The Economic Impact of Electricity Price Increases on Various Sectors of the South African Economy

A consolidated view based on the findings of existing research
# Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contents</td>
<td>0</td>
</tr>
<tr>
<td>List of Tables</td>
<td>5</td>
</tr>
<tr>
<td>List of Figures</td>
<td>6</td>
</tr>
<tr>
<td>Executive Summary</td>
<td>8</td>
</tr>
<tr>
<td>Introduction</td>
<td>19</td>
</tr>
<tr>
<td>1. The structure of the South African economy and trend in electricity consumption</td>
<td>21</td>
</tr>
<tr>
<td>1.1. Introduction</td>
<td>21</td>
</tr>
<tr>
<td>1.2. Analysis of the current structure of the SA economy</td>
<td>21</td>
</tr>
<tr>
<td>1.2.1. The relative contribution of various sectors to the SA economy</td>
<td>21</td>
</tr>
<tr>
<td>1.3. Current breakdown and historical trends in electricity consumption by sector</td>
<td>25</td>
</tr>
<tr>
<td>1.3.1. Total electricity consumption by sector</td>
<td>25</td>
</tr>
<tr>
<td>1.3.2. Trend in electricity consumption by sector and customer segment</td>
<td>26</td>
</tr>
<tr>
<td>1.4. Key drivers of electricity consumption</td>
<td>28</td>
</tr>
<tr>
<td>1.4.1. Macroeconomic drivers of electricity consumption</td>
<td>28</td>
</tr>
<tr>
<td>1.4.2. Microeconomic drivers of electricity consumption – structural and efficiency effects</td>
<td>29</td>
</tr>
<tr>
<td>1.4.2.1. The structural effect</td>
<td>30</td>
</tr>
<tr>
<td>1.4.2.1. The efficiency effect</td>
<td>31</td>
</tr>
<tr>
<td>1.4.2.1. A decomposition analysis of electricity consumption in South Africa</td>
<td>31</td>
</tr>
<tr>
<td>1.5. The outlook for electricity consumption</td>
<td>32</td>
</tr>
<tr>
<td>1.6. Conclusion</td>
<td>34</td>
</tr>
<tr>
<td>2. Electricity prices in South Africa– history, methods and the move to cost-reflective tariffs</td>
<td>37</td>
</tr>
<tr>
<td>2.1. Introduction</td>
<td>37</td>
</tr>
<tr>
<td>2.2. History of electricity prices in South Africa</td>
<td>37</td>
</tr>
<tr>
<td>2.2.1. Trend in real and nominal electricity prices</td>
<td>37</td>
</tr>
<tr>
<td>2.2.2. Impact of Eskom’s investment history on electricity prices (1974 to 2001)</td>
<td>38</td>
</tr>
<tr>
<td>2.2.3. The era of formal electricity price regulation in South Africa</td>
<td>40</td>
</tr>
<tr>
<td>2.3. International comparison of electricity prices</td>
<td>41</td>
</tr>
<tr>
<td>2.4. The major criticisms South Africa’s historical pricing policies</td>
<td>43</td>
</tr>
<tr>
<td>2.4.1. Impact of Eskom’s accounting policies on electricity prices</td>
<td>44</td>
</tr>
<tr>
<td>2.4.2. Similar experience of international electricity utilities</td>
<td>45</td>
</tr>
<tr>
<td>2.5. Requirements of an effective electricity pricing regime</td>
<td>46</td>
</tr>
</tbody>
</table>
3. **Assessing the vulnerability of different sectors of the SA economy to rising electricity costs** ..................................................... 55

3.1. Introduction .............................................................................. 55

3.2. Defining ‘vulnerability criteria’ .............................................. 55

3.2.1. Reliance on electricity as an input to production ................. 56

3.2.1.1. Direct electricity costs as a proportion of total costs .......... 56

3.2.1.2. Electricity intensity ................................................................. 56

3.2.1.3. Direct and indirect electricity costs as a proportion of total input costs ................................. 56

3.2.2. Ability to mitigate against the impact of rising electricity prices ................................. 57

3.2.2.1. Ability to pass on the cost (ie. Pricing power and price elasticity of demand) ........ 57

3.2.2.2. Scope for energy efficiency gains ........................................ 57

3.2.2.3. Potential to substitute electricity with alternative energy sources ................. 58

3.3. Assessing the vulnerability of different sectors to rising electricity costs ......................... 58

3.3.1. Direct electricity costs as a proportion of total input costs ........ 58

3.3.2. Electricity intensity ................................................................. 61

3.3.3. Direct and indirect electricity costs as a proportion of total input costs ......................... 62

3.3.4. Ability to pass on the cost of higher electricity tariffs ................. 63

3.3.5. Scope for electricity efficiency gains or electricity savings .......... 64

3.3.6. Potential to substitute electricity with alternative energy sources ................. 66

3.4. Assessing the relative vulnerability of different types of firms within sectors ................. 66

3.4.1. Mining and quarrying ............................................................. 67

3.4.1.1. Direct electricity costs as a proportion of total input costs ........ 67

3.4.1.2. Ability to pass on costs ........................................................... 70

3.4.2. Manufacturing ................................................................. 71

3.4.3. Construction ................................................................. 74

3.4.4. Wholesale and retail trade .................................................... 74
3.4.5. Real estate, catering and accommodation services .............................................. 75
3.4.6. Finance, Insurance and Banking ........................................................................... 76
3.4.7. Telecommunications and media ........................................................................... 76
3.4.8. Transport equipment and logistics services ......................................................... 77
3.5. Summary of findings and concluding remarks .......................................................... 77

4. Assessing the impact of electricity price increases on sector employment, output and profitability ................................................................. 79
   4.1. Introduction ............................................................................................................. 79
   4.2. Survey-based studies to determine the impact of electricity price increases ......... 79
         4.2.1. A Survey of Eskom’s Key Industrial Customers ............................................ 79
         4.2.2. Surveys of small retailers and a variety of other firms .................................. 80
   4.3. Empirical studies to determine the impact of electricity price increases .......... 80
         4.3.1. Study on the impact of electricity price increases on employment and output .. 81
               4.3.1.1. Assessing the impact of price increases in a CGE modelling framework 81
               4.3.1.1. Assessing the impact of electricity price increases in a TSME modelling framework 85
         4.3.2. A study on the vulnerability of sector profitability to price increases .......... 86
   4.4. Concluding remarks .............................................................................................. 90

5. Exploring policy options available to government and the case for industry support .... 92
   5.1. Introduction ........................................................................................................... 92
   5.2. A summary and critique of the options presented by industry to mitigate against high electricity prices ........................................................ 92
   5.3. The cost of failing to achieve cost-reflective tariffs .............................................. 95
         5.3.1. Distributional impacts ..................................................................................... 95
         5.3.2. Load shedding and unserved energy come at greater cost to the economy than electricity price increases ......................................... 96
   5.4. Exploring the policy options available to government to mitigate against the impact of rising electricity tariffs ......................................................... 96
         5.4.1. Subsidies .......................................................................................................... 97
               5.4.1.1. Grounds for subsidising electricity ............................................................... 97
               5.4.1.2. The ‘right’ to low electricity prices discriminates against others .......... 97
               5.4.1.1. Characteristics of a good subsidy ................................................................. 98
         5.4.2. Gradual price adjustments and transition credits ............................................. 98
               5.4.2.1. Increase tariffs gradually ............................................................................. 98
               5.4.2.1. Increase tariffs immediately to cost-reflective levels and provide temporary subsidies or transition credits ........................................ 99
         5.4.3. Accelerated energy-efficiency and demand side management ...................... 99
List of Tables

Table 1 Electricity intensity and output share by sector, 2006 ................................................................. 62
Table 2 Scope for efficiency gains - comparing electricity intensities across sectors between South Africa and OECD, 2006 ................................................................................................................. 65
Table 3 Reliance of selected mining companies on electricity and ability to pass on increased costs .................................................. ................................................... .................................................. 71
Table 4 Reliance of selected retailers on electricity and ability to pass on increased costs ........ 75
Table 5 Reliance of firms in the finance, insurance and banking industry on electricity as a % of costs .............................................................................................................................................. 76
Table 6 Reliance of firms in the telecommunications and media industry on electricity as a % of costs .............................................................................................................................................. 77
Table 7 Overall ranking of the relative vulnerability of different sectors to rising electricity prices .... 78
Table 8 TSME Long-run Sectoral Impact results - Impact of electricity prices ................................. 86
Table 9 Summary of the findings ................................................................................................................. 90
Table 10 Summary and critique of options presented by industry to mitigate against high electricity prices .............................................................................................................................................. 93
List of Figures

Figure 1 South African GDP by Sector, 2010 ................................................................. 22
Figure 2 Sectoral contribution to total employment in South Africa, 2011 ..................... 23
Figure 3 The demand for skilled, semi-skilled and unskilled labour by sector, 2010 ....... 23
Figure 4 South Africa’s top merchandise exports by value, 2010 ..................................... 24
Figure 5 Trend in manufacturing exports 3Q2006-3Q2011 ............................................. 25
Figure 6 Consumption of electricity by sector, 2010 ...................................................... 25
Figure 7 Sectoral comparison of electricity use and contribution to GDP, 2009 ..................... 26
Figure 8 Eskom direct sales of electricity to the mining sector, 1980-2008 ....................... 27
Figure 9 Eskom direct sales of electricity to the manufacturing sector, 1980-2008 ......... 27
Figure 10 Trend in Eskom sales by category of customer, 1980-2008 ............................. 28
Figure 11 Relationship between income (GDP) and electricity consumption in South Africa, 1993 to 2006 ................................................................. 28
Figure 12 Price and income elasticities of electricity demand, 1986 to 2005 .............. 29
Figure 13 Changing Structure of the South African Economy, 1970 to 2010 .................. 30
Figure 14 Electricity Intensity of the South African Economy ........................................ 31
Figure 15 Contribution of output, structural changes and efficiency to total electricity consumption (1993 to 2006) ................................................................. 32
Figure 16 Forecast Real GDP growth (2011 to 2015) .................................................... 33
Figure 17 Forecast of the energy intensity of the South African economy, 2010 to 2020 .... 33
Figure 18 Trend in Average Electricity Prices realised by Eskom per kWh (1974 to 2011) .... 38
Figure 19 Electricity tariff for industrial consumers, 2006 ............................................ 42
Figure 20 Electricity tariff for household consumers, 2006 ........................................... 42
Figure 21 Electricity tariff for industrial consumers, 2006 ........................................... 42
Figure 22 Electricity tariff for household consumers, 2006 ........................................... 42
Figure 23 Average electricity price comparison, 2011 ................................................ 43
Figure 24 Tariff Profile under the historical cost asset valuation method ....................... 45
Figure 25 Effect of ‘lumpy’ investments on prices set at short-run marginal cost ............ 48
Figure 26 Tariff formula – Eskom’s allowable revenue ............................................... 49
Figure 27 Value of electricity consumed expressed as a percentage of intermediate inputs . 58
Figure 28 Electricity costs as a percentage of total operational costs, 2009 ................. 59
Figure 29 The 30 most electricity-dependant sub-industries (electricity costs % of total costs), 2002 ................................. 60
Figure 30 The 30 sub-industries least reliant on electricity (electricity costs % of total costs), 2002 61
Figure 31 Percentage of output sold as intermediate goods/services ............................. 63
Figure 32 Percentage of output sold as final consumption ............................................. 63
Figure 33 Would you be able to pass on the cost of increased electricity prices if they rose by 50%? ................................................................. 64
Figure 34 Has your firm has been able to realise gains in electricity efficiency? .............. 65
Figure 35 Share of electricity in total costs – selected mining companies ...................... 68
Figure 36 Gold and Platinum miners - significant increase in utilities as a percentage of total costs? 70
Figure 37 Electricity costs as a % of total operational costs – Various manufacturing firms .... 72
Figure 38 Electricity costs as a % of total operational costs – various metal manufacturers .... 74
Figure 39 Impact of a 25% price increase on the output of various sectors in the long-run .... 82
Figure 40 Impact of a 24.8% price increase on the output of 39 sub-industries in the long-run .... 83
Figure 41 Impact of a 24.8% price increase on unskilled employment in the long run, across various sectors ................................................................. 84
Figure 42 Impact of a 24.8% price increase on unskilled employment in the long run across 39 sub-industries ................................. 85
Figure 43 Mining sector profit vulnerability to real price Increases ................................ 87
Figure 44 Low Electricity Intensive Manufacturing Sectors Profit Vulnerability to Electricity Price Increases ................................................................. 88
Figure 45 High Electricity Intensive Manufacturing Sectors Profit Vulnerability to Electricity Price Increases ................................................................. 88
Figure 46 Agricultural Sectors Profit Vulnerability to Real Electricity Price Increases .......................... 89
Executive Summary

**Purpose of the study**

For much of the past three decades, electricity prices in South Africa have been low and declining. But from 2008 the trend in prices took a dramatic turn when, in response to serious power supply shortages, Eskom embarked on a massive build programme to increase power generation capacity. Between 2008 and 2011 real electricity prices rose by 78%. It is argued that electricity prices will need to continue rise towards 'cost-reflective' levels so that a repeat of the costly over-investment in generation capacity in the late 1980s and the current supply shortages (and ever-increasing threat of a repeat of the highly disruptive load-shedding episodes of 2008) can be avoided.

This report was commissioned by Eskom as part of its preparation for the third Multi-Year Price Determination (MYPD 3) process. In the context of rising electricity prices, the overall objective of this study was to contribute towards a better understanding of the potential impact that further electricity price increases could have on the various sectors of the economy by consolidating the findings of a number of existing studies and academic papers on the subject.

In this report we give some context to the broader analysis of the impact of rising electricity prices on different sectors of the economy, by providing a brief overview of the current structure of the South African economy and the trend in and drivers of electricity consumption. We also give a brief overview of the history of electricity pricing in South Africa and examine some of the factors that have historically had a bearing on the level and trend in electricity prices, with a particular focus on the influence of Eskom’s investment history and pricing policies. This is followed by an analysis of the relative vulnerability of different sectors to rising prices and the potential impact of price increases on output, employment and profitability. We conclude the report by exploring the policy options available to government to mitigate against the impact of rising electricity prices and provide a critical review of the case for industry support.

**Key findings and recommendations**

The report is structured around five chapters and the key findings of the report have been summarised by chapter below.

**Chapter one**

The purpose of this chapter was to give context to the broader analysis of the impact of rising electricity prices on different sectors of the economy, by providing a brief overview of the current structure of the South African economy and the trend in and drivers of electricity consumption.

The SA economy is dominated by the services sector but the contribution of manufacturing and other relatively energy-intensive sectors remains significant
In terms of the current structure of the economy and contribution of the various sectors we found that the South African economy, like most post-industrial, middle to high income economies, is dominated by services-related activity which accounted for just over two thirds (67%) of GDP in 2010. However, manufacturing remained the second-largest individual sector contributor at 17.2% of GDP and the, the direct contribution of the relatively energy-intensive primary and secondary activities which include manufacturing, mining, electricity and other utilities, and agriculture remains significant at 28% of GDP.

The sectors that make the largest contribution to employment are wholesale\retail trade, government services and manufacturing

The importance of an individual sector to a national economy however should be assessed both in terms of its contribution to output and employment. The sectors that make the largest contribution to employment in South Africa are wholesale and retail trade, government services and manufacturing. Industries such as construction and personal services make a relatively small contribution to GDP but are nevertheless critically important to the South African economy because they are very labour intensive and employ 9% and 12% respectively of the total labour force.

The industries that demand the highest proportion of unskilled labour are among the least energy-intensive and include private households, construction and agriculture

In South Africa, the extent to which an industry generates or can generate employment for relatively low-skilled workers is also of interest to policymakers because a large proportion of the potential workforce and unemployed have attained only a basic level of education. It has been argued that the economy would become more energy intensive if it is reoriented towards creating employment for semi-skilled and unskilled workers but it is not clear that this would be the case since the industries that demand the largest proportion of low and semi-skilled labour are agriculture (85%), private households (89%) and construction (70%) and wholesale\retail trade (53%) and these labour intensive industries are generally among the least energy-intensive.

Non-ferrous metals and gold mining account for 25% of electricity consumption but only 4% of GDP

In terms of the contribution of sectors to total electricity consumption we found that non-ferrous metals and gold mining are the single largest consumers of electricity in SA, responsible for 25% of total consumption, but they make a relatively small direct contribution to GDP (about 4%). The overall contribution of these sectors to GDP however, also depends on their linkages to sectors in the economy. By definition, energy-intensive sectors like gold mining, non-ferrous metals, soap and pharmaceuticals add relatively little value to the economy (in terms of GDP) per unit of energy consumed.

Over the past two decades, the dominant driver of electricity consumption in South Africa has been economic growth; the impact of price was negligible but it is expected to play an increasing role.

In terms of the key drivers of electricity consumption we found that the demand for electricity is based on number of factors that differ in terms of both their levels of significance and complexity. But at a macroeconomic level, the key drivers of electricity consumption are income and price. Over the past two decades, economic growth (income) has proven to have been the main driver of electricity consumption in South Africa and by contrast electricity prices have had almost no effect. The responsiveness of electricity
consumption to prices however, has not been constant over time and as price rise beyond certain ‘threshold’ levels it is likely they will once again have a greater impact on consumption.

**Structural and efficiency effects are also key drivers of electricity consumption**

At a microeconomic level the two main influences on electricity consumption are the changing structure of the economy or ‘structural effect’ and the influence of new technologies or the ‘efficiency effect’. In terms of the structural effect is surprising to find that despite the increasing contribution of less energy-intensive services to the economy, the electricity intensity of the South African economy more than doubled in the period from 1990 to 2007. This was probably due to the increase in energy-intensive manufacturing activities in the 1990s, particularly investment in the non-ferrous metals sector.

The findings of one study suggest that over the period 1993 to 2006 efficiency gains had a significant positive impact on overall electricity consumption but it is acknowledged that the results could be misleading since the greatest gains in efficiency were in the transport sector and were in fact due to the collapse of the rail freight sector and switch in transport modes from rail (which consumes electricity) to road freight (which consumes petroleum products).

**Economic growth is likely to remain the dominant driver of electricity consumption**

With respect to the outlook for energy consumption it seems unlikely that rising in prices or increased uptake of energy efficiency measures will be sufficient to offset the impact of rising national income on the demand for electricity over the next decade. It is however, not clear what impact structural effects will have on demand (whether they will have a positive or negative impact) given the considerable differences in opinion around the trend in the electricity intensity of the South African economy.

**Chapter two**

In this chapter we set out to provide an overview of the factors that have historically had a bearing on the trend and level in electricity prices in South Africa. We also aimed to provide some insight into South Africa’s past and present electricity pricing policies and to explore the economic and pricing principles that underlie the current transition to cost-reflective electricity tariffs.

**Despite the 78% increase in real electricity prices in South Africa since 2008, electricity tariffs are still low by international standards**

For much of the past three decades, electricity prices in South Africa have been low and declining so that despite the significant increases in electricity prices in South Africa in recent years (78% increase in real prices between 2008 and 2011), are still low by international standards and do not yet reflect the full economic cost of supplying power.

**The South African experience has demonstrated that electricity prices that do not reflect the true economic cost of supplying power lead to poor investment decisions and a misallocation of resources**

While there are many factors that have historically had a bearing on the level and trend in electricity prices in South Africa, it appears that the dominant influences were Eskom’s investment history and its accounting and pricing policies. The experience of the South African electricity supply industry over the past thirty-odd years
has demonstrated that electricity prices that do not reflect the true economic costs of supplying power, lead to poor decision-making and a gross misallocation of the country’s economic resources.

Eskom was able to charge artificially low electricity prices because it did not bear the full economic cost of the capital it employed (this cost was borne in part by the state/taxpayers). Because of the lenient financial requirements Eskom historically enjoyed under full state ownership (including exemption paying from taxes and dividends and state guarantees on its debt) it did not have to bear the full economic opportunity cost of the capital employed to finance its investments. In the 1970s Eskom was oriented to providing an abundant supply of electricity, and giving little thought to the economic opportunity cost of the capital employed, substantially overinvested in capacity. Despite the fact that Eskom was stranded with surplus capacity for much of the following two decades its financial position improved. This was largely because Eskom did not have to bear the full economic cost of the finance it had employed and was able to repay its debt while maintaining artificially low electricity prices.

While tariffs were sufficiently high to allow Eskom to repay its debt they did not allow Eskom to recover full costs of its assets. In reality though while Eskom’s cash flow was sufficient to amortise its debt, significant surplus capacity meant it never realised much of the potential sales and associated cash flow and higher-than-expected inflation gradually eroded the real return it received on its assets, as a result Eskom did not accumulate reserves to replace its assets in future. Consumers however did benefit from the fact that Eskom did not historically recover the full costs of its assets in the form of a 17 year decline in real electricity prices that resulted in some of the most inexpensive electricity in the world.

The historic cost approach Eskom historically used for asset valuation is not appropriate in the context of the electricity industry and is partly to blame for the sharp electricity price hikes. The fact that Eskom’s tariffs were (until recently) determined the basis of historical cost accounting principles also had an influence. We noted that in the capital intensive electricity supply industry, where investments are lumpy and assets may last for 20 to 40 years, the historic cost approach is not appropriate since it will typically result in a declining tariff over the life of the asset and a massive increase in tariffs when the old asset is replaced. In Eskom’s case the decline in prices was particularly severe because after the over-investment in base load generating capacity in the late 1970s and early 1980s no new capacity was built for almost 20 years. As the build programme resumed, the existing asset base was so heavily depreciated that the significant prices hikes we have recently experienced were required to fund new investment in new capacity.

The primary objective of any pricing regime should be to ensure that resources are allocated efficiently – an objective that can be achieved through cost-reflective tariffs. Exploring the requirements of an effective electricity pricing regime we found that while in practice it is often necessary to try and satisfy a range of, sometimes conflicting, social, economic and political objectives, the primary objective of any pricing regime should be to ensure that national economic resources are allocated efficiently both among different sectors of the economy and within the electricity supply industry. This implies that tariffs should be cost-reflective – in other word they should be set at a level that reflects the true economic costs of supplying each consumer’s electricity needs. In addition to designing and appropriate pricing regime,
it also important that sound investment decisions ensure that demand is met at least cost, meaning that the cost of labour, fuel and capital inputs to production are minimised.

The basic properties of an ‘optimal’ electricity tariff which in addition to cost-reflectivity include satisfying objectives such as revenue adequacy and transparency in the provision of subsidies, have already been accepted by both NERSA and Government and are laid out in the Electricity Act of 1996 and Electricity Pricing Policy of 1998. However these principles have not yet been fully implemented.

Conceptually, a ‘cost-reflective’ tariff can be defined as a tariff equal to the long-run marginal cost (LRMC) of supply, since this is consistent with the efficient allocation of economic resources.

We also noted that while the South African government have made commitments towards achieving ‘cost reflective’ tariffs, there are many differences of opinion around how the term ‘cost-reflective’ should be defined. In terms of economic theory, a ‘cost-reflective’ tariff is most often defined as a tariff equal to the long-run marginal cost (LRMC) of supply, since this concept is consistent with the efficient allocation of economic resources.

In practice however the economic concept of a ‘cost-reflective’ tariff is difficult to operationalize and involves the choice of a method of price regulation and agreement on how to measure some subjective components of the relevant tariff formula (e.g. asset valuation method).

While a theoretically robust concept, LRMC in practice is hard to estimate. In practice, determining a ‘cost-reflective’ tariff that approximates the economic concept of LMRC involves the choice of a method of price regulation and then agreement on how to measure some of the more subjective components of the relevant tariff formula so as to approximate LMRC. In non-competitive electricity markets, end-user prices are typically set with regulatory approval. Two of the most widely used methods of price regulation that are the rate-of-return regulation or ‘revenue requirement’ regulation and the performance-based or ‘price-cap-system’.

Electricity price adjustments in South Africa are currently determined by NERSA through the Multi-Year Price Determination (MYPD) methodology. The MYPD is based on rate-of-return principles and was developed for the regulation of Eskom’s required revenues, which is the basis on which prices are effectively adjusted.

If NERSA was to systematically apply its current rate-of-return methodology, Eskom’s would realise tariffs that are more or less ‘cost-reflective’.

Finally we found that if NERSA systematically applies its current rate-of-return methodology and calculated Eskom’s allowable revenue on the basis of a regulatory asset base revalued at depreciated replacement cost, Eskom will realise revenues that translate into a close approximation of ‘cost-reflective’ tariffs. In practice however, tariffs remain well below cost-reflective levels because while NERSA has in principle adopted the depreciated replacement cost approach to asset valuation it has not yet been fully implemented. This is because an immediate revaluation of Eskom’s asset base would hugely inflate its allowable revenue from current levels and would ultimately result in a massive one-off increase in electricity tariffs.

In practice however, the tariff-formula has not been fully applied by NERSA since a once-off adjustment would result in a price shock.

While it is clear the that revaluation of Eskom’s asset base will need to be phased in over an appropriate period of time, NERSA needs to be more explicit about the rate at which assets will be revalued and the
methodology that they intend to employ. It is recommended that NERSA phase in only one component of the tariff formula, such as the ROA so that the method of transitioning to cost-reflective and time period over which it will be achieved is more transparent.

**Chapter three**

In this chapter we set out to evaluate the relative vulnerability of different sectors, sub-industries and firms in the South African economy to rising electricity prices, in terms of their reliance on electricity as an input and their ability to effectively mitigate the impact.

**An industry’s vulnerability to rising electricity prices depends on its reliance on electricity as an input to production and on the extent to which it can mitigate against the impact of rising electricity prices**

Within the existing body of literature on this subject we identified six criteria within that can be used to evaluate the relative vulnerability of different industries and firms to rising electricity prices, the first three relate to reliance on electricity and the next three to ability to mitigate, they are: direct electricity costs as a proportion of total inputs costs; electricity intensity (i.e. electricity consumption per unit of output); direct and indirect electricity costs as a proportion of total inputs costs; ability to pass on the cost (i.e. pricing power and price elasticity of demand); scope for electricity efficiency gains; and the potential to substitute electricity with cheaper energy sources.

It is difficult to draw generalised conclusions about the relative vulnerability of major sectors of the economy to rising electricity costs since there is considerable variation within each sector

The considerable variation in the apparent vulnerability of different firms and sub-industries to rising electricity costs, both across and within the major sectors of the economy, has made it difficult to draw generalised conclusions. We were however able to provide a fairly consolidated picture of the relative vulnerability of each sector (and some sub-sectors) to electricity prices increases in terms of the three criteria that were the most widely reported across the range studies and surveys we investigated – the share of electricity costs in total costs, the electricity intensity of the sector and the ability of firms in the sector to pass on costs.

**The mining sector as a whole is the most reliant of all the major sectors of the economy on electricity as an input but some mining activities (such as coal) have relatively low exposure to electricity costs**

The mining sector is both heavily reliant on electricity as an input to production and demonstrates limited ability pass on increased costs, which immediately signals that it is among the most vulnerable to price increases. Not all mining activities however would be classified as ‘vulnerable’, coal miners and some of the diversified mining groups have relatively low exposure to electricity costs and are no more vulnerable to rising prices than the agricultural sector and several of the less electricity intensive manufacturers. Of all the mining firms South African gold mining firms of the most vulnerable to electricity prices increasing because of very electricity intensive deep mining operations and a dwindling share of global production which means they are unable to influence the price of the metal.

**Manufacturing on aggregate appears to be fairly resilient to price increases, but there is considerable variation in the vulnerability of different sub-industries and firms within this very diverse sector**

All metal manufacturers are heavily dependent on electricity, but ferrochrome and non-ferrous metal producers are particularly vulnerable to rising prices. That said, South African ferrochrome producers control a
significant share of the global market, so some analysts have argued that they should be able to pass on the costs of rising electricity prices. Chemical, Paper and Cement manufacturers also appear to be relatively vulnerable to electricity price increases while food and beverage and associated packaging producers are among the more resilient manufacturers.

Utilities including water, gas and electricity are also heavily reliant on electricity but are not particularly vulnerable to price increase because as monopoly supplier of largely non-tradable goods they can easily pass on increased costs.

The services industries as a whole appear to be relatively resilient to price increases because they have limited direct exposure to electricity costs – an outlier though is the accommodation industry. As was anticipated, the services industries appear to be relatively resilient to price increases because they have limited direct exposure to electricity costs and can in most cases pass on higher costs to their consumers. The outliers in the services industry are the property leasing and accommodation providers who according to some reports are very exposed to electricity in their direct costs. The variation in estimates of the share of electricity in total costs is a bit puzzling but one report suggested that electricity accounts for 22% of costs in the property leasing sector while another suggests that accommodation was ranked 11 out of 94 sub-industries in terms of its exposure to direct electricity costs.

The industries that appear to be the least vulnerable to rising electricity prices are the finance and business service sector, the community social and personal services sector and construction.

Chapter four
In this chapter we attempted to gauge the impact rising electricity prices would have on employment and output across different sectors of the economy and ultimately how rising prices would affect their viability. Our findings are largely based on the results of two empirical studies – the first simulated the impact of rising electricity prices on different sectors of the South African economy and a second estimated the vulnerability of sector profits to real electricity price increases.

The results of empirical studies suggest that the mining and manufacturing sectors are likely to suffer the largest declines in output and employment as electricity prices rise but there is considerable variation within these sectors. Comparing results across the various models and studies, it not surprising to find that it is the relatively electricity-intensive mining and manufacturing sectors that suffer the largest declines in output and employment as electricity prices increase. But once again, we note that there is considerable variation within these broad sectors – rising electricity prices result in a significant decrease in employment and output in the gold and platinum mining, non-ferrous metals and ferrochrome industries but have a negligible impact on employment and output in the coal mining and food and beverage manufacturing sectors.

Macroeconomic modelling of the impact of price increases reveals that because of second-round impacts the services sectors are more exposed to electricity prices than basic vulnerability assessment would suggest.
While it seems in most cases that the simple assessment of the relative vulnerability of different sectors that we conducted in Chapter 3 would suffice, there are some additional insights to be gleaned from the simulated impact of price increases in more sophisticated empirical frameworks. In particular the results of the CGE and TSME models suggest that the services sector is far more exposed to rising electricity prices than the simple ‘vulnerability criteria’ assessment suggested.

The models suggest that electricity price increases are likely to result in a fairly significant decrease in output and employment across all of the major service sectors, because they are exposed to the second-round effects of price increases on consumer spending. The results suggest that the negative impact of rising prices on employment is particularly severe in the transport and communications sector.

A simple profit vulnerability analysis suggests that the paper and chemical manufacturing industries are vulnerable to price increases despite their relatively low reliance on electricity as an input as their already slim profits would be quickly eroded by electricity price increases.

The construction and finance and business services sectors emerge once again as the industries that are the least affected by electricity price increases.

Chapter five
In this chapter we explored the policy options available to government to mitigate against the impact of rising electricity prices and provide a critical review of the case for industry support.

While representatives of electricity-intensive industry appear in principle to support the notion that the electricity prices need to rise to a ‘cost-reflective’ level, they also maintain that current electricity price path is not ‘justifiable’

The sharp increases in electricity tariffs since 2008 have predictably, been met with significant public resistance. Representatives of electricity-intensive industry (and some members of the general public) contend that the current electricity price path is ‘unjustifiable’. While representatives of electricity-intensive industry appear in principle to support the notion that the electricity prices need to rise to a ‘cost-reflective’ level, they have argued that lower and more ‘affordable tariffs’ can be achieved primarily by manipulating aspects of Eskom’s tariff formula.

A critique of the options presented by industry to mitigate against higher electricity prices reveals that many of the arguments are flawed

However, a summary and critique of the options presented by industry to mitigate against high electricity prices reveals that many of the arguments presented are flawed. Lowering Eskom’s return on assets, as industry suggests, implies that taxpayers continue to subsidise electricity, would jeopardise the financially sustainability of the utility and would not give rise to ‘cost-reflective’ tariffs. Retaining historic cost accounting practices, would in all likelihood give rise to more rapid electricity price increases over the next few years and while lowering the target for renewable energy would result in lower tariffs, it would be at the expense of the environment. Of the options presented by industry the argument that the introduction of IPPs would result in lower tariffs is the most robust since it has been proven that increased competition in the electricity supply
industry often results in lower prices but this is not always the case since IPPs also face a higher cost of capital and are unlikely to enter the market until tariffs are cost-reflective and provide the incentive to do so.

If consumers don’t bear the full cost of electricity supply, the taxpayer will
Too often the criticism levied against Eskom or NERSA with respect to electricity prices hikes simply implies that tariff increases can be avoided without considering how the cost of new power capacity will be paid for or who will ultimately bear the burden. We found that while debt and equity are used to prefund major capital investment in electricity supply, ultimately tariffs need to cover the full cost of electricity supply, including the provision of an acceptable return on the equity or debt provided by the utility’s shareholders and lenders. So in other words, if electricity consumers don’t bear the full cost of electricity supply, the taxpayer eventually will.

Many studies of the impact of rising electricity prices fail to acknowledge that load shedding and ‘unserved energy’ (foregone growth) comes at far greater cost to the economy than rising prices.
Most studies of the impact of electricity price increases also focus solely on the short-run impact of rising prices on employment and output but fail to note that in the absence of cost-reflective prices, costly mismatches between supply and demand are likely to continue to occur. It has been proven that power outages or ‘unserved energy’ come at far greater cost to the economy than rising electricity prices. A study by Deloitte (2008) found that load-shedding had substantial economic impacts across most sectors of the economy and continued at 10% of total power capacity over a year could shave as much as 0.7 percentage points off GDP growth.

The policy options available to government to mitigate the impact of rising electricity prices may include subsidies, gradual price adjustments and transition credits, accelerated energy efficiency and demand side management, promoting competition in the electricity supply industry and providing targeted support to vulnerable industries.

As long as electricity tariffs in South Africa remain below cost-reflective levels, consumers of electricity are effectively receiving a subsidy from the government or taxpayer
We noted that many Governments, while aware of the enormous costs of maintaining inefficient electricity prices have been reluctant to increase them and continue to provide implicit or explicit electricity subsidies. Any measure that keeps energy prices for consumers below market levels can be deemed an energy subsidy so as long as electricity tariffs in South Africa remain below cost-reflective levels, consumers of electricity are effectively receiving a subsidy from the taxpayer. This implicit subsidy not only distorts the efficiency of the electricity market but promotes a transfer of wealth from South African taxpayers to the large consumers of electricity (which include large industrial consumers with substantial foreign shareholding).

Funding subsidies through budget provisions is always more efficient than cross subsidies, because it better preserve proper economic price signals
Subsidies no matter how justified socially severely distort demand patterns for energy and associated with significant economic, financial and environmental costs, but cross subsidies are particularly insidious because they imply that not only that some customers benefit from tariffs that are below cost-reflective levels but that some consumers must possibly bear tariffs that are higher than cost-reflective levels to fund them. Funding subsidies through budget provisions is always more efficient than cross subsidies, because it better preserve
proper economic price signals (and therefore investment and consumption decision) and avoid the negative impact on other customers that are not subsidised.

While all subsidies are associated with significant drawbacks, the provision of a subsidy can be justified if it enhances access to sustainable modern energy or has a positive impact on the environment, while sustaining incentives for efficient delivery and consumption.

A good subsidy should be targeted, efficient, based on a rigorous analysis of the costs and benefits, practical, transparent and should only be provided for a limited amount of time. As such, we found that temporary and well-targeted subsidies could potentially be provided to vulnerable industries to give them time to adjust to higher electricity prices.

More gradual tariff adjustments are often proposed as an obvious way to minimise the impact of rising electricity prices on the economy but this policy prolongs energy-inefficient investment and consumption and as a result could increase the risk of load-shedding.

It is often argued that increasing tariffs more gradually is one of the most obvious ways to minimise the short-run impact of rising prices on output and employment. The basic reasoning is that gradual price increases over a given time path, provide firms with certainty, gives them time to adapt and therefore minimise adjustment costs. However, the policy of gradual price adjustments also suffers from some drawbacks. Firstly, if cost-reflective tariffs are to be attained, domestic electricity prices must still rise faster than world electricity prices over the 'transition period'. Secondly, introducing tariff increases more gradually prolongs the period over which energy-inefficient investment takes place and also moderates the pace of improvements in energy-efficiency. Given that South Africa is currently facing power capacity constraints, introducing tariff increases more gradually could prove very costly if limits the extent to which higher prices encourage efficiency-improvements and therefore exacerbates the shortage and results greater load-shedding.

A sudden adjustment to ‘cost-reflective’ prices combined with transition credits proportional to current consumption is a policy alternative to gradual price adjustments. The advantage is that it provides an immediate incentive for consumers to become more energy-efficient but could be costly to administer.

An alternative to gradual price adjustments would be to move electricity prices suddenly to cost-reflective levels and then recycle revenue to consumers in the form of a temporary subsidy or ‘transition credit’ which would be proportional to the consumer’s initial or current energy consumption. The advantage of this approach is that it provides an immediate incentive for consumers to investment in more energy-efficient technologies because the credit is only provided on historical consumption and any additional consumption is immediately subject to cost-reflective prices. The drawback of this approach (relative to more gradual price increases) is the cost of administering such a program but if it were feasible to administer efficiently, this policy option would have the same benefits as a gradual price adjustment without incurring the costs.

Improved incentives for energy-efficiency and demand side management could contribute to lower electricity prices although it has been proven that prices are the primary driver of mitigation behaviour. Promoting the accelerated uptake of energy-efficiency and demand side management initiatives reduces the need for additional generating capacity so provided it is more cost-effective than new supply can also be considered a strategy to mitigate against higher electricity tariffs. Studies have noted however that South
African firms have historically made little use of public or external support energy efficiency and that increased energy prices and not incentives had been the primary driver of mitigation behaviour. It has been noted that improved incentives may speed up mitigation behaviour and is it encouraging to note that Eskom has recently revamped its EEDSM business model and in 2011 launched a standard offer programme that promises to promote more rapid uptake of EEDSM.

**Subjecting the electricity supply industry to greater competition and private sector involvement has been proven to increase efficiency of supply so that electricity demand can be met at a lesser cost (and consequently lower tariffs).** South Africa has been unsuccessful in attracting private sector involvement but higher tariffs and regulatory reform will encourage participation.

International experience has shown that one way to achieve improved efficiency in the electricity supply industry is to promote commercialisation of state-owned utilities and exposure the industry to greater competition and private sector involvement. Despite the stated intentions, South Africa has failed to attract IPPs into the electricity supply industry. Low electricity tariffs and an unfavourable regulatory environment have been identified as some of the main factors that have hindered progress on this front. One of the first steps in encouraging IPPs to enter the market it to provide the right price signals by subjecting customers to cost-reflective prices. In addition, the South African government is in the process of creating an independent system operator that would act as a non-conflicted buyer of power, the Independent System and Market Operator Bill was approached by Cabinet on the 16 March 2011.

**Providing transition credits that are proportional to existing electricity consumption or other carefully targeted subsidies could be a means to accommodate the special characteristics of the most vulnerable consumers**

Finally, given that electricity in prices in South Africa have been subsidised implicitly by the taxpayer for a considerable length of time, it can be argued that it is necessary to provide additional ‘transition’ support to industries that have come to rely on low electricity prices as a source of comparative advantage and that are vulnerable to price increases. Providing transition credits that are proportional to existing electricity consumption or other carefully targeted subsidies could be a means to accommodate the special characteristics of these particularly vulnerable consumers.

**Identifying the vulnerable sectors for targeted policies would present some significant challenges since there is considerable variation in the vulnerability of different firms and sub-industries within major sectors to electricity price increases**

Policy makers may want to consider supporting only those vulnerable industries that also make a significant contribution to the economy.
Introduction

For much of the past three decades, electricity prices in South Africa have been low and declining. But from 2008 the trend in prices took a dramatic turn when, in response to serious power supply shortages, Eskom embarked on a massive build programme to increase power generation capacity. Between 2008 and 2011 real electricity prices rose by 78%. It is argued that electricity prices will need to continue rise towards ‘cost-reflective’ levels so that a repeat of the costly over-investment in generation capacity in the late 1980s and the current supply shortages (and ever-increasing threat of a repeat of the highly disruptive load-shedding episodes of 2008) can be avoided.

This report was commissioned by Eskom as part of its preparation for the third Multi-Year Price Determination (MYPD 3) process. The overall objective of this study was to contribute towards a better understanding of the potential impact that further electricity price increases could have on the various sectors of the economy by consolidating the findings of a number of existing studies and academic papers on the subject.

The report is structured around five chapters. In Chapter one, we give some context to the broader analysis of the impact of rising electricity prices on different sectors of the economy, by providing a brief overview of the current structure of the South African economy and the trend in and drivers of electricity consumption. The chapter includes an analysis of the contribution of each sector to the economy in terms of the impact it has on gross domestic product and employment and trade and identifies the key drivers of the demand for electricity which include income, price, structural effects and efficiency effects.

In chapter two we provide a brief overview of the history of electricity pricing in South Africa and examine some of the factors that have historically had a bearing on the level and trend in electricity prices, with a particular focus on the influence of Eskom’s investment history and pricing policies. We also aim to provide some insight into South Africa’s past and present electricity pricing policies and to explore the economic and pricing principles that underlie the current transition to cost-reflective electricity tariffs.

In Chapter three we offer an assessment of the vulnerability of different sectors of the South African economy to rising electricity prices. The chapter begins with a discussion of the factors the influence a firm or industry’s vulnerability to electricity prices and identifies a number of criteria against which this can be assessed. The remainder is devoted to a comparison of the vulnerability the main industry groups (and firms and sub-sector within them) to rising electricity costs, in terms of some of the previously identified ‘vulnerability criteria’

In Chapter four we consider the findings of a number of studies that have attempted to gauge the magnitude of impact that rising electricity prices would have on the South Africa economy. These studies typically focus on the impacts on employment, output, and profitability for various sectors or sub-sectors over different periods of time and varying price scenarios.
Finally, in Chapter 5 we explore some of the policy options that may be available to government to assist vulnerable industries in transitioning to cost-reflective tariffs while minimising the negative impacts on output, employment and profitability.
1. The structure of the South African economy and trend in electricity consumption

1.1. Introduction
The purpose of this chapter is to give some context to the broader analysis of the impact of rising electricity prices on different sectors of the economy, by providing a brief overview of the current structure of the South African economy and the trend in and drivers of electricity consumption. In the first section of this chapter we analyse the contribution of each sector to the economy in terms of the impact it has on gross domestic product and employment and trade. In the next section we examine the key drivers of the demand for electricity which include income, price, structural and efficiency effects. In the final section we comment on the trend in and outlook for electricity consumption.

1.2. Analysis of the current structure of the SA economy

1.2.1. The relative contribution of various sectors to the SA economy
The South African economy, like most post-industrial, middle to high income economies, is dominated by services-related activity which accounted for just over two thirds (67%) of GDP in 2010. Of the five largest sectors of the economy in 2010, four were services-related - finance and business was the largest at 23.5% of GDP followed by Government services (15.1%), trade and accommodation (13.7%) and transport (10.2%). It is however important to note that manufacturing remained the second-largest individual sector contributor at 17.2% of GDP in 2010 with half its output in turn, due to activity in the petroleum, chemical and related products and metals, machinery and equipment industries. Frost and Sullivan (2011) argue that while South Africa has become a largely services-oriented economy, the direct contribution of the relatively energy-intensive primary and secondary activities which include manufacturing, mining, electricity and other utilities, and agriculture remains significant. Excluding construction which has little reliance on electricity, these industries contribute around 28% of GDP.

Although the direct contribution of electricity, gas and water to overall South African GDP is relatively small at 2.1%, the sector plays a significant enabling role in that it serves as a critical input for all the other sectors of the economy. Although the primary sector contributes only 12% towards GDP directly, the sector’s indirect contribution towards jobs and output within the tertiary and secondary sectors is significant. The importance of the primary sector towards the rest of the economy is highlighted in the Human Science Research Council (HSRC, 2008) report (HSRC, 2008) where a static input-output econometric analysis reveals that a decline in production within the mining sector will have negative effects on the secondary and tertiary sectors.

The importance of an individual sector to a national economy should be assessed both in terms of its contribution to output and employment. In a country like South Africa which suffers from a very high rate of unemployment, almost 25% in the 3rd quarter of 2011, the contribution of a sector to employment is arguably more important to future social and economic stability, than GDP. The South African government is trying to provide opportunities to all, yet historical disadvantages continue to have an adverse effect on the majority of the population. This is particularly true in employment, partly as a result of educational disparities, which the national planning commission (NPC) has identified as one of the most pressing challenges facing the country. Similar to the NPC report the New Growth Path (NGP) also identifies employment creation as one of the
highest priorities, where a 15% unemployment rate in 2020 is set as the target that will inform both the annual employment and growth targets. It is true that because of South Africa’s high unemployment issues most national polices are heavily focussed on increasing the number of jobs, especially within those sectors that are labour intensive.

Some sectors of the South African economy are by nature, more labour-intensive (high employment to GDP ratios) than others. For example, finance and business services, the largest sector of the economy, contributed 23.5% of GDP in 2010 but accounted for only 14% of employment in 2011. By contrast, wholesale and retail trade contributed 13.7% of GDP but employed a quarter of South African workers in 2011. The sectors that make the largest contribution to employment in South Africa are wholesale and retail trade, government services and manufacturing. Industries such as construction and personal services make a relatively small contribution to GDP but are nevertheless critically important to the South African economy because they are very labour intensive and employ 9% and 12% respectively of the total labour force.

Figure 1 South African GDP by Sector, 2010

Source: Frost and Sullivan, Reconstructed: Stats SA
In South Africa, a large proportion of the potential workforce and unemployed have attained only a basic level of education and according to the Q3-2011 labour force survey 75% of this group have not yet completed their secondary education. Thus the extent to which an industry generates or can generate employment for relatively low-skilled workers is also of interest to policymakers. The proportion of skilled, semi-skilled and unskilled labour required by each sector is illustrated in Figure 3.

Frost and Sullivan (June 2011) argue that the economy would become more energy intensive if it is reoriented towards creating employment for semi-skilled and unskilled workers but it is not clear that this would be the case since the industries that demand the largest proportion of low and semi-skilled labour are agriculture (85%), private households (89%) and construction (70%) and wholesale-retail trade (53%) and these labour
intensive industries are generally among the least energy-intensive. Energy-intensive industries by contrast, tend to be more capital intensive.

Mining, Manufacturing and Agricultural industries are also important in that they contribute to exports and South Africa’s foreign exchange earnings. For the first three quarters of 2011 manufacturing accounted for 73% of total merchandise exports by value while mining contributed 24% and agriculture 2%. The top four exports by value in 2010 were basic or semi-manufactured metals or minerals - Platinum, Coal, Iron Ore and Ferro Alloys.

**Figure 4 South Africa’s top merchandise exports by value, 2010**

![Exported Value in 2010, $US Million](chart)

<table>
<thead>
<tr>
<th>Product</th>
<th>Exported Value in 2010, $US Million</th>
</tr>
</thead>
<tbody>
<tr>
<td>Platinum</td>
<td>9,377</td>
</tr>
<tr>
<td>Iron ores &amp; concentrates</td>
<td>5,469</td>
</tr>
<tr>
<td>Cars</td>
<td>5,408</td>
</tr>
<tr>
<td>Diamonds</td>
<td>4,671</td>
</tr>
<tr>
<td>Unwrought aluminum</td>
<td>2,185</td>
</tr>
<tr>
<td>Transportation vehicles</td>
<td>1,952</td>
</tr>
<tr>
<td>Citrus fruit, fresh or dried</td>
<td>1,434</td>
</tr>
<tr>
<td>Flat-rolled products of stainless steel</td>
<td>1,235</td>
</tr>
<tr>
<td>Chemical wood pulp</td>
<td>1,169</td>
</tr>
<tr>
<td>Aluminum plates, sheets and strip</td>
<td>1,107</td>
</tr>
<tr>
<td>Cars</td>
<td>897</td>
</tr>
<tr>
<td>Diamonds</td>
<td>783</td>
</tr>
<tr>
<td>Iron ores &amp; concentrates</td>
<td>768</td>
</tr>
<tr>
<td>Platinum</td>
<td>764</td>
</tr>
<tr>
<td>Unwrought aluminum</td>
<td>598</td>
</tr>
<tr>
<td>Chemical wood pulp</td>
<td>597</td>
</tr>
<tr>
<td>Aluminum plates, sheets and strip</td>
<td>517</td>
</tr>
<tr>
<td>Platinum</td>
<td>500</td>
</tr>
</tbody>
</table>

Source: Deloitte Analysis, TradeMap 2011

From 2006 to 2011 exports of metals and other basic minerals grew significantly when compared to other exports, despite volatile and uncertain economic conditions globally. China is driving much of the demand for basic metals and minerals and has been the top destination for South Africa's exports since 2009. China is also South Africa's leading source of imports. China is the dominant investment partner among all the emerging partners with its foreign direct investment ranked fifth in terms of value in early 2010, at R33 billion. From the trend in manufacturing exports from 2006 to 2011, it is clear that exports of basic metals have returned to pre-recession levels and exports in basic chemicals and machinery are growing at attractive rates (Figure 5).
1.3. Current breakdown and historical trends in electricity consumption by sector

1.3.1. Total electricity consumption by sector

The non-ferrous metals (aluminium) and gold mining industries are the single largest consumers of electricity in South Africa and as such are important drivers of the overall demand for electricity. According to data from Statistics South Africa, gold and non-ferrous metals account for just under a quarter of total electricity consumption in South Africa (Figure 6).

Figure 6 Consumption of electricity by sector, 2010

Source: Stats SA.
Electricity, wholesale and retail trade, other mining and petroleum sectors are the next four largest consumers of electricity, and together account for another 25% of South Africa’s total electricity consumption.

As noted in Frost and Sullivan (June 2011), the top 15 sector-consumers of electricity in South Africa also contribute 45% of GDP. While the non-ferrous metals and gold mining sectors are the largest consumers of power, they make a relatively small contribution to gross domestic product (GDP). The wholesale\retail trade sector on the other hand is among the largest consumers of electricity but makes an even larger proportional contribution to GDP. By definition, energy-intensive sectors like gold mining, non-ferrous metals, soap and pharmaceuticals add relatively little value to the economy (in terms of GDP) per unit of energy consumed. The overall contribution of these sectors to GDP however, also depends on their linkages to sectors in the economy. For example, while the direct contribution of the mining and quarrying industry to GDP is only 6% it is linked to number of other sectors in the economy (e.g. Engineering services, financial and business services, banking, construction, transport, manufacturing etc.) and so its indirect contribution to GDP would be significantly higher.

![Figure 7 Sectoral comparison of electricity use and contribution to GDP, 2009](source: Reconstructed from Frost and Sullivan (2011))

**1.3.2. Trend in electricity consumption by sector and customer segment**

Given that gold, coal and ‘other’ mining are together responsible around 18% of total electricity consumption it is interesting to examine the trend in sales of electricity to the mining sector over time. A breakdown of Eskom’s sales to the mining industry from 1980 to 2008 reveals that gold has been the dominant consumer of electricity in the mining industry over this period. Overall consumption of electricity by the mining sector has remained relatively stable since the 1990s, since the decrease in electricity consumption from the gold sector has been replaced by the increase in electricity consumption by the platinum sector (Figure 8).
By contrast sales of electricity to the manufacturing sector increased sharply from 1980 to 2008 driven mainly by growth and increased consumption by the non-ferrous metals and iron and steel sub-sectors (Figure 9).

Overall, the analysis of the sub-categories of Eskom sales reveals that growth in electricity consumption from 1980 to 2008 was largely due to increased demand from the large manufacturing customers and sales to redistributors (municipalities) who primarily supply residential and commercial customers (Figure 10).
1.4. Key drivers of electricity consumption

1.4.1. Macroeconomic drivers of electricity consumption

The demand for electricity is based on number of factors that differ in terms of both their levels of significance and complexity. But at a macroeconomic level, the key drivers of electricity consumption are income price and technology (Platchkov & Pollitt, 2011). Rising levels of national income (or GDP) drive increased demand for electricity while increasing electricity prices reduce consumption.

Income however is the dominant macroeconomic driver of electricity consumption, meaning that consumption is typically more responsive to changes in income than it is to changes in price. A study on the price elasticity of demand for electricity in South Africa, Deloitte (2009) notes that the price elasticity of demand for electricity (responsiveness of electricity demand to a change in prices) across a wide range of countries typically lies
between -0.2 and -0.4, meaning that a 1% increase in prices usually results in a 0.2 to 0.4% decrease in demand. The income elasticity of demand for electricity on the other hand, usually ranges from 0.8 to 1.1 although in some countries it is significantly higher. This means that a 1% increase in income or GDP would typically be associated with a 0.8% to 1.1% increase in electricity consumption.

The strong historical correlation between GDP and electricity consumption in South Africa is illustrated in Figure 11. In a study on the evolution of the price elasticity of electricity demand in South Africa from 1986 to 2005, Blignaut & Inglesi-Lotz (2011) note that economic growth has proven to have been the main driver in South Africa and by contrast electricity prices have had almost no effect (Figure 12). The responsiveness of electricity consumption to prices however, has not been constant over time. When real electricity prices rose sharply in the early 1980’s, the price elasticity of electricity demand in South Africa was significantly negative (meaning that consumers decreased demand significantly in response to price increases). From the mid-1980s to 2007 however, there was a steady decline in real electricity prices and over this period they had increasingly little influence on consumption (Blignaut & Inglesi-Lotz, 2011). It seems likely therefore that as real electricity prices rise (as they have done since 2008), consumers will again become more sensitive to price and prices will again play an important role in determining electricity consumption in South Africa (Blignaut & Inglesi-Lotz, 2011).

**Figure 12** Price and income elasticities of electricity demand, 1986 to 2005

Source: (Blignaut & Inglesi-Lotz, 2011)

### 1.4.2. Microeconomic drivers of electricity consumption – structural and efficiency effects

While economic growth and prices are the key drivers of electricity consumption in the long-term, total energy consumption in developed countries has risen by less than the historical relationship between GDP and electricity consumption would have suggested. This as we have seen is because not all sectors of the economy are equally reliant on electricity and consumption patterns can vary considerably from one to another. In addition new technologies and sources of electricity demand are continually influencing the ways in which electricity is consumed (Platchkov & Pollitt, 2011). There are two main influences on electricity consumption at the sectoral or microeconomic level – the changing structure of the economy or ‘structural
effect’ which relates to differences in the energy intensity of different sectors; and the influence of new
technologies – or the ‘efficiency effect’.

1.4.2.1. The structural effect

The electricity intensity of a sector or economy can be defined as the amount of electricity consumed (in kWh
or GWh) to produce any given unit of output (in values). Because the electricity-intensity of production varies
considerably from one sector to the next, changes in the structure on an economy can have a significant
impact on the trend in energy consumption. Overall the energy-intensity\(^1\) of any given economy will typically
increase as the country industrialises and moves from an agricultural economy to an industrial economy. The
energy-intensity of the economy however starts to decline as it begins to move into the post-industrial phase
where growth is based increasingly on the rising demand for services (such as health, education and tourism)
rather than material goods (Inglesi-Lotz & Blignaut, 2011 b). Electricity intensity as compared to energy
intensity is expected to follow a similar trend.

As the South African economy has evolved it has become more diversified, more services-based and less
dependent on the primary sector (mining and agriculture). In 1970 mining accounted for nearly a fifth (21%) of
South Africa’s total GDP, while in 2010 its direct contribution was only 6% of GDP (Figure 13). By contrast
finance and business services contributed 24% to GDP in 2010 as compared to only 15% in 1970.

Despite the increasing contribution of less energy-intensive services to the economy, the electricity intensity of
the South African economy more than doubled in the period from 1990 to 2007 (Inglesi-Lotz & Blignaut, 2011 b).This was probably due to the increase in energy-intensive manufacturing activities in the 1990s, particularly
investment in the non-ferrous metals sector. The electricity intensity of the South African economy is thought
to have peaked between 2001 and 2007 (Figure 14). The decline in the electricity intensity of the economy
since 2007 is probably due in part to the impact of the global economic recession in 2008\(^9\) on the demand for

\(^{1}\) It is important to note that energy does not imply electricity, since other fuels such as petrol or diesel are also significant
sources of energy in many industries.
mining and manufacturing exports from South Africa. But it could also mark the beginning of a new phase in which growth will increasingly be based on the demand for less energy-intensive services and we will see further improvements in energy-efficiency of existing firms and industries as electricity prices continue to rise.

Figure 14 Electricity Intensity of the South African Economy

1.4.2.1. The efficiency effect

According to the World Energy Council in (Inglesi-Lotz & Blignaut, 2011 b), “[e]nergy 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’).” Energy-efficiency policies are receiving support from governments around the world because improvements in energy efficiency are increasingly recognised as one of the most economical ways of slowing down or reducing the demand for energy and mitigating the risk of negative environmental impacts. A study by Inglesi-Lotz & Blignaut (2011 b) which compares the electricity intensity of various sectors of the South African economy to the same industries in the OECD, found that there was significant scope for energy-efficiency gains in South Africa and noted that the importance of encouraging energy-efficiency and demand-side management could not be overstated.

1.4.2.1. A decomposition analysis of electricity consumption in South Africa

In a decomposition analysis of electricity consumption in South Africa, Inglesi-Lotz and Blignaut (2011a) found the main drivers of electricity consumption from 1993 to 2006, were output (economic growth) followed by efficiency improvements (technology/substitute) and lastly structural effects (Figure 15). This finding was not surprising since from 1994 up until the 2008/9 recession the South African economy had continue to expand at GDP growth rates that were above historical averages (Inglesi-Lotz & Blignaut, 2011 a).
From 1993 to 2006, the top three contributors to total national electricity consumption were ‘non-ferrous metals’ (14,089 GW h), ‘iron and steel’ (13,027 GW h) and ‘chemicals and petrochemicals’ (8449 GW h). A concerning trend was observed in the ‘non-ferrous metals’ industry which is not only the single largest consumer of electricity but also the sector that experienced the greatest decline in electricity efficiency over the period under study (Inglesi-Lotz & Blignaut, 2011 a). There was also a decline in energy-efficiency in the chemical and petrochemical industry but not to the same extent as the ‘non-ferrous metals’ sector. In addition, the overall increase in efficiency is misleading since the greatest gains in efficiency were in the transport sector and were in fact due to the collapse of the rail freight sector and switch in transport modes from rail (which consumes electricity) to road freight (which consumes petroleum products).

Inglesi-Lotz and Blignaut (2011 a) note that further (and bona fide) improvements in efficiency will be required to offset the positive impact that economic growth is having on electricity consumption. They also note that current macroeconomic and industrial policy frameworks (such NGP and the Industrial Policy Action Plan II (IPAP2), if successful in meeting their targets, will quite logically increase electricity consumption of all the sectors of the economy. They felt however, there was significant scope for an improvement in electricity efficiency and that policy makers should focus on sector-specific measures to achieve such improvements given large inter-sectoral differences.

1.5. The outlook for electricity consumption
Economic growth has been the primary driver of electricity consumption in South Africa and is likely to remain so for the foreseeable future. GDP is forecast to expand at an annual average rate of 4% from 2012 to 2015. Given that the income elasticity of electricity demand is estimated to be around 1.2 (approximately unit elastic), in the absence of other influences, the demand for electricity would rise at a similar rate to GDP.
In terms of the possible ‘structural effect’ on electricity consumption, forecasts by CSIR (in Frost and Sullivan 2010), suggest that the electricity intensity of the South African economy is likely to continue to decline over the next two decades. While declining energy-intensity would assist in moderating the increase in the demand for electricity, forecasts by the Economist Intelligence Unit (EIU) suggest that the energy intensity of growth in South Africa will continue to rise until 2020, Figure 17.
The CSIR appear to have based their forecast of a declining trend in the electricity intensity of the South African economy on the assumption that the contribution of the energy-intensive mining and manufacturing sectors to the economy will continue to fall, in keeping with recent historical trends. Frost and Sullivan argue that this may not be the case since the current government economic and industrial policy frameworks (NGP, IPAP2) are actively seeking to promote the relatively energy-intensive mining and manufacturing industries. IPAP2 includes the aim of developing a Green industry that contains an industrial energy efficiency plan which looks at upgrading industrial machinery, facilitation of a national smart grid and reducing the transport sectors dependence on oil. If these plans are put in place then the electricity intensity of the manufacturing sector will fall, but the amount of total electricity consumption by the sector is still likely to increase given the policies aims of developing the metal fabrication, capital and transport equipment, oil and gas, agro-processing and boat building industries. In addition to these industries IPAP2 identifies the medium and heavy commercial vehicles, plastic, pharmaceutical & chemicals, clothing & textiles and forestry industries for additional support. If government is successful in driving increased investment in the primary and secondary sectors of the economy, then electricity intensity of growth will in all likelihood increase.

While the demand for electricity in South Africa has historically been very unresponsive to price, it seems likely (as we noted in Section 281.4.1) that as real electricity prices rise (as they have done since 2008), consumers will again become more sensitive to price and prices will again play an important role in determining electricity consumption in South Africa. However it is too early to identify the impacts of recent prices increases so one can only speculate about the magnitude of the impact.

Overall it seems unlikely that rising in prices or increased uptake of energy efficiency measures will be sufficient to offset the impact of rising national income on the demand for electricity over the next decade. It is not clear what impact structural effects will have on demand given the considerable differences in opinion around the trend in the electricity intensity of the South African economy.

1.6. Conclusion

The purpose of this chapter was to give context to the broader analysis of the impact of rising electricity prices on different sectors of the economy, by providing a brief overview of the current structure of the South African economy and the trend in and drivers of electricity consumption.

In terms of the current structure of the economy and contribution of the various sectors we found that the South African economy, like most post-industrial, middle to high income economies, is dominated by services-related activity which accounted for just over two thirds (67%) of GDP in 2010. However, manufacturing remained the second-largest individual sector contributor at 17.2% of GDP and the, the direct contribution of the relatively energy-intensive primary and secondary activities which include manufacturing, mining, electricity and other utilities, and agriculture remains significant at 28% of GDP.

The importance of an individual sector to a national economy however should be assessed both in terms of its contribution to output and employment. The sectors that make the largest contribution to employment in South Africa are wholesale and retail trade, government services and manufacturing. Industries such as construction and personal services make a relatively small contribution to GDP but are nevertheless critically important to
the South African economy because they are very labour intensive and employ 9% and 12% respectively of the total labour force.

In South Africa, the extent to which an industry generates or can generate employment for relatively low-skilled workers is also of interest to policymakers because a large proportion of the potential workforce and unemployed have attained only a basic level of education. It has been argued that the economy would become more energy intensive if it is reoriented towards creating employment for semi-skilled and unskilled workers but it is not clear that this would be the case since the industries that demand the largest proportion of low and semi-skilled labour are agriculture (85%), private households (89%) and construction (70%) and wholesale/retail trade (53%) and these labour intensive industries are generally among the least energy-intensive.

In terms of the contribution of sectors to total electricity consumption we found that non-ferrous metals and gold mining are the single largest consumers of electricity in SA, responsible for 25% of total consumption, but they make a relatively small direct contribution to GDP (about 4%). The overall contribution of these sectors to GDP however, also depends on their linkages to sectors in the economy. By definition, energy-intensive sectors like gold mining, non-ferrous metals, soap and pharmaceuticals add relatively little value to the economy (in terms of GDP) per unit of energy consumed.

An analysis of the sub-categories of Eskom sales reveals that growth in electricity consumption from 1980 to 2008 was largely due to increased demand from the large manufacturing customers and sales to redistributors (municipalities) who primarily supply residential and commercial customers.

In terms of the key drivers of electricity consumption we found that the demand for electricity is based on number of factors that differ in terms of both their levels of significance and complexity. But at a macroeconomic level, the key drivers of electricity consumption are income and price. Over the past two decades, economic growth (income) has proven to have been the main driver of electricity consumption in South Africa and by contrast electricity prices have had almost no effect. The responsiveness of electricity consumption to prices however, has not been constant over time and as price rise beyond certain ‘threshold’ levels it is likely they will once again have a greater impact on consumption.

While economic growth and prices are the key drivers of electricity consumption in the long-term, total energy consumption in developed countries has risen by less than the historical relationship between GDP and electricity consumption would have suggested. This as we have seen is because not all sectors of the economy are equally reliant on electricity and consumption patterns can vary considerably from one to another. At a microeconomic level the two main influences on electricity consumption are the changing structure of the economy or ‘structural effect’ and the influence of new technologies or the ‘efficiency effect’.

Despite the increasing contribution of less energy-intensive services to the economy, the electricity intensity of the South African economy more than doubled in the period from 1990 to 2007. This was probably due to the increase in energy-intensive manufacturing activities in the 1990s, particularly investment in the non-ferrous metals sector.
A study comparing the electricity intensity of various sectors of the South African economy to the same industries in the OECD, found that there was significant scope for energy-efficiency gains in South Africa and noted, that the importance of encouraging energy-efficiency and demand-side management could not be overstated. Another study found that over the period 1993 to 2006 efficiency gains had a significant positive impact on overall electricity consumption but it is acknowledged that the results could be misleading since the greatest gains in efficiency were in the transport sector and were in fact due to the collapse of the rail freight sector and switch in transport modes from rail (which consumes electricity) to road freight (which consumes petroleum products).

Finally, with respect to the outlook for energy consumption it seems unlikely that rising in prices or increased uptake of energy efficiency measures will be sufficient to offset the impact of rising national income on the demand for electricity over the next decade. It is however, not clear what impact structural effects will have on demand (whether they will have a positive or negative impact) given the considerable differences in opinion around the trend in the electricity intensity of the South African economy.
2. Electricity prices in South Africa—history, methods and the move to cost-reflective tariffs

2.1. Introduction
In early 2008 South Africa experienced a series of highly disruptive outages and load-shedding episodes that came at an enormous cost to the economy. The electricity supply crisis, finally prompted decision makers to respond to the capacity shortage that had been threatening to emerge for some time, and Eskom was the go-ahead to embark on a massive investment programme. However, in the 20 years since Eskom had last invested in base load capacity, electricity tariffs had declined to such an extent that it became apparent that Eskom would not be in a position to finance the new build programme on the basis of its existing low tariffs and inadequate revenue stream.

The purpose of this chapter is to provide some context to the recent electricity price hikes and to ‘set the scene’ for an analysis of the impact of rising electricity prices on different sectors of the economy. We begin the chapter by examining some of the factors that have historically had a bearing on the level and trend in electricity prices in South Africa, and focus in particular on the influence of Eskom’s investment history and pricing policies. In the next section we examine some of the criticism of Eskom’s historical pricing policies and draw some insights from the similar experiences of other international utilities. The remainder of this chapter is structured as follows: in the next section we identify the requirements of an effective electricity pricing regime and define and explain the concept of ‘cost reflective tariffs’. The chapter concludes with a critical review of the current multi-year price determination process and methodology.

2.2. History of electricity prices in South Africa

2.2.1. Trend in real and nominal electricity prices
For much of the past three decades, electricity prices in South Africa have been low and declining (in real terms) (Blignaut & Inglesi-Lotz, 2011). Between 1978 and 2008 the real average price of electricity\(^2\) fell by more than 40% from 39.7 c/kWh (in 2011 rands) in 1978 to 22.7 c/kWh in 2008 (Figure 18). From 2008 the trend in prices took a dramatic turn when, in response to serious power supply shortages, Eskom was forced to embark on a massive build programme to increase power generation capacity. In an uncanny resemblance to the events and trend in prices in the late 1970s, real electricity prices rose by 78% between 2008 and 2011.

There are many factors that have historically had a bearing on the level and trend in electricity prices in South Africa, including changes in the broad political and regulatory environment (Steyn G., Administered Prices, Electricity - A Report for National Treasury, 2004). It is argued however, that the dominant driver of price changes was Eskom’s investment history and its accounting and pricing policies (Steyn G., 2006).

\(^2\) Average prices are calculated as the total electricity revenue realised by Eskom divided by the total kWh produced in a given period, these are then adjusted for inflation to calculate real prices and expressed in 2011 Rands.
2.2.2. Impact of Eskom’s investment history on electricity prices (1974 to 2001)

In 1974, a year after the international oil crisis, the prices of many fossil and nuclear fuels including coal, oil and uranium had soared while electricity prices in South Africa had remained relatively low and stable. (Steyn G., 2006). The relative change in energy prices prompted South African to switch from expensive sources of power to electricity (the diesel and oil-fired generators of municipalities became uncompetitive and were replaced with wholesale electric power purchases). From 1971 to 1975 the demand for electricity supplied by ESCOM, the state-owned electricity utility (now Eskom) consistently outstripped growth in supply. In response to the shrinking capacity reserve margin and reacting to concerns that the utility was holding back economic growth, ESCOM rapidly increased its plant orders. Construction of coal-fired power station Matla began in October 1974, the Drakensberg pump storage scheme in January 1975 and coal-fired Duva in November 1975. The construction of Koeberg nuclear plant, which was commissioned by Government largely for strategic political reasons, began in August 1976. (Steyn G., 2006) (Eberhard & Mtepa, Rationale for restructuring and regulation of a ‘low priced’ public utility, 2003).

In order to be able to finance the build programme and service its rapidly increasing debt, sharp increases in electricity prices were required. Between 1974 and 1978, ESCOM increased electricity prices by just under 70% (in real terms). Despite the fact that ESCOM had technically created sufficient capacity to meet demand, the utility underestimated the risks associated with up-scaling to larger units and it ran into enormous operational difficulties which culminated in wide-spread load shedding in 1981 (Steyn G., 2006).
To counter the perceived threat of further power shortages, ESCOM embarked on an expansion programme in the early 1980s that dwarfed all its previous efforts. The result was an overestimation of demand (based on historical trends and optimistic growth forecasts), over-building of plant a massive power capacity surplus that persisted for the following decade (Eberhard & Mtep a, Rationale for restructuring and regulation of a low priced public utility, 2003). “By 1983 Eskom had generation plant totalling 22 260 MW under construction or on order. This would have effectively have doubled its total plant in commission” (Steyn G., 2006). As result, not long after the sharp increases of the late 1970s, Eskom was again compelled to increase price in real terms from 1982 to 1983.

The second round of price increases provoked a public outcry and led directly to the appointment of the De Villiers Commission of Enquiry into Eskom’s activities in 1983. “The Commission was critical of ESCOM’s governance, management, forecasting methods, investment decisions, and accounting” (Eberhard & Mtep a, Rationale for restructuring and regulation of a low priced public utility, 2003)). The commission found that Eskom, having grossly overestimated future demand, was substantially overinvesting in capacity. In addition the commission found that ESCOM was “fundamentally oriented to providing an abundant supply of electricity” (de Villiers et al in (Steyn G., 2006)), and that given the demands being placed on finite capital in the South African economy, the notion of providing abundant supply at cost (or any cost) should be discarded.

One area in which the recommendations of the De Villiers report was heavily criticised was with respect to pricing. Kantor (1988) noted that Commission felt it was undesirable to expose South Africa to marginal cost pricing (presumably long-run marginal cost pricing) because it felt it may jeopardise industry exports and instead recommended a system of ‘consumer-privileged’ tariffs with objectives that were ‘debt management driven’. In doing so the Commission gave precedence to financial management over sound economic principles (Kantor, 1988). The Commissions view was that because ESCOM’s equity was dividend free, consumers should enjoy lower tariffs than if ESCOM’s equity had consisted of dividend paying share capital (Steyn G., 2006).

Following the findings of the commission, ESCOM underwent a major restructuring and was renamed Eskom. New Electricity and Eskom Acts were passed in 1987 and an Electricity Council comprising of mainly of representatives of major consumers but also distributors and government was formed. A clause in the electricity act exempt Eskom from having its prices regulated, and so effectively relied on the consumer-dominated Electricity Council to control prices. In place of the principle of operating at ‘neither a profit or loss’ Eskom was increasingly subject to commercial imperatives and was given the overall objective of providing a system to satisfy the electricity needs of consumers in the most cost-effective manner subject to resources constraints and national interest.

The reforms however did not change the way in which Eskom’s management was able to shift economic and financial risks onto its consumers and the government nor did they foster a better appreciation of the economic cost of excess capacity. The substantial over-investment in generation capacity went ahead, destroying significant public economic value in the process. Eskom’s enormous build programme could only be partly delayed and only one of the power stations on order were cancelled. By the late 1980s a substantial surplus power capacity problem had emerged. In a bid to further reduce excess capacity, Eskom mothballed and decommissioned a number of old and less efficient power plants. The utility also actively marketed its
surplus capacity to the industries for use in mineral beneficiation projects and negotiated interruptible supply agreements with Aluminium and ferrochrome plants. (Steyn G., 2006).

Having increased its price levels sharply in the late 1970s Eskom was able to contain its rapidly increasing debt burden by more or less maintaining prices in real terms throughout the 1980s (Figure 20). And despite the fact that Eskom was stranded with costly surplus capacity its financial position improved. This was largely because Eskom was able to take advantage of its monopoly position and maintain real prices (whereas in a competitive environment it would have been forced to reduce them) (Steyn G., 2006). Eskom (and its customers in turn) also benefited from the fact that it was exempt from paying profits (dividends) and tax and it did not have to bear the full economic opportunity cost of the debt finance (including risk and uncertainty) that employed to finance its investments. “Government guarantees, open-ended Reserve Bank forward cover, and its monopoly position effectively shifted most of its business and financing risk on to consumers and the state.” (Steyn G., 2004). Over this period Eskom was primarily concerned with satisfying its debt financiers and highlighting its performance as a borrower. Its strong financial position was emphasised while the little thought was given to the inefficient manner in which it had employed economic resources and the large implicit ‘economic opportunity cost’ incurred.

By the early 1990s, the interest burden on Eskom’s debt had declined and the option of increasing profit margins was not politically viable. Eskom came under pressure to reduce its prices but according to (Steyn G., 2004), “cleverly turned this situation into a public relations triumph by announcing a pricing compact which was designed to allow average prices to gradually reduce in real terms as its debt continue to decline in real terms”. Under the first voluntary pricing compact, Eskom told government it was prepared to reduce the real price of electricity by about a fifth between 1992 and 1996 (Eberhard & Mtepa, Rationale for restructuring and regulation of a ‘low priced’ public utility, 2003). In a second pricing compact “the RDP commitment” Eskom aimed to reduce the real price of electricity by 15% between 1994 and 2000.

A National Electrification Forum recommended the rationalisation of the distribution sector and the conversion of the Electricity Control Board into a NER (National Electricity Regulator) with powers to regulate the entire industry. The NER was established in 1995 but because of Eskom’s self-adopted pricing compact, it had limited influence in price setting until 2001. Because of its surplus generation capacity and financial policies, Eskom was able to allow real prices to decline throughout the 1990s and by the end of the decade prices were well below full-economic levels (long-run marginal cost). The low price of electricity prices attracted further investment by energy-intensive industries, which were in addition often able to secure pricing contracts at well below the already under-priced average tariff (Steyn G., 2004). In the same period, South Africa held its first democratic elections ushering in a new government with changed priorities. Eskom embarked on a massive electrification programme which increased the proportion of the population with access to electricity from one third to two thirds. Financial surpluses generated in the 1990s were used to fund the electrification programme (at least initially) and to implicitly under-price wholesale power.

2.2.3. The era of formal electricity price regulation in South Africa
It was only in 2001 that the NER really began to engage in effective electricity price regulation and the development of a uniform regulatory methodology for price setting was initiated (Deutsche Securities Pty Ltd, March 2010). In the same year, The Eskom Conversion Bill of 2001 replaced the old Eskom Act of 1987 and
Eskom was converted into a public company (Eskom Holdings Ltd), which with its share capital owned by the state was now subject to taxes and dividends. The stated aim of the bill was to bring about more efficiency and competitiveness in the running of Eskom, to expose the utility to global trends and to ensure that it was run in terms of a protocol on cooperative governance (Eberhard & Mtepa, Rationale for restructuring and regulation of a ‘low priced’ public utility, 2003).

Although a framework for the economic regulation of electricity prices based on the Rate of Return (ROR) Methodology was approved in 2003 for implementation in 2004 it is clear that between 2001 and 2007, the price of electricity was simply increased in line with or somewhat below consumer price inflation. In 2005 the National Energy Regulator (NERSA) was established (replacing the NER in July 2006). In 2005 NERSA moved to multi-year price determination (MYPD) process for Eskom covering the period April 2006 to March 2009. The intention was that the MYPD would allow price stability and a longer term planning horizon as Eskom had to start providing for massive capital investments in new generation capacity. (NERSA, 2009).

For the first MYPD period, Eskom was initially granted a price increase of CPI plus 1%. The approved price increases however proved completely inadequate as the projected capital costs associated with the construction of Medupi and Kusile power stations (and associated infrastructure) rose from initial estimates of R97 billion to R345 billion. Eskom was also subject to massive increases in primary energy costs as it increasingly had to source coal on the open market.

In December 2007, NERSA granted Eskom a revised increase of 14.2% for 2008/9 (up from 6.2% previously). In early 2008 demand for electricity outstripped supply and Eskom was forced to engage in extensive loadshedding. In March 2008 Eskom applied for a further revision of the 14.2% increase (for 2008/9) to 60%, the Regulator approved a further price increase of 13.3% bringing the overall increase for 2008/9 to 27.5%. Eskom was unable to submit a second MYPD application within the stipulated timelines because of uncertainty regarding its funding model and applied instead for an interim price increase of 34% for 2009/10. In September NERSA approved a 31.3% increase but this included a government environmental levy of 2c/kWh (so Eskom’s effective increase was considerably lower). (NERSA, 2010).

NERSA received Eskom’s MYPD2 application in September 2009. The application generated considerable public interest and so after a process of extensive stakeholder engagement NERSA granted Eskom price increases of 24.8%, 25.8% and 25.9% for 2010/11 through to 2012/13. In an attempt to appear to be softening the blow NERSA also decided to implement an inclining block tariff for domestic customers in the MYPD2 period. Over the period 2008 to 2011 NERSA’s pricing decisions gave rise to a 78% increase in real electricity prices.

2.3. International comparison of electricity prices
An international comparison of South Africa with a broad selection of countries (based on data provided in the International Energy Agency Energy Statistics Report, 4Q10) reveals that in 2006, Eskom’s industrial and household electricity tariffs were among the lowest in the world (Figure 21 and Figure 22 ). In 2006, tariffs for
industrial consumers in South Africa\textsuperscript{3} were about one fifth of the equivalent OECD Europe average tariff and the lowest of all countries included in the International Energy Agency Report.

\textbf{Figure 21} Electricity tariff for industrial consumers, 2006

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure21}
\caption{Electricity tariff for industrial consumers, 2006}
\end{figure}

\textsuperscript{3} Industrial tariffs were defined in the IEA report as direct sales by Eskom to industry, while the household tariff was defined as direct sales by Eskom for domestic use and street lighting.

Similarly, tariffs for household consumers in South Africa were about one third of the OECD Europe average and the average for South African household tariffs in 2006 and were the second lowest of all countries included in the International Energy Agency Report (only Kazakhstan had lower tariffs).

\textbf{Figure 22} Electricity tariff for household consumers, 2006

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure22}
\caption{Electricity tariff for household consumers, 2006}
\end{figure}

Source: (International Energy Agency, 2010). Data for Russia and Cyprus was not available for 2006.
Despite the sharp 78% increase in real electricity prices between 2008 and 2011, a more recent survey of international electricity prices by NUS Consulting (June 2011) shows that compared to a smaller sample of 15 developed countries, South Africa still had one of the lowest average electricity tariffs, second lowest only to Canada\(^4\). Additionally, at the time of the survey, the rand was relatively strong, trading at 6.80 to the dollar. At current exchange rates (around R8.10 to the dollar), South Africa would have the lowest price in the sample. Although the gap between the price of electricity in South Africa and other developed countries appears to have narrowed, this comparison suggests that in 2011 electricity prices in South Africa were still low by international standards and are likely to be below ‘cost-reflective’ levels. While countries that generate a larger proportion of their electricity from renewable sources, such as Germany are likely to face higher generation costs, South Africa’s tariffs are still low when compared to a country like Australia which also generates electricity largely from coal.

Figure 23 Average electricity price comparison, 2011

Source: NUS Consulting, 2011

2.4. The major criticisms South Africa’s historical pricing policies

One of the major criticisms of Eskom’s historical pricing policies is the fact that electricity prices in South Africa, while low by international standards, have remained well below ‘cost-reflective’ levels for a prolonged period of time. Electricity prices have not reflected the true economic cost of supplying power, which has led to poor investment decisions and a gross-misallocation of the country’s economic resources.

It is argued that lenient financial requirements under full state ownership, state guarantees and Eskom’s flawed historic cost-accounting practices contributed directly to the under-pricing of electricity (Steyn G., 2004). Eskom was a state-owned utility until 2001 and was not subject to taxes, dividends or other typical commercial imperatives. In the late 1980s it also receive free forward cover on its foreign currency loans from the Reserve Bank and benefited from government guarantees on its debt. As such Eskom did not have to bear the full economic opportunity cost of the capital employed to finance its investments (including risk and uncertainty) and it was effectively able to amortise its debt while maintaining artificially low electricity prices.

\(^4\) The survey was based on prices as of 1 June 2011 for the supply of 1,000 kW with 450 hours use. For deregulated supplies, 1 June contract pricing was obtained during the week of 26 April 2011. All prices are in US cents per kilowatt hour and exclude VAT.
2.4.1. Impact of Eskom’s accounting policies on electricity prices

Until recently, Eskom’s prices were determined on the basis of historical cost accounting principles. The traditional historical cost accounting approach is concerned with the recovery of sunk costs (for example recovering the actual cost of an investment in a newly constructed power station). Under this approach, electricity tariffs were designed to recover (in addition to variable costs) the depreciated historic cost of Eskom’s assets multiplied by a nominal return on assets (ROA) (Deutsche Securities Pty Ltd, March 2010).

But the historical cost asset valuation approach suffers from a number of drawbacks - Firstly it is a backward-looking approach implies that future generation capacity will be as cheap or as expensive as it was in the past (Vedavelli, 1989). For example, if the cost of building a coal-fired power station has doubled since the last coal-fired power station was built and tariffs are based on the depreciated historic value of the existing station, there would be no incentive to expand capacity unless tariffs rose sharply since the power station investor would not be able to recover the cost of their capital investment at the existing low tariff. Secondly tariffs based on historical cost accounting cannot incorporate the impact of evolving technologies and a potential change in plant mix. Tariffs based on historical cost approaches will not reflect the costs of a utility employing new technologies (be they nuclear, renewable or simply more efficient). (Telecommunication Development Bureau, March 2009). Thirdly, the depreciation charge is determined somewhat arbitrarily and if assets exceed their estimated ‘useful lives’, the depreciated value of the asset will be zero and tariffs will reflect only the operating costs associated with the power plant and not its true economic value.

In the capital intensive electricity supply industry, where investments are lumpy and assets may last for 20 to 40 years, the historic cost approach will typically result in a declining tariff over the life of the asset and a massive increase in tariffs when the old asset is replaced (Figure 24). In Eskom’s case the decline in prices was particularly severe because after the over-investment in base load generating capacity in the late 1970s and early 1980s no new capacity was built for almost 20 years. Once the build programme resumed, the existing asset base was so heavily depreciated that significant prices hikes were required to fund new investment in new capacity. Steyn (2006) notes that in 2006, Eskom’s 39810 MW generation capacity had a balance sheet had a depreciated value of R24.7 billion. In the same year, the construction a new 4000MW plant which would have added 10% to installed capacity would have cost around R26 billion – more than the balance sheet value of the entire existing asset base.
An argument often presented by the public is that cash flows generated by Eskom when its depreciated asset values and consequently tariffs were still relatively high, should have been sufficient to repay its debt and accumulate reserves to replace its assets in future. In reality though while Eskom’s cash flow was sufficient to amortise its debt, significant surplus capacity meant it never realised much of the potential sales and associated cash flow and higher-than-expected inflation gradually eroded the real return it received on its assets (Deloitte, 2010). Consumers also benefitted from the fact that Eskom was not able to recover the full costs of its assets in the form of a 17 year decline in real electricity prices that have resulted in some of the most inexpensive electricity in the world.

2.4.2. Similar experience of international electricity utilities

The major issues and criticisms that Eskom has faced are not however peculiar to South Africa. In a World Bank study of energy pricing policy in 1989, Vedavelli noted that the experience of World Bank borrowers had demonstrated that in the energy supply industry, poor investment decisions (such the installation of insufficient or excess capacity or a sub-optimal plant mix) take many years to recover from. Where insufficient capacity had been installed, long lead times to build additional plant meant it could take years to years to restore adequate supply and where excess capacity had been installed it typically took many years for demand to increase to a level justifying the plant additions (Vedavelli, 1989).

Providing an example of a typical case in which poor price signals led to poor decision making, Vedavelli describes a situation that closely resembles recent experience in the South African electricity supply industry, “A classic case of power system disequilibrium arises when tariffs are too low and demand is consequently stimulated. Because of low tariffs internal cash generation is insufficient to finance new investment… Potential capacity shortages lead to low capital cost, high fuel cost plant (e.g. gas turbines) being installed, which aggravates the imbalance in the system and promotes higher imports (or reduced exports) of petroleum. Chronic shortages of finance make the utility more dependent on government support, which usually leads to lack of autonomy, government interference in day to day affairs and further loss of efficiency…Such tendencies tend to reinforce each other in a downward spiral that eventually impacts on the wider economy,
e.g. the government budget, balance of payments, or lost output due to power shortages, resulting in painful adjustment process.”

2.5. Requirements of an effective electricity pricing regime

2.5.1. General Pricing Principles

In designing an effective electricity pricing regime it is often necessary to try and satisfy a range of, sometimes conflicting, social, economic and political objectives. It is argued however, that primary objective of any pricing regime should be to ensure that national economic resources are allocated efficiently both among different sectors of the economy and within the electricity supply industry (Vedavelli, 1989). “This implies that cost-reflecting prices must be used to indicate to the electricity consumers the true economic costs of supplying their specific needs, so that supply and demand can be matched efficiently” (Vedavelli, 1989). Prices should also reflect the differences in the cost of supplying different groups of consumers (e.g. Residential vs. Industrial, Rural vs. Urban). In addition an effective pricing regime should aim to satisfy the following objectives:

a) Fair allocation of costs among consumers according to the burdens they impose on the system
b) Large fluctuations in prices from year to year are avoided;
c) A minimum level of basic service is provided to those who cannot afford them;
d) Prices raise sufficient revenue to ensure the industry is financially sustainable;
e) The tariff structure is administratively efficient;
f) And, to the extent possible, other political objectives can be considered (e.g. subsidies to enhance growth and/or regional development).

In addition to designing an appropriate pricing regime, it also important that sound investment decisions ensure that demand is met at least cost, meaning that the cost of labour, fuel and capital inputs to production are minimised. (Vedavelli, 1989).

2.5.2. Tariff principles accepted by NERSA and Government

While the basic properties of a ‘optimal’ electricity tariff, which as discussed include cost-reflectivity and efficiency, revenue adequacy and transparency in the provision of subsidies, have already been accepted by both NERSA and Government, it is argued that these principles have not yet been systematically implemented (Newbury & Eberhard, 2008). According to NERSA (14 October 2011), the legal basis for the current multi-year price determination process lie in the Electricity Regulation Act of 2006 which prescribes the following tariff principles:

1) A license condition determined under section 15 relating to setting or approval of prices, charges and tariffs and the regulation of revenues –
   a) Must enable an efficient licensee to recover the full cost of its licensed activities, including a reasonable margin or return;
   b) Must provide for or prescribe incentives for the continued improvement of the technical and economic efficiency with which the services are to be provided;
   c) Must give end users proper information regarding the costs that their consumption imposes on the licensee’s business;
d) Must avoid undue discrimination between customer categories; and may permit the cross subsidy of tariffs to certain classes of customers.

2) A licensee may not charge a customer any other tariff and make use of provisions in agreements other than that determined or approved by the Regulator as part of its licensing conditions.

In addition to the Act, the Electricity Pricing Policy (EPP) published by the Department of Mineral Affairs and approved by cabinet in 2008 stipulates broad pricing principles and guidelines that NERSA should follow. It is interesting to note that the EPP went as far as to stipulate the timeline over which government felt that cost-reflective prices should be achieved, “All [electricity] tariffs should become cost-reflective over the next five years [by 2013] subject to specific cross-subsidies as provided for in section 9.”

2.5.3. Defining ‘cost-reflective’ tariffs

While the term “cost-reflectivity” is often used in political rhetoric relating to the energy supply industry and both NERSA and the South African government have made commitments towards achieving ‘cost reflective’ tariffs, in reality there are many differences of opinion about how ‘cost-reflectivity’ should be defined (Danilyuk, 2009).

The definition of cost-reflective tariffs is complicated by differences in the economic and accounting definitions of costs. Accounting costs are the costs that appear on firm financial statements, they are explicit financial costs that have been incurred in the past and tend to be backward looking. Economic costs by contrast are the sum of explicit costs and the implicit opportunity cost incurred and are forward-looking. As Turvey (2000) notes, “Economists tend to think about costs in terms of static, timeless models with continuous cost functions. The real context is, however, one of businesses and systems which already exist and have accumulated a collection of assets of various vintages whose accounting cost reflects past prices, past circumstances and arbitrary conventions about depreciation.”

In terms of economic theory, a ‘cost-reflective’ tariff is most often defined as a tariff equal to the long-run marginal cost (LRMC) of supply, since this concept is consistent with the efficient allocation of economic resources. “One of the best-known results in economics is that resources are most efficiently [allocated] when prices are set according to marginal costs” (London Economics, 1997). In the case of an electricity utility, the marginal cost is the cost of supplying one additional unit of electricity. However, because there are massive economies of scale to be realised in the generation of electricity and investments in additional capacity take place in large discrete amounts and at intervals of several years, conventional short-run marginal cost pricing would lead to massive fluctuations in electricity prices. By way of illustration, Q1 in Figure 3 represents an energy utility’s current capacity and Q2 the next instalment in capacity (a new plant). The capital investment in Q1 is a sunk cost so until demand begins to approach Q2, prices set at marginal cost are simply equivalent to the operating and maintenance costs. However as demand increases and new users are added to the grid existing capacity will eventually start to come under strain, marginal cost (and therefore prices) will rise sharply to reflect the full investment cost of additional capacity that will soon be required to meet growing demand and get to Q2. As soon as capacity is installed, the marginal cost is again equivalent to just the operating and maintenance costs associated with capacity Q2.
Since massive spikes in electricity prices are unlikely to be acceptable and could come at significant social costs, most economists favour long-run marginal cost as the basis for electricity prices (and for setting prices in other industries where investments are similarly long-term). Long-run marginal costs can be defined as the cost of supplying one additional unit of electricity when all the inputs (including capacity) are variable.

While a theoretically robust concept, LRMC in practice is hard to estimate and so it has been difficult for public utilities to define the concept in operational terms and as Andersson and Bohman (1985) note, average cost concepts are often used as approximations.

### 2.5.4. Operationalising the concept of ‘cost-reflectivity’ - a review of tariff setting methodologies

In practice, determining a ‘cost-reflective’ tariff that approximates the economic concept of LRMC involves the choice of a method of price regulation and then agreement on how to measure some of the more subjective components of the relevant tariff formula. In non-competitive electricity markets, end-user prices are typically set with regulatory approval. Two of the most widely used methods of price regulation that are the rate-of-return regulation or ‘revenue requirement’ regulation and the performance-based or ‘price-cap-system’. Currently NERSA uses the rate-of-return approach to regulation which involves defining the utility’s revenue requirement, on a cost plus basis. Eskom allowed a ‘revenue amount’ to cover its operating costs plus a return on its assets ideally calculated to match the utility’s cost of capital. The return on assets component should be designed to ensure the sustainability of Eskom by providing for sufficient revenue to maintain and upgrade existing infrastructure and investment in new capacity when required. One of the drawbacks of this approach, is that if the allowed return is applied to a historic cost asset base, it may not provide sufficient
incentive and financing ability for future investment. Alternatively, an arbitrary return or inappropriate asset valuation method could be chosen (in essence tariffs might not reflect the LMRC of supply). (Danilyuk, 2009).

Under the performance-based regulation, the regulator sets a long-term (usually 4-5 years) cap on the unit price of electricity. Operators are only allowed to adjust prices for inflation and productivity gains. The advantages of this approach are that it can encourage efficiency (which can be achieved through both cost reductions and technological innovation) and drive increased competition. (Danilyuk, 2009).

2.6. The current multi-year price determination process and methodology

Electricity price adjustments in South Africa are currently determined by NERSA through the Multi-Year Price Determination (MYPD) methodology. The MYPD is based on rate-of-return principles and was developed for the regulation of Eskom’s required revenues, which is the basis on which prices are effectively adjusted. As discussed above, the first implementation period for the MYPD was from 01 April 2006 to 31 March (the duration of each MYPD period is three years) while the second and current period MYPD2 runs from 1 April 2010 to 31 March 2013. (NERSA, 14 October 2011).

In terms of the MYPD, Eskom’s allowed revenue must be determined by applying the ‘allowed revenue’ formula illustrated in Figure 26.

**Figure 26 Tariff formula – Eskom’s allowable revenue**

\[ AR = (RAB \times WACC) + E + PE + D + TNC + R&D + IDM + SQI + L&T +/- RCA \]

Source: Deloitte Analysis, NERSA (14 October 2011).

**2.6.1. Defining the subjective components of tariff formula to achieve cost-reflective tariffs**

When aiming to establish a ‘cost-reflective’ tariff that approximates LRMC, the two tariff formulae components that are likely to have the largest impact are the Regulatory Asset Base and Weight Average Cost of Capital (or return on assets). As noted in the Electricity Pricing Policy (DME, 2008), “The revenue requirement for a regulated licensee must be set at a level which covers the full cost of production, including a reasonable risk adjusted margin or return on appropriate asset values. The regulator, after consultation with stakeholders, must adopt an asset valuation methodology that accurately reflects the replacement value of those assets such as to allow the electricity licensee to obtain reasonably priced funding for investment; to meet Government defined economic growth.” In other words the EPP requires an asset valuation method that reflects the replacement costs of assets.
2.6.1.1. Selecting an appropriate asset valuation method

As we noted earlier much of the criticism of Eskom’s previous pricing policies was directed at the inappropriate accounting policies that led to an undervaluation of Eskom’s asset base. Once the size of the regulatory asset base has been established (there are ‘best practice’ criteria to establish which assets should be included) an appropriate basis for valuation of the Regulatory Asset Base (RAB) must be defined.

There is no single ‘best practice’ asset valuation method, since the appropriate choice of method depends on the type of asset and characteristics of the industry. Most method fall into one of two categories – methods based on valuing assets at historic cost and those based on re-valued assets as discussed below:

Methods Based on Historic Cost

1) **Historical Cost (HC):** This is the simplest method of valuing the asset base – the actual cost incurred when the asset was purchased is adjusted for historic capital expenditure, asset disposals, and depreciation to arrive at the final asset value (Danilyuk, 2009). Under this method the investor is awarded a nominal WACC (the real estimated cost of capital adjusted for expected inflation) on the depreciated asset value plus the depreciation charge. In essence the investor is able to recover, over the life of the asset, the original acquisition cost of the asset plus the ‘interest’ cost of the invested capital. But as discussed earlier, this method suffers some serious drawbacks in the electricity supply industry where assets have long lives and investments are made in large discrete chunks - primarily because it results in a declining real electricity price over the life of the asset followed by a massive price hike when the asset is replaced. The price shock is particularly severe if the build programme is not staggered and there has been a long ‘build holiday’ as is presently the case in South Africa (Joubert, October 2011).

Another drawback is that under the HC approach, the investor (utility) is compensated for expected inflation through the nominal WACC (or return on assets). If inflation is higher than expected between price revisions (as was consistently the case in 1980s South Africa), the real value of the fixed nominal cashflows the investor receives will be lower than expected, and essentially will lead to an under-recovery of the true asset cost by the investor (Irwin & van Zijl, 2001). In addition and as discussed in section 2.4.1, the HC approach is backward-looking, so that if the cost of building the same asset increases over time, tariffs under the HC approach (especially towards the end of the plant life) end up being too low to incentivise new investment.

The historical cost method is appropriate when: The assets do not have significant value; the assets are not subjected to significant price variations; there is no technological change associated to the asset or the change is not significant, and/or the effect of revaluation would be immaterial. (Telecommunication Development Bureau, March 2009).

2) **Indexed Historical Cost:** Under this method the regulator simply applies an inflation index to the gross historical cost of the assets which is then depreciated for the remaining useful life of the asset. This method results in a higher depreciated value and depreciation charge than under the historical cost method. It is however more or less equivalent to the historic cost approach since the return on
assets applied to the asset base changes from a nominal to a real (inflation adjusted) rate and the present value of future revenues is the same under both methods. The only advantage is that the profile of the tariffs over the asset’s life cycle will be flatter i.e. the tariffs start out at a lower level (due to using a lower rate of return which is based on real WACC) but (due to the asset being indexed to inflation from that point onwards) do not decline as steeply over the life of the asset and when the asset is replaced there is less of a price shock. (Joubert, 2011) and (Deutsche Securities Pty Ltd, March 2010). It appears that this was the method employed by the regulator in the second multi-year price determination period (although as will be demonstrated in section 2.6.1.2, only in principle as it was not systematically applied).

Methods Based on Modern Equivalent Asset Values

Methods based on modern equivalent asset values should be used whenever it is possible, as they are forward-looking and better reflect the cost of an efficient operator, by capturing the associated costs (and efficiencies) that an entrant/alternative operator would face, if they were currently entering the market (Telecommunication Development Bureau, March 2009). Some critics of this approach argue that replacement cost methods are not sustainable where technological improvements are lowering the cost of modern equivalent assets (since the utility would still be burdened with the debt service responsibilities associated with its original investment) but others argue that this is not the case since downward revaluations are compensated for through an increased depreciation charge (which is registered as a pass-through cost).

3) **Depreciated Replacement Cost**: under this method assets are valued on the basis of the estimates of lowest current cost to replace existing assets with modern equivalent assets with a similar capacity and technology. This method bridges the gap between historic costs and current value, but it doesn’t make any adjustments for technological advances and does not correct for current inefficiencies within the system (Danilyuk, 2009). Under this valuation method, the investor receives a real WACC (return on assets) on the depreciated current replacement value of the asset plus a depreciation charge. This is the asset-valuation method than NERSA proposes to employ for the forthcoming MYPD3 period. An advantage of the DRC approach is that it should give rise to flatter revenue and consequently tariff profile (lower initial revenues than under the HC approach but much higher revenues toward the end of the life of the asset)

4) **Depreciated Optimized Replacement Cost (DORC)**: This variation of the DRC method is based on calculating the replacement cost of an ‘optimised system’. “An optimised system is a re-configured system designed to serve the current load plus expected growth over a specified [planning] period but using modern technology” (Johnstone, 2002). The DORC method excludes any unused or underutilised assets beyond the specified planning horizon, and allows for potential cost savings which may have resulted from technological improvement.

It is argued that DORC is the method that mostly closely approximate the true long run marginal cost of electricity at a given level of demand because tariffs will be based on the revenue requirement of an efficient market entrant (Danilyuk, 2009)). “The economic rationale of the DORC model is that it emulates the workings of a contestable market, by setting tariffs at a level just short of that required to motivate a new entrant.” However in industries like the electricity supply industry where assets are
sunk’ and have long useful lives, the DORC is often criticised and found to be politically unpalatable. This is because the approach implies that tariffs will be set at levels close to that which would allow new infrastructure assets to built at today’s prices and the utility is able to earn a return on new investments that have not yet been made. In particular, the implied tariff levels for such assets are very close to those that would apply to new infrastructure assets built today at today’s prices.

2.6.1.2. Will the tariff setting methodologies currently employed by NERSA give rise to cost reflective tariffs?

If NERSA systematically applied its current rate-of-return methodology and calculated Eskom’s allowable revenue on the basis of a regulatory asset base revalued at depreciated replacement cost, Eskom would realise revenues that would allow it to set tariffs at rates that would closely approximate a true ‘cost-reflective’ tariff.

In practice however, NERSA has never applied the agreed rate-of-return methodology consistently because the immediate revaluation of Eskom’s asset base (be it on a HC, HIC or DPR basis) would hugely inflate its allowable revenue from current levels and would ultimately result in a massive one-off increase in electricity tariffs.

For the current MYPD2 period NERSA did not in fact calculate Eskom’s allowable revenue strictly on the basis of its published methodology. NERSA determined the “reasonable margin or return” on assets to 8.16%, but instead awarded Eskom a real (pre-tax) Weighted Average Cost of Capital (WACC) of 0.08%, 2.8% and 4.2% for the three respective financial years. It was not clear on what basis the revised WACC figures were determined, which the created the impression the Eskom’s tariffs had been determined in a completely arbitrary manner. (Steyn G., 2010)). In the ‘MYPD2 reasons for decision document’ NERSA implied that to achieve this transition it is phasing in 3 components of the tariff formula – the ROA, the value of the asset base and the depreciation charge. (Joubert, October 2011).

While it is clear the that revaluation of Eskom’s asset base will need to be phased in over an appropriate period of time, NERSA needs to be more explicit about the rate at which assets will be revalued and the methodology that they intend to employ. As it stands Eskom has been awarded an effective return on assets that is well below the true weighted average cost of capital employed and no provision for the future compensation of this loss has been made. It is recommended that NERSA phase in only one component of the tariff formula, such as the ROA so that the method of transitioning to cost-reflective and time period over which it will be achieved is more transparent.

2.7. Conclusion

In this chapter we set out to provide an overview of the factors that have historically had a bearing on the trend and level in electricity prices in South Africa. We also aimed to provide some insight into South Africa’s past and present electricity pricing policies and to explore the economic and pricing principles that underlie the current transition to cost-reflective electricity tariffs.

For much of the past three decades, electricity prices in South Africa have been low and declining so that despite the significant increases in electricity prices in South Africa in recent years (78% increase in real
prices between 2008 and 2011), they remain among the lowest in the world and do not yet reflect the full economic cost of supplying power.

While there are many factors that have historically had a bearing on the level and trend in electricity prices in South Africa, it appears that the dominant influences were Eskom’s investment history and its accounting and pricing policies. The experience of the South African electricity supply industry over the past thirty-odd years has demonstrated that electricity prices that do not reflect the true economic costs of supplying power, lead to poor decision-making and a gross misallocation of the country’s economic resources.

Because of the lenient financial requirements Eskom historically enjoyed under full state ownership (including exemption paying from taxes and dividends and state guarantees on its debt) it did not have to bear the full economic opportunity cost of the capital employed to finance its investments. In the 1970s Eskom was oriented to providing an abundant supply of electricity, and giving little thought to the economic opportunity cost of the capital employed, substantially overinvested in capacity. Despite the fact that Eskom was stranded with surplus capacity for much of the following two decades its financial position improved. This was largely because Eskom did not have to bear the full economic cost of the finance it had employed and was able to repay its debt while maintaining artificially low electricity prices.

In reality though while Eskom’s cash flow was sufficient to amortise its debt, significant surplus capacity meant it never realised much of the potential sales and associated cash flow and higher-than-expected inflation gradually eroded the real return it received on its assets, as a result Eskom did not accumulate reserves to replace its assets in future. Consumers however did benefit from the fact that Eskom did not historically recover the full costs of its assets in the form of a 17 year decline in real electricity prices that resulted in some of the most inexpensive electricity in the world.

The fact that Eskom’s tariffs were (until recently) determined the basis of historical cost accounting principles also had an influence. We noted that in the capital intensive electricity supply industry, where investments are lumpy and assets may last for 20 to 40 years, the historic cost approach is not appropriate since it will typically result in a declining tariff over the life of the asset and a massive increase in tariffs when the old asset is replaced. In Eskom’s case the decline in prices was particularly severe because after the over-investment in base load generating capacity in the late 1970s and early 1980s no new capacity was built for almost 20 years. As the build programme resumed, the existing asset base was so heavily depreciated that the significant prices hikes we have recently experienced were required to fund new investment in new capacity.

Exploring the requirements of an effective electricity pricing regime we found that while in practice it is often necessary to try and satisfy a range of, sometimes conflicting, social, economic and political objectives, the primary objective of any pricing regime should be to ensure that national economic resources are allocated efficiently both among different sectors of the economy and within the electricity supply industry. This implies that tariffs should be cost-reflective – in other word they should be set at a level that reflects the true economic costs of supplying each consumer’s electricity needs. In addition to designing and appropriate pricing regime, it also important that sound investment decisions ensure that demand is met at least cost, meaning that the cost of labour, fuel and capital inputs to production are minimised.
The basic properties of an ‘optimal’ electricity tariff which in addition to cost-reflectivity include satisfying objectives such as revenue adequacy and transparency in the provision of subsidies, have already been accepted by both NERSA and Government and are laid out in the Electricity Act of 1996 and Electricity Pricing Policy of 1998. However these principles have not yet been fully implemented.

We also noted that while the South African government have made commitments towards achieving ‘cost reflective’ tariffs, there are many differences of opinion around how the term ‘cost-reflective’ should be defined. The definition of cost-reflective tariffs is complicated by differences in the economic and accounting definitions of costs. Accounting costs are the costs that appear on firm financial statements, they are explicit financial costs that have been incurred in the past and tend to be backward looking. Economic costs by contrast are the sum of explicit costs and the implicit opportunity cost incurred and are forward-looking. In terms of economic theory, a ‘cost-reflective’ tariff is most often defined as a tariff equal to the long-run marginal cost (LRMC) of supply, since this concept is consistent with the efficient allocation of economic resources.

While a theoretically robust concept, LRMC in practice is hard to estimate. In practice, determining a ‘cost-reflective’ tariff that approximates the economic concept of LMRC involves the choice of a method of price regulation and then agreement on how to measure some of the more subjective components of the relevant tariff formula so as to approximate LRMC. In non-competitive electricity markets, end-user prices are typically set with regulatory approval. Two of the most widely used methods of price regulation that are the rate-of-return regulation or ‘revenue requirement’ regulation and the performance-based or ‘price-cap-system’. Electricity price adjustments in South Africa are currently determined by NERSA through the Multi-Year Price Determination (MYPD) methodology. The MYPD is based on rate-of-return principles and was developed for the regulation of Eskom’s required revenues, which is the basis on which prices are effectively adjusted.

Finally we found that if NERSA systematically applies its current rate-of-return methodology and calculated Eskom’s allowable revenue on the basis of a regulatory asset base revalued at depreciated replacement cost, Eskom will realise revenues that translate into a close approximation of ‘cost-reflective’ tariffs. In practice however, tariffs remain well below cost-reflective levels because while NERSA has in principle adopted the depreciated replacement cost approach to asset valuation it has not yet been fully implemented. This is because an immediate revaluation of Eskom’s asset base would hugely inflate its allowable revenue from current levels and would ultimately result in a massive one-off increase in electricity tariffs.

While it is clear that revaluation of Eskom’s asset base will need to be phased in over an appropriate period of time, NERSA needs to be more explicit about the rate at which assets will be revalued and the methodology that they intend to employ. It is recommended that NERSA phase in only one component of the tariff formula, such as the ROA so that the method of transitioning to cost-reflective and time period over which it will be achieved is more transparent.
3. Assessing the vulnerability of different sectors of the SA economy to rising electricity costs

3.1. Introduction

In the previous chapter we noted that despite the significant increases in electricity prices in South Africa in recent years, they remain among the lowest in the world and do not yet reflect the full economic cost of supplying power. The experience of the South African electricity supply industry over the past thirty-odd years has demonstrated that poor price signals lead to poor decision-making and, given the nature of the industry (long lead-times required to install new capacity and large discontinuous investments) poor investment decisions take many years to recover from. Prices will inevitably need to continue rise towards ‘cost-reflective’ levels so that a repeat of the costly over-investment in generation capacity in the late 1980s and the current supply shortages (and ever-increasing threat of a repeat of the highly disruptive load-shedding episodes of 2008) can be avoided.

It has been argued however, that further increases in electricity prices, especially if the adjustment to ‘cost-reflective’ tariffs is a rapid one, will jeopardise the viability of firms and industries who invested in South Africa on the basis of cheap electricity and who have come to rely on this as a major source of comparative advantage. Local business and industry associations have argued that a more thorough understanding of the impact of rising electricity prices on the South African economy at a firm and sector level is required.

The purpose of this chapter is to provide an assessment of the vulnerability of different sectors of the South African economy to rising electricity prices, by presenting a consolidated and critical review of findings of the existing research on the subject. We begin the chapter with a discussion of the factors the influence a firm or industry’s vulnerability to electricity prices and identify a number of criteria against which this can be assessed. The remainder of this chapter is structured as follows: the next section we present a brief comparison of the vulnerability the main industry groups (e.g. Agriculture, Mining etc.) to rising electricity costs in terms of some of the previously identified ‘vulnerability criteria’. Recognising that there are considerable variances in the vulnerability of sub-industries and firms within each sector in the subsequent section we discuss the costs structures, pricing power, possible efficiency gains and the reliance on electricity supply for various firms within each sector. We conclude the chapter with a table summary which lists all the readings used and their reported vulnerability measurements for each of the sectors investigated.

3.2. Defining ‘vulnerability criteria’

An industry’s vulnerability to rising electricity prices depends, most obviously, on its reliance on electricity as an input to production but also on the extent to which it is able mitigate against the impact of rising electricity prices.

Within the existing body of literature on this subject we have identified several criteria that can be used to evaluate the relative vulnerability of different industries and firms to rising electricity prices. The first group of criteria are indicators of the firm/industry reliance on electricity as a factor input, these include:

- Direct electricity costs as a proportion of total inputs costs
• Electricity intensity (i.e. electricity consumption per unit of output)
• Direct and indirect electricity costs as a proportion of total inputs costs

The second group of criteria are indicators of the extent to which a firm\industry is able to adapt to rising prices and thereby mitigate against the negative impact on its output and/or profitability.

• Ability to pass on the cost (i.e. pricing power and price elasticity of demand)
• Scope for electricity efficiency gains
• Potential to substitute electricity with cheaper energy sources

3.2.1. Reliance on electricity as an input to production
Electricity is an input to the production of almost all goods and services in a modern economy, whether it is consumed directly or used indirectly in the production of other intermediate inputs. So while it is a relative low-value commodity in itself it is a key enabler economic growth (Blignaut, 2009 in Ingelesi-Lotz and Blignaut 2011).

3.2.1.1. Direct electricity costs as a proportion of total costs
At the most basic level, an industry’s vulnerability to rising electricity prices can be assessed in terms of the contribution electricity makes to its total costs – i.e. Its direct electricity costs expressed as a percentage of its total inputs costs. If electricity only makes up a small proportion of a firm’s direct costs, the direct impact of rising prices on its profitability is likely to be fairly insignificant. If on the other hand electricity is one of a firm’s major input costs, then the majority of firms within the industry would have to make major adjustments to their input mix, price or the electricity-efficiency of their operations to maintain the same level of profitability. The share of electricity costs in total costs is one of the most widely reported indicators in the available literature on the vulnerability of the South African economy to electricity price increases – this is presumably in part, because it is a fairly objective measure and the data is relatively easy to obtain\(^5\).

3.2.1.2. Electricity Intensity
As noted in Chapter 1, where we examined the relative energy intensity of the various sectors of the economy, electricity intensity can be defined as the ratio of electricity consumption to a unit output. Electricity intensity is simply another measure of a firm or industry’s reliance on electricity to produce a given quantity of output. It follows that the more electricity-intensive a firm’s operations are, the more exposed the firm will be to price increases.

3.2.1.3. Direct and indirect electricity costs as a proportion of total input costs
“Industries use electricity not only directly but also indirectly through the inputs they purchase from other sectors” (Human Sciences Research Council, 2008). While the share of direct electricity costs in an industry’s total costs and measures of electricity intensity provide a fair indication of the industry’s exposure to rising prices, it is preferable to consider the share of both direct and indirect energy costs in an industry’s total input costs. For example some low electricity consuming sectors use inputs from highly intensive electricity sectors,

\(^5\) Reports using the share of electricity in the cost structure of an industry to estimate vulnerability include (Human Sciences Research Council, 2008), (Deloitte, 2009), (Conningarth Economists, 2011), (RMB|Morgan Stanley, 2011), (Deutsche Securities, 2010) and (Pan_African Investment & Research Services, Eskom, May 2011). The Pan African Investment & Research Services report uses the ratio of capital to labour to approximate electricity cost shares.
thus indirectly the industry is electricity intensive. In practice however, this is quite difficult to determine and one would need to consider inter-industry linkages. Industries that are further along the product and services value-chain (sell a high-proportion of their output to the end-consumer) are likely to be exposed to a higher proportion of indirect electricity costs. Price increases in industries that are early on the value chain (e.g. Agriculture) could have large knock-on effects on prices in the rest of the economy (unless they export 100% of their output).

### 3.2.2. Ability to mitigate against the impact of rising electricity prices

#### 3.2.2.1. Ability to pass on the cost (ie. Pricing power and price elasticity of demand)

A firms’ or industry's vulnerability to rising electricity prices should also be assessed in terms of its ability to pass on the increased cost. The ability of a firm to pass on the costs depends in turn on its pricing power (whether it has any influence over the price of its output) and the price elasticity of demand for its output (how responsive the demand for its output is to changes in price). Firms with significant pricing power, ‘price-setters’ are usually monopolistic in nature, meaning are one of only a few providers or the sole provider of the product or service in the market they supply. “Price setters’ should generally be less vulnerable to increases in electricity prices than ‘price-takers’, since they are able to pass-on the full increase to their consumers. But a ‘price setter’ may not be able to pass on the full electricity price increases if the demand for its output is elastic (sensitive to changes in prices). If a the demand for the ‘price setters’ output is price elastic, an increase in prices will lead to a fall in output and could still negatively impact its profitability. Goods and services that are price elastic (demand is responsive to price) are typically non-essential, homogenous products that can be easily substituted for a similar good or services or sourced from another supplier. Goods and services that price inelastic are generally necessities with no close substitutes, such as food and medical services.

Firms that are ‘price-takers’ usually operate in very competitive environments, where goods are easily traded and the prices is set in the open market. Price-takers are particularly vulnerable if they are exposed to international competition and their prices are set in global markets since the demand for their products is likely to be very price elastic.

#### 3.2.2.2. Scope for energy efficiency gains

According to the World Energy Council, quoted in (Inglesi-Lotz & Blignaut, 2011), “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’)”. Improvements in energy efficiency have been recognised as one of the most economical means of achieving a reduction in energy costs and demand (Inglesi-Lotz & Blignaut, 2011). According to Inglesi and Blignaut (2011), “The importance of electricity efficiency cannot be overstated”. It follows that an industries that are able to realise significant gains in electricity efficiency (in a cost-effective manner) can reduce limit their exposure to rising prices by reducing the electricity intensity of production. Some of studies investigating the potential for improvements in electricity efficiency include Human Sciences Research Council (2008), and Deloitte& Eskom (2009) and Inglesi-Lotz & Blignaut (2011).
3.2.2.3. Potential to substitute electricity with alternative energy sources

The vulnerability of a sector to rising electricity prices also depends on the availability of cost-effective substitute energy sources. The extent to which electricity can be substituted for alternative energy inputs (including diesel, gas and coal among others) varies from one firm to the next, especially within diverse industries such as manufacturing. In the South African context, the cost of alternative energy sources has generally compared unfavourably with historically low electricity costs so the potential for cost effective substitution is likely to be limited.

3.3. Assessing the vulnerability of different sectors to rising electricity costs

In this section we attempt to assess and compare the exposure of the main sectors of the economy (e.g. Agriculture, Mining etc.) to rising electricity costs in terms the ‘vulnerability criteria’ identified in section 3.2. The assessment is based on a critical review and consolidation of the data and findings presented in existing research on the subject.

3.3.1. Direct electricity costs as a proportion of total input costs

A high-level analysis by the South African Chamber of Mines compares the reliance of all the major sectors of the economy on electricity, in terms of the direct share of electricity in their total input costs\(^6\) (Figure 27). On this basis, mining and quarrying emerges as the sector with the greatest reliance on electricity, with electricity accounting for almost 5% of the sectors total input costs. In the Construction industry, which is at the other end of the spectrum, direct electricity costs are less than 0.5% of total input costs. Interestingly, the ratio of electricity costs to total input costs is higher for the transport, storage and communication and wholesale/retail trade sectors than is it for manufacturing which one would typically expect to be more reliant on electricity. This however is probably because of the considerable variation in reliance on electricity within the manufacturing sector.

![Figure 27 Value of electricity consumed expressed as a percentage of intermediate inputs](source: Chamber of Mines in (Pan-African Investment & Research Services, Eskom, May 2011))

In a survey of 31 of Eskom’s Key Industrial Customers\(^7\), the share of electricity costs in total operating expenditure is compared across three types of firms – mining companies, metal manufacturers and other

---

\(^6\) Approximated as value of electricity consumed as a percentage of the value of the industry’s total intermediate inputs.

\(^7\) The survey was conducted by Deloitte on behalf of Eskom in 2009 and was designed primarily to understand the impact of electricity disruption on Eskom’s Key Industrial Customers. Of the total KIC list of clients only 55% responded to the survey making a total of 31 respondents. The survey was conducted before any large price increases were introduced so any questions relating to electricity prices or
manufacturers (Figure 28). Metal Manufacturers (including aluminium manufacturers amongst others), reported that electricity accounted for nearly one fifth (18%) of their total operating expenditure and are clearly the most heavily reliant on electricity as an input to production. The mining companies in the survey sample reported that electricity accounted for 8% of their direct operating costs which is more or less in line with the broader industry average of 5% reported in the Chamber of Mines analysis in Figure 27. For the other manufacturing (all excluding metals and one ‘outlier’) the average electricity cost as a percentage of total costs was 11%, significantly higher than the average for the broader manufacturing industry (just under 2%). This is a plausible result since the manufacturers within the key industrial customer group are by definition some of Eskom’s largest industrial customers and would quite logically be more reliant on electricity that the average firm in the industry. The significant difference between the two values does serve to further highlight the fact there is considerable variation in the vulnerability of firms to electricity price increases within the diverse manufacturing sector.

Figure 28 Electricity costs as a percentage of total operational costs, 2009

An even more disaggregated view of the share of electricity in the cost structure of South African industries is presented in a 2008 report by the HSRC. These estimates were calculated on the basis of data provided in the 2002 Supply Use Tables (SUTs) published by Statistics South Africa (Stats SA) in 2005. The 2002 SUTs disaggregated the economy into 94 different activities or product groups and although the data are out of date the relative dependence of each industry on electricity is unlikely to have changed much (i.e. the most reliant industries will still be among the most reliant). Given sharp increases in electricity prices over the past decade, it is likely however that this data underestimates the share of electricity costs in total costs, but it will be by a fairly consistent margin across all industries. It is also important to note that because cost data show expenditure on electricity rather than consumption (e.g. kWh) and some big users are charge at more favourable tariffs, relative use will be underestimated for big users.

In Figure 3, sub-industries are ranked according to the share of electricity in their total costs –only data 30 most-dependent industries out of the total of 94 have been presented. Of the 94 sub-industries, non-ferrous vulnerability should not be subject to significant bias. The survey only covers three main interlinked industries, mining, metals and manufacturing. The survey found that electricity costs as a percentage varied across firms within similar industries.

8 The 2005 SUTs were released in 2010 so the data could be updated but it would still be fairly out of date.
metals (aluminium) is by far the most reliant on electricity – electricity made up 11% of its costs in 2002. The other manufacturing sub-industries in the top 10 include ‘other’ textiles and knitting, general hardware, tyres, soap and pharmaceuticals. The water and electricity supply industries are also among the ten most electricity dependent industries, together with gold mining.

It is interesting to note that 24 of the 30 industries that were most reliant on electricity in terms of their cost structure are classified as manufacturing activities. The only service to feature in the top 30 is accommodation, which is quite surprisingly ranked 11th. Mining also features quite strongly since there were only 3 mining categories in the list of 94 sub-industries and all 3 are among the top 30.

**Figure 29 The 30 most electricity–dependant sub-industries (electricity costs % of total costs), 2002**

In Figure 30 we have identified the 30 (out of 94) sub-industries that are the least reliant on electricity. For all 30, electricity costs were less than or equal to 0.5% of total costs. In keeping with the finding of the much more high-level chamber of mines analysis (Figure 27), construction and several major service industries display a very low reliance on electricity in terms of its share in their direct costs (it accounts for 0.3% or less of total direct costs). Major service industries in this group include government, business services, insurance and media (radio and television and publishing). There are also several manufacturing activities that rank among the least reliant on electricity including motor vehicles, special machinery, wire and cabling, pesticides, plastics, agricultural equipment, structural metal, engines and mining machinery (Figure 30).
Figure 30 The 30 sub-industries least reliant on electricity (electricity costs % of total costs), 2002

3.3.2. Electricity intensity
Electricity intensity is another measure of the reliance of an industry on electricity based on actual consumption rather than expenditure on electricity. An analysis by Inglesi-Lotz & Blignaut (2011) of the electricity intensity\(^9\) of various industries confirms that there is considerable variation within the manufacturing sector (Table 1). While the basic metals industry (which includes iron and steel and non-ferrous metals) emerges as the most electricity-intensive of the thirteen industries reported, other manufacturing activities including transport equipment, machinery and food in were among the least energy-intensive.

---

\(^9\) Defined as GWh consumed /$million output
Table 1 Electricity intensity and output share by sector, 2006

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

Source: (Inglesi-Lotz & Blignaut, 2011)

3.3.3. Direct and indirect electricity costs as a proportion of total input costs

As noted earlier, it would be preferable to consider the share of both direct and indirect energy costs in an industry’s total input costs or by the same token the total (direct plus indirect) electricity intensity of production. In practice however this is difficult to determine and none of the studies investigated made an attempt to do so. One can however assume that for industries early on in the value chain (e.g. Agriculture and mining), indirect electricity costs are fairly immaterial. These industries typically sell a large proportion of their output to other industries to be used as an input in the provision of further goods and services, and can be easily identified on this basis (Figure 30). The relevance of this is that when rising electricity prices affect the prices of basic goods such as plastic, wood, basic chemicals and metal products, the input costs of the industries they directly supply also increases (both directly due to higher electricity costs, and indirectly to other increased input costs). The so-called ‘knock-on’ impact of higher electricity prices can be significant for industries at the other end of the value chain (such as food, beverages and tobacco, medical services and hotels and accommodation) and as such direct costs measures may understate their relative vulnerability (Figure 32).
3.3.4. Ability to pass on the cost of higher electricity tariffs

A firm or industry's vulnerability to rising electricity prices should also be assessed in terms of its ability to pass on the increased cost. Firms that operate in a competitive environment with little pricing power are more vulnerable to electricity price increases since, in the worst-case scenario, they may have to absorb full the cost. There has been limited analysis of the ability of South African firms and industries to pass on higher electricity costs and most studies are on fairly small scale and so say little about the differences between industries but rather focus on a particular industry or group of firms.

In the survey of 31 of Eskom’s Key Industrial Customers (introduced in section 3.2.1.1, page 56) respondents representing the mining, manufacturing and metal manufacturing industries were asked if they thought they would be able to pass on a 50% nominal increase in electricity prices to their customers. The vast majority of respondents felt they would not be able to pass on the cost – none of the mining companies, only 14% of the
metal manufacturers and 30% of the ‘other’ manufacturers. These results are plausible since most mining and metal manufacturing companies produce basic commodities that are relatively homogeneous, so they have little influence over the price of their output which is set and traded in highly competitive global markets. There are however some possible exceptions where South African producers control a large share of total global output (discussed further in Section 3.4.1.2). At this point it is worth noting that mining and metal manufacturers are among the 30 sub-industries that are the most heavily dependent on electricity as an input (% of costs and intensity measures) and could also be vulnerable in terms of their limited ability to pass on costs.

**Figure 33** Would you be able to pass on the cost of increased electricity prices if they rose by 50%?

![Bar Chart](image)

Source: (Deloitte & Eskom, 2009)

### 3.3.5. Scope for electricity efficiency gains or electricity savings

Vulnerability to rising prices is reduced in industries where there is scope to realise significant gains in electricity efficiency, in a cost-effective manner. In the same survey of Eskom’s key industrial customers representatives of the 31 mining, metal manufacturing and ‘other’ manufacturing firms were asked to what extent their firm had managed to realise gains in electricity efficiency. All respondents in the mining sector either agreed or strongly agreed that efficiency gains had been realised as compared to 90% of respondents in ‘other’ manufacturing and 62% in metal manufacturing. The results tentatively suggest that there is more scope for efficiency gains in mining and manufacturing that in the metals sector.
In an analysis comparing the electricity-intensity of various South African industries to their counterparts in OECD countries, Inglesi-Lotz and Blignaut (2011) found that South Africa’s electricity intensity was at a level much higher than that of OECD countries and that that South Africa’s electricity intensity more than doubled in the period from 1990 to 2007. Compared to the OECD average, South Africa was at roughly the same intensity level of 0.3 GWh/$m in 1990 but by 2006 was almost twice the OECD average at 0.69 GWh/$m compared to 0.34 GWh/$m.

Table 2 Scope for efficiency gains - comparing electricity intensities across sectors between South Africa and OECD, 2006

<table>
<thead>
<tr>
<th>Sectors</th>
<th>Electricity intensity GWh/$million</th>
<th>Difference</th>
<th>Weighted relative to output difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>South Africa</td>
<td>OECD</td>
<td></td>
</tr>
<tr>
<td>Agriculture and forestry</td>
<td>0.316</td>
<td>0.016</td>
<td>1870.90%</td>
</tr>
<tr>
<td>Basic metals</td>
<td>1.095</td>
<td>0.111</td>
<td>887.30%</td>
</tr>
<tr>
<td>Chemical and petrochemical</td>
<td>0.203</td>
<td>0.034</td>
<td>494.70%</td>
</tr>
<tr>
<td>Construction</td>
<td>0.002</td>
<td>0.087</td>
<td>-97.90%</td>
</tr>
<tr>
<td>Food and tobacco</td>
<td>0.021</td>
<td>0.023</td>
<td>-11.30%</td>
</tr>
<tr>
<td>Machinery</td>
<td>0.005</td>
<td>0.028</td>
<td>-81.20%</td>
</tr>
<tr>
<td>Mining and quarrying</td>
<td>0.634</td>
<td>0.026</td>
<td>2305.60%</td>
</tr>
<tr>
<td>Non-metallic minerals</td>
<td>0.524</td>
<td>0.02</td>
<td>2517.70%</td>
</tr>
<tr>
<td>Paper, pulp and printing</td>
<td>0.207</td>
<td>0.021</td>
<td>891.50%</td>
</tr>
<tr>
<td>Textile and leather</td>
<td>0.067</td>
<td>0.01</td>
<td>548.80%</td>
</tr>
<tr>
<td>Transport equipment</td>
<td>0.003</td>
<td>0.004</td>
<td>-20.10%</td>
</tr>
<tr>
<td>Transport sector</td>
<td>0.089</td>
<td>0.013</td>
<td>563.40%</td>
</tr>
<tr>
<td>Wood and wood products</td>
<td>0.069</td>
<td>0.027</td>
<td>153.60%</td>
</tr>
</tbody>
</table>

Source: (Inglesi-Lotz & Blignaut, 2011)

The study found that nine of the thirteen sectors were less efficient than the OECD group equivalent and were an average of 981% more electricity intensive. The most substantial differences were observed in the non-metallic minerals sector (2517% greater), agriculture (1870% greater) and mining and quarrying (2305%...
greater) (Inglesi-Lotz & Blignaut, 2011). These differentials suggest that there is significant scope for efficiency gains in South Africa, particularly in the non-metallic miners, mining and quarrying, agriculture, paper and basic metals sectors. While the high-level comparisons of electricity intensity across sectors are a useful starting point, they may mask significant underlying differences in the characteristics of the industries across countries that make them inherently more or less energy-intensive. For example, the construction industry in South Africa is far more labour intensive than the industry in OECD countries so the electricity intensity of operations is naturally a lot lower.

In addition, realistic assumptions need to be made about the speed at which companies can adjust since the investing in new more electricity efficient technologies can be costly and can take a long time to implement, especially within capital intensive sectors like mining. A study by the HSRC (2008) found that the only short term energy saving options available to the mining sector, which did not involve reducing output, were in the hostels or administrative offices. The problem could have arisen due to historically low electricity prices which eroded any incentives to implement energy efficient (and possibly more expensive) production mechanisms during the late 1980’s and early 1990’s. Inglesi-Lotz and Blignaut (2011) also found that if South Africa is to remain competitive relative to its OECD counterparts under more stringent trade regimes, including carbon and climate change considerations, improvements in efficiencies would be necessary. The (Inglesi-Lotz & Blignaut, 2011) study was based on data from 2006 and given the sharp increase in electricity tariffs since then, it is likely that some efficiency gains will already have been realised.

There are also possibilities for co-generation of power within the paper and pulp, sugar and petrochemicals industries but improvements to approval processes, tax incentives and EIA’s are needed to streamline the process. Most of the improvements to the manufacturing sector in the HSRC report are based on Howells (2006) report which may be out of date but further investigation will allow for comparisons which could help in updating the results and recalculating potential opportunities to save on electricity.

### 3.3.6. Potential to substitute electricity with alternative energy sources

The vulnerability of a sector to rising electricity prices also depends on the availability of cost-effective substitute energy sources. A survey conducted on behalf the South African National Treasury, of 32 firms across 17 sub-sectors of the economy found that a few firms had implemented fuel switching investments in response to rising electricity prices (DNA Economics, 2011). The vast majority of these investments have been made since 2008 when real electricity prices began to rise sharply. The study found that while investments were concentrated in a small number of sectors, the costs saving from fuel switching could be significant. Most of the firms who were invested in fuel substitution were switching away from grid electricity towards more efficient and less costly low-carbon alternatives including gas, waste and biomass.

### 3.4. Assessing the relative vulnerability of different types of firms within sectors

In the previous section (3.3) we assessed and compared and the exposure of the main sectors of the economy (e.g. Agriculture, Mining etc.) to rising electricity. We found that the mining and manufacturing are in general more vulnerable to electricity prices increases than the construction and finance and business service sectors, but the usefulness of these blanket assessments is limited because of significant variation in the vulnerability of different firms and sub-industries within these sectors. In this section we further investigate
factors that affect the vulnerability of different firms within a single industry group to rising energy costs. The more detailed level of analysis allows us to generate some additional insights around individual firm characteristics and their reliance on electricity.

3.4.1. Mining and quarrying
Within the broad category of mining most electricity consumption comes from refrigeration, ventilation, compressed air generation, pumping, hoisting, milling, processing, furnaces, hostels and admin offices. Of these processes the most significant are pumping, cooling and ventilation which account for 50% of the total power consumption by mines (Human Sciences Research Council, 2008). The share of electricity in total costs varies considerably from one type of mining operation to another because of the considerable additional costs associated with underground mining. Underground mining tends to be more labour and electricity intensive due to ventilation, lighting and hoisting requirements whereas open cast mining is more exposed to logistical and fuel (petroleum and diesel) costs (RMB|Morgan Stanley, 2011).

3.4.1.1. Direct electricity costs as a proportion of total input costs
The materiality of electricity costs to a selection of gold, platinum and diversified mining companies is compared in Figure 35. This comparison, based on figures presented in a report by Deutsche Securities (2010) reveals that gold mining companies are the most reliant on electricity as an input to production (with electricity costs as a percentage of total costs ranging from 6 to 14%), followed by platinum miners and lastly the diversified mining groups. The one major outlier in the diversified mining category is Merafe, which is one of the world’s largest ferrochrome producers. Since electricity costs constitute just over a fifth (21%) of its total costs, it is very exposed to electricity price increases, but since it is mostly engaged in smelting, should probably have been classified as a manufacturer.

Gold Mining
There are five major players in the South African gold mining industry - AngloGold Ashanti, Gold Fields, Harmony, DRDGold and Gold One. Of the gold miners, AngloGold Ashanti appears to be least vulnerable position in terms of its share of electricity costs in total costs but this is only because its exposure to South Africa’s deep level gold mines, which are electricity intensive operations is diluted by less energy-intensive operations offshore (Deutsche Securities, 2010).
This highlights one of the major challenges in any analysis that attempts to assess the impact of rising electricity prices at a firm level - in instances where costs between local and off shore activities cannot be distinguished from one other, comparisons against other South African firms an attempts to assess the impact of rising prices on firm profitability will not be robust. This problem is further exaggerated in the case of large global diversified mining groups who are involved in a multitude of activities and typically only report financial results at a group level.

Platinum Mining
The Platinum-Group Metals (PGM) consist of six closely related metals; platinum, palladium, rhodium, ruthenium, iridium and osmium, all of which commonly occur together. Platinum is only mined in five countries around the world and South Africa is the largest producer followed by Russia, with small amounts also being mined in the United States, Canada and Zimbabwe. While the share of electricity costs in total costs is slightly lower on average for platinum miners than gold miners, the platinum mining sector is also heavily reliant on electricity as an input to production. Like the gold mining sector in South Africa, the platinum sector also engages in deep level mining and in addition, the smelting process for platinum is extremely power-intensive (Deutsche Securities, 2010). Direct electricity costs as a percentage of total costs range from 3 to 7%.

Diversified Mining Companies
The exposure of the diversified mining groups to electricity costs is also summarised in Figure 35. The extent to which a diversified mining company is exposed to electricity costs depends on the nature of the mining activities it is involved. Because the companies are by definition involved in a range of activities, with varying

![Figure 35 Share of electricity in total costs – selected mining companies](image-url)
energy intensities, they are generally less dependent on electricity than the gold and PGM miners. According to Deutsche Securities (2010) the diversified miners can be split into three camps – thermal coal mines that have limited exposure to electricity costs and actually benefit from increased demand for coal in energy production; open cast and underground operations (including iron ore, platinum, manganese and nickel amongst others) whose operation are low to moderately electricity intensive; and smelting and refining companies whose operations are highly electricity intensive and who have relied on cheap electricity (manufacturing rather than mining firms).

Exxaro falls into the first category since it is primarily a producer of thermal coal. Electricity costs at 4% of total costs are relatively high but these will fall when Exxaro closes its KZN Sands and zinc operations.

Anglo America, Kumba Iron Ore (a subsidiary of Anglo American) and African rainbow minerals all fall into the second category and are involved in mix of energy-intensive and moderately energy intensive mining operations. Anglo American is a highly diversified global mining company involved in mining a range of commodities. Deutsche Securities estimated that 3% of the groups (excluding Kumba and Angloplat) direct costs are for electricity. Kumba Iron Ore uses relatively low amounts of electricity. Direct electricity costs are around 3% of total costs but all the processes required to export the ore, which include processing and rail, are also reliant on electricity. African Rainbow Minerals (ARM) is involved in mining manganese and PGM and is quite heavily reliant on electricity, with direct costs amounting to 7% of total costs.

Merafe falls into the third category because it is engaged in highly electricity intensive smelting and refining operations which might be better classified as a manufacturing rather than mining activity. As noted above Merafe is one of the world’s largest ferrochrome producers and with direct electricity costs making up 21% of its total costs, it is very exposed to electricity price increases.

**Significant increase in utilities as a percentage of total costs**

According to report by RMB-Morgan Stanley (2011) the share of utility costs (water, electricity and fuel) in total costs is around 13% for gold mining companies and 9% for platinum mining companies. Since these estimates include the contribution of fuel and water costs in addition to electricity costs they seem very much in line with the estimates used in Figure 35. It is interesting to note that for both platinum and gold miners the contribution of utility costs to total costs has rose steadily from 2007 to 2010, probably largely as a result of the sharp and consistent increases in real electricity prices over the period (Figure 36). According to RMB-Morgan Stanley (2011), the cost of mining has been increasing due to electricity price increases, wage increases above inflation, global energy price increases and increased costs due to environmental and safety issues. But these increases are not equal for all mines, where precious metal mining has more exposure to electricity and labour costs whereas general mining is more exposed to logistical and oil prices.
3.4.1.2. Ability to pass on costs

Analysts from Deutsche Securities (2010) believe that the platinum mining sector in South Africa is less vulnerable to electricity price electricity increases than the gold mining sector because in addition to facing slightly lower share of electricity costs in total costs, the platinum sector should be able to pass on higher costs. They argue that given limited above-ground stocks, the large proportion of global production that SA contributes and the level of industrial consumption (Demand) the platinum sector should be able to pass increasing costs onto consumers.

Gold sector analysts believe that the sector will have little capacity to pass on any costs to consumers because of large above ground reserves and SA’s falling percentage of world production (8% - 10%) (Deutsche Securities, 2010). In addition to these factors South African gold is already relatively expensive to so any increase in price due to cost pressures will likely result in lost competitiveness. Of the five gold mining companies, analyst believe that Harmony is the in the worst position because its ability to pass on costs is very poor (Table 3).

Of the diversified mining companies, only Merafe is in a good position to pass on increased costs, since it controls 50% of world supply. Anglo American may be able to pass on some of its costs, but only for commodities were South Africa is the marginal producer. The other diversified miners are believed largely to be price takers in the markets in which they operate and so have little pricing power.
<table>
<thead>
<tr>
<th>Firm</th>
<th>Sector</th>
<th>Electricity costs % total costs</th>
<th>Ability to pass on costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northam Platinum</td>
<td>Platinum</td>
<td>6.6%</td>
<td>Good</td>
</tr>
<tr>
<td>AngloPlat Platinum</td>
<td>Platinum</td>
<td>5.0%</td>
<td>Very Good</td>
</tr>
<tr>
<td>Implats Platinum</td>
<td>Platinum</td>
<td>6.0%</td>
<td>Very Good</td>
</tr>
<tr>
<td>Lonmin Platinum</td>
<td>Platinum</td>
<td>3.0%</td>
<td>Good</td>
</tr>
<tr>
<td>Harmony Gold</td>
<td>Gold</td>
<td>12.0%</td>
<td>Very Poor</td>
</tr>
<tr>
<td>Gold Fields</td>
<td>Gold</td>
<td>7.0%</td>
<td>Poor</td>
</tr>
<tr>
<td>AngloGold Ashanti</td>
<td>Diversified mining</td>
<td>6.0%</td>
<td>Poor</td>
</tr>
<tr>
<td>Merafe Diversified mining</td>
<td>Diversified mining</td>
<td>21.0%</td>
<td>Good</td>
</tr>
<tr>
<td>ARM</td>
<td>Diversified mining</td>
<td>7.0%</td>
<td>Poor</td>
</tr>
<tr>
<td>Exxaro Diversified mining</td>
<td>Diversified mining</td>
<td>4.0%</td>
<td>Poor</td>
</tr>
<tr>
<td>Anglo Diversified mining</td>
<td>Diversified mining</td>
<td>3.0%</td>
<td>Moderate</td>
</tr>
<tr>
<td>Kumba Diversified mining</td>
<td>Diversified mining</td>
<td>3.0%</td>
<td>Poor</td>
</tr>
</tbody>
</table>

Table 3 Reliance of selected mining companies on electricity and ability to pass on increased costs

<table>
<thead>
<tr>
<th>Firm</th>
<th>Sector</th>
<th>Electricity costs % total costs</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northam Platinum</td>
<td>Platinum</td>
<td>6.6%</td>
<td>Big geographic concentration but, in the medium term, pricing power in Platinum is strong.</td>
</tr>
<tr>
<td>AngloPlat Platinum</td>
<td>Platinum</td>
<td>5.0%</td>
<td>Big geographic concentration but, in the medium term, pricing power in Platinum is strong</td>
</tr>
<tr>
<td>Implats Platinum</td>
<td>Platinum</td>
<td>6.0%</td>
<td></td>
</tr>
<tr>
<td>Lonmin Platinum</td>
<td>Platinum</td>
<td>3.0%</td>
<td></td>
</tr>
<tr>
<td>Harmony Gold</td>
<td>Gold</td>
<td>12.0%</td>
<td>Worst positioned within the Gold sector. We see the ability to pass this cost on as very poor.</td>
</tr>
<tr>
<td>Gold Fields</td>
<td>Gold</td>
<td>7.0%</td>
<td></td>
</tr>
<tr>
<td>AngloGold Ashanti</td>
<td>Diversified mining</td>
<td>6.0%</td>
<td></td>
</tr>
<tr>
<td>Merafe Diversified mining</td>
<td>Diversified mining</td>
<td>21.0%</td>
<td></td>
</tr>
<tr>
<td>ARM</td>
<td>Diversified mining</td>
<td>7.0%</td>
<td></td>
</tr>
<tr>
<td>Exxaro Diversified mining</td>
<td>Diversified mining</td>
<td>4.0%</td>
<td>For heavy minerals the operations are not the global prices setters but costs are near marginal cost, and there has been limited benefit from higher prices in recent years. SA is not large enough to directly influence prices but the steepening of the cost curve is supportive.</td>
</tr>
<tr>
<td>Anglo Diversified mining</td>
<td>Diversified mining</td>
<td>3.0%</td>
<td>Only commodities where SA is the marginal producer are able to pass cost increases onto consumers. These include PGMs (Platinum Group Metals), ferrochrome, and, to some extent, manganese</td>
</tr>
<tr>
<td>Kumba Diversified mining</td>
<td>Diversified mining</td>
<td>3.0%</td>
<td>Iron ore prices are determined between large Brazilian and Australian producers and Eastern consumers. There is no ability to pass price pressure onto consumers other than for the cost plus contracts with ArcelorMittal SA</td>
</tr>
</tbody>
</table>

Source: Deloitte analysis adapted from (Deutsche Securities, 2010)

3.4.2. Manufacturing

As noted in Section 3.3.1 (page 58), the manufacturing sector is too diverse to make any generalisations about the vulnerability of the sector to rising electricity prices and it was more useful to identify those sub-industries within manufacturing that are very exposed to electricity costs. But some further insights into electricity intensive manufacturing industries can be gleaned from surveys conducted at firm level.

General Manufacturers

A survey of 31 of Eskom’s Key Industrial Customers (introduced in section 3.2.1.1, page 56) reveals that electricity costs account for a substantial share of total costs for some manufacturing firms.

An outlier and by far the most electricity intensive of all producers surveyed was Air Products SA, a manufacturer of a wide variety of industrial and specialty gas products and chemicals, who reported that...
electricity is 80% of their total cost of production. Silican tech, a ferrosilicon producer is also highly energy intensive and reported that 34% of total costs are for electricity.

Figure 37 Electricity costs as a % of total operational costs – Various manufacturing firms

![Diagram showing electricity costs as a percentage of total operational costs for various manufacturing firms](Source: Deloitte & Eskom, 2009)

Cement production is also quite heavily reliant on electricity, with estimates of the direct costs of electricity in total operating costs ranging from 10% to 15% (Figure 37). However, the ability of cement producers to pass on increased costs is relatively strong since is it unlikely that the competition in a concentrated market would be willing to absorb price increases unless there is significant surplus capacity (Deutsche Securities, 2010). Safripol, one of South Africa’s leading plastics manufacturers reported that electricity costs contributed 9% to overall production costs. PetroSA, the operator of one of the world’s largest Gas to liquid refineries faces electricity costs of 10% of operating costs.

Paper and pulp-manufacturing is also a relatively energy intensive activity, but the share of electricity in total costs seems to vary considerably from one plant to the next. Sappi report that electricity costs ranged from 5% to 9% of total costs for three of its plants (Figure 37), while Deutsche Securities maintains that electricity cost are 3% of total costs for Sappi SA as a whole. Electricity costs account for approximately 5% of Mondi’s total operating costs within South Africa. Mondi’s Richards Bay mill which accounts for 45% of SA production is energy self-sufficient but focuses exclusively on the export market (Deutsche Securities (Pty) Ltd, 2010). SANS Fibres, a textile firm which reported that electricity costs were only 1% of its total costs in 2009 has since closed down.

Manufacturers of metal, glass, paper and plastic packaging for food and beverages is surprisingly reliant on electricity as an input with electricity costs for a diversified packaging company, such as Nampak, amounting to 4% of total costs (Deutsche Securities, 2010). And while some pricing flexibility may exist in terms of the firm’s supply contracts, analysts believe that the ability of packaging companies to pass on costs may be very limited in more competitive formats such as paper, so that overall they are relatively vulnerable to price increases (Deutsche Securities, 2010).
The food and beverage manufacturers produce a variety of goods which involve very different production, storage and transportation processes, especially when cold-chain methods are necessary (Human Sciences Research Council, 2008). According to Deutsche Securities (2010) electricity is a relatively small portion (around 2.3%) of total costs for major food manufacturers such as Tiger Brands and Pioneer Foods. In addition food producers can pass on higher costs relatively easily although the degree to which they are able to pass on costs is also dependent on the strength of their brands. Indirect impacts due to falling consumer disposable income could be significant in this industry (Deutsche Securities, 2010).

**Metal Manufacturers**

In section 3.3.3, basic metal manufacturers emerged as the industry group that was the most heavily reliant on electricity, both in terms of the share of electricity in direct costs and measures of electricity intensity. In Figure 38 the direct exposure of some the key players in the metal manufacturing industry to electricity costs is compared. Assmang which is mainly involved in manganese mining which is generally electricity non-intensive also has smelting and iron ore operations, which are considered highly electricity intensive. The 30% share of electricity in total costs must be related largely to smelting activity. Because of the large electricity requirements of smelters, the industry is both vulnerable to electricity price increases as well as shortages.

Tubatse and SA Chrome (like Merafe in Figure 35) are ferrochrome producers and are engaged in highly electricity intensive smelting and refining operations. All three ferrochrome producers reported that their direct electricity costs constitute around a fifth (20%) of their total costs. As noted earlier since South African firms control a large proportion of global ferrochrome supply, they are in relatively good position to pass on higher electricity costs.

It is interesting to note that there is considerable variation in the proportion of electricity costs faced by steel producers – Highveld, Arcelor Mittal and Cisco (a former division of Murray and Roberts that has since closed down). The electricity intensity of steel production and therefore the direct costs faced vary according to the type of steel products produced and processes used. For the South African steel producers surveyed electricity costs as a percentage of total costs ranged from 4% to 20%. The ability of steel producers to pass on their costs will depend on their share of the global market.
3.4.3. Construction

In analyses of the relative vulnerability of various industries and sub-industries, the construction industry consistently comes up as having the lowest reliance on electricity of any major industry group. The industry as a result has very limited direct exposure to rising electricity prices by may be impacting indirectly through lower investment spending and lower demand for new construction. Some of the major construction companies in South Africa include WBHO, Murray and Roberts Holding, Group Five and the Aveng Group who according to Deutsche Securities (2010) are likely to face direct electricity costs of between 0.25% and 0.3% of total costs.

3.4.4. Wholesale and retail trade

In the retail environment electricity consumption is driven by lighting, air conditioning units, escalators and elevators and there is generally significant potential for electricity savings. For food retailers, refrigeration is another significant driver of electricity consumption. As such food retailers are generally exposed to a much higher proportion electricity costs in total costs.

The relative vulnerability of 10 large South African retail firms to rising electricity costs is compared in Table 4. Rising electricity prices could have a material impact on food retailers whose share of electricity costs in total costs ranges from 3% for Woolworths to 4.3% in the case of Shoprite. The estimate of 1% of costs for the Spar group is not realistic as it does not include the electricity costs that the individual store franchisees face. Non-food retailers report that their direct electricity costs are between 1 and 2% of total costs - as such the impact of rising prices on non-food retailers is likely to be relatively muted.

According to sector analysts a further source of electricity-related cost pressure in the retail industry is the increase in ‘common charges’ incorporated in lease costs. These typically comprise a third of total lease costs which in turn range from 14-35% of total operating costs. Roughly a fifth of common costs are relative to electricity usage and clothing retailers such as Foschini and Truworths appear to be most exposed to this category of costs (Deutsche Securities, 2010).
Food retailers are in good position to pass on increased electricity costs to their consumers because they face relatively inelastic demand (consumers are unresponsive to changes in the price of food in general because it is a necessity). The demand for discretionary items such as clothing and big ticket items such as furniture and appliances is likely to be more responsive to changes in prices and may limit the extent to which non-food retailers can pass on higher costs. Given the concentrated nature of the retail market (limited competition) however, most retailers should be in a relatively good position to pass on costs. (Deutsche Securities, 2010).

Because the retail industry is at the end of the value chain, retailers are also quite exposed to the second-round impact of price increases. If second-round impacts of electricity price increases result in higher consumer price inflation and squeezed real incomes, consumers are likely to reduce their spending on discretionary items. Durable product retailers (DIY, furniture, and appliances) will be the most exposed in terms of the second-round effects, followed by clothing and footwear and finally food retailers. (Deutsche Securities, 2010).

<table>
<thead>
<tr>
<th>Firm</th>
<th>Sector</th>
<th>Electricity costs % total costs</th>
<th>Comment</th>
<th>Ability to pass on costs</th>
<th>Second-round impact on disposable income of customers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lewis</td>
<td>Retail</td>
<td>1.0%</td>
<td>Franchisees pick up direct electricity cost, making it the exception among food retailers.</td>
<td>Moderate</td>
<td>High</td>
</tr>
<tr>
<td>Spar</td>
<td>Food Retail</td>
<td>1.0%</td>
<td>Franchisees pick up direct electricity cost, making it the exception among food retailers.</td>
<td>Good</td>
<td>Low</td>
</tr>
<tr>
<td>JD Group</td>
<td>Retail</td>
<td>1.6%</td>
<td>We have not included the indirect component via leases – Truworths is one of the more exposed in this regard.</td>
<td>Moderate</td>
<td>High</td>
</tr>
<tr>
<td>Truworths</td>
<td>Retail</td>
<td>1.8%</td>
<td>We have not included the indirect component via leases – Truworths is one of the more exposed in this regard.</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Clicks</td>
<td>Retail</td>
<td>1.9%</td>
<td>We have not included the indirect component via leases – Foschini is one of the more exposed in this regard.</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Foschini</td>
<td>Retail</td>
<td>1.9%</td>
<td>We have not included the indirect component via leases – Foschini is one of the more exposed in this regard.</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Massmart</td>
<td>Retail</td>
<td>2.3%</td>
<td>Cost of refrigeration makes electricity more significant for food retailers.</td>
<td>Moderate</td>
<td>Moderate</td>
</tr>
<tr>
<td>Woolies</td>
<td>Retail</td>
<td>3.0%</td>
<td>Cost of refrigeration makes electricity more significant for food retailers.</td>
<td>Good</td>
<td>Low</td>
</tr>
<tr>
<td>Pick n Pay</td>
<td>Food Retail</td>
<td>3.1%</td>
<td>Cost of refrigeration makes electricity more significant for food retailers.</td>
<td>Good</td>
<td>Low</td>
</tr>
<tr>
<td>Shoprite</td>
<td>Food Retail</td>
<td>4.3%</td>
<td>Cost of refrigeration makes electricity more significant for food retailers.</td>
<td>Good</td>
<td>Low</td>
</tr>
</tbody>
</table>

3.4.5. Real estate, catering and accommodation services
Of all the services sectors, real estate and accommodation services are probably one of the most heavily reliant on electricity in terms of their exposure to electricity in operating costs. According to survey by the South African Property Association (SAPOA) electricity accounts for 23% of total operating costs in retail property leasing, 22.6% in office leasing and 16.5% in industrial property leasing (23% if triple net leases are taken into account). While no estimates of the electricity costs faced by individual firms in the hospitality industry were available, we noted in Section 3.3.1 that accommodation services was the only services sub-industry to feature in a list of the 30 sub-industries most reliant on electricity in operating costs.
While lease agreements are typically structured to allow recovery of near 100% of electricity costs from tenants, property owners do face the risk of losing their tenants. Property owners with large anchor tenants in high-traffic shopping centres are the best positioned in terms of their ability to pass on costs because they face the lowest risk of losing tenants (demand is fairly price inelastic). Top grade office buildings will also be able to pass costs onto tenants, especially blue-chip clients. The vulnerability of property owners is thus measured as the proportion of rental income that electricity costs constitute. Hyprop, Resilient, Fountainhead, Sycom and Acucap include large exposure to dominant malls and anchor tenants, thus their stocks are less vulnerable to electricity price increases. Companies such as SA Corporate, Vukile, Octodec, Emira, Pangbourne's, Premium and Capital have exposure to smaller retail operations, too much small office exposure or large residential exposures making them less able to pass on any costs to tenants, thus making them more vulnerable to electricity price increases.

There is also substantial scope for gains in energy efficiency in the property sector, with potential improvements ranging from solar power, efficient lighting and air-conditioning technologies and efficient building materials and design.

### 3.4.6. Finance, Insurance and Banking

Firms in the finance, insurance and banking sector are relatively resilient to electricity prices increases since electricity costs only account for between 0.2% and 1.1% their total operating costs (Table 5). That said, the profitability of firms in this sector could be negatively impacted by the second-round impact of higher electricity prices. Because electricity is an input into almost all economic activity, consistent above-inflation increases in electricity prices would in all likelihood fuel general price inflation. Rising inflation would have a negative impact on the real disposable income of households and may also result in higher interest rates and increased borrowing costs, potentially impacting the profitability of firms across a wide range of sectors in the economy (including financial services).

<table>
<thead>
<tr>
<th>Firm</th>
<th>Sector</th>
<th>Electricity costs as a % total costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absa</td>
<td>Banks</td>
<td>1.0%</td>
</tr>
<tr>
<td>Metropolitan</td>
<td>Life Assurance</td>
<td>1.1%</td>
</tr>
<tr>
<td>Nedbank</td>
<td>Banks</td>
<td>0.8%</td>
</tr>
<tr>
<td>FirstRand</td>
<td>Banks</td>
<td>0.8%</td>
</tr>
<tr>
<td>ABIL</td>
<td>General financials</td>
<td>0.7%</td>
</tr>
<tr>
<td>Standard Bank</td>
<td>Life Assurance</td>
<td>0.6%</td>
</tr>
<tr>
<td>Discovery</td>
<td>Life Assurance</td>
<td>0.6%</td>
</tr>
<tr>
<td>Liberty</td>
<td>Life Assurance</td>
<td>0.6%</td>
</tr>
<tr>
<td>Sanlam</td>
<td>Life Assurance</td>
<td>0.2%</td>
</tr>
<tr>
<td>Old Mutual</td>
<td>Life Assurance</td>
<td>0.2%</td>
</tr>
</tbody>
</table>

Source: Deutsche Securities, 2010

### 3.4.7. Telecommunications and media

Firms in the telecommunication and media sector have very limited direct exposure to rising electricity prices, since the proportion of electricity costs in total costs is between 0.1% and 0.8% total costs made up by
Eskom-sourced costs is insignificant, as can be seen from Table 6. Until this becomes a more material cost, there will probably little response by media and telecommunications firms to rising prices.

<table>
<thead>
<tr>
<th>Company</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telkom</td>
<td>0.76</td>
</tr>
<tr>
<td>Vodacom</td>
<td>0.43</td>
</tr>
<tr>
<td>MTN</td>
<td>0.09</td>
</tr>
<tr>
<td>Naspers Media</td>
<td>0.5%</td>
</tr>
</tbody>
</table>

Source: Based on Deutsche Securities (2010)

3.4.8. Transport equipment and logistics services

Firm involved in the leasing and sale of transport equipment in South Africa are typically also involved in a whole host of other integrated services such as; freight management, car rental automotive retailing, material handling, and logistics. Firms engaged in transport equipment and logistics in South Africa include Barloworld, Imperial and Bidvest. Logistics providers in general have a relatively low reliance on electricity because they are mainly dependent on fuel as a source of energy. Among the three firms identified, electricity as a share of total operating ranges from 0.1% for Barloworld to 0.9% for Bidvest (Deutsche Securities, 2010). In these highly fragmented (particularly in the case of Bidvest) and diverse companies is difficult to say to what extent they would be able to pass on higher electricity costs, but they are likely to operate in fairly competitive markets in which case their pricing power may be limited.

3.5. Summary of findings and concluding remarks

In this chapter we set out to evaluate the relative vulnerability of different sectors, sub-industries and firms in the South African economy to rising electricity prices, in terms of their reliance on electricity as an input and their ability to effectively mitigate the impact. The considerable variation in the apparent vulnerability of different firms and sub-industries to rising electricity costs, both across and within the major sectors of the economy, has made it difficult to draw generalised conclusions. We have however attempted to summarise the main findings in Table 7, which provides a consolidated picture of the relative vulnerability of each sector (and some sub-sectors) to electricity prices increases in terms of the three criteria that were the most widely reported across the range studies and surveys we investigated – the share of electricity costs in total costs, the electricity intensity of the sector and the ability of firms in the sector to pass on costs.

At even the most aggregate level of analysis - the 10-sector view of the economy, it clear that the mining sector is heavily reliant on electricity as an input to production and that it has very limited ability pass on increased costs, which immediately signals that it is among the most vulnerable to price increases. Not all mining activities however would be classified as ‘vulnerable’, coal miners and some of the diversified mining groups have relatively low exposure to electricity costs and are no more vulnerable to rising prices than the agricultural sector and several of the less electricity intensive manufacturers. Of all the mining firms South African gold mining firms of the most vulnerable to electricity prices increasing because of very electricity intensive deep mining operations and a dwindling share of global production which means they are unable to influence the price of the metal.

Manufacturing on aggregate appears to be fairly resilient to price increases, but as we discovered there is considerable variation in the vulnerability of different sub-industries and firms within this very diverse sector.
All metal manufacturers are heavily dependent on electricity, but ferrochrome and non-ferrous metal producers are particularly vulnerable to rising prices. That said, South African ferrochrome producers control a significant share of the global market, so some analysts have argued that they should be able to pass on the costs of rising electricity prices. Chemical, Paper and Cement manufacturers also appear to be relatively vulnerable to electricity price increases while food and beverage and associated packaging producers are among the more resilient manufacturers.

Table 7 Overall ranking of the relative vulnerability of different sectors to rising electricity prices

<table>
<thead>
<tr>
<th>Overall vulnerability ranking</th>
<th>Electricity as % of total operating costs</th>
<th>Electricity costs as % of total operating costs</th>
<th>Electricity Intensity</th>
<th>Able to pass on costs?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture, forestry and fishing</td>
<td>1.1</td>
<td>1.5</td>
<td>0.316</td>
<td>0.16</td>
</tr>
<tr>
<td>Mining and Quarrying</td>
<td>2.5</td>
<td>5</td>
<td>8</td>
<td>6.7</td>
</tr>
<tr>
<td>Gold Mining</td>
<td>4.8</td>
<td>10.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Platinum Mining</td>
<td>5.1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other/Diversified Mining</td>
<td>2</td>
<td>4.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coal Mining</td>
<td>1</td>
<td>&lt; 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacturing</td>
<td>1.5</td>
<td>1.7</td>
<td>0.33*</td>
<td></td>
</tr>
<tr>
<td>Other manufacturing (average)</td>
<td>1.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemicals and petrochemicals</td>
<td>1.1 to 4</td>
<td>9</td>
<td>6</td>
<td>0.263*</td>
</tr>
<tr>
<td>Paper and pulp</td>
<td>0.6</td>
<td>5 to 9</td>
<td>3 to 5</td>
<td>0.297</td>
</tr>
<tr>
<td>Food and Beverages</td>
<td>1.4</td>
<td>2.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cement</td>
<td>2.1</td>
<td>10 to 15</td>
<td>5</td>
<td>0.21</td>
</tr>
<tr>
<td>Packaging (paper, glass etc)</td>
<td>0.3</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metal manufacturing (average)</td>
<td>3.1</td>
<td>17</td>
<td></td>
<td>1.095</td>
</tr>
<tr>
<td>Ferrochrome</td>
<td></td>
<td>20</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>Non-ferrous metals</td>
<td>11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electricity, gas and water</td>
<td>4.9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td>0.3</td>
<td>0.2</td>
<td>0.4</td>
<td>0.002</td>
</tr>
</tbody>
</table>

Utilities including water, gas and electricity are, somewhat ironically, also heavily reliant on electricity as an input to production. But in South Africa these firms are typically monopoly suppliers and can therefore pass on the costs so that they emerge as being only moderately vulnerable to price increases.

As was anticipated, the service industries appear to be relatively resilient to price increases because they have limited direct exposure to electricity costs and can in most cases pass on higher costs to their consumers. The outliers in the services industry are the property leasing and accommodation providers who according to some reports are very exposed to electricity in their direct costs. The variation in estimates of the share of electricity in total costs is a bit puzzling but one report suggested that electricity accounts for 22% of costs in the property leasing sector while another suggests that accommodation was ranked 11 out of 94 sub-industries in terms of its exposure to direct electricity costs.

The industries that appear from this analysis to be the least vulnerable to rising electricity prices are the finance and business service sector, the community social and personal services sector and construction.
4. Assessing the impact of electricity price increases on sector employment, output and profitability

4.1. Introduction
In the previous chapter we assessed the relative vulnerability of different sectors, sub-industries and firms in the South African economy to rising electricity prices, in terms of their reliance on electricity as an input and their ability to effectively mitigate the impact. While this exercise assisted us in identifying industries that are likely to be vulnerable to price increases and that may require support, it is also important to consider the impact rising prices would have on profitability, output and employment in these sectors.

There are a few studies that attempt to assess the impact of electricity price increases on the different sectors and firms within the South African economy. These studies typically focus on the impacts on employment, output, and profitability for the various sectors or sub-sectors over various periods of time and under different assumed price increases.

In the first section of this chapter we briefly consider the results of a few small-scale firm-based surveys that give some insight into the perceived impact of electricity price increases on various firms in the South African economy. But because the results of these surveys are based on the ‘reported’ rather than actual impacts of electricity price increases on the surveyed firms, they are likely to be subject to bias.

In the next section we discuss the results of two separate empirical analyses of the impact of rising electricity prices on the South African economy. In a study conducted by (Pan_African Investment & Research Services, Eskom, May 2011), the net impact of rising electricity prices and Eskom’s six-year capital investment programme were evaluated in the context of both a dynamic time-series macro-econometric (TSME) framework and a static Computable General Equilibrium (CGE) framework. In the second study by Conningarth economists (2011), the vulnerability of sector profits to real electricity price increases is modelled and compared.

4.2. Survey-based studies to determine the impact of electricity price increases
In this section we consider the results of two survey-based studies that were designed to investigate the combined impact that unplanned load shedding and rising electricity prices were having on firm output and employment levels

4.2.1. A Survey of Eskom’s Key Industrial Customers
The first of these studies, conducted by Deloitte in 2009, was based on a survey of 31 of Eskom’s key industrial customers (KICs) and was designed primarily in response to the need for Eskom to better understand the impact that electricity supply disruptions in 2008 had had on the revenue and output of some of its major customers. The survey however also included a number of questions relating to the potential impact of future price hikes. The survey was conducted before any large price increases were introduced so any questions relating to electricity prices or vulnerability should not be subject to significant bias. The firms in
the KIC group span three closely related and relatively energy-intensive industries - mining, metal manufacturing and ‘other’ manufacturing.

In the first question relating to future prices increases, firms were asked whether they thought output would fall in response to either of following two tariff increase scenarios:

- A once-off price increase of 50% in 2009
- A 33% price increase every year for 3 years (2009 to 2011)

The aim of the question was to try and establish whether a more gradual increase in tariffs would give firms more time to adjust to higher prices and consequently minimise any negative impact on output. The vast majority of mining and metal industry respondents felt there would be no impact on output under either scenario, implying that their firms were in a position to absorb the price increases. 30% of manufacturing sector respondents felt that output would fall under the 50% increase scenario, while a slightly smaller proportion (20%) felt this would be the case under the constant 33% increase. Overall it was unclear whether there would be any benefit associated with phasing in the required tariff increase in over a longer period.

When asked how employment would be impacted by a once-off price increase of 50% or a 33% price increase every year for 3 years, the majority of respondents agreed that the there was a risk that price increases (under either scenario) would lead to job losses, particularly in marginal operations.

4.2.2. Surveys of small retailers and a variety of other firms

A study by Pan African Investment and Research Services (May 2011) reports the results two separate surveys that were conducted to assess the impact of electricity price increases on South African firms.

The purpose of the first survey, which targeted small retailers in middle income communities, was to assess the impact of municipal electricity tariff increases on the end-consumer. Overall, 64% of the retail merchant owners surveyed believed that the increasing electricity price hikes had materially affected their bottom line. 61% of respondents noted that they had not managed to pass increased electricity costs on to the end consumer but had adopted energy savings practices instead.

The purpose of the second survey, a national survey which targeted 80 companies, was to assess the economic impact of price increases on a range of industries and firms in the South African economy (Pan_African Investment & Research Services, Eskom, May 2011). 73% of the senior staff surveyed reported that rising electricity prices had a noticeable impact on their profitability while only 18% claimed that they had managed to pass the rising costs on to their customers.

4.3. Empirical studies to determine the impact of electricity price increases

In this section we consider the finding of two empirical studies that have modelled the impact of electricity price increases on different sectors of the South African economy. The first of these is a study by Pan African Investment & Research Services (May 2011) on the impact of electricity price increases and Eskom’s six-year capital investment programme. The second is a study by Conningarth economists which explores the ‘profit vulnerability’ of different sectors of the economy to increases in real electricity prices, where ‘profit vulnerability’ was defined as the real electricity price an industry could absorb before becoming unprofitable.
4.3.1. Study on the impact of electricity price increases on employment and output

In the study on the impact of electricity price increases and Eskom’s six-year capital investment programme, Pan African Investment & Research Services (May 2011) models the combined impact of increased capital expenditure by Eskom and rising electricity prices on the South African economy. The study makes use of two different types of economic models: a Time-Series Macro-Econometric (TSME) model and; a Computable General Equilibrium (CGE) model.

Each model is subject to certain limitations; while the TSME model is able to capture some of the structural changes that occur over time, it is not able generate insights around the impact of price increases on sub-sectors of the economy. The CGE model on the other hand is a static model that provides more detail around sectoral impacts but is unable to measure the dynamic impacts over time.

4.3.1.1. Assessing the impact of price increases in a CGE modelling framework

In their CGE modelling analysis, Pan-African Investment & Research Services estimated the short and long-run impact of rising electricity prices on the economy under the following four price scenarios:

- Scenario 1 – prices increased by 24.8%
- Scenario 2 – prices increased by 15% in
- Scenario 3 – prices increased by 10%
- Scenario 4 – prices increased by 8%

In this report we investigate the long-run impacts of scenario 1 where prices were increased 25% and all other factors are held constant (i.e. this scenario did not include the impact of increased capital investment in the electricity sector). Upper and lower bound estimates for the impact of a 25% increase in electricity prices on the output of the 9 major sectors of the economy are illustrated in Figure 39. The upper and lower bound estimates reflect the fact that there is considerable variation on the impact of electricity prices on different industries within these aggregate sectors. Contrary to what one would expect, the results suggested that the output of the utilities (electricity, gas and water) would be most adversely affected by the 25% increase in prices. This is because the model implicitly assumes that an increase in the price of the electricity leads to a fall in the demand for electricity. In reality however studies have shown the demand for electricity in South Africa is fairly inelastic (unresponsive to price) so a reduction in the demand for electricity of this magnitude seems unlikely. In addition, in reality the negative impact of price increases in the sector would be offset by the positive impact of increased investment in the sector (to fund new capacity) but for the purposes of this report we have chosen not to elaborate on the results of an alternative scenario where the combined impact of price increases and increased investment were modelled because it becomes more difficult to distinguish the impact of price increases from increased investment in these scenarios.

---

10 Pan-African Investment & Research Services made use of the University of Pretoria CGE model of South Africa (UPGEM model)
Aside from utilities the sectors that are likely to experience the largest decline in output as a result of a 25% increase are manufacturing, community social and personal services and transport and communication. In Chapter 3 we identified that some sub-sectors of the manufacturing industry have a heavy reliance on electricity so this finding is not surprising. More puzzling is the impact of price increases on the community, social and personal service sector which as we saw in chapter 3, has very limited direct exposure to electricity costs so the decline in output in this sector we assume is due to the second-round impact of price increases on disposable income of consumers. The relatively moderate impact output on the mining sector (and even an increase in output at the lower bound) is also quite surprising since major mining sub-sectors – platinum and gold are very electricity intensive. In keeping with the findings of our analysis of the relative vulnerability of sectors in Chapter 3, there is very little impact on the output of the construction sector and only a moderate impact on output in the wholesale/retail sector.

The level of detail on the structure of the economy CGE model used in this study was such that it is also possible to determine the impact of prices increases on the output of 39 individual sub-industries. The impact of 24.8% price increase on the output of these 39 sub-industries is illustrated in Figure 40. The sectors that experienced the largest decline in output in response to an electricity price increase of 24.8% were (electricity excluded) iron and steel (-5.3% drop in output), non-ferrous metals (-4.6%), Health Services (-2.6%), Communication Services (-2.0%) and real estate services (-1.8%).
Figure 40 Impact of a 24.8% price increase on the output of 39 sub-industries in the long-run

<table>
<thead>
<tr>
<th>Industry</th>
<th>Impact (in %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>-6.8</td>
</tr>
<tr>
<td>Iron and Steel</td>
<td>-5.3</td>
</tr>
<tr>
<td>Non-ferrous Metal</td>
<td>-4.6</td>
</tr>
<tr>
<td>Health Services</td>
<td>-2.9</td>
</tr>
<tr>
<td>Communication services</td>
<td>-2.0</td>
</tr>
<tr>
<td>Real estate</td>
<td>-1.9</td>
</tr>
<tr>
<td>Gold</td>
<td>-1.6</td>
</tr>
<tr>
<td>Financial Institutions</td>
<td>-1.5</td>
</tr>
<tr>
<td>Livestock</td>
<td>-1.4</td>
</tr>
<tr>
<td>Hotels</td>
<td>-1.4</td>
</tr>
<tr>
<td>Water</td>
<td>-1.3</td>
</tr>
<tr>
<td>Radio</td>
<td>-1.1</td>
</tr>
<tr>
<td>Food</td>
<td>-1.1</td>
</tr>
<tr>
<td>Other Agriculture</td>
<td>-1.1</td>
</tr>
<tr>
<td>Transport Services</td>
<td>-1.0</td>
</tr>
<tr>
<td>Footwear</td>
<td>-0.8</td>
</tr>
<tr>
<td>Other Service Activities</td>
<td>-0.8</td>
</tr>
<tr>
<td>Trade</td>
<td>-0.7</td>
</tr>
<tr>
<td>Business Activities</td>
<td>-0.7</td>
</tr>
<tr>
<td>Petroleum Refineries</td>
<td>-0.7</td>
</tr>
<tr>
<td>Forestry</td>
<td>-0.6</td>
</tr>
<tr>
<td>Crude, Petroleum &amp; Gas</td>
<td>-0.6</td>
</tr>
<tr>
<td>Construction</td>
<td>-0.3</td>
</tr>
<tr>
<td>Other Metal Products</td>
<td>-0.2</td>
</tr>
<tr>
<td>Irrigated Field</td>
<td>-0.2</td>
</tr>
<tr>
<td>Dry Field</td>
<td>-0.2</td>
</tr>
<tr>
<td>Coal</td>
<td>-0.2</td>
</tr>
<tr>
<td>Other Non-metallic Mineral Products</td>
<td>-0.1</td>
</tr>
<tr>
<td>Chemicals and Other Non-metallic Mineral Products</td>
<td>0.0</td>
</tr>
<tr>
<td>Transport Equipment</td>
<td>0.0</td>
</tr>
<tr>
<td>Dry Horticulture</td>
<td>0.0</td>
</tr>
<tr>
<td>Irrigated Horticulture</td>
<td>0.0</td>
</tr>
<tr>
<td>Wood, Paper and Pulp</td>
<td>0.0</td>
</tr>
<tr>
<td>Electrical Machinery</td>
<td>0.0</td>
</tr>
<tr>
<td>Textiles</td>
<td>0.0</td>
</tr>
<tr>
<td>Other Machinery</td>
<td>0.0</td>
</tr>
<tr>
<td>Other Mining</td>
<td>0.0</td>
</tr>
<tr>
<td>Other Manufacturing</td>
<td>0.8</td>
</tr>
<tr>
<td>Electricity</td>
<td>1.1</td>
</tr>
</tbody>
</table>

Source: (Pan_African Investment & Research Services, Eskom, May 2011)

The simultaneous impact of a 24.8% increase in electricity prices on the employment of unskilled workers across all sectors is illustrated in Figure 41. It was assumed that skilled and semi-skilled workers would be able to find alternative employment in the long-run so only unskilled labour is allowed to vary in the long-run (the loss of employment may be more permanent for unskilled workers due to the high structural unemployment rate among unskilled workers in South Africa). Once again the results of the modelled scenario suggests that utilities sectors would be the most adversely affected, but in reality this is an unlikely result since in reality the price increase in the electricity sector would be accompanied by increased investment in the sector. Notwithstanding the limitations of the exercise, the model output suggests that the sector that would experience the largest decrease in employment in the long-run is the manufacturing sector, followed by mining and community social and personal service sectors.
Once again the level of detail on the structure of the economy CGE model employed permits an analysis of the impact of price increases on employment in 39 individual sub-industries. The impact of 24.8% price increase on employment in these 39 sub-industries is illustrated in Figure 42. The sectors that experienced the largest decline in employment of unskilled labour in response to an electricity price increase of 24.8% were iron and steel (-4.6% decline in employment), non-ferrous metals (-3.7%), Health Services (-1.7%), Communication Services (-1.5%) and livestock (-1.3%).
4.3.1.1. Assessing the impact of electricity price increases in a TSME modelling framework

Pan-African Investment & Research Services (May 2011) also modelled the short and long-run impacts of electricity price hikes on different sectors of the economy using a dynamic time-series macro-econometric (TSME) approach. A number of different price increase scenarios were simulated – some scenarios assumed large price increases over a short period (e.g. 75% increase over three years) while others were based on more gradual price increases over a longer period (e.g. 10% per year over 10 years).

The results in Table 8 suggest that the impact of electricity price increases on the economy is greatly diminished if tariff increases are introduced more gradually, as was the case in the ‘baseline scenario’. Under ‘the NERSA price scenario’ it was assumed that prices would increase by 25% per year for three years and by 6% per year for a further 7 years. Under the ‘baseline price scenario’ tariffs are increased more gradually at a constant rate of 10% per year over the full 10 years.
scenario might not satisfy other objectives, for example they may have been insufficient to secure the financial sustainability of Eskom.

The sectors that suffered the largest declines in employment, when electricity prices were increased in line with the ‘NERSA scenario’, were mining (-1.8%), transport and communications (-0.8%) and wholesale/retail trade (-0.6%). Mining and transport were also among the sectors that suffered the largest declines in output, along with manufacturing and agriculture (Table 8).

In the TSME model, the electricity sector benefits from price increases and posts strong increases in employment, output and investment under the ‘NERSA price scenario’ assumptions. Construction and finance and business services emerge again as the most resilient to electricity price increases (aside from electricity itself). These two sectors were found to have a very limited reliance on electricity as a direct input to production in Chapter 3.

### Table 8 TSME Long-run Sectoral Impact results - Impact of electricity prices

<table>
<thead>
<tr>
<th>Sectors</th>
<th>Scenarios</th>
<th>Employment</th>
<th>Output</th>
<th>Investment</th>
<th>Real Wages</th>
<th>Exports</th>
<th>Imports</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>25% 3yr &amp; 6% 7yr</td>
<td>0.23%</td>
<td>2.16%</td>
<td>-2.9%</td>
<td>-2.11%</td>
<td>-0.00%</td>
<td>-2.60%</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>10% 10yrs Baseline</td>
<td>0.02%</td>
<td>0.20%</td>
<td>0.40%</td>
<td>0.17%</td>
<td>0.03%</td>
<td>0.27%</td>
</tr>
<tr>
<td></td>
<td>25% 3yr &amp; 6% 7yr</td>
<td>-1.83%</td>
<td>-4.38%</td>
<td>-4.21%</td>
<td>-4.86%</td>
<td>-0.22%</td>
<td>-4.99%</td>
</tr>
<tr>
<td>Mining</td>
<td>10% 10yrs Baseline</td>
<td>0.36%</td>
<td>0.80%</td>
<td>0.43%</td>
<td>1.00%</td>
<td>-0.09%</td>
<td>0.90%</td>
</tr>
<tr>
<td></td>
<td>25% 3yr &amp; 6% 7yr</td>
<td>-0.05%</td>
<td>-1.77%</td>
<td>-2.28%</td>
<td>-1.51%</td>
<td>-0.31%</td>
<td>-5.37%</td>
</tr>
<tr>
<td>Agriculture</td>
<td>10% 10yrs Baseline</td>
<td>-0.06%</td>
<td>0.27%</td>
<td>0.06%</td>
<td>0.25%</td>
<td>-0.05%</td>
<td>1.29%</td>
</tr>
<tr>
<td></td>
<td>25% 3yr &amp; 6% 7yr</td>
<td>-0.30%</td>
<td>-0.98%</td>
<td>-0.19%</td>
<td>-0.70%</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Construction</td>
<td>10% 10yrs Baseline</td>
<td>0.12%</td>
<td>0.35%</td>
<td>0.17%</td>
<td>0.25%</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>25% 3yr &amp; 6% 7yr</td>
<td>9.26%</td>
<td>11.05%</td>
<td>8.48%</td>
<td>9.32%</td>
<td>-2.48%</td>
<td>11.27%</td>
</tr>
<tr>
<td>Electricity</td>
<td>10% 10yrs Baseline</td>
<td>0.90%</td>
<td>1.10%</td>
<td>1.80%</td>
<td>1.00%</td>
<td>0.90%</td>
<td>-0.69%</td>
</tr>
<tr>
<td></td>
<td>25% 3yr &amp; 6% 7yr</td>
<td>-0.80%</td>
<td>-3.02%</td>
<td>-3.49%</td>
<td>-2.27%</td>
<td>-0.29%</td>
<td>-0.67%</td>
</tr>
<tr>
<td>Wholesale &amp; Retail</td>
<td>10% 10yrs Baseline</td>
<td>0.21%</td>
<td>0.50%</td>
<td>-0.38%</td>
<td>0.42%</td>
<td>0.03%</td>
<td>0.20%</td>
</tr>
<tr>
<td></td>
<td>25% 3yr &amp; 6% 7yr</td>
<td>-0.64%</td>
<td>-1.44%</td>
<td>-1.96%</td>
<td>-1.41%</td>
<td>13.00%</td>
<td>-0.89%</td>
</tr>
<tr>
<td>Transport &amp; Communication</td>
<td>10% 10yrs Baseline</td>
<td>0.11%</td>
<td>0.24%</td>
<td>0.27%</td>
<td>0.24%</td>
<td>-0.07%</td>
<td>0.14%</td>
</tr>
<tr>
<td></td>
<td>25% 3yr &amp; 6% 7yr</td>
<td>-0.22%</td>
<td>-0.71%</td>
<td>-1.34%</td>
<td>-0.85%</td>
<td>0.27%</td>
<td>-1.68%</td>
</tr>
<tr>
<td>Finance</td>
<td>10% 10yrs Baseline</td>
<td>0.12%</td>
<td>0.09%</td>
<td>0.13%</td>
<td>0.11%</td>
<td>0.30%</td>
<td>0.32%</td>
</tr>
</tbody>
</table>

Source: Pan-African Investment & Research Services (May 2011)

### 4.3.2. A study on the vulnerability of sector profitability to price increases

As part of broader study around meeting South Africa’s future electricity needs, Conningarth economists (2011) explore the ‘profit vulnerability’ of different sectors of the economy to increases in real electricity prices, where ‘profit vulnerability’ is defined as the real electricity price an industry could absorb before becoming unprofitable. According to Conningarth (2011), the extent to which a sector can absorb price increases before becoming unprofitable depends on, “the weight of electricity costs in total production costs and the sector’s current level of profitability.” While the methods and data used in calculating the relative ‘profit vulnerability’ were not clearly articulated in the report, it appears that the analysis was based on data from the 2006 national social accounting matrix for South Africa and that the gross operating surplus of each industry may have been used as a proxy for its profit.

Some of the industries that exhibit the greatest ‘profit vulnerability’ to electricity price increases are the Cereal & Crop, Gold, Iron Ore, Magnetite, Silver, Asbestos, other non-metallic minerals, Platinum, Stone quarrying,
Zinc, Paper & Paper Products, Publishing & Printing, Wood and Wood Products, Manufacturing of Transport Equipment, Rubber, Basic Metals, Meat, Fish and Vegetables industries. The analysis of profit vulnerability by Conningarth (2011) implies that in 2006, these industries would have been unable to absorb more than a 50% increase in real electricity tariffs prices before they became unprofitable. Had this measure of ‘profit vulnerability’ been accurate most of these industries would have already closed down since real electricity prices increased by close to 80% between 2008 and 2011. While it is clear that industries are able to absorb a larger cumulative increases in real electricity prices than these rough estimates of profit vulnerability suggest, they probably still provide us a with a reasonably good indication of which sub-sectors of the economy are more vulnerable to electricity price increases than others.

Within the mining sector, gold, platinum, iron ore, silver, magnetite and asbestos mining emerge as the mining industries that are most vulnerable to electricity price increases (Figure 43). Manganese and coal mining emerge as the least sensitive to electricity price increases and at 2006 levels of profitability could have absorbed real electricity price increases in excess of 200%.

Figure 43 Mining sector profit vulnerability to real price Increases

In the analysis of relative profit vulnerability, the manufacturing sector was split into two groups based on the estimated electricity intensity of their production processes. Among the manufacturing industries with a relatively low electricity intensity, paper and wood products and printing and publishing appear to be the most vulnerable to price increases, presumably because rising electricity prices would only put further pressure on their already slim profit margins (Figure 44).

Among the electricity intensive group of manufacturing industries that are already relatively exposed to price increases, rubber products, basic metals, meats, fish and vegetables and basic chemicals are the most
vulnerable while the structural metal and machinery and equipment industries appear to be less vulnerable (Figure 45).

Figure 44 Low Electricity Intensive Manufacturing Sectors Profit Vulnerability to Electricity Price Increases

Source: (Conningarth Economists, 2011)

Figure 45 High Electricity Intensive Manufacturing Sectors Profit Vulnerability to Electricity Price Increases

Source: (Conningarth Economists, 2011)

On the basis of profit vulnerability estimates, the agricultural sector appear on the whole to, be in a better position to absorb electricity prices increases than the mining and manufacturing sectors. Aside from the cereals and crops industry that relies heavily on electricity for irrigation and the dairy industry that is also relatively electricity intensive, all the agricultural industries should be able to absorb at least a 200% increase in real electricity prices before they become unprofitable (Figure 46).
Figure 46 Agricultural Sectors Profit Vulnerability to Real Electricity Price Increases

Source: (Conningarth Economists, 2011)
4.4. Concluding remarks

In this chapter we attempted to gauge the impact rising electricity prices would have on employment and output across different sectors of the economy and ultimately how rising prices would affect their viability. Our findings are largely based on the results of two empirical studies – the first simulated the impact of rising electricity prices on different sectors of the South African economy and a second estimated the vulnerability of sector profits to real electricity price increases.

We have summarised the main findings of these studies in Table 9 and have also attempted to relate the simulated impact of price increases on each of the sector profitability, output and employment back to the assessment we made of the relative vulnerability of each sector in Chapter 3.

### Table 9 Summary of the findings

<table>
<thead>
<tr>
<th>Overall vulnerability ranking</th>
<th>Profit Vulnerability</th>
<th>Impact of electricity price increase on output</th>
<th>Impact of electricity price increase on employment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Max % increase in real electricity prices that industry can absorb</td>
<td>25% for 3yrs and 6% for 7yrs</td>
<td>25% price increase - lower estimate</td>
</tr>
<tr>
<td>Agriculture, forestry and fishing</td>
<td>10% to 550% (320% on average)</td>
<td>-0.05%</td>
<td>-1.39%</td>
</tr>
<tr>
<td>Mining and Quarrying</td>
<td>10% to 400% (105% on average)</td>
<td>-1.83%</td>
<td>-1.62%</td>
</tr>
<tr>
<td>Gold Mining</td>
<td>10%</td>
<td>-1.60%</td>
<td>-1.60%</td>
</tr>
<tr>
<td>Platinum Mining</td>
<td>20%</td>
<td>-1.60%</td>
<td>-1.60%</td>
</tr>
<tr>
<td>Other/Diversified Mining</td>
<td>10% to 250%</td>
<td>-0.20%</td>
<td>-0.20%</td>
</tr>
<tr>
<td>Coal Mining</td>
<td>400%</td>
<td>-0.20%</td>
<td>-0.20%</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>10% to 450% (141% on average)</td>
<td>-0.23%</td>
<td>-5.29%</td>
</tr>
<tr>
<td>Other manufacturing (average)</td>
<td>60%</td>
<td>-0.1% to -0.6%</td>
<td>0.1% to -0.5%</td>
</tr>
<tr>
<td>Paper and pulp</td>
<td>10%</td>
<td>0%</td>
<td>0.40%</td>
</tr>
<tr>
<td>Food and Beverages</td>
<td>250% to 350%</td>
<td>-1%</td>
<td>-1%</td>
</tr>
<tr>
<td>Cement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Packaging (paper, glass etc)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metal manufacturing (average)</td>
<td>10% to 200%</td>
<td>-1.83%</td>
<td>-1.62%</td>
</tr>
<tr>
<td>Ferrochrome</td>
<td>10%</td>
<td>-1.60%</td>
<td>-1.60%</td>
</tr>
<tr>
<td>Non-ferrous metals</td>
<td>10%</td>
<td>-4.60%</td>
<td>-4.60%</td>
</tr>
<tr>
<td>Electricity, gas and water</td>
<td>9.3%</td>
<td>11.1%</td>
<td>11.1%</td>
</tr>
<tr>
<td>Construction</td>
<td>-0.30%</td>
<td>-0.21%</td>
<td>-0.98%</td>
</tr>
<tr>
<td>Services Sectors</td>
<td>Wholesale and Retail Trade</td>
<td>-0.64%</td>
<td>-1.37%</td>
</tr>
<tr>
<td></td>
<td>Transport, storage and telecommunication</td>
<td>-0.80%</td>
<td>-1.95%</td>
</tr>
<tr>
<td></td>
<td>Finance and business services</td>
<td>-0.22%</td>
<td>-1.84%</td>
</tr>
<tr>
<td></td>
<td>Real estate and Accomodation</td>
<td>-2.00%</td>
<td>-2.00%</td>
</tr>
<tr>
<td></td>
<td>Community, social and personal services</td>
<td>-2.91%</td>
<td>-2.91%</td>
</tr>
</tbody>
</table>

Comparing results across the various models and studies, it is not surprising to find that it is the relatively electricity-intensive mining and manufacturing sectors that suffer the largest declines in output and employment as electricity prices increase. But once again, we note that there is considerable variation within these broad sectors – rising electricity prices result in a significant decrease in employment and output in the gold and platinum mining, non-ferrous metals and ferrochrome industries but have a negligible impact on employment and output in the coal mining and food and beverage manufacturing sectors.
While it seems in most cases that the simple assessment of the relative vulnerability of different sectors that we conducted in Chapter 3 would suffice, there are some additional insights to be gleaned from the simulated impact of price increases in more sophisticated empirical frameworks. In particular the results of the CGE and TSME models suggest that the services sector is far more exposed to rising electricity prices than the simple ‘vulnerability criteria’ assessment suggested.

The models suggest that electricity price increases are likely to result in a fairly significant decrease in output and employment across all of the major service sectors, because they are exposed to the second-round effects of price increases on consumer spending. The results suggest that the negative impact of rising prices on employment is particularly severe in the transport and communications sector.

The profit vulnerability analysis suggests that the paper and chemical manufacturing industries are vulnerable to price increases despite their relatively low reliance on electricity as an input as their already slim profits would be quickly eroded by electricity price increases.

The construction and finance and business services sectors emerge once again as the industries that are the least affected by electricity price increases.
5. Exploring policy options available to government and the case for industry support

5.1. Introduction

In previous chapters we noted that despite the sharp increases in electricity tariffs in recent years, prices will inevitably need to continue rise towards ‘cost-reflective’ levels so that a repeat of the costly over-investment in generation capacity in the late 1980s and the current supply shortages can be avoided. But it is also clear that because electricity prices remained very low for a prolonged period, some industries have come to rely on inexpensive electricity as a key source of comparative advantage and are vulnerable to price increases.

In this chapter we explore some of the policy options that may be available to government to assist vulnerable industries in transitioning to cost-reflective tariffs while minimising the negative impacts on output, employment and profitability.

Recognising that there has been significant public resistance to recent electricity price hikes we begin the chapter by summarising and critiquing the options presented by various industry groups to curb further electricity price increases. Too often the criticism of Eskom and NERSA implies that tariffs increases can be avoided without any repercussions, so in the next section we consider what the consequences might be if Eskom fails to achieve cost-reflective tariffs. We conclude the chapter by identifying some of the policy options that are available to government to lessen the impact of rising electricity price and discuss their respective merits and drawbacks. The policy options identified include: subsidies, pricing policy options, accelerated energy efficiency and demand side management, promoting competition in the electricity supply industry and providing targeted support to vulnerable industries.

5.2. A summary and critique of the options presented by industry to mitigate against high electricity prices

The sharp increases in electricity tariffs since 2008 have been met with significant public resistance. Some critics contend that “consumers [have] borne the brunt of a series of unjustifiable electricity price increases” (Motau, 2012), while an association representing large industrial electricity consumers, the Energy Intensive Users Group (EIUG) have argued that rising electricity prices pose a serious threat to growth and that many industries are at “the tipping point” (EIUG, 2011).

In a 2011 report, the Energy Intensive Users Group maintain “that South Africa must have a transparent affordable [electricity] price” and argue that the affordable price path is one that balances viability, economic growth, global competitiveness and social development (where viability is defined as a price path that reflects a fair and efficient cost of supply) (EIUG, 2011). While the EIUG appear to support the notion that the electricity prices need to rise to a ‘cost-reflective’ level in principle, they argue that lower and more ‘affordable tariffs’ can be achieved by manipulating five aspects of the Eskom’s ‘allowed revenue’ formula—namely the rate of depreciation, the rate of return on assets (WACC), the cost of new capacity, assumptions regarding independent power producers and taxes and levies.
Following a similar line of argument, Xstrata Alloys (January 2011) and Frost and Sullivan (2011) call for a ‘justifiable’ electricity price path for South Africa which offers viable and affordable tariffs and that balances and supports future supply requirements with developmental objectives. They argue that options to mitigate high electricity prices should be considered, including:

1. Lower Eskom’s allowed return on assets
2. Don’t revalue the asset base (retain historic cost accounting)
3. Lower the target for renewable energy generation capacity in the current integrated resource plan
4. Allow independent power producers (IPPs) to sell to a system operator and to trade bilaterally

However, as argued in Joubert (October 2011) each of the options presented by industry representatives suffer from considerable drawbacks. A summary and critique of each of the options presented by industry is provided in Table 10. In short it can be argued that the first option, lowering Eskom’s ROA is not consistent with the fundamental principles of an effective pricing regime – tariffs that are ‘cost-reflective’ tariffs and promote a financially sustainable electricity supply industry. The second option, retaining historic cost accounting practices, would in all likelihood give rise to more rapid electricity price increases over the next few years. Lowering the target for renewable energy would result in lower tariffs but at the expense of the environment. The argument that the introduction of IPPs would result in lower tariffs is the most robust since it has been proven that increased competition in the electricity supply industry often results in lower prices but this is not always the case since IPPs also face a higher cost of capital and are unlikely to enter the market until tariffs are cost-reflective and provide the incentive to do so.

Table 10 Summary and critique of options presented by industry to mitigate against high electricity prices

<table>
<thead>
<tr>
<th>Option</th>
<th>Argument</th>
<th>Criticisms and Implications</th>
</tr>
</thead>
</table>
| Lower Eskom’s return on assets (ROA) | • A return on assets sensitivity analysis indicates that this is one variable which can be easily adjusted to change the trajectory of the electricity price path.  
• Dropping the allowed ROA from 8% to 6% drops the electricity price by 10c/kWh while still allowing Eskom to effectively manage its balance sheet. | • The ROA component should be designed to ensure the sustainability of Eskom by providing for sufficient revenue to maintain and upgrade existing infrastructure and investment in new capacity when required (Danilyuk, 2009).  
• The allowed return on assets is not determined arbitrarily but must be referenced to the utility’s actual risk-adjusted weighted average cost of capital (WACC).  
• If the ROA is set below the true risk-adjusted cost of capital, the resulting tariff is not cost-reflective, will not allow Eskom to recover the full cost of its assets or provide incentive to invest further. IPPs facing a higher cost of capital also have little incentive to invest.  
• Tariffs that do not reflect the true cost of electricity supply lead to a misallocation of national resources and to mismatches between electricity supply and demand (Vedavalli, 1989).  
• To assume that equity costs less than it actually costs implies that the shareholders (the state and taxpayers) would be subsidising electricity prices. (Joubert, October 2011).  
• In addition as noted in section 2.6.1.2 for the current MYPD2 period NERSA did not in fact calculate Eskom’s allowable revenue on the basis of its published methodology. NERSA determined the “reasonable margin or return” on assets to 8.16%, but instead awarded Eskom a real (pre-tax) Weighted Average Cost of Capital (WACC) of 0.08%, 2.8% and 4.2% for the three respective financial years. This is because Eskom is currently still transitioning to more cost-reflective tariffs and a massive one-off price adjustment would be politically unviable. |
| Don’t revalue Eskom’s assets | • One of the more controversial changes in the pricing methodology has been the reweighting of historical assets to reflect long run marginal cost of electricity. By 2025, the amount of new build capacity in the system would effectively raise the average value of the assets to replacement cost.  
• By simply following the natural progression, the price path is lowered significantly. | • Ironically (as noted in section 2.6.1.1), the historic cost method gives rise to higher initial revenues (and therefore higher prices) than the depreciated replacement cost method during a period when large investments are undertaken. Therefore if NERSA retains the historic cost approach to asset valuation, tariff increases, as Eskom expands its build programme in the next few years, will in all likelihood increase more rapidly than if it adopts the depreciated replacement cost method. In addition all the drawbacks of the HC approach in the context of the electricity supply industry (as outlined in section 2.6.1.1) would continue to apply in future.  
• It is also important to note that while NERSA have in principle adopted the depreciated replacement cost approach to asset valuation it has not yet been fully implemented. Tariffs currently remain well below levels that reflect the true depreciated replacement cost of Eskom’s assets because NERSA will only allow Eskom to transition to cost-reflective tariffs over a number of years so as to avoid a one-off adjustment (and massive price shock). In the ‘MYPD2 reasons for decision document’ NERSA implied that to achieve this transition it is phasing in 3 components of the tariff formula – the ROA, the value of the asset base and the depreciation charge. (Joubert, October 2011). |
| Less Renewables | • 33% of the new build plan is committed to renewable energy technologies and almost all to carbon neutral technologies  
• From 2022 there is also a significant amount of OCGT capacity added to balance out uncertainty regarding renewable feedstock.  
• The high capital costs for renewables combined with high operating costs for OCGT inflates tariffs and increases uncertainty regarding security of supply.  
• A slower transition to renewables would allow for a lower tariff and a more thorough evaluation of the efficiency and reliability of renewable technology | • A slower transition to renewables would result in lower electricity prices to the extent that electricity produced from renewable technologies costs more than from conventional technologies. However this may not be true if the external environmental costs of conventional coal-fired power stations are factored in.  
• It is government policy to apply multi-criteria to the evaluation and choice of technologies for future electricity infrastructure planning, not only the criteria of lowest cost. (Joubert, October 2011). Environmental sustainability in electricity pricing is recognised as a objectives of the South African government in the official electricity pricing policy. “The production and transport of electricity should be done in a sustainable way and be mindful of the impact on the environment.” (DME, 2008).  
• Environmental costs may soon be internalised through the introduction on taxes on carbon and other greenhouse gas emissions both domestically and internationally. |
| Allow IPPs to sell to an independent system operator | • There are several reasons that introducing IPPs lowers the price path. They are proven to manage their CAPEX and OPEX more efficiently than SOEs, their speed of implementation is faster and lastly, as opposed to Eskom, they are unable to earn a return on work under construction  
• By allowing Eskom to complete committed and new nuclear build plans and with IPPs delivering the remainder of new build | • IPPPs are unlikely to enter the electricity supply industry until tariffs are cost-reflective and provide the incentive for them to do so.  
• It is often argued that IPPs deliver power at least cost and lowest risk. In practice there is wide variation in the outcomes of IPP projects but there are many projects that are viewed as a success by investors and their host countries alike. (Woodhouse, 2005).  
• While IPPs in a competitive environment may manage capex and opex more efficiency than Eskom, they would also face a higher cost of capital which greatly increases the cost of supply in the capital intensive electricity supply industry and this may offset any potential reduction in capital and operating costs due to improved efficiency.  
• Allowing a return on works under construction (WUC) is a common practice that has been widely adopted by regulators in countries including the UK, Australia and the US. Although it implies that some revenue is collected before the asset is
it is possible to maintain the price in between the justifiable range of 75c/kWh to 85c/kWh.

operational, it is compensated for by reduced revenue over the rest of the operational life of the asset resulting in a similar present value of the total future revenue stream.

Regardless of whether there is an independent system operator or Eskom acts as a single buyer, the final electricity tariffs consumers’ face will be a blended rate, so while Eskom’s tariffs may be lower due to the avoided capital expenditure, the blended tariff would include the IPP tariffs which will presumably be cost-reflective. (Joubert, October 2011).

5.3. The cost of failing to achieve cost-reflective tariffs

Too often the criticism levied against Eskom or NERSA with respect to electricity prices hikes simply implies that tariff increases can be avoided without considering how the cost of new power capacity will be paid for or who will ultimately bear the burden. In this section we consider what the consequences might be if Eskom continued to supply electricity at prices set below cost-reflective levels.

As Deutsche Securities (2010) note, “There are three sources of funding for Eskom – equity, debt and tariffs - with the first two little more than a means to pre-fund major capital investment.” What this means is that ultimately tariffs need to cover the full cost of electricity supply, including the provision of an acceptable return on the equity or debt provided by the utility’s shareholders and lenders.

As discussed in Chapter 2, tariffs set below cost-reflective levels do not reflect the true economic cost of supplying power (which includes the opportunity cost of the capital employed to finance the investment in power capacity) and as such, send incorrect price signals to both investors and consumers. Poor price signals ultimately lead to poor investment decisions, a misallocation of economic resources and a mismatch between supply and demand.

For example, low tariffs signal to consumers that electricity cheap and abundant and this consequently stimulates demand. In a normal competitive market as demand rises, price should rise to reflect increasing scarcity of supply which sends a signal to investors to mobilise resources to finance new investment. But in the case of a regulated monopoly, if prices remain too low, revenue generated will be insufficient to finance new investment. Low prices and inadequate revenue streams mean the market will also fail to attract private sector investment. The required investment in additional capacity has to be funded from somewhere, failing which the utility unable to meet demand and power outages will occur. The cost to an economy of power outages or ‘unserved energy’ is enormous so government will usually step into the breach, meaning that ultimately the current and future taxpayer will end up meeting the cost of the funding shortfall. Simply put, if electricity consumers don’t bear the full cost of electricity supply, the taxpayer eventually will (Vedavalli, 1989) and (Deutsche Securities, 2010).

5.3.1. Distributional impacts

As the United Nations Environment Programme (UNEP) notes, any measure that keeps energy prices for consumers below market levels can be deemed an energy subsidy (UNEP, 2008). As long as electricity tariffs in South Africa remain below cost-reflective levels, consumers of electricity are effectively receiving a subsidy from the taxpayer. The existence of this implicit subsidy not only distorts the efficiency of the electricity market but promotes a transfer of wealth from South African taxpayers to the large consumers of electricity (which include large industrial consumers with substantial foreign shareholding).
5.3.2. Load shedding and unserved energy come at greater cost to the economy than electricity price increases

It is however not just a case of who bears the cost of the implicit subsidy to electricity prices when tariffs are set below cost-reflective level (consumer or taxpayer) but also but how great the overall cost to the economy becomes. Unfortunately because of the long-lead times required to build new plant poor investment decisions in the electricity supply industry take years to recover from and the additional costs to the economy associated with subsidised electricity begin to mount (Vedavalli, 1989). In the event of surplus capacity the economy bears the opportunity cost of capital that could have been more usefully deployed elsewhere (e.g. to fund education, health or other needs) while in the event of a shortage of capacity the costs include power outages and constrained growth (unserved energy).

In a report on the impact of price increases and rationing on the SA economy, the HSRC (2008) note that while it is natural to focus on the short-run impact of rising prices or power rationing on employment and output, cost of foregone growth (in the case of insufficient power capacity) to the economy is probably the greater cost. The study notes that a lack of electricity was constraining South Africa’s ability to benefit from the international commodity boom and could also exacerbate other negative influences such us increasing the country’s reliance on substitute energy sources in a time of rising oil prices.

In a study which investigated options to mitigate the economic impact of power outages using a computable general equilibrium (CGE) modelling framework, Deloitte (2008) found that increasing electricity prices (which dampen demand and incentivise energy-efficiency and demand side management) was a far less costly solution to addressing power shortages than load-shedding. The study found that load-shedding had substantial economic impacts across most sectors of the economy and continued at 10% of total power capacity over a year could shave as much as 0.7 percentage points off GDP growth. The study noted that unscheduled load-shedding (unplanned power outages) would have worse impact, but it was difficult to quantify.

Frost and Sullivan (2010) noted that the cost of unserved energy (COUE) could not be measured directly but was rather inferred from customer research. Estimates of the COUE range from R75/kWh (derived from the impact on consumers most adversely affected by 2008 load shedding episodes) to R10/kWh (the average electricity intensity of output). Therefore given that the Medium Term Risk Mitigation Plan (MTRMP) predicts a power capacity shortfall of 42 000 GWh between 2010 and 2020, the lost value to the economy of unserved energy could range from R419 billion to R3.15 trillion over this period (Frost and Sullivan, 2011)

5.4. Exploring the policy options available to government to mitigate against the impact of rising electricity tariffs

In this section we identify some of the policy options that are available to government to lessen the impact of rising electricity price and discuss their merits and drawbacks. The policy options identified include: subsidies, gradual price adjustments and transition credits, accelerated energy efficiency and demand side management, promoting competition in the electricity supply industry and providing targeted support to vulnerable industries.
5.4.1. Subsidies

5.4.1.1. Grounds for subsidising electricity

Many Governments, while aware of the enormous costs of maintaining inefficient electricity prices have been reluctant to increase them and continue to provide implicit or explicit electricity subsidies. Governments usually justify electricity subsidies on one or more of the following grounds:\(^\text{11}\):

- To maintain industrial competitiveness – protect a particular domestic industry against international competition and to preserve jobs.
- To meet broad social objectives – provide a basic level of electricity services to the poor
- To stimulate regional or rural economic development
- To promote macroeconomic stability (counteract the inflationary effects of rising prices or reduce dependence on imports)
- To protect the environment

However, the validity of a wide range of energy subsidies are being questioned given that they often associated with significant economic, financial and environmental costs, Vedavelli (1989) maintains that “subsidies no matter how justified socially severely distort demand patterns for energy.” Hope and Singh (1995) noted that while electricity subsidies in developing countries are often justified on the basis of a need to promote industrial development but this introduces a bias in favour of energy-intensive industries. And given that these industries (including metal-smelting, paper and petrochemicals) are capital intensive, this type of development support is not all the appropriate for a developing country with abundant labour.

5.4.1.2. The ‘right’ to low electricity prices discriminates against others

Cross subsidies are particularly insidious because they imply that not only that some customers benefit from tariffs that are below cost-reflective levels but that some consumers must possibly bear tariffs that are higher than cost-reflective levels to fund them. These distortions not only affect investment decisions but can also act as a barrier to entry and prevent competition in the electricity supply industry (if the utility offers large industrial customers better deals and makes up the difference by charging less price sensitive customers more, IPPs cannot match the low prices offered to large industrial customers and so the distortion prevents the entry of new competitors). If low electricity prices are established for one group of firms, it may discriminate against new and more efficient firms that have made more technologically efficient choices.

Funding subsidies through budget provisions is always more efficient than cross subsidies, because it better preserve proper economic price signals (and therefore investment and consumption decision) and avoid the negative impact on other customers that are not subsidised (Rosenzweig, Voll, & Pabon-Agudelo, 2002). Funding subsidies though the fiscus is more transparent and represents a deliberate choice by government to subsidise the energy costs of industrial consumers at the expense of alternative uses for public funds but this is policy decision that can be evaluated more transparently if it is an explicit budget line item than if it is hidden in cross-subsidises within the utility tariff structure. It is also preferable to fund targeted subsidies (such as those to low-income consumers) from the public budget because it creates fewer distortions.

\(^{11}\) (UNEP, 2008) and (Hope & Singh, 1995)
5.4.1.1. Characteristics of a good subsidy

According to UNEP (2008), “A good subsidy is one that enhances access to sustainable modern energy or has a positive impact on the environment, while sustaining incentives for efficient delivery and consumption.” There are really only two instances where a clear case can be made for subsidising electricity - firstly to provide a basic level of electricity services to the poor as a means of alleviating poverty and promoting social and economic development and secondly to promote the development and use of more environmentally friendly renewable energy technologies.

Given the significant drawbacks associated with providing subsidies and difficulty in removing them, it is essential that the decision to introduce any new subsidy is evaluated carefully on a case-by-case basis. According to UNEP (2008) the basic principles that should be followed in introducing or reforming electricity subsidies are as follows, the subsidy should be:

- **Targeted**: carefully targeted at the designated group
- **Efficient**: should not undermine incentives for suppliers or consumers to provide or use a service efficiently.
- **Soundly based**: should be based on a rigorous analysis of the associated costs and benefits.
- **Practical**: should be affordable and easy to administer in a low-cost way.
- **Transparent**: it should be clear to the public how much a subsidy programme costs and who benefits from it.
- **Limited in time**: should be subject to a ‘sunset clause’, meaning that they will only be provided for a limited period, stipulated at the outset so that the recipients do not become reliant on them.

Although we found few examples of the use of targeted subsidies to shelter industries from rising electricity prices, temporary and well-targeted subsidies could potentially be provided to vulnerable industries to give them time to adjust to higher electricity prices. In 2000 the UK introduced a temporary subsidy on coal to give the mining industry a chance to further improve competitiveness at a time of low oil and gas prices, but the subsidy was removed in 2002 as initially agreed (UNEP, 2008).

5.4.2. Gradual price adjustments and transition credits

5.4.2.1. Increase tariffs gradually

Policy makers argue that for countries that are transitioning to cost-reflective electricity tariffs, one of the most obvious ways to minimise the short-run impact of rising prices on output and employment is to introduce tariff increases more gradually. The basic reasoning is that gradual price increases over a given time path, provide firms with certainty, gives them time to adapt and therefore minimise adjustment costs. It is argued that if the future electricity price path was announced, consumers would be able to gradually replace energy-inefficient technologies and improve their processes. This should limit the negative impact of rising prices on employment and output and help to prevent sudden losses and bankruptcies. (Vedavalli, 1989).

As discussed in section 4.3.1.1, the results of an empirical study by Pan African (May 2011) suggest that the negative impact of electricity price increases on employment, output and investment is greatly diminished if tariff increases are introduced more gradually. The HSRC (2008) notes that, “in industry, the major energy
savings cannot be implemented within very short periods of time. New equipment and machinery must be identified, then ordered either locally or overseas, delivered, and installed… the minimum period of adjustment is approximately six to 18 months.” As such, a large sudden price is likely to result in a contraction in output rather than a fall in consumption due to productivity improvements.

The policy of gradual price adjustments however, also suffers from some drawbacks. Firstly, if cost-reflective tariffs are to be attained, domestic electricity prices must still rise faster than world electricity prices over the ‘transition period’. Secondly, introducing tariff increases more gradually prolongs the period over which energy-inefficient investment takes place and also moderates the pace of improvements in energy-efficiency. Given that South Africa is currently facing power capacity constraints, introducing tariff increases more gradually could prove very costly if limits the extent to which higher prices encourage efficiency-improvements and therefore exacerbates the shortage and results greater load-shedding.

5.4.2.1. Increase tariffs immediately to cost-reflective levels and provide temporary subsidies or transition credits

Another option would be to move electricity prices suddenly to cost-reflective levels and then recycle revenue to consumers in the form of a temporary subsidy or ‘transition credits’ proportional to the consumer’s initial energy consumption. This effectively gives consumers an offsetting credit for their ‘old’ energy consumption but subjects them to long-run marginal costs for any new consumption (Rosenzweig, Voll, & Pabon-Agudelo, 2002). The advantage of this approach is that it sends a strong signal about the true cost of energy and would provide an immediate incentive for consumers to investment in more energy-efficient technologies (they would still receive the same transition credits regardless of their future consumption). The subsidy could then be phased out over a period that allows the utility to remain financial sustainable but that allows consumers to time to adjust (Vedavalli, 1989).

The drawback of this approach (relative to more gradual price increases) is the cost of administering such a program. But, if it were feasible to administer efficiently, this policy option would have the same benefits as a gradual price adjustment without incurring all the costs (Vedavalli, 1989).

5.4.3. Accelerated energy-efficiency and demand side management

As noted in Section 3.2.2.2, improvements in energy efficiency have been recognised as one of the most economical means of achieving a reduction in energy costs and demand. Promoting the accelerated uptake of energy-efficiency and demand side management initiatives reduces the need for additional generating capacity. Therefore, provided the cost of achieving a unit of energy savings are less than what it would cost to provide an additional unit of energy, accelerated EEDSM can also be considered a strategy to mitigate against higher electricity tariffs.

However, based on the results of survey, DNA economics (2011) noted that firms had made little use of public or external support energy efficiency and that increased energy prices and not incentives had been the primary driver of mitigation behaviour. They did however note that Eskom’s demand side management programme had been more successful and that improved incentives may speed up mitigation behaviour. This finding is also supported by the HSRC (2008) who found substantial energy savings could be possible over a two-year period, and then many firms had not implemented them due to cost of investment. They noted that
rising prices would increase the return on these investments but the application of incentives to the relevant categories of EEDSM investments could also halve the amortisation period.

In light of the disappointing uptake of EEDSM initiatives relatively to expectations, Eskom recently revamped its EEDSM business model and in 2011 launched a standard offer programme. “The standard offer is a mechanism under which Eskom purchases energy savings and/or demand reductions using a predetermined and pre-published rate in cents per kWh or Rand per kW based on verified savings. Any energy user (utility customer) or energy service company that can deliver energy and/or demand savings is paid the fixed amounts per kWh or kW (the Standard Offer amounts) upon completion of the EE/DSM project and certification of the achieved savings by an authorized measurement and verification organisation.” (ESMAP, 2011).

5.4.4. Promoting competition in the electricity supply industry
In addition to adopting an appropriate pricing regime, it also important that sound investments decisions are made to ensure that electricity demand is meat a least cost (Vedavelli, 1989). International experience has shown that one way to achieve improved efficiency in the electricity supply industry is to promote commercialisation of state-owned utilities and exposure the industry to greater competition and private sector involvement (Goldstein, 2009). Examining the experience of markets that had already undergone this transformation, Frost & Sullivan has found that even those utilities that had been well-regarded had shown marked efficiency gains in a newly competitive market (Goldstein, 2009).

In practice there is wide variation in the outcomes of IPP projects but there are many projects that are viewed as a success by investors and their host countries alike (Woodhouse, 2005). The experience of IPPs in Kenya was fairly positive - the requisite power in a time of capacity shortages was supplied although initially at a rate three times higher than the public utility, later however prices become more competitive (Eberhard & Gratwick, 2005).

It is argued that the South African government needs to create a regulatory and legislative environment that promotes competition in the electricity supply industry by enabling the integration of independent power producers into the electricity supply grid. Despite intentions by government to promote increased involvement of IPs (government stated that IPPs should be responsible for 30% of power generation after 1998), South Africa has failed to attract IPPs into the electricity supply industry. Low electricity tariffs and an unfavourable regulatory environment are some of the factors that have hindered progress on this front. One of the first steps in encouraging IPPs to enter the market it to provide the right price signals by subjecting customers to cost-reflective prices. In addition, the South African government is in the process of creating an independent system operator that would act as a non-conflicted buyer of power, the Independent System and Market Operator Bill was approached by Cabinet on the 16 March 2011.

5.4.5. Providing targeted support to vulnerable industries
Given that electricity in prices in South Africa have been subsidised implicitly by the taxpayer for a considerable length of time, it can be argued that it is necessary to provide additional ‘transition’ support to industries that have come to rely on low electricity prices as a source of comparative advantage and that are vulnerable to price increases. Providing transition credits that are proportional to existing electricity
consumption or other carefully targeted subsidies could be a means to accommodate the special characteristics of these particularly vulnerable consumers.

However as noted in chapters 3 and 4, identifying the vulnerable sectors for targeted policies would present some significant challenges since there is considerable variation in the vulnerability of different firms and sub-industries within major sectors to electricity price increases. In addition policy-makers may want to consider supporting only those vulnerable industries that also make a significant contribution to the economy in terms of factors highlight in Chapter 1 – namely output, employment, ability to absorb unskilled labour and linkages to the rest of the economy. It may also be difficult to scale the level of transition support provided to the degree of vulnerability and many industries may end up requesting support. Transition assistance would have to be time-bound, so that the dependence on subsidies would eventually be removed.

5.5. Conclusion
Despite the rapid increases in electricity prices in South Africa since 2008, prices are still low by international standards. Prices will inevitably need to continue rise towards ‘cost-reflective’ levels so that a repeat of the costly mismatches in supply and demand – which included over-investment in generation capacity in the late 1980s and the current supply shortages can be avoided.

It has been argued however, that further increases in electricity prices, especially if the adjustment to ‘cost-reflective’ tariffs is a rapid one, will jeopardise the viability of firms and industries who invested in South Africa on the basis of cheap electricity and who have come to rely on this as a source of comparative advantage. In this chapter we explored the policy options available to government to assist vulnerable industries in transitioning to cost-reflective tariffs while minimising the negative impacts on output, employment and profitability.

The sharp increases in electricity tariffs since 2008 have predictably, been met with significant public resistance. Representatives of electricity-intensive industry (and some members of the general public) contend that the current electricity price path is ‘unjustifiable’. While representatives of electricity-intensive industry appear in principle to support the notion that the electricity prices need to rise to a ‘cost-reflective’ level, they have argued that lower and more ‘affordable tariffs’ can be achieved primarily by manipulating aspects of Eskom’s tariff formula.

However, a summary and critique of the options presented by industry to mitigate against high electricity prices reveals that many of the arguments presented are flawed. Lowering Eskom’s return on assets, as industry suggests, implies that taxpayers continue to subsidise electricity, would jeopardise the financially sustainability of the utility and would not give rise to ‘cost-reflective’ tariffs. Retaining historic cost accounting practices, would in all likelihood give rise to more rapid electricity price increases over the next few years and while lowering the target for renewable energy would result in lower tariffs, it would be at the expense of the environment. Of the options presented by industry the argument that the introduction of IPPs would result in lower tariffs is the most robust since it has been proven that increased competition in the electricity supply industry often results in lower prices but this is not always the case since IPPs also face a higher cost of capital and are unlikely to enter the market until tariffs are cost-reflective and provide the incentive to do so.
Too often the criticism levied against Eskom or NERSA with respect to electricity prices hikes simply implies that tariff increases can be avoided without considering how the cost of new power capacity will be paid for or who will ultimately bear the burden. We found that while debt and equity are used to prefund major capital investment in electricity supply, ultimately tariffs need to cover the full cost of electricity supply, including the provision of an acceptable return on the equity or debt provided by the utility’s shareholders and lenders. So in other words, if electricity consumers don’t bear the full cost of electricity supply, the taxpayer eventually will.

Most studies of the impact of electricity price increases also focus solely on the short-run impact of rising prices on employment and output but fail to note that in the absence of cost-reflective prices, costly mismatches between supply and demand are likely to continue to occur. It has been proven that power outages or ‘unserved energy’ come at far greater cost to the economy than rising electricity prices. A study by Deloitte (2008) found that load-shedding had substantial economic impacts across most sectors of the economy and continued at 10% of total power capacity over a year could shave as much as 0.7 percentage points off GDP growth.

In our analysis we identified that the policy options available to government to mitigate the impact of rising electricity prices may include subsidies, gradual price adjustments and transition credits, accelerated energy efficiency and demand side management, promoting competition in the electricity supply industry and providing targeted support to vulnerable industries.

We noted that many Governments, while aware of the enormous costs of maintaining inefficient electricity prices have been reluctant to increase them and continue to provide implicit or explicit electricity subsidies. Any measure that keeps energy prices for consumers below market levels can be deemed an energy subsidy so as long as electricity tariffs in South Africa remain below cost-reflective levels, consumers of electricity are effectively receiving a subsidy from the taxpayer. This implicit subsidy not only distorts the efficiency of the electricity market but promotes a transfer of wealth from South African taxpayers to the large consumers of electricity (which include large industrial consumers with substantial foreign shareholding).

Subsidies no matter how justified socially severely distort demand patterns for energy and associated with significant economic, financial and environmental costs, but cross subsidies are particularly insidious because they imply that not only that some customers benefit from tariffs that are below cost-reflective levels but that some consumers must possibly bear tariffs that are higher than cost-reflective levels to fund them. Funding subsidies through budget provisions is always more efficient than cross subsidies, because it better preserve proper economic price signals (and therefore investment and consumption decision) and avoid the negative impact on other customers that are not subsidised.

While all subsidies are associated with significant drawbacks, the provision of a subsidy can be justified if it enhances access to sustainable modern energy or has a positive impact on the environment, while sustaining incentives for efficient delivery and consumption. We noted that a good subsidy should be targeted, efficient, based on a rigorous analysis of the costs and benefits, practical, transparent and should only be provided for a limited amount of time. As such, we found that temporary and well-targeted subsidies could potentially be provided to vulnerable industries to give them time to adjust to higher electricity prices.
It is often argued that increasing tariffs more gradually is one of the most obvious ways to minimise the short-run impact of rising prices on output and employment. The basic reasoning is that gradual price increases over a given time path, provide firms with certainty, gives them time to adapt and therefore minimise adjustment costs. We noted however that the policy of gradual price adjustments also suffers from some drawbacks. Firstly, if cost-reflective tariffs are to be attained, domestic electricity prices must still rise faster than world electricity prices over the ‘transition period’. Secondly, introducing tariff increases more gradually prolongs the period over which energy-inefficient investment takes place and also moderates the pace of improvements in energy-efficiency. Given that South Africa is currently facing power capacity constraints, introducing tariff increases more gradually could prove very costly if it limits the extent to which higher prices encourage efficiency-improvements and therefore exacerbates the shortage and results greater load-shedding.

An alternative to gradual price adjustments would be to move electricity prices suddenly to cost-reflective levels and then recycle revenue to consumers in the form of a temporary subsidy or ‘transition credit’ which would be proportional to the consumer’s initial or current energy consumption. The advantage of this approach is that it provides an immediate incentive for consumers to invest in more energy-efficient technologies because the credit is only provided on historical consumption and any additional consumption is immediately subject to cost-reflective prices. The drawback of this approach (relative to more gradual price increases) is the cost of administering such a program but if it were feasible to administer efficiently, this policy option would have the same benefits as a gradual price adjustment without incurring the costs.

Promoting the accelerated uptake of energy-efficiency and demand side management initiatives reduces the need for additional generating capacity so provided it is more cost-effective than new supply can also be considered a strategy to mitigate against higher electricity tariffs. Studies have noted however that South African firms have historically made little use of public or external support energy efficiency and that increased energy prices and not incentives had been the primary driver of mitigation behaviour. It has been noted that improved incentives may speed up mitigation behaviour and is it encouraging to note that Eskom has recently revamped its EEDSM business model and in 2011 launched a standard offer programme that promises to promote more rapid uptake of EEDSM.

International experience has shown that one way to achieve improved efficiency in the electricity supply industry is to promote commercialisation of state-owned utilities and exposure the industry to greater competition and private sector involvement. Despite the stated intentions, South Africa has failed to attract IPPs into the electricity supply industry. Low electricity tariffs and an unfavourable regulatory environment have been identified as some of the main factors that have hindered progress on this front. One of the first steps in encouraging IPPs to enter the market it to provide the right price signals by subjecting customers to cost-reflective prices. In addition, the South African government is in the process of creating an independent system operator that would act as a non-conflicted buyer of power, the Independent System and Market Operator Bill was approached by Cabinet on the 16 March 2011.

Finally, given that electricity prices in South Africa have been subsidised implicitly by the taxpayer for a considerable length of time, it can be argued that it is necessary to provide additional ‘transition’ support to industries that have come to rely on low electricity prices as a source of comparative advantage and that are vulnerable to price increases. Providing transition credits that are proportional to existing electricity
consumption or other carefully targeted subsidies could be a means to accommodate the special characteristics of these particularly vulnerable consumers.

However as noted in previous chapters, identifying the vulnerable sectors for targeted policies would present some significant challenges since there is considerable variation in the vulnerability of different firms and sub-industries within major sectors to electricity price increases. Policy makers may want to consider supporting only those vulnerable industries that also make a significant contribution to the economy.


DNA Economics. (2011). *Ability of firms to adjust to higher energy costs*.

Dr Miriam Altman, P. R. (2008). *THE IMPACT OF ELECTRICITY PRICE*. HSRC.


EIUG. (2011). *Affordable electricity in South Africa@ a Tipping point?*


NERSA. (14 October 2011). *NERSA CONSULTATION PAPER:ESKOM MULTI-YEAR PRICE DETERMINATION METHODOLOGY.*


RMB|Morgan Stanley. (2011). *South Africa Mining - Structural cost increases a bigger concern than cyclical cost pressures.*


Xstrata Alloys. (January 2011). Towards a justifiable electricity price path.