http://dx.doi.org/10.17159/2411-9717/2018/v118n6a2

Tariff developments for electricity-intensive industry in South Africa

by C.S. Mahony and J.M. Baartman

Synopsis

It is common cause that South Africa's mining and industrial sectors are struggling to compete in global markets. Electricity pricing is frequently cited as one of the primary causes; typically current price levels, uncertainty around future prices, or both.

From a low base by international standards, South Africa has experienced above-inflation electricity price increases over the past decade. Eskom's sales data confirms a declining trend in electricity sales to its large industrial consumers, particularly since 2011; attributable to efficiency gains, an increase in cogeneration, as well as cutbacks and closures across a range of market segments. High and/or rising electricity prices inevitably pose the greatest threat to the most electricity-intensive users, including the ferroalloy producers. Logically, other competitiveness factors, such as manpower and logistics costs, rise in relative importance as electricity intensity decreases.

Reduced consumption by large industrial consumers reduces the system load factor, exerting upward pressure on the unit cost of electricity at the generation level. Furthermore, as large users contribute significantly to the subsidization of other users' prices, falling consumption risks ever-increasing cross-subsidy contributions by the remaining contributors, further increasing prices.

In response, Eskom proposes to introduce a suite of more cost-reflective tariffs aimed at stabilizing, and even growing, consumption by electricity-intensive customers with high load factors, who stand to gain the most from more cost-reflective electricity pricing, while contributing meaningfully to keeping the unit cost of electricity down.

Keywords
ferroalloys, electricity-intensive industry, electricity price, electricity cost.

Introduction

Given South Africa's rich mineral endowment, it is inevitable that a substantial portion of its electricity is consumed in the mining and further processing of a wide range of ores. Metallurgical processes are characteristically very electricity-intensive; ferroalloy manufacture alone accounted for an estimated 7.5% of South Africa's total electricity consumption in 2017, despite the severe cutbacks in the country's output of both manganese and silicon alloys in recent years.

The decline in consumption of grid-supplied electricity by South Africa's key industrial consumer (KIC) segment (≥ 100 GWh/a) in recent years has been widespread, with 12 of the 21 sub-segments tracked by Eskom registering declines over the past 11 years. Since the end (31 March) of Eskom's 2011 financial year (FY), the downward trend has been more consistent. In fact, if data for the aluminium smelter sub-segment is excluded for this period (on the basis that pricing to these consumers was not based on standard tariffs; *i.e.* contractual pricing applies), there is fairly convincing evidence that price elasticity has become a significant factor in determining purchases of grid-supplied electricity by Eskom's KICs, as demonstrated in Figure 1. It should be noted that while the vast majority of South Africa's KICs are supplied by Eskom, some are supplied by municipal electricity undertakings.

Based on feedback from its KICs, Eskom attributes the observed trend primarily to a combination of improved energy efficiency (in line with the global trend), an increase in self-generation, switching to alternative energy sources, limited investment in new capacity, as well as total or partial plant closures. The latter two factors strongly suggest that South Africa's KICs, most of whom compete in global commodity markets, are struggling to remain globally competitive. Feedback from KICs confirms this view, but it must be noted that other cost elements contribute to the lack of competitiveness, in particular for the less electricity-intensive KICs. It is clear that more competitive electricity costs would help to stabilize consumption and potentially reverse the trend to some degree.

* *Eskom, South Africa.*
 ISSN 2225-6253. This paper was first presented at the INFACON XV: International Ferro-Alloys Congress, *25–28 February 2018, Century City Conference Centre and Hotel, Cape Town, South Africa*

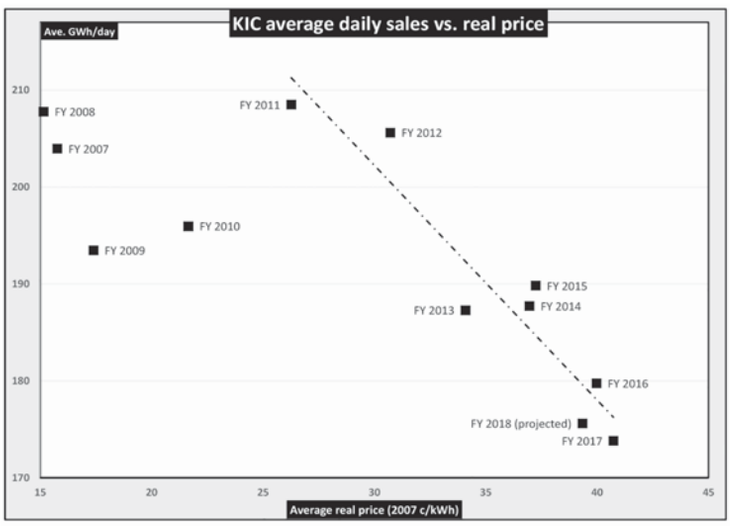

Figure 1—Sales to Eskom KICs (excluding Al) *vs* real price

Electricity cost considerations

Offtake of grid-supplied electricity

Although there has been some growth in electricity consumption in past years in the residential and services segments, as well as in selected KIC sub-segments, this growth has been offset by reductions in other KIC sub-segments and among smaller secondary industries. More recently, a growing trend towards rooftop solar photovoltaic generation for own use has emerged, particularly in the services and higher-LSM residential segments, posing another threat to growth in grid-supplied electricity. When the cost of storage options becomes competitive, this trend is likely to increase. At present, only the lower-LSM residential sub-segment is showing consistent growth in consumption, driven by ongoing electrification. If present trends persist, total grid-supplied consumption might decrease over time, particularly in the absence of substantial economic growth.

High unit fixed cost of electricity

With South Africa's electricity generation fleet primarily consisting of large 'base-load' coal and nuclear plant, it is inevitable that the cost of energy generation will primarily be fixed; with transmission and distribution networks as well as committed centralized renewable energy purchases, adding further fixed cost elements. To compound matters further, South Africa has recently invested in two new, large, coal-fired generation plants and several renewable plants, on top of investing a considerable amount to return mothballed stations to service in order to deal with the capacity crisis (2008-2014). A combination of stagnant offtake and rising fixed costs inevitably implies that the unit fixed cost of electricity in South Africa must increase in real terms, exerting upward pressure on prices. Unit fixed costs would rise even more strongly were total grid-supplied electricity to decrease.

Deteriorating system load factor

For the most part, South Africa's KICs operate at load factors above the system load factor, which implies more efficient utilization of South Africa's predominantly base-load fleet (*i.e.* generation plant designed to operate most efficiently when running continuously). At the other extreme, consumption by lower-LSM residential consumers tends to be concentrated during peak periods, particularly in the evening, with the opposite effect. The combination of falling KIC offtake, while lower-LSM offtake continues to rise, implies a deterioration in the system load factor over time. In turn, this implies that the ratio between installed capacity and energy dispatched will increase and that the generation ramp-ups to both the morning and evening peaks can be managed only by keeping more generators in 'spinning reserve'. Both of these outcomes will further increase the unit cost of electricity in real terms. It should be noted that an increase in photovoltaic generation, whether grid-contracted or privately used, leads to a dip in demand from the rest of the fleet during the day, which intensifies the impact of a deteriorating load factor. Increased use of energy storage can help to dampen the impact, but is still too expensive to justify the investment required.

Rationale for a new industry tariff

On the basis of the considerations outlined below, Eskom took a decision to develop a new suite of tariffs that would be specifically targeted at qualifying KICs, whether supplied by Eskom or by municipal licensees. The interim name is 'EIIC tariff suite', the acronym meaning 'electricity-intensive industry consumer'.

Economic imperative

South Africa's KICs are largely capital-intensive mining and industrial consumers. In the long run, the South African government favours transforming the economy from the historical mix of primary and heavy secondary industry to a much less capital-intensive, more labour-absorbing mix of secondary and tertiary elements. However, the lack of headway to date indicates that this transformation will take many years to achieve. In the interim, it appears vital to preserve a substantial portion of the capital-intensive

economic base as, along with the tertiary services sector, it provides the bulk of current economic activity, employment, and tax revenue.

Optimizing unit fixed cost

It may be deduced from the previous section (Electricity cost considerations) that the fixed cost component of the unit electricity cost could potentially be stabilized, and even reduced, by increasing the offtake of grid-sourced electricity. In general, this can only be achieved with a sustained higher level of economic growth, particularly as, globally, electricity intensity is on a downward trend. On the other hand, many of our KICs' markets are influenced more by global economic activity and trends than by local ones, implying that targeted tariff development can potentially be applied to sustain and potentially grow offtake from this segment, notwithstanding low economic growth within South Africa. A successful electricity price intervention in the KIC segment would have a favourable effect on fixed unit costs via both the volume and load factor effects. In turn, this would beneficially affect electricity prices for other consumers.

Tariff cross-subsidies

Megaflex is the tariff that applies to most of the KICs supplied by Eskom, while the relevant municipal licensees apply their own tariffs. Eskom's *Megaflex* tariff for non-municipal customers incorporates three transparent cross-subsidies, namely:

- The *Affordability Subsidy* (AS) – funded by Eskom's direct industrial and business customers
- The *Electrification and Rural Subsidy* (ERS) – funded by Eskom's direct industrial and business customers and municipalities
- The *Urban Low Voltage Subsidy* (ULV) – funded by all Eskom's customers on urban tariffs that take supply at 66 kV or a higher voltage.

Importance of cross-subsidies

A study carried out for NER (Adams, 2004), found that the average impact of cross-subsidies (then only ERS, ULV, and municipal subsidies) on the contributors' effective price levels across all South African tariffs averaged about 7%. As this figure included the cross-subsidies in municipal tariffs, the percentage in Eskom's tariffs was definitely lower at the time. The study concluded that this extent of cross-subsidy was quite acceptable, particularly in light of the highly competitive prices paid by South African industry at the time. In the intervening years, particularly since 2009, dramatically increasing costs have inevitably resulted in Eskom's tariffs increasing at rates well above South African inflation (both CPI and PPI). In an effort to address affordability for low-usage residential customers, the National Electricity Regulator (NERSA) responded by introducing the AS. Collectively, the above cross-subsidies currently make up some 10–16% of the all-in average prices (in cents per kWh) paid by Eskom's industrial customers on *Megaflex*; those at the lower end of the range not being required to pay the ULV.

The fact that the cross-subsidy share of Eskom's industrial prices has increased at a faster rate than the corresponding cost of supply stands in stark contrast to the views expressed in both the Electricity Pricing Policy (EPP) (DME, 2008) and the Guidelines on Cross-subsidies (NER, 2005). The following extracts from the latter document are particularly pertinent.

- *Cross-subsidies should be eliminated gradually in a phased in manner over a period of 10 years*
- *(stated as a cross-subsidy principle) Social 'obligation', so that the economy and society as a whole benefits. Application should not jeopardise the efficiency and the competitiveness of the benefactor customer class*.

It is clear that tariff cross-subsidies have actually increased in percentage terms (of far higher prices, in real terms). Furthermore, many KICs argue that current electricity price levels present a major threat to the survival of several industry sub-segments. As the KICs are seeking more cost-reflective prices, by implication the cross-subsidies they pay have become unaffordable, effectively a violation of the principle quoted above.

Cross-subsidies arising from costing methodology

By their very nature, all costing methodologies that are applied to apportion costs between consumers that share resources will result in cross-subsidies. In the case of electricity, consumers share resources throughout the value chain, from generation to billing, which implies multiple cross-subsidies that arise from the complexity of the cost allocation methodology applied, as well as the level of detail available in respect of usage patterns. In general, these cross-subsidies are too small to cause significant price distortion, particularly between high-level consumer groupings (*e.g.* residential *vs*. industrial). Other than the load factor cross-subsidy discussed below, Eskom has not identified any other individual cross-subsidies that distort prices sufficiently to warrant consideration in the context of the EIIC.

Load factor cross-subsidy

Megaflex tariff energy rates are differentiated seasonally, per time-of-use (TOU) period, by transmission zone, and by voltage group. However, they do not accurately reflect the relative costs of supply for consumers that have vastly different load factors, owing to the fact that all retail energy rates are derived from a single set of (internal) wholesale rates, which have already been differentiated seasonally and per time-of-use period. By implication, the energy costing methodology adopted by Eskom up to now results in a non-transparent cross-subsidy; users with load factors higher than the system load factor being the contributors, to the ultimate benefit of other consumers' prices. While contributing consumers are almost exclusively supplied on either Megaflex or Nightsave Large, recipients are spread across all consumer classes and tariffs, including Megaflex.

EIIC tariff eligibility

The eligibility criteria will be finalized in due course, but current thinking is along the lines outlined in the sub-sections below. The ultimate objective is that consumers that merit qualification should do so, while those that ought not to qualify are excluded. In this context, the authors appreciate that some modifications, or even additions, to the eligibility criteria outlined above are almost inevitable over time and may well be introduced before the criteria are finalized.

Power system factors

As one of the key drivers for the introduction of the new tariff is to optimize the power system, it was essential that EIIC eligibility should be structured accordingly. Three factors have been chosen, as follows.

- *Annual consumption*—Primarily to limit qualifying consumers to those with the greatest potential to optimize the system. Likely initial threshold – 80 GWh/a. for at least two of the past three calendar years.
- *Average monthly load factor*—To ensure that qualifying consumers will maintain or increase the system load factor. Likely threshold – 0.75 (75%) monthly average for at least two of the past three calendar years. Consumer response to time-of-use and seasonal price signals will be taken into account in determining eligibility.
- *Average monthly power factor*—To minimize grid expenditure required to optimize power factor. Likely threshold – 0.96 (96%) monthly average for at least two of the past three calendar years.

It is anticipated that all the above criteria would be mandatory and subject to annual review. Conditional leniency could be allowed for start-ups.

Economic policy alignment factors

Economic benefit is arguably the most important driver for the introduction of the new tariff. Accordingly, alignment to the South African government's industrial policy and strategy is paramount, so consumers will have to meet at least one of the following criteria.

- *Strategic industry*—Endorsement by either the Department of Trade and Industry (DTI) or the Department of Mineral Resources (DMR), in consultation with National Treasury (NT), that the consumer produces a sufficient quantity of at least one product deemed by the government to be of strategic importance to the country.
- *Strategic value chain*—Endorsement by the DTI, in consultation with NT, that at least one of the consumer's products is considered to be a key element of a value chain that the government considers to be of strategic importance to the country.

The above endorsements would need to be renewed annually, to ensure sustained alignment in the event of changes to government policy.

Economic efficiency factors

In the interest of economic efficiency, it is considered crucial that consumers should demonstrate a real need to access the most cost-reflective tariff available in the country. Accordingly, consumers will be required to meet both of the following criteria.

- *Electricity intensity*—Intended to ensure that the cost of electricity plays a primary role in determining qualifying consumers' ability to compete effectively in the markets in which they operate. The qualifying electricity intensity threshold has not yet been determined, but it will be defined in terms of the ratio between annual energy consumed (in kWh) and the 'rand value added' for that period, where rand value added equals gross margin plus manpower cost. In line with the other threshold-based criteria, this threshold will need to have been met for at least two of the past three years, though in this instance the consumer's financial year will be used.
- *Lack of pricing power*—Intended to ensure that qualifying consumers are not able to pass on cost increases in their product prices without significant risk of losing market share to producers outside South Africa. It is possible that a signed declaration from the consumer may be considered sufficient, but a more likely outcome is that the consumer's declaration will require endorsement by an external party considered to have the necessary expertise and to be independent of the consumer.

Eligibility in respect of electricity intensity will be subject to annual review, while the declaration in respect of pricing power will need to be renewed annually, to ensure sustained alignment in the event of sustained changes in the markets served.

Conceptual tariff design

As with the eligibility criteria, the tariff design will be finalized in due course. Current thinking is along the lines outlined in the sub-sections below. The first two deal specifically with reducing or eliminating the cross-subsidies discussed earlier, with the objective of enhancing cost-reflectivity; the third addresses the TOU issue, which has long been problematic for several customers.

More cost-reflective energy rates

As indicated earlier, the suggested EIIC tariff load factor threshold is 0.75, the intent being to differentiate the wholesale energy rates used for the EIIC tariff from those used to determine other Eskom tariffs. However, it goes without saying that a single load factor band spanning 0.75–1.00 would still imply a considerable degree of cross-subsidization in favour of relatively lower load factor consumers. The current proposal is to create three energy rate bands in the EIIC tariff, as follows.

- Band 1: EIIC-qualified consumers with load factors from 0.90 upward would gain access to the lowest energy rates
- Band 2: EIIC-qualified consumers with load factors from 0.825 upward (but below 0.90) would gain access to mid-range energy rates
- Band 3: EIIC-qualified consumers with load factors from 0.75 upward (but below 0.825) would gain access to the highest EIIC energy rates, though slightly lower than the Megaflex rates.

Seasonal and time-of-use considerations

In order to allow for qualifying consumers that opt to use less energy during the high-demand season (June–August), and/or to reduce usage during peak periods when energy rates are higher, two potential solutions are under consideration, namely:

- *Seasonal variation*—Permitting consumers to qualify in different bands for the two seasons, *e.g.* band 2 for the

low-demand season and band 3 for the high-demand season
- *Peak reduction*—Excluding peak periods from the load factor calculations.

There is also a possibility that an alternative rate structure will be offered to the higher bands (1 and 2) wherein the differentiation between seasonal (and potentially also time-of-use) rates is removed, which would benefit qualifying consumers that maintain consistent load profiles throughout the year, either by choice or because their processes cannot tolerate much variation. The availability of this option is likely to be contingent on participant consumers contracting to provide interruptible load as outlined below.

Reduced cross-subsidy contributions

The key purpose of the economic eligibility criteria outlined above is to enable eligible consumers to gain access to lesser contributions to the AS, ERS, and ULV cross-subsidies, in the interests both of enhanced cost-reflectivity and greater affordability. The intent is to link the level of benefit to electricity intensity so as to align affordability with consumers' sensitivity to electricity prices. The details of the mechanism will follow analysis of electricity intensity values obtained from a substantial sample of Eskom's KICs, but it is likely that 2–3 bands will be established, with subsidy contributions lowest for the highest intensity band. Whether or not cross-subsidy contributions can be completely eliminated for the highest band remains to be tested.

Other products

Eskom is currently in the process of reviewing its approach to contracting with its customers for *Interruptibility*, a product that permits willing and able consumers to provide demand-side support to the grid, both during peak periods and during system emergencies. The changes envisaged would enable the National System Operator to cut costs by utilizing a portfolio of contracted interruptibility as a virtual 'peaking' power station. The cost benefits would be shared with participating consumers.

Other opportunities are also being explored, including the possible introduction of a super-off-peak tariff and a so called 'take-or-pay' option, whereby volume risk in the power system is reduced; again applying the shared-benefit principle.

Implications for consumers

At this stage, the implications of introducing EIIC tariffs for Eskom's other tariffs are not clear; the final outcome depending on a number of variables, including:

- Final tariff design
- Projected impact on total and unit cost of supply
- Projected impact on KIC prices and consumption volumes
- Projected tariff and price implications for other consumers
- Projected overall revenue, bottom line, and cash flow implications
- Decisions around the motivation, quantum, and future funding of cross-subsidies.

International trends

KIC electricity prices

On average, across all customer segments, South African prices compare favourably to global peers. In fact, in US dollar terms, South Africa electricity prices have been relatively constant over the last few years, owing to depreciation of the rand. However, South Africa's KIC prices are increasingly becoming less competitive relative to other countries in which electricity-intensive industries operate. While it is always difficult to obtain information on 'special pricing arrangements' in other countries, what is available has indicated that KICs in certain other jurisdictions are experiencing falling prices. According to data from a German study, compiled jointly by Ecofys, Fraunhofer-ISI, and GWS (EFG), (Grave *et al.*, 2015), lower prices were available for very large (so called 'privileged') consumers in Canada (Quebec), France, and the USA (Texas) than for South African KICs in 2014. Information obtained confidentially from a global commodity producer confirms this, further indicating that KIC prices in these and other jurisdictions actually dropped in US dollar terms between 2014 and 2017, while US dollar-denominated (Eskom) KIC prices in South Africa rose about 9% over the same period. Although the volatile rand/dollar rate improves the competitiveness of South Africa's KIC prices from time to time, industry cannot plan on this basis.

Price variation with load factor

In many jurisdictions, KICs now purchase energy on wholesale markets, following the deregulation of traditional, regulated electricity arrangements. In these markets, KIC purchase prices are invariably influenced by load factor. Even prior to deregulation, it was fairly commonplace for industry tariffs to be differentiated on the basis of load factor (EDF, 1995).

Different pricing approaches for KICs

The prevailing situation in South Africa is that socio-economic cross-subsidies increase electricity prices to KICs, impacting global competitiveness. In countries covered by the German study (Grave *et al.*, 2015), privileges depend either on tax treatment or on a range of other factors such as purchase volume, load factor, supply voltage, industry sector, and electricity intensity. For example, in Germany the prevailing combination of the above benefits leads to prices for 'privileged' industrial consumers being less than half of what would apply without those privileges. In France, it was noted that a consortium of very large consumers was able to negotiate a long-term, fixed price agreement with EDF. According to information provided to Eskom on a confidential basis, a range of further benefits has been made available to what might be termed 'ultra-privileged' large consumers in France, reducing effective prices even further.

Stakeholder engagement

The EIIC tariff concept represents a fairly radical departure from South Africa's past electricity tariff practice. Therefore, decision-making will be influenced as much on the wide-ranging economic implications thereof as on the structural

details of the tariff itself. Consequently, it is anticipated that stakeholder engagement will be both extensive and intensive. Aside from consumer and municipal representative groupings, those to be consulted must necessarily include (at least) NERSA along with several government departments including the NT, DTI, DMR, the Department of Energy (DoE), and the Department of Economic Development.

Approvals

Although Eskom's Board has approved the EIIC tariff concept, final approval of the detailed tariff design will be required in due course. Furthermore, any tariff change, including the introduction of a new tariff, is subject to approval by NERSA. In this context, it is conceivable that the DoE may issue policy guidance to NERSA.

Conclusions

Eskom believes that it is critically important for South Africa that steps are taken to sustain and grow industry, not least by enhancing the competitive position of those industries that compete in the global marketplace, simultaneously providing both direct and indirect employment to many thousands of South Africans, contributing substantially to the fiscus, and enhancing the value of the currency.

That said, Eskom readily acknowledges that the proposed introduction of the EIIC tariff suite is but one part of a comprehensive set of initiatives South Africa needs to implement in order to achieve the desired outcome.

Finally, it is encouraging to note that measures taken elsewhere to protect KICs struggling to remain competitive do not differ fundamentally from Eskom's proposals.

Acknowledgements

The authors wish to thank Eskom for granting permission to publish this paper. Thanks are also due to the many colleagues who, along with a range of customers and government officials, have both supported the initiative and contributed positively to the development of the EIIC tariff concept. Details of the Eskom tariffs referred to herein may be obtained on the Tariffs and Charges page of Eskom's website.

References

Adams, I. 2004. Allocation methodology for cross subsidies in electricity tariffs on the basis of a macro-economic impact study. Report for the National Electricity Regulator, now NERSA.

Department of Minerals and Energy. 2008. Electricity pricing policy (EPP) of the South African electricity supply industry. December.

Electricité de France (now EDF). 1995. Verbal communication. June.

Grave, K., Hazrat, M., Boeve, S., von Blücher, F., Bourgault, C., Breitschopf, B., Friedrichsen, N., Arens, M., Aydemir, A., Pudlik, M., Duscha, V., Ordonez, J., Lutz, C., Grossmann, A., and Flaute, M. 2015. Electricity Costs of Energy Intensive Industries; an International Comparison. Report for the German Ministry of Economic Affairs and Energy. July.

National Electricity Regulator (now NERSA). 2005. Regulatory guidelines on cross subsidies. ◆