slEconomics

Electricity Supply Industry Insights

Economic Impacts of Electricity Price Increases in South Africa

Dr Stephen Labson - August 2012

About slEconomics

- *slEconomics is a boutique economics consulting firm providing specialised advice to governments, regulators and corporate clients in the area of utilities and infrastructure. We are based in Sydney Australia and have an international network of associates to bring global experience to local initiatives.*

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- The author of this review – Dr. Stephen Labson, has 20 years experience in energy, utility and infrastructure economics gained through advising governments, regulators and leading corporate clients in Australia, Africa, Asia and the United States

- Dr. Labson earned his PhD in economics at the University of California at Berkeley, and has a publication record which includes over 20 articles – many appearing in leading international journals

Preface

- slEconomics Pty Ltd has undertaken this review with the purpose of highlighting what we see as some of the more significant issues associated with electricity pricing in South Africa and its impact on the economy.

- In providing our note on this issue, we have had regard to a substantial body of research carried out by others, and synthesized selected parts of their analysis so as to highlight what we believe are some of the fundamental issues and implications at hand. While we have made extensive reference to others' research to *illustrate* the issues we wish to highlight, the views we have provided in this brief note may or may not reflect the conclusions drawn by the authors of the research we have referenced. The views provided here are those of slEconomics.

- The structure of our note is as follows:

Executive summary

Section 1: Overview – Tariffs and the long term electricity price path

Section 2: Price increases and investment in the ESI – economic impacts

Section 3: The alternative scenario – assessing the impact of reduced power supply and constrained growth

Section 4: Concluding thoughts

Executive summary

Crucial decisions will be made on tariffs that will have repercussions for the broader economy

- While electricity prices will increase considerably during the course of MYPD 2 they will still not have converged to what many would consider a sustainable medium to long term price path. For example, the Government's Integrated Resource Plan 2010-2030 places its conservative price path well above the levels that will have been reached at the end of MYPD 2.
  - In the coming year NERSA will need to decide on Eskom's allowed revenue and average selling price for MYPD 3 .
  - Whatever the outcome of NERSA's decision for Eskom's MYPD 3 – there will be implications for the economy in general and unique distributional impacts across various subsectors of the economy. There is no 'business as usual' option to fall back on.

Investment in the Electricity Supply Industry

- The IRP shows roughly a doubling in installed power generation capacity needed from 2010 to 2030. Even with the price increases provided for under MYPD 2 further increases will be required if prices are to recover the cost of investment in new capacity associated with the IRP. This is the case whether investment in the Electricity Supply Industry (ESI) is undertaken by Eskom or the private sector.

- Moreover, Government has stated in its National Development Plan 2030 that "*Government has probably reached its limit of fiscal and guarantee support for Eskom*" . If one rules out further Government support for major capital projects in the ESI,there are two basic options remaining:
  - Increasing tariffs to cost reflective levels; or
  - Constraining investment in the ESI and planning for consequential shortfalls in electricity supply.

- These are policy choices to be made by South Africa, but there are a number of studies at hand that provide broad insights into some of the more fundamental economy wide implications of the policy choices at hand.

Executive summary

Economic impacts of a shortfall in supply

- Our premise has been that if electricity prices are below the cost of supply investment in the ESI will be constrained with a consequential constraint on energy supply in the long term. Research has been carried out by HSRC that assesses the economic impact of electricity cuts on the South African economy. While the study was carried out in 2008 and would not be expected to mirror a particular supply imbalance that might obtain in the future from a reduced capital expansion plan for the ESI, the assumed 10% cut in electricity output examined in that study provides a reference point to track the broad impacts on various sectors of the economy. (i.e. HSRC explain their modeling strategy as assuming that there is a 10% fall in electricity output consequent upon a reduction in the capacity of the sector.)

- The impact on total output of the economy (i.e. real GDP) from a 10% shortfall in power supply is a reduction of 0.9% (i.e. -0.9% real GDP) with similar decreases to employment (-1.4%) and household income (-1.2%) . However, we must caution that these results cannot be *directly* compared to the results of studies that examine the alternative – electricity price increases relating to price increases and capital investment as there would be numerous assumptions made that would vary between the studies. Nevertheless, the HSRC study and other research we have examined does show that the cost to the economy of a shortfall in energy supply is material – which is what one would naturally expect.

Impact of increasing prices

- In reviewing quantitative studies undertaken on the effect of electricity price increases on the South African economy, one will see that there are numerous and complex linkages to account for, and the findings of these studies provide a divergent range of results. Nevertheless, in synthesizing the findings of various studies we believe there are a few consistent and robust conclusions that can be drawn.

Executive summary

- First, and not surprisingly – output and employment in electricity intensive industries is adversely effected by an increase in electricity prices *all else constant* – although perhaps not nearly to the degree that their share of electricity as an input to production might imply.
  - However, not all will remain constant if prices remain below cost reflective levels of supply. It seems unlikely to us that the growth path provided for under the IRP can be achieved in such case, and constrained energy supply will place limits on the South African economy and the jobs it creates.
  - Moreover, if the revenue raised from increased tariffs is fed back into the economy by investment in the ESI the negative impacts on the economy as a whole are significantly reduced, and perhaps reversed in many cases given the size of the investment programme and the positive impacts it will have on the economy. Nevertheless, further analysis would be helpful in better understanding the implications at the level of industries and households.

The economic cost of pricing below cost reflective levels

- The results of quantitative studies such as those cited by us do not fully measure the real cost to the economy stemming from prices that are below the cost of supply (e.g. related to inefficient use of electricity, induced adoption of technologies, mis-allocation of capital, deadweight loss from taxation, etc).
  - We are not aware of existing studies that fully quantify the types of costs suggested above for South Africa, but given the magnitude of the issue at hand such costs are likely to be significant. If this part of the equation was fully accounted for it may very well change a number of the adverse outcomes suggested by existing studies at hand. We look forward to future research that explicitly addresses this important component of economic analysis.

- Finally, as our intent is not to debate the many fine points of the findings of others, we think the fundamental conclusion to be drawn here is that both theory and practice indicate that the economy wide negative implications of electricity price increases within the current context are at worst rather small, and perhaps more likely to be positive in the long term as prices move to cost reflective levels - thereby promoting allocative efficiencies in terms of energy use and capital investment, and placing the ESI on a sustainable path in which it is able to provide reliable electricity supply for a growing South African economy.

Section 1

- Overview – Tariffs and the long term electricity price path

Overview of recent price increases and the prospect for MYPD 3

- South Africa's National Energy Regulator (NERSA) has allowed Eskom to increase its standard average price by roughly 25% for each year of the period covering MYPD 2 (NB. With tariffs increases for 2011/12 subsequently adjusted downward to 16.0 %)

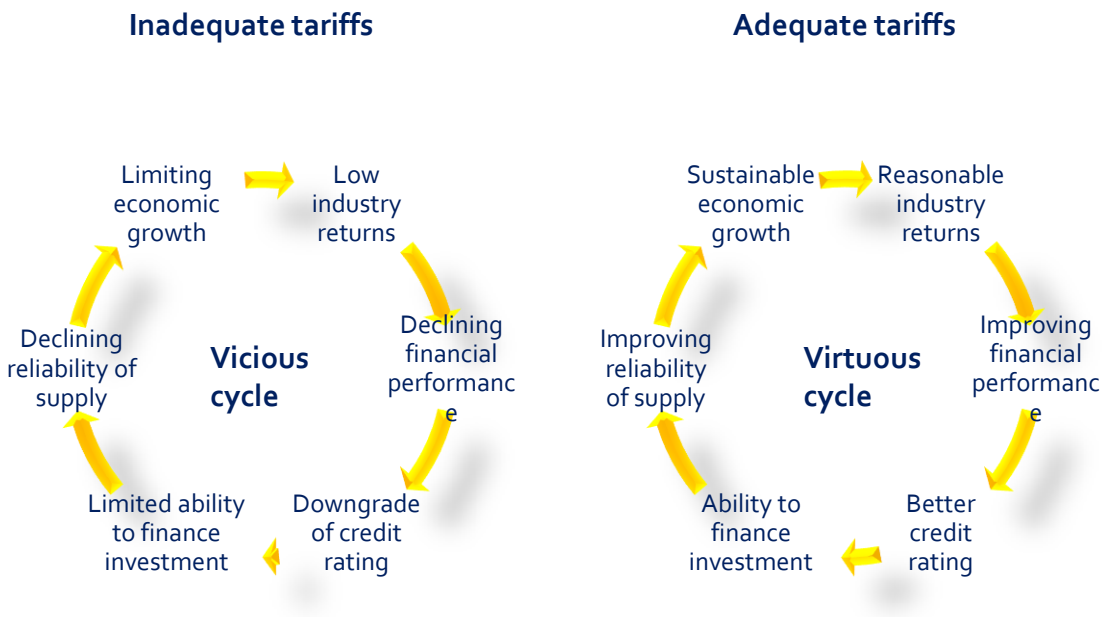
	2010/11	2011/12	2012/13
Allowed revenues from tariffs based sales (nominal R'm)	85 180	109 948	130 258
Standard average price (nominal c/kWh)	41.57	52.30	60.66
Percentage price increase (nominal)	24.8%	25.8%	16.0%

Source: NERSA Reasons for Decision Table 1 ,and NERSA RfD March 2012

- While prices will increase considerably during the course of MYPD 2 – they will still not have converged to what many would consider a sustainable medium to long term price path. For example, the Government's Integrated Resource Plan 2010-2030 places its conservative price path well above the levels that will have been reached at the end of MYPD 2.
- In the coming year NERSA will need to decide on Eskom's allowed revenue and average selling price appropriate for MYPD 3.
- Whatever the outcome of NERSA's decision for Eskom's MYPD 3 – there will be implications for the economy in general and unique distributional impacts across various subsectors of the economy. We explore some of the key issues and implications in the material that follows.

Virtuous and vicious cycles – the role of tariffs

Adequate tariff levels plays a crucial role in the long term viability of a regulated business in that it provides the foundation for investment and growth. The long term implications of this situation are highlighted in terms of "virtuous and vicious cycles" of returns and investment in essential infrastructure.



Source: Adapted by slEconomics from Acil Tasmen 2004

Adequate tariffs support investment in the power sector - thus providing a foundation for growth in the broader economy. Strong economic growth then provides ongoing support for adequate industry returns, and a cycle of investment and growth to the future.

Alternatively, inadequate tariffs and the consequential downgrading of credit ratings will place a hard constraint on needed investment – leading to deficient reliability of supply and thus slowing overall economic growth. Once in this downward spiral it is difficult to obtain funding and investment needed to reverse the course of these actions

Embedded subsidies

- Government subsidies are often used to fill the gap between the revenue need of a utility and allowed tariffs. Defining and measuring such subsidies is beset by a number of challenges. However, two standard definitions applied within the context of the energy sector provide some level of guidance here.

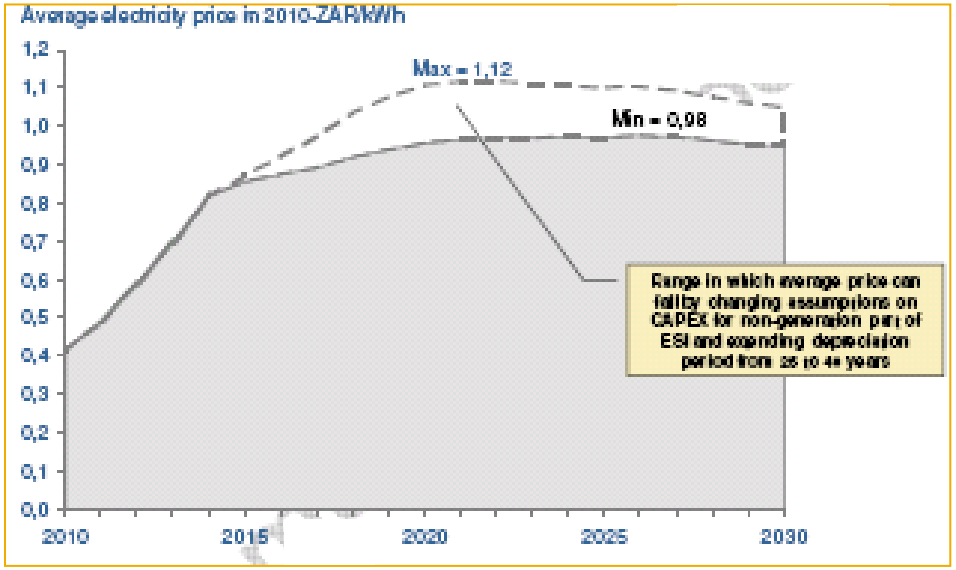
WTO Agreement on Subsidies and Countervailing Measures "Article 1 states that a "subsidy" exists when there is a "financial contribution" by a government or public body that confers a "benefit". A "financial contribution" arises where: (i) a government practice involves a direct transfer of funds (e.g. grants, loans, and equity infusion), potential direct transfers of funds or liabilities (e.g. loan guarantees); ,,,"	**Government support to Eskom** • R350 billion in loan guarantees • R60 billion subordinated shareholder loan • A proposed R20 billion equity injection. *(source: Eskom Integrated Report 2011)*
IEA Price gap methodology The IEA defines an energy subsidy as any government action that concerns primarily the energy sector that lowers the cost of energy production, raises the price received by energy producers **or lowers the price paid by energy consumers.** The latter is measured as the difference between the end user price and a reference price consistent with market outcomes (i.e. price gap).	**A point of reference:** •Eskom average price **(inclusive** *generation , transmission and distribution costs*) as of 2012/13 **60. 66 c/kWh.** •Levelised Cost of Electricity (new build) for large base load pulverized coal plant with FDG* (***exclusive*** *transmission and distribution costs)* = ***59.1c/kWh*** ***NB****. in looking at this simple comparison, we note that transmission and distribution costs can add 60% or so to base generation costs. Of course there are numerous other matters to consider in a comparative assessment and this is illustrative only.* *Source: EPRI, Power Generation Technology Data for Integrated Resource Plan of South Africa*

The 'price gap' (i.e. current and long term price path)

The Government's IRP sheds further light on the 'price gap' between current (Eskom) average electricity price and the long term price path for generation and network costs (NB. exclusive non-Eskom distribution costs).

Even with the increases provided for in MYPD2 there will still be a considerable price gap remaining .

It is not our intent to provide a view on the exact level at which prices would become cost reflective and we recognize the debate over certain assumptions implicit to estimating the price path . Nevertheless, we think the balance of research clearly indicates that there is still some way to go before the price gap is closed.



INTEGRATED RESOURCE PLAN FOR ELECTRICITY 2010-2030 Revision 2 FINAL REPORT

Why not subsidize electricity production though government support?

Fiscal constraints

Generically speaking, taxes might be raised to fund the ESI, but this is not without its own set of adverse consequences.

However, in regard to funding major investments in the ESI, we note the recent view of Government in its National Development Plan 2030 that "Government has probably reached its limit of fiscal and guarantee support for Eskom. "

Simply put – the level of funds needed by the sector as a whole are substantial, and of a magnitude that has implications for the sovereign.

Efficient allocation of resources

As noted in a report to National Treasury*

> *"…continued sub-economic pricing (prices below long-run marginal costs) in the industry ironically run the risk of increasing real costs in the economy (by reducing allocative efficiency). Furthermore, sub-economic energy prices benefit energy and capital intensive growth, and places labour and skills intensive development paths at a disadvantage. Proper economic pricing of power will reverse skewed incentives in the long-term and support South Africa's primary economic aim, which is to establish labour absorbing development paths".*

Further noting:

> *"Moving to cost reflective prices will save real costs in the economy…by encouraging efficient use of energy and capacity (including demand side investments) which, if electricity service is priced correctly, will be cheaper in real resource terms, than new supply capacity…".*

We are not aware of existing analysis that fully quantifies the types of costs suggested above for South Africa, but given the magnitude of the issue at hand, such costs are likely to be significant.

** Administered Prices : Electricity : A Report for National Treasury by. Grové Steyn – 2003.*

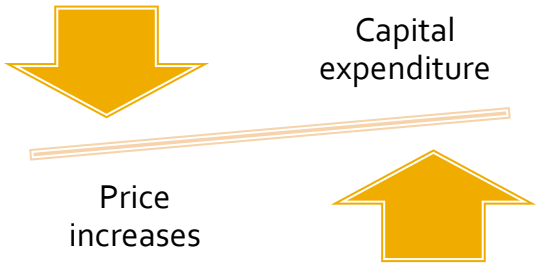
Section 2

- Price increases and investment in the ESI – economic impacts

Counterbalancing impacts of tariff increases and investment

- In considering cost reflective pricing it is important to understand the various distributional implications of increased electricity prices in terms of factors such as sectoral output, employment, and household consumption.

- **In undertaking such analysis it is important to include the increased investment in the ESI that will be made possible by moving towards cost reflective prices.**
- Pan-African Investment and Research Services (Pan-African) examined these two factors both individually and jointly in a study carried out in 2011. Impacts of prices and investment are illustrated below.



Price impact (only)

Economy wide impacts from an 24.8% increase in electricity price (long term)	
Real household consumption	-2.37%
Aggregate capital stock	-1.82%
Real GDP	-1.03.%
Average real wage	-2.12.%
Unskilled employment	-1.32%

Adapted from Pan Africa page 30

ESI investment impact (only)

Economy wide impacts from an 18% increase in ESI investment (long term)	
Real household consumption	1.22%
Aggregate capital stock	0.52%
Real GDP	0.75%
Average real wage	1.05%
Unskilled employment	0.79%

Adapted from Pan Africa

- As illustrated here many of the negative economic impacts of price increases are of a similar order of magnitude as for ESI investment. The net effects are shown on the following page.

Economic impacts of tariff increases and investment

- Pan –African estimated the **net impacts** on key macroeconomic variables from an 18% increase in ESI capital investment, combined with various levels of electricity price increases.
- While the assumed level of investment does not quite off-set the negative impacts of a 24.8% increase in electricity price, it does largely mitigate these impacts and reverses the outcome for smaller price increases.
- Moreover, the assumed level of capex modeled here appears to us a rather lower then planned for, and to this degree would further off-set the negative outcomes of the 24.8% scenario suggested by Pan-African.

Economy wide net impacts from an increase in price (various scenarios) and 18% increase in ESI investment (long run)

Electricity price increase	**24.8%**	**15%**	**10%**	**8%**
Real household consumption	-1.15 %	-0.03%	0.56%	0.80%
Aggregate capital stock	-1.3%	-0.44%	0.01%	0.19%
Real GDP	-0.28 %	0.22%	0.47%	0.57%
Average real wage	-1.07 %	-0.06%	0.46%	0.67%
Unskilled employment	-0.53%	0.10%	0.43%	0.56%

Adapted from Pan African page 85

Sub-industry impacts - output

Table D4.3: Long-run output changes by sub-industry

	Long-run			
	24.8 percent	8 percent	10 percent	15 percent
Irrigated Field	0.13	0.29	0.28	0.23
Dry Field	0.14	0.29	0.27	0.23
Irrigated Horticulture	0.2	0.2	0.2	0.2
Dry Horticulture	0.2	0.2	0.2	0.2
Livestock	-0.64	0.51	0.37	0.03
Forestry	-0.1	0.36	0.31	0.17
Other Agriculture	-0.42	0.47	0.35	0.1
Coal	0.97	1.09	1.08	1.02
Gold	0.2	1.57	1.42	1.03
Crude, Petroleum and Gas	0.18	0.42	0.39	0.32
Other Mining	0.81	0.16	0.24	0.45
Food	-0.47	0.46	0.35	0.07
Textiles	0.27	0.17	0.18	0.21
Footwear	-0.43	0.41	0.31	0.08
Chemicals and Rubber	0.26	0.37	0.35	0.33
Petroleum Refineries	-0.06	0.5	0.44	0.27
Other Non-metallic Mineral Products	0.09	0.23	0.21	0.17
Iron and Steel	-1.22	3.16	2.64	1.34
Non-ferrous Metal	-1.12	2.72	2.28	1.12
Other Metal Products	0.15	0.31	0.3	0.25
Other Machinery	0.38	0.25	0.27	0.31
Electrical Machinery	0.4	0.36	0.35	0.37
Radio	-0.42	0.52	0.41	0.13
Transport Equipment	0.27	0.3	0.3	0.29
Wood, Paper and Pulp	0.37	0.35	0.35	0.37
Other Manufacturing	0.84	-0.06	0.05	0.32
Electricity	-0.91	4.49	3.75	2.02
Water	-0.44	0.64	0.51	0.18
Construction	-0.06	0.11	0.09	0.03
Trade	-0.18	0.46	0.35	0.2
Hotels	-0.48	0.65	0.52	0.18
Transport Services	-0.25	0.64	0.53	0.27
Communication services	-0.84	0.77	0.58	0.1
Financial Institutions	-0.62	0.64	0.49	0.11
Real estate	-0.88	0.64	0.45	0
Business Activities	-0.14	0.44	0.37	0.2
Health Services	-1.49	0.91	0.62	-0.1
Other Service Activities	-0.17	0.49	0.41	0.22

Source: Pan African table D4.3

- The modeling carried out by Pan-African is helpful in tracking the some of the broad dynamics at hand at a level of sub-industries.
- For example, in the larger price increase scenario of 24.8%, 17 of the 38 industries reduce output, but equivalently 21 industries increase output as resources are reallocated reflecting the change in relative prices. Of course, aggregate output (i.e.GDP) was shown to decrease (and benefits in terms of economic efficiencies of reducing distortionary price subsidies are not explicitly accounted for in this modeling).
  - Energy intensive industries such as iron and steel, and non-ferrous metals are, as one might expect, impacted the most in terms of output under a 24.8% price increase.
  - Gold does not appear to be negatively impacted in this study – and is perhaps indicative of the anomalies that can result from these complex models.

The banker's perspective

The table below is taken from a Deutsche Securities review of tariff increases in South Africa.

Company	Sector	Eskom electricity cost as a % of total costs (last reported data)	Impact of 35% electricity price hike in one year forward earnings	Comment
Mesafe	Diversified Mining	21.0%	25.5%	We believe ability to pass cost on is reasonably good – SA is 50% o world production.
Harmony	Gold	12.0%	14.6%	
Nampak	Diversified Industrials	4.0%	7.9%	Management believes it can pass the cost on. We are concerned the major customers, such as SABMiller can easily switch to imports.
Northam	Platinum	6.6%	5.0%	Silo oligopolistic concentration but, in the medium term, pricing powe in platinum is strong.
AngloPlat	Platinum	5.0%	5.3%	
Mondi	Paper	0.7%	5.0%	Low profitability at the moment amplifies the impact on the botton line.
Implats	Platinum	6.0%	4.2%	
Octodec	Property	21.2%	4.1%	Our analysis assumes no pass-through to tenants. In reality, this cos is recoverable from tenants, unless leases state otherwise or tenant default.
ARM	Diversified Mining	7.0%	4.0%	Main exposure is ferrochrome, manganese and platinum, all with reasonably good pricing power for SA producers.
Sasol	Oil and Chemicals	6.0%	4.0%	We have factored into our estimate of the impact the additiona internal generation which drops Sasol's reliance on Eskom from two thirds to one-half of its power requirement.
Premium	Property	21.4%	3.7%	Our analysis assumes no pass-through to tenants. In reality, this cos is recoverable from tenants, unless leases state otherwise or tenant default.
Gold Fields	Gold	7.0%	3.6%	
Lonmin	Platinum	3.0%	3.4%	
Pick n Pay	Retail	3.1%	3.4%	Cost of refrigeration makes electricity more significant for foo retailers.
AngloGold Ashanti	Gold	6.0%	3.3%	
Shoprite	Retail	4.3%	3.2%	Cost of refrigeration makes electricity more significant for foo retailers.
Aquarius	Platinum	5.0%	3.1%	
Vukile	Property	22.0%	3.0%	Our analysis assumes no pass-through to tenants. In reality, this cos is recoverable from tenants, unless leases state otherwise or tenant default.
Woolies	Retail	3.0%	2.8%	
JD Group	Retail	1.6%	2.7%	

Source: adapted from Deutsche Securities, March 2010

We have replicated part of the Deutsche review to counterpoise the economists' view to the banker's view. We think there are some broadly consistent themes: for example –

Even for industries that have large exposure to electricity costs there are many cases where those costs can be passed though and the impact might not in all cases be as extreme as the relative proportion of electricity as an input might suggest – although more rigorous analysis would be required to adequately assess the impact of trade exposed industries.

Alternatively, Deutsche's comments on food retailers' exposure to electricity prices (i.e. refrigeration) leads (us) to think of how cost reflective electricity prices might further drive uptake of energy efficient processes and tecnologies.

Pan-African sector summary – output and employment

Key findings from the Pan-African CGE analysis provides a broad indication of the impacts of price increases on output and employment by sector (**NB.** ranges reported for min and max of sub- industries in each sector)

Output – long run net effect of a 24.8% increase in price and 18% increase in ESI capital expenditure

Mining and quarrying: 0.16% to 0.97% (**NB** alternative modeling by Pan-African finds a negative impact)

Manufacturing: -1.22% to 0.84%

Agriculture, hunting, forestry and fishing: -0.64% to 0.2%

Electricity, gas and water : - 0.91% to – 0.44%

Transport, storage and communication: -0.84 %to -0.25%

Wholesale and retail trade: -0.48% to 0.4%

Financial services: - 0.88 %to - 0.14%

Community and social services: - 1.49% to -0.17%

Construction: -0.06%

Employment – long run net effect of a 24.8% increase in price and 18% increase in ESI capital expenditure

Mining and quarrying: 0.28% to 1.62%

Manufacturing: -0.77% to 1.62%

Agriculture, hunting, forestry and fishing: -0.6 % to – 0.48%

Electricity, gas and water : 0.26%

Transport, storage and communication: 0.62% to 0.02%

Wholesale and retail trade: -0.24% to -0.76%

Financial services: - 0.53% to 0.02%

Community and social services: - 0.88% to 0.14%

Construction: 0.33%

Source: Pan African table 4.11 and 4.12

The problem with '*ceteris paribus*' in economic modelling

- The Pan African study illustrates (among many other matters) the linkage between price increases, investment in the ESI, and economic impacts. Importantly, it demonstrates that if a price increase is combined with capital investment many of the negative outcomes associated with the price increase are largely mitigated.

- Nevertheless, a 24.8% increase in the price of electricity is found to have a negative impact in terms of output and employment ***all else constant***. (i.e. *ceteris paribus)* which is only natural in this type of economic analysis.

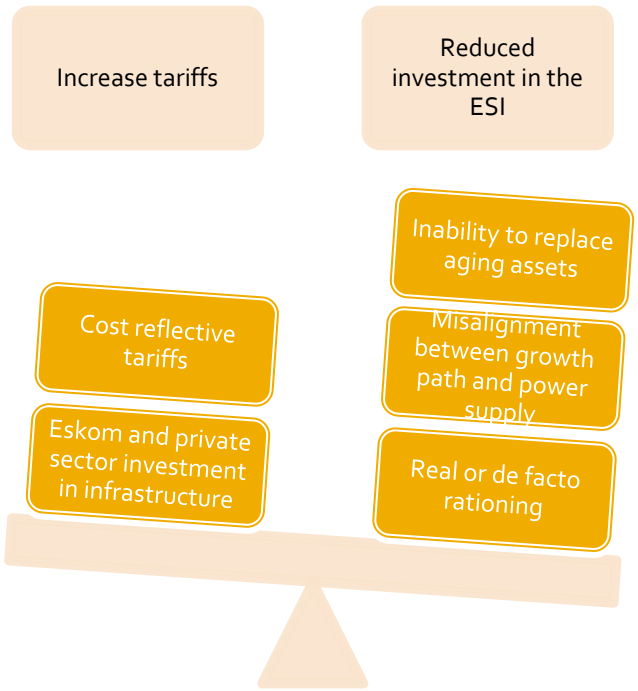
- The problem is – all else will not be constant if electricity tariffs do not recover the full cost of supply. In this case, the relevant point of comparison is the cost to the economy of deficient investment in the ESI and consequential short fall in future power supplies. This component of the problem is examined in the section that follows.

Section 3

- The alternative scenario – assessing the impact of reduced power supply and constrained growth

There is not a 'business as usual' option – either prices must increase or investment in the ESI will be constrained

When electricity tariffs are insufficient to cover the cost of investment and government is constrained in its ability to provide further support for the industry – the options at hand reduces to two broad choices.



- Eskom is in the middle of a significant capacity expansion plan – supported with some R350 billion of Government loan guarantees.
  - Government has recently stated that it will not be able to provide further support to Eskom, and electricity prices are not at a level that would provide a return on investment in further capacity whether undertaken by Eskom or the private sector.
  - However, analysis carried out for the IRP and elsewhere clearly shows the significant need for further phases of capacity expansion in the long term to replace aging facilities and to support economic growth.
  - Unless prices are at a level that supports ongoing investment in the ESI, real or *de facto* rationing of power supply seem inevitable.

Quantifying the impact of a short fall in electricity supply.

- The Human Sciences Research Council (HSRC) has undertaken a quantitative study that assesses the economic impact of electricity cuts on the South African economy.
- While the study was carried out in 2008 and would not be expected to mirror a particular supply imbalance that might obtain from a reduced capital expansion plan for the ESI into the future, the assumed 10% cut in electricity output provides a reference point to track the broad impacts on various sectors of the economy.
- HSRC explain their modeling strategy as assuming that there is a 10% fall in electricity output consequent upon a reduction in the capacity of the sector.
- **The impact on total output of the economy (i.e. real GDP) from a 10% shortfall in power supply is a reduction of 0.9% (i.e. -0.9% real) with broadly similar decreases to employment and household income as shown in the table opposite.**

Impact of a 10% reduction in electricity output	
Impact on GDP	-0.9%
Employment	-1.4%
Household income	-1.2%

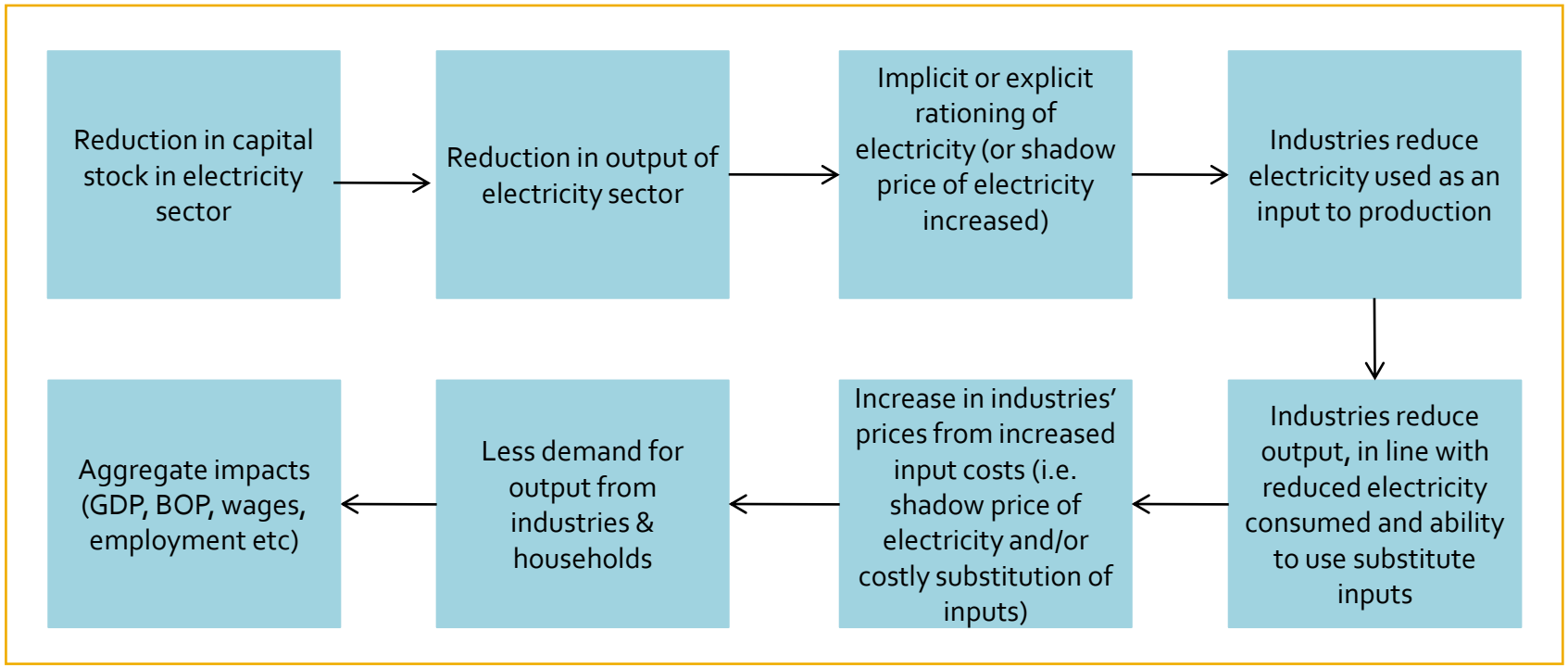
Source: adapted from HSRC table 2

NB. These results are the 'best case' from the HSRC analysis. In this analysis the modeling necessarily assumes a hypothetical market clearing mechanism (we characterize as a shadow price) that allocates electricity supply.

They also show that administered rationing (e.g. targeted at sectors such as mining and smelting) have even greater negative impacts.

Economic impact of a short fall in electricity supply.

- While there are numerous forward and feedback relationships to consider in fully assessing the economic impact of a shortfall in electricity supply, some of the more significant relationships are reasonably direct in effect and often modeled as follows:



Impacts of a 10% shortfall in electricity supply by sector

- HSRC provides a breakdown of some 109 sub sectors. For ease of presentation we have taken the top 40 sub sectors in terms reduction of output from the HSRC study as shown opposite.
- The reduction in power supply as compared to a base case has a measurable impact on electricity intensive industries , and due to the assumption of a 10% decrease in electricity output ,coal mining and industries that service electricity production show a measurable decrease in output from the base case.
- Some 24 sectors of the economy reduce output by 1% or more.

Reduction in output (and rank) from a 10% reduction in power supply

Sector	%	R
Coal	-2.13	1
Tyres	-1.95	2
Electricity Apparatus	-1.91	3
Gold	-1.85	4
Knitting Mills	-1.79	5
Electric Motors	-1.68	6
Lighting Equipment	-1.67	7
General Hardware	-1.67	8
Non-Ferrous Metals	-1.63	9
Soap	-1.61	10
Other Textiles	-1.41	11
Accommodation	-1.36	12
Accumulators	-1.33	13
Pharmaceuticals	-1.32	14
Treated Metals	-1.32	15
Wire & Cable	-1.28	16
Other Construction	-1.22	17
Water	-1.15	18
Other Chemicals	-1.13	19
Gears	-1.12	20
Machine Tools	-1.09	21
Buildings	-1.07	22
Activities/ Services	-1.04	23
Electrical Equipment	-1.00	24
Structural Ceramics	-0.96	25
Mining Machinery	-0.95	26
Engines	-0.95	27
Structural Metal	-0.93	28
Pumps	-0.89	29
Other Rubber	-0.88	30
Other Non-Metallic	-0.87	31
Non-Structural Ceramics	-0.84	32
General Government	-0.82	33
Handbags	-0.81	34
Bakeries	-0.80	35
Lifting Equipment	-0.78	36
Confectionery	-0.78	37
Other Transport	-0.77	38
Textiles	-0.76	39
Household Appliances	-0.76	40

Source: adapted from HSRC Table 5.

Qualitative findings

- To give a better idea of the sector specific implications, HSRC provide their thinking as to some of the key features of economic adjustment to a shortfall in electricity supply broadly consistent with the quantitative analysis which we have taken a short excerpt from.
  - **Mining:** Adjustments would be difficult and the short-term impact of such a large cut is likely to be the closure of marginal mines.
  - **Agriculture:** There are few significant ways of immediately reducing power use in agriculture, although milling and some processing could be shifted to off-peak periods. Load shedding is extremely damaging to this already precarious sector, especially in dairy, poultry and aquaculture.
  - **Motor industry:** As motor manufacturing involves 'jobbing', a power cut stops production but does not cause damage. However, motor manufacturing is a major source of exports and relies on timeous delivery.
  - **Food industry**: The food and beverage industries involve batch and/or continuous processes. The critical problem arises where stocks are damaged due to loss of refrigeration. This can have uncertain knock-on effects on agriculture, and therefore on employment and rural livelihoods.
  - **Chemicals industry:** Particularly in continuous processes, power cuts can damage equipment, and certainly cause delays. In many industries, a two-hour cut results in a disproportionate loss of production due to the need to clear machinery and re-start processes. This will be the case particularly if machinery is damaged in the process.

Sectors with greater ability to adjust to electrify short falls

- Other sectors are seen as having relatively more ability to adjust production processes and/or take up energy savings methods and technologies.
  - **Property:** Savings of up to 57% are possible in a 10,000m2 commercial office, and can be achieved quickly. Incentives would help in this regard. The more critical concern is for the possible delay in building projects.
  - **Retail :** As with property, it should not be difficult to achieve a 10% cut in power consumption through simple changes related to light bulbs or temperature control in air conditioning.
  - **Residential :** Savings of 15% to 20% should be possible through the implementation of a range of measures outlined in this document, translating into about 26 million kilowatt hour (kWh). If radical improvements were made, up to 57% energy savings could be possible.

    Adapted from HSRC pages 8 and 9

Cost of unserved energy - survey analysis

- The cost of unserved energy (COUE) refers to a methodology often used in the ESI to assign a value (or shadow cost) of supply constraints, often carried out on a survey type basis. It is a methodology particularly well suited to more sporadic and unanticipated supply disruptions measuring direct costs to industry and end users (e.g. such as loss of perishable goods from loss of refrigeration, damaged production process, lost time from employees, etc.)

  - The IRP assigns values from R75 kWh to R10 kWh. The higher value would perhaps be more relevant for more sporadic supply outages where there is not scope to put into place contingency plans. The lower value is perhaps more indicative of long term supply deficiencies where backup energy sources can be planned for (i.e. small scale diesel generators, etc.).

- The direct cost of power outages as typically measured by the 'COUE approach' is significant and does represent an important aspect of the cost of insufficient electricity supply. However, it does not capture the many linkages and adjustments made in an economy and would tend to overstate the long term cost to the economy from insufficient supply. In light of this, it is a very helpful tool for estimating the costs of short term supply disruptions, but perhaps not for long term structural adjustments to an economy.

Section 4

- Concluding thoughts

Key issues and implications

- The Government's Integrated Resource Plan For Electricity shows roughly a doubling in installed power generation capacity needed from 2010 to 2030.
- Even with the significant price increases provided for under MYPD 2, further increases will be required if prices are to recover the cost of investment in new capacity associated with the IRP. This is the case whether investment in the ESI is undertaken by Eskom or the private sector.
- Government has stated in its National Development Plan 2030 that "*Government has probably reached its limit of fiscal and guarantee support for Eskom*". If one rules out any further Government support for major capital projects in the ESI, there are two basic options to consider going forward:
  - Increasing tariffs to cost reflective levels; or
  - Constraining investment in the ESI and planning for consequential shortfalls in electricity supply.
- These are policy choices to be made by South Africa, but there are a number of studies at hand that provide broad insights into some of the more fundamental economy wide implications of the policy choices at hand.

Reduced investment and reductions in power supply

- Our premise has been that if electricity prices are below the cost of supply investment in the ESI will be constrained with a consequential constraint on energy supply in the long term.

- Research has been carried out by HSRC that assesses the economic impact of electricity cuts on the South African economy. While the study was carried out in 2008 and would not be expected to mirror a particular supply imbalance that might obtain in the future from a reduced capital expansion plan for the ESI, the assumed 10% cut in electricity output examined in that study provides a reference point to track the broad impacts on various sectors of the economy. (i.e. HSRC explain their modeling strategy as assuming that there is a 10% fall in electricity output consequent upon a reduction in the capacity of the sector.)

- The impact on total output of the economy (i.e. real GDP) from a 10% shortfall in power supply is a reduction of 0.9% (i.e. -0.9% real GDP) with similar decreases to employment (-1.4%) and household income (-1.2%) . However, we must caution that these results cannot be *directly* compared to the results of the studies that examine the alternative – electricity price increases relating to price increases and capital investment as there would be numerous assumptions made that would vary between the studies.

- Nevertheless, the HSRC study and other research we have examined does show that the cost to the economy of a shortfall in energy supply is material – which is what one would naturally expect.

The impact of increasing prices

- In the long run, economic theory and real world experience suggest that the economy as a whole benefits from the application of cost reflective pricing . This is not to rule out targeted subsidies (e.g. such as Free Basic Electricity, etc) but as a broad principle for the industry as a whole.
  - While we have not aimed to provide a view on the exact value at which prices would achieve cost reflectivity – it seems clear that this level will not have been reached by the end of MYPD 2.
- In reviewing quantitative studies undertaken on the effect of electricity price increases on the South African economy, one will see that there are numerous and complex linkages to account for, and the findings of these studies provide a divergent range of results. Nevertheless, in synthesizing the findings of various studies we believe there are a few consistent and robust conclusions that can be drawn.
  - First, and not surprisingly – output and employment in electricity intensive industries is adversely effected by an increase in electricity prices *all else constant* – although perhaps not nearly to the degree that their share of electricity as an input to production might imply.
    - However, not all will remain constant if prices remain below cost reflective levels of supply. It seems unlikely to us that the growth path provided for under the IRP can be achieved in such case, and constrained energy supply will place limits on the South African economy and the jobs it creates.
    - Moreover, if the revenue raised from increased tariffs is fed back into the economy by investment in the ESI the negative impacts on the economy as a whole are significantly reduced, and perhaps reversed in many cases given the size of the investment programme and the positive impacts it will have on the economy.

The cost of pricing below cost-reflective levels

- The results of quantitative studies such as those cited here do not fully measure the real *cost to the economy* stemming from prices that are below the cost of supply (e.g. related to inefficient use of electricity, induced adoption of technologies, mis-allocation of capital, deadweight loss from taxation, etc).

  - We are not aware of any studies that fully quantify the types of costs suggested above for South Africa, but given the magnitude of the issue at hand such costs are likely to be significant. If this part of the equation was fully accounted for it may very well change a number of the adverse outcomes suggested by existing studies at hand. We look forward to future research that explicitly addresses this important component of economic analysis.

- Finally, as our intent is not to debate the many fine points of the findings of others, we think the fundamental conclusion to be drawn here is that both theory and practice indicate that the economy wide negative implications of a price increase within the current context are at worst rather small, and perhaps more likely to be positive in the long term as prices move to cost reflective levels - thereby promoting allocative efficiencies in terms of energy use and capital investment, and placing the ESI on a sustainable path in which it is able to provide reliable electricity supply for a growing South African economy.