elasticity of electricity for members of the Energy Intensive User's Group (EIUG) as they are themselves price takers for their commodities. As we know, the commodity boom is over and there is an expectation that it will take some time for it to recover.

The Energy Intensive Users Group's (EIUG)[13] 31 members account for 44% of all electricity consumed in South Africa but, collectively, they also have an 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 the EIUG. 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[14]. Moreover, many of them form an important base upon which the economy rests. One needs to be aware that in making investment decisions security of supply can be more important than the cost of that supply. It is not sufficient to be price competitive in the resource sector, the country also needs to be able to ensure the security of supply.

2.4 Implications for future demand

There is a clear delinking of energy use and GDP growth in the USA[15] and in many other countries[16]. Planners are struggling to adjust. The case of both Australia and South Africa are illustrative. Both countries have important mining sectors. Australia's actual and forecast demand are shown in Figure 6 above[17].

South Africa's demand forecasts in recent years have been equally wrong (Figure 12).

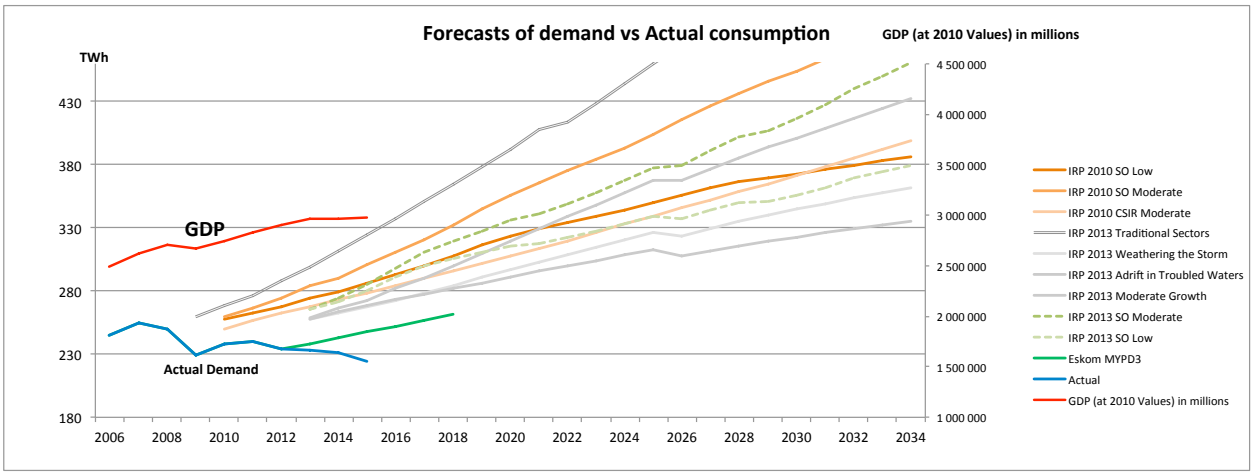


Figure 12: South Africa's forecast and actual demand versus GDP

3 Metropolitan electricity sales and average prices

[13] EIUG website at http://www.eiug.org.za/about/
[14] National Productivity Institute (NPI) : What does South Africa export? http://www.tradesecrets.co.za/pdf/sec3-1.pdf
[15] Spross, Jeff: How the U.S. Is Breaking the Link Between Energy Use and Economic Growth 2014 http://thinkprogress.org/climate/2014/01/29/3220341/energy-economic-growth/
[16] Plumer, Brad: Can we sever the link between energy and economic growth? http://www.washingtonpost.com/blogs/wonkblog/wp/2014/01/17/can-we-sever-the-link-between-energy-and-growth/
[17] Liebreich, Michael http://about.bnef.com/content/uploads/sites/4/2015/10/Liebreich_BNEF-Summit-London.pdf

3.1 The distribution business

The structure of the electricity distribution industry is shaped by its Apartheid heritage when municipalities distributed electricity in historically white areas and Eskom provided electricity in the historically black townships and some of the former so-called homelands. The share of customers and sales between municipalities and Eskom by customer category is shown below.

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

While Eskom and Municipalities both have a similar number of domestic customers (about 3.4 million each in total), domestic use accounts for a much higher share or total use for municipal electricity distributors (approximately one third for municipalities compared to much less than one tenth for Eskom).

While the residential sector represents only about 18% of total electricity consumption, residential consumption has peaks in both the early morning and the early part of the evening that affect the overall demand pattern of electricity demand in South Africa (Figure 13).[18] These peaks are more pronounced in winter. During the peak times, the residential sector makes up 35% of Eskom's total demand.[19]

[18] Eskom report to Parliament, July 2015 (p 25).

[19] The Electricity Governance Initiative of South Africa Smart Electricity Planning 2013: http://www.90x2030.org.za/oid%5Cdownloads%5CFinal%20smart%20electricity%20planning%20report%206%20May%202013.pdf Extracted from (p27)

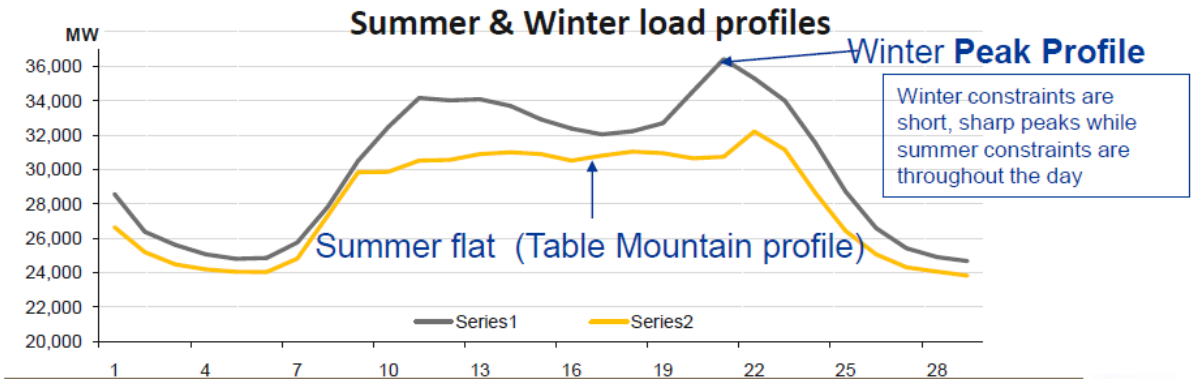


Figure 13: Summer and Winter demand profiles

There is a 4000 MW difference between daytime consumption and the evening peak in winter and this has important implications for the structure and cost of supply, as well as for the pricing of electricity.

3.2 The significance of the metros

The eight metros dominate the national economy, accounting for close to 60% of total economic activity (measured as Gross Value Add), with a population of 22 million people (42% of total population). These areas are also experiencing high rates of urbanisation.

Eskom sells 42% of its electricity to municipalities, and 80% of this goes to just 12 municipalities, including the eight metros (34% of Eskom's total). While Eskom's own distribution business is the single largest distributor, with revenues in 2013 of R20 billion, the 5 largest metros generated revenues of more than R10 billion each.

3.3 Metropolitan electricity sales

Sales of electricity in the Metropolitan municipalities have shown a sustained downward trend over the last 6 or 7 years and have, in some cases, dropped significantly (Figures 14 and 15).

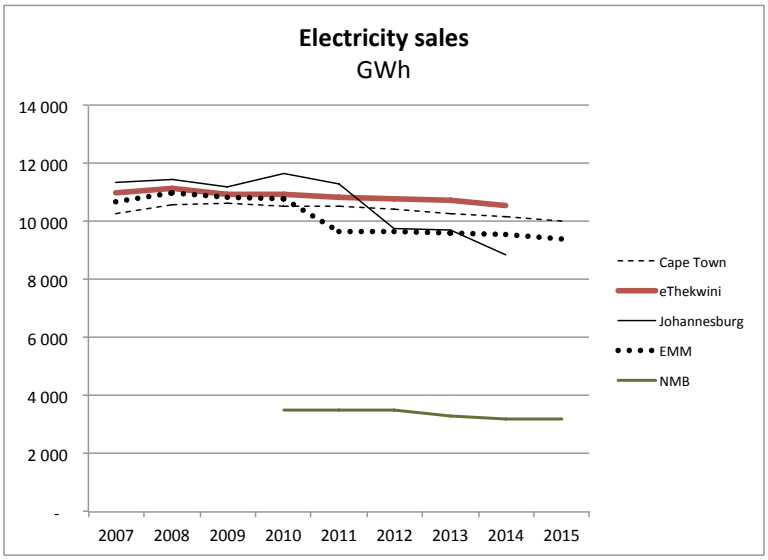


Figure 14: Metropolitan electricity sales

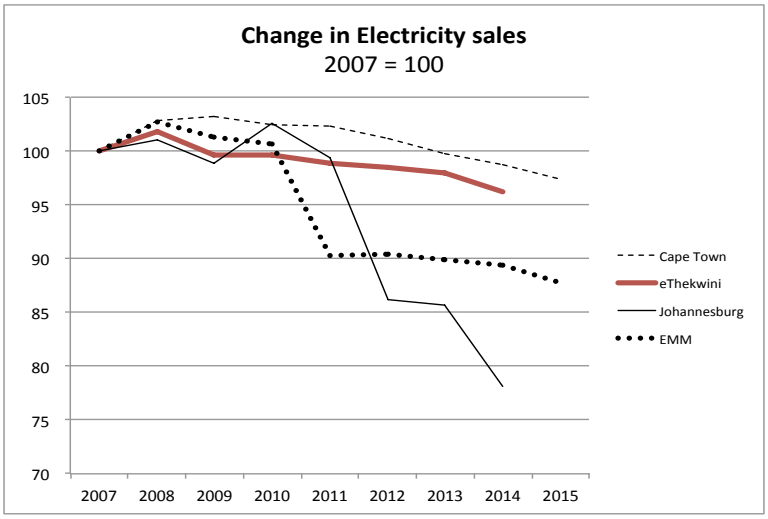


Figure 15: Change in metropolitan electricity sales

Whereas overall municipal purchases from Eskom are 5% up on 2007 (Figure 9), the sale of electricity is below 2007 levels for all the metropolitan municipalities, dramatically so in the case of both City Power (Johannesburg) and Ekurhuleni who are down by 22% and 13% respectively (Figure 15).

3.4 Real changes in average effective prices

Changes in average effective electricity tariffs for the metropolitan municipalities have been more dramatic than the Eskom price increases (Figures 16 and 17 below, compared to figures 14 and 15 above).

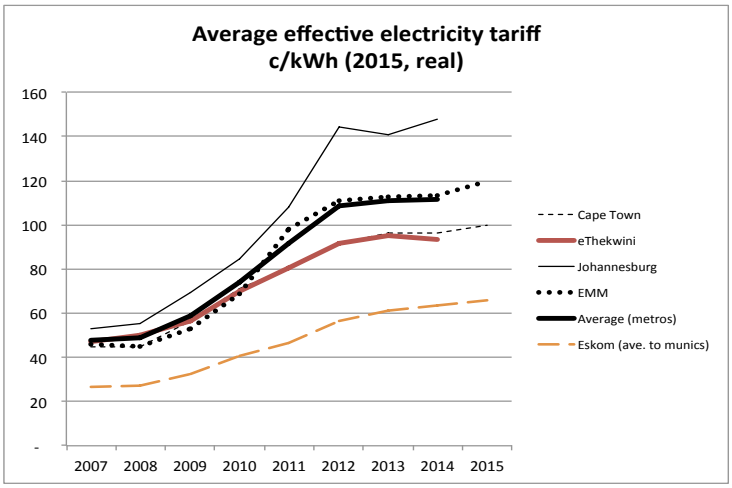


Figure 16: Average effective real price of electricity

While the average price of electricity sold to municipalities has gone up by 39 c/kWh in real teams (27 to 66 c/kWh in 2015), the average effective retail price in electricity in the metros has gone up by 63 c/kWh in real terms (48 to 111 c/kWh in 2014). There is also a growing divergence between retail electricity prices between metros. Whereas there was only an 8 c/kWh difference between metros in average effective retail prices in 2007 (in 2015 Rands), the gap had grown to 55 c/kWh in 2014 (in 2015 Rands).

The relative changes in price are show in Figure 17 below.

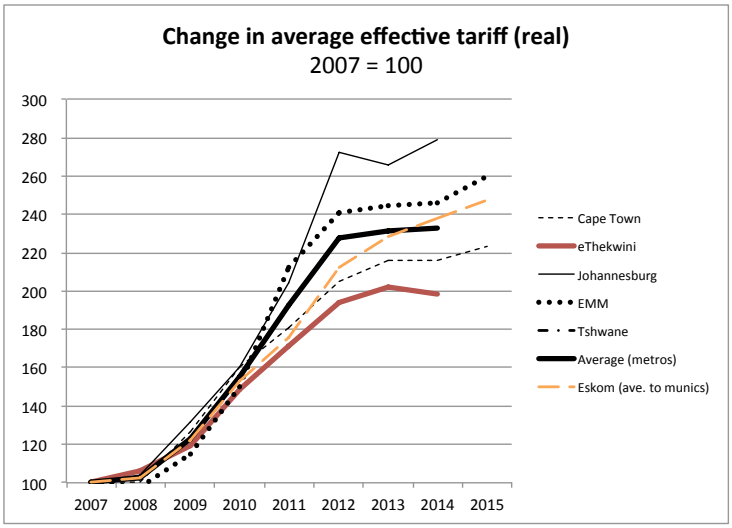


Figure 17: Change in average effective real tariff

The average effective retail price changed by a factor of 2.8 for City Power (Johannesburg) compared to a factor of 2 for eThekwini in the period 2007 to 2014.

Comment: This data shows that the metropolitan municipalities have been able to use the significant increases in the input costs (price of purchasing electricity from Eskom) as a basis to achieve equally significant (on average) real increases in the average effective retail price. It is expected that this would result in a financial bonanza for the distribution business, which is analysed in the following section.

3.5 Impact on municipal distribution business and municipal finances

The steep real electricity price increase has been, at face value, very good for the metro municipalities, with the exceptions of City Power (Johannesburg) and Nelson Mandela Bay.

The most reliable and comparable financial measure is to assess the total cost of the distribution business to the consumer. This can be done by subtracting the cost of bulk electricity purchases from the total revenue from the sale of electricity. This amount represents the total cost to the consumer imposed by the municipality (over and above the cost of buying electricity from Eskom). The amount includes any surplus generated by the municipality from the sale of electricity for use for other purposes. This is still a cost to the consumer of electricity.

Both of the two accounting line items (revenue from sale of electricity and cost of buying electricity from Eskom) should be consistent between municipalities, reliable and verifiable. (There is a great deal of 'accounting noise' in the detailed expenditure line items and these are difficult to verify and compare between municipalities.)

The cost to the consumer, of the municipal distribution business, is shown in Figure 18.

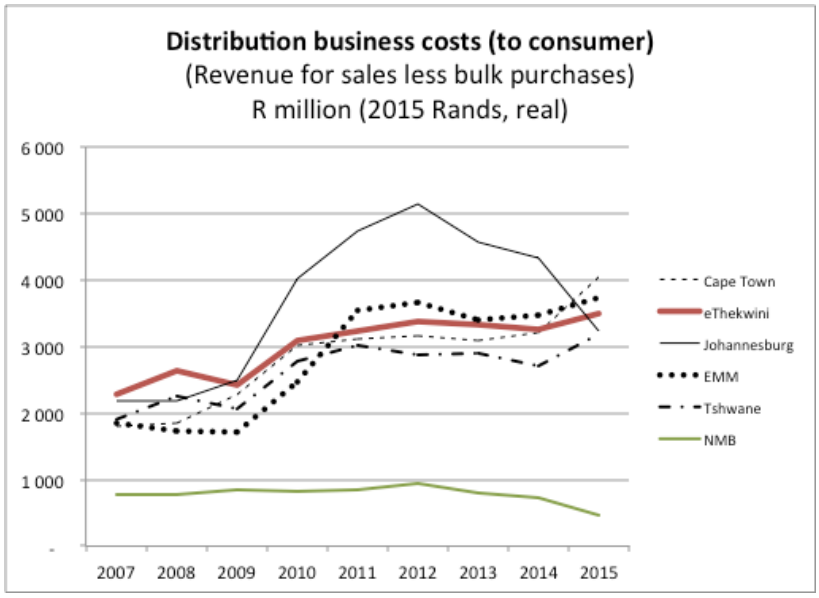


Figure 18: Cost of the municipal distribution business (to the consumer)

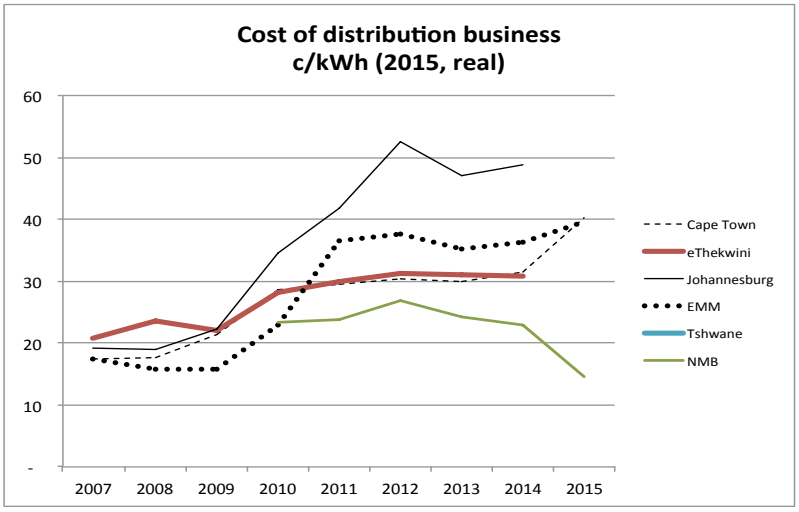


Figure 19: Cost to consumer of distribution business - c/kWh (2015)

The data is quite remarkable. In 2007, the distribution business cost between R1.8 billion and R2.3 billion for the five largest metros (and R770 million for NMB), in 2015 Rands, which represented between 17 to 21 c/kWh (2015 Rands). The five metros managed to increase their costs to the consumer by between R1 billion and R3 billion *per annum* (in 2015 Rands), to between 30 and 53 c/kWh for the distribution business. This is a combination of real costs and rent extraction. It is difficult, without further data, to determine which is which.

Electricity direct operating surpluses (defined in the report as direct operating revenue less direct operating expenditure) are shown in aggregate for the 8 metros in Figure 20. Surpluses grew in real terms from R2 billion in 2009 to R8 billion in 2013 (a 4-fold increase in *real* terms), but have fallen back somewhat in the subsequent two years, mainly as a result of the poor performance of City Power.

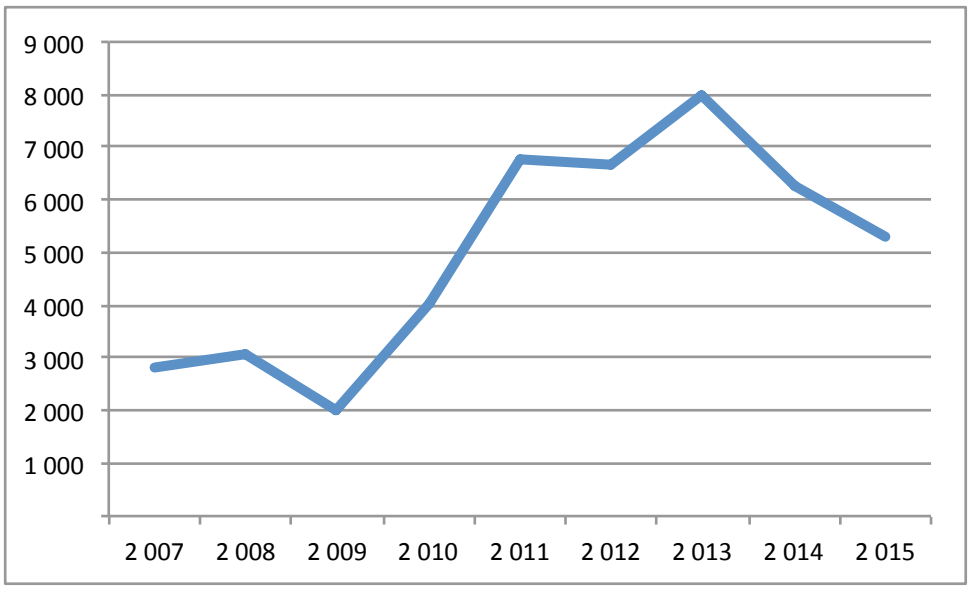


Figure 20: Aggregate direct operation surpluses for the 8 metros – R million (2015 Rands)

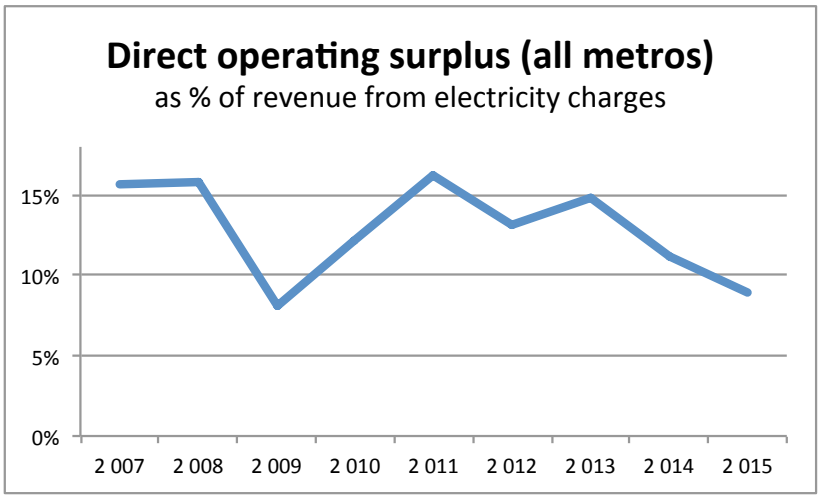


Figure 21: Direct operating surplus as percentage of electricity sales revenue

There are a number of factors that point to these surpluses not being sustainable. These will be examined in detail in Briefing Paper 3.

3.6 Changes in consumption patterns

Detailed information on consumption and demand patterns at the city level are hard to come by. Some information for City of Cape Town and eThekwini was obtained at the consumer category (or tariff category) level.

Cape Town, like many other municipalities, has a policy of actively encouraging the use of prepaid meters. Consequently, the number of domestic customers with credit meters decreased by nearly 29 000, a 20% reduction, and the number of domestic prepaid meters increased by 51 000, a 13% increase, over the period 2007 to 2015.

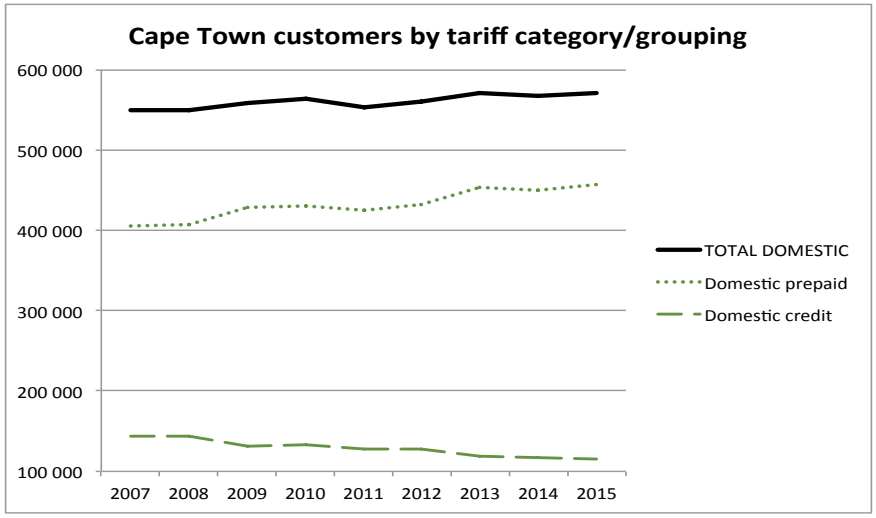


Figure 22: Number of domestic customers by category in City of Cape Town

The decline in average consumption per domestic customer is significant (Figure 23).

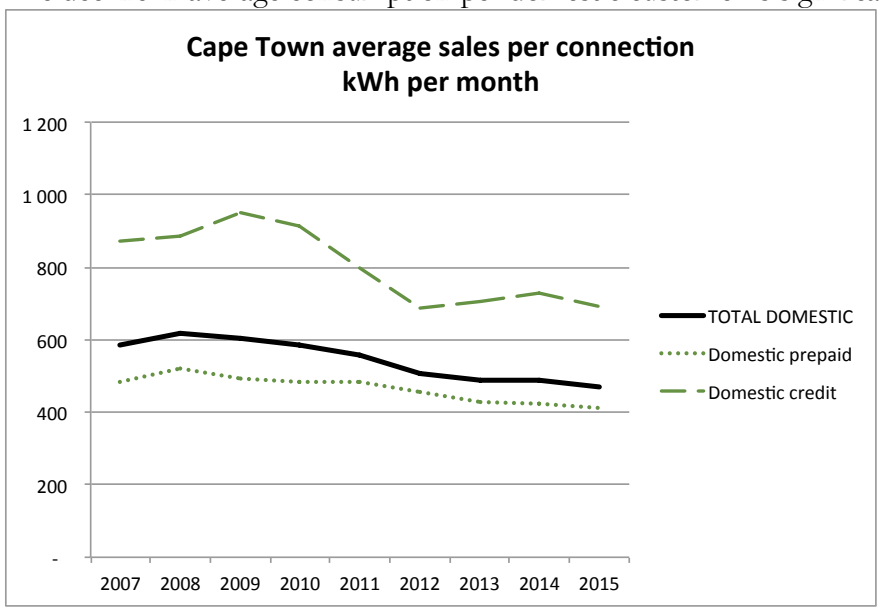


Figure 23: Average consumption per domestic connection (Cape Town)

Overall, consumption per connection declined from 617 kWh per month in 2008 to 469 in 2015, with the municipality losing sales of 148 kWh/month per customer, representing a 24% reduction in sales per customer. The reduction was more dramatic for credit meter customers, whose average consumption dropped from 953 kWh/month in 2009 to 694 kWh/month in 2015, with the municipality losing 259 kWh per month per customer, which was a 27% drop in revenues per customer. Average consumption for prepaid customers also reduced by 110 kWh/month per customer, from 522 to 412 kWh/month, a 21% reduction.

The changes in overall sales per customer category is shown in Figure 24.

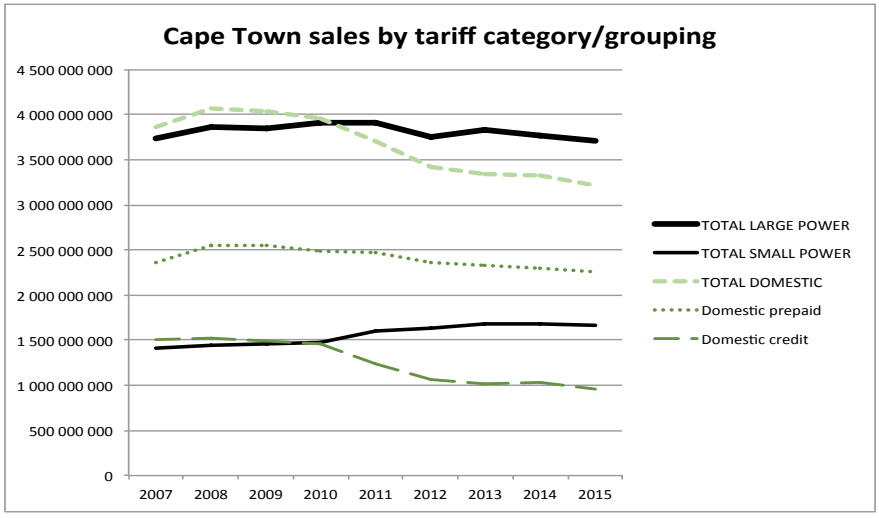


Figure 24: Sales per customer category (City of Cape Town) – kWh per annum

Whereas the trend in large power use follows the national trends for Eskom with a modest reduction (-4%), reduction in domestic sales was more dramatic, reducing by 853 GWh (21%) from 2008 to 2015. The major share of the reduction was in the credit meter category, with a 500 GWh per annum reduction (37% reduction).

eThekwini also experienced significant declines in the domestic sector (Figure 25) although these were not dramatic as in Cape Town.

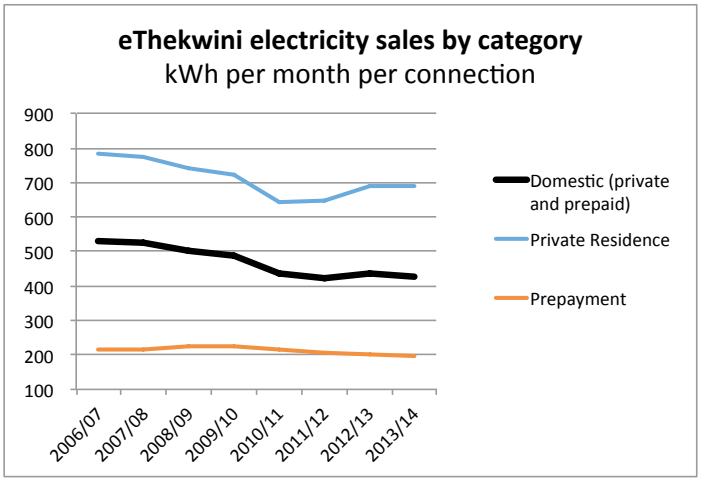


Figure 25: Average consumption per domestic connection (eThekwini)

3.7 Higher prices associated with increased business stress

In the case of City Power, the higher electricity prices have been associated with increased business stress (Figure 24). The dramatic increase in prices in City Power (Figure 16) was accompanied by a dramatic reduction in sales and an increase in commercial losses from 2012 onwards. This shows a distribution business in serious trouble (Figures 26 and 27).

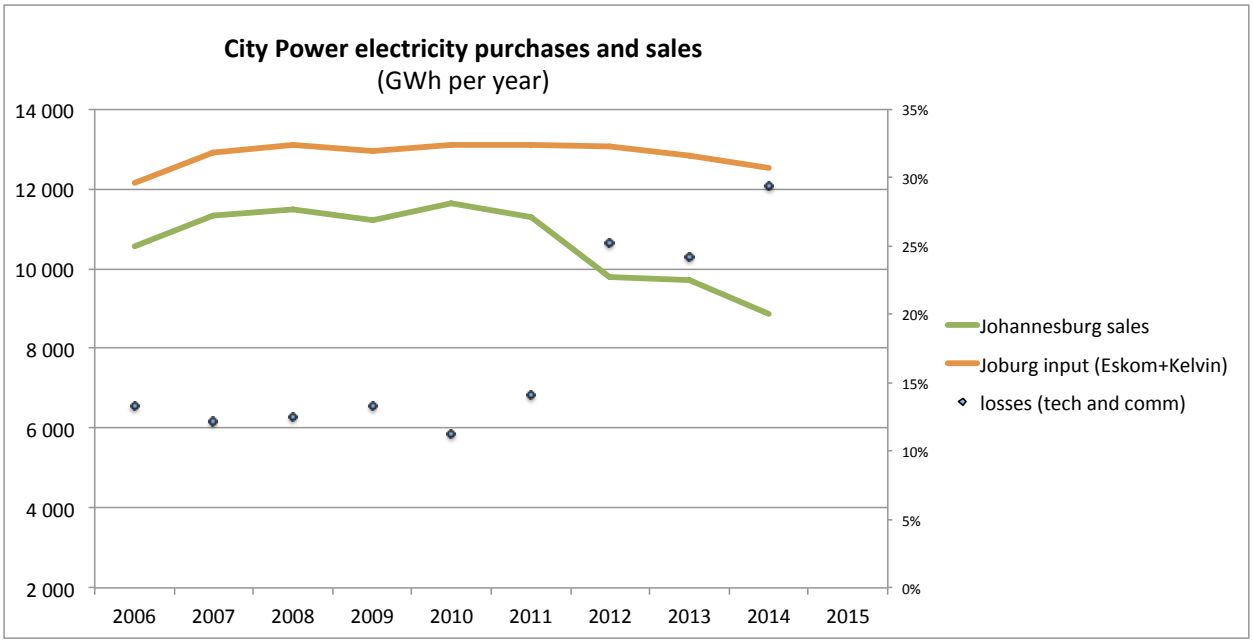


Figure 26: City Power - electricity purchases, sales and losses

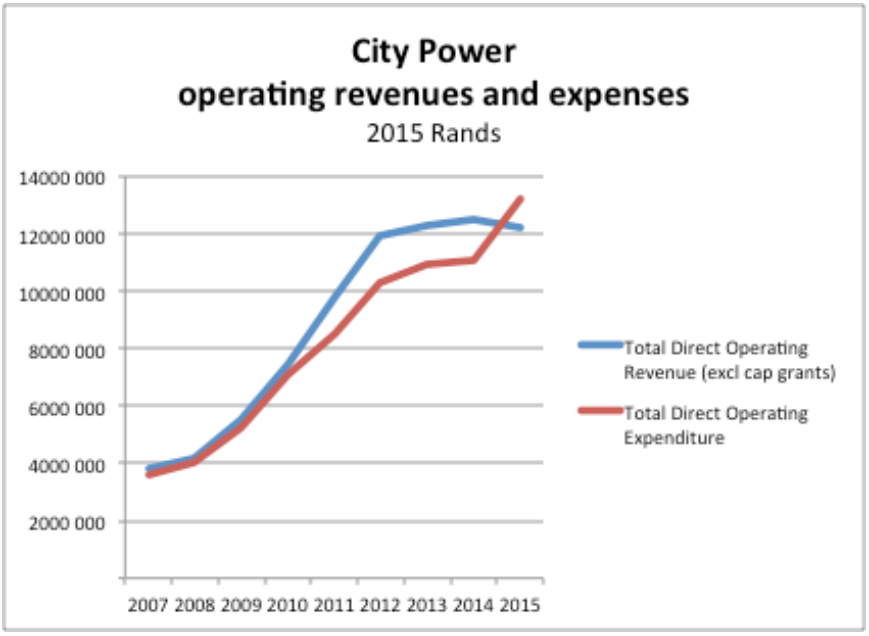
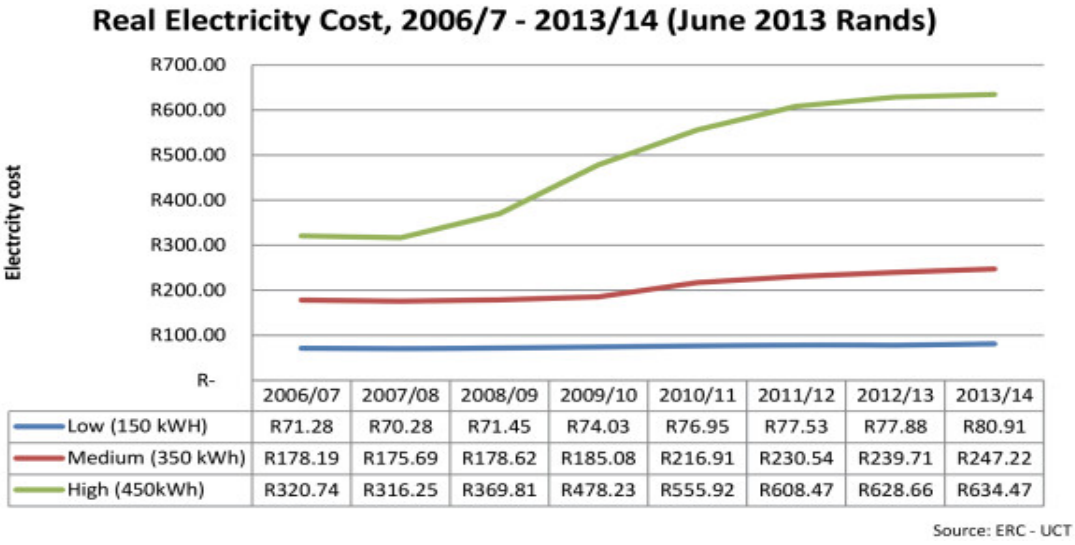


Figure 27: City Power operating revenue and expenses

3.8 Cross-subsidies under threat

Cheap electricity was woven into metro budgets and electricity was used as a source of funds to pay for other municipal costs and services outside of electricity. Initially, the steep price increases were good for the metros. The value of the surpluses increased significantly in real terms and the value of money available to municipalities from the electricity business more than doubled. However, there are signs that this model is now under threat. When electricity was cheaper, it was easier to fund low-income users via a basic free allocation and the inclining black tariffs. However, the high consumption users in the metros have experienced much higher increases in the price of electricity compared to customers with small usage and the cost of the cross-subsidy has increased substantially (see Figure 28).[20]



	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14
Low (150 kWH)	R71.28	R70.28	R71.45	R74.03	R76.95	R77.53	R77.88	R80.91
Medium (350 kWh)	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	R634.47

Figure 28: The real change in monthly electricity bills over time for different levels of use

The cross-subsidy only works when there are sufficient high consumption users in the system. If the type of customers that provide the cross-subsidy are no longer in part of the system or consume "too little" electricity to adequately fund the cross-subsidy and surpluses, then the cross-subsidy model breaks down. The decrease in the average consumption by domestic credit meter customers in Cape Town is therefore cause for concern.

4 Energy efficiency and demand effects

As electricity prices continue to increase in real terms, initiatives to improve energy efficiency will become increasingly important and an integral part of our economy, leading over time to a more energy-efficient economy overall. In broad terms, energy efficiency covers two things: (1) demand management that controls and limits the demand for power from the grid by limiting the maximum

[20] *http://www.erc.uct.ac.za/*extracted from *http://www.ee.co.za/article/south-africa-electricity-pricing-paralysing-poor.html*

demand or peak power demand, and (2) efficiency measures that reduce the amount of energy used by industrial machinery and systems, but that may also have the effect of reducing the power demand of a system for the same output.

Government has introduced several energy and power restriction programmes such as the Power Conservation Programme that included schemes such as the *energy conservation scheme* targeted at large users. Under the scheme users would have receive an annual energy allocation, based on historical consumption patterns. Exceeding this consumption level would attract stiff penalties but consumption of energy less than the allocation would generate credits which may be traded with other users.

The scheme, along with other schemes addressing energy efficiency such as solar hot water geysers and energy efficient light bulb replacements, have seen partial implementation. Other schemes, such as National Treasury's sponsored Section 12L tax incentive scheme, have not been taken up in any significant way. Section 12L offers a tax reduction incentive to companies that achieve energy reduction, based on the number of kWh saved using energy efficiency practices within a financial year.

The steep increases in electricity tariffs have forced users to investigate ways of reducing electricity consumption and this has seen the emergence of specialist firms aimed at reducing electricity costs, independent of any government or utility programme.

Changes in energy efficiency are a key factor affecting demand forecasts. The IRP 2013 envisaged or proposed a "centrally mandated entity to pursue energy efficiency in order to realise the expected electricity intensity" set out in the plan. Increasing efficiency does not always have the desired effect of decreasing consumption, due the rebound effect, and in some cases has actually resulted in an increase in consumption. Efficiency gains means that a given unit of output uses less energy and so costs less. People then respond by buying more and therefore, in turn, consume more energy.

It ought to be pointed out that energy savings initiatives can have unforeseen consequences. For example, efforts to reduce peak demand are likely to be accompanied by a reduction in total energy consumed and hence electricity sold. In a constrained generation environment, this is necessary but it can also lead, in a less constrained environment, to underutilised or stranded assets resulting in increased costs of generation for consumers to recover high fixed costs of existing assets. Where generating capacity is via technologies where fuel costs are a significant part of the total generating cost, this is less of a problem but it becomes an important issue for technologies with high capital costs and low fuel costs, such as renewables, nuclear and coal.

Where future demand is highly uncertain, there is greater value in adopting a flexible and incremental approach to increasing supply, which is the topic of the accompanying briefing paper (Briefing Paper 2).