Electricity Intensities of the OECD and South Africa: A Comparison

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Abstract

Improving a country's electricity efficiency is considered one of the important ways to reduce its greenhouse gas emissions and to meet its commitments concerning climate change mitigation. In this paper, we conduct a comparative analysis between South Africa and OECD members' total and sectoral electricity intensities. This is done to establish a sense of South Africa's relative performance in this regard, to ascertain the possible scope for improvement and, if such scope exists, to determine in which of the industrial sectors.

1 Introduction

Improving the electricity efficiency of a country is an important step towards decreasing greenhouse gas emissions originating from fossil fuelbased electricity generation and consumption. Studying the intensity of electricity use (the quantitative measure of electricity efficiency) is important from an energy policy-making perspective since it is a measure that combines electricity consumption with economic output (Liddle 2009). It is equally imperative for the energy authorities to understand how electricity demand will change under conditions of structural change in the economy (Markandya, Pedroso-Galinato & Streimikiene 2006).

A large number of studies have been conducted to identify the dynamics, determinants and characteristics of electricity intensity in developed and developing economies (Zhao, Ma & Hong 2010; Mendiluce, Pérez-Arriaga & Ocaña 2010; Andrade Silva & Guerra 2009; Tiwari 2000). These studies indicate that electricity intensity first increases as a consequence of rising economic growth and development, but subsequently falls as a result of a shift to a services-based economic structure (Medlock III & Soligo 2001). This trend can be compared to the famous environmental Kuznets curve (Gergel *et al.* 2004; Baker 2003), but applied to electricity intensity. A general policy objective is to 'tunnel through' the curve and hence the need to compare one's own position relative to the objective. This is to be followed by policies to achieve such tunnelling.

Here we seek to answer the question whether South Africa follows international trends regarding electricity intensity. We do this by conducting a comparison between South Africa's national and sectoral electricity intensities and the equivalents thereof for the member countries of Organisation for Economic Co-operation and Development (OECD).

This exercise will indicate whether there is any scope for improvement in South Africa, on both a national and a disaggregated, sectoral level. This layered approach has at least two benefits. Firstly, the economic sectors of a country have dissimilar economic and energy characteristics and it is therefore important to understand these differences (Inglesi & Blignaut 2010). Secondly, not all economies produce the same basket of goods in the same proportion. Hence, there is a need to

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examine the country's electricityintensity profiles on a sectoral level to be able to make comparisons as well as to use the example of successful case studies (Weber 2009).

The next section of this paper introduces the meaning of electricity efficiency and intensity and describes current levels of electricity efficiency in South Africa. This is followed by the description of the data used and an international electricityintensity comparison on both a national and a disaggregated level. Finally, we conclude with a discussion of the findings.

2 Background

2.1 *Electricity efficiency and intensity*

The definition of energy (*sic.* electricity) efficiency seems to be complex and depends largely on the context within which the term is being used. An economist, a politician and a sociologist may have different opinions in defining the energy efficiency. When the Energy Information Administration (EIA) (1999) asked participants in workshops to define 'energy efficiency', the answers varied, ranging from a service to a mechanistic perspective. The World Energy Council (2008:9), however, provides the following guiding definition:

Energy efficiency improvements refer to a reduction in the energy used for a given service (heating, lighting, etc.) or level of activity. The reduction in the energy consumption is usually associated with technological changes, but not always since it can also result from better organisation and management or improved economic conditions in the sector ('non-technical factors').

The importance of electricity efficiency cannot be overstated. Policies to this effect have been accepted globally, as it is seen as one of the most economical ways towards the reduction or slowing down of the increasing energy demand as well as its cost and environmental effects. Repetto and Austin (1997) further demonstrate the significance of electricity efficiency improvement for positive results not only in the energy sector and the environment but also in the economy as a whole. In order to measure electricity efficiency, the EIA (1999) proposes two methods: the so-called market-basket approach and the comprehensive approach. The first approach refers to the estimation of the energy consumption for a set of electricity services based on their share in an index computed as the Index of Industrial Production. The second approach refers to the estimation of broader indicators and is an assessment of the changes that are not connected with electricity efficiency directly.

In contrast to the above, Mukherjee (2008) proposes a measurement approach from a production-theoretic perspective. His measurement models are founded on the objectives of energy management and cost minimisation as well as the capacity output of the economy. The conceptual difficulty in the analysis of energy efficiency, according to Bosseboeuf *et al.* (1997), is that the evaluation and progress thereof is made after the implementation of energy efficiency policies. There is therefore a temporal, and even spatial, decoupling of the policy and its implementation, and that which is measured and observed later. This also complicates comparison among countries. Bosseboeuf *et al.* (1997) therefore make an effort to focus on the convergence of energyefficiency indicators globally by classifying the indicators used in the literature as follows:

- Macro-indicators versus micro-indicators: Macro-indicators are linked with the economy in its entirety or its main sectors. From a micro-perspective, the indicators are concerned with the level of the main end-users such as companies or households.
- Ratios versus quantities: Ratios such as energy use per GDP or quantities such as variations in the demand for energy are both used in the literature.
- Descriptive versus explanatory indicators: The descriptive indicators explain the energy-efficiency situation and progress; conversely, the explanatory indicators describe the factors responsible for the evolution.

Following from the above, energy efficiency is therefore often measured in terms of the change in energy intensity in an effort to describe more accurately its quantitative nature. Energy intensity, in turn, is defined as the ratio of energy consumption to a unit of measurement (e.g. floor space, households, number of workers, GDP per capita) (EIA 1999). In response to Freeman *et al.* (1997), who critically assess the commonly used energy intensity indicators for analysis particularly of the industrial sector, Andrade-Silva and Guerra (2009) argue that there are six possible ways of calculating energy intensity. The existence of different measures is based on the definition of energy intensity as energy consumption (numerator) divided by the production or economic activity (denominator) of the economy. Energy consumption can be measured according to its thermal equivalence (in joule), or in economic terms (price). Accordingly, the economic activity of a country can be measured as the value added or value of delivered goods (production value minus the value of inventories) or production value (Andrade-Silva & Guerra 2009). Therefore, the proposed measures in accordance with Bor (2008) are:

1. Thermal equivalence/added value
2. Thermal equivalence/value of delivered goods
3. Thermal equivalence/production value
4. Economic measure/added value
5. Economic measure/value of delivered goods
6. Economic measure/production value

Andrade-Silva and Guerra (2009:2590) also state:

...even when the physical measures can be used at the desired levels (disaggregated and aggregated), the economic nature measures emerge more strongly within the upper aggregation levels. This feature leans on favouring the establishment of a standard consumption measure per national production unit such as the joule (J) per US$ of GDP.

Based on this, we have decided to standardise the definition of electricity intensity for our analysis as follows:

$$\text{Electricity intensity} = \frac{\textit{Electricity consumption}}{\textit{output}} \tag{1}$$

This is a common definition also used by Mukherjee (2008), Choi and Ang (2003), Sun and Ang (2000).

2.2 *Electricity intensity: The South African case*

Following the political transition in 1994, the new democratically elected South African government considered energy issues to be of great importance for the economic development of the country. In the first White Paper on Energy Policy (DME 1998), energy efficiency was mentioned among the *cross-cutting issues.* More specifically for the industrial and commercial sectors, the government committed itself to the following:

- Promotion of energy-efficiency awareness
- Encouragement of the use of energy-efficiency practices
- Establishment of energy-efficiency standards for commercial buildings
- Monitoring the progress

While progress on these was slow due to pressing socio-economic and development considerations the South African Department of Minerals and Energy released its first Energy Efficiency Strategy in 2005 (DME 2005). The purpose of the Strategy was to provide a policy framework toward affordable energy for all and diminish the negative consequences of the extensive energy use in the country. Its national target for electricity efficiency was to improve efficiency by 12% by 2015. It is conceded in the document that this target can be questioned and challenged, but the target was set in light of the fact that the country was the seventh biggest emitter of greenhouse gases on a per capita basis (Sebitosi 2008) the national electricity intensity was almost twice the average of the OECD countries, and that efficiency improvements are a necessity. It however has had limited impact to date and is currently being revised. This is clearly illustrated in Figure 1.

Figure 1 shows the economy-wide electricity intensity and its growth for the period 1994–2006. Total electricity intensity showed a sharp upward trend until 2004. This trend was broken in 2005 when intensity declined by 8.4% mainly as a result of a small decline of electricity consumption by 5.4% (South Africa 2004–2006). By and large, however, the trend is strongly upward. However, if the residential, commercial and non-classified electricity consumption is excluded from the calculation, a lower intensity is observed, with the growth not being as steep as before.See Figure 1 below.

Large inter-sectoral variations exist, however, as can be seen in Table 1. In the first column, the sectors are ranked based on their electricity-intensity levels from the more intensive to the more efficient in 2006. This is contrasted with the sector's contribution or share to output and its relative ranking. (See table 2 below).

The three most electricity-intensive sectors in 2006 were 'basic metals' (which includes 'iron and steel' and 'non-ferrous metals'), 'mining and quarrying' and 'non-metallic minerals', while 'agriculture and forestry' was fourth in the ranking. The 'construction', 'transport equipment', 'machinery and equipment' and 'food and tobacco' sectors were the most electricity-efficient sectors of the economy.

Various anomalies, however, exist when comparing the relative size of the sector to its electricity efficiency. The largest sector, 'chemical and petrochemical', has the sixth highest intensity, whereas 'basic metals', the most electricity-intense sector, is only seventh in size. 'Mining and quarrying', on the other hand, is second both in terms of size and intensity. Therefore, there clearly are inter-sectoral differences that can and should be ascribed? to sectoral characteristics and that have to be taken into account when considering any electricity-efficiency plan. Given this general information, how does South Africa compare, both on a national as well as sectoral level, with the OECD countries? We turn to this next.

3 Research method and data

Several studies concerned with inter-country comparison of electricity intensities have been conducted (Schipper *et al.* 1997; ECE 1996; IEA 1994; Bosseboeuf *et al.* 1997). These studies have, however, encountered certain difficulties, namely:

1. the heterogeneous definition of variables,
2. the ratios to calculate electricity intensity differ from country to country, and
3. the diverse interpretations of the ratios calculated.

We tried to avoid these problems by estimating the electricity intensities for each country using the same definition (i.e. electricity consumption/gross domestic product (GDP)) and the same dataset.

The group of OECD countries is selected for four distinct reasons: a) among the OECD countries, there is a group (admittedly a small minority) of developing countries (according to IMF classification); b) South Africa should be compared with international 'best practice' in order to have the opportunity to learn and improve; c) the country's major trading partners as well as trade competitors are included in the OECD panel, hence South Africa needs to be compared against their industrialisation levels and their sophisticated energy sectors, and d) South Africa has mixed characteristics resembling those of both developing and developed countries alike. This is also recognized by the U.S. Department of State (2010) which argues that the country has a two-tiered economy: '..one rivalling other developed countries and the other with only the most basic infrastructure'. The main aim however is not to be good among the developing countries, but to be good overall. Being compared with developed countries in energy matters is therefore appropriate given that South Africa's energy and industry sectors resemble those of the OECD.

Moreover, South Africa is one of the many non-member economies with which the OECD has working relationships in addition to its member countries. The OECD Council at Ministerial level adopted a resolution in 2007 to strengthen the co-operation with South Africa through a programme of enhanced engagement. While enhanced engagement is distinct from accession to the OECD, it has the potential in the future to lead to membership. This makes South Africa a unique case of a developing economy that is not far from being considered a developed one.

Also, this group's data and definitions are consolidated under one umbrella organisation. This limits the risk of data inconsistencies.

The data for electricity consumption (total and sectoral) were obtained from the OECD's *Energy balances for OECD countries* (OECD 2009a) and for South Africa from *Energy balances for non-OECD countries* (OECD 2009b). The national GDP data (in current prices), the consumer price index (base year 2000) and the Power Purchasing Parity (PPP) adjusted real exchange rate values for all the countries were derived from the *World Economic Outlook April 2010* of the International Monetary Fund (IMF). The disaggregated data for output for OECD members were derived from the STAN Database for Structural Analysis of OECD.

4 Comparative analysis

4.1 *Comparing South Africa to OECD averages*

In 1980 South Africa's electricity intensity was substantially lower than that of OECD countries (see Figure 2). This is to be expected given the high level of welfare enjoyed by a minority of people based on an industrial sector that services only a few, with limited focus on exports at that point in time.See Figure 2.

The country's electricity use rose sharply since the early 1990s with the abolishment of sanctions, the internationalisation of the markets to international trade, and the more stable economic and political situation after the first democratic elections in 1994. Since the 1990s, however, the electricity intensity in South Africa kept rising at an alarming rate and currently far exceeds that of the OECD countries, with no sign of any change. While the OECD countries kept their average electricity intensity relatively constant, in the range of 0.34-0.35 GWh/$ million (PPP adj.) over the period 1990 to 2007, South Africa's electricity intensity almost doubled from 0.329 in 1990 to 0.657 in 2000 and increased even further to 0.694 (2006) and 0.713 (2007).

In the same figure, we extracted the developing economies of the OECD group (Hungary, Poland, Mexico and Turkey) and weight their average against South Africa for a better view of the country's position in comparison with emerging economies. South Africa's electricity efficiency was significantly higher than that of the average of the OECD developing economies, through the years. Although they also showed a substantial increase from 1990 to 2000 (536.5%), the starting point of 1990 was significantly lower than that of South Africa.

4.2 *South Africa and OECD member states: An economy-wide comparison*

Following this analysis, we disaggregate the OECD average to examine how South Africa compares with the OECD countries individually over the study period. The economy-wide percentage change of electricity intensity for the period 1990 to 2007 as well as the electricity intensity of 2007 for the OECD members and South Africa is presented in Figure 3. It should be noted that Poland, Hungary, Mexico and Turkey were outliers (hence, excluded from the figure) with changes in electricity intensity for the examined period of 382%, 401%, 493% and more than 1,000% (from 0.0006 in 1990 to 0.723 in 2007) respectively. Also, the Czech and Slovak Republics were excluded due to lack of data points for 1990. For a comparison of only the OECD developing economies see Figure 3b.

From Figure 3a it is clear that South Africa has shown an increase in electricity intensity of 117% over the study period. This is in sharp contrast to the average of the OECD members (excluding Poland, Hungary, Mexico Turkey, Slovakia and Czech Republic), which was only 10.09%. Only the Mediterranean countries (Spain, Greece, Portugal and Italy) as well as Korea and Iceland experienced an increase in their electricity intensities. Both their output and electricity consumption increased substantially, but the increase in consumption was higher than the growth in output. All the other countries' intensity levels declined over the study period, indicating remarkable improvements in electricity efficiency.

A further remarkable trend can be observed from Figure 3a There is a statistically significant negative, or inverse, relationship between the level of electricity intensity in 1990 and its growth over the study period. (See the Appendix for statistical results on the significance of the relationship.) This implies that, generally speaking, the higher the electricity intensity of a country in 1990, the more negative its growth was from 1990 to 2007 Countries such as Norway, Canada and Sweden, who were the most electricity intensive in 1990, were the ones that managed to decrease their intensity of electricity usage meaningfully, namely by 32%, 24% and 30% respectively.

On the contrary, Italy, Portugal and Greece with the lowest intensities in 1990, raised them by 33%, 88% and 138% respectively. South Africa does not fit this trend well. It had average electricity intensity in 1990 and yet it had the secondhighest increase (after Greece) of its intensity (117%).

Figure 3b presents a rather dismal picture for South Africa's electricity intensity in comparison with the developing countries of the OECD. Its growth for the period 2000 to 2007 was significantly less than Turkey's (255%) and less than Hungary's and Mexico's (13% and 17%). However, Poland managed to reduce its electricity intensity by 16% for the same period. It is interesting to see that South Africa and Turkey had similar intensities in 2007 (0.71 and 0.72), but that Turkey increased its sharply (255%) to 'catch up' with the South African level.

The country, therefore, does not follow international trends in this regard. What are the implications thereof on the country's overall relative position in terms of improvements in efficiency? We turn to this next.

To determine the change in the country's relative position we calculated the weighted growth rate of each of the countries in order to take into account both the changes and the final electricity intensity levels of the respective countries over the study period. We did this using equation (2) and normalising the result so that South Africa's growth equals 1. The results are presented in Figure 4.

$$\text{Weighted growth} = \frac{\text{electricity intensity}_{i,2007}}{\text{electricity intensity}_{SA,2007}} \text{ x intensity}''^{\text{real}}\text{g row th}_i \qquad (2)$$

From Figure 4 it can be seen that the only countries that fared worse than South Africa was Iceland and the developing OECD countries (Hungary, Poland, Mexico and Turkey with the latest being excluded from the graph as an outlier). All the other OECD members' (excluding the outliers as discussed for Figure 3a) weighted growth was either positive, but lower than the South African (six out of twenty-eight countries), or negative for the majority of the countries (seventeen out of twenty-eight).

The results from Figures 3 and 4 clearly indicate that South Africa's electricity intensity was not only higher than the majority of OECD countries in absolute terms (for 2007), but also showed excessive increase for the period 1990 to 2007 compared to the rest of the countries in the studied group The next question that arises is whether this trend and big difference compared to OECD countries holds for all the economic sectors of South Africa.

4.3 *South Africa and OECD member states: A sectoral comparison*

To investigate the differences among industrial sectors, Table 2 presents the sectoral electricity intensities for South Africa and OECD average in 2006 and their differences. The last column presents a weighted difference relative to the output shares of each sector and was calculated as follows:

$$\text{Weighted difference} = \frac{\text{sector's output share}_{OECDave}}{\text{sector's output share}_{SA}} \text{ x intensity difference \%} \tag{3}$$

The majority of the South African sectors are more electricity intensive than the OECD average. Only four out of thirteen were more efficient than OECD countries and they are 'construction', 'food and tobacco', 'machinery' and 'transport equipment'. On average, these four sectors were 150.5% more efficient than the OECD average. In stark contrast, the nine sectors which were less efficient than the OECD average fared, on average, 980.7% worse than the OECD grouping – a 6.5-fold difference. See Table 2.

'Basic metals' have the highest electricity intensity in both South Africa and the OECD countries. Comparatively speaking, however, South Africa's 'basic metals' sector was significantly more intensive (886%) than the OECD average, and 644% after adjusting for relative size (or contribution to output). The most efficient sector was 'construction' mainly due its high labour intensity and lower use of electricity-demanding technologies. On top of that the South African 'construction' sector was significantly more efficient than the OECD average. One can only speculate why the 'construction' sector is more efficient compared to the rest. A number of inter-linked factors come to mind; one of them being the labour intensity of the sector. While all South African sectors are more labour intensive compared to OECD countries, 'construction' is 600% more labour intensive than its OECD equivalents, compared with a differential of 100-300% for the rest of the South African sectors The weighted difference shows that the South African intensity was 156% lower than the OECD average.

While most electricity intensive South African sectors, i.e. 'basic metals' and 'non-metallic minerals', present high differences compared with the OECD average (644% and 2517%), 'mining and quarrying' does not. Here the South African electricity intensity was 2305% higher than the OECD average; however, considering that the South African mining sector is a dominant one for the economy (14.6% of total output) and a very small proportion of the OECD production (3%), the weighted difference is considerably lower (482%), albeit still very meaningful.

5 Discussion

It is evident from our analysis that South Africa's electricity intensity was at a level much higher than that of OECD countries and that the gap between South Africa and OECD countries is increasing at an alarming rate. This differential points to the scope for improvement. At the same time, if South Africa is to remain competitive relative to its OECD counterparts under more stringent trade regimes, including carbon and climate change considerations, such improvement is essential (Blignaut *et al.* 2005, Van Heerden *et al.* 2005).

South Africa has experienced an increase in electricity intensity of 117% over the study period – more than doubling its electricity intensity from 0.32 to 0.71 GWh/millions $ (PPP). This is in sharp contrast to the average of the OECD members (except Poland, Hungary, Mexico, Turkey, Slovakia and Czech Republic), which was only 10.09%. After adjusting this growth in electricity intensity for different starting levels in 1990, it was evident that South Africa's performance was significantly worse than that of the OECD member states.

The economy-wide results show that South Africa is perhaps slowly reaching the level of development that would place the country on the top of the environmental Kuznets curve, with a positive but declining growth rate of efficiency. Moreover, the main objective of countries is to tunnel through the curve. Hence, it is important to know the aim and compare with countries with improved conditions, i.e. countries on the 'other (or downhill) side' of the curve.

Furthermore, reaching a certain development level or income growth is a necessary but not sufficient condition to improve the country's electricity efficiency levels. As Yandle and Vijaraghavan (2002) argue, economic prosperity does not automatically result in an improvement of efficiency levels and of the environment. Instead, these depend on appropriate policies and institutions. Hence, high-income economies do not necessarily have the appropriate policies; they are placed on their way down the Kuznets curve, in contrast to South Africa.

In order to identify the possible differences between the economic sectors of OECD member countries and those of South Africa, we examined the differences between their electricity intensity. Nine out of thirteen South African sectors are more electricity intensive than their OECD equivalents, and by a considerable margin. 'Basic metals', 'mining and quarrying' and 'non-metallic minerals' were the most electricity-intensive sectors; these were also the sectors where South Africa fared worst relative to OECD countries. The analysis showed, also, that the electricity efficiency behaviours of the various economic sectors were radically different. This necessitates a sector-specific policy approach to improve efficiency levels.

The next step is to identify possible reasons why South Africa moved towards greater electricity intensity compared to OECD members (both developed and developing). In this paper, we only discuss possible ways to explain this phenomenon.

One possible reason might be the low and stable prices of electricity in South Africa for the studied period. South African producers were not concerned about electricity efficiency given the relatively low price levels of electricity over the period. Figure 5 plots average electricity prices in comparison with the total electricity intensity in South Africa for the period from 1993 to 2005. See Figure 5.

This figure illustrates the existence of low and stable electricity prices in the period 1993 to 2002; price restructures are responsible for the structural break in the years 2002 and 2003, when prices more than doubled. In contrast, electricity intensity has been increasing since 1993, but at a decreasing rate, especially after the rises of the electricity prices.

The period 2005-2006 was characterised by a notable decrease of 8.4% in electricity intensity; in the same period prices increased by only 3.5%. There are two possible reasons for this change. Firstly, electricity prices increased by 182% in 2003 and it was impossible for electricity consumers to change their behaviour in the short run. Hence, the drop in electricity intensity (caused by a decrease in electricity consumption) might be considered the lagged impact of the high increase in electricity prices.

Also, the South African Department of Minerals and Energy released its first Energy Efficiency Strategy in 2005 (DME 2005). The purpose of the strategy was to provide a policy framework toward affordable energy for all and to diminish the negative consequences of extensive energy use in the country. Its national target was to improve efficiency by 12% by 2015. From a policy perspective, this document might also be the cause of the decrease in 2005/06. However, it has not had the desired effects to date and is currently being revised.

However, due to lack of data for the subsequent years, it is not yet possible to determine whether this is a permanent change in overall electricity intensity or if it was only a temporary drop.

6 Conclusion

The study of the efficiency of electricity use recently has become an important topic owing to the linkage of high electricity consumption with the negative consequences of greenhouse gas emissions. The energy policy-makers should take into account the electricity efficiency of the economy, because it is a measure that combines electricity consumption with economic output (Liddle 2009).

South Africa's electricity intensity more than doubled in the period from 1990 to 2007 (from 0.329 to 0.713) and the country's weighted growth was higher than the majority of the OECD members by a considerable margin. In addition, nine out of thirteen South African sectors are more intensive than their OECD counterparts.

To conclude, it became apparent that for South Africa to reduce its electricity intensity, it has to either reduce its electricity usage, or increase its production while keeping its electricity consumption stable. This can be done through concerted industrial policy to enhance the use and development of electricity-efficient appliances. Electricity-price reform, such as what has been recently announced, whereby the electricity price level is increased significantly in conjunction with block-rate tariffs that charges a higher rate to those that consume more, is also vital. These results also point to the need for a nation-wide demand-side management programme to improve efficiencies.

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Appendix: Summary of statistic tests pertaining to the trend in electricity intensity and its growth rate

Test	Chi-square	Bartlett chi-square
Statistic	3.63	3.41
p-value	0.057	0.065
Conclusion	Statistically significant	Statistically significant

Table 1: Electricity intensity and output share per sector in South Africa: 2006

Sectors	Electricity intensity GWh/$million (PPP adj)	Ranking	Output share	Ranking
Basic metals*	1.095	1	7.1%	7
Mining and quarrying	0.634	2	14.6%	2
Non-metallic minerals	0.524	3	1.6%	12
Agriculture and forestry	0.316	4	6.0%	8
Paper, pulp and printing	0.207	5	2.8%	10
Chemical and petrochemical	0.203	6	16.3%	1
Transport	0.089	7	12.5%	3
Wood and wood products	0.069	8	1.4%	13
Textile and leather	0.067	9	2.5%	11
Food and tobacco	0.021	10	12.0%	4
Machinery and equipment	0.005	11	2.9%	9
Transport equipment	0.003	12	9.8%	6
Construction	0.002	13	10.5%	5

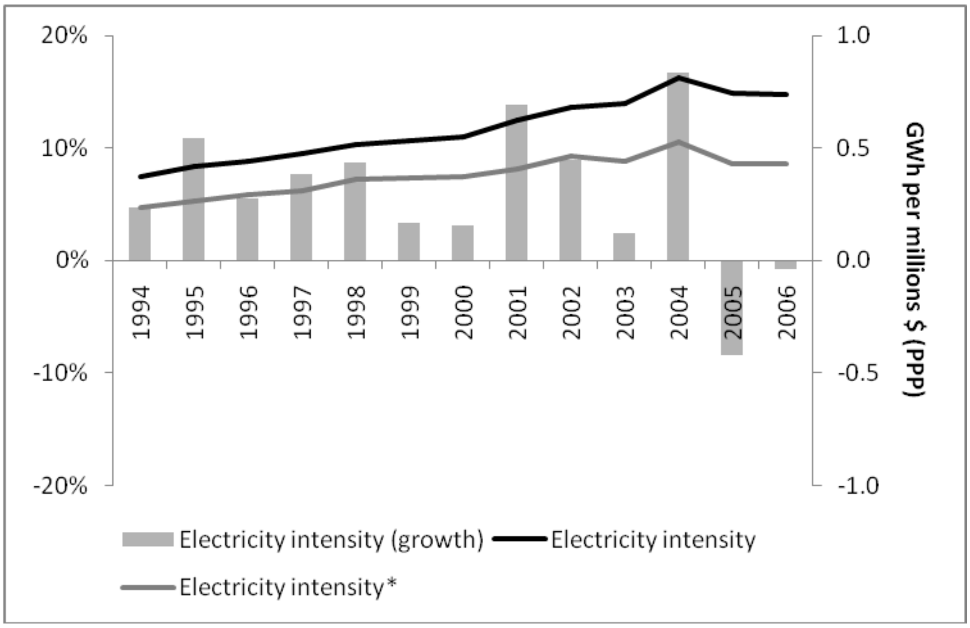
* Includes 'iron and steel' and 'non-ferrous metals'

Table 2: Sectoral electricity intensities in 2006: South Africa and OECD

	South Africa		OECD			
Sectors	Electricity intensity	Output share	Electricity intensity	Output share	Difference	Weighted relative to output difference
Agriculture and forestry	0.316	6.0%	0.016	4.0%	1870.9%	1242.4%
Basic metals*	1.095	7.1%	0.111	5.1%	887.3%	644.2%
Chemical and petrochemical	0.203	16.3%	0.034	15.2%	494.7%	462.9%
Construction	0.002	10.5%	0.087	16.6%	-97.9%	-155.9%
Food and tobacco	0.021	12.0%	0.023	8.3%	-11.3%	-7.8%
Machinery	0.005	2.9%	0.028	15.0%	-81.2%	-416.9%
Mining and quarrying	0.634	14.6%	0.026	3.0%	2305.6%	482.1%
Non-metallic minerals	0.524	1.6%	0.020	2.0%	2517.7%	3169.7%
Paper, pulp and printing	0.207	2.8%	0.021	5.5%	891.5%	1758.6%
Textile and leather	0.067	2.5%	0.010	1.9%	548.8%	398.3%
Transport equipment	0.003	9.8%	0.004	10.5%	-20.1%	-21.7%
Transport sector	0.089	12.5%	0.013	11.2%	563.4%	505.7%
Wood and wood products	0.069	1.4%	0.027	1.5%	153.6%	162.5%

* Includes 'iron and steel' and 'non-ferrous metals'

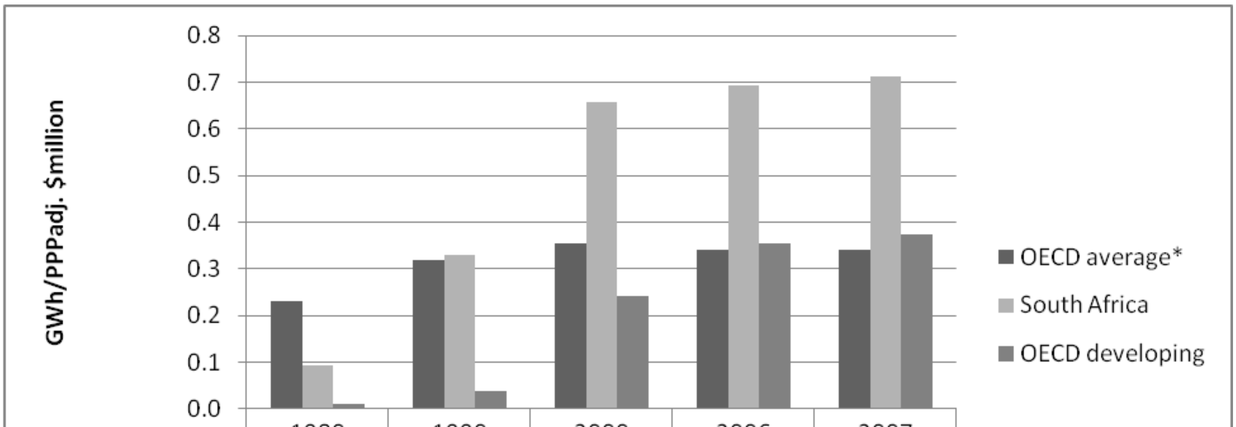
Figure 1: Electricity intensity and its growth in South Africa: 1994 to 2006



*excluding residential, commercial and non-classified electricity consumption

Sources: Authors' calculations based on IMF (2010) and OECD (2009b)

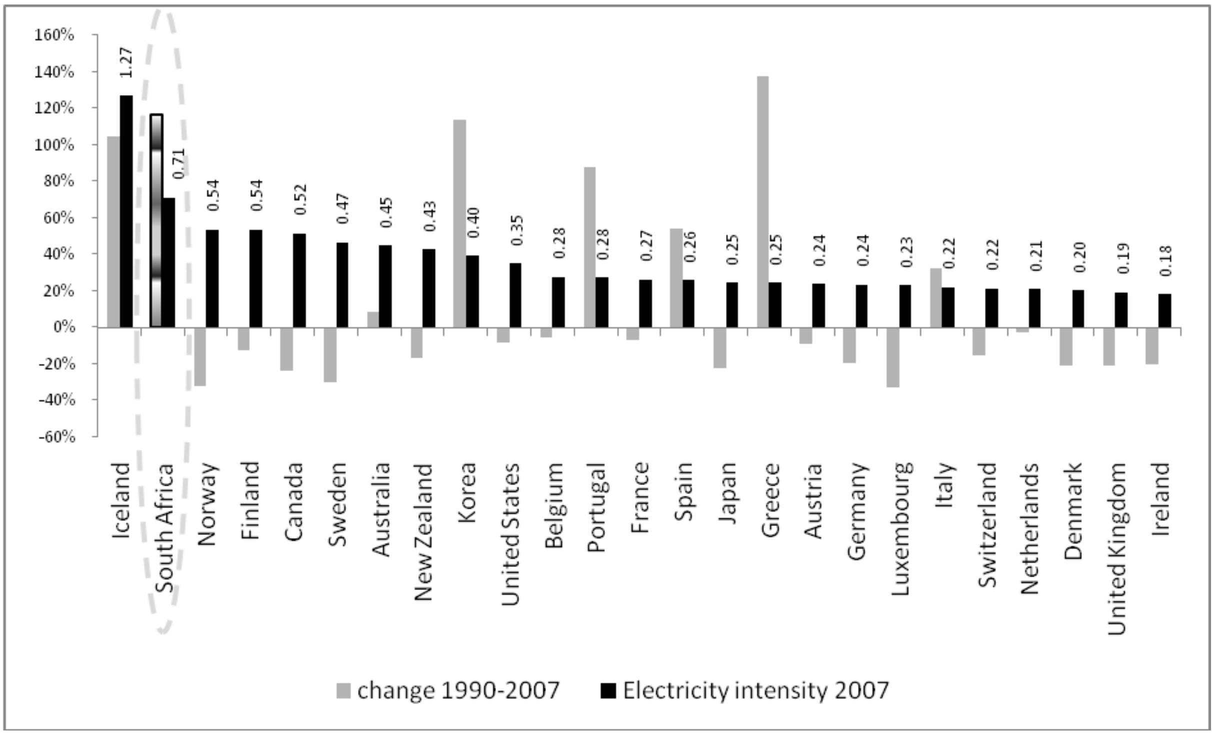
Figure 2: Evolution of electricity intensity: OECD and South Africa



	1980	1990	2000	2006	2007
OECD average*	0.2302	0.3184	0.3544	0.3418	0.3422
South Africa	0.0948	0.3291	0.6573	0.6935	0.7132
OECD developing	0.0105	0.0378	0.2406	0.3560	0.3742

* It excludes Czech Republic, Slovak Republic and Turkey due to lack of data of 1980 and 1990.
Source: Authors' calculations based on IMF (2010) and OECD (2009a and 2009b)

Figure 3a: Electricity intensity in 2007 (in GWh/$million (PPP adj.)) and its growth: 1990 to 2007 for South Africa and OECD members



Source: Authors' calculations based on IMF (2010) and OECD (2009a and 2009b).

Figure 3b: Electricity intensity in 2007 (in GWh. $million (PPP adj)) and its growth: 2000-2007 for South Africa and OECD developing countries.

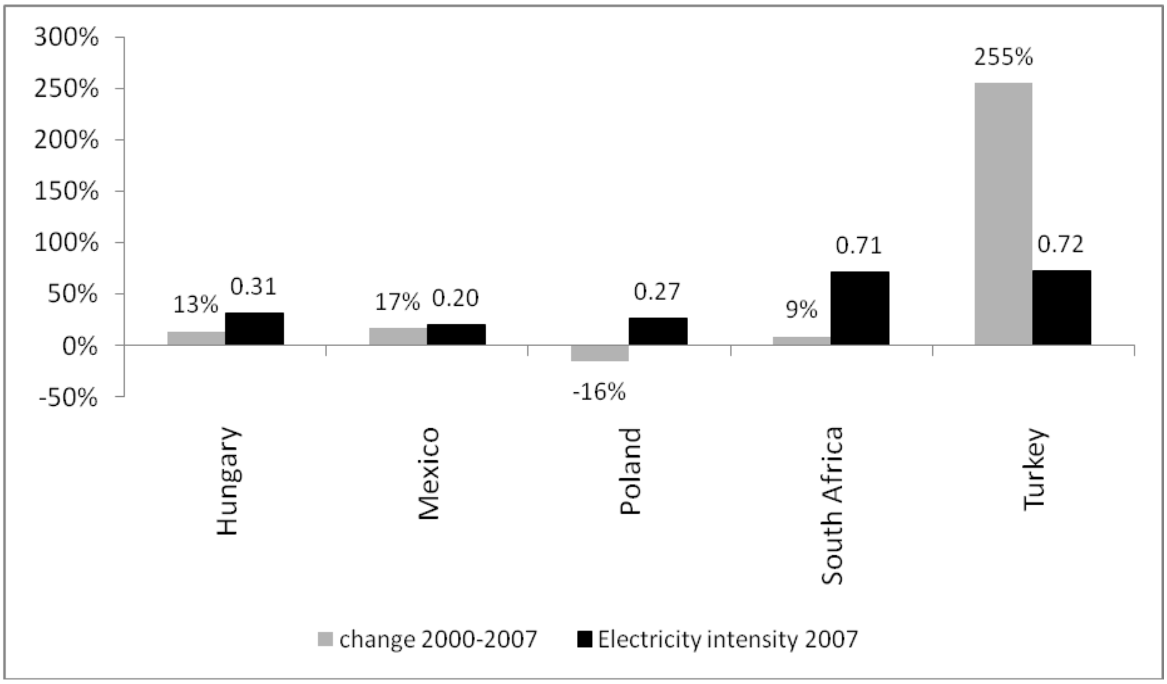
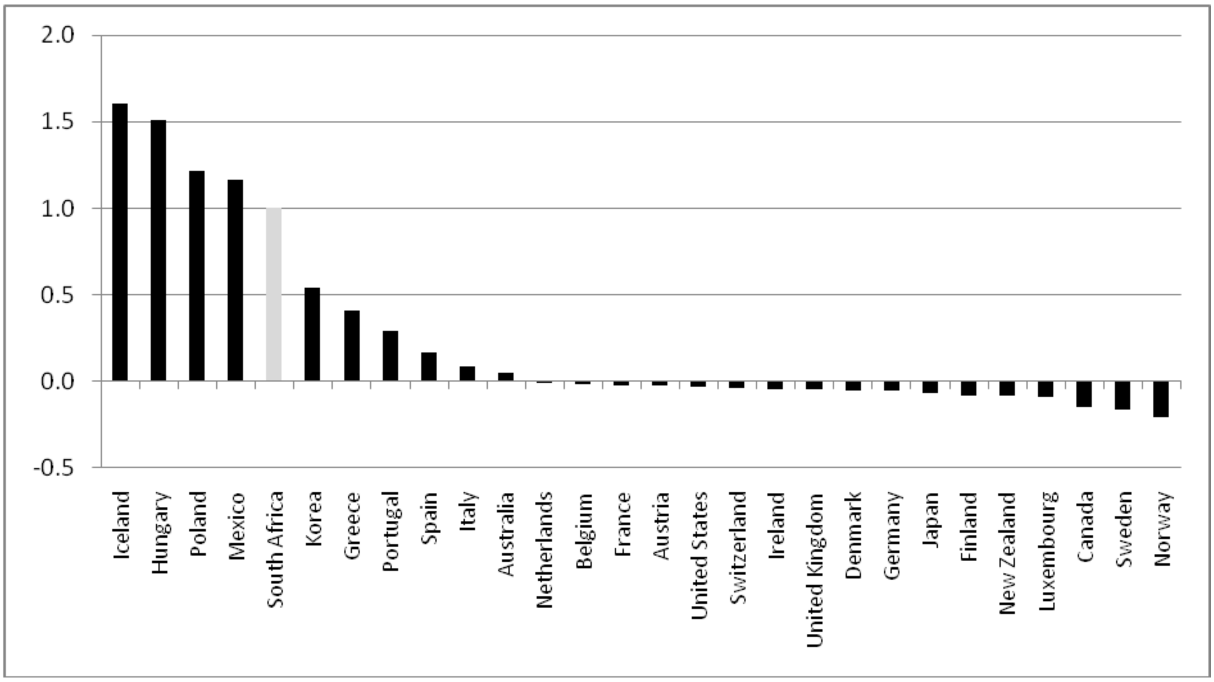
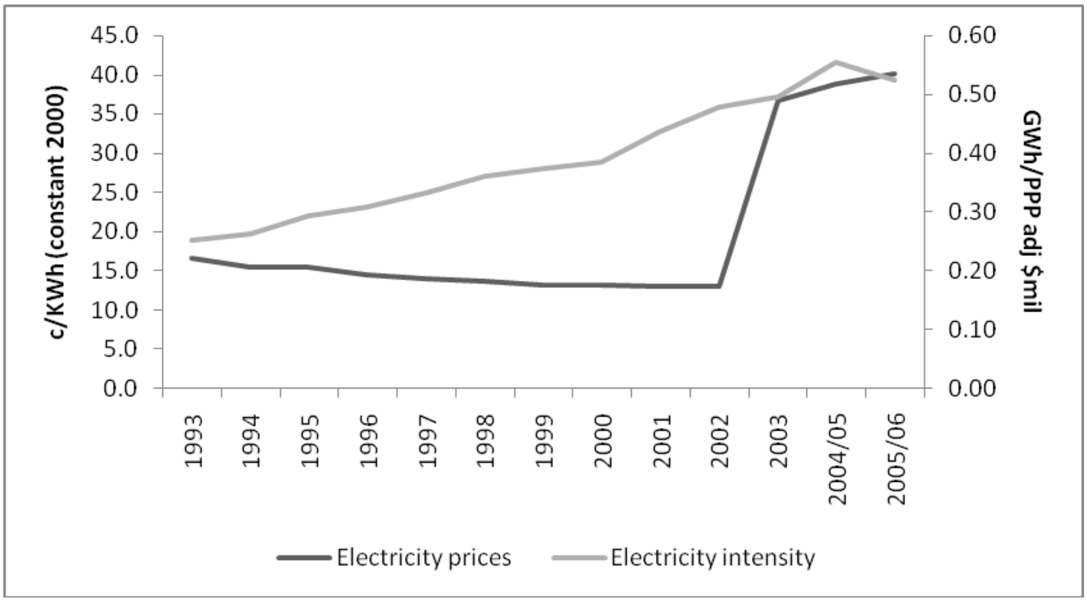


Figure 4: Weighted electricity intensity growth relative to South Africa's electricity intensity (where SA (2007)=1)



Source: Authors' calculations based on IMF (2010) and OECD (2009a and 2009b).

Figure 5: Electricity intensity and electricity prices in South Africa: 1993 to 2005



Source: DME (2009) and authors' calculations based on IMF (2010) and OECD (2009a and 2009b).