The Tipping Point: The Impact of Rising Electricity Tariffs at Firm and Sector Level

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Abstract

The electricity sector in South Africa has been in the spotlight over the past seven years since supply demand imbalances began in 2008. While much attention has been focused on the negative impacts of load shedding on the economy, fewer studies have focused on the impacts of rapidly rising electricity tariffs. There have been some studies that have attempted to estimate the price elasticity of electricity demand or show vulnerable sectors based on their electricity intensity, but all have struggled to demonstrate the potential impacts on the competiveness of individual firms and their decisions, and the longer run impacts on electricity demand should certain "tipping points" be breached. For this paper, we model where and when such tipping points might be breached using financial information from 21 large firms in various sectors, cost information for alternative generation, as well as price increase scenarios for Eskom and municipalities. We then overlay this with sector level information from the Supply-Use Tables which is fed into an Input-Output multiplier model to analyse the direct, indirect as well as induced effects of some initial change in final demand. The ultimate objective is to determine the impact of rapid electricity tariff increases on a sector and company level, accounting for spill-over effects to other sectors.

[1] Disclaimer: The views expressed in this working paper are personal views of the authors and do not represent those of the National Treasury, South African Revenue Services or Government of the Republic of South Africa.

1. INTRODUCTION

While much attention has been focused on the negative impacts of load shedding on the growth of the economy, there has been less analysis on the impacts of rapidly rising electricity tariffs on firms. It is commonly agreed that for Eskom to become sustainable, real tariffs will have to rise further if other funding alternatives are not explored. However, prices cannot continue to rise without affecting firm profits and competitiveness. From 2009 onwards various studies tried to look at the price elasticity of demand for electricity,[2] and whether this would affect particular energy intensive sectors levels of consumption and ouput, and thereby growth.[3] However this proved a difficult task because of historically low electricity prices and the fact that they had changed very little in real terms over an extended period of time.

Electricity prices were generally a relatively small proportion of a firm's overall operating expenditure, or a household's consumption expenditure, but critical nonetheless (for the operation of machinery, running of lights and appliances). Hence firms and individuals were relatively inelastic in their demand patterns. In addition, the direct prices of alternatives energy sources at the time, or the indirect costs associated with the installation of the necessary infrastructure and the sourcing and logistics of obtaining it, meant there was little or no cross-price elasticity. Essentially, electricity demand was largely determined by the income effect, and for firms by output or value added growth. But, starting in 2008, electricity prices started to rise steeply, changing the relative costs of electricity, with respect to alternative energy options and in relation to output prices. This in turn should have made consumers more elastic.

Between 2008/09 and 2013/14, electricity prices have increased by an average rate of 10.6 per cent per year. It is difficult to estimate however how much of a demand response there has been in the market and thereby to forecast what this might mean for both Eskom sales and general national electricity planning (as per documents such as the Integrated Energy Plan, (IEP)), but also what indirect impacts there might be on the economy through reduced output, and shifted, delayed or cancelled investment. The price elasticity of demand for electricity, or the strongly related energy intensity of economic growth, have been difficult to estimate because of the current electricity shortfalls which artificially constrain the market, thereby masking price elasticity effects.[4] The timing of the price increases, which largely coincided with an economic recession also make estimation difficult, as does the lumpy long-term nature of energy intensive investments (which use a particular energy source and which cannot be easily changed without significant outlay). Finally, the quality of data, including the availability of municipal data, disaggregated for sector specific analysis, is problematic. Nevertheless, anecdotal evidence suggests that the combination of steep electricity price increases over the previous seven years, combined with lower economic growth, low commodity prices and generally low inflation rates, and excess productive capacity in many countries around the world means that many firms are under severe price pressure.

Given rising electricity prices, there are a number of possible electricity cost "tipping points" that might result in firms making decisions that significantly alter their electricity demand profiles, including:

- deciding to generate their own electricity
- deciding to not invest any further (given current revenue/cost ratios),

[2] For Example Deloitte, 2010, "Price elasticity of electricity demand". Inglesi-Lotz, R. & Blignaut, J. 2011. "Estimating the price elasticity of demand for electricity by sector in South Africa".

[3] Price elasticity of supply has been a less interesting subject because of the nature of the commodity and the structure of the market, with the dominant incumbent historically planning new generation options to meet security of supply. The regulatory methodology then determines the price of electricity, through the allowed revenue methodology (return on assets and pass through costs).

[4] For example the key industrial customers of Eskom have been 'load curtailed' by about 10 per cent from pre 2008 baselines since 2008. From January to June 2015 there was 'load shedding' on 82 days and for 709 hours, with unserved energy amounting to 1095 GW.

- deciding to invest elsewhere in the region or in another sector,
- deciding to invest in large energy efficiency programmes, or
- deciding to shut down one or more parts of their business.

Decisions taken around “tipping points” will have large ramifications for Eskom sales and for the economy more broadly. If firms choose to delay or cancel investment, or indeed shut plants/mines down, this will affect forecasts of both economic growth (shut downs will have an immediate impact whilst other investment decisions may have medium to long term impacts) but also that of electricity demand and how much supply is required to meet this demand. Whilst decisions to invest in other sectors may not affect growth, they will contribute to structural transformation and could impact on variables such as employment and exports. The decision to build own generation may be viewed by some in a positive light, as it is better than the shutting down facilities and will result in some investment expenditure. However it could have large impacts on future Eskom revenue, and this in turn could have large implications for the average price level for those still supplied from the grid. Further, it could impact the fiscus in terms of demands for guarantees or recapitalisation. Finally, any decision to invest in energy efficiency is generally viewed in a positive light (despite some potential decline in sales revenue for Eskom) in that firms will become less energy intensive, potentially more competitive and sustainable, and it will contribute to environmental objectives (like emissions reductions) whilst also contributing to investment expenditure.

Overall these decisions will have clear and important impacts on the economy. We therefore try to look at the firm-level and broader economic impacts of electricity price increases. The first part of this paper attempts to model where and when such “tipping points” might be breached using financial information from 21 large companies in various sectors, cost information for own generation technologies, as well as tariff increase scenarios for Eskom and municipalities. The second part of this paper uses an Input-Output multiplier model, with sector level information from the Supply-Use Tables, to analyse the direct, indirect as well as induced effects of some initial change in final demand (for electricity and investment expenditure) brought about changes in electricity prices.

2. LITERATURE REVIEW

There have been a few elasticity and sector level studies related to electricity tariffs. A study by Deloitte (2009) tried to estimate price elasticity of demand for electricity by sector by estimating an error correction VECM model, using detailed sector level data from Eskom’s Key Industrial Customer (KSACs) and Distribution division. Although the data did not cover residential and commercial customers sufficiently to be considered as representative for South Africa, it did cover a significant proportion of most mining and many manufacturing sectors where Eskom tends to supply large customers directly. The results however showed very inelastic demand, and the authors argued that there had been insufficient variation in price in the data set to test the price effect sufficiently. A longer run estimation – based on publically available data sets – showed more elastic demand responses, with electricity consumption increasing as real prices declined over a period of 20 years, although there are some methodological issues with using this data.[5]

Inglesi and Pouris (2010) used Engle-Granger methodology to model electricity demand with data from 1980 until 2007 and found that while in the short-run, firm demand for electricity is influenced by economic and population growth, whilst in the long run, income and the price of electricity are larger determinants. Inglesi-Lotz and Blignaut, in their 2011 panel data analysis of the various sector’s response to electricity price increases between 1993 and 2006 find that the industrial sector with a statistically significant negative price elasticity of demand of -0.869, whilst other sectors were found to not be sensitive to historical electricity price increases. However, the paper concludes that

[5] Publically available data from supply use tables shows values in Rand of electricity outputs consumed as inputs in various sectors. It does not however show actual volume in kWhs consumed, and average electricity prices vary greatly between sectors. It is possible to get broad categories of electricity sales by value and volume using Eskom’s high level categorisation; mining, manufacturing, rural, resellers, traction, commercial, residential.

structural change is expected in economic sectors due to the high increases in electricity prices which may spur sectors to invest in more efficient technologies or other forms of energy that are more affordable.

All these studies recommended that changing levels of elasticity or tipping points should be examined. More recently, Kohler (2013) suggests that while price elasticity of demand might have been an inelastic -0.738 for 1989-2009, more recently it has become more elastic – and even suggested a long run elasticity of up to -3.4 for industry.

According to Edwards (2012), higher electricity tariffs encourage innovation in terms of production processes as well as investment in own generation. In their paper on effects of electricity shortages on productivity, Fisher-Vanden, Mansur & Wang (2013) found that in Chinese firms exposed to power shortages, there was no indication of an increase in own generation by these firms in the early 2000's. [6]However, the generation market has changed substantially since then and the costs of own generation have been on the decline (SAPVIA 2013).

From a firm-level perspective, TIPs (2014) explored the impact of electricity price increases on the competitiveness of mining industries and what role these increases have had in renewable energy and energy investments in mining value chains. The study used annual financial statements and company interviews and found surface mining, coal and platinum group metal firms to have been marginally affected by electricity price increases, whilst gold miners were strongly affected. Overall, the analysis concluded that effect of electricity price increases have not been sufficient enough to change firm behaviour and processes substantially, although some firms were reported to have already explored more energy efficient technologies, co-generation and renewables.

A study by Cameron & Rossouw (2012), commissioned by Eskom, tried to look directly at the issue of tipping points, by using directly obtained key industrial customer information about electricity consumption and operating expenditure (obtained through Eskom-run surveys) to model the "shut down" point. They use a Cost of Production Tipping Point Decision Support Model and develop a framework to provide Eskom management with a tool for strategic decision making. Cameron *et al.* found that customers in 13 sectors – particularly in the *Manufacturing of basic and fabricated metals* and *Manufacturing of coke, refined petroleum products, nuclear, chemicals, rubber, plastic* had the potential for reaching the tipping point. These customer's account for about 25 per cent of Eskom's revenue. Further, six customers – accounting for 4.1 per cent of Eskom's revenue – were identified as being in "jeopardy" based on their tipping point analysis. Deloitte (2011) found the electricity and non-ferrous metals sectors to be particularly vulnerable to electricity prices.

There have been numerous recent studies on the economic impact of supply shortages and load shedding. Studies on the economic impact of price increases have been less common. Impact studies of this kind typically make use of a range of techniques, from the basic input-output (I-O) analysis to the more complex computable general equilibrium (CGE) type models (see for example Tiwari, 2000, Pachauri and Spreng, 2002).

Some examples include the HSRC (2008) study which focused on the impact of electricity price increases as well as rationing on the South African economy using computable general equilibrium methods. The study by Deloitte (2010) for Eskom used a set of scenarios of potential price increases, and calculated their direct impact on inflation – as per electricity weightings in the CPI and PPI indexes. Then using an I-O matrix it calculated potential pass through costs and induced costs – thus

[6] In the Manufacturing Circle's Quarterly Review for the second quarter of 2015, the ongoing electricity supply challenges were widely identified as a key concern for manufacturers – with loadshedding, supply uncertainty and rising electricity tariffs impacting on profitability. The Manufacturing Circle (2015) surveyed its members about mitigation strategies against electricity shortages and 63 per cent of those surveyed have their own generation (likely fuel generators), 53 per cent rescheduled production, 19 per cent reduced production and 15 per cent either closed down production lines or substituted local manufacture for imports. Furthermore 33 per cent of firms upgraded their existing capacity for greater energy and water efficiency.

arriving at a total inflationary figure. This inflation assumption was then inputted into a macroeconomic model, with a strong inflation targeting built-in assumption to see what the impact would be on forecast growth, investment, and job creation. The results showed quite strong negative results, but again highlighted that the modelling was unable to measure the impact on competitiveness or the possibility of tipping points being breached, further reducing investment and output.

Cameron and Rossouw (2012) took their tipping point model and expanded it in a CGE model to show economy wide impacts. The impact of the shutdown of three KSAC's firms, identified in the Cost of Production Tipping Point Decision Support Model, as a result of electricity price increases was modelled. It found that real GDP growth would be reduced by 0.73 per cent and overall employment would be reduced by 1.03 per cent in comparison with the base case.

Our study tries to continue the research that has already been done on elasticity of demand and 'tipping points' by updating older research with newer, higher electricity prices, and by including other tipping points into the analysis. Not only have electricity prices continued to increase since Cameron and Rossouw conducted their research in 2012, but commodity prices have recently come under extreme pressure. In addition, it is anticipated that large increases will be requested, when Eskom table the next full tariff re-opener for the remaining 3 years of the MYPD3. An additional contribution is that this paper extends the tipping point analysis to the potential for own generation for various electricity scenarios in the midst of falling levelised costs of own generation.

3. IMPACTS OF ELECTRICITY TARIFFS ON OPERATING PROFITS AND FIRM-LEVEL DECISIONS

3.1. Method

This section of the paper uses financial and sustainability information from the publicly available annual reports of 21 companies across different sectors (12 energy intensive firms[7] and nine less-energy intensive firms).[8] Nominal data for the last four available years of the annual financial statements of companies is extrapolated until 2040/41, using various assumptions around variables such as revenue growth, increases in costs, and tax to operating profit ratios. The electricity costs of these companies are determined using annual electricity consumption data, also taken from firm sustainability reports. Where not available in the annual report, electricity cost information is taken from existing literature or from the companies directly. Electricity price data is sourced from Eskom as well as NERSA's municipal benchmark data and electricity price increases are forecast until 2040/41 using three tariff scenarios: a base/ low tariff scenario (the MYPD 3 as it stands), a high tariff scenario and a moderate tariff scenario. In the outer years, it is assumed that electricity prices rise by assumed CPI. The municipal tariff increase differential is assumed to be one percentage point.

Table 1: Eskom tariff scenarios

	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26
Base (low)	12.7%	8.0%	8.0%	8.0%	5.8%	5.8%	5.8%	5.8%	5.8%	5.8%	5.8%
High	12.7%	25.0%	25.0%	20.0%	8.0%	8.0%	8.0%	5.8%	5.8%	5.8%	5.8%
Moderate	12.7%	15.0%	15.0%	15.0%	10.0%	8.0%	8.0%	5.8%	5.8%	5.8%	5.8%

Source: Authors (2015)

Table 2: Municipal tariff scenarios

	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	2021/22	2022/23	2023/24	2024/25	2025/26
Base (low)	13.7%	9.0%	9.0%	9.0%	6.8%	6.8%	6.8%	6.8%	6.8%	6.8%	6.8%
High	13.7%	26.0%	26.0%	21.0%	9.0%	9.0%	9.0%	6.8%	6.8%	6.8%	6.8%
Moderate	13.7%	16.0%	16.0%	16.0%	11.0%	9.0%	9.0%	6.8%	6.8%	6.8%	6.8%

Source: Authors (2015)

Individual firm electricity costs are linked to the tariff scenarios above. It is assumed that the large electricity users are supplied by Eskom and that the less energy intensive firms are municipal customers. In order to determine the impacts of electricity price increases on the firms in the analysis, the net present value (NPV) of the operating profits from 2015/16 until 20140/41 are calculated for

[7] Sibanye, Harmony Gold, AngoPlat, Lonmin, Implats, Kumba Iron Ore, Evraz Highveld Steel, Arcelor Mittal, Hulamin, PPC, AECI and Transnet.

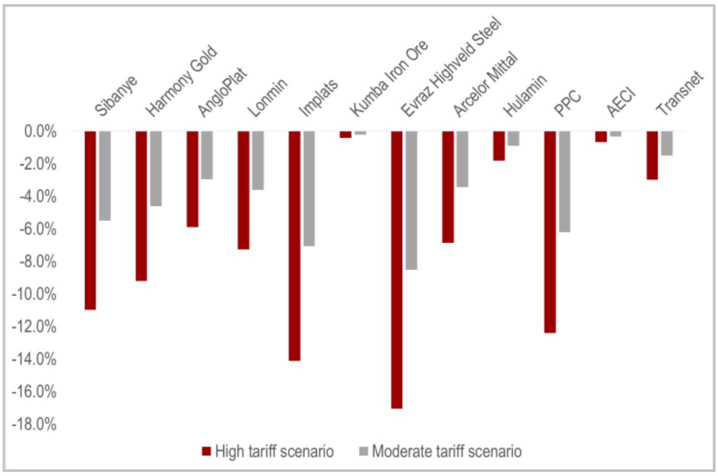
[8] Astral Foods, Clover, Pioneer Foods, Distell, Nampak, Nedbank, Telkom, Tsogo Sun and Netcare.

each firm. For comparison purposes, the NPV of the base scenario (the best case from a business perspective) for each firm is compared with the high and moderate increase scenarios to see the size of the loss in the NPV due to higher electricity tariffs.

3.2. Results

When evaluating the energy intensive firms, there was no clear "shut down" point (i.e. a point where the NPV's of their operating profits became marginal or negative) either in the base, high or moderate tariff scenarios for most companies with the exception of Evraz Highveld Steel and Lonmin. However, there was a significant loss in the NPV of the operating profits of energy intensive users between 2015/16 and 2040/41 when comparing the base scenario to high and moderate electricity price increases, as Figure 1 indicates. In the high tariff scenario, declines in the net present values of the operating profits of energy intensive firms were between 0.4 percent and 17.1 per cent, whilst in the moderate scenario the declines were between 0.2 and 8.5 per cent. As expected, the largest declines in operating profit NPVs can be seen in firms with the highest energy intensities. The biggest declines were seen in Evraz Highveld Steel (17.1 percent), Implats (14.1 per cent) and PPC (12.4 per cent) in the high tariff scenarios, representing a net loss in operating profits of R14.5bn over the 26 years of the analysis. Kumba Iron Ore and AECI (the chemicals manufacturer) are the least affected energy intensive users due to their relatively low electricity intensities and costs.

Figure 1: The impact of high and moderate tariffs scenarios on operating profits in comparison with the base scenario – energy intensive users



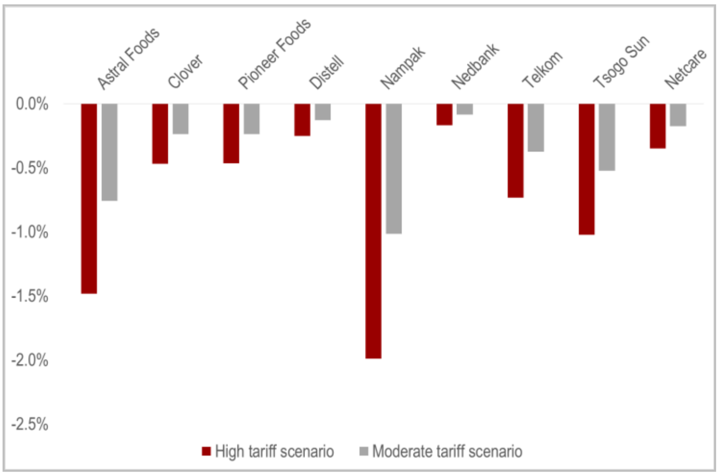
Source: Authors (2015)

Regarding the less energy intensive users, the picture is rather similar, in that these firms do not reach "shut down" point in any scenario, but that they do have lower operating profit NPVs in the high and moderate scenarios in comparison with the base scenario. However, the magnitude of the decline in the NPVs is much smaller than those in case of the energy intensive users (Figure 2).

In the high tariff scenario, declines in the net present values of the operating profits are between 0.2 percent and 2.0 per cent, whilst in the moderate scenario the declines are between 0.1 and 1.0 per cent, in comparison with the base scenario. Nampak, Astral Foods and Tsogo Sun are the most affected amongst this group.

The analysis of the impact of tariff increases on operating profits indicates, that while firms may not reach shutdown point, there is a material impact on the future operating profits of several firms. This, in turn, will likely impact on decisions to invest – dependant on shareholders' willingness to tolerate lower returns.

Figure 2: The impact of high and moderate tariffs scenarios on operating profits in comparison with the base scenario – other users



Source: Authors (2015)

4. THE ABILITY OF FIRMS TO INVEST IN OWN GENERATION

The levelised costs of alternative technologies have been declining dramatically over the past few years and are expected to continue falling until 2020 (Table 3). In addition, DNA (2011) found that, although rising electricity tariffs were a major concern, sustainability of electricity supply was the most important factor for companies seeking to move towards own-generation technologies. So own-generation is becoming increasingly more viable for firms in the current environment of rising electricity tariffs and load shedding and curtailment.

Table 3: Anticipated changes in the levelised cost of electricity for various generation technologies

R/kWh	2012	2020	% change
Concentrating solar power	2.40	1.71	-29%
Coal	0.80	1.69	111%
Open cycle gas turbines	6.93	1.63	-76%
Wind	0.86	0.76	-12%
Photovoltaics	1.79	1.05	-41%

Source: South African Photovoltaic Industry Association (2013)

The likelihood of firms investing in own generation depends on a few factors such as: electricity intensity, scope for energy efficiency gains, the ability to pass on costs and the cost of own generation relative to direct electricity costs. The general investment climate is an additional consideration for firms looking to invest in own generation, particularly for long-term investments like coal or Closed Cycle Gas Turbines (CCGT). It may be difficult for firms to invest in a 20 year project given the current uncertainty, particularly for firms in the mining sector. Also, shareholders may not have the appetite to spend so much in investing in a non-core asset.

4.1. Method

This component of the study weighs up the costs of investing in own-generation (including capital expenditure, operating expenditure and financing costs) for each of the companies in the analysis against the avoided electricity costs (i.e. benefits) under the different tariff scenarios for each of the companies. For each scenario, the NPVs of the net benefits of each own generation technology,[9] over

[9]For energy intensive users the following technologies are evaluated: a large (750MW) coal plant; a small (250 MW) coal plant; a CCGT plant (711MW); a 200MW wind farm; a 50MW wind farm; and 10 MW photovoltaic and concentrating solar technologies. For the less energy intensive firms, the coal, gas and large capacity wind

their lifespan, are determined for each firm. Then the internal rates of returns (IRRs) are compared to an assumed market return of 12 per cent. In other words, if the IRRs of the net benefits of a particular technology are less than 12 per cent for a firm, the company could make a better return by continuing to rely on the national grid and investing elsewhere.

The capex and opex data for the various technologies were obtained from EPRI's 2011 *Power Generation Technology Data for the Integrated Resource Plan*, and was adjusted from 2011/12 to 2020/21 by price forecasts from the South African Photovoltaic Industry Association. From 2021/22 onwards, it is assumed that the costs of these technologies rise by the inflation assumption. The avoided electricity costs are equivalent to the electricity costs calculated in the first component of the study (section 3). It is assumed that firms start investing in 2015/16[10] and only start benefitting from avoided electricity costs once construction is complete. A critical assumption in the model is the location of generation plant with respect to the location of the firms plants, branches, factories, head offices, depots, or mines. As all the statements used are group financial statements, they will include sites of different type (and energy intensity) across a wide range of locations.

Some firms might have relatively concentrated sites of electricity use, whilst others will be spread out across South Africa[11]. Building own generation and supplying different sites will require the use of existing transmission and distribution infrastructure, where all transmission infrastructure is owned by Eskom, and distribution infrastructure by both Eskom and municipalities. Wheeling charges, or the charge for the use of this transmission and distribution infrastructure, were not taken into account in the first set of models, but we attempt to account for it in the second. Again there are assumptions that need to be made about where the generation plant is located, and what proportion needs to be wheeled as financial statements do not disaggregate the information to this level. It is assumed unviable to invest in a particular generation plant (by source of energy and size) if the load factor or operating capacity required of that plant in order to meet a firms electricity demand, is less than 55 per cent. This assumes, therefore, that any generation plant investment made by a firm is done so only for its own consumption (and not for feeding back into the grid with feed-in tariffs, or selling to another firm). The model includes various assumptions around load factors,[12] maintenance and energy costs, financing costs and debt/equity ratios, build times and so on.

4.2. Results

Table 4 below summarises the viability of various own generation technologies across all three tariff scenarios. In the base, moderate and high tariff scenarios, it is viable for three energy intensive firms to build a large coal plant. Whilst the 100 x2MW wind plant is viable for between seven to ten firms out of the energy intensive users. In terms of the other firms, for whom coal, CCGT and large wind plants are not viable, a 25 x2MW wind plant is viable for six firms in the base and moderate scenarios and eight firms in the high tariff scenario.

Table 4: Number of firms for whom own generation is viable under various tariff scenarios

	Large coal (750 MW)	Small coal (250 MW)	CCGT (711 MW)	Wind (100 x 2MW)	Wind (25 x 2MW)	Wind (10 x 2MW)	Solar PV (10 MW)	Concentrating solar (10 MW)
Energy intensive firms (out of 12 firms)								
Base	3	5	4	7	4	n/a	4	4
High	3	6	4	10	8	n/a	7	7
Moderate	3	5	4	10	6	n/a	5	6
Other firms (out of 9 firms)								
Base	n/a	n/a	n/a	n/a	6	5	5	5
High	n/a	n/a	n/a	n/a	8	7	6	7
Moderate	n/a	n/a	n/a	n/a	6	6	6	6

Source: Authors (2015)

plants are excluded and the net benefits of a 50 and 20 MW wind farms and 10 MW photovoltaic and concentrating solar technologies are determined.

10 If firms choose to invest later, own-generation becomes progressively more viable.

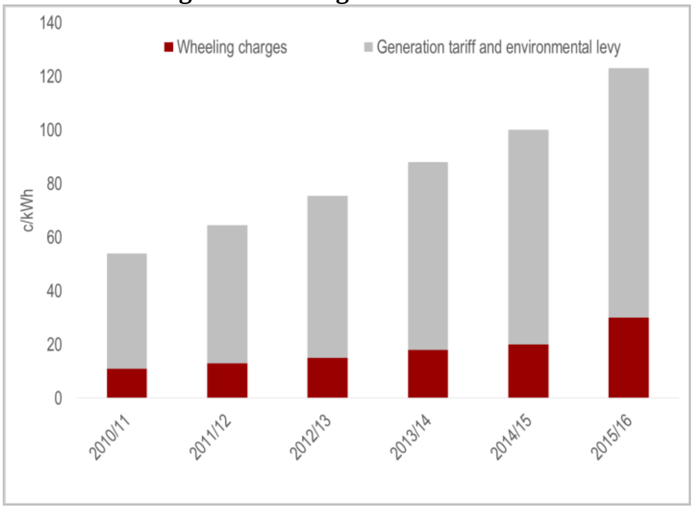
11 Although these firms are international we attempt to isolate South African operations and energy use

12 For example the load factors for solar and wind are assumed at 25%, although latest CSIR estimates show wind load factors could be as high as 34% in many parts of the country.

Wheeling charges

The above analysis of own generation potential does not include wheeling charges. Wheeling charges are a significant cost component of private generation and according to SAPVIA (2013), these charges are expected to reach 30c/kWh in 2015/2016 (Figure 3). Wheeling charges, which are regulated by NERSA, have been highlighted as a significant barrier to the growth of alternative generation, particularly smaller generators (Nkabinde, 2015). However, in many circumstances firms struggle to get access to Eskom's grid in order to wheel. There have been calls for a standardised framework and procedure for wheeling power and determining wheeling costs. NERSA is in the process of finalising such a framework.

Figure 3: Average tariff structure

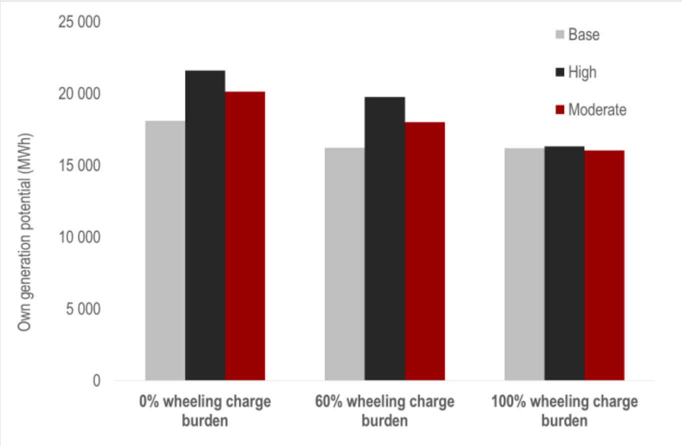


Source: SAPVIA (2013)

The own-generation component of the net-benefit model was expanded to include a wheeling charge in the costs of own-generation projects,[13] to determine the impacts of wheeling charges on the viability of these projects for firms. The impacts of three wheeling charge burden scenarios (zero per cent, 60 per cent and 100 per cent),[14] assumed to apply to all firms in the study for simplification purposes, are compared with one another to see the impact on the own generation potential[15] across the 21 firms in the study.

The potential size of own generation is determined by selecting the technology which has the highest generation capacity, with an IRR of 12 per cent or more, for each firm under each tariff scenario. Looking at the results in Figure 4, wheeling charges do make some own generation projects unviable, however, the bulk of the projects (at least 16 000MWh worth) remain viable. This is likely due to the fact that this study only looks at large, generally profitable, firms.

Figure 4: Own generation potential under various wheeling charge and tariff scenarios



Source: Authors (2015)

Implications for Eskom

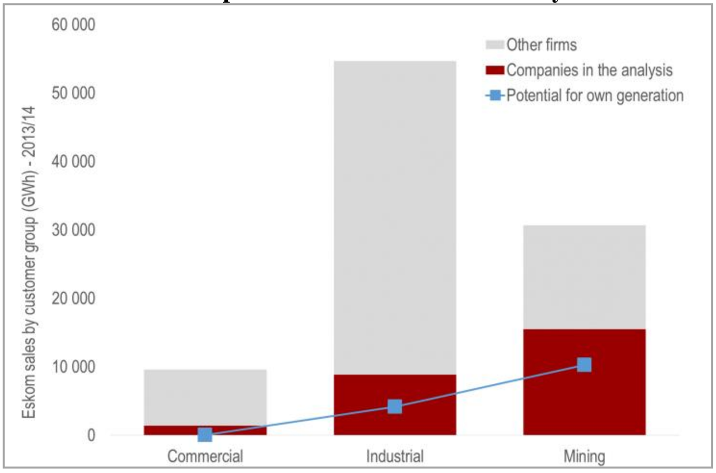
Figure 5 depicts Eskom's total sales by customer group for industrial, commercial and mining customers. For example Eskom sells 54 658GWh to industrial, and 30 667GWh to mining customers. The four commercial companies in this analysis account for 14 per cent of Eskom's commercial sales,

[13] These costs were taken from SAPVIA (2013) figures and extrapolated forward using the electricity tariff growth assumptions.

[14] The 60 per cent wheeling charge scenario assumes that the own generation plant is built at the location of the most energy intensive plant of the firm, which consumes 40 per cent of the electricity produced and the remaining 60 per cent of the generation capacity is wheeled. The zero per cent and 100 per cent wheeling charge scenarios are used in order to determine the range of wheeling costs.

the ten industrial companies account for 16 per cent of Eskom's industrial sales, and the six mining firms in the study account for 51 per cent of mining sales. The estimated potential for own generation among these customer groups, assuming grid access, a 60 per cent wheeling charge and the moderate tariff scenario, is equivalent to one per cent of Eskom's commercial sales, eight per cent of Eskom's industrial sales and 34 per cent of Eskom's mining sales.

Figure 5: Max own generation potential under the three tariff scenarios in comparison with Eskom's sales by customer[16]



Source: Authors (2015)

This finding has significant implications for Eskom sales and financial sustainability. As prices rise and alternative generation technologies become cheaper, Eskom could lose a portion of its customer base.

Sensitivities and model limitations

The models' results are not very sensitive to changes in energy efficiency, as the NPV impacts of improvements in energy efficiency gains to counter higher electricity tariffs are marginal over the entire 26-year period. But there is some sensitivity to changes in the revenue growth assumption. The operating profit model is not very sensitive to changes in the required rate of return assumption, whilst the effect of changes to this assumption are different from firm to firm in the potential for own generation model – however, many of the technologies have very high IRRs for some companies, which far exceed any reasonable rate of return assumption.

The models assume fixed and homogenous rates of growth in revenues and operating profits for the various companies and does not model individual management decisions at firms, such as cutting costs or undertaking investments to increase revenues. This part of the analysis also does not take into account the ability of the firms to pass on costs onto consumers, and assumes that firms absorb all costs of the electricity price increases and that these firms do not adjust to higher prices by cutting costs, making energy efficiency investments, etc. over the period in the analysis. Further it assumes away external influences such as cost escalations changes to exchange rates or sector-specific changes in demand or changes in commodity prices – although the model can be easily extended in this regard by changing the assumptions.

Second round effects of the tariff increases are also not included in the operating profit and own generation models (for example knock on impacts on prices in other energy intensive inputs). With regards to the potential own generation model, it does not take into account the appetite of shareholders to invest in a potentially costly project that is not core to their business, or the impact of the current investment climate on the willingness of firms to invest in a potentially long-term projects (such as a 30 year coal plant). The cost of land is not included and, critically, the own-generation model does not include the cost of unserved energy, which is likely increase the net benefit of own generation significantly – particularly if firms are very dependent on stable and consistent electricity supply. Finally, this analysis only focuses on large firms and does not look at the impacts of rising tariffs on smaller firms, which is likely to be larger, particularly as many of them already face higher charges in the municipalities and have constraints in their decision making or options available to them.

[16] With a 60 per cent wheeling charge burden under the moderate tariff scenario

5. POTENTIAL EFFECT OF HIGHER ELECTRICITY COSTS ON ECONOMIC SECTORS: AN INPUT-OUTPUT MULTIPLIER APPROACH

5.1. Method

For this section, the impact of the anticipated increase in electricity tariffs on economic sectors is modelled using an I-O multiplier approach. I-O analysis is used to study the flow of goods and services between industries in an economy. According to Stilwell and Minnitt (2000: 456), I-O analysis forms an essential component of quantitative economics, and is a key tool in the United Nations system of National Accounts as well as in most developed and developing nations. A standard quantity based I-O model is employed in this section, given the difficulties associated with sourcing detailed price information for purposes of developing a price based I-O model. This implies that instead of focusing on the proposed price increases, emphasis is placed on the assumed drop in quantities of electricity consumed by industries due to a lack of supply as well as a projected increase in price.

5.2. Assumptions and limitations

Christ (1968: 139-141) outlines the basic assumptions of I-O models (constant returns to scale, no substitution of inputs, no process produces more than one output, supply-side constraints and immobile capital are ignored and the same technology is used by an industry to produce all its products). Two additional assumptions will be made for purposes of this paper. First, it will be assumed here that the adjustment in response to a shock will be completed in one year. This is done for simplicity purposes. An additional assumption, based on Bess and Amargis (2011: 7-8), is that this section will only focus on backward-linkages, implying that if industry production increases/(decreases), the demand for industries that produce intermediate inputs will increase/(decrease).

5.3. Overview of electricity as an input cost

The 2013 SU-tables are used for this study and is the latest official version available from Statistics South Africa. For analysis purposes the industries and products are disaggregated into 104 products, while the number of industries totals 59. Electricity usage by domestic industries is a composition of the *electricity and gas*[17] (P8) and *electricity distribution* (P88) products. The first step is to analyse the proportion of electricity relative to overall industry input costs of selected industries. Table 5 shows industries ranked by their share of electricity as a portion of total input costs. The *mining of gold and uranium ore industry* are clearly vulnerable to electricity shortages given that electricity-related costs constitute more than 12 per cent of total input costs. A cursory look at the rankings shows many industries that are predominantly involved in mining and manufacturing activities.

Table 5: Electricity intensity by industry

	Industry	Intermediates: Excl electricity	Intermediates: Electricity	Wages	Gross operating surplus	Taxes/subsidies	Total
1	Mining of gold and uranium ore	29.3	12.3	36.4	21.0	1.1	100
2	Nuclear fuel, basic chemicals	75.9	8.4	10.5	5.9	-0.7	100
3	Electricity, gas, steam and hot water supply	33.3	5.8	16.6	44.2	0.1	100
4	Basic precious and non-ferrous metals	71.8	5.7	9.7	12.7	0.2	100
5	Basic iron and steel, casting of metals	84.7	5.4	9.4	0.3	0.3	100
6	Glass	61.7	4.9	27.6	5.3	0.5	100
7	Mining of metal ores	43.7	4.6	20.5	31.0	0.3	100
8	Other chemical products, man-made fibres	75.0	3.6	19.5	1.5	0.4	100
9	Real estate activities	40.7	2.4	4.2	46.0	6.7	100
10	Agriculture, forestry and fishing	59.0	2.1	12.3	26.4	0.2	100

Source: Statistics South Africa (2015)

In terms of aggregate electricity (and gas) usage by domestic industry, Table 6 shows that the *mining of gold and uranium ore* as well as the *mining of metal ores* industries were the largest consumers of electricity, constituting 11 per cent of total domestic electricity usage respectively. Other industries that constitute a large portion of overall domestic electricity use include the *nuclear fuel, basic chemicals* and the *basic iron and steel, casting of metals* industries. Furthermore, the top 10 industry users of electricity (and gas) constitute almost 70 per cent of total electricity (and gas) usage in the

[17] Following discussions with Mr. Gerhard Bouwer from Statistics South Africa, it does not appear to be possible to split the gas component from the electricity and gas product grouping. It is however assumed here that the gas component is very small for most industries.

country. The above analysis confirms that the mining and manufacturing sectors are dominant industry consumers of electricity in South Africa, and therefore are likely to be adversely affected by any electricity tariff increases. Note that information relating to the *electricity, gas, steam and hot water supply* industry, which largely consists of Eskom, is only shown for comparative purposes and won't be analysed for this exercise.

Table 6: Aggregate electricity (and gas) usage by industry, 2013

	Industry	Share	Cumulative Share
1	Mining of metal ores	11.1	11.1
2	Mining of gold and uranium ore	10.7	21.9
3	Nuclear fuel, basic chemicals	8.6	30.4
4	Electricity, gas, steam and hot water supply	8.5	38.9
5	Basic iron and steel, casting of metals	7.7	46.6
6	Real estate activities	7.5	54.1
7	Other business activities	4.8	58.8
8	Other chemical products, man-made fibres	4.1	62.9
9	Agriculture, forestry and fishing	3.8	66.7
10	Food	2.8	69.5

Source: Statistics South Africa (2015), own calculations

The HSRC (2008: 18-19) highlights some of the shortcomings related to using SU-tables for purposes of analysing electricity. First, SU-tables show expenditure on electricity and not physical use. These two measures are not perfectly correlated. Second, no information on peak demand is contained in SU-tables. Third, the SU-tables do not show the use of electricity generated by users. The aforementioned shortcoming becomes a problem when changing technologies are introduced due to electricity shortages and possibility of co-generation arises by private producers.

5.4. Setting up the electricity scenarios

Analysing the relative and absolute importance of electricity on an industry basis as was done in the prior section does not take into consideration the inter-industry linkages and feedback effects that exist between industries. It is therefore necessary to resort to I-O multiplier analysis with a closure in terms of household spending which takes into consideration the direct, indirect as well as induced effects of some initial change in final demand. Given that the household sector has been endogenised, a shock will be imposed on the model by shocking the final demand components (excluding households). It is important to note that I-O analysis in this context will not provide the researcher with forecasts, but may allow the researcher to think about how certain events may impact on the economy, keeping all other factors constant.

A challenging aspect of this study was deciding on the most appropriate strategy to analyse the increase in electricity prices on the economy using a quantity based I-O table. The following though process was followed. First, given the lack of price information, the emphasis should be shifted to how expenditure on electricity would respond to electricity price increases. Second, previous empirical studies on the price elasticity of demand for electricity have generally shown many sectors to be insensitive to price changes. However, given the average compound increase in electricity prices over the past few years, it is expected that most sectors will react to price increases. As a result, it will be assumed that demand for electricity will respond to changes in the electricity price with an elasticity equal to -0.6, based on the results of Kohler (2013). This elasticity implicitly includes income effects and pent-up demand. Third, three electricity price increases scenarios will be used, which is essentially the 3-year cumulative tariff increase over 2015/16 to 2017/18 as depicted in Table 1. The corresponding decline in electricity usage by applying the elasticity is shown in Table 7.

Table 7: Scenarios for decline in electricity expenditure (in percentage terms)

	Cumulative decline (2015/16 - 2017/18)
Base (low)	-17.2
High	-37.6
Moderate	-25.6

Source: Authors (2015)

Table 8 shows Type II multipliers for selected industries. The multipliers can be broadly interpreted as the rand increase/(decrease) in industry output arising from an initial one rand increase/(decrease) in final demand. Note that import leakages are separated out. Although the multiplier effects for the indicated electricity products in terms of total output are on the low side, its impacts on domestic output are fairly large relative to other products. As expected, import leakages are not large in terms of electricity, while the income effect multiplier also appears to be on the high side. The above discussed multipliers will be used in determining the impact of an initial change in final demand on selected electricity intensive industries.

Table 8: Type II Multipliers for selected industries

	Total output	Domestic output	Import leakage	Income effect	Employment effect
Electricity and electricity distribution multiplier					
Electricity and gas	2.8	2.2	0.6	1.1	2.9
Electricity distribution	2.7	2.1	0.6	1.1	2.7
Products with the highest total output multiplier					
Printing	4.3	2.7	1.7	1.1	5.5
Animal feeding	4.3	2.5	1.8	1.1	5.2
Sugar	4.2	2.6	1.6	1.1	5.3
Dairy products	4.2	2.6	1.6	1.1	5.3
Iron, steel products	4.1	2.7	1.5	1.0	4.2
Products with the lowest total output multiplier					
Office machinery	1.7	0.6	1.1	0.2	1.1
Engines, turbines	1.9	0.6	1.3	0.3	1.4
Other transport equipment	2.0	0.7	1.2	0.3	2.0
Medical appliances	2.1	0.8	1.3	0.4	1.9
Domestic appliances	2.1	0.9	1.2	0.4	1.6

Source: Statistics South Africa (2015); own calculations

5.5. Results

Table 9 summarises the results for the I-O multiplier analysis using the three scenarios where each depicts a three-year cumulative decline in the production or use of electricity, including transmission and distribution. The total impact on gross value added in the economy is not as large as was expected, with the largest expected decline in economy-wide gross value added being 0.6 per cent. It should be noted, however, that electricity costs as a percentage of total industry inputs constitute less than 2 per cent after taking into consideration intermediate inputs, wages and gross operating surplus. This outcome may confirm some of the earlier studies' conclusions that it is not price that is necessarily the primary determinant of demand or expenditure on electricity, but sectoral output.

Table 9: Results of I-O scenario analysis

	Increase in GVA	Scenario 1	Scenario 2	Scenario 3
1	Electricity, gas, steam and hot water supply	-7.86%	-11.70%	-17.18%
2	Mining of coal and lignite	-1.58%	-2.36%	-3.46%
3	Electrical machinery and apparatus	-0.59%	-0.88%	-1.29%
4	Auxiliary transport	-0.50%	-0.75%	-1.09%
5	Financial intermediation	-0.28%	-0.42%	-0.62%
6	Other mining and quarrying	-0.26%	-0.39%	-0.57%
7	Water transport	-0.26%	-0.38%	-0.56%
8	Activities to financial intermediation	-0.25%	-0.37%	-0.55%
9	Coke oven, petroleum refineries	-0.25%	-0.37%	-0.55%
10	Sale, maintenance, repair of motor vehicles	-0.25%	-0.37%	-0.54%
TOTAL		**-0.25%**	**-0.38%**	**-0.56%**

Source: Statistics South Africa (2015); own calculations

The main (non-electricity) industries affected are: *Mining of coal and lignite*; *electrical machinery and apparatus*; and *auxiliary transport*. Given that coal is a key input in terms of electricity generation, lower production in terms of electricity will require less coal production, which explains the large reduction in gross value added in the coal mining industry. The *electrical machinery and apparatus* industry are also strongly linked to electricity generation as well as mining operations. Given the reduced output from mining and electricity operations, fewer inputs will be required from this industry. The decline in the gross value added of the transport industries, in addition to financial intermediation activities, are likely attributable to lower household spending (i.e. induced effect) which results in less expenditure available for these types of services.

6. CONCLUDING REMARKS

Historically, the total impact of electricity price increases on gross value added in the economy was not severe given the relatively small proportion of electricity as an input cost. More recently demand for electricity seems to be becoming more elastic, as there are more options and alternatives becoming viable (or tipping points). The impact of rising electricity tariffs, through three tariff scenarios, on firm operating profits and the potential for own generation is explored in this paper. Although only two of the firms in this analysis are near a potential estimated ‘shut-down’ point, the net present values of all firms and their future operating profits are being eroded under the higher tariff scenarios – and significantly so for the many of the energy intensive users. This erosion in operating profits will likely have an impact on investment decisions. Firms may decide to cut costs, implement energy efficiency measures, close parts of their operations, move plants to neighbouring countries, invest in other sectors, or invest in own generation capacity

Investing in own generation capacity is apparently relatively viable, and some firms appear to have already reached a “tipping point”, even under a low tariff scenario. Whilst this can have a positive outcome from a business sustainability and economic growth perspective, in light of the frequent load shedding and curtailment, and if the firms actually undertake the investment – it can also impose costs on the economy more broadly and over the long term (as these smaller generation options are less efficient or do not benefit from economies of scale). In addition, it poses significant threats to the financial sustainability of Eskom and municipalities who rely heavily on these firms for revenue, and to cross subsidize indigent consumers.

Own generation decisions, whilst able to temporarily add capacity to electricity capacity in the short term, do not however affect overall electricity consumption and output over the longer period. When prices rise some firms will choose to generate their own power, but others will simply look to reduce consumption and output, invest less in energy intensive sectors, or shut down. We have also tried to model these impacts on the broader economy. The main industries affected were related to coal mining activities and electrical machinery. Certain industries ended up being supported by induced effects from additional household spending, such as financial intermediation activities.

With rising tariffs and falling costs of own generation technologies, large firm decisions may lead to significant structural changes in the coming years.

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Annex

Table 1. Impact on operating profits - base vs high and moderate tariff scenarios

Company	Electricity intensity	Base Scenario* NPV @12% (Rmillions)	High Scenario NPV @12% (R millions)	Difference between base and high scenario (Rmillions)	*% difference*	Moderate Scenario NPV @12% (R millions)	Difference between base and moderate scenario (Rmillions)	*% difference*
ELECTRICITY INTENSIVE FIRMS								
Sibanye	20.0%	107 120	95 357	-11 763	*-11.0%*	101 238	-5 882	*-5.5%*
Harmony Gold	15.0%	83 597	75 897	-7 700	*-9.2%*	79 747	-3 851	*-4.6%*
AngloPlat	11.0%	211 746	199 221	-12 525	*-5.9%*	205 483	-6 263	*-3.0%*
Lonmin	7.2%	39 560	36 687	-2 872	*-7.3%*	38 123	-1 436	*-3.6%*
Implats	12.0%	45 529	39 101	-6 428	*-14.1%*	42 315	-3 215	*-7.1%*
Kumba Iron Ore	3.4%	321 465	320 093	-1 372	*-0.4%*	320 779	-686	*-0.2%*
Evraz Highveld Steel	15.9%	18 767	15 567	-3 200	*-17.1%*	17 167	-1 600	*-8.5%*
Arcelor Mittal	10.1%	114 379	106 508	-7 871	*-6.9%*	110 443	-3 936	*-3.4%*
Hulamin	20.0%	34 831	34 192	-639	*-1.8%*	34 511	-320	*-0.9%*
PPC	10.0%	38 918	34 088	-4 830	*-12.4%*	36 503	-2 415	*-6.2%*
AECI	10.0%	70 570	70 082	-487	*-0.7%*	70 326	-244	*-0.3%*
Transnet	11.2%	387 468	375 857	-11 611	*-3.0%*	381 662	-5 807	*-1.5%*
OTHER FIRMS								
Astral Foods	2.5%	91 583	90 224	-1 359	*-1.5%*	90 889	-695	*-0.8%*
Clover	2.3%	92 601	92 166	-435	*-0.5%*	92 379	-222	*-0.2%*
Pioneer Foods	2.0%	275 523	274 234	-1 289	*-0.5%*	274 864	-659	*-0.2%*
Distell	2.3%	157 727	157 326	-401	*-0.3%*	157 522	-205	*-0.1%*
Nampak	6.0%	124 011	121 544	-2 467	*-2.0%*	122 750	-1 261	*-1.0%*
Nedbank	0.8%	474 575	473 775	-801	*-0.2%*	474 166	-409	*-0.1%*
Telkom	0.8%	428 541	425 393	-3 149	*-0.7%*	426 932	-1 609	*-0.4%*
Tsogo Sun	2.0%	120 561	119 326	-1 235	*-1.0%*	119 930	-631	*-0.5%*
Netcare	2.0%	429 053	427 553	-1 500	*-0.3%*	428 286	-767	*-0.2%*

Tables 2- 22. Rates of return of net benefits of various own-generation technology option, without wheeling charges (in comparison with assumed market IRR of 12%). ***Technologies with IRR's >12 are highlighted in green, but if plant capacity falls below 55%, i.e. turns red, then the technology is unviable***

Sibanye

2014/15 electricity consum	*4 274 290*					
Energy intensity	*20%*					
Technology	Capacity of plant	MWH produced p.a	% of total demand	Base case IRR	High scenario IRR	Moderate scenario IRR
Large coal	66.0%	3 976 295	93.0%	11%	20%	16%
Small coal	85.0%	1 682 796	39.4%	16%	30%	24%
CCGT	71.0%	3 926 856	91.9%	79%	111%	95%
Wind (100 x 2MW)	15.0%	250 974	5.9%	10%	22%	17%
Wind (25 x 2MW)	15.0%	62 744	1.5%	4%	15%	10%
Solar PV	26.0%	22 320	0.5%	3%	12%	8%
Concentrating solar	26.0%	21 637	0.5%	5%	14%	9%

Harmony Gold						
2014/15 electricity consum	*2 798 000*					
Energy intensity	*15%*					
Technology	Capacity of plant	MWH produced p.a	% of total demand	Base case IRR	High scenario IRR	Moderate scenario IRR
Large coal	45.0%	2 711 111	96.9%	0%	9%	5%
Small coal	85.0%	1 682 796	60.1%	8%	24%	17%
CCGT	49.0%	2 710 084	96.9%	44%	76%	61%
Wind (100 x 2MW)	15.0%	250 974	9.0%	4%	17%	11%
Wind (25 x 2MW)	15.0%	62 744	2.2%	-1%	10%	5%
Solar PV	26.0%	22 320	0.8%	-1%	8%	4%
Concentrating solar	26.0%	21 637	0.8%	0%	10%	5%

AngloPlat						
2014/15 electricity consum	*4 551 144*					
Energy intensity	*11%*					
Technology	Capacity of plant	MWH produced p.a	% of total demand	Base case IRR	High scenario IRR	Moderate scenario IRR
Large coal	70.0%	4 217 283	92.7%	22%	29%	26%
Small coal	85.0%	1 682 796	37.0%	31%	43%	37%
CCGT	80.0%	4 424 627	97.2%	123%	147%	135%
Wind (100 x 2MW)	15.0%	250 974	5.5%	22%	33%	28%
Wind (25 x 2MW)	15.0%	62 744	1.4%	15%	25%	20%
Solar PV	26.0%	22 320	0.5%	13%	21%	17%
Concentrating solar	26.0%	21 637	0.5%	15%	24%	19%

Lonmin						
2014/15 electricity consum	*1 043 777*					
Energy intensity	*7%*					
Technology	Capacity of plant	MWH produced p.a	% of total demand	Base case IRR	High scenario IRR	Moderate scenario IRR
Large coal	16.0%	963 950	92.4%	#NUM!	-6%	-10%
Small coal	52.0%	1 029 475	98.6%	1%	13%	8%
CCGT	19.0%	1 050 849	100.7%	17%	36%	27%
Wind (100 x 2MW)	15.0%	250 974	24.0%	6%	18%	13%
Wind (25 x 2MW)	15.0%	62 744	6.0%	0%	12%	7%
Solar PV	26.0%	22 320	2.1%	0%	9%	5%
Concentrating solar	26.0%	21 637	2.1%	1%	11%	6%

Implats						
2014/15 electricity consum	*2 335 790*					
Energy intensity	*12%*					
Technology	Capacity of plant	MWH produced p.a	% of total demand	Base case IRR	High scenario IRR	Moderate scenario IRR
Large coal	40.0%	2 409 876	103.2%	3%	11%	8%
Small coal	85.0%	1 682 796	72.0%	17%	31%	25%
CCGT	40.0%	2 212 313	94.7%	53%	78%	66%
Wind (100 x 2MW)	15.0%	250 974	10.7%	11%	23%	17%
Wind (25 x 2MW)	15.0%	62 744	2.7%	5%	16%	11%
Solar PV	26.0%	22 320	1.0%	4%	12%	8%
Concentrating solar	26.0%	21 637	0.9%	5%	14%	10%

Kumba Iron Ore						
2014/15 electricity co	498 600					
Energy intensity	*3%*					
Technology	Capacity of plant	MWH produced p.a	% of total demand	Base case IRR	High scenario IRR	Moderate scenario IRR
Large coal	8.0%	481 975	96.7%	-7%	-4%	-5%
Small coal	25.0%	494 940	99.3%	11%	16%	14%
CCGT	8.0%	442 463	88.7%	30%	37%	34%
Wind (100 x 2MW)	15.0%	250 974	50.3%	37%	46%	42%
Wind (25 x 2MW)	15.0%	62 744	12.6%	31%	40%	35%
Solar PV	26.0%	22 320	4.5%	26%	35%	30%
Concentrating solar	26.0%	21 637	4.3%	30%	39%	34%

Evraz Highveld Steel						
2014/15 electricity consum	*1 431 000*					
Energy intensity	*16%*					
Technology	Capacity of plant	MWH produced p.a	% of total demand	Base case IRR	High scenario IRR	Moderate scenario IRR
Large coal	23.0%	1 385 679	96.8%	-14%	-4%	-8%
Small coal	70.0%	1 385 832	96.8%	0%	14%	8%
CCGT	25.0%	1 382 696	96.6%	15%	36%	26%
Wind (100 x 2MW)	15.0%	250 974	17.5%	0%	12%	7%
Wind (25 x 2MW)	15.0%	62 744	4.4%	-5%	6%	2%
Solar PV	26.0%	22 320	1.6%	-4%	4%	1%
Concentrating solar	26.0%	21 637	1.5%	-3%	6%	2%

Arcelor Mittal						
2014/15 electricity consum	*3 520 000*					
Energy intensity	*10%*					
Technology	Capacity of plant	MWH produced p.a	% of total demand	Base case IRR	High scenario IRR	Moderate scenario IRR
Large coal	58.0%	3 494 320	99.3%	12%	19%	16%
Small coal	85.0%	1 682 796	47.8%	22%	33%	28%
CCGT	62.0%	3 429 086	97.4%	86%	108%	97%
Wind (100 x 2MW)	15.0%	250 974	7.1%	15%	24%	20%
Wind (25 x 2MW)	15.0%	62 744	1.8%	9%	17%	13%
Solar PV	26.0%	22 320	0.6%	7%	14%	10%
Concentrating solar	26.0%	21 637	0.6%	9%	16%	12%

Hulamin						
2014/15 electricity consum	*285 848*					
Energy intensity	*20%*					
Technology	Capacity of plant	MWH produced p.a	% of total demand	Base case IRR	High scenario IRR	Moderate scenario IRR
Large coal	4.0%	240 988	84.3%	-3%	-1%	-2%
Small coal	13.0%	257 369	90.0%	20%	22%	21%
CCGT	5.0%	276 539	96.7%	51%	54%	52%
Wind (100 x 2MW)	15.0%	250 974	87.8%	84%	87%	86%
Wind (25 x 2MW)	15.0%	62 744	21.9%	91%	96%	93%
Solar PV	26.0%	22 320	7.8%	94%	100%	97%
Concentrating solar	26.0%	21 637	7.6%	104%	110%	107%

PPC						
2014/15 electricity consum	*2 160 000*					
Energy intensity	*10%*					
Technology	Capacity of plant	MWH produced p.a	% of total demand	Base case IRR	High scenario IRR	Moderate scenario IRR
Large coal	32.0%	1 927 901	89.3%	#NUM!	-8%	#NUM!
Small coal	85.0%	1 682 796	77.9%	#NUM!	4%	-7%
CCGT	35.0%	1 935 774	89.6%	#NUM!	24%	8%
Wind (100 x 2MW)	15.0%	250 974	11.6%	#NUM!	0%	-9%
Wind (25 x 2MW)	15.0%	62 744	2.9%	#NUM!	-4%	-13%
Solar PV	26.0%	22 320	1.0%	#NUM!	-4%	-10%
Concentrating solar	26.0%	21 637	1.0%	#NUM!	-3%	-8%

AECI						
2014/15 electricity consum	***217 959***					
Energy intensity	***10%***					
Technology	**Capacity of plant**	**MWH produced p.a**	**% of total demand**	**Base case IRR**	**High scenario IRR**	**Moderate scenario IRR**
Large coal	**3.0%**	**180 741**	**82.9%**	**-2%**	**-1%**	**-1%**
Small coal	**11.0%**	**217 774**	**99.9%**	**25%**	**26%**	**26%**
CCGT	**3.0%**	**165 924**	**76.1%**	**44%**	**46%**	**45%**
Wind (100 x 2MW)	**15.0%**	**250 974**	**115.1%**	**104%**	**106%**	**105%**
Wind (25 x 2MW)	**15.0%**	**62 744**	**28.8%**	**121%**	**125%**	**123%**
Solar PV	**26.0%**	**22 320**	**10.2%**	**138%**	**144%**	**141%**
Concentrating solar	**26.0%**	**21 637**	**9.9%**	**151%**	**157%**	**153%**

Transnet						
2014/15 electricity consum	***3 554 822***					
Energy intensity	***11%***					
Technology	**Capacity of plant**	**MWH produced p.a**	**% of total demand**	**Base case IRR**	**High scenario IRR**	**Moderate scenario IRR**
Large coal	**57.0%**	**3 434 073**	**96.6%**	**13%**	**22%**	**18%**
Small coal	**85.0%**	**1 682 796**	**47.3%**	**24%**	**39%**	**32%**
CCGT	**63.0%**	**3 484 394**	**98.0%**	**91%**	**121%**	**106%**
Wind (100 x 2MW)	**15.0%**	**250 974**	**7.1%**	**16%**	**29%**	**23%**
Wind (25 x 2MW)	**15.0%**	**62 744**	**1.8%**	**10%**	**22%**	**16%**
Solar PV	**26.0%**	**22 320**	**0.6%**	**8%**	**18%**	**13%**
Concentrating solar	**26.0%**	**21 637**	**0.6%**	**10%**	**20%**	**15%**

Astral Foods						
2014/15 electricity consum	***280 560***					
Energy intensity	***3%***					
Technology	**Capacity of plant**	**MWH produced p.a**	**% of total demand**	**Base case IRR**	**High scenario IRR**	**Moderate scenario IRR**
Wind (10 x 2MW)	**15.0%**	**25 097**	**8.9%**	**4%**	**14%**	**10%**
Wind (25 x 2MW)	**15.0%**	**62 744**	**22.4%**	**1%**	**11%**	**7%**
Solar PV	**26.0%**	**22 320**	**8.0%**	**3%**	**11%**	**7%**
Concentrating solar	**26.0%**	**21 637**	**7.7%**	**4%**	**13%**	**9%**

Clover						
2014/15 electricity consum	*89 849*					
Energy intensity	*2%*					
Technology	Capacity of plant	MWH produced p.a	% of total demand	Base case IRR	High scenario IRR	Moderate scenario IRR
Wind (10 x 2MW)	15.0%	25 097	27.9%	24%	32%	28%
Wind (25 x 2MW)	15.0%	62 744	69.8%	21%	30%	26%
Solar PV	26.0%	22 320	24.8%	20%	28%	24%
Concentrating solar	26.0%	21 637	24.1%	23%	32%	27%

Pioneer Foods						
2014/15 electricity consum	*266 172*					
Energy intensity	*2%*					
Technology	Capacity of plant	MWH produced p.a	% of total demand	Base case IRR	High scenario IRR	Moderate scenario IRR
Wind (10 x 2MW)	15.0%	25 097	9.4%	11%	20%	16%
Wind (25 x 2MW)	15.0%	62 744	23.6%	8%	17%	13%
Solar PV	26.0%	22 320	8.4%	8%	16%	12%
Concentrating solar	26.0%	21 637	8.1%	10%	18%	14%

Distell						
2014/15 electricity consum	*82 793*					
Energy intensity	*2%*					
Technology	Capacity of plant	MWH produced p.a	% of total demand	Base case IRR	High scenario IRR	Moderate scenario IRR
Wind (10 x 2MW)	15.0%	25 097	30.3%	65%	70%	68%
Wind (25 x 2MW)	15.0%	62 744	75.8%	77%	84%	80%
Solar PV	26.0%	22 320	27.0%	82%	89%	85%
Concentrating solar	26.0%	21 637	26.1%	90%	98%	94%

Nampak						
2014/15 electricity consum	*509 385*					
Energy intensity	*6%*					
Technology	Capacity of plant	MWH produced p.a	% of total demand	Base case IRR	High scenario IRR	Moderate scenario IRR
Wind (10 x 2MW)	15.0%	25 097	4.9%	22%	31%	27%
Wind (25 x 2MW)	15.0%	62 744	12.3%	20%	29%	24%
Solar PV	26.0%	22 320	4.4%	19%	27%	23%
Concentrating solar	26.0%	21 637	4.2%	22%	30%	26%

Nedbank						
2014/15 electricity co	**165 273**					
Energy intensity	***1%***					
Technology	**Capacity of plant**	**MWH produced p.a**	**% of total demand**	**Base case IRR**	**High scenario IRR**	**Moderate scenario IRR**
Wind (10 x 2MW)	**15.0%**	**25 097**	**15.2%**	**15%**	**24%**	**20%**
Wind (25 x 2MW)	**15.0%**	**62 744**	**38.0%**	**12%**	**21%**	**17%**
Solar PV	**26.0%**	**22 320**	**13.5%**	**12%**	**20%**	**16%**
Concentrating solar	**26.0%**	**21 637**	**13.1%**	**14%**	**22%**	**18%**

Telkom						
2014/15 electricity consum	***650 000***					
Energy intensity	***1%***					
Technology	**Capacity of plant**	**MWH produced p.a**	**% of total demand**	**Base case IRR**	**High scenario IRR**	**Moderate scenario IRR**
Wind (10 x 2MW)	**15.0%**	**25 097**	**3.9%**	**#NUM!**	**2%**	**-5%**
Wind (25 x 2MW)	**15.0%**	**62 744**	**9.7%**	**#NUM!**	**0%**	**-7%**
Solar PV	**26.0%**	**22 320**	**3.4%**	**-12%**	**1%**	**-4%**
Concentrating solar	**26.0%**	**21 637**	**3.3%**	**-11%**	**2%**	**-3%**

Tsogo Sun						
2014/15 electricity consum	***255 000***					
Energy intensity	***2%***					
Technology	**Capacity of plant**	**MWH produced p.a**	**% of total demand**	**Base case IRR**	**High scenario IRR**	**Moderate scenario IRR**
Wind (10 x 2MW)	**15.0%**	**25 097**	**9.8%**	**0%**	**12%**	**7%**
Wind (25 x 2MW)	**15.0%**	**62 744**	**24.6%**	**-2%**	**9%**	**4%**
Solar PV	**26.0%**	**22 320**	**8.8%**	**0%**	**9%**	**5%**
Concentrating solar	**26.0%**	**21 637**	**8.5%**	**1%**	**10%**	**6%**

Netcare						
2014/15 electricity consum	***309 733***					
Energy intensity	***2%***					
Technology	**Capacity of plant**	**MWH produced p.a**	**% of total demand**	**Base case IRR**	**High scenario IRR**	**Moderate scenario IRR**
Wind (10 x 2MW)	**15.0%**	**25 097**	**8.1%**	**15%**	**24%**	**20%**
Wind (25 x 2MW)	**15.0%**	**62 744**	**20.3%**	**12%**	**21%**	**17%**
Solar PV	**26.0%**	**22 320**	**7.2%**	**12%**	**19%**	**16%**
Concentrating solar	**26.0%**	**21 637**	**7.0%**	**14%**	**22%**	**18%**

Table 23. Own generation potential with 100% wheeling charges

	Base	High	Moderate
Sibanye	3 926 856	3 926 856	3 926 856
Harmony Gold	-	-	-
AngloPlat	4 424 627	4 424 627	4 424 627
Lonmin	-	-	-
Implats	-	250 974	-
Kumba Iron Ore	250 974	62 744	62 744
Evraz Highveld Steel	-	-	-
Arcelor Mittal	3 429 086	3 429 086	3 429 086
Hulamin	250 974	250 974	250 974
PPC	-	-	-
AECI	250 974	250 974	250 974
Transnet	3 484 394	3 484 394	3 484 394
Astral Foods	-	-	-
Clover	22 320	22 320	22 320
Pioneer Foods	-	25 097	21 637
Distell	62 744	62 744	62 744
Nampak	62 744	62 744	62 744
Nedbank	-	25 097	22 320
Telkom	-	-	-
Tsogo Sun	-	-	-
Netcare	21 637	25 097	25 097
Total (MWH)	16 187 330	16 303 728	16 046 517
Eskom sales (2013/14) G	217 903	217 903	217 903
Eskom sales (2013/14) M	217 903 000	217 903 000	217 903 000
% of Eskom sales	7.4%	7.5%	7.4%

Table 24. Own generation potential with 60% wheeling charges

	Base	High	Moderate
Sibanye	3 926 856	3 976 295	3 926 856
Harmony Gold	-	1 682 796	-
AngloPlat	4 424 627	4 424 627	4 424 627
Lonmin	-	-	-
Implats	-	1 682 796	1 682 796
Kumba Iron Ore	250 974	250 974	250 974
Evraz Highveld Steel	-	-	-
Arcelor Mittal	3 429 086	3 494 320	3 494 320
Hulamin	250 974	250 974	250 974
PPC	-	-	-
AECI	250 974	250 974	250 974
Transnet	3 484 394	3 484 394	3 484 394
Astral Foods	-	-	-
Clover	25 097	25 097	25 097
Pioneer Foods	-	25 097	25 097
Distell	62 744	62 744	62 744
Nampak	62 744	62 744	62 744
Nedbank	21 637	25 097	25 097
Telkom	-	-	-
Tsogo Sun	-	-	-
Netcare	25 097	62 744	25 097
Total (MWH)	16 215 204	19 761 673	17 991 791
Eskom sales (2013/14) G	217 903	217 903	217 903
Eskom sales (2013/14) M	217 903 000	217 903 000	217 903 000
% of Eskom sales	7.4%	9.1%	8.3%

Table 25. Own generation potential with 0% wheeling charges

	Base	High	Moderate
Sibanye	3 926 856	3 976 295	3 976 295
Harmony Gold	-	1 682 796	1 682 796
AngloPlat	4 424 627	4 424 627	4 424 627
Lonmin	-	250 947	250 974
Implats	1 682 796	1 682 796	1 682 796
Kumba Iron Ore	250 947	250 947	250 974
Evraz Highveld Steel	-	1 385 832	-
Arcelor Mittal	3 494 320	3 494 320	3 494 320
Hulamin	250 947	250 947	250 974
PPC	-	-	-
AECI	250 947	250 947	250 974
Transnet	3 484 394	3 484 394	3 484 394
Astral Foods	-	62 744	-
Clover	62 744	62 744	62 744
Pioneer Foods	25 097	62 744	62 744
Distell	62 744	62 744	62 744
Nampak	62 744	62 744	62 744
Nedbank	62 744	62 744	62 744
Telkom	-	-	-
Tsogo Sun	-	25 097	-
Netcare	62 744	62 744	62 744
Total (MWH)	18 104 651	21 599 153	20 125 588
Eskom sales (2013/14) G	217 903	217 903	217 903
Eskom sales (2013/14) M	217 903 000	217 903 000	217 903 000
% of Eskom sales	8.3%	9.9%	9.2%

Table 26. Sensitivity of own generation potential to NPV %* moderate scenario no, wheeling charges, build 2015/16, EIA forecast

	9	12	15	18
Sibanye	3 976 295	3 976 295	3 976 295	3 926 856
Harmony Gold	1 682 796	1 682 796	1 682 796	-
AngloPlat	4 424 627	4 424 627	4 424 627	4 424 627
Lonmin	250 974	250 974	-	-
Implats	1 682 796	1 682 796	1 682 796	1 682 796
Kumba Iron Ore	250 974	250 974	250 974	250 974
Evraz Highveld Steel	-	-	-	-
Arcelor Mittal	3 494 320	3 494 320	3 494 320	3 429 086
Hulamin	250 974	250 974	250 974	250 974
PPC	-	-	-	-
AECI	250 974	250 974	250 974	250 974
Transnet	3 484 394	3 484 394	3 484 394	3 484 394
Astral Foods	25 097	-	-	-
Clover	62 744	62 744	62 744	62 744
Pioneer Foods	62 744	62 744	25 097	-
Distell	62 744	62 744	62 744	62 744
Nampak	62 744	62 744	62 744	62 744
Nedbank	62 744	62 744	62 744	25 097
Telkom	-	-	-	-
Tsogo Sun	-	-	-	-
Netcare	62 744	62 744	62 744	25 097
Total (MWH)	20 150 683	20 125 585	19 836 965	17 939 106
Eskom sales (2013/14) G	217 903	217 903	217 903	217 903
Eskom sales (2013/14) M	217 903 000	217 903 000	217 903 000	217 903 000
% of Eskom sales	9.2%	9.2%	9.1%	8.2%