Executive Summary
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Comparing the economic impacts of different modelling scenarios to cover the cost of producing electricity

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The modelling team at the University of Pretoria was tasked with comparing the economic impacts of different price path and revenue scenarios that would allow Eskom to cover the full cost of producing electricity. In this context ‘full cost’ does not directly include annual capital expenditure but is defined as consisting of annual fuel, operating and maintenance costs, as well as annual depreciation charges and interest charges i.e. ‘cost of capital’ on net invested (unrecovered) capital (with the annual value of the depreciation charges based on amortisation over the full useful lives of the assets). Tax cost is accounted for by virtue of utilising the pre-tax cost of capital. In addition, as is common internationally for economic regulation of capital intensive infrastructure industries with long asset lives and especially if operating in an inflationary environment, ‘cost reflective’ for this purpose was defined as being based on depreciated replacement asset values. For the purpose of the economic modelling task, Eskom calculated and provided the modelling team with the numbers.

In conducting this research, the team used a state-of-the-art dynamic CGE model of the South African economy based on the MONASH model described in Dixon & Rimmer (2002). MONASH-style models belong to the Johansen class of economy-wide models that provide industry-level disaggregation in a quantitative description of the whole economy. The model postulates neo-classical production functions and price-responsive demand functions, linked around an input-output matrix in a general equilibrium model that endogenously determines quantities and prices. In contrast to a partial equilibrium analysis, general equilibrium models are able to account for all

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1 The main purpose for this approach world-wide is because it results in much more stable / flatter life cycle price profiles i.e. on this approach the initial tariffs (on new assets) are lower than when using historical asset values (due to using a ‘real’ cost of capital instead of a ‘nominal’ cost of capital, as is the case when using historical asset values) but the tariffs thereafter do not decline as steeply as is the case with historical assets. The present value of the life cycle revenue stream is the same in both cases.
the linkages between sectors and agents of an economy. All simulations in this study were conducted for the period 2012 to 2020.

In the first part of the study we conduct simulations to confirm two aspects of the current electricity situation in South Africa:

- By comparing a business-as-usual baseline forecast for the economy with a perturbed scenario in which electricity output is not allowed to grow beyond its current level, our analysis clearly shows deterioration in outcomes across all major economic indicators. The analysis serves to quantify the order of magnitude of this intuitive deterioration. This confirms the benefit of expanding production capacity in order to facilitate future economic growth and rising demand.

- In a second simulation, we compare the baseline forecast scenario to a perturbed scenario in which electricity prices are kept artificially low i.e. not allowed to reach the level of cost-reflectivity as defined. Our analysis shows that under such conditions there would be much higher demand for electricity relative to the baseline and hence the need for further and costly capacity expansion. The analysis serves to quantify the order of magnitude of this intuitive outcome of increased demand. This confirms the benefit of pricing electricity at a cost-reflective and sustainable level in order to facilitate allocative efficiency across the economy.

In the second part of the study we compare the economic impacts of different modelling scenarios to cover the cost of producing sufficient electricity. The modelling exercise conducted in this part essentially compares different models of raising the same amount of required revenue. Five modelling scenarios, analysing the economy-wide impacts over the nine-year period, were compared in this study:

- The first scenario (S1) simulated an electricity tariff increase of 26%, 25% and 25% in the first three periods, respectively, followed by inflation related increases. The net revenue generated by the electricity tariff increase in S1 was then held constant (exogenous) in the remaining scenarios and the impact of different funding scenarios compared.
For scenario two (S2), an exogenous 26% electricity tariff increase in period one, followed by inflation related increases, combined with an endogenously determined increase on taxes related to household purchases (equivalent to a VAT) to generate the required net revenue set in S1 was simulated.

For scenario three (S3), an exogenous 26%, 18%, 18%, 18% tariff increase over the first four periods, followed by inflation related increases, combined with an endogenous change to the tax rate on household purchases (VAT) to generate the required revenue set in S1 was simulated.

For scenario four (S4), an exogenous 26% tariff increase in period one, followed by inflation related increases, combined with an endogenously determined increase on labour and capital income taxes to generate the required net revenue set in S1 was simulated.

For scenario five (S5), an exogenous 26%, 18%, 18%, 18% tariff increase over the first four periods, followed by inflation related increases, combined with an endogenous change to labour and capital income taxes to generate the required net revenue set in S1 was simulated.

We investigate both macroeconomic and industry-level results across all five scenarios. It is expected (and indeed shown) that virtually all economic variables would be negatively affected at the end of the simulation period, for any scenario. More important to our analysis are the relative positions and outcomes of the different scenarios to each other.

The first noticeable result is the relatively poor outcomes associated with S4 (income tax increases) across all economic variables. The impact of using labour and income taxes as the main instrument towards generating the required revenue for Eskom in S4 affects the supply side of the economy in a much more severe manner.

Macroeconomic results for the other scenarios show mixed results. In the long run S2 (VAT increases) has the least impact on GDP by a small margin, relative to S1 (25% price increases) and to S3 and S5 (18% price increases combined with increases in either VAT or Income Tax) but shows even less comparative advantage in the medium run. The nature of the taxes imposed in S2 however makes it the worst for households in the short to medium run, albeit by a very small margin (ignoring the
always worst S4). In most economic variables and over most sectors, S1 (25% price increases) and S3 (18% price increases combined with increases in VAT) show similar results that are well balanced and always slightly better than the outcomes produced under S5 (18% price increases combined with increases in Income Tax).

Industry-level results generally confirm the relative outcomes of those at a macro level. Industry results are typically driven by three factors: i) the impact of the shock, ii) the impact on its most closely linked macro variable, and iii) compositional effects such as capital-labour ratios.

The direct impact of the ‘policy shocks’ on the output of the electricity industry is naturally more severe. The strong electricity price shocks in S1, S3 and S5 relative to those in S2 (VAT) and S4 (Income Tax) dictate the outcomes seen in the electricity industry’s output. These outcomes, all relative to the baseline that includes sufficient electricity output growth, are of significant importance. Although it seems like the electricity industry is performing better under S2 and S4, the ‘mispricing’ of electricity under these scenarios actually leads to higher levels of electricity produced in the economy. That equates into more required capacity expansion and expensive investments that would have to be funded in future. The outcomes seen here can be closely tied to that shown in the first part of the study. The relatively short modelling period however, does not yet incorporate such additional required capital investment in the future even though the difference in electricity demand might imply the need for additional investment during the modelling period.

For the remaining industries, S4 (Income Tax) is once again clearly the worst performer. The relative difference in industry results across scenarios can be explained through a combination of the three above mentioned factors i.e. the impact of the shock; the impact on its most closely linked macro variable; compositional effects such as capital-labour ratios.

In general, S1 (25% price increases), S2 (VAT) and S3 (18% price increases combined with increases in VAT) performed better than S5 (18% price increases combined with increases in Income Tax). S4 (income tax increases) performed significantly worse than any of the other scenarios across all economic variables.

Concern about the allocative efficiency and strong impact of the regressive VAT on households in S2 (VAT) reduces contenders for ‘best scenario’ down to S1 (25%
price increases) and S3 (18% price increases combined with increases in VAT). Since S3 suffers from the same criticisms as S2 (albeit in a much smaller capacity) we believe that, on balance, S1 (25% price increases) is the best model for generating the required revenue to cover the cost of producing electricity.

Based on the evidence produced in this study, our conclusion is to favour the direct increase in electricity tariffs over a period of three to four years as the main instrument towards covering the cost of electricity production. Industry-specific solutions (e.g. targeted support mechanisms), taking into account environmental and efficiency considerations, may be used in conjunction with direct tariff increases during the transition to enable additional time for industries to adapt to cost-reflective electricity prices.

In the short term it might be possible, if electricity industry sustainability and cash flow considerations allow, for the path towards cost-reflective tariffs to be further prolonged i.e. with increases of lower than 25% per annum and spread over a longer period but without over this period already triggering the need for supplementary income for the electricity industry via increases in either VAT or Income tax. The opportunity cost which is implied by this approach i.e. sometime in the future government income would be less due to less tax and dividend income from Eskom (thus, taxpayers then having to carry a heavier burden, ceteris paribus) would imply that ultimately such a scenario with its delayed achievement of macro-economic allocative efficiency, would be less beneficial to the economy overall. However, based on the results found in the modelling, in the short to medium term such a scenario might have slightly less negative economic impact than the best of those modelled.

It should be noted though that the prolonging of a non cost-reflective price signal would increase the volume of electricity demanded by the economy under such a scenario and would thus require additional capacity investment, for potentially little net gain in economic output, which would negatively affect the overall economic outcome. As noted earlier in this report, the additional impact of increased investment in order to meet such increased demand at lower electricity price levels is not incorporated in the modelling approach followed for this study.