Eskom Asset Restructuring –

A Study into the Impact on the Long-Run Tariff Path

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Acronyms

Acronym	Meaning
CAPM	Capital asset pricing model
CCGT	Closed-cycle gas turbine
CPI	Consumer price index
DoE	Department of Energy
EPRI	Electric Power Research Institute
ESI	Electricity supply industry
IDM	Integrated demand management
IPP	Independent power producer
IRP	Integrated Resource Plan
ISMO	Independent system and market operator
LCOE	Levelised cost of electricity
MEAV	Modern equivalent assets value
MYPD	Multi-year price determination
NERSA	National Energy Regulator of South Africa
NT	National Treasury
OCGT	Open-cycle gas turbine
PPA	Power purchase agreement
PPI	Producer price index
RAB	Regulatory asset base
RCA	Regulatory clearing account
ROA	Return on assets
TSO	Transmission system operator
WACC	Weighted average cost of capital

1. INTRODUCTION

1.1. BACKGROUND AND STUDY CONTEXT

This study was commissioned by BLSA (Business Leadership South Africa) and TIPS (Trade and Industrial Policy Strategies) to assess the tariff impact of selected restructuring options for the South Africa Electricity Supply Industry ('ESI'). This report presents a comparison of the indicative future electricity price paths arising from different scenarios for reforms of the electricity supply industry and the associated restructuring of Eskom's electricity assets. This report accompanies a report commissioned by TIPS and BLSA entitled "Electricity Supply Industry Restructuring: Options for the Organisation of Government Assets" (hereafter referred to as the "ESI reform report"), where the various reform scenarios were developed. It is envisaged that development and rigorous analysis of alternative indicative price paths associated with different restructuring scenarios will provide insights and constructive inputs supporting the policy debate on the restructuring options for Eskom.

In the ESI reform report it was proposed that the reorganisation of Eskom's assets could provide a solution to some of the challenges that South Africa's ESI is currently facing. A number of factors were identified as contributing to pressure on South Africa's electricity supply. These include delays in the construction and commissioning of the coal-fired power stations Medupi and Kusile; Eskom's strained financial position; unplanned outages; and the maintenance requirements of ageing generation plants. The assessment reviewed alternative approaches to the organisation of the state-owned assets in the ESI assets in order to ensure sustainability of the sector, and enhance Eskom's creditworthiness, whilst ensuring the ability of the sector to provide reliable electricity generation, transmission and distribution services.

The report on the study identified the drivers of reform in South Africa as well as the constraints facing electricity sector reform, together with the desired ESI outcomes. Characteristics of the current South African ESI, that act as constraints and are therefore drivers of reform, include: inadequacy and unreliability of supply; concerns about long term financial sustainability; the ability to attract investment; the rising costs of electricity; lack of access for the poor; and environmental sustainability. The analysis that followed was undertaken with a view to determining the best structure to achieve the desired outcomes, namely:

(i) sufficient and reliable electricity supply;

(ii) financial sustainability for Eskom and the industry; and

(iii) efficient and reasonable electricity prices.

The various options for the restructuring of Eskom were evaluated against a number of criteria, namely:

- the impact on efficiency;
- the creation of an environment conducive to private investment;
- the reliance on government funding;
- the ease and cost of implementation; and

- the impact on electricity prices.

This report expands on how electricity prices are impacted as a result of reforms, with three of the reform scenarios identified in the ESI reform report examined in greater detail.

The scenarios for which electricity price paths are modelled are: (1) the status quo, i.e. no asset restructuring; (2) legal separation of the generation and transmission/distribution functions; and (3) a variation of wholesale competition, where there is no government involvement in generation. A long-term tariff (electricity pricing) model developed by Genesis Analytics to assess the impact on electricity prices in South Africa of investment planning decisions, cost drivers and price determinations provided the methodological underpinning for the reform-specific tariff models. Various components of the price model were flexed for each scenario to develop comparative price paths. A scenario in which no restructuring takes place is then compared to the outcomes of the two identified reform options.

A comparison of the resultant price paths reveals the probable impact and likely direction of change in key variables of the two reform scenarios vis-à-vis the no-reform scenario.

In order to determine what impact the aforementioned three options have on electricity prices, the relationship between the distinguishing characteristics of each option and the relevant 'building blocks' of the electricity price were assessed. Irrespective of the particulars of the chosen reform path, there are some ubiquitous effects from restructuring, particularly when moving from a fully vertically-integrated utility. In the scenarios, various components of the tariff path change to varying degrees, and the modelling exercise seeks to quantify these effects and determine the overall impact on electricity prices arising from each scenario.

The purpose of this exercise has been to present price paths for alternative reorganisation scenarios in order to inform decisions regarding Eskom's future direction. It must be noted that the modelling is not meant to provide definitive predictions of the future, but rather to yield assessments of the possible price paths under different reform scenarios, which should aid weighing up the attractiveness of each option, and thus assist policy makers in decision making processes. It is important to note that these findings are presented with a significant amount of intellectual humility. Economic models provide a stylised version of reality, and in the process of simplifying an intricate reality, some complexity and many nuances are lost. It is suggested that this study is most effective when used in a comparative, rather than an absolute manner, and its value is found in indicating the direction and relative magnitude of the changes in prices and other variables as a result of one reform scenario relative to another.

In order to model the price paths, an extensive review of international experience and economic literature regarding the impact of reforms was undertaken, which revealed a dearth of quantitative reform impact findings with, at times, conflicting results. This is due to the highly divergent contexts of each study, each particular to a specific country or set of countries, each faced with different ESI landscapes, government directives, as well as a range of institutional and market reform arrangements considered appropriate and therefore considered in the literature. Unfortunately this means that there are no definitive causal relationships in order to predict, with a high degree of certainty, what the precise impact of the reforms will be in South Africa's situation. Yet the results clearly signpost the direction of the changes and, as the modelling has been tailored to the context of the ESI under consideration, are likely to be highly indicative. As authors who assessed various unbundling options so eloquently state: "Sometimes one can learn from foreign experiences, but in the absence of useful comparisons one has to rely on theoretical arguments, expert judgement and educated guess. This may seem unsatisfactory, in particular for the parties involved, but one cannot do better."[1]

1.2. STRUCTURE OF THE REPORT

This report is structured as follows:

- At the end of Section 1 is a brief overview of the methodology used, which will be expanded upon in the relevant sections of the report;
- In Section 2 the restructuring options chosen are discussed in detail, after which the generic effects from restructuring and their likely impact on prices are outlined;
- Section 3 further explores how restructuring effects the price path by firstly explaining how South African electricity prices are set and then identifying those components of the price path that are affected by restructuring;
- Section 4 ultimately provides the price paths of the three scenarios under consideration. A discussion of the original model used in the study and the adjustments made to the model under each scenario precede the presentation of the results;
- In section 5 the report is concluded.

1.3. OUTLINE OF METHODOLOGY USED

As discussed above, the methodology used for this project involved flexing various components of a long-term price path model in order to develop comparative price paths for a number of the scenarios that were developed in the DP project. The following steps were taken in the development of the final output:

- The scenarios to be modelled were chosen. This involved consultations with the industry experts as well as an evaluation of the likely next steps for ESI restructuring in the South African context, given stated government policy and recent developments therein.
- The possible impact on electricity prices of ESI reform was researched in the relevant literature, in order to categorise the various effects that impact upon electricity prices.
- The literature revealed a number of generic restructuring effects, which were then used to identify those elements of the price path (in the South African context this is the regulated 'allowable revenue') that would be impacted by restructuring. The literature was used to provide guidance on the direction and the magnitude of change of the relevant variables under the alternative scenarios.
- In addition, adjustments to the model were informed by NERSA's Multi-Year Price Determination ("MYPD") methodology and known facts about South Africa's ESI, in conjunction with existing evidence from the relevant literature.
- The changes in magnitude that were applied to the variable components of the tariff path differ in each scenario, with the modelling exercise building each scenario from a base case original

[1] Mulder, M., Shestalova, V. & Lijesen, M. 2005. *Vertical Separation of the Energy Distribution Industry: an assessment of several options for unbundling.* CPB Netherlands Bureau for Economic Policy Analysis. No. 84: p. 90.

model. This original model projects prices to 2030 using the Levelised Cost of Electricity ("LCOE") approach, and augments the price determinations by NERSA (up to 2017/18) with long-term publicly available data from the Integrated Resource Plan of 2010 and Electric Power Research Institute (EPRI).[2]

- Adjustments were made to the model for each scenario by levering the affected tariff components as appropriate. Although there are limitations to the model in terms of its ability to capture the nuances of each scenario, it is able to capture the "caricatured" versions of the scenarios, the results of which are sufficiently reliable to draw instructive conclusions.

[2] EPRI. 2012. Power Generation Technology Data for Integrated Resource Plan of South Africa: vertically integrated electric utilities. Final technical update.

2. RESTRUCTURING OPTIONS AND POTENTIAL EFFECTS

In the aforementioned ESI reform report a number of alternative models were presented for the reorganisation of the ESI in South Africa, based on international experience following ESI reform. The models that were evaluated can be summarised as follows:[3]

A.1: Status quo without any ESI reorganisation.

Additionally, status quo with two variations:

> A.2: Status quo with independent power producers (IPPs) being able to sell directly to eligible customers (direct contracts); and
>
> A.3: Status quo with legal separation of Eskom's generation and network components.

B: Restructuring of Eskom assets and/or operations with the following variations:

> B.1: Introduction of Independent System and Market Operator (ISMO) (as per ISMO Bill) (separating out system operations),
>
> B.2: Introduction of Transmission System Operator (TSO) (separating out transmission and system operations),
>
> B.3: Unbundling of generation from the wires business. State-owned generation companies and private sector companies participate in generation;

C. Wholesale competition with power exchange pool (multiple buyers); and

D. Retail competition.

In this study the price path under the status quo (A1) is determined, after which two other proposed scenarios are evaluated. The premise is that any kind of restructuring should result in benefits to the South African electricity consumer, and the expectation is that electricity prices should fall, in relative terms, in comparison with the status quo scenario. The first of these alternatives is a single buyer model with legal separation of Eskom's generation and network components (A3), henceforth referred to as the "legal separation scenario." The second is wholesale competition where the government has no involvement in the generation of electricity and Eskom would take on the role of a TSO (B3). It is subsequently referred to as the "wholesale competition scenario", not to be confused with the variation of wholesale competition with a power exchange pool (C), which is not considered here. Common to all the scenarios under consideration is the presence of a single buyer, and where competition is introduced it is in the generation part of the value chain only.

The rationale for this choice of scenarios to model is that the legal separation scenario (A3) is a logical next reform step in South Africa, as Eskom has to some extent already undertaken accounting separation of its generation, transmission and distribution activities.[4] Functional separation requires the separation of operational and management activities and it will

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[3] Teljeur, E., Sheik Dasarath, F., Kolobe, T., Da Costa, D. (2016), Electricity Supply Industry Restructuring: Options for the Organisation of Government Assets, TIPS, p. 46-47.

[4] In terms of the regulatory requirements implemented by NERSA, Eskom is required to have and report separate accounts for the different activities of generation, transmission and distribution.

presumably be undertaken in conjunction with the legal separation of the network services under A3. The wholesale competition scenario (B3) is then a progressively reformed situation that could, if not implemented at once, follow the implementation of legal separation, and the modelling of this scenario provides an indication of the extent to which prices may change as a result of further restructuring.

Although a number of nuances characterise both alternative scenarios (legal separation and wholesale competition), what is presented in this report are simplified "caricatures" of the scenarios. This is done in order to demonstrate how the tariff path could be affected without making an unwieldy large number of assumptions or undertaking numerous sensitivity analyses on multiple variables, which would impact the usefulness of the findings. As the purpose of this study is not to develop definitive price paths under the three scenarios, but instead to use an existing projection to determine the relative prices under the alternatives, less nuanced reform options yield the most informative findings.

2.1. SUMMARY OF THE THREE SCENARIOS

The descriptions of the scenarios that follow are based on the ESI reform report.[5]

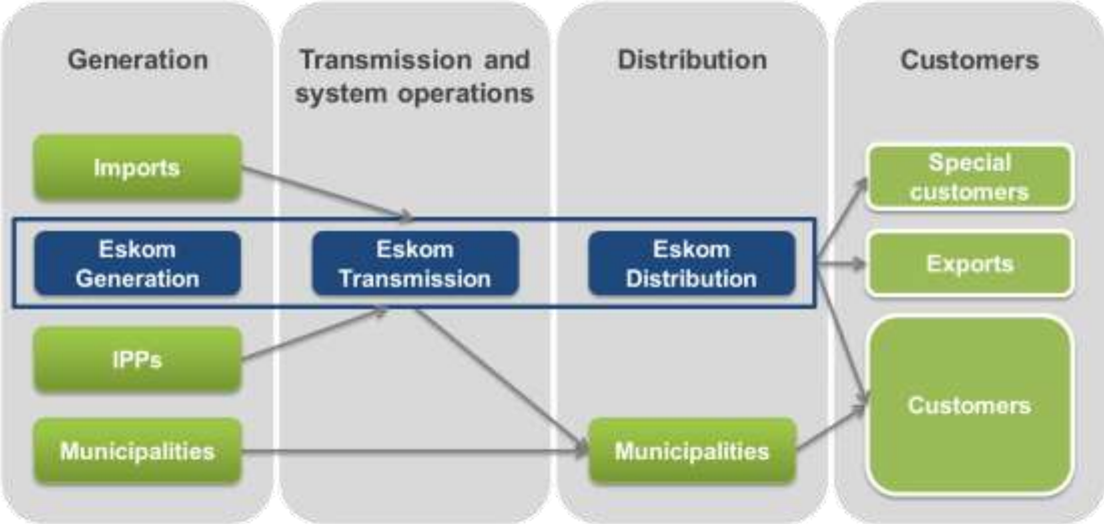
2.1.1. Status quo

The current model in South Africa is essentially a vertically-integrated single buyer model. Eskom is the dominant generator and is responsible for transmission and a large portion of distribution. The balance of distribution is undertaken by local municipalities. Several small IPPs provide additional generation capacity. Eskom is the single buyer of electricity generated by IPPs, and although IPPs can theoretically supply electricity directly to distributors, there are many hurdles in practice. Planning and procurement is the prerogative of the Minister of Energy, the implementation of which is undertaken by the Department of Energy (DoE) and the IPP office (under the auspices of the DoE and National Treasury (NT)).

In the status quo scenario there are no changes to the market structure or structure of Eskom. The ESI reform report found that the status quo did not perform well against the identified criteria, namely the impact on efficiency, the creation of an environment conducive to private investment, the reliance on government funding, the ease and cost of implementation, and the impact on electricity prices.

[5] Teljeur, E., Sheik Dasarath, F., Kolobe, T., Da Costa, D. (2016), Electricity Supply Industry Restructuring: Options for the Organisation of Government Assets, TIPS, p. 54-71.

Figure 1: Current South African electricity supply industry structure



Source: Genesis Analytics

2.1.2. Single buyer model with legal separation ("legal separation")

In this alternative, Eskom would be restructured into two subsidiaries, an Eskom generation subsidiary and an Eskom transmission and distribution subsidiary as illustrated in Figure 2 below.[6] The shareholding of these subsidiaries would remain the same under the holding company – Eskom Holdings. Legal separation would entail dividing the different activities into two wholly-owned subsidiaries with autonomy in relation to operations and corporate governance.

Legal separation applies operational rules that create a Chinese wall between the generation and transmission /distribution subsidiaries. These operational rules are aimed at controlling the flow of information between the two subsidiaries as well as the management and mode of corporate governance of the transmission subsidiary.[7]

The implementation of this alternative will necessitate some changes to the regulatory framework as each subsidiary may be required to submit tariff and pricing applications independently. Frameworks may need to be developed for non-discriminatory and reasonably-priced access to transmission infrastructure as there would be an incentive for Eskom's transmission/distribution subsidiary to favour the Eskom generation subsidiary. Further, it may also be necessary for the regulator to monitor the transactions and relationship between the two subsidiaries to ensure it is fair and at arm's length.

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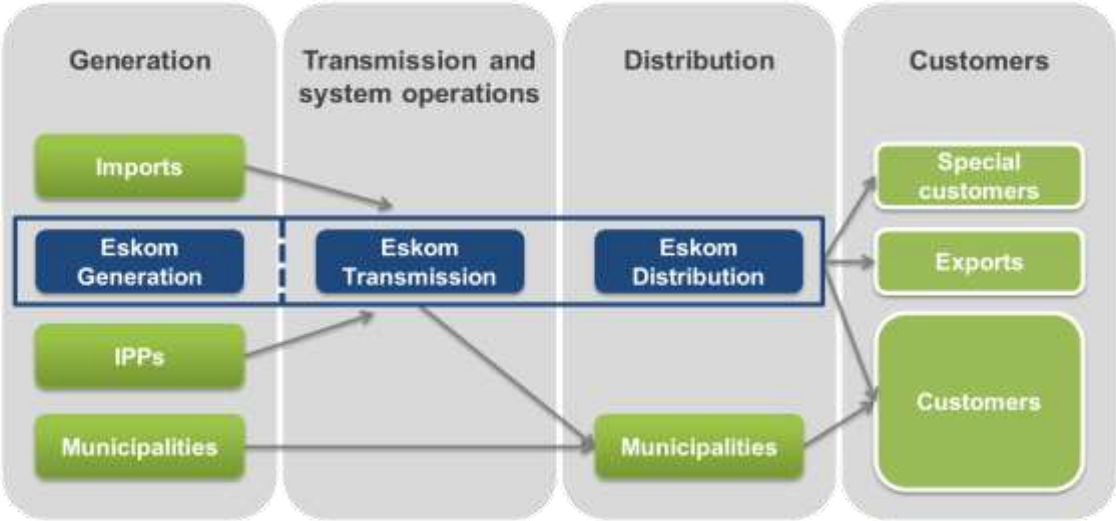
[6] Eskom could be separated into three subsidiaries – one each for generation, transmission and distribution. However, as the focus is on addressing issues primarily in generation, only the option of separating Eskom into two subsidiaries is considered – one for generation and another for transmission and distribution, the latter being a 'wires' only business.

[7] Autorite de Regulation des Communications Electroniques et des Postes. 2007. Functional separation: pros and cons. Available online: http://www.arcep.fr/uploads/tx_gspublication/lettre55-eng.pdf [2016, February 17].

Figure 2: Industry structure A3 – single buyer model with legal separation



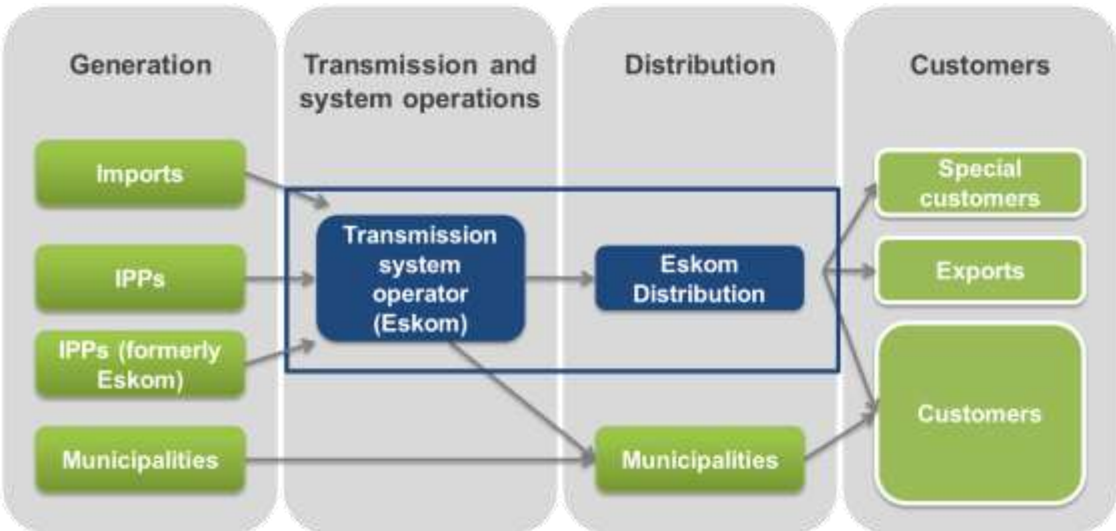
Source: Genesis Analytics

2.1.3. Wholesale competition with state-owned TSO and no government involvement in generation ("wholesale competition")

In this model, Eskom divests from generation and is only active in transmission/distribution. Eskom would take on the role of the TSO that is not affiliated with any of the generators. Eskom would remain active in distribution. The TSO would also act as the single buyer of electricity from the generators. There would be no state involvement in generation. As a TSO would have to be established, new policies, regulations and legislation would be required to set out the mandate of the TSO and govern its behaviour.

A key distinguishing characteristic of this alternative is that as generation is housed in a separate company, there is a much stronger impact on the efficiency of the management of the generation assets and a much more conducive environment for private funding. This means that the impact on many other criteria, including the reliance on government funding for generation assets and electricity prices, is also stronger.

Figure 3: Industry structure B3 – no government involvement in generation



Source: Genesis Analytics

2.2. POTENTIAL IMPACT ON PRICES FROM RESTRUCTURING

Following from the literature, there are a number of ubiquitous effects of restructuring that generally occur irrespective of the restructuring option chosen. However, the universal effects of any restructuring differ in direction and magnitude depending on the current industry structure and the characteristics associated with the proposed industry reforms.

The literature from which these effects are drawn is based on varying contexts, and characterised by different industry structures and sequences of reforms, following from country-specific approaches.[8] The papers reviewed range from discussion papers and theoretical arguments to empirical studies, all with the purpose of identifying the impacts of ESI restructuring. The case studies reviewed revealed results with some incongruities, as the impact of restructuring is highly country specific. However, economic theory does indicate that the impact on electricity prices can be categorised into a number of effects, which are consistent in terms of how they impact on prices. These effects are discussed below.

2.2.1. Competition effect

It makes economic sense to introduce competition into the generation and retail levels of the ESI, as this is where the commercial and potentially competitive activities of the supply chain lie. Unbundling focusses on separating the natural monopoly parts of the supply chain, i.e. the "wires" businesses of transmission/distribution, from the competitive activities. The introduction of competition into these levels is motivated by the fact that it should increase efficiencies, and prevent abuse of its monopoly position by the incumbent. Prior to the introduction of competition, the ESI is often characterised by cross-subsidisation between supply-chain levels; lack of access to the networks; and lack of incentives to realise efficiencies and promote innovation.[9] In the literature it is a given that the introduction of a competitive constraint is expected to add pressure on industry participants to reduce costs; gain efficiencies; secure supply; prevent third-party discrimination; and promote innovation.[10]

In order for the benefits of the competition effect to be realised in the ESI (under both the legal separation and wholesale competition scenarios), the entry of third-party generators is required. To stimulate entry into the market, investors need to perceive the market as being a level playing field. If unbundling restores a level playing field, third party entry will translate into accelerated increases in total capacity; competition between generators; and the reduced dominance of the incumbent firm, resulting in increased competition in the market.[11]

Increased competitive intensity should lead to downward pressure on costs, especially marginal costs.[12] This is demonstrated across market reform experiences in general, particularly in generation. This effect is likely to reduce operating costs in the scenarios that

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[8] See Appendix 1 for a summary of the primary literature.
[9] Nillesen, P. & Pollitt, M. 2008. *Ownership Unbundling in Electricity Distribution: empirical evidence from New Zealand*. EPRG Working Paper 0820 and Cambridge Working Paper in Economics 0836.
[10] See for example the following: Brunekreeft (2008), "Ownership Unbundling in Electricity Markets – a social cost benefit analysis of the German TSOs" which speaks to a reduction in marginal costs; de Nooij and Baarsma (2008), "An Ex Ante Welfare Analysis of the Unbundling of the Distribution and Supply Companies in the Dutch Electricity Sector" makes reference to efficiency gains; Pollitt (2007), "The Arguments For and Against Ownership Unbundling of Energy Transmission Networks" lists security of supply as a benefit to unbundling; Nillesen and Pollitt (2008), "Ownership Unbundling in Electricity Distribution: empirical evidence from New Zealand" mentions, *inter alia*, prevention of third-party discrimination and promotion of innovation as motives for unbundling.
[11] Brunekreeft, G. 2008. *Ownership Unbundling in Electricity Markets – a social cost benefit analysis of the German TSOs*. EPRG Working Paper 0816 and Cambridge Working Paper in Economics 0833.
[12] Brunekreeft, G. 2008. *Ownership Unbundling in Electricity Markets – a social cost benefit analysis of the German TSOs*. EPRG Working Paper 0816 and Cambridge Working Paper in Economics 0833.

are alternative to the status quo, with the effect being largest (out of the scenarios under consideration) in wholesale competition.[13]

2.2.2. Efficiency effect

There are two efficiency effects resulting from unbundling. Firstly, by introducing competition,[14] industry participants are encouraged and incentivised to operate more efficiently, and secondly, unbundling a utility results in the business units of that utility benefiting from efficiency gains arising from specialisation. The second of these two effects is discussed here as the first is captured under the competition effect.

In the South African context the specialisation effect would be specific to Eskom, as under either legal separation or wholesale competition, Eskom's business units are being reorganised, whereas the other generators are themselves already assumed to be efficient (as they are already exposed to market forces).

Efficiency gains from unbundling stem from the fact that the separated business operations formed from unbundling may develop a specialisation advantage due to a "better management focus on specific tasks in comparison to a multi-product company."[15] Separation fosters greater discipline regarding efficiency as business units are able to address issues without the distraction and issues of other activities. This improved focus is expected to result in "clearer incentives to improve business,"[16] and therefore an avoidance of unnecessary overcapitalisation or "gold-plating". It is also likely that "the separation will increase scrutiny, this [is] likely to have a downward impact on costs, in jurisdictions where regulators are effective."[17]

As a result of this effect it is expected that operating costs decrease as imprudent costs are cut due to the separated operations becoming more streamlined, in addition to improved regulatory oversight of the separate businesses allowing for more in-depth assessments. This effect will likely be stronger under wholesale competition than legal separation, as under the former Eskom Holdings will only have one business focus (i.e. networks).

2.2.3. Loss of economies of scope

A further effect that is specific to the unbundled vertically-integrated utility is a loss of economies of scope. Despite efficiency gains from separation, it is also anticipated that vertical synergies will be lost. Therefore, in addition to the once-off transaction costs of unbundling, there are permanent cost increases resulting from restructuring.

The literature indicates that it is commonly acknowledged that some vertical synergies will be lost as a result of vertical unbundling in the ESI.[18] These losses are primarily a result of coordination economies, as restructuring creates a coordination cost by requiring the duplication of tasks such as general management, human resources, information and communications technology, finance, and support. In addition to coordination economies,

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[13] If retail competition were considered, the effect would be largest there.

[14] In the South African context this would be competition for the market rather than in the market.

[15] Meyer, R. 2011. *Vertical Economies of Scope in Electricity Supply – analysing the costs of ownership unbundling*. Ph.D. Thesis. Jacobs University.

[16] Pollitt, M. 2007. *The Arguments For and Against Ownership Unbundling of Energy Transmission Networks.* EPRG Working Paper 0714 and Cambridge Working Paper in Economics 0737: p. 8.

[17] Nillesen, P. & Pollitt, M. 2008. *Ownership Unbundling in Electricity Distribution: empirical evidence from New Zealand*. EPRG Working Paper 0820 and Cambridge Working Paper in Economics 0836: p. 10.

[18] See for example: Brunekreeft, G. 2008. *Ownership Unbundling in Electricity Markets – a social cost benefit analysis of the German TSOs*. EPRG Working Paper 0816 and Cambridge Working Paper in Economics 0833: p. 24.

another vertical synergy noted in the literature is market risk.[19] Transaction costs of using a market (such as contracts or spot market transactions) rather than firm-internal mechanisms result in market risks.

In the South African context it is likely (under both legal separation and wholesale competition) that there will only be coordination losses rather than market risks. This is because independent planning and procurement, together with regulation, will facilitate competition for the market rather than in the market. Under both the legal separation and wholesale competition scenarios Eskom's network business (of transmission and distribution) will not be allowed to discriminate between generators in terms of providing access to the network. Thus there is reduced concern of market risks from transactions. Additionally, as the industry will also be characterised by a single buyer for which the total required generation capacity and its designation (between competitors) is known, there is a lower risk of asymmetric information in the market, meaning that competitors are unlikely to have misaligned incentives in terms of a lack of investment coordination (which if present would result in a loss of economies of scope due to market risk).

The presence of loss of economies of scope (primarily through coordination economies) will have a persistent cost impact, negatively impacting on operating costs. Whether the magnitude of this increase in costs outweighs the decreases in costs resulting from the competition and efficiency effects is discussed later. As mentioned above, in addition to these increases there are once-off transaction costs of restructuring a utility that need to be accounted for, but the impact of these costs on tariffs is not permanent.

2.2.4. Capital expansion effect

With respect to the capital expansion effect, the literature notes that "the major effect on the cost side of unbundling comes with the investment of generation assets."[20] Although opening up the generation market to competition in South Africa may accelerate the investment in capital, installed capacity is likely to remain equal to the capacity planned under the Integrated Resources Plan (IRP), with planned build simply being undertaken by different entities. This differs from international experience where competition among generators can potentially create a lack of investment coordination,[21] as well as high initial capital expenditure on generation assets.[22] This is not likely to happen in South Africa where new build is planned far in advance under integrated planning by Government.

In the South African context it is anticipated that new build undertaken by IPPs will follow the IRP in terms of its timing and cost. This is in contrast to Eskom's commissioning of Medupi, Kusile and Ingula which have been delayed and experienced cost overruns (not only as a result of the delays). These delays have resulted in failure to reach the IRP targets, and the cost overruns associated with the projects have resulted in a larger than planned Regulatory Asset Base (RAB) and capitalised interest.

If competition for the market were introduced, new build would be contracted via Power Purchase Agreements (PPAs). In these contracts risk would be allocated appropriately

[19] Meyer, R. 2011. *Vertical Economies of Scope in Electricity Supply – analysing the costs of ownership unbundling*. Ph.D. Thesis. Jacobs University: p. 10.
[20] Brunekreeft, G. 2008. *Ownership Unbundling in Electricity Markets – a social cost benefit analysis of the German TSOs*. EPRG Working Paper 0816 and Cambridge Working Paper in Economics 0833.
[21] Meyer, R. 2011. *Vertical Economies of Scope in Electricity Supply – analysing the costs of ownership unbundling*. Ph.D. Thesis. Jacobs University: p. 31.
[22] Brunekreeft, G. 2008. *Ownership Unbundling in Electricity Markets – a social cost benefit analysis of the German TSOs*. EPRG Working Paper 0816 and Cambridge Working Paper in Economics 0833: p. 29.

between those commissioning the new build and those being contracted, with the ability of IPPs to pass on cost-overruns being limited by the ISMO. Although a tolling agreement[23] may present some room for risk, there is a hardened budget constraint, when compared to a situation in which a utility operates a portfolio of different generation assets and is tasked with achieving a number of policy objectives. Eskom is currently able to claim allowable revenues under the Electricity Regulation Act as tariff principles “must enable an efficient licensee to recover the full cost of its licensed activities.”[24] However, there are difficulties in determining what an efficient operator’s costs should be, making a tolling arrangement with IPPs more desirable as power is purchased by an ISMO at an agreed rate for each kWh.

It is by no means anticipated that entities independent of Eskom will not encounter commissioning delays or cost overruns, but as the performance indicators are narrowly focused, their incentives to prevent such overruns are stronger than those experienced by Eskom. As a result of the requirement that IPPs provide 30% equity in advance of commissioning, and as they do not have access to subordinated government loans, they are incentivised to avoid cost overruns and run new build programs as efficiently as possible. Further, as independent generators they are also not under any political pressure to delay maintenance to “keep the lights on.”

In contrast, Eskom faces intense pressure to provide electricity at the cost of maintenance, noting in its MYPD 3 application that “in recent years the constrained supply-and-demand situation often led [it] to shift planned maintenance work in order to ensure it had the generating capacity to meet demand.”[25] Keeping the lights on at all costs undermines Eskom’s maintenance philosophy of 93-4-3 (the proportion of time that stations are available, undergoing planned maintenance and experiencing unplanned maintenance respectively) and detracts from the performance of its generation fleet. In fact not maintaining plants can result in plants spending more time offline than would have initially been required had planned maintenance taken place. By having to shift maintenance Eskom have noted the possible resultant increase in shutdown that follows, in conjunction with insufficient downtime.[26]

From the literature, which is largely based on experience in the USA and Europe, the capital expansion effect would normally result in an increased RAB ex-post the restructuring, however this effect is market driven and not applicable under a regulatory planning model (as in South Africa). In the South African context the asset base is higher under the status quo than it is anticipated to be after restructuring. This is a result of the inflated costs incurred by Eskom for new build in the status quo, and the expectations of independent commissioning of the new build, under both alternative scenarios.

2.2.5. Financing effect

As discussed above, it is expected that ESI restructuring will result in investment in the industry (in generation specifically in the South African context), as a result of increased competition and efficiency. These market changes will impact upon the cost of debt, the indicator of market risk (the β), and leverage of the various market participants, which together impact on the Weighted Average Cost of Capital (WACC).

[23] This is where an IPP would provide the ISMO with power for which it is paid a specified rate on a kWh basis. This agreement allows for risk to be managed between the buyer and seller, but fuel costs (the price of which is difficult to forecast) are allowed to be passed-through.
[24] Electricity Regulation Act. 2006. *Government Gazette*. Volume 493, number 28992, p.16.
[25] Eskom. 2012. Part 1 Revenue Application: multi-year price determination 2013/14 to 2017/18 (MYPD 3): p. 97.
[26] Eskom. 2012. Part 1 Revenue Application: multi-year price determination 2013/14 to 2017/18 (MYPD 3): p. 106.

Entities in the ESI that are separate from Eskom (in its current structure) are expected to have different risk profiles compared to the incumbent utility. This is captured by the three main components of the WACC, namely the cost of debt, cost of equity, and gearing. Given Eskom's declining credit rating and balance sheet concerns, it is anticipated that competitors in the market will be able to attract debt more easily and at a better rate than Eskom. However, their cost of equity could be higher than Eskom's due to uncertainty coming into this restructured industry and investors demanding a higher return on this risk. This is captured by the β rating of the competing firm, which influences its cost of equity through the capital asset pricing model (CAPM). Finally, the leverage of a new entrant may also differ from that of Eskom, as a specified amount of equity may be required by the TSO before starting on new build, and the gearing of an IPP would likely be higher.

Until these effects are quantified their final impact on the WACC is ambiguous, with only a decrease in the cost of debt and cost of equity, together with an increase in the gearing, resulting in an unambiguous decrease in the WACC. If the WACC for Eskom's competitors were to be higher than that of Eskom, this is expected to be outweighed by efficiency gains and a decrease in cost overruns. Each of the five effects discussed above influences different components of the tariff path. What follows is a discussion of how the electricity price in South Africa is determined, and how the identified restructuring effects influence the various building blocks of the electricity price determination.

3. IMPACT OF INDUSTRY REORGANISATION ON THE PRICE PATH

The National Energy Regulator of South Africa (NERSA) is responsible for the regulation of the ESI's prices and tariffs, which involves setting guidelines and structures, implementing the methodology used to determine prices, and pricing frameworks. NERSA developed the multi-year price determination (MYPD) methodology that is currently used to set Eskom's tariffs and prices. Under this system Eskom applies for the level of revenue which allows it to cover its costs, with NERSA's methodology mandating that a tariff should enable an efficient licensee to recover the full cost of its licensed activities, including a reasonable return. This application is then evaluated by NERSA and an approved level of allowable revenue is used to calculate the approved average tariff. The approved revenues, together with forecasted sales of electricity to different customer categories, then determine the prices to be charged to customers in the coming tariff periods.

The purpose of this study is to present three different price paths (from 2017 to 2030) for the scenarios under review in order to inform decisions regarding Eskom's future direction.

3.1. HOW PRICES ARE SET

Eskom applies to NERSA for an average tariff (and thereafter individual tariffs of the tariff structure) based on allowable revenues and forecasted Gigawatt hours sent out. Under NERSA's MYPD Methodology Eskom's required revenues are determined on "a cost-of-service-based methodology with incentives for cost savings and efficient and prudent procurement by the licensee (Eskom)."[27] This implies that the reasonableness of all costs presented ex ante by Eskom will be assessed by NERSA in order to establish a cost-reflective tariff.

The formula that is used to establish the allowable revenue is comprised of a number of elements that are summed together, with the five key elements explained below.

3.1.1. Return on assets (ROA) and depreciation

ROA is the product of the weighted average cost of capital ("WACC") and the regulatory asset based (the "RAB"). The WACC is calculated as follows:

$WACC = Kd * g + \left(\frac{Ke}{1-T}\right) * (1-g)$, where Kd is the cost of debt, g is gearing, Ke is the cost of equity, and T is the corporate tax rate. The cost of debt is the sum of the risk-free interest rate and the debt premium, with the cost of equity determined by CAPM.

The RAB includes the sum of the assets used to provide regulated services by each of Eskom's business operations i.e. generation, transmission and distribution. The basis for valuation of the RAB is the modern equivalent assets value (MEAV) which was changed from historical cost valuation in the MYPD 2 in response to Government's Electricity Pricing Policy.[28] This includes existing fixed assets in use, new investments upon commissioning, works under

[27] NERSA. 2012. Multi-Year Price Determination Methodology. 1st edition. Available online: http://www.nersa.org.za/ [2015, November 4]: p. 5.
[28] Department of Minerals and Energy. 2008. *Electricity Pricing Policy of the South African Electricity Supply Industry*. Government Notice no. 31741.

construction (excluding interest during construction), as well as an allowance for net working capital.[29]

Depreciation is allocated to recover the capital investment (the “return of capital”) on a straight-line basis over the course of an asset’s economic/regulatory useful life. Therefore the amount of depreciation incurred is directly linked to the RAB.

3.1.2. Operating costs

These are included in accordance with the Electricity Regulation Act, which in Section 16(1)(a) provides that the “regulation of revenues must enable an efficient licensee to recover the full cost of its licensed activities, including a reasonable margin or return.”[30] The cost of licensed activities is inclusive of both operating and maintenance costs, which must be prudently and efficiently incurred in order to be passed on to consumers.[31]

3.1.3. Primary energy costs

These must also be prudently and efficiently incurred. When considering these costs the IRP and the appropriate load factors for the different generation plant is taken into account to ensure that the generation mix is suitable and is in the best interest of both the customer and supplier. Eskom applies to NERSA for allowances for each generation technology individually and separate approval is given for coal, coal handling, water, water treatment, start-up gas and oil, nuclear, open-cycle gas turbines (OCGTs), fuel procurement, sorbent, road maintenance etc.

3.1.4. IPP costs

These are incurred as a result of power purchase agreements (PPAs) entered into by the licensee and subject to NERSA approval, with any payments set out in the PPA allowed as a full pass-through cost under NERSA’s MYPD Methodology.

3.1.5. Integrated Demand Management (IDM)

The IDM programme requires revenue for project or programme costs, operating costs, and measurement and verification costs in support of energy efficiency projects and users scaling back demand when necessary. When Eskom submits costs, demand and energy savings to NERSA, they are evaluated against criteria presented in NERSA’s methodology in order to determine whether or not IDM projects are accepted or rejected. The MYPD 3 decision stipulated that IDM funds should be ring-fenced within Eskom to allow for the transfer of the funds to a suitable agency. This is due to it being a conflict of interest for Eskom to encourage its customers not to purchase its generated electricity.[32]

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[29] NERSA. 2012. Multi-Year Price Determination Methodology. 1st edition. Available online: http://www.nersa.org.za/ [2015, November 4]: p. 10-11.
[30] Electricity Regulation Act. 2006. *Government Gazette*. Volume 493, number 28992.
[31] NERSA. 2012. Multi-Year Price Determination Methodology. 1st edition. Available online: http://www.nersa.org.za/ [2015, November 4]: p. 18.
[32] Eskom. 2012. Part 1 Revenue Application: multi-year price determination 2013/14 to 2017/18 (MYPD 3): p. 30-31.

3.2. PRICE COMPONENTS AFFECTED BY RESTRUCTURING

The effects of restructuring are expected to only affect three components of the tariff path: the return on assets (because of adjustments to both the WACC and RAB); depreciation (resulting from changes to the RAB); and operating costs. The remaining elements of the allowable revenue are not anticipated to be affected by ESI restructuring, and therefore the effects of those components on the tariff path are not considered.

Primary energy costs are not expected to change for two reasons:

- The IRP is expected to be adhered to, and expected primary energy costs associated with the approved asset base being incurred.
- It cannot be objectively assessed as to whether Eskom's procurement of primary energy is efficient, with large uncertainty around the future price of coal, and the nature of the spot market procurement; therefore it cannot be assumed that independent generators would be able to lower the primary energy cost.

IPP costs also remain unadjusted. Under the tariff model IPP costs only cover non-renewable IPP costs into the future, while renewables form part of the new build costs 2017 onwards. As the model is designed to build an industry-wide tariff (for all licensees and not just Eskom), IPPs will apply for separate allowable revenues as any other licensee would under the MYPD methodology. The model is designed as such so that all restructuring options can be taken into account.

IDM costs are also not anticipated to be different for the industry as a whole after restructuring.

3.2.1. Summary of the effects

Having discussed the ubiquitous effects of unbundling presented in the literature, as well as the components of the price path, the evidence on how these effects influence the tariff is now assessed. This is done before modelling the tariff path and assigning magnitudes to the changes anticipated under the restructuring scenarios. The changes made to certain variables which affect various components of the electricity price are summarised in the table below, after which the likely direction of the change in the variables and the resultant effect on the components of allowable revenue are discussed.

Table 1: Summary of the restructuring effects impact upon affected variables and ultimately price components

Restructuring effect	Affected variables	Affected component of allowable revenue
Competition effect	Various operating costs	Opex
Efficiency effect	Various operating costs	Opex
Loss of economies of scope	Various operating costs	Opex
Capital expansion effect	RAB	Return on assets
		Depreciation
Financing effect	Cost of debt Cost of equity WACC Gearing (Cost of debt, Cost of equity, Gearing: Components of WACC)	Return on assets

Source: Genesis Analytics

- It is expected that the **competition and efficiency effects**, as well as the **loss of economies of scope**, which all impact solely on operating costs, will do so in the same direction for both legal separation and wholesale competition when moving from the status quo. Although the magnitudes of change may differ depending on the scenarios, the competition and efficiency effects are expected to reduce operating costs under restructuring, with a loss of economies of scope resulting in an increase in operating costs. This means that the direction of change that these effects of restructuring have on operating costs is unclear until estimation, as it is unknown upfront as to which effect will be larger.

- Under the status quo the **capital expansion effect** results in a higher RAB and therefore higher depreciation expense for Eskom than if the ESI were restructured. This also impacts on the absolute level of the returns on assets, though as the effect of restructuring on the WACC is uncertain upfront, so is the effect on the return on assets.

- The **financing effect**, which influences the WACC, is expected to result in a decreased cost of debt and increased gearing after restructuring (under both legal separation and wholesale competition). However, the effect on the cost of equity under the alternative scenarios, relative to the status quo, is ambiguous as discussed later. As the WACC will only decrease (increase) if the cost of debt falls (rises), the cost of equity decreases (increases) and gearing rises (falls), an ambiguous change in one of the WACC components means the anticipated effect on the WACC cannot be predicted. This is due to the relative size of the impacts not being known.

These anticipated directional changes are discussed further below, with predictions based on literature as well as NERSA decisions. This is followed by a quantification of restructuring when the modelling of the tariff path is presented.

3.2.2. Operating costs

Operating costs are influenced by different effects in opposing directions, with the competition and efficiency effects placing downward pressure on costs, and the loss of economies of scope placing upward pressure on costs. This leaves us with an ambiguous effect on operating costs until their quantification in the next section.

The literature reveals that when operating costs change post-restructuring, it is unfortunately difficult to isolate the part of the change that is attributable to the benefits of restructuring (such as the competition and efficiency effects).[33] This is not to say that these benefits do not occur, but that the quantification of the direct costs of restructuring (as opposed to the benefits) is vastly better documented in the literature. Quantifying the loss of economies of scope is often done by using samples of electricity supply companies with varying structures (something that is only possible in markets with multiple companies in the different parts of the ESI) and

[33] de Nooij and Baarsma note "the fact that the effects [of unbundling] cannot be estimated with any great degree of certainty" may affect their recommendation in their paper (de Nooij, M. & Baarsma, B. 2008. *An Ex Ante Welfare Analysis of the Unbundling of the Distribution and Supply Companies in the Dutch Electricity Sector*. SEO Discussion Paper 52 and UNECOM DP 2008-02: p. 2). Further, Dee notes that the results of her paper (on quantifying the benefits of structural reforms) "should not be taken to mean that structural reform in electricity markets has minimal effect on efficiency. It just means that is has little discernible effect on the particular efficiency measures chosen in this exercise. Reform could still have a large beneficial effect on other measures…" (Dee, P. 2010. *Quantifying the Benefits from Structural Reforms in the Electricity and Gas Markets in APEC Countries.* Paper prepared as a contribution to the project "The impacts and benefits of structural reforms in transport, energy and telecommunications sectors", commissioned by the APEC Policy Support Unit: p. 13.)

therefore not replicable here.[34] Cost-benefit analyses have also been conducted on ESI restructuring, which generally conclude that the benefits of restructuring are mitigated by the costs, with the end result being neutral.[35] The papers that consider both the costs and benefits of restructuring bring a different perspective to the impact that restructuring has on operating costs, in contrast to only focusing on the loss of economies of scope. This is the balanced perspective used in the modelling that follows.

Despite the lack of quantification around the competition and efficiency effects (in isolation), there are quantified effects of how the loss of economies of scope affects operating costs. Unfortunately, comparisons are difficult to make between the literature and predicting the future when both the structure of the industry and the regulatory framework are markedly different.[36] As noted earlier there are also different reforms and reform sequencing applied in different jurisdictions. Therefore, when estimating the effect of restructuring on operating costs, inferences are drawn based on what is understood of the current South African ESI and a collation of results in the literature that would be sensible to apply to this case.

In addition to the changes in operating costs resulting from the restructuring, there is also a once-off transaction cost of reform to take into account. These are both quantified for the South African context in the next section.

3.2.3. Regulatory asset base and depreciation

As discussed earlier, the capital expansion effect in South Africa is anticipated to have the opposite effect as in the literature. Here, restructuring the industry is expected to decrease the RAB, and consequently depreciation, given that under the status quo there are significant cost overruns and construction delays, based on recent history.

3.2.4. Weighted average cost of capital

The literature on ESI restructuring does not explicitly deal with financing changes, or at most is limited and not adequate for extrapolating to the South African context. However, given Eskom's current financial situation, it would be remiss to neglect industry changes relating to financing that would be likely to occur as a result of restructuring. The WACC calculation is given in the previous section, with three of its components anticipated to be affected by the restructuring. The tax rate is assumed to be applicable to the industry, and is therefore not changed by the restructuring.

- *Cost of debt (K_d)* is the sum of the risk-free rate and a debt premium. The risk-free rate is assumed to be consistent for the industry, with the debt premium being subject to change.

It is anticipated that from the next MYPD period (from 2018) Eskom's debt premium will increase given its downgraded corporate credit rating. In NERSA's MYPD 2 decision it is noted

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[34] Examples of this quantification can be found in papers by both Meyer and Gugler et al. (Meyer, R. 2011. *Vertical Economies of Scope in Electricity Supply – analysing the costs of ownership unbundling*. Ph.D. Thesis. Jacobs University; Gugler, K., Liebensteiner, M. & Schmitt, S. 2014. *Vertical Disintegration in the European Electricity Sector: empirical evidence on lost synergies*. Vienna University of Economics and Business, Department of Economics. Working paper no. 190.)

[35] For example, see: Brunekreeft, G. 2008. *Ownership Unbundling in Electricity Markets – a social cost benefit analysis of the German TSOs*. EPRG Working Paper 0816 and Cambridge Working Paper in Economics 0833. There are also other papers which weigh up the costs and benefits of restructuring under various scenarios, though not quite to the extent of Brunekreeft's analysis.

[36] Gugler, K., Liebensteiner, M, & Schmitt, S. 2014. Assessing the Economies of Scope from Vertical Integration: empirical evidence from European electricity utilities. Unpublished manuscript: Vienna University of Economics and Business.

that a negative impact on the credit rating will consequently increase the cost of debt.[37] Moody's ratings actions have progressively downgraded Eskom, with ratings changed from Baa3 to Baa2, and subsequently to Ba1 between the MYPD 2 and MYPD 3 periods (2010, 2013 and 2014).[38] The relationship between a ratings downgrade and an increase in yield spread has been proven[39] and is generally accepted, as creditors expect a higher return on a riskier loan.

It is anticipated that Eskom's cost of debt will increase under the status quo, with IPPs expected to be able to attract cheaper debt relative to Eskom. It is also predicted that if Eskom restructures it may boost investor confidence and improve its credit rating, therefore allowing it to attract cheaper debt than under the status quo. This is especially thought to be the case for Eskom's transmission and distribution business under both legal separation and wholesale competition, as network assets are less risky.

- *Cost of equity (K_e)* is determined by the CAPM, where $Ke = Rf + \beta * MRP$. β measures a company's volatility relative to the market (which has a β of 1) and the *MRP* is the market risk premium (the difference between the expected market return and the risk-free rate). It is again assumed that the risk-free rate (R_f) is industry-specific, with the expected market return also remaining unchanged. This leaves the value for β, for which there is an expected change across the industry post-restructuring.

Between the status quo, legal separation and wholesale competition, three different types of electricity business structures need to be considered in order to assess the industry as a whole. These are: an integrated electricity utility, a generation-only company, and an electricity "wires" business comprising of a transmission and distribution company. Under the status quo the ESI remains as it is, with an integrated electricity utility generating most electricity and purchasing some power from small generation-only companies; under legal separation these generation-only companies compete with the generation business of the legally separated utility for the market, and sell their generated capacity to the network arm of the utility; and under wholesale competition there are generation-only companies and an electricity "wires" company, which is no longer part of a vertically-integrated utility.

Before the magnitude of the change in the cost of equity is determined (which is undertaken in the next section), the βs (i.e. risk) for the three types of businesses can be ranked. It is anticipated that the β for an energy network company will be the lowest as the natural monopoly aspects and the de jure monopoly status of the network business is likely to have the least systematic risk. Consequently, an integrated utility is expected to have a β between that of the wires company and a generation-only company, as it would also be involved in energy delivery, but would have generation assets that create more uncertainty with investors. This is why a generation-only business is likely to have the highest β of the three types of business.

The three businesses, the vertically integrated utility: generation only company, and network (wires) company also have a different risk profile depending on the scenario. Accordingly, as can be seen in the table below, the β values will be ambiguous under the various scenarios before quantification, given the various business mixes. This is shown in Table 2 below, where

[37] NERSA. 2010. Reasons for Decision: Eskom's MYPD 2 revenue application. Available online: http://www.nersa.org.za/ [2015, November 4]: paragraph 105.
[38] Moody's. 2015. Eskom Holdings SOC Limited. Available online: https://www.moodys.com/credit-ratings/Eskom-Holdings-SOC-Limited-credit-rating-600008659 [2015, November 26].
[39] Tang, T. 2006. *Information Asymmetry and Firms' Credit Market Access: Evidence from Moody's Credit Rating Format Refinement.* Finance workshop: University of Chicago Graduate School of Business.

the three scenarios as illustrated in figures 1 to 3, are represented by their constituent businesses, and those individual businesses are described in terms of their level of risk.

Table 2: Anticipated risk for the various businesses under the considered scenarios

Scenario	Businesses	Associated level of risk
Status quo	Eskom as a vertically integrated utility involved in generation, transmission and system operations, and distribution	Medium
	IPPs involved in generation only	High
Legal separation	Eskom as a separated utility with two business branches: generation and transmission/distribution	Combination of low and high risk: high market risk for generation and low market risk for transmission/distribution
	IPPs involved in generation only	High
Wholesale competition	Eskom as a transmission and distribution business only	Low
	IPPs and state generation companies involved in generation only	High

Source: Genesis Analytics

- *Gearing* is the amount of debt a company has as a proportion of the sum of its debt and equity.

As a firm's cost of debt rises it is likely to change its capital structure, with equity becoming more attractive as debt becomes more expensive.[40] However, despite the likely increase in Eskom's cost of debt, it is unlikely to be able to obtain further funding from the government (its only shareholder) due to the precarious fiscal situation.[41] Therefore, Eskom's gearing is not anticipated to change in the next MYPD period (it is currently 65% under MYPD 3). As IPPs are required to provide 30% equity (as was required for the renewables projects), their gearing is expected to be 70%. Therefore, relative to the status quo restructuring should result in an increase in the industry's gearing.

It is anticipated that cost of debt will decrease and gearing will increase as a result of restructuring the ESI. Both of these effects decrease the WACC, but the overall effect on the WACC is ambiguous given the uncertainty around the cost of equity.

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[40] Kisgen, D. 2007. Do Firms Target Credit Ratings or Leverage Levels? Workshop: Boston College.

[41] The constrained resources of the government, the need to stop bailing out state entities, and the issues relating to the financing of state-owned entities were all issues raised in the 2016 Budget Speech. (National Treasury, 2016 Budget Speech. Available online: http://www.treasury.gov.za/documents/national%20budget/2016/speech/speech.pdf [2016, February 25]: p. 6 and p. 20.)

4. MODELLING THE TARIFF IMPACT

In order to better understand the impact of the various restructuring options on electricity prices, a detailed electricity price path model was constructed, which projects average electricity prices per annum up to 2030. This model computes the levelised cost of electricity (LCOE), that is total allowable revenue divided by sales volumes for the life of the assets, following NERSA's MYPD methodology and the IRP.

4.1. THE BASE MODEL

Before modelling the three scenarios under consideration a model that represents the current situation was constructed. This current (or 'base') model should not be confused with the status quo, which uses this model as the starting point (as do the other two scenarios under consideration). The current or base model projects the tariff path based on the IRP and other publicly available information, whilst the status quo adjusts this model to account for the current reality Eskom faces. In other words, the original or current model attempts to replicate that price path which the IRP and other publicly available information indicates, whilst the status quo takes into account other factors that have materialised since the publication of the IRP.

The period considered starts with NERSA's approved average prices for the MYPD 2 and MYPD 3 periods (i.e. up to 2017), as well as including the MYPD 2 Regulatory Clearing Account (RCA) decision.[42] Then a tariff path was constructed using publicly available information from the IRP[43] and EPRI[44] to project the various components of Eskom's allowable revenue (that is, depreciation, return on assets, operating costs, primary energy costs, IPP costs and DSM) and electricity sales.

- Depreciation and Return on Assets: these were both calculated using the RAB, with the starting values of the RAB obtained from NERSA's MYPD 2 and MYPD 3 determinations.
  - Capital expenditure for new-build assets was calculated using EPRI data on asset life, lead time and construction value.[45] All planned capital expenditure in the IRP report that was not included in Eskom's MYPD 3 application is assumed to take place after 2018 (in the "MYPD 4" period). The technology mix in the generation fleet is taken from the IRP, and thus incorporates the planned supply from renewables in the period up to 2030.
  - Regarding the WACC, a pre-tax rate of return of 7.65% was applied to new build assets, which is the return that NERSA deemed applicable to Eskom in its MYPD 3 decision. However, this is not the return that NERSA applied in the MYPD 3 decision, as Eskom's application requested that its ROA move from 0.9% in year one of MYPD 3 to 7.8% at the end of the period. Rather, NERSA granted returns ranging from 3.4%

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[42] As per the IRP, calendar years are used as a basis of estimating tariffs rather than Eskom's financial year. Accordingly, the financial year cost estimates (e.g. March 2012) were converted to calendar year estimates (e.g. December 2011).

[43] Department of Energy, 2011. Integrated Resource Plan for Electricity: 2010-2030. Revision 2, Final Report; Department of Energy, 2013. Integrated Resource Plan for Electricity: 2010-2030. Update Report. Note that the model is based on the IRP's Revised Balanced Scenario.

[44] EPRI, 2012. Power Generation Technology Data for Integrated Resource Plan of South Africa: vertically integrated electric utilities. Final technical update.

[45] EPRI, 2012. Power Generation Technology Data for Integrated Resource Plan of South Africa: vertically integrated electric utilities. Final technical update.

to 4.7% in its MYPD 3 determination, hence maintaining a "revenue sacrifice"[46] on the part of Eskom's shareholder. For the MYPD 4 period onwards the full 7.65% return on the entire RAB is applied in the model.

- Operating costs: these comprise human capital, maintenance, demand side management, arrear debt, cost of cover and other costs, which are then adjusted for transmission losses and ancillary charges. For existing capacity, the MYPD 3 figures were extrapolated using inflation and adjusted for efficiency and capacity (note that each component of operating costs was projected individually, which enhances the robustness of the model). For new capacity, EPRI data on variable and fixed costs was used in order to establish Eskom's operating costs post the MYPD 3 period.

- Primary energy costs: these comprise the cost of fuel and the environmental levy. For existing capacity, the producer price index (PPI) is used to inflate the cost of fuel post-2017. For new capacity, EPRI data is used to determine the cost of fuel. Thus the projections of these costs will be too low if Eskom continues to rely on the use of OCGTs when under pressure. Additionally, as discussed earlier, it is indeterminable whether IPPs would be able to put pressure on primary energy costs, and therefore this component of the tariff path stays as it is for all scenarios considered.

- IPP costs: these costs comprise monies paid by Eskom to the IPPs for their electricity supply, which thus covers all the IPPs costs (i.e. primary energy, operating costs, depreciation and return on assets). The model only projects non-renewable IPP costs into the future, as renewables form part of the new build costs post-2017. In other words, IPP costs for non-renewables are projected as a separate item in the allowable revenue from 2018 whilst renewables form part of the new build projections and thus their separate cost components (i.e. opex, depreciation and return on assets) form part of those line items.

- Electricity sales were assumed to increase by only 2.1%[47] per annum to 2030 as this is the forecasted growth rate in NERSA's MYPD 3 decision for the last year of the MYPD 3 period. Given that this growth rate represents the best available estimate, and is significantly lower than the growth rate assumed in the IRP 2010 update (which contains a growth rate of 2.7% per annum) this figure has been used and not adjusted it downwards. However, it must be noted that if growth is in fact lower than 2.1%, it would not affect the IRP's capital expenditure schedule but would likely increase the per unit cost of electricity as a result of reduced volume throughput.

4.2. ADJUSTING THE MODEL

Once the original model was constructed, the impact on the tariff path of the three chosen scenarios was modelled. It is assumed that the ESI changes occur in 2018, which is the start of the post MYPD 3 period, dubbed 'MYPD 4' for convenience. The steps taken and the assumptions made in each of the three scenarios are discussed below.

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[46] Eskom, 2012. Part 1 Revenue Application: multi-year price determination 2013/14 to 2017/18 (MYPD 3): p. 72.
[47] Note that this figure is subject to debate, but it is believed that the MYPD 3 figure represents the best publicly available estimate. For completeness, the IRP 2010 update cites a figure of 2.7%, whilst the more recent forecast cited by Eskom in its RCA submission to NERSA (November 2015) is significantly lower at 0.9%.

4.2.1. The status quo

The status quo uses the original model as discussed above, with adjustments made to the RAB and WACC, which impact on the return on assets and depreciation components of the allowable revenue determination.

RAB. In this scenario it is assumed that all new build undertaken by Eskom is subject to a capital cost 2.2 times that budgeted for. This figure of 2.2 was calculated using publicly available information on the realised capital costs of the Medupi and Kusile projects.[48]

Assumptions also had to made regarding which of the new build projects are to be undertaken by Eskom, and which by IPPs. It is understood that there is an ESI target for the allocation of new build between Eskom and the IPPs, and that currently the target is 70% Eskom and 30% IPPs.[49] This target is also understood to have changed over time and appears to be quite imprecise as it is not clear how the split will be effected and whether this involves the allocation of discrete plants, or whether an individual plant could be 70% Eskom and 30% owned by IPPs. Given the high level percentage allocation of the new build programme, and the practical hurdles associated with allocating individual plants over the SOE and the IPPs, the model uses a split based on actual plant sizes. Hence it was not possible to generate the 70/30 split precisely in the model. The assumptions regarding the allocation of new build between Eskom and the IPPs are as follows:

- Eskom: Medupi, Kusile, Ingula, Sere, Nuclear, Landfill, Coal PV+FGD, Coal FBC and Import coal from Mozambique.
- IPPs: Import hydro from Mozambique, Solar CSP, Solar PV, Wind, closed-cycle gas turbine (CCGT), and OCGT.

Based on these assumptions, the allocation of new build between Eskom and the IPPs yields a ratio of 69/31 of total capacity by 2030.

By inflating the new build RAB for Eskom, this has increased the return on assets and depreciation components of allowable revenue. Return on assets is also impacted upon by the WACC, which is discussed below.

WACC. As discussed previously, a WACC of 7.65% was used in the original model. In this scenario separate WACCs are calculated for Eskom and the IPPs, and these are respectively applied to their proportions of the RAB. The RAB for the existing capacity was split between Eskom and the IPPs based on the actual capacity of their operations.

As discussed above the only aspects of the WACC that change under restructuring are: the debt premium, the β, and the debt/equity ratio (affecting the cost of debt, cost of equity, and gearing respectively). The other components of the WACC are considered industry-specific and are taken from the MYPD 3 reasons for decision from the calculation of the 25 year real pre-tax WACC. By adjusting these aforementioned components of the WACC for the status quo scenario, the WACC used for Eskom is 8.85% and for the IPPs 8.22%. A full explanation

[48] Steyn, L. 2015. Sinking into Eskom's Black Hole. Available online: http://mg.co.za/article/2015-02-05-sinking-into-eskoms-black-hole [2016, January 25]. In this article it was reported that Medupi’s estimated cost at inception in 2007 was R69.1bn but that by February 2015 the estimated cost had increased to R154.2 bn. For Kusile, the estimated cost at inception was R80.6 bn, and the estimated cost at February 2015 was R172.2 bn. To be conservative no attempt has been made to inflate the costs further into the future.

[49] GCIS. 2007. Statement on Cabinet meeting of 5 September 2007. Available online: http://www.gcis.gov.za/content/newsroom/media-releases/cabinet-statements/statement-cabinet-meeting-5-september-2007 [2016, March 1].

of these WACC values can be found in Appendices 2 and 3, with Eskom's increased WACC a result of an increased debt premium and β relative to the original model, and for IPPs a result of a higher debt premium and β than the original model, as well as a higher gearing. These changes are quantified in **Error! Reference source not found.**.

4.2.2. Legal separation

In this scenario the operating costs and return on assets components of allowable revenue change.

Operating costs. With respect to operating costs, there is upward pressure on prices due to the once-off cost of the legal separation, in addition to permanent increases in costs due to the duplication of functions across the new entities. In this scenario there is no downward pressure on prices from increased competition or efficiencies. Thus operating costs are expected to increase relative to the status quo. The assumptions made with respect to operating costs are discussed below.

- There is a once-off cost of unbundling in 2018 of 3.5% of generation revenue,[50] amounting to R5.7 bn. The cost of legal separation may be lower than the cost of unbundling, but given the lack of information on the once-off costs of legal separation, the same unbundling cost was used in this scenario.
- There is permanent upward pressure on operating costs due to the duplication effect, as above. An additional 15% was added to the operating costs in this model.

Return on assets. With respect to the calculation of the return on assets, separate WACCs were applied to Eskom's generation RAB, Eskom's "wires" RAB and the IPP's RAB. Eskom's RAB consists of all its existing assets in generation, transmission and distribution plus its portion of new build (assumed to all be in generation); whilst the IPPs' RAB consists of their existing generation assets plus their portion of new build (as Eskom and IPPs will both be taking on new build under this scenario). To determine the allocation of the existing RAB between Eskom and the IPPs, their proportion of existing capacity was used.

A *WACC* of 8.97% was calculated for Eskom generation, 7.17% for Eskom "wires" and 8.22% for the IPPs. Eskom generation has a higher WACC than Eskom "wires" due to both a higher cost of debt and cost of equity (resulting from an elevated β) as the type of business is considered more risky necessitating higher returns. The WACC for IPPs is the same under legal separation as under the status quo. For a full explanation of the changes in the WACC refer to Appendices 2 and 3.

4.2.3. Wholesale competition

As with the legal separation scenario, the operating costs and return on assets components of allowable revenue change under wholesale competition.

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[50] Brunekreeft (2008) "Ownership Unbundling in Electricity Markets - a social cost benefit analysis of the German TSOs." This paper reports a once-off cost of unbundling of 3.5% of the distribution revenue, as the distribution portion of the business was unbundled. To determine generation revenue in 2018, generation revenue in 2015 was calculated (from Eskom's Annual Financial Statements, pg. 67) as a proportion of allowable revenue in 2015, and applied this to allowable revenue in 2018.

Operating costs. As discussed previously, the impact of this scenario on operating costs is not clear-cut and unambiguous, and as a result a number of assumptions are made regarding the magnitude of the costs.

- There is a once-off cost of unbundling in 2018 of 3.5% of generation revenue,[51] i.e. R5.7 bn.

- There is permanent upward pressure on operating costs due to the structural cost of unbundling or the duplication effect. It is assumed that this amounts to 15% of the projected operating costs in each year, which excludes primary energy (which is a separate line item in allowable revenue). This assumption is based on findings of a number of studies:

  - From a study estimating lost synergies due to unbundling in the EU,[52] scope economies for large utilities were calculated at above 15%.

  - In another study of the EC, Meyer found scope economies to range from 12% to 17%, with higher values applying to larger utilities.[53]

  - In a Deloitte report on the Dutch electricity sector,[54] the duplication effect is quantified to some extent. This paper shows that there is an average increase of 60% in the shared costs that comprise 20% of the integrated utilities' total costs. This equates to an average of 12% of overall operating costs, but no information is given on the weighted average (which may be higher or lower).

- There is also a permanent downward pressure on operating costs due to the competition and efficiency effects. As discussed in the review of the literature, these effects have been difficult to quantify in empirical studies. In order to quantify them for this modelling exercise data from the World Energy Council[55] was examined which provides operating costs for various technologies in various geographic regions. In many instances a range was given, which was used to determine a "competition and efficiency factor" i.e. the percentage difference between the lowest cost and highest cost producers of this particular technology in a particular location. There is significant variation in the competition and efficiency factors calculated, with the lowest being 2%, the highest being 67% and the average being 25%.

- The average factor was used in the model and it is thus assumed that post unbundling the IPP's operating costs (in the generation sector, not including primary energy) would be 25% lower than those experienced by Eskom in the generation sector. Operating costs

[51] Brunekreeft (2008) "Ownership Unbundling in Electricity Markets - a social cost benefit analysis of the German TSOs." This paper reports a once-off cost of unbundling of 3.5% of the distribution revenue, as the distribution portion of the business was unbundled. To determine generation revenue in 2018, the figure for 2015 (from Eskom's Annual Financial Statements, pg. 67) was taken as a proportion of allowable revenue in 2015, and applied this to allowable revenue in 2018.
[52] Gugler, K., Liebensteiner, M. & Schmitt, S. 2014. *Vertical Disintegration in the European Electricity Sector: empirical evidence on lost synergies*. Vienna University of Economics and Business, Department of Economics. Working paper no. 190: p. 20.
[53] Meyer, R. 2011. *Vertical Economies of Scope in Electricity Supply – analysing the costs of ownership unbundling*. Ph.D. Thesis. Jacobs University.
[54] Deloitte. 2005. Reorganisatiekosten Splitsing Energiedrijven.
[55] World Energy Council. 2013. World Energy Perspective: Cost of Energy Technologies. Available online: https://www.worldenergy.org/wp-content/uploads/2013/09/WEC_J1143_CostofTECHNOLOGIES_021013_WEB_Final.pdf [2016, January 20].

were split between Eskom and IPPs in the model based on available information on segmental expenses.[56]

Return on assets. With respect to the calculation of the return on assets, a separate WACC was applied to Eskom's RAB and the IPP's RAB. Eskom's RAB consists of the transmission and distribution assets, whilst the IPP's RAB consists of the generation assets. To determine the allocation of the generation RAB to the IPP's, Eskom's allocation of its assets between its divisions (generation, transmission and distribution) was used.[57] All new-build RAB was allocated to the IPPs, as it is assumed that this comprises generation assets only.

A *WACC* of 7.17% was calculated for Eskom, and 8.41% for the IPPs. This decrease in Eskom's WACC between the status quo and wholesale competition is a result of Eskom's debt premium and β lowering due to Eskom's business model being reduced to electricity transmission and distribution only.

The WACC for IPPs increased between the status quo and wholesale competition because of an increased risk in the market due to more competition, and this was reflected in an increase in the β value. A more complete explanation of this effect can be found in Appendices 2 and 3.

4.3. SUMMARY OF VARIABLES FLEXED UNDER THE SCENARIOS

The discussion in the previous section outlined the adjustments made under the three scenarios, and the table below provides a summary of the variables that were changed under the three different scenarios. The first column lists the variables that were adjusted, and the second column highlights which element of allowable revenue changed as a result of that adjustment. A table that shows the components of the WACC under the three scenarios then follows.

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[56] The only available information on segmental expenses was for "net employee benefits" and "other expenses" in 2015, which were then used to allocate operating expenses between generation and transmission/distribution. (Eskom. 2015. Annual Financial Statements: 31 March 2015. Available online: http://www.eskom.co.za/IR2015/Documents/EskomAFS2015.pdf [2015, December 4]: p. 67.)

[57] Eskom. 2014. Supplementary and Divisional Report 2014. Available online: http://integratedreport.eskom.co.za/pdf/full-supplementary-divisional.pdf [2015, December 4].

Table 3: Variables changed under the three scenarios

Variable	Affected component of allowable revenue	Status quo	Legal separation	Wholesale competition
RAB	Return on assets, Depreciation	Eskom new build RAB inflated by 2.2	No change	No change
Operating costs (opex)	Opex	No change	Once-off cost of unbundling of 3.5% of generation revenue; Upward pressure on costs due to duplication effect (15% of opex, which excludes primary energy costs)	Once-off cost of unbundling of 3.5% of generation revenue; Upward pressure on costs due to duplication effect (15% of opex, which excludes primary energy costs); Downward pressure on IPP's costs in the generation sector due to the efficiency effect (25% reduction in opex)
WACC	Return on assets	Eskom = 8.85% IPPs = 8.22%	Eskom generation = 8.97%, Eskom transmission/ distribution = 7.17%, IPPs = 8.22%	Eskom = 7.17% IPPs = 8.41%

Source: Genesis Analytics

Table 4: The WACC and its components for the ESI businesses under each scenario

		Status quo		Legal separation			Wholesale competition	
WACC components	MYPD 3	Eskom under status quo	IPPs under status quo	Eskom generation under legal separation	Eskom "wires" under legal separation	IPPs under legal separation	Eskom "wires" under wholesale competition	IPPs under wholesale competition
Risk-free rate	12.69%	12.69%	12.69%	12.69%	12.69%	12.69%	12.69%	12.69%
CPI	7.82%	7.82%	7.82%	7.82%	7.82%	7.82%	7.82%	7.82%
Real risk-free rate	4.51%	4.51%	4.51%	4.51%	4.51%	4.51%	4.51%	4.51%
Beta	0.84	0.95	1.00	1.00	0.44	1.00	0.44	1.08
Market risk premium	5.3%	5.3%	5.3%	5.3%	5.3%	5.3%	5.3%	5.3%
Real cost of equity	**8.96%**	**9.56%**	**9.81%**	**9.81%**	**7.17%**	**9.81%**	**7.17%**	**8.41%**
Debt premium	0.60%	2.10%	1.50%	2.10%	1.50%	1.50%	1.50%	1.50%
Nominal cost of debt	13.29%	14.79%	14.19%	14.79%	14.19%	14.19%	14.19%	14.19%
Real cost of debt	**5.07%**	**6.46%**	**5.91%**	**6.46%**	**5.91%**	**5.91%**	**5.91%**	**5.91%**
Gearing	**65%**	**65%**	**70%**	**65%**	**65%**	**70%**	**65%**	**70%**
Tax rate	28%	28%	28%	28%	28%	28%	28%	28%
WACC (real pre-tax)	**7.65%**	**8.85%**	**8.22%**	**8.97%**	**7.17%**	**8.22%**	**7.17%**	**8.41%**

Source: Genesis Analytics

Notes: The WACC from the MYPD 3 is based on a 25 year time horizon.

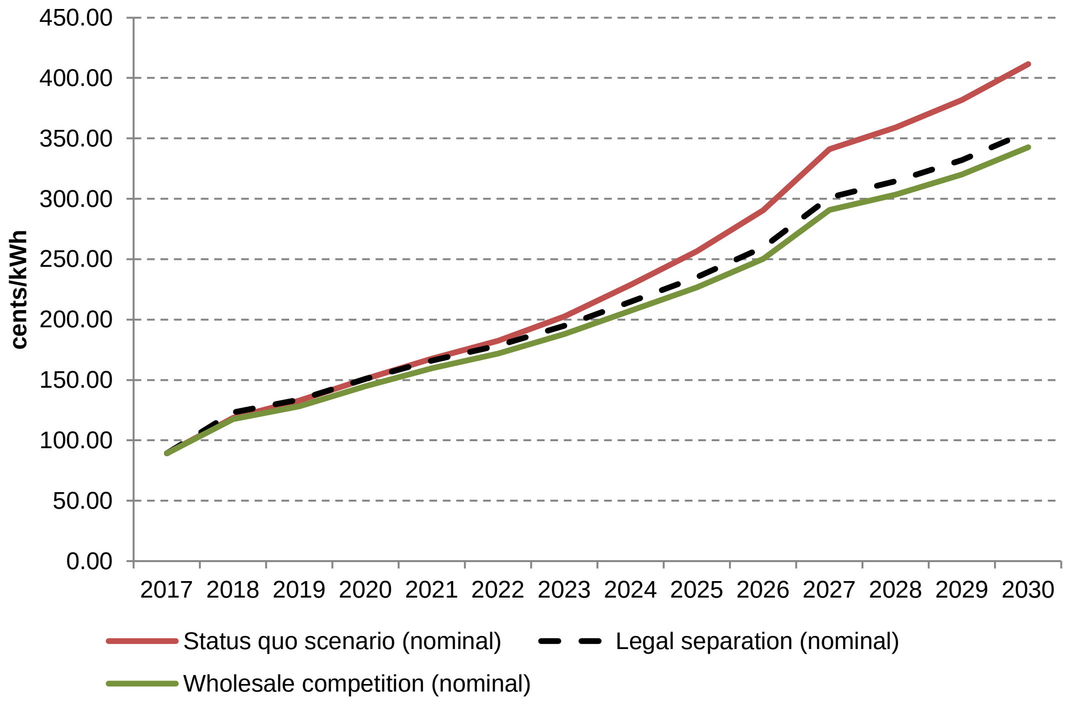
4.4. RESULTS OF THE MODELLING EXERCISE

The charts below show the projected tariff path from 2017 to 2030 in nominal and real terms (using 2015 prices) for the three scenarios used in the model. It is clear from the charts that electricity prices are projected to increase significantly between 2017 and 2030, with the results showing that a lack of reform is likely to lead to the highest price path (a 116% real price increase is forecasted by 2030 under the status quo scenario).

A comparison of the three scenarios reveals that reform in the ESI should lower prices in the long run. The projected tariff paths show that prices under the status quo are likely to be the highest, and that the wholesale competition model projects the lowest prices in the long run. The model shows that by 2030, electricity prices under wholesale competition would be 17% lower than under the status quo. This is primarily driven by the significantly reduced operating costs in the wholesale competition model (which are explored below). The chart reveals that restructuring of the ESI should decrease electricity prices in the long run, and that the more extreme restructuring option of wholesale competition has a slightly lower price path than the more moderate restructuring option of legal separation.

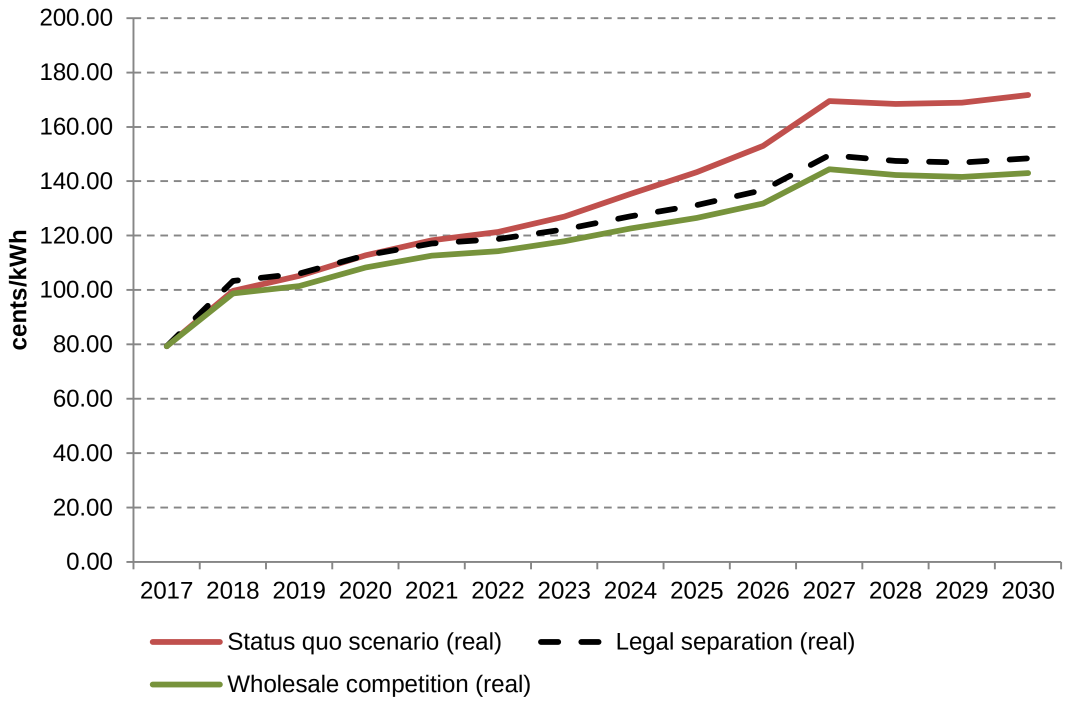
The model thus indicates that there is scope for using restructuring of the ESI as a means to lower electricity prices in South Africa. This project required Genesis to project the tariff path under a number of reform options, in order to better understand the potential benefits of restructuring the ESI, especially on tariffs. This exercise has indicated that reform should have a positive impact on tariff levels, with a widening gap between the status quo and reform options' tariff paths further into the future.

Figure 4: Projected tariff path nominal prices



Source: Genesis Analytics

Figure 5: Projected tariff path in real prices



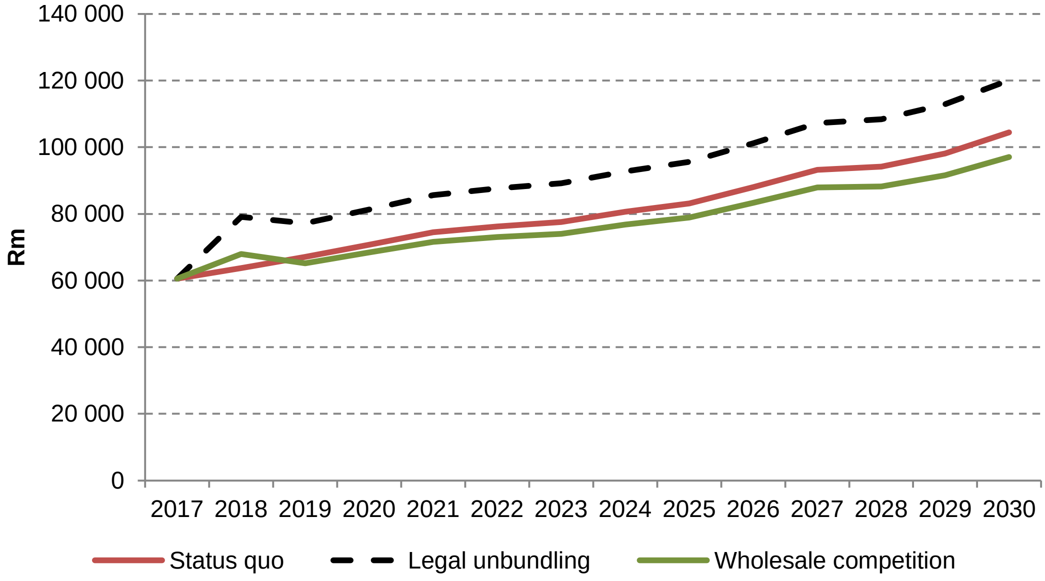
Source: Genesis Analytics

The charts above show the tariff paths over the 14 year period under review. An examination of the working model showed that the trajectory of the three tariff paths are largely driven by the operating costs and return on assets components of allowable revenue. It is thus useful to present these components of the tariff path. The charts below show a comparison of the operating costs and the return on assets over the three scenarios.

- With respect to operating costs, it is clear that the duplication effect results in higher operating costs in the legal unbundling scenario relative to the status quo, whilst the efficiency effect outweighs the duplication effect in the wholesale competition model which results in lower operating costs relative to the status quo.

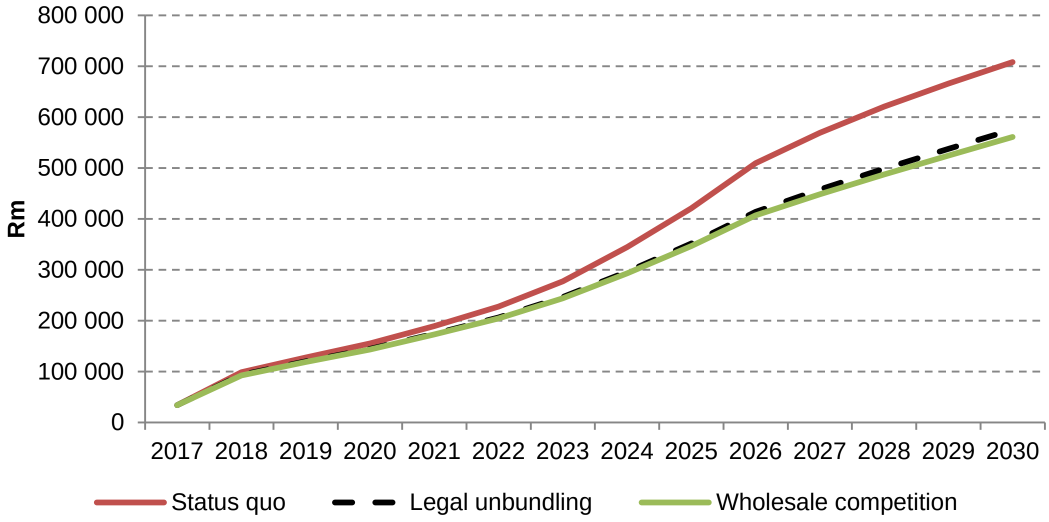
- With respect to return on assets, the size of Eskom's new build RAB has a considerable impact on the return on assets in the status quo, which is higher than in the alternative scenarios. The industry WACC is lower in the wholesale competition model compared to the legal separation model, however the impact on the return on assets is not marked.

Figure 6: Comparison of nominal operating costs in the various scenarios



Source: Genesis Analytics

Figure 7: Comparison of nominal return on assets in the three scenarios



Source: Genesis Analytics

5. CONCLUSION

The purpose of this study was to construct indicative price paths for selected reform options that are both available and practicable in the South African ESI. In order to evaluate different reform scenarios a long term electricity price model (or 'tariff path' model) was developed to use as a base and subsequently tailored according to the different reform scenarios. This exercise was conducted in order to contribute to the critical policy debates around ESI reform that are currently taking place in South Africa. The impact on tariffs is an important evaluation criterion for restructuring options and the modelling underpinning the price paths developed in this report can be used to assess relative price paths and outcomes.

The purpose of the model was to project price paths from 2017 to 2030 for three scenarios, whereupon the price paths could be compared and the most favourable reform scenarios in terms of price impact identified. The scenarios selected for the purposes of modelling the respective price paths are: the status quo, legal separation and a variation of wholesale competition.

The model reveals that the status quo is the least desirable scenario, in terms of the impact on tariffs as well as in terms of the burden on the country's fiscus. This scenario is in fact effectively untenable, given Eskom's new build obligations in conjunction with the diminished strength of its balance sheet and its downgraded credit rating. Based on prior experience, Eskom commissioned new build is expected to result in cost-overruns and delays being incurred, consequently inflating the RAB and depreciation. Eskom's cost of debt is anticipated to increase as its credit rating has consistently been worsening, and it is unlikely to be able to attract more equity from its shareholder. It is also more difficult to manage the risk of Eskom's costs compared to tolling arrangements that can be established between a TSO and IPPs. These factors contribute to the status quo scenario requiring the largest allowable revenue relative to the other scenarios and therefore presenting the highest average tariff path of the scenarios considered.

The restructuring of Eskom, whether using the legal separation or wholesale competition structures should result in lower prices over the long run, as opposed to a continuation of the status quo. The projected price paths under legal separation and wholesale competition were not significantly different and therefore the reader is reassured that the implementation of the legal separation scenario would result in a price outcome that is relatively close to that which would be achieved under the more extensive reform option of wholesale competition as favoured in the literature, but without the disruptive impact of such rigorous reforms.

In conclusion, there is scope to use restructuring of the ESI as a means to temper increases in electricity prices in South Africa, and the logical next step of legal separation is a favourable reform option given that the benefits are close to those achieved under a wholesale competition industry structure.

APPENDICES

APPENDIX 1: SUMMARY OF PRIMARY LITERATURE

Below is a table of the primary literature from which the discussions around the effects of restructuring are drawn. This table serves to contextualise the papers as they are characterised by different industry structures and sequences of reforms (following from country-specific directives). The papers reviewed range from discussion papers and theoretical arguments to empirical studies, all with the purpose of identifying the impacts of ESI restructuring.

Table 5: Summary of ten relevant papers that form the basis of the literature of the report

Paper	Context	Effects discussed	Effects quantified
Brunekreeft, G. 2008. *Ownership Unbundling in Electricity Markets – a social cost benefit analysis of the German TSOs*. EPRG Working Paper 0816 and Cambridge Working Paper in Economics 0833.	This paper conducts a social cost benefit analysis of ownership unbundling of the electricity transmission system operators in Germany. It is referred to in the referenced Meyer (2011) paper because its results indicate that the net effects of ownership unbundling may be positive, but probably small. The paper concentrates on the “marginal step from legal unbundling to full ownership unbundling”.	15 effects are identified which fall into the following three categories: - Competition effect - Interconnector effect - Cost effect	Some quantified costs: Marginal costs are 1% lower, restructuring in New Zealand was 3.5% of the annual distribution revenues, permanent loss of synergies amounts to 0.1% of total costs of the sector. The final result of this paper is that “the weighted net effect on social welfare is likely to be positive, but small”. Notably, “Numerical results are context-specific and are not easily transferred to other countries, or other times”.
de Nooij, M. & Baarsma, B. 2008. *An Ex Ante Welfare Analysis of the Unbundling of the Distribution and Supply Companies in the Dutch Electricity Sector*. SEO Discussion Paper 52 and UNECOM DP 2008-02.	This paper aims to test the belief of the Dutch Minister of Economic Affairs that the benefits of increased competition outweigh the reorganisation costs.	“Benefits may not materialise directly” and can take time – resulting in differences between estimations. • Benefits: More competition leading to more efficiency; cheaper regulatory oversight; more efficient distribution companies; improved reliability of the distribution grid. • Costs: Cost of reorganising (unbundling, transferring of management); cost associated with cross-	Effects of 9 restructuring alternatives are given. The quantified effects include: efficiency gains, increased reliability, reorganisation cost (one-off and annual), and amending the regulations (one-off and annual). All of these effects are taken on aggregate, with most of the alternatives having an overall negative cost (net present value).

		border leases; cost of finance (integrated companies might have an advantage when it comes to attracting money on the international credit market – expected that unbundled companies will pay higher interest on their loans); cost of legal cases; cost of implementing and enforcing legislation and regulation	
Dee, P. 2010. *Quantifying the Benefits from Structural Reforms in the Electricity and Gas Markets in APEC Countries.* Paper prepared as a contribution to the project "The impacts and benefits of structural reforms in transport, energy and telecommunications sectors", commissioned by the APEC Policy Support Unit.	This paper models electricity prices as being determined by measures of regulatory policy, as well as a number of non-regulatory controls. This is done as there are a number of factors that have a role to play in the ability of reforms to deliver real gains. It is also noted that there are unobservable influences on electricity price and efficiency.	It is found that third party access, a wholesale market and unbundling all tend to reduce electricity prices.	The effect that measures of regulatory policy have on industry price is tested (rather than the effect that they have on cost). It is found that the existence of vertical separation between transmission and generation decreases industry price for a sample of OECD countries.
Gugler, K., Liebensteiner, M. & Schmitt, S. 2014. *Vertical Disintegration in the European Electricity Sector: empirical evidence on lost synergies*. Vienna University of Economics and Business, Department of Economics. Working paper no. 190.	On the back of the EU promoting unbundling of the transmission grid, the authors feel that the policy debate generally neglects the potential costs of unbundling, with a focus on the benefits. This paper investigates and quantifies vertical synergies between the stages of generation and transmission. "Our results confirm the presence of substantial EVI [economies of vertical integration], which put the policy measure of transmission unbundling into question".	This paper focuses on loss of economies of scope. Examples of cost savings from vertical integration: "sharing of information, use of common inputs, sharing of staff, efficient planning of investments, protection against uncertainty and financial risk, among other factors, which cannot be easily realised by unbundled firms".	Using a dataset of European electricity utilities, a quadratic cost function is applied to estimate the magnitude of economies of vertical integration. This model finds that there are substantial scope economies, especially for large utilities where cost advantages may be "beyond **15 percent**". However, this model only partly confirms the presence of fixed cost synergies only partly confirmed, with strong evidence to support the presence of variable cost synergies.
Höffler, F. & Kranz, S. 2007. *Legal*	Theoretical rather than empirical paper.	"If legal unbundling can ensure that the	No quantifiable results given, merely based

Unbundling: a "golden mean" between vertical integration and vertical separation (first draft). Available online: [58] [2015, December 7].	It is based on a model with upstream monopolist, a potentially integrated downstream firm (the incumbent) and downstream competitors. It is found that under general assumptions legal unbundling exhibits desirable properties relative to vertical integration and vertical separation.	network company controlling the essential facility maximises only the own profits, legal unbundling ensure higher quantities and better investment incentives, which usually will also lead to higher social surplus."	on the theoretical model developed in the paper.
Meyer, R. 2011. *Vertical Economies of Scope in Electricity Supply – analysing the costs of ownership unbundling*. Ph.D. Thesis. Jacobs University.	This paper is written in the context that the EC hold a strong view in favour of ownership unbundling, but it is felt that the loss of vertical integration economies requires more focus.	Theoretical effects of vertical integration which will be affected by unbundling are broken down into the categories of coordination economies, market risk economies and specialisation advantage. The first of these two are seen to be negatively affected by unbundling, with the third one being the only positive.	Out of the options for reform generation unbundling is found to be the most costly unbundling scenario. Summarising the literature Meyer finds that synergy losses exceed 15% of total costs. Using a multi-stage cost function it is estimated that **scope economies range from 12% to 17%** of total cost (opex and capital cost).
Mulder, M., Shestalova, V. & Lijesen, M. 2005. *Vertical Separation of the Energy Distribution Industry: an assessment of several options for unbundling.* CPB Netherlands Bureau for Economic Policy Analysis. No. 84.	Analysis of the costs and benefits of the proposal by the Dutch government to introduce ownership separation between energy distribution on the one hand, and production and retail on the other. Also gives context to the restructuring in the European policy directives, and then more specifically for the Netherlands.	• Benefits: Unbundling enhances independent network management; improves effectiveness and efficiency of regulation; enhances retail competition but welfare effects are probably small (could significantly affect wholesale competition); creates a possibility to privatise commercial activities. • Costs: Unbundling gives rise to one-off transaction costs; leads to a loss of economies of scope; could temporarily affect investments in generation.	"This overview is of a highly qualitative nature because these types of restructuring are inherently hard to assess."
Nillesen, P. & Pollitt,	This paper examines	The following benefits	"Our empirical

[58] https://www.infraday.tu-berlin.de/fileadmin/fg280/veranstaltungen/infraday/conference_2007/papers_presentations/paper---hoeffler_kranz.pdf

M. 2008. *Ownership Unbundling in Electricity Distribution: empirical evidence from New Zealand*. EPRG Working Paper 0820 and Cambridge Working Paper in Economics 0836.	the impact of forced ownership unbundling of distribution in New Zealand's ESI on electricity prices, quality of service and costs. (Unbundling network companies from commercial activities.) The primary motive cited for separation is to increase competition, thereby avoiding the negative effects of a monopoly. They find that the policy did not achieve its objectives of facilitating greater competition in the ESI but that it did lead to lower costs and higher quality of service.	and costs are described thoroughly in text. • Benefits: Ownership unbundling is posited to have a positive effect on competition (prevents the abuse of a monopoly position); positive effect on investment levels and therefore improved quality of the network; removal of cross-subsidies and cross-financing; separation is also likely to increase focus and unlock latent value; from a regulatory perspective there is an anticipated increase in transparency and therefore regulatory scrutiny. • Costs: One-off transaction costs (advisory fees, new IT system, and contract renegotiations); removal of synergies and economies of scope (such as sharing IT platforms).	evidence does not provide a clear positive or negative conclusion." Overall, it is determined that competition has not benefitted from ownership unbundling, but quality has improved. One-off transaction costs were proven to be substantial, but operational costs decreased by **17%** (though this was not entirely passed through as a decrease in tariffs, with price-cost margins increasing). This could have been avoided if a strong sector-specific regulator was in place.
Pollitt, M. 2007. *The Arguments For and Against Ownership Unbundling of Energy Transmission Networks.* EPRG Working Paper 0714 and Cambridge Working Paper in Economics 0737.	"There is general concern about whether current transmission ownership agreements are delivering non-discriminatory access to electricity and gas networks and whether they or (indeed alternative) arrangements will deliver efficient and timely investment in capacity… The role of vertically integrated incumbents has been highlighted by the recent EU Energy Sector Enquiry." This paper goes on to identify different models of transmission ownership and	The costs and benefits of a number of effects are presented, with the balance of the arguments leading to a decision on whether the effect is an overall pro or con of ownership unbundling. • Pros: Effect on competition; east and effectiveness of regulation; facilitation of privatisation; security of supply; synergy/focus effects; and reduced risk of arbitrary government intervention. • Cons: Transaction costs of unbundling.	This paper does not do any specific analysis, but is focused rather on a literature review. The econometric literature summarised in this paper has conflicting findings.

	assesses theoretical and empirical evidence of the various models to choose which would be the best. Ownership unbundling is found to be the most successful.	• Neutral: Cost of capital investment.	
Pollitt, M., Davies, S., Price, C.W., Haucap, J., Mulder, M., Shestalova, V. & Zwart, G. 2007. Vertical Unbundling in the EU Electricity Sector. *Intereconomics*. 42(6): 292-310.	This is a forum of four papers, presenting a mix of case study evidence, and theoretical costs and benefits of ownership unbundling. Ownership unbundling is focused on as in 2007 the European Commission expressed its preference for ownership unbundling as the most effective way of separating transmission from other stages of the value chain. This paper also makes reference an EY paper on "The case for liberalisation" which discusses the theoretical arguments for why prices would fall when no longer a monopoly.	• Benefits: Decreases incentives for discrimination; increases incentive to invest in cross-border transmission; unbundling removes undesirable network and competitive businesses, and improves retail competition; unbundling makes network regulation easier and improves network quality; improves competition in wholesale markets. • Costs/cons: Double mark up; a decrease in network operator's incentive to ensure reliability; unbundling creates large one-off costs of contract renegotiation; undermines the financial strength of energy companies – putting investment at risk; loss of scope economies.	The paper by Mulder, et al assesses the order of magnitude with regards to certain effects. However, no econometric study is undertaken, but rather results relating to both welfare gains[59] and loss of economies of scope[60] are quoted from other papers.

[59] Newberry, D. & Pollitt, M. 1997. The Restructuring and Privatisation of the CEGB – was it worth it? Journal of Industrial Economics. 45(3): 269-303.
[60] Deloitte Consultancy.2005. Reorganisatiekosten Splitsing Energiebedrijven.

APPENDIX 2: WACC VALUES EXPLAINED

A WACC of 7.65% was used in the original ('base') model, with revised WACC values calculated for each business under the scenarios considered. These WACC figures are applied to the RAB for each business in order to obtain the ROA for that business. The only aspects of the WACC that change under restructuring are: the debt premium, the β, and the debt/equity ratio (affecting the cost of debt, cost of equity, and gearing respectively). The other components of the WACC are considered industry-specific and are taken from the MYPD 3 reasons for decision from the calculation of the 25 year real pre-tax WACC. By adjusting these aforementioned components of the WACC the results in **Error! Reference source not found.** re obtained. What follows below is a discussion of how the components of WACCs for the various scenarios were assessed.

- Status quo

Under the status quo scenario, the WACC used for Eskom is 8.85% and for the IPPs 8.22%.

  - Eskom

Given the downward trend in Eskom's credit ratings it is anticipated that its cost of debt should rise accordingly. It is understood that when pressed on what its cost of debt should be, Eskom revealed in a NERSA hearing that it should be 1.5% points higher than it currently is – this translates into a debt premium of 2.1% points (it is currently 0.6%). This is lower than what Eskom argued was appropriate in the MYPD 2 application, which was a 300 basis point debt premium.

NERSA prescribed the use of proxy companies to obtain a β value for Eskom[61]. This is done by using electric utilities listed on the NYSE, and the methodology is applied by NERSA in its MYPD 2 reasons for decision. By updating this methodology, a β of 0.95 was obtained. An explanation of the β calculations can be found in Appendix 3.

Under MYPD 3 Eskom's gearing is 65%, and this is anticipated to still be the case post-2017. Although Eskom's cost of debt is expected to increase, it is unlikely that Eskom will attract more equity given that the NT is constrained[62] and that between the MYPD 2 and MYPD 3 periods Eskom's gearing already increased from 60% to 65%.

Updating the cost of debt, cost of equity and the gearing, Eskom's real pre-tax WACC over a 25 year horizon is 8.85% (which is 1.20% point higher than the 7.65% approved under MYPD 3).

  - IPPs

As a rule of thumb the debt premium is usually 1.5% points above the MRP, however in this industry Eskom's debt premium is anticipated to be higher. The rule is however, applied to IPPs. This increases their cost of debt to 14.19%, as the risk-free rate is 12.69% to which the debt premium is added. This risk-free rate is across the industry and does not differ between Eskom and the IPPs.

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[61] This follows Note 1 to the MYPD methodology.

[62] The constrained resources of the government, the need to stop bailing out state entities, and the issues relating to the financing of state-owned entities were all issues raised in the 2016 Budget Speech. (National Treasury. 2016. 2016 Budget Speech. Available online: http://www.treasury.gov.za/documents/national%20budget/2016/speech/speech.pdf [2016, February 25]: p. 6 and p. 20.)

The β for IPPs is calculated using electric generation proxy companies on the NYSE, following the MYPD methodology. This results in a β value of 1.08 for IPPs involved in generation. As this result is based on the United States' market, which is a merchant market characterised by both competition for and in the market and where sales are not guaranteed and there is no single buyer, this β value is adjusted. It is moderated for centralised procurement and having a single buyer market in which there will be regulated PPAs or off take agreements. As it can be argued that the IPPs entering into this regulated industry can be either more or less risky than the market, a β value of 1 is used (i.e. their risk tracks that of the market).

Together with the risk-free rate, consumer price index (CPI) and market risk premium, the real cost of equity for IPPs under legal separation is calculated as 9.81%.

As IPPs are required to provide 30% equity upfront, their gearing is taken as 70% as it is unclear as to how much equity they will be able to attract.

By inputting all of these components into the WACC calculation, a real pre-tax WACC of 8.22% over a 25 year period is obtained.

- Legal separation

A WACC of 8.97% was used for Eskom generation, 7.17% for Eskom "wires" and 8.22% for the IPPs.

  - Eskom

Under legal separation Eskom has two subsidiaries, which will each have their own WACC values (these will apply to their separated assets in order to obtain a return on assets reflective of the restructuring). Eskom's gearing remains the same for both businesses, with the cost of equity changing for Eskom's generation business, and both the cost of equity and cost of debt changing for Eskom's energy delivery business relative to the status quo.

Eskom's generation business holds only generation assets, making it comparable to IPPs in terms of risk. Therefore, the β value used for IPPs under the status quo is used here, i.e. a β value of 1. Keeping both the cost of debt and gearing the same as under the status quo, Eskom's generation business has a WACC of 8.97% under legal separation.

Eskom's network business is characterised the same as under wholesale competition, where this is Eskom's only business. Under this scenario Eskom has a lower cost of debt (5.91%), and lower cost of equity (6.86%) than in the status quo. These factors result in the WACC for this Eskom subsidiary being 7.17%. These figures are fully explained below under wholesale competition.

  - IPPs

As the move from the status quo to legal separation primarily affects Eskom's business operations, IPPs are not anticipated to be financially impacted by this move. Therefore, as under the status quo, their real cost of equity is 9.81%, their real cost of debt is 5.91%, and their gearing is 70%, meaning a real pre-tax WACC of 8.22%.

- Wholesale competition

A WACC of 7.17% was used for Eskom, and 8.41% for the IPPs.

  - Eskom

In this scenario Eskom is solely involved in energy delivery, and consequently its credit rating and investor confidence is expected to improve. Resultant to this is a lower cost of debt, with the 2.1% debt premium being revised down to the standard 1.5% premium. This brings Eskom's real cost of debt to 5.91%.

Further, Eskom's restructuring results in a networks business which is expected to have lower risk. Using energy delivery proxy companies to obtain a new β provides a β value for Eskom of 0.44. This means that the real cost of debt for Eskom under wholesale competition is 6.86% (2.7% points lower than under the status quo).

Under this scenario Eskom's gearing is anticipated to remain at 65%. Taken together with the cost of debt and cost of equity, Eskom's real pre-tax WACC under wholesale competition is 7.17%

- IPPs

Under wholesale competition, the cost of debt and gearing for IPPs is not expected to be different from the status quo. However, there is expected to be more risk for generators in this market given increased competition without the previous incumbent's involvement in the electricity supply business. Therefore, the cost of equity is revised with an updated β. This value is taken from proxy generation companies without revision, and is 1.08.

Consequently, the real pre-tax WACC for IPPs under wholesale competition is 8.41% (0.19% points higher than under the status quo).

APPENDIX 3: AN EXPLANATION OF THE BETA CALCULATIONS

In calculating the WACC the variable component of the cost of equity is the beta (β). This is a measure of a stock's systematic risk relative to the market (which has a β of 1). As Eskom is not a listed company, the MYPD Methodology stipulates that Eskom's β is benchmarked using international proxy companies. These proxy β values are then unlevered using the debt/equity ratios and tax rates of the chosen proxy companies, and these unlevered values are weighted using the companies' valuations. This is in order to obtain a value that can be re-levered for Eskom using its debt/equity ratio and own tax rate.

In order to follow this process proxy companies are chosen and the following information is required for each of them: a debt/equity ratio, a tax rate, a raw β, and a valuation. The debt/equity ratio is from the company's most recent financial year, its tax rate is the corporate tax rate of the country in which the company is operational, the raw β is a stock's historical β, and the valuation is the company's market capitalisation. Three of these four data requirements can be found relatively easily, whereas the raw β needs to be calculated as it is obtained from a linear regression of a stock's historical returns relative to the market's historical returns. The time period for these returns, as well as the data frequency used in this regression, are subject to debate. In the calculations of the raw β that follow, daily data over two years is used, as is the method followed by Ofgem[63], with the linear regression following the methodology in Brigham and Houston's "Fundamentals of Financial Management".[64]

As the various scenarios assessed in this report result in different β values, and therefore affect both the cost of equity and in turn the WACC, the table below summarises these differences before an explanation of each β is given.

Table 6: Different β values, costs of equity and WACCs for Eskom and IPPs under the three scenarios

Scenario	Eskom			IPPs		
	Raw beta	Real cost of equity	Real pre-tax WACC	Raw beta	Real cost of equity	Real pre-tax WACC
Status quo	0.95	9.56%	8.85%	1.00	9.81%	8.97%
Legal separation	Gen: 1.00 Wires: 0.44	Gen: 9.81% Wires: 6.86%	Gen: 8.97% Wires: 7.17%	1.00	9.81%	8.97%
Wholesale competition	0.44	6.86%	7.17%	1.08	10.25%	8.41%

Source: Genesis Analytics.

- Status quo

In establishing a β value for Eskom under the status quo the same proxy companies used by NERSA in their MYPD 2 reasons for decision are used. One company, Alegheny Energy, is

[63] Ofgem. 2010. The Weighted Average Cost of Capital for Ofgem's Future Price Control. Available online: https://www.ofgem.gov.uk/sites/default/files/docs/2010/12/europe-economics-final-report---011210.pdf [2016, February 12]: p. 23.
This methodology is applied in a 2014 Ofgem determination. (Ofgem. 2014. Decision on Our Methodology for Assessing the Equity Market Return for the Purpose of Setting RIIO-ED1 Price Controls. Available online: https://www.ofgem.gov.uk/sites/default/files/docs/decisions/decision_on_equity_market_return_methodology.pdf, [2016, February 12]: p. 8).
[64] Brigham, E. & Houston, J. 2009. *Fundamentals of Financial Management*. 12th edition. United States of America: South-Western Cengage Learning: p. 247.

excluded as it merged with First Energy Corp, meaning that only five companies of the recommended six are considered. As these companies were chosen by NERSA, and their selection criteria for these proxies is unclear, no new companies are added, but rather the β figure is updated based on the companies still listed on the NYSE. The raw β is calculated relative to a NYSE composite stock (with the ticker NYA) and historical data is drawn daily for the last two years (running from 8 February 2014 to 8 February 2016). Presented below is an update to Table 18 of NERSA's MYPD 2 reasons for decision[65] which informs the decision of what Eskom's β would be going forward. The final β used for Eskom under the status quo is 0.95.

Table 7: Beta calculation for Eskom under the status quo

Proxy company	D/E	Tax rate	Equity %	Raw Beta	Unlevered pre-tax	Unlevered after tax	Valuation	Weighted unlevered after tax
First Energy Corp	1.78	0.4	0.3597	0.68	0.24460	0.32882	14.26	0.04603
Exelon	0.99	0.4	0.5025	0.76	0.38191	0.47679	30.25	0.14158
Ameren	1.04	0.4	0.4902	0.59	0.28922	0.36330	11.28	0.04023
Public Service Enterprise	0.74	0.4	0.5747	0.69	0.39655	0.47784	21.71	0.10183
PPL Corp	1.69	0.4	0.3717	0.66	0.24535	0.32771	24.37	0.07840
Average			0.4598	0.6760	0.3115	0.3949		
Total							101.87	0.41
Eskom	**1.86**	**0.28**	**35%**					**0.95**

Sources: Genesis Analytics. D/E ratios taken from Nasdaq for the most recent financial year, corporate tax rate from KPMG (unchanged between 2006 and 2015), raw beta and valuation from Yahoo finance (with market capitalisation in billions of US$ taken on 8 February 2016 for the valuation measure).

In order to calculate a *β* value for **IPPs**, which are pure generation companies, the same process as above is followed, except with proxy generation companies. Given the structure of the ESI in the USA, there are a limited number of companies for which the primary focus is electricity generation, as most are utilities with involvement in more than one stage of electricity supply. Despite the lower number of proxy companies used to obtain the *β*, its value (1.08) makes sense given that these generation companies will be taking on more risk as the industry in the USA is a merchant market.

[65] NERSA. 2010. Reasons for Decision: Eskom's MYPD 2 revenue application. Available online: http://www.nersa.org.za/ [2015, November 4]: p. 27.

Table 8: Beta calculation for IPPs

Proxy company	D/E	Tax rate	Equity %	Raw Beta	Unlevered pre-tax	Unlevered after tax	Valuation	Weighted unlevered after tax
Covanta Holding Corp	2.86	0.4	0.2591	0.76	0.19689	0.27982	1.86	0.14744
Atlantic Power Corp	3.11	0.4	0.2433	1.16	0.28224	0.40475	0.21	0.02408
Dynegy Inc	2.39	0.4	0.2950	1.37	0.40413	0.56286	1.46	0.23280
Average			0.2658	1.0967	0.2944	0.4158		
Total							3.53	0.40
IPPs	**2.33**	**0.28**	**30%**					**1.08**

Sources: Genesis Analytics. D/E ratios taken from Nasdaq for the most recent financial year, corporate tax rate from KPMG (unchanged between 2006 and 2015), raw beta and valuation from Yahoo finance (with market capitalisation in billions of US$ taken on 8 February 2016 for the valuation measure).

This ESI market in the United States is characterised by both competition for and in the market, where off-sale is not guaranteed and there is no single buyer. As such this β value is adjusted for the South African market. It is moderated downwards for centralised procurement and having a single buyer market in which there will be regulated PPAs or off take agreements. As the IPPs entering into this regulated industry can be argued to be either more or less risky than the market, their **β value is taken to be 1** (i.e. their risk tracks that of the market on average).

- Legal separation

Under legal separation **Eskom** has two separate businesses, a generation business and a transmission and distribution ("wires") business. The β values and debt premiums differ for these two businesses, with the gearing remaining the same. Overall, the WACC is higher for Eskom's generation business than wires business (attributable to both a higher β and debt premium).

The **β for Eskom's generation business is 1**, following from the reasoning above for the **β** value of IPPs under the status quo. The β for the wires business is generated by using energy delivery proxy companies, with the calculations shown in Table 9 below.[66] The final **β value for Eskom's wires business is 0.44**.

[66] Although more proxy companies would be desirable, there are very few listed on the NYSE. When searching for companies listed on other stock exchanges (namely the LSE and ASX) the information required to use them for β proxy calculations is limited relative to companies listed on the NYSE. This is exemplified by the fact that to calculate raw β values for these companies composite indices for the stock exchanges on which they are listed would be required, but as these may differ from that of the NYSE composite index, there could be comparability issues with the results.

Table 9: Beta calculation for Eskom "wires"

Proxy company	D/E	Tax rate	Equity %	Raw Beta	Unlevered pre-tax	Unlevered after tax	Valuation	Weighted unlevered after tax
ITC Holdings Corp	2.46	0.4	0.2890	0.55	0.15896	0.22213	6.04	0.10498
Pepco Holdings Inc	1.35	0.4	0.4255	0.29	0.12340	0.16022	6.74	0.08450
Average			0.3573	0.4200	0.1412	0.1912		
Total							12.78	0.19
Eskom "wires"	1.86	0.28	35%					0.44

Sources: Genesis Analytics. D/E ratios taken from Nasdaq for the most recent financial year, corporate tax rate from KPMG (unchanged between 2006 and 2015), raw beta and valuation from Yahoo finance (with market capitalisation in billions of US$ taken on 8 February 2016 for the valuation measure).

Under legal separation **IPPs** are assumed to have the same β as under the status quo, taking on a **value of 1**. This is because their role in the ESI does not substantially change between the status quo and legal separation, but rather the change is apparent in Eskom.

- Wholesale competition

Under wholesale competition **Eskom** is purely involved in the delivery of electricity, with the **same β as the wires part of their business under legal separation, i.e. 0.44**.

IPPs under wholesale competition are open to more competition among themselves and this could open them up to more risk. Therefore, the β value calculated in Table 8 is used to characterise IPPs under wholesale competition, i.e. **1.08**.