Developing South Africa's Electricity Wheeling Framework:
Barriers and Key Principles
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RES4Africa Foundation 2023
EXECUTIVE SUMMARY

The energy transition in South Africa is marked by a growing number of electricity consumers procuring energy directly from third-party generators (usually privately owned). These generators require the Eskom and municipality distribution networks to transport or wheel the purchased electricity to the offtakers. However, the South African electricity sector still faces various challenges with respect to wheeling, including:

- Low operational efficiency of the current generation fleet leading to loadshedding and the inability to consume wheeled electricity during grid interruptions.
- Municipalities facing large financial difficulties.
- Eskom is facing large financial difficulties amidst being in the process of unbundling.
- The legal framework, which allows implicitly for consumers to contract directly but with no clear regulatory framework.
- Certain municipalities have no internal wheeling frameworks, making it difficult for external private generators and traders to interface with generators or consumers in these municipalities.

Within the South African context, the benefits of wheeling are clear as it not only allows for energy to be procured at a cheaper rate by means of bilateral contracting, but also improves energy security in the country, because wheeling supports the business case for the increased deployment of renewable generation capacity.

Based on the regulatory analysis, it was found that there are many regulations and rules that could be retained (e.g. Distribution and Transmission Tariff Codes) and which support (at least in theory) open and non-discriminatory access to the network. However, there are many roadblocks that remain, such as a lack of standardisation in tariffs, practical difficulties engaging with municipalities with regards to negotiating connection, use of system agreements and wheeling arrangements, uncertainty around the authority of NERSA pertaining to tariff-setting, out of date rules on third party access, and a lack of policy guidance on the future market structure for South Africa.

Based on the international case study analysis of India and the United States, the following key principles can be considered in the South African context in order to promote wheeling in the country:

- The rules and regulations pertaining to the planned wholesale electricity market must be published. Once the new market structure is understood, the 2012 Third Party Network Charges Rules should be substantially amplified from a tariff framework to include a framework for the non-discriminatory access by third parties to the Eskom transmission network and the Eskom and municipal distribution network.
- The Eskom unbundling must be expedited in order to achieve a more open electricity market and consequently increase the number of bilateral agreements whereby third-party access to the grid will be necessary.
• Municipal distribution licences must be amended to explicitly require municipalities to provide non-discriminatory access to third parties. In order to solidify the need for municipalities to provide non-discriminatory access, it is also recommended that section 14 of ERA be amended in order to specifically make require non-discriminatory access as a licence condition for municipalities. In cases where such access is granted for purposes of wheeling, but it impacts the municipality’s revenue stream and cross subsidisation abilities, subsidies similar to that implemented in India can be considered to benefit poor and vulnerable communities. Additionally, a national wheeling framework and support for smaller municipalities without the required skills are necessary.

• There is a need for the wheeling and energy balancing rules to explicitly consider imports and exports to enable generators, traders and customers to access the competitive markets of the Southern African Power Pool (SAPP) and regional bilateral markets. The current structure is heavily focused on domestic wheeling, in accordance with which wheeling charges can be recovered from a domestic customer.

• When a customer enters into a wheeling agreement with a non-Eskom generator, Eskom uses a net billing framework whereby it charges customers for the full cost of energy (i.e. as if Eskom is supplying all electricity) and then credits the customer account for the wheeled energy (excluding losses) and the affordability subsidy charge. Eskom then levies an additional administration charge for undertaking this reconciliation. This system can be considered to be unfair, as customers who do not wheel energy do not pay this charge (i.e. there is an additional cost to wheeling compared to purchasing from Eskom); and Eskom continues to make a retail margin on the component of energy supplied by third parties (i.e. Eskom does not deduct any retail component from customer bills. In order to remove this irregularity, Eskom would need to implement a billing system for levying use of system charges at Eskom, which does not require “netting” to be undertaken. In doing so, it will remove the additional service charge levied for wheeling. This will further incentivise customers to wheel electricity without paying the additional charges imposed by Eskom for providing net metering services. Additionally, Eskom would need to develop an imbalance pricing regime in order to penalise off takers who under and/or over consume electricity and generators who over and/or under produce, resulting in an imbalance in the grid. The same principle can be applied in the case where the generator over-generates, resulting in an imbalance.
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<th>Abbreviation</th>
<th>Definition</th>
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<tbody>
<tr>
<td>A&amp;E</td>
<td>Average and excess</td>
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<tr>
<td>AGP</td>
<td>Amatola Green Power</td>
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<td>BMW</td>
<td>Bayerische Motoren Werke AG</td>
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<tr>
<td>BBP</td>
<td>Bronkhorstspruit Biogas Project</td>
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<tr>
<td>CERC</td>
<td>Central Electricity Regulatory Commission</td>
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<tr>
<td>CoS</td>
<td>Cost of Supply</td>
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<tr>
<td>DBT</td>
<td>Direct Benefits Transfer</td>
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<td>DC</td>
<td>Direct current</td>
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<tr>
<td>DER</td>
<td>Distributed energy resources</td>
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<tr>
<td>DMRE</td>
<td>Department of Mineral Resources</td>
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<tr>
<td>DUoS</td>
<td>Distribution Use of System</td>
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<td>ERA</td>
<td>Electricity Regulation Act</td>
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<td>ERCOT</td>
<td>Electric Reliability Council of Texas</td>
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<tr>
<td>EV</td>
<td>Electric vehicles</td>
</tr>
<tr>
<td>FERC</td>
<td>Federal Energy Regulatory Commission</td>
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<tr>
<td>IOC</td>
<td>Indian Oil Corporation</td>
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<tr>
<td>IOU</td>
<td>investor-owned utilities</td>
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<tr>
<td>IPP</td>
<td>Independent Power Producers</td>
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<tr>
<td>ISO</td>
<td>Independent System Operators</td>
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<tr>
<td>ITC</td>
<td>Investment Tax Credit</td>
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<tr>
<td>ITOU</td>
<td>Industrial Time of Use</td>
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<tr>
<td>kVA</td>
<td>kilovolt-ampere</td>
</tr>
<tr>
<td>kWh</td>
<td>Kilowatt hour</td>
</tr>
<tr>
<td>MW</td>
<td>Megawatt</td>
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<tr>
<td>MWh</td>
<td>Megawatt hour</td>
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<tr>
<td>NERSA</td>
<td>National Energy Regulator of South Africa</td>
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<tr>
<td>NMBMM</td>
<td>Nelson Mandela Bay Metropolitan Municipality</td>
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<tr>
<td>PPA</td>
<td>Power Purchasing Agreement</td>
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<td>PTC</td>
<td>Production tax credit</td>
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<tr>
<td>RTO</td>
<td>Regional Transmission Operators</td>
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<tr>
<td>SAREM</td>
<td>South African Renewable Energy Masterplan</td>
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<tr>
<td>SEB</td>
<td>State Electricity Board</td>
</tr>
<tr>
<td>SOE</td>
<td>state-owned enterprise</td>
</tr>
<tr>
<td>SMME</td>
<td>small, medium, and micro enterprises</td>
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INTRODUCTION
1. Introduction

South Africa is actively pursuing a transition towards a cleaner and more sustainable energy sector, with a particular focus on increasing the share of renewable energy in the country’s electricity mix. Wheeling is seen as an essential mechanism to facilitate the integration of renewable energy into the grid and support the diversification of the energy supply.

The implementation of a comprehensive wheeling framework in South Africa involves various stakeholders, including regulatory authorities, transmission and distribution system operators, independent power producers (IPPs), municipalities, traders, importers, exporters and electricity consumers. Clear regulations, market rules, and technical standards need to be established to govern wheeling operations, ensure fair access, and address issues related to pricing, metering, billing, and infrastructure requirements.

While existing legislation allows for the wheeling of electricity, there have been calls for a national wheeling framework that details how wheeling should be implemented. The Presidency’s National Energy Crisis Committee (NECOM) led the drafting of a draft wheeling framework, a process which included consultation with municipalities and other stakeholders, and embodies the key principles of third-party wheeling. Once the wheeling framework is finalised, NECOM will engage NERSA on next steps with the intention of developing wheeling regulations.

A step in the right direction is the recent presentation to Parliament of the Electricity Regulation Amendment Bill (the “Amendment Bill”) whose objective is to introduce a competitive market in the electricity sector. With the proposed migration from a monopolistic electricity supply industry model to a competitive model, non-discriminatory third-party access to the transmission and distribution network must be provided to ensure that the competitive market is able to function. This necessitates legislative measures to clarify the respective rights, roles and responsibilities of different role players in the electricity sector, the interactions between them and the term, including charges, upon which grid access will be assured. The Amendment Bill attempts to address these measures.

The importance of wheeling is also mentioned in the latest South African Renewable Energy Masterplan (SAREM) as a key factor to successfully increase the deployment of renewable energy in the country. Importantly, the plan acknowledges that a supportive wheeling environment is only one of the development areas needed in order to help address South Africa’s energy security problem. It is important to note that the development of appropriate tariffs, more efficient licensing/registration procedures, as well as trading frameworks coupled with a fully-fledged power exchange must be fast-tracked to ensure the growth of all market segments.

To date, various, barriers have hampered the implementation of wheeling in South Africa, and there is a pressing need to standardise the approach taken by municipalities to wheeling, and to ensure consistency in the way in which tariff methodologies are employed. The municipal wheeling market is still in its early stages with only a few operational municipal wheeling systems in place. Additionally, where municipal wheeling structures have been implemented, they are not aligned with one another and municipalities have varying approaches to calculating wheeling charges and facilitating wheeling within their distribution networks. There is a need to introduce key principles that would not only assist and guide municipalities with facilitating wheeling, but would standardise the approach that municipalities
take pertaining to wheeling. In order to set out recommended regulatory and tariffing principles to affect such standardisation, this study sets out to address and provide context to the following:

- An overview of wheeling in South Africa.
- The key benefits of wheeling.
- An overview of existing wheeling agreements in South Africa.
- An overview of the current South African regulatory framework pertaining to wheeling.
- Barriers complicating wheeling at a municipal level.
- An international case study analysis of wheeling in India and the United States, and
- Key principles to increase wheeling in South Africa.

1.1 The approach to the study

In order to cover the scope of work mentioned above, we followed the 4-step approach outlined below.

1. **Overview of Wheeling**
   We have outlined the three main scenarios currently being implemented within the South Africa wheeling landscape which includes Eskom wheeling, eskom and municipal wheeling and wheeling with electricity traders. We also assessed the current South African regulatory landscape in relation to wheeling.

2. **Stakeholder Analysis**
   We conducted a desktop study of the outlining the currently wheeling arrangements being implemented by municipalities. Additionally, we have interacted Eskom as well as the City of Cape Town and eThekwini municipality to ascertain what their key challenges and concerns are in relation to wheeling.

3. **International Case Study Analysis**
   We conducted a desktop based analysis of the wheeling frameworks in India and the United States (California) in order to establish a benchmark of global best practices that can serve as a point of reference and provide transferable lessons to South Africa.

4. **Key Principles**
   Based on the analysis, we proposed principles related to regulatory reformations and tariff setting that can be considered by government to help standardise and support the wheeling of electricity in South Africa.

If adopted and implemented, key principles outlined in the report would assist municipalities with facilitating wheeling within their distribution networks and contribute towards clarifying the roles and responsibilities of all parties involved when entering into wheeling arrangements.
OVERVIEW OF WHEELING IN SOUTH AFRICA
2. Overview of wheeling in South Africa

Wheeling can be defined as the movement of electrical power between a seller and a buyer via a network owned by another party.

Other definitions include wheeling as defined in the Electricity Regulation Act which provides that wheeling means “conveyancing of electricity from the Point of Connection to a point of consumption through a third-party transmission or distribution network.”

The ERA states that “A transmission or distribution licensee must, to the extent provided for in the license, provide non-discriminatory access to the transmission and distribution power systems to third parties”. Furthermore, the Act states that access must be provided on the conditions set out in the license of the distributor.

The vertically integrated nature of the South African electricity sector did not allow for a competitive environment and hence did not promote private generation to a large extent. Without private generation, there was no demand for wheeling. However, with the recent change to schedule 2 of the Electricity Regulation Act, generation facilities are now exempt from a licence condition. The licence relaxation, coupled with the higher grid electricity prices, naturally created a more conducive environment for the rise of private generators. As more generators intend to join the grid, there is a need for more offtakers and the need to create an enabling regulatory environment to support wheeling.

The advantages of wheeling include the servicing of a variety of power demands without the restrictions of ground or roof space in the immediate vicinity. Wheeling also enables increased efficiency and value, as high renewable-resource but low environmental and social impact areas can be utilised, allowing lower-

<table>
<thead>
<tr>
<th>The Generator - Seller</th>
<th>The Transporter – Network / Municipality</th>
<th>Off-Taker – Buyer</th>
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<td>The creation of a wheeling transaction is based on the availability of a generator with excess generation capacity to sell to third parties. Ideally, such a generator must be able to produce electricity at a price cheaper than the prevailing energy component of the retail price of electricity. An added advantage would be if the generator can produce electricity from cleaner sources compared to the conventional supply.</td>
<td>With an available generator, a transporter of the electricity is required. Although the electricity would not flow from the generator to the buyer per se, a theoretical path is required to complete the transaction. In the South African context, the electricity either flows through the transmission infrastructure (mostly Eskom owned) and/or the distribution infrastructure (mostly owned by municipalities).</td>
<td>A critical component of the wheeling transaction is to be able to find a willing buyer. Customers can enter into bilateral trading agreements directly with generators or enter into agreements with traders who facilitate the wheeling transaction as an intermediary between the generator and the offtaker. Further, with the drive to a low carbon economy, customers seek alternate suppliers that can offer electricity generated via cleaner energy sources. Buyer willingness is enhanced when alternate energy prices are cheaper than the conventional supply.</td>
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</table>
cost, cleaner energy to be utilised when needed. With the spread of wheeling, renewable hubs can be created to decrease costs of electricity further. A wheeling transaction depends on three main aspects, a generator, a network, and an off-taker. There could also be multiples of each within the transaction. However, note that this relationship is conceptual as it does not correlate with the flow of electrons.

In South Africa, the distribution network service providers (Distributors) are Eskom Distribution and Municipalities (Local Authorities). Wheeling in Distribution networks refers to electricity supply involving a third-party generator selling electricity to a customer situated in a Distributor’s network. A third-party generator may be located or embedded in a municipal network whilst the consumer is in an Eskom network and vice-versa. Both the generator and consumer can be in either an Eskom or Municipal network. A consumer may therefore need to wheel energy using the generator's municipal network and then through an Eskom network to eventually receive the wheeled electricity at their connection located in yet another municipal network; this is referred to as inter-distributor wheeling. Given the involvement of multiple parties in an inter-distributor wheeling transaction, there is a need to create a national framework based on sound principles to ensure alignment and standardisation between parties involved.

Distribution network services involve providing the capacity to transport and transform the electricity supply to voltage levels at which receiving loads can consume. This requires that Distributors provide voltage regulation services, invest in installation and refurbishment of transformers, cables, and lines. This is whilst ensuring the appropriate maintenance and operations for safe, available, dependable, and connected supply to consumers or customers connected in their networks. Municipalities should therefore be able to unbundle their tariffs into the associated cost reflective tariff elements and charge a wheeling tariff which recovers the costs associated with wheeling and the maintenance of their infrastructure.

2.1. There are three key scenarios applicable to wheeling

2.1.1. Eskom wheeling

In the case where the customer would only use the distribution grid owned and operated by Eskom, a connection and wheeling agreement is signed between Eskom and the electricity generator. In this case the Power purchase agreement is concluded between the Generator and Off-taker/Customer. In addition, an amendment to the existing supply agreement between the Customer and Eskom is concluded in order to reflect the wheeling transaction.
2.1.2. Eskom and municipal wheeling

Where the distribution networks of Eskom as well as a municipality are required in order to convey the electricity from the supplier to the offtaker, a connection and wheeling agreement is entered into between Eskom and the Generator. Similarly, to the first scenario, a power purchase agreement is concluded between the Generator and the Off-taker/Customer. However, an amendment to the existing supply agreement with Eskom and Municipality will be required in order to reflect the wheeling transaction. An electricity supply agreement is entered into between the Municipality and the Customer and due consideration of the wheeling agreement between the Municipality and Off-taker is necessary.

2.1.3. Wheeling with electricity traders

A new type of wheeling arrangement is emerging where traders are responsible for the wheeling of electricity purchased from them as an intermediary between the generator and the offtaker. In this circumstance National Energy Regulator of South Africa (NERSA) issues the trader with a licence to buy from Independent Power Producers/Generators and sell electricity to end-users. Ultimately, this becomes an intermediary electricity transaction. In this scenario, the necessary agreements such as connection, wheeling and supply agreements get concluded including amendments to the existing agreements. This process and related agreements are not fully defined in South Africa and would need to be refined. Traders are able to aggregate supply and demand, enabling supply from multiple generators to be wheeled to multiple offtakers as opposed to the bilateral one-to-one wheeling scenarios described above.
Energy traders play a crucial role in the energy landscape, offering practical solutions that benefit both generators and consumers. These licensed entities act as intermediaries, connecting with end users and wider power markets, both at domestic and regional level. The role of traders is to streamline the energy supply chain, fostering efficiency and diversification in the market by enabling multiple generators to serve a variety of end-users.

In order to operate, a trader must obtain an energy trading licence from NERSA, a process which is subjected to prior formalisation of PPAs with generators and consumers implication is that a trader must be fully established before licensing and in a competitive market like South Africa, in which most creditworthy consumers prefer fully licenced and established suppliers, and most generation developers need a fully licenced and/or established offtaker to satisfy their investor and lender requirements, the licencing process is often challenging.

Energy traders promote competition and choice in the energy sector, empowering consumers with options and pricing flexibility. Their role extends to stimulating investment into renewable energy generation projects, thereby contributing to a more sustainable energy future. As the energy sector evolves, the value of energy traders as pragmatic facilitators becomes increasingly evident, driving innovation, market expansion, and overall efficiency.

2.1.4. Virtual wheeling

Under the virtual wheeling framework, Eskom and the Buyer, who may supply multiple consumers, enter into a virtual wheeling contract and through this, the Eskom WEPS Credit is no longer deducted from the end user consumer invoice. Instead, consumers will now pay the full bill, as if Eskom supplied. Eskom then effects a consolidated WEPS-based refund to the Buyer in respect of the “wheeled energy” and the Buyer then allocates refunds to each consumer in line with their respective PPA tariff (WEPS – PPA tariff delta/savings). In the case of having PPA tariffs higher than the Eskom WEPS, the consumer pays the Buyer the difference.

As for customers sitting within municipalities, the municipality revenue will not be affected. But one issue is that if an Eskom connected offtaker or a municipality with municipal connected offtakers is in debt to Eskom, there will be no wheeled energy refund processed for the wheeled energy associated with the offtaker, until the Eskom account is in good standing. A new charge, called the administrative charge, will be introduced to the Buyer in respect of the wheeled energy refund processed. It should be noted however that there has been no explicit definition of what consumer category (as regards MVA or MW level) or what type of consumer portfolio will fall under the virtual wheeling platform (e.g.: If you are selling 5MW to 5 consumers of 1MW each, will you need to be in the platform?) so the assumption is that any “Buyer” supplying multiple customers will be subjected to virtual wheeling.

In summary, virtual wheeling will come with some advantages through supply to consumers at lower voltages as well (current wheeling framework only looks at HV and MV), explicit consideration of traders and small consumers, as well as access to consumers in municipalities that do not have wheeling frameworks. Some disadvantages include the fact that “bankability” of consumers will be affected by way of Eskom being a primary revenue route, and a new payment risk has been introduced for municipality tied consumer supply (there is no telling if a municipality will always be in good standing so there is a risk of indefinite revenue interruption).
2.2. There are three key scenarios applicable to wheeling

2.2.1. Wheeling in relation to electricity prices

Despite provision for of wheeling in several regulations and acts and the existence of a wheeling framework by Eskom, wheeling has not yet attained widespread adoption at the scale necessary to help address South Africa’s electricity crisis. However, the requirement to deliver electricity to consumers is gaining popularity due to increasing liberalisation in the electrical sector that enables private generators to more actively participate in the energy sector. Transporting electricity from private producers to end-users is essential for both generators and consumers, as grid supplied electricity is currently more expensive than solar/wind generating systems. This is partially due to the fact that grid supplied electricity includes distribution/transmission charges, cross-subsidies and other surcharges. Moreover, the economic case becomes more compelling as electricity prices continue to increase annually at a rate that exceeds inflation.1 Technology advancements and a maturing alternate energy sector promoting economies of scale in South Africa have drastically dropped solar and wind prices. Solar and wind are variable generation sources; therefore, comparing these prices directly with non-intermittent sources distorts the picture. The cost of suitable backup must be included to affect a fair comparison. With that said, the case of alternate generation at reduced prices is now a reality in South Africa.

Intermittent renewable energy could be made available by a renewable energy generator, and backup is taken care of by another service provider. The arrangement then gives rise to wheeling, where the generator makes electricity available per the technology’s availability. This energy can be wheeled to one or more prospective off-takers, and the utility provision for the backup/shortfall in the customer’s demand. The financial case for a wheeling transaction can be lucrative as renewable energy can be generated at a much lower cost price compared to traditional generation.2

2.2.2. The role of wheeling in presence of load shedding

As a result of South Africa’s electricity shortage, the demand for wheeling has also increased. The energy shortage results in frequent load shedding plaguing the country into darkness. Private power investment can quickly introduce new generation capacity to the grid; however, there would need to be an understanding and framework that would detail how wheeled electricity would be transported from generator to off-taker.3 Wheeling will add variable power to grids, however, this will require enhanced flexibility in transmission and distribution infrastructure, as well as steeper ramp rates during evening peak periods. Additional wheeling might reduce the need for Eskom to provide emergency power to keep its grid stable, including through firing up its open-cycle gas turbines which are costly to run during peak or emergency periods, although reserves will still be required to manage fluctuations on the grid. Where the transmission and distribution infrastructure is operating at full capacity, grid strengthening may be required.

The opposite is also true where wheeling is affected by loadshedding. Typically, a wheeling transaction can be affected when the generator is unable to supply electricity as agreed, the customer is unable to

3 It must be noted that the generated electrons are not actually transported from generator to offtaker. The concept of wheeling is therefore not associated with electrons, but rather the financial relationship based on the entry/exit charge implemented by Eskom.
consume electricity as agreed, or the municipality is unable to provide the network as agreed. Network unavailability would generally be due to load shedding and or network faults. These scenarios typically place a burden on the management of the wheeling transaction.

There are specific circumstances where municipalities have adopted policies that ease the loss of revenue associated with undelivered loadshedding. For example, the City of Cape Town has agreed to purchase electricity not delivered/consumed as a result of load shedding and credit the account of the customer with the amount of wheeled electricity lost due to loadshedding.4

2.3. Current wheeling arrangements

The current extent and number of wheeling arrangements in South Africa are unknown. However, municipalities are publicly showing their commitment to accommodate wheeling within their networks. For example, the City of Cape Town launched the first pilot project in September 2023 in which 15 commercial electricity suppliers, representing 25 generators, started selling electricity to 40 commercial consumers using the City's grid, marking a significant milestone in the project. The pilot focusses on large electricity consumers who are connected at medium voltage levels of 11kV and higher. Although the client will be subject to loadshedding, the City believes that its supportive wheeling framework will ultimately create a more conducive investment environment for the private sector in order to increase investment in new generation capacity and reduce load shedding in the medium term.

The framework includes the development of a new billing engine and the completion of the necessary wheeling agreements. The programme allows electricity to be wheeled over both the municipal and Eskom distribution networks in Cape Town.5 Sales are governed by bilateral power purchase agreements within a market environment, as opposed to a regulated environment, as the price of the energy is set between the parties and not by the City, Eskom or NERSA. Moreover, the City's electricity supply by-law has been amended in order to allow for retail wheeling of electricity through the network. The 15 wheeling pilot projects who submitted valid applications to generate and sell power are Amazon Data Service South Africa, Brinmar Private Energy trading, Distributed Power Africa, Energy Exchange of Southern Africa, Energy Partners Utilities, EnerJ Carbon management, Empower Trading, Floating Solar, Make a Difference Ventures GP LLC, Naura Trading, Phofu Solar Plant, PowerX Proprietary Limited, Redefine Properties Ltd, Solar Africa Energy and Swoish Property Seven.

The City of Ekurhuleni has also made progress to unlock its wheeling potential. In July 2022, the City Ekurhuleni signed an agreement with Teraco, an interconnection hub and data centre company, to unlock renewable energy wheeling in the metro. The agreement provides Teraco with certainty for its investment in two 100 MW utility-scale solar power generation projects, which, when fully operational, are expected to produce more than 500 000 MWh per annum. The agreement also enables Teraco to discuss power purchase agreements to procure renewable energy from independent power producers.

In 2012 the Nelson Mandela Bay Metropolitan Municipality (NMBMM) council passed a resolution to source 10% of the total electricity consumption in the municipality from renewable energy sources, with

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4 Based on interview with Cape Town energy representatives on 8 June 2023.
an emphasis on local projects. The resolution included that the municipality would “wheel” such power from private producers to willing buyers. Once NERSA approval was obtained the first, non-exclusive, 20-year wheeling agreement was signed between the Municipality and Amatola Green Power (AGP). Based on the 2012 council agreement, NMBMM developed their framework Wheeling Agreement. This is a generic agreement that states the maximum private power that will be accepted for wheeling by the municipality and the conditions under which the municipality will wheel the power. The agreement allows for a maximum of 10% of the municipality's total energy consumption to come from privately traded renewable power and at least 80% of this must come from local developers.

The City of Tshwane has also taken numerous steps to facilitate wheeling within its distribution network. The Bronkhorstspruit Biogas Project (BBP) is the first large scale animal waste-to-energy project in South Africa, addressing clean and secure energy needs while resolving waste issues. Bayerische Motoren Werke AG (BMW) South Africa (the electricity off-taker) has signed a power purchasing agreement (PPA) with the project developer, Bio2Watt. This development has been made possible through agreements with the City of Tshwane and Eskom for the wheeling of the power between the project developer (Bio2Watt) and the power purchaser (BMW).

It is clear that municipalities are taking action to facilitate wheeling and to offer their distribution networks to generators and off-takers to help improve the energy security in the country. However, municipalities have found it challenging to facilitate wheeling in practice, as no standard approach to wheeling agreements or use of system charges across municipalities exist. Given the large number of municipalities and high level of dysfunctionality, this lack of standardisation and consistency in application of the regulatory framework creates a barrier to entering into bilateral contracts with municipalities and/or their customers. The section below outlines the extent to which the current regulatory framework supports wheeling in South Africa.

2.4. Regulatory analysis

Electricity wheeling is supported within the electricity regulatory framework in South Africa. The framework alludes to principles and rules that would be best suited to enable wheeling; however, it is not necessarily feasible to implement currently, as the on-the-ground facilitation of wheeling still faces practical issues. Wheeling may therefore be ready to be enacted in theory but not necessarily in reality unless the matters are suitably addressed.

Regulations and methodologies specific to wheeling include NERSA Regulatory rules on network charges for third-party transportation of energy, the Tariff Code, and the NERSA Cost of Supply (CoS) framework. The Third-party rules and Tariff Code both require Cost of Supply studies as the basis for calculating Distributor Wheeling charges. Additionally, the Tariff code requires that Distribution Use of System (DUoS) charges for generators and loads (consumers) are based on the same CoS study. And, for inter-Distributor wheeling, raising of DUoS charges is limited to the immediate distributor where the end-customer is connected.

2.4.1. Electricity Regulation Act

The starting point for evaluation of the regulatory framework in relation to wheeling is the Electricity Regulation Act (ERA), in particular the role of NERSA and Department of Mineral Resources (DMRE), and the provisions of the transmission and distribution licences that are provided for under ERA.
ERA expressly mandates NERSA (established under Section 3 of the National Energy Regulator Act) with extensive functions and powers in the regulation and administration of the South African electricity sector. The preamble of ERA notes that NERSA serves as the custodian and enforcer of the national electricity regulatory framework. In particular, section 4 of ERA stipulates that NERSA must perform the following functions:

- Consider applications for licences and may issue licences for the operation of generation, transmission or distribution facilities, the import and export of electricity, and electricity trading;
- regulate prices and tariffs;
- register persons who are required to register with NERSA where they are not required to hold a licence;
- issue rules designed to implement the national government’s electricity policy framework, the Integrated Resource Plans and ERA itself;
- establish and manage monitoring and information systems and a national information system, and coordinate the integration thereof with other relevant information systems; and
- enforce performance and compliance with ERA, and take appropriate steps in the case of non-performance.

Section 34(3)(b) of ERA provides that NERSA may facilitate the conclusion of an agreement to buy and sell power between a generator and a purchaser of that electricity. Thus, it is not open to NERSA to determine for itself the commercial terms between such parties where they have agreed between themselves to such terms. For example, where the generator and the offtaker have agreed in their PPA an energy rate that is substantially below the norm, it is not for NERSA to determine that such rate is inappropriate or unacceptable, thereby rejecting such terms and thus refusing to issue a generation licence.

When considering the transmission and distribution of electricity, the ERA provides that

- Most importantly, the transmission and distribution licensees must, to the extent stipulated in the relevant licence, provide for non-discriminatory access by third parties to transmission and distribution power systems (Section 21(3)). From this provision, a general positive obligation arises whereby municipal distribution licensees are required to provide non-discriminatory access to networks for the purposes of wheeling services.
- Transmission and distribution licence conditions for third-party access may relate to circumstances in which access must be allowed or may be refused, the strengthening and upgrading of the transmission and distribution networks in order to be able to provide for such access, compliance with codes, rules, and practices made by the Regulator, and fees to be charged for the use of the transmission and distribution systems (Section 21(4)).
- The Regulator may, in consultation with transmission and distribution licensees, municipalities that reticulate electricity, and other interested and affected parties as necessary, make guidelines, codes of conduct, and/or rules relating to, amongst other things, the relationship between licensees, customers, and end-users, the use of transmission and distribution power systems, and any other ancillary matter appropriate for the implementation of the ERA (Section 35).
- Transmission and distribution licences may impose the duty or obligation on the licence holder to transmit or distribute electricity (Section 14(1)(m)).
A determined framework for the setting of tariffs (Section 15(1)). Specifically, in this regard, the setting or approval of prices, charges, and tariffs must follow the following principles:

- An “efficient” licensee must be enabled to recover the full cost of its licensed activities, including a reasonable marginal return.
- There must be incentives for continued improvement of the technical and economic efficiency with which services are to be provided.
- Undue discrimination between customer categories must be avoided.
- The licensee must give end-users proper information regarding the costs their consumption imposes on the licensee’s business.

It should be noted that it is NERSA, as the Regulator defined under ERA, that has the power and authority to regulate these tariffs, as part and parcel of its overall role as custodian and enforcer of the regulatory framework provided for in ERA (Section 3). As such, NERSA approves the connection and use-of-system fees, applying the principles set out above.

Transmission and distribution licensees must, to the extent stipulated in the relevant licence, provide for non-discriminatory access by third parties to transmission and distribution power systems (Section 21(3)). Transmission and distribution licence conditions for such third-party access may relate to circumstances in which access must be allowed or may be refused, the strengthening and upgrading of the transmission and distribution networks in order to be able to provide for such access, compliance with codes, rules, and practices made by the Regulator, and fees to be charged for the use of the transmission and distribution systems (Section 21(4)).

The Regulator may, in consultation with transmission and distribution licensees, municipalities that reticulate electricity, and other interested and affected parties as necessary, make guidelines, codes of conduct, and/or rules relating to, amongst other things, the relationship between licensees, customers, and end-users, the use of transmission and distribution power systems, and any other ancillary matter appropriate for the implementation of the ERA (Section 35). With specific reference to the question of open access to the South African electricity network, from the above it can be seen that the legislative framework already exists in the primary law. Section 2(f) of ERA – one of the objectives of the Act is “to promote competitiveness and customer and end user choice” - but usually, there is a gradual market opening.

An important development has been the amendment of Schedule 2 of the Act. Schedule 2 focuses on exemption from the requirement to apply for and hold a licence. In a previous amendment to the Schedule, generation facilities of up to 100 MW installed capacity were excluded from the requirement to apply for a generation licence with NERSA. However, the latest amendment in January 2023 removed the threshold in its entirety, meaning that any generation facility, irrespective of its size, are exempted from licensing subject to the provision that such activities must comply with the Code and must be registered with the Regulator. This exemption removes the tremendous administrative burden of obtaining a generation licence, and specifically also relates to generation facilities that supply electricity to one or more customers by Wheeling.6 The latest amendment to schedule 2 does not exempt generators from

6 Clause 3 of Schedule 2 provides that: “The operation of any generation Facility with or without energy storage, irrespective of size or capacity, with a Point of Connection on the transmission or distribution power system, in circumstances where—
3.1.1 the generation Facility is operated to supply electricity to one or more customers by Wheeling; and the generator has entered into a Connection agreement with the holder of the transmission or distribution licence in respect of the power system over which the electricity is to be wheeled; or
3.1.2 the generation Facility has a Point of Connection but does not export nor import any electricity onto or from the transmission or distribution power system.”
needing to obtain permission to connect and comply with Grid Codes, which will remain critical to ensure grid stability. Although, the amendment removes one bottleneck – i.e. delays caused by the licensing process, and requirement to have a PPA in place to obtain such a licence, it does not address any other deficiencies in the wheeling framework (e.g. consistency and existence of municipal arrangements) and will accelerate the need to implement a balancing framework. In this regard, NERSA’s role will need to gradually change for generation/supply to focus on market power and abuse. It is important to note that NERSA has taken active steps in order to assist them with market abuse. NERSA and the Competition Commission of South Africa has entered into a Memorandum of Agreement (MoA) enabling the entities to “effectively coordinate the exercise of the Commission’s jurisdiction and powers when making decisions on competition matters within the energy sector”. The MoA will enable the Commission to determine whether there is sufficient competition in the electricity, piped gas, and petroleum pipelines.⁷

2.4.2. Electricity Regulation Amendment Bill

The focus under the Amendment Bill is on the formation of the South African internal competitive market. It attempts to ensure that third parties are not discriminated against and that they will be granted access to the Transmission System Operator (TSO) transmission or distribution power systems to evacuate their generated power. This would ensure that the competitive market would be able to function. This necessitates that measures, such as legislative provisions providing for non-discrimination against third parties, be put in place to provide for the interaction between the different role players in the electricity sector, to provide the process whereby new role players would be guaranteed access to the use of the electricity grid system, and to provide for such access charges. In addition, the Amendment Bill seeks to ensure that there will not be discrimination between different generators or customers in relation to dispatching or balancing the system. The Amendment Bill also makes it clear that “Third party access to the transmission and distribution power system must be based on published tariffs, applicable to all eligible customers, and applied objectively and without discrimination between the system users.”

Some relevant definitions include:

- “market transaction” means a transaction that occurs in a competitive environment, either on a competitive trading platform or bilaterally;
- “multi-market” means a hybrid market model accommodating market transactions, physical bilateral transactions and regulated transactions;
- “power market participants” means participants that meet the qualifying criteria set, and choose to participate, in the market platform established by the market operator;
- “trading platform” means a platform where power market participants conduct trade.
- Under the Amendment Bill,” trading” is also redefined to mean “the wholesale or retail buying [or] and selling of electricity [as a commercial activity]”, and ‘trade’ has a corresponding meaning.

The Bill also outlines other key concepts. More specifically, section 34B sets out the Powers and functions of the transmitter, system operator, market operator and central purchasing agency:

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Importantly, the transmitter must implement infrastructure plans for the transmission network, incorporating the capacity and demand and outlook to ensure reliable grid services to generators and customers. The transmitter must also provide non-discriminatory access to the transmission power system to third parties.

The market operator is responsible for establishing a non-discriminatory electricity trading platform as well as the supporting market code and rules. The market operator must be able to identify imbalances between scheduled and actual production, the consumption of electricity by power market participants, and the allocation of costs of remedial action and penalties where applicable. This is an important consideration for the development of an imbalance pricing mechanism as will be discussed in the sections below.

The central purchasing agency will be responsible for legacy power contracts and regulated transactions between IPPs and Eskom. The central purchasing agency will also conclude vesting contracts with Eskom generators and/or distribution licensees to manage the transition to a competitive market. Lastly, in relation to ancillary services, the CPA will act as the balance responsible party for power market participants. In addition, the Amendment Bill provides that the system operator shall not discriminate between different generators or customers in relation to dispatching or balancing the system, except for objectively justifiable and identifiable reasons approved by the Regulator. Following its initial adoption by cabinet in March, the Amendment Bill was formally introduced in parliament this August. Currently, it is undergoing a vital public consultation phase, allowing a 30-day period for submissions.

2.4.3 Electricity pricing policy

The 2008 Electricity Pricing Guidelines (Electricity Pricing Guidelines) essentially are a guide issued by NERSA indicating the methodology followed in establishing tariffs. In regulating tariffs, NERSA seeks to enable an efficient distributor of electricity to recover the full costs of licensed activities, and in addition, a reasonable return and margin as required by section 16 of ERA.

NERSA approves tariffs for its municipal licensees on an annual basis (except for Eskom, who is considered on a multi-year basis for its revenues and annually for its retail tariffs). The approved tariffs are communicated to all licensees and are also published on NERSA’s website, as well as in the tariff publication. In respect of large municipalities, NERSA approves a percentage guideline increase as well as municipal tariff benchmarks.8

In respect of wheeling arrangements, such transactions involve a financial reconciliation on Eskom’s bill in respect of the energy purchased between the generator and buyer which includes use of system charges associated with the delivery of the energy. It must be noted that this arrangement works when both the generator and customer are connected to the Eskom network. Unlike the ERA, the electricity pricing policy of South Africa dedicates a paragraph to discuss the concept of wheeling. The principal points as set out in Clause 2.6 of the Policy Position 5 are highlighted below:

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8 The percentage guideline increase is developed based on the determinations made in respect of Eskom. The municipal tariff benchmarks have been developed based on five tariff categories and their corresponding average consumption levels. The tariff categories of customers: commercial / business; industrial / manufacturing customers; agricultural / rural customers; schools / hostels / places of worship.
a. Fair and non-discriminatory access to and use of networks to all users of the relevant networks.

b. The total cost to operate the networks is reflected in the various connection and use of system charges; therefore, no additional charges for wheeling electricity will be levied unless the wheeling action introduces incremental costs.

c. Any incremental wheeling costs associated with a specific wheeling transaction and its fair share must be recovered as a connection charge.

d. Wheeling of electricity can only be permitted if the action complies with all technical, safety and commercial requirements.

e. A methodology for transmission and distribution wheeling, including the treatment of network congestion, must be developed by NERSA.

The policy has forward stepped and pronounced on two specific issues of wheeling, including the access rights of wheeling (5a) as well as the pricing methods (5b,5c); however, it also pronounces in (5e) that NERSA must develop a methodology for wheeling. Based on the principles above, a municipality is not entitled to seek to levy a surcharge on electricity services for wheeling unless incremental costs will be incurred. It is however questionable whether the wheeling costs should be recovered as a connection charge, unless this refers to an entry/exit charge. Moreover, customers entering into wheeling agreements should not be paying any retail element associated with energy procured from another source. While the Electricity Pricing Guidelines (not being a regulation) do not have force of law, a failure to adhere to the guideline may result in any tariff determination being judicially reviewed for want of administrative fairness and failure to pass the ‘rationality’ test.

In February 2022, a revised version of the Electricity Pricing Policy was issued out for comments by industry stakeholders. Though some positive initiatives and considerations were made, there still remain a few matters to be considered such as:

• Consideration of traders – it is imperative that traders be considered in definitions as well in pricing guidelines.

• Charges – the Pricing Policy reflected the need to consider capacity charges in multiple pricing structures for services and industry stakeholders. It should be noted, however, that capacity charges, if not implemented with due consideration, tend to discriminate against intermittent players such as variable renewable energy generators and energy traders. In this regard, an all-energy pricing methodology that considers capacity and load factors may be maintained or if the goal is to settle on capacity charges, then there is need for consideration of intermittent players in the electricity sector.

• Consideration of storage initiatives as they serve as a key initiative in promoting the implementation of variable renewable energy projects as well as provision of other services such as ancillary services or transmission and distribution support.

• Green energy tariffs were mentioned but there was no clarity on structure or how this will affect renewable energy generators and consumers.

• The introduction of a framework for energy balancing, which is a service provided to cater to inconsistent generation and consumption on account of technologies (for generators), or consumption patterns (for consumers).

• Wholesale market – this market is set to come in the future but there was no mention of traders when potential participants were listed.

• Imports and exports – the policy does not state which parties import and export. The use of the term “South Africa” poses a challenge as it is not explicitly stated if the policy encourages and supports imports and exports by private parties (subject to NERSA licencing).
Cross border trading – governance of cross border trades needs to be further unpacked to reflect the two types of trades into and out of South Africa: bilateral purchase/supply agreements with external entities, and spot market trading on the SAPP competitive markets. The SAPP is a SADC body and therefore is able to “reach” out across the region.

2.4.4. Third-Party Transportation of Energy Rules

Pursuant to its obligations under Section 35 of the ERA, the Regulator has published “Regulatory Rules on Network Charges for Third Party Transportation of Energy” (2012 Third Party Network Charges Rules) to regulate the pricing of network access and transportation of electricity across transmission and distribution systems.

The Rules provide guidance on prices and tariffs relating to the wheeling of power and reinforces the principles of non-discriminatory access and the ability to enter bilateral contracts with third-party generators that are not Eskom. Section 12 specifically deals with Wheeling and sets out the key principles in relation to wheeling arrangements. The following key aspects must be highlighted.

- Wheeling of energy shall be allowed, subject to the generator receiving its approvals from NERSA to sell to a third party and the signing of the network service provider's Connection and Use-of-System Agreement.
- Generators connected at below 11kV shall not be allowed to wheel energy.
- Only non-Eskom generators may enter into wheeling arrangements for the sale of energy to a consumer who may be an existing Eskom load customer or a new load customer.
- Cross-border wheeling should be treated in terms of the South African Power Pool (SAPP) rules between operating members and charges for incremental losses incurred as a result should also be treated according to these SAPP rules.
- Use-of-system charges for wheeled energy imports or exports should be raised at the relevant Transmission station where the imports or exports take place.
- An end-customer supplied through inter-distributor wheeling should be required to pay the Distribution use of-system charges of the last distributor, for avoidance of doubt the last distributor means the immediate distributor that the end customer is connected to.
- If a network operator's performance drops below the 98% and 95% availability limits for Transmission and Distribution Systems, respectively, then the network operators should compensate the generator for energy that could have been exported into the system at WEPS rate.
- In the event of network unavailability, UOS charges should not be raised from generators.
- The 300MW embedded generator capacity limit shall be applicable as an interim arrangement until a supply and demand balancing mechanism is implemented by an independent system operator.

Additionally, Section 6.11 of the rules says generators’ Use of System charges must be fixed and indexed annually to CPI. The third-party transportation rule document states that the increase in UOS charges must be indexed to CPI, however, the UOS charges are indexed to actual costs experienced. Further, the UOS charge is calculated by dividing the total cost by the total sales; should sales drop significantly, the UOS charge rises significantly, irrespective of CPI. As such, unfortunately, not all costs are indexed to CPI, hence, municipalities may be under-recovering in these cases where cost increases are above CPI. Additionally, section 11.3 states, upstream reinforcements costs shall not be raised from wheeling
generators, but an early termination guarantee for shared assets. The non-raising of costs can be viewed as municipalities funding infrastructure used by generators.

These rules included the methodologies for developing transmission and use of system charges but as NERSA developed new transmission and distribution tariff codes, the methodologies described in the 2012 rules are now obsolete. The 2012 rules do not describe how parties could access the grid and the type of contracts they should sign with transmission and distribution owners (what is usually called a transmission/distribution use of system agreement). The rules also do not discuss how the transmission owner(s) would relieve grid congestion.

2.4.5. The Distribution Network Code

The Distribution network code sets out the basic rules of connecting to the Distribution System. It also aims to ensure that all users of the Distribution System are treated in a non-discriminatory manner and specifies the technical requirements to ensure the safety and reliability of the Distribution System.

Clause 4(1) of the RSA Distribution Network Code (v6.1) states that a distributor shall make capacity available on its networks and provide open and non-discriminatory access for the use of this capacity to all customers including Embedded Generators, and that, in exchange for such service, the Distributor is entitled to fair compensation through electricity tariffs as described in the Tariff Code.

2.4.5.1. Distribution Tariff Code

The Tariff Code sets out the objectives and rules for retail tariff structures and connection charges for distribution retail and network services raised by Licensed Distributors. The appendix of the Distribution Code also provides a detailed description of the process for developing tariffs, including separate distribution use of system tariffs. The tariff grid code v6.2 states the following:

- Embedded generators, including those that wheel, that use the distribution network to export power shall pay the Distribution generator use-of system charges.
- All customers receiving a network service (including wheeling) shall pay the distribution use of system charges, irrespective of any energy trading arrangement, which may or may not be unbundled depending on the tariff structure.
- All load customers, including those wheeling energy, shall be required to contribute to network-related subsidies.

The Distribution Tariff Code sets out clear guidance for developing unbundled distribution use of system charges. It is also a requirement for licensees to develop tariffs that are consistent with this code. However, the Code does not oblige municipalities to follow a specific methodology. Appendix 1 that sets out the guidelines to design the tariffs provides that: “Each distributor shall publish its own methodologies once approved by the NERSA”. This contributes to the fact that there could be multiple methodologies being used by municipalities when designing tariffs and leads to complications to implement wheeling arrangements when more than one municipal distribution system is involved in the wheeling transaction.
2.5. There are fundamental barriers pertaining to wheeling

The current South African electricity market structure is supportive of wheeling in theory, but issues persist that limit the development of increased wheeling and the development of a competitive electricity open market structure. Some of the key barriers include the following:

- The market structure primarily relies on a single buyer model for procuring new generation capacity in accordance with the outdated IRP through a bidding process. However, this framework has seen some evolution as the law now permits wheeling, facilitating trading between IPPs and private offtakers and a number of large commercial and industrial customers are undertaking private procurement processes.
- Moreover, the notable increase in the licensing threshold to 100 MW in 2021, and total removal in December 2022, has resulted in an increase of private sector project registrations with NERSA.
- Although the Electricity Regulation Amendment Bill has outlined a proposed new wholesale market structure, there is a lack of supporting rules and regulations that clearly define the market model (who can sell to whom and under which conditions) and market rules/code (which usually explains how trading is carried out).
- It is difficult to give customers choice (and allow municipalities to contract) without deciding on the overall market model and to ultimately move away from having 98% of the IPPs selling to Eskom.
- Standardised transmission and distribution tariff codes but not applied by municipalities.
- Completing the current process of Eskom unbundling.
- The need to have municipalities to improve their financial health to become bankable and thus being able to at least, procure partially from IPPs their expected load. Whilst some large metros (such as the City of Cape own) is in the process of direct IPP procurement, the majority of municipalities do not have the financial or human resources in order to support direct IPP procurement.
- Lack of knowledge of key aspects of competitive electricity markets and wheeling and how it differs from current modes of operation (e.g. key function generation and load forecasting, energy balancing and importance of the retail function) among stakeholders.9

The various challenges specific to South Africa are also compounded by the overall changes facing all electricity systems and their search for flexibility, in the context of deeper penetration of intermittent renewables. Many of these intermittent resources are or will be connected to the distribution grids, thus the utmost importance of fixing the problems of the various municipalities.

Whilst the regulatory analysis above showed that there are many pieces of law and policy that could be retained (e.g. Distribution and Transmission Tariff Codes) and which support (at least in theory) open and non-discriminatory access to the network (e.g. as required under ERA), there are many roadblocks that remain. This includes a lack of standardisation in tariffs, use of system agreements, practical difficulties engaging with municipalities, and requirements for NERSA approval of each transaction agreed by a trader, severely limiting flexibility, out of date rules on third party access, a lack of policy guidance on future markets, etc. Some of these key barriers are discussed in more detail below.

9 The lack of knowledge and expertise to facilitate wheeling has specifically been highlighted as an issue by the municipalities interviewed and is based on publicly available research.
2.5.1. There is no standardised approach to calculate wheeling charges

While the South African power sector structure is supportive of wheeling, this is still only in theory as there are various issues that still persist that limit the development of more third-party network access and the development of a competitive, open-access electricity market. South Africa’s electricity market structure is mostly a single buyer model, despite the law allowing for wheeling. The lack of a clearly defined market model and wheeling framework to determine who can sell power to whom, under which conditions and market rules around how trading is carried out, is a barrier to enabling investment in new generating capacity. However, the Amendment Bill is set to bridge this gap, transforming the power sector from theory to practice by addressing barriers to third-party network access, promoting a competitive market, and fostering investment in generating capacity.

Due to the rise of an emerging renewable energy industry, wheeling has been taking place for some time in South Africa through bilateral trade agreements between generators and off-takers that determine the unit price of the electricity, however the wheeling tariffs must still be determined. There are currently no unified rules for calculating the wheeling charge and as a result, each method used in these agreements varies in accuracy and complexity when calculating wheeling charges. In addition, the calculation becomes more complex when wheeling occurs across multiple municipalities through the Eskom network. In these cases, charges will be raised by all of the network operators, and the methodology of charging may be different as there is no uniform method of charging at this stage nationally.

Electricity and wheeling tariffs are currently bundled together, which previously was not an issue, but in a competitive market with multiple generators that need to use the same network, the tariff for the use of the network needs to be stripped out and charged separately. The third-party transportation rule document states that the increase in UoS charges must be indexed to CPI; however, the UoS charges are indexed to actual costs experienced. Further, the UoS charge is calculated by dividing the total cost by the total sales; should sales drop, the UoS charge rises, irrespective of CPI. As such, an argument can be built that increases must be indexed in line with the actual costs of maintaining the grid. The drawback of this approach and not linking it to CPI is that the contract reduces bankability as there is uncertainty in increases.

Wheeling charges are standard tariff charges raised to all parties that use the grid. The use-of-system, are unbundled tariff structures and rates that recover the costs associated with the delivery of energy and making capacity available on an electricity network. These are payable by generators and load customers for all wheeling/delivery of energy. In addition, connection charges are raised and are recovered upfront for connection costs not recovered through use-of-system charges.

There is a misconception that wheeling charges are additional charges, which is not the case, since all customers whether buying from Eskom or from private generators will pay the same “wheeling charges” whether supplied by Eskom or through bilateral trade. The only additional charge is the administration charge to facilitate the wheeling transaction. It is important that wheeling charges reflect the reality, as recognised in the ‘Proposed Regulatory Rules for Third Party Generator to Load Wheeling’ issued by NECOM in August 2023, that there will be no direct flow of electrons from the generator to the end user customer’s point of supply. In reality, the electrons will serve the customers closest to the generator and the contractual end-user customer will be served by other electrons. The wheeling charge should
therefore be a financial transaction whereby the wheeled energy (as measured at the Generator meter) is accounted for on the electricity bill of the customer rather than being based on the physical path between the generator and the customer. In the context of the growing role of intermediaries and traders it is also important that wheeling charges are based on an entry/exit model, rather than being applied to each purchase and sale transaction, as otherwise costs may be duplicated if the same power is bought and sold multiple times, as is seen in more developed power markets.

The current tariff structures and price regimes are insufficient to allow wheeling without inflicting revenue losses for municipalities. Changing the pricing mechanisms and tariff structures adopted by municipalities to recover customer network expenses independent of energy charges is one technique municipalities can adopt to avert revenue losses. Changing recovery methodologies, however, is time-consuming and will impact revenue recovery for other customers. Therefore, there must be an intense effort to migrate to wheeling frameworks that minimise revenue losses to municipalities while maximising the benefits of wheeling.

Notwithstanding the challenges associated with wheeling, there must be a progressive implementation plan, as it is not only policy driven but is now becoming a crucial component of connecting private generators to off-takers. If there is a failure to accommodate wheeling, there is a risk of underutilised generators. Moreover, the relationship between private generators and off-takers is becoming economically more robust in value as grid-priced electricity continues to grow above inflation yearly. Municipalities will therefore continue to feel the pressure to implement wheeling frameworks to enable the virtual flow of energy from private generators to off-takers.

The CoS framework guides the development of CoS studies for all licensed distributors enabling a consistent approach in performing their cost of supply studies. This can be used to develop consistent methods to calculate wheeling charges. The CoS framework also provides for a comprehensive recognition of Distribution network costs that include shared costs, municipal surplus, operating costs, network line losses, repairs and maintenance. According to the CoS framework, demand-driven distribution network costs are to be allocated using maximum demand using the average and excess (A&E) method. The A&E method enables that every connection contributes to network costs relative to their maximum demand. Detailed unit costs from CoS studies can be used to evaluate future possibility of wheeling charges and to separate technical and non-technical line losses costs.

Further, CoS studies may be expanded to separately cost embedded generators to enhance an understanding of their impact on distribution network costs. There is an additional opportunity through CoS studies for customers that only receive a network service from Distributors to contribute to the Municipal Surplus similar to other municipal customers. This can be achieved by redistributing the municipal surplus during the CoS study by allocating portions of the Municipal surplus to energy, retail, and network costs. The required explicit provision of municipal surplus in municipal tariffs can still be adhered to by separately outlining the embedded municipal surplus.

2.5.2. Delays in tariff guidelines causes further delays to a wheeling framework

NERSA published the updated consultation paper on the review of the Municipal Tariff Guideline Increase, Benchmarks and Proposed Timelines for the Municipal Tariff Approval Process for the 2023/24 financial year, on 4th April 2023 for review and public comment due 4th May 2023\textsuperscript{10}. NERSA, annually approves a guideline increase and reviews the benchmarking for municipal tariff setting.

The guideline is aimed at assisting municipalities that do not have a CoS Study, to develop budgets and for evaluation of municipal tariff applications. This guideline has been used for the last ten years, and this approach has been declared unlawful. In 2022 the High Court of South Africa, Gauteng Division, in two judgments reviewed, set aside and declared the Municipal Guideline Increase and Benchmark Methodology unlawful\textsuperscript{11}, with the first judgement giving NERSA 12 months to rectify the defect and apply a cost of study approach in effect for the 2024/2025 financial year.

NERSA is required to develop a new methodology that bases tariffs on the efficient cost of supply study approach, with a reasonable margin, in compliance with the Electricity Regulation Act. The regulator has for the past decade, published this guideline increase and tariff benchmarks every year, and if municipalities adhered to this their real cost of supply is not considered. Wheeling tariffs were still not addressed in this consultation paper, which will cause an even further delay and continue to inhibit the growth of the country’s energy industry.

2.5.3. Under-Recovery of municipal revenue due to wheeling

Municipalities have a crucial role in electricity wheeling. From the regulatory analysis above, the following three principles emerge in relation to municipalities and wheeling:

- Municipalities have executive and legislative authority for setting and implementation of tariffs.
- Municipalities should conduct a cost of supply study in order to determine a cost reflective wheeling tariff.
- Electricity revenue is expected to fund other municipal activities while sustaining the wires business.

In general municipalities recover a portion of network-related costs via the sale of kWhs. As a result, the reduction in kWh sales contributes less to the network-related costs. The tariffs for other customers not forming part of a bilateral PPA must be increased to cater for this loss. In this context, the implementation of wheeling is not gaining popularity in Municipalities and regulatory/policy recommendations need to be adopted in order to ensure that municipalities are not disadvantaged by wheeling whilst promoting wheeling as a more cost-effective approach to promote energy security. This point was also highlighted during stakeholder engagements with Ethekwini municipality. The under-recovery of electricity costs as well as the fact that customers are increasingly moving away from municipal electricity supply in favour of embedded/self-generation solutions makes the cross subsidisation in other key municipal areas difficult.

Additionally, given the fact that there are over 250 municipalities in South Africa with around 170 providing electricity services, revenue from electricity sales often constitute the bulk of the income generated in

\textsuperscript{11} https://www.saflii.org/za/cases/ZAGPPHC/2022/778.pdf
the local government sphere. Of the 170 municipalities, most are small and do not have experience in contracting directly with IPPs in order to procure energy. As such, municipalities lack the necessary skills required in order to facilitate electricity procurement and the wheeling of electricity within their distribution networks.

In many instances, municipalities would not only be expected to facilitate wheeling through their distribution networks for the benefit of industrial off takers, but for their own benefit in order to sell such electricity to their customers. However, given the current financial state of most municipalities in the country it is unlikely that banks will lend to new IPPs where PPA's exist between the IPP and a municipality lacking the necessary creditworthiness. As such, provincial or national governments would need to step in and provide guarantees to back such municipal PPAs.

2.5.4. Regulatory uncertainties pertaining to market reform

The relevant legislation and regulations make it clear that network owners (i.e. licensed distributors) may not refuse access to the grid for wheeling electricity, provided such access does not violate any technical or safety requirements. The market model remains a quasi-single buyer one with a good system for tendering new generation. It is possible to revise the regulatory framework to increase the level of direct contracting between consumers, traders and IPPs but this will always remain marginal if there is not a fundamental review of the overall legal/regulatory framework and market model.

South Africa has since been on a journey of market reform, driven by the goal of enhancing competitiveness and rectifying historical disparities. Throughout this period, the nation has witnessed substantial economic and policy changes, all geared towards these objectives.

As the country moves away from vertical integration, structured coordination falls away, which must be replaced by market coordination amongst the various role-players. Market coordination must be implemented through stringent policy and regulatory instruments, minimising misalignment of incentives and improving the market's overall efficiency. Market coordination is an iterative and challenging task. The integrative wheeling framework and current regulatory protocols are inadequate, leading to an uncoordinated approach to wheeling amongst municipalities.

2.5.5. Eskom's current billing regime

Eskom publishes its tariffs on its website. Eskom has a range of tariffs available depending on the category of customer. These are built up based on a combination of charges for energy, use of the electricity network (separate transmission and distribution use of system charges), administrative charges, subsidy charges, and adjustments for network losses. However, Eskom does not have a separate retail charge.

When a customer enters into a wheeling agreement with a non-Eskom generator, Eskom uses a credit mechanism for wheeled electricity whereby it charges customers for the full cost of energy (i.e. as if Eskom is supplying all electricity) and then credits the customer account for the wheeled energy (excluding losses) and the affordability subsidy charge.\(^{12}\) Eskom then levies an additional administration charge for

\(^{12}\) https://www.eskom.co.za/CustomerCare/TariffsAndCharges/Pages/Tariffs_And_Charges.aspx#:~:text=On%209%20 March%202020,implemented%20on%201%20July%202020.
undertaking this reconciliation. This means that Eskom effectively treats wheeling as an additional service, on top of its normal practices. This could be seen as unfair as customers who do not wheel energy do not pay this charge (i.e. there is an additional cost to wheeling compared to purchasing from Eskom). In parallel, the customer will pay the generator the agreed upon price of the electricity provided (which is currently also regulated by NERSA, which is totally uncommon for open market transactions), as per their bilateral contract.

Because of the complications of the production and delivery system, it is certain that at all times and for all contracts there will be a difference between the amounts contracted and the amounts actually sent out by the supplier and consumed by the customer in real time. This difference is called an imbalance. Typically, generators/customers should pay an imbalance charge if the metered production and consumption on an hourly basis is different from the schedule sent the day ahead for actual production and consumption. As will be mentioned below, India has implemented a similar imbalance mechanism to help stabilise the grid. Eskom has not imposed any imbalance charges under the current net billing system (except for the implicit penalty that customers may face due to the inability to go into credit on their bills). At this stage, given the relatively small amount of electricity contracted under this framework, this does not pose a burden on the system in real time. However, if the number of bilateral contracts between non-Eskom generators and customers grows, particularly based on supply from intermittent generation sources, then the lack of an imbalance charge would become an issue as the total amount of imbalances might require Eskom to carry out more actions in real time in order to balance the electricity grid.

Given the above, there is a limit to the extent to which wheeling contracts can increase under the current framework, before Eskom will require imbalance charges to be introduced. Introducing imbalance charges would fundamentally change the risk allocation for market participants and incentivise customers to not under-consume electricity in comparison to what is outlined in the bilateral PPA. Imbalance charges should reflect the cost to Eskom of providing balancing energy to compensate for under-delivery by a generator, and should also be structured to disincentivise over-delivery.
INTERNATIONAL CASE STUDY ASSESSMENT
3. International Case Study Assessment

3.1. Diverse approaches to the development of a wheeling framework

The aim of this section is to establish a benchmark of global best practices that can serve as a point of reference and provide transferable lessons for developing wheeling frameworks in South Africa. The decision on which markets to benchmark as based on two factors:

1. The key drivers and their impact on the South African market context based on relevant geographic factors and climate change.
2. The benchmarking exercise aims to identify various experiences from diverse market contexts and draw conclusions on how they can be applied to South Africa.

Based on the above criteria, the markets chosen are India and the United States. Both countries have a wheeling framework in place, despite having distinctly different market structures and enabling factors that lead to the facilitation of wheeling frameworks. Morocco and Namibia are also assessed to a lesser extent whereby the regulation in place applicable to specific issues in South Africa have been highlighted through the use of boxes. The differences in their establishment and implementation suggest that there is no existing one-size-fits all approach as the geographic landscape and regulatory landscape might vary. Thus, to ensure successful implementation, consideration needs to be given to the existing regulatory environment and economic enablers to speak to the specific market contexts.

3.2. Wheeling in India and the USA

3.2.1. India

In the last two and a half decades, the Indian electricity sector has struggled with low-quality power supply, lack of sufficient investment in infrastructure, energy access issues, and rising debt. Until the early 1990s, each Indian state had its own State Electricity Board (SEB), which were vertically integrated, state-owned monopoly utilities. SEBs made a first step toward reform in 1991 by allowing private sector investment in generation, and in the early 2000s, Odisha and Delhi became the first states to privatise their distribution sectors.

India ranks as the world’s third-largest electricity producer, following China and the United States. Like South Africa, India heavily relies on coal-fired power generation. As of January 31, 2023, India has an installed generation capacity of 411.6 GW, with thermal sources accounting for 57%, renewable energy at 30%, hydro power at 11%, and nuclear energy at 2%. In 2021, the country generated a total of 1,715 TWh of electricity.

Similarly, to the process being followed in South Africa, India’s electricity sector also underwent a reformation process. The introduction of the Electricity Act in 2003 set the framework for reform that aimed to improve the technical performance of the system, increase electricity access, improve transparency and governance of SEB utilities, and increase competition and private sector participation. Overall, the reforms aimed to create a more accountable and commercial performance-driven culture. The SEB utilities were unbundled into generation, transmission, and distribution functions. Each state created several companies for these functions (e.g., distribution companies, referred to as DISCOMs, and generation companies). In generation,
private sector participation has increased, whereas transmission, a natural monopoly, has remained mostly publicly owned and operated.

Electricity prices continue to be regulated for end consumers in all Indian states. However, heavily subsidised electricity prices that don’t allow DISCOMs to recover costs have been a key driver of their financial distress. As such, there was a need to remove inefficient consumer subsidies so that DISCOMs can cover their costs while also providing targeted support to poor and vulnerable consumers. To better target its electricity subsidies, India has announced its plan to include power sector consumer subsidies under its Direct Benefits Transfer (DBT) scheme as of March 2019). This reform aims to allow for market-based, cost-reflective electricity pricing while simultaneously ensuring better targeting of subsidies for the poor and vulnerable to maintain energy access.

India has set an ambitious target of achieving 500 GW of renewable energy capacity and has implemented policy support and sector reforms to work towards this goal. The Ministry of Power has identified 81 thermal units that will transition from coal to renewable energy generation by 2026. India’s grid management system was established in the 1960s, interconnecting individual state grids to form five regional grids covering mainland India, namely the Northern, Eastern, Western, North Eastern, and Southern Grids. These regional links enable the transmission of surplus electricity between states within each region.

India also introduced an electricity balancing mechanism known as the Deviation Settlement Mechanism (DSM) – a regulatory mechanism to maintain grid frequency in India. The DSM 2014 regulation is designed to have three cost components: Base charges are the amount payable for all the extra units of electricity drawn over the final schedule, termed as ‘over-drawal’ (OD) or amount receivable for all the units of electricity drawn less than the final schedule, known as ‘under-drawal’ (UD). India also introduced charges that are additional and frequency dependant. For frequencies between 49.85 to 50.5 Hz, additional charges are levied over and above the base charges for any deviations beyond pre-defined limits. These limits are set in megawatts (MW), and differ for renewable-energy rich and renewable-energy deficit states. If an entity continuously over-draws or under-draws for more than six 15-minute time blocks, it is counted as a violation and the entity is penalised by means of a sustained deviation charge. This mechanism ensures that demand and generation is forecast more accurately and that suppliers or generators stick to their given schedules.

For frequencies lower than 49.85 Hz, the state incurs an additional charge, which is equal to the base charge, for each unit of electricity drawn over the schedule. This frequency band puts the grid at high risk, and therefore the charges for over-drawing are equivalent to a double penalty (i.e. base + additional charges).

India has made an interesting policy development related to wheeling that aligns with South Africa’s green hydrogen ambitions. Under India’s National Hydrogen Policy, renewable energy used for producing green hydrogen will be allowed to be wheeled freely. Companies will have the flexibility to establish renewable energy generation capacity anywhere in the country, either privately or through a developer, and transmit the electricity to the hydrogen production facility without incurring transmission charges. The policy also permits the storage of excess green hydrogen produced for up to 30 days if capacity is set up before 2025.

Similar to South Africa, India anticipates large-scale renewable energy projects to be located in resource-rich areas far from major load centres. To transmit this power to the load centres within the state or other states, open access through transmission and distribution systems is required. The Central Electricity Regulatory Commission (CERC) in India has addressed this need by implementing concessional transmission charges.
for solar PV projects, exempting them from payment of transmission charges and losses for inter-state transmission. This incentivized investment in solar energy and facilitated inter-state sale of solar power.

Considering the similarities in energy profiles and socio-economic circumstances between India and South Africa, India’s wheeling frameworks and principles can offer valuable insights for the development of South Africa’s national wheeling framework.

3.2.2. Determining the wheeling charge in India

Cost Components and Allocation: Regulatory authorities typically consider the various costs associated with operating and maintaining the distribution network when formulating wheeling charges. These costs include expenses related to infrastructure, maintenance, losses, administration, and return on investment. The authorities analyze these costs to allocate them to different user categories.

Load Profile and Consumption Patterns: The load profile and consumption patterns of different consumer categories are important factors. Large industrial consumers may have different load profiles compared to residential consumers. The charges can be structured to account for the stress each consumer category places on the distribution network.

Distance and Voltage Level: The distance over which electricity is wheeled and the voltage level at which it is transmitted play a role in determining charges. Longer distances and higher voltage levels might result in higher charges due to increased losses and infrastructure requirements.

Cross-Subsidy Mitigation: Regulatory authorities often aim to mitigate cross-subsidies, which occur when one consumer category’s charges subsidise another. Wheeling charges might be designed to ensure that consumers who opt for open access and wheeling pay a fair share of the costs, rather than relying on traditional cross-subsidies.

Time of Day and Seasonal Variation: The regulatory frameworks consider time-of-day and seasonal variations in consumption patterns. Wheeling charges might reflect this variation to incentivize users to shift their electricity consumption away from peak hours.

Network Losses: Energy losses occur during the transmission and distribution of electricity. Wheeling charges incorporate a component to recover the losses incurred while transmitting electricity through the network.

Regulatory Objectives: Regulatory authorities often have broader objectives, such as promoting renewable energy or improving energy efficiency. Wheeling charges might be structured to incentivize consumers to adopt these objectives, such as by offering lower charges for transmitting renewable energy.

Public Consultation and Stakeholder Engagement: The formulation of wheeling charges often involves public consultations and stakeholder engagement to gather feedback and ensure that the proposed charges align with the interests of various parties, including consumers, generators, and distribution companies.

Review and Revision: Wheeling charges are not static and can be subject to periodic review and revision. Regulatory authorities assess the effectiveness of the charges, their impact on the market, and any changes in cost factors. This review process ensures that charges remain fair and relevant.
3.2.3. Key drivers of wheeling frameworks in India

India has a diverse geographic landscape that includes vast plains, mountain ranges, plateaus and coastal regions. The country also has a large population, with a large proportion living in rural areas. The geographic landscape of India presents both opportunities and challenges for implementing an electricity wheeling framework. Through various initiatives, India has also been able to increase access to energy from 76.3% in 2010 to 99.6% in 2021. Given South Africa's energy poverty, there are lessons to be learnt from India with respect to increasing energy access within a country.

In terms of opportunities, the diverse geography of India provides ample opportunities for renewable energy deployment, such as solar and wind power. For instance, the country has large desert regions that receive high levels of solar radiation, making it an ideal location for solar power generation. Similarly, India's long coastline provides opportunities for offshore wind power generation.

On the other hand, the diverse geography of India can also pose challenges for implementing an electricity wheeling framework. The transmission and distribution infrastructure in India is not uniformly developed across the country, with some regions having more developed infrastructure than others. This can result in transmission bottlenecks and congestion, making it challenging to transport power from one region to another. Moreover, the rugged terrain in some parts of the country can make it difficult to construct transmission lines and other infrastructure, which can lead to higher costs.

Despite these challenges, the Indian government has been investing heavily in transmission and distribution infrastructure to support the deployment of renewable energy and facilitate electricity wheeling. The government has also implemented several policies and regulatory reform to encourage investment in the power sector and improve the efficiency and reliability of the electricity system.

There are several key drivers shaping the electricity market in India. Some of the major drivers include:

**Renewable energy targets:** The Indian government has set a target of achieving 450 GW of renewable energy capacity by 2030, including 280 GW of solar power and 140 GW of wind power. This has led to an increase in renewable energy deployment in the country, with several policies and incentives in place to support renewable energy projects.

**Energy access:** Despite progress in recent years, a large population in India still lacks access to reliable and affordable electricity. The government has launched several initiatives to provide electricity access to all households in the country, including the Saubhagya scheme.

**Increasing demand:** India’s growing population and rapid economic development are driving an increase in electricity demand. To meet this demand, the government is promoting investments in the power sector, including transmission and distribution infrastructure.

**Technology advancements:** Advances in technology, such as smart grids, energy storage, and digitalization, are enabling greater integration of renewable energy and improving the efficiency of the electricity system.

**Energy security:** India is heavily dependent on imported fossil fuels to meet its energy needs. To reduce dependence on imports and enhance energy security, the government is promoting domestic production of renewable energy.
Regulatory reforms: The Indian government has introduced several regulatory reforms in the electricity sector, such as the Electricity Act of 2003 and the Ujwal DISCOM Assurance Yojana (UDAY), to address financial and operational challenges faced by the sector and promote competition and efficiency.

3.2.4. The United States

The electricity industry in the United States is a highly intricate system that encompasses a wide range of utilities, power generators, grid operators, regulatory authorities, and regional power grids. The continental U.S. is divided into three independently synchronised grids: the Eastern Interconnection, the Western Interconnection, and the Electric Reliability Council of Texas (ERCOT). Unlike many other countries that have a single grid or participate in a multinational grid, these grids are connected through a limited number of low-capacity direct current (DC) lines.

Similar to the ongoing restructuring in South Africa, many states in the U.S. have undergone retail electric utility restructuring, transitioning from vertically integrated utilities to separate entities for generation, transmission, and distribution. Some states have also introduced competition in retail services, primarily for larger commercial and industrial customers. This restructuring process coincided with the reformation of wholesale electricity markets and the establishment of Independent System Operators (ISOs) and Regional Transmission Operators (RTOs). This bears a resemblance to the planned reforms in the South African market. In the U.S., energy wheeling from renewable generators occurs within an ISO/RTO, between different ISOs/RTOs, and between ISOs/RTOs and regions without an ISO/RTO. Thus, wheeling can take place within the same state or involve multiple states, depending on the location of the IPP and the buyer’s point of delivery defined in their PPA. As part of the electricity industry restructuring, the Federal Energy Regulatory Commission (FERC) mandated open access to transmission facilities. FERC specified that transmission charges should be fair and economically based, which means that renewable energy generators pay the same rates as non-renewable generators for interstate transmission and wheeling. The U.S. has a well-developed wheeling framework and regulatory environment that supports increased deployment of renewables in the country. Given South Africa’s current reliance on fossil fuel-based power and its planned transition to renewable energy, having wheeling provisions that support increased renewable deployment will be crucial for the country.

In recent years, there has been a focus on transmission planning in the U.S. to connect remote areas with high renewable energy potential to major load centres. RTOs and ISOs in different states have promoted initiatives such as the Renewable Energy Transmission Initiative in California and Competitive Renewable Energy Zones in Texas. Considering South Africa’s proposed establishment of a Transmission System Operator through the Electricity Regulation Amendment Bill and the fact that many of the country’s prime renewable energy resources are located in isolated and underdeveloped areas, the U.S. model can provide valuable insights to ensure prioritised development of such areas and the evacuation of energy through supportive wheeling frameworks.

While the structure of the U.S. electricity distribution system differs from that of South Africa, the well-developed wheeling frameworks and key principles in the U.S. can offer valuable benefits to South Africa as it develops its own wheeling framework.
The geographic landscape of the United States is vast and diverse, spanning a wide range of terrains and natural features. It consists of various regions with distinct characteristics that can impact the facilitation of a wheeling framework.

On one hand, the geographic diversity allows for the development of diverse renewable energy resources. Different regions have varying potentials for solar, wind, hydro, geothermal, and biomass energy generation. This enables the establishment of renewable energy projects in areas with optimal resource availability, which can contribute to the overall generation mix and support the wheeling of clean energy across regions.

On the other hand, the vastness of the country and the geographical distance between load centres and renewable energy sources can pose transmission challenges. Large-scale renewable energy projects are often located in remote areas with abundant resources, which may be far from population centres and major demand centres. This necessitates the construction of extensive transmission infrastructure to transport the electricity generated from these remote locations to areas where it is needed. However, the U.S. already has a well-developed transmission network that spans the country, connecting different regions and enabling the transmission of electricity over long distances. This existing infrastructure can provide a foundation for implementing a wheeling framework and facilitating the movement of renewable energy across the grid.

Furthermore, the U.S. has established RTOs and ISOs that oversee the operation of the transmission grid and facilitate wholesale electricity markets. These organisations play a crucial role in managing the transmission system and coordinating the movement of electricity across regions. Their existence and experience in operating a complex grid can support the implementation of a wheeling framework by providing the necessary infrastructure, market mechanisms, and regulatory oversight.

Since many RTOs operate wholesale markets that encompass multiple states, they are regulated by the FERC. FERC has oversight of all wholesale power transactions on the two large interconnected grids: the eastern and western interconnects. Deregulated retail utilities purchase electricity at market-determined wholesale prices and then sell that electricity to customers at market-determined retail prices, given competition from other retailers. RTOs typically run three kinds of markets that determine wholesale prices for these services: energy markets, capacity markets, and ancillary services.

Several key drivers shape the electricity sector in the United States:

**Energy Transition:** The growing recognition of climate change and the need to reduce greenhouse gas emissions has driven a shift toward cleaner and renewable energy sources. This transition is driven by federal and state-level policies, environmental regulations, and public demand for sustainable energy solutions.

**Renewable Energy Growth:** The increasing affordability and technological advancements in renewable energy, such as solar and wind power, have led to their rapid deployment across the country. State and federal incentives, tax credits, and renewable portfolio standards have further stimulated the growth of renewable energy generation.

**Decentralisation and Distributed Energy Resources:** The rise of distributed energy resources (DERs) like rooftop solar panels, energy storage systems, and electric vehicles has disrupted the traditional centralised power generation model. Consumers are now actively participating in the energy market by generating their own electricity and selling excess power back to the grid.
**Grid Modernization**: Aging infrastructure, the integration of intermittent renewable energy sources, and the need for enhanced reliability and resiliency have driven investments in grid modernization. Smart grid technologies, advanced metering infrastructure, and grid automation are being deployed to improve the efficiency and flexibility of the electric grid.

**Electrification of Transportation**: The shift toward electric vehicles (EVs) is gaining momentum in the U.S. as efforts to reduce dependence on fossil fuels and curb transportation-related emissions intensify. Increasing EV adoption requires the development of charging infrastructure and supportive policies to facilitate widespread deployment.

**Grid Resilience and Cybersecurity**: With the increasing reliance on interconnected and digital systems, ensuring grid resilience and cybersecurity has become a priority. Protecting critical infrastructure from physical and cyber threats is essential to maintain a reliable and secure electricity supply.

**Market Competition and Consumer Choice**: The restructuring of wholesale electricity markets, the introduction of competitive retail markets, and the unbundling of utilities in some states have fostered market competition and increased consumer choice. This shift has opened opportunities for independent power producers, retail energy suppliers, and energy service providers to enter the market.

These key drivers interact with each other, shaping the future of the U.S. electricity sector. They influence policy decisions, technology adoption, infrastructure investments, and market dynamics as the country moves toward a more sustainable, resilient, and customer-centric energy system.

The presence of a share of variable renewable energy sources (primarily solar PV) in California has posed considerable challenges in balancing the supply and demand of electricity on the grid. This challenge, often referred to as the «duck curve,» arises from the imbalance between peak electricity demand and the generation of renewable energy. Compounding this issue is the ageing infrastructure of conventional peak capacity generation, which requires decommissioning.

To address the duck curve and enhance system flexibility, the California Independent System Operator (CAISO) has imposed certain obligations on utilities. One notable measure is Assembly Bill 2514, enacted in 2013, which mandates investor-owned utilities (IOUs) to procure 1,325 MW of large-scale energy storage and have it operational by 2024. This command-and-control approach aims to mitigate the challenges posed by the variability of renewable energy generation.

In addition to regulatory measures, the adoption of electricity wheeling in California has been facilitated by fiscal incentives. The FERC established an Investment Tax Credit (ITC) that allows for a deduction of a certain percentage of investment from taxes, proportionate to the charging time associated with renewable sources. Additionally, the US introduced a production tax credit (PTC). The PTC is a per kilowatt-hour (kWh) tax credit for electricity generated by solar and other qualifying technologies for the first 10 years of a system’s operation. It reduces the federal income tax liability and is adjusted annually for inflation. Generally, project owners cannot claim both the ITC and the PTC for the same property, although they could claim different credits for co-located systems, like solar and storage, depending on what further guidance is issued by the IRS. These initiatives in California demonstrate a proactive approach to addressing the challenges of integrating renewable energy into the electricity grid and implicitly supports the concept of wheeling.
KEY PRINCIPLES TO INCREASE WHEELING IN SOUTH AFRICA
4. Key principles to increase wheeling in South Africa

Currently, a national wheeling framework is being developed by the National Energy Crisis Committee (NECOM). The idea behind the framework is that NERSA would adopt the framework in order to provide regulatory oversight and guidance to distributors. Although the details of the framework are still vague, the idea is that the framework should not be too prescriptive due to the fact that distributors at various stages of being able to facilitate wheeling within their networks. Based on discussion with Eskom, the key principles of the framework are aligned with the basic principle of non-discriminatory access to the grid. The framework would need to be based upon core principles and may require regulatory reformations in order to support municipalities with the wheeling of electricity, irrespective of where they may be in relation to facilitating wheeling within their networks.

The key principles required to increase the application of electricity wheeling in South Africa relate to 2 key elements:

1. Wheeling will require certain regulatory reformations to be introduced in South Africa. Such reformations would ultimately result in increased generation capacity becoming available due to favourable regulatory and market conditions, thereby stimulating demand from private offtakers by means of wheeling.
2. Standardisation of tarriffing mechanisms to be used by municipalities in order to provide participants within a wheeling transaction with clarity regarding the tariffs applicable to the sale of electricity.

The key principles are unpacked in more detail below.

4.1. Regulatory reform recommendations to increase electricity wheeling

Based on the assessment of South Africa’s regulatory framework it is clear that the rules and regulations align with the most important key principle in other countries - Generators must be provided with access to the transmission and distribution network on a non-discriminatory basis. What is also clear from the international best practices is that the introduction of third party access to the grid via wheeling resulted in a seismic shift in the development of the specific country’s power sector. Wheeling and its associated rules and implementation framework requires careful design, detailed planning and a realistic impact assessment for each concerned party.

4.1.1. Introducing a market structure in line with South Africa’s Electricity Regulation Amendment Bill

The introduction of a wholesale electricity market in South Africa will most likely see an increasingly important role for energy traders to act as intermediaries within such a market structure. Energy traders could help expand the number of IPPs and customers that willingly enter into supply agreements. However, this sector is in its infancy in South Africa. Removing barriers to expand the role of traders in the market should be considered. The introduction of energy aggregators and traders allows for a portfolio effect, making it more efficient for smaller generators and customers to participate in the market, for example by facilitating power from a large generator being sold to multiple smaller customers, or generation
from multiple smaller generators being sold to a single large customer. The introduction of intermediary traders also makes it increasingly important that use of system and wheeling charges are based on an entry/exit model, rather than being applied to each purchase and sale transaction, as otherwise costs may be duplicated if the same power is bought and sold multiple times, as is seen in more developed power markets. This also reflects the reality, as recognised in the ‘Proposed Regulatory Rules for Third Party Generator to Load Wheeling’ issued by the South African National Energy Crisis Committee (NECOM) in August 2023, that as there will be no direct flow of electrons from the generator to the end user customer's point of supply, the wheeling charge should be a financial transaction whereby the wheeled energy (as measured at the Generator meter) is accounted for on the electricity bill of the customer rather than being based on the physical path between the generator and the customer.

The role and relevance of the IRP must also be considered when a wholesale market is introduced in South Africa. The requirement for IPP procurement to follow capacity allocations as set out by ministerial decisions, based on the IRP, could be restraining the development of new IPPs and hindering the role of wheeling to deliver electrons within a more open market structure. However, a number of private procurement processes, both by end users and traders, are already emerging which directly support new generation outside of the IRP.

Additionally, as stated above, current rules, such as the 2012 Third Party Access Rules would need to be updated to align with the wholesale market structure as set out in the Electricity Regulation Amendment Bill. The 2012 Third Party Network Charges Rules should be substantially amplified from a tariff framework to include a framework for the non-discriminatory access by third parties to the Eskom transmission network and the Eskom and municipal distribution networks. These revised rules would need to be complementary to a market code, which would include for example, the rules for scheduling for each of the markets: day ahead, balancing, imbalance pricing methodology, specific congestion management rules, various charges that the TSO could invoice, etc. To reflect grid constraints and incentivise generation being developed where most beneficial to the grid, location-specific entry and exit charges can provide clear signals to the market.

South Africa can look to the Southern African Power Pool and the US example to build the market structure. In the US, regional transmission organisations typically run two energy markets: the day-ahead and real-time markets. The day-ahead market, which represents about 95% of energy transactions, is based on forecasted load for the next day and typically occurs the prior morning in order to allow generators to prepare for operation. This is similar to the market configuration envisaged under the ERAB. The remaining energy market transactions take place in the real-time market, which is typically run once every hour and once every five minutes to account for real-time load changes that must be balanced at all times with supply.

4.1.2. The need to consider a regional lens

Considering the regional perspective is crucial when discussing changes in electricity market structures. South Africa is an integral part of the Southern African Power Pool (SAPP) that operates as a cooperative energy market, facilitating the trade and exchange of electricity between members and member states. Therefore, any alterations or reforms within the South African electricity market should be made with an awareness of the existing regional dynamics.
The SAPP offers a significant opportunity for South Africa to enhance energy security and ensure a stable power supply. Through interconnected grids and power trading agreements, member countries within the SAPP can share electricity resources. This regional collaboration minimizes the risk of load shedding and blackouts, which have historically plagued South Africa. Consequently, changes in South Africa’s market structure should align with SAPP objectives to ensure seamless cross-border electricity trade.

By leveraging its energy infrastructure and generation capacity, South Africa can become a key player in the regional energy market. This not only enhances the nation’s reputation as a reliable energy partner but also fosters economic opportunities through increased energy exports and foreign investments.

Additionally, recognizing the SAPP’s competitive markets is crucial. The SAPP encompasses various market segments, including the day-ahead, intra-day, week-ahead, month-ahead and balancing markets. These diverse markets cater to different energy needs and preferences. Consequently, South Africa should adapt its market structures to harmonise with these existing market segments. Ensuring compatibility with the SAPP’s competitive markets allows South African traders and generators to access a broader customer base and diversify revenue streams.

4.1.3. The need to expedite Eskom unbundling

South Africa is undertaking the reform of its heavily indebted state-owned electricity utility, Eskom. Statements promising reforms and other steps to improve the status quo have been announced amid concerns about possible job losses, issues around ownership of assets, a need for decarbonization, and likely electricity price hikes. As stated above, India followed a more practical approach to unbundling. Similar to India, a more pragmatic approach to electricity sector reform might be a better fit for South Africa. Reforms should consider the South African context and impacts beyond economic efficiency and consider the need to keep prices affordable for the poor, vulnerable, and small, medium, and micro enterprises (SMMEs), provide decent jobs, reduce coal dependence, and acknowledge calls to retain forms of public and community ownership.

From the case study analysis, it is clear that unbundling of the electricity value chain is the key prerequisite for the development of competitive electricity markets, with accounting separation between the key functions of the electricity sector at a minimum as a first step. While unbundling in general is a good initial step, unbundling of the system operation function is also often mentioned as a prerequisite for the development of national competitive electricity markets, including for open access to the grid.

In the USA, it has been difficult to legally separate transmission from generation and thus the concept of independent system operator (ISO) has been created, similar to what is envisioned for South Africa. Such a system creates the need for additional agreements and governance between the transmission owners and the ISO and is probably warranted only for larger systems. What is critical is that the system operator be truly independent of ownership and control by market participants, generators, distributors, and suppliers.

The benefit of unbundling is that autonomous entities with clear responsibilities are created, and conflicts of interests are removed. It can also result in improved network performance, as the network companies are solely interested in the efficient operation of the networks. Additionally, unbundling will improve the efficiency of regulatory activities. as unbundling should bring a greater degree of transparency, and
increased competition in generation and retail markets. These aspects would all create a more conducive environment for wheeling and providing non-discriminatory third-party access to the grid.

Based on desktop research, it is clear that some stakeholders in South Africa are concerned about the privatisation of electricity sector assets, and India has sought to implement only partial privatisation as part of its reform. Although reform has enabled greater private sector participation in generation, which has allowed an increase in the installed renewables, it has not prevented Indian SOEs from also developing and owning renewable energy projects. For example, the Indian Oil Corporation (IOC), India’s state-owned oil and gas company, has converted many of its power stations to run on solar power and now owns 222 MW of wind and solar. However, because most renewable projects were privately developed and owned in India following reform, opposition to private ownership may create a barrier to decarbonization. If public ownership and state-owned enterprises are to continue to play a strong role in the sector, there remain questions around how they can also support decarbonization and a just transition. Given the dual need to decarbonize and retain a form of public ownership in South Africa, future research is needed to evaluate how public, municipal, or community ownership could integrate renewables in South Africa.

In July 2023, NERSA issued the National Transmission Company South Africa SOC Ltd (NTCSA) with a licence to operate the Transmission system. The NTCSA has also applied for a trading licence and an import/export licence, which NERSA is currently considering. The granting of the requisite operating licences to NTCSA is one of the key dependencies required to enable the operationalisation of the NTCSA. As part of the unbundling exercise, Eskom applied to NERSA for the approval of its revenue modelling. This application is submitted for each of Eskom’s operating arms (generation, transmission and distribution) and a single decision is granted. When the unbundling materialises, this process would need to change. Based on a discussion with Eskom, what the changes would entail remain unclear. However, based on the engagement with Eskom, a lack of unbundled tariffs that properly reflects the associated costs and charges would affect Eskom’s ability to reclaim such charges and costs. Wheeling and net billing could then cause a loss of revenue for the entity, more specifically, Eskom distribution.

The question arises as to what changes, if any, will be required to ERA for the implementation of Eskom’s proposed ‘unbundling’ and restructure. It should be noted that this presently does not have any implications for ERA regarding open access and wheeling, seeing as the aspects related to wheeling are determined by the transmission/distribution licence provisions. For as long as Eskom Transmission remains a division within Eskom Holdings SOC, there will not be any impact on existing PPAs with IPPs nor on future PPAs where the Minister might determine that Eskom Transmission (as a division of Eskom Holdings SOC) is the designated buyer of electricity generated from determined new generating capacity. This does not affect the basic premise regarding Eskom and municipalities’ obligation to afford third parties open access to their networks for the purposes of wheeling electricity, unless the provisions of licence conditions are changed contrary to the express requirements of ERA.

Under the Amendment Bill the competitive market model will see the creation of a TSO under Eskom Holdings which will foster a competitive market and encourage the use of diversified market. The transmission entity has been registered by Eskom as the National Transmission Company South Africa SOC Ltd (NTCSA) in August 2023 and was issued a trading licence. Additionally, NERSA also approved an import and export license for the NTCSA, subject to license conditions imposed. As per the Amendment Bill the TSO will serve as the supervisor of the competitive market. Aside from transmission planning and
managing the transmission system, the TSO will also build a transmission expansion plan that aligns with expected power demand.

Within the TSO, the Amendment Bill also seeks to establish a central purchase agency. It will buy legacy power purchase contracts and extra energy if necessary, to retain system integrity during the transition to a competitive electricity market. The Amendment Bill also extends the list of licensable activities to include a licence for a market and system operator.

4.1.4. Enforcing municipal participation

In some instances, research has shown that municipalities are hesitant to enter into wheeling agreements. There could be numerous plausible reasons for such hesitance, however the key principle relates to the fact that municipalities would be losing a certain percentage of its customer base -

1. Reluctance on the part of the relevant municipality to relinquish customers, which will take place in the event that end-users conclude PPAs with IPPs/traders.
2. Electricity tariffs are seen as a means of subsidising local government operations on a general basis. By facilitating wheeling, the municipalities may lose a certain percentage of electricity tariffs from such customers.
3. Municipalities desire that wheeling tariffs should be structured in such a way as to recover the full surplus that the municipality would have derived from supplying electricity to a customer to whom the electricity is now to be wheeled over the municipal network.
4. Municipalities are regulated by strict municipal legislation in the form of the Municipal Financial Management Act, the Municipal Systems Act, as well as the Municipal Structures Act and the associated regulations. The implications of wheeling in relation to these pieces of legislation are difficult to navigate and understand. It will require the necessary guidance from entities such as National Treasury and SALGA in order better understand how the increased facilitation of wheeling fits into the current municipal regulatory framework.

Given the provisions of ERA and a municipalities constitutional role to provide electricity reticulation services, it can be argued that a municipality is not entitled to refuse to enter into a wheeling agreement with third parties. Nor is it entitled to impose excessive wheeling tariffs to recover surpluses that it would otherwise have recovered by supplying electricity directly to the end use.

Typically, a municipal distribution licence stipulates that NERSA shall determine the prices at which the licensee shall supply electricity to its consumers, and that the licensee is not permitted to charge any consumers with tariffs other than specified in the tariff guidelines published by NERSA. Pursuant to this framework, the typical municipal distribution licence expressly requires the municipality to maintain separate, ring-fenced accounts in respect of the electricity distribution business affairs from its other affairs so that, amongst other things, the cost of providing electricity services can be measured accurately. Similarly, the Eskom transmission and distribution licence expressly stipulate that Eskom as a licensee must provide for non-discriminatory access by third parties to the transmission and distribution power systems, and that it may not discriminate between customers, classes of customers, or end-users, regarding access, tariffs, prices, or conditions, except where objectively justifiable and identifiable differences have been approved by the Regulator. The City of Cape Town distribution licence issued in 2010 contains similar provisions.
However, based on a desktop analysis, the typical municipal distribution licence issued in 2007 does not contain similar express provisions pertaining to non-discriminatory access. Although it can be argued that licences implicitly include the principle of non-discriminatory access due to the required compliance with ERA, it is understood that certain municipalities contend that based on the omission of such a provision, they are not obliged to provide third parties with access to their distribution systems in order to roll out wheeling. However, the express obligation under section 21(2) of ERA not to discriminate as regards access cannot be ignored and must be given effect to unless and until such provision in ERA is repealed. In order to avoid confusion that may arise from the application of the provisions of section 21(3) of ERA, and to avoid any contention by Eskom or the City of Cape Town that they are being discriminated against, it is strongly recommended that NERSA amend the municipal distribution licences to include such express stipulation similar to that as set out in the Eskom and the City of Cape Town distribution licences. In order to enforce the principle of non-discriminatory access, it is recommended that section 14 of the ERA be amended to make non-discriminatory access to a municipal distribution network a licence condition that needs to be imposed by the regulator.

In addition, as stated in the regulatory analysis above, the Distribution Tariff Code stops short of mandating an approach to a specific methodology to calculating use of system tariffs by stating “Appendix 1 is a guideline for tariff design. Each distributor shall publish its own methodologies once approved by the NERSA.” Therefore, distribution licensees are allowed (under this Code) to develop their own methodologies for approval by NERSA. This could create divergences in approach (and tariff levels) due to the large number of municipalities, compared to a system whereby a single methodology is imposed. A mandated methodology must therefore be introduced for calculating charges for the use of the electricity distribution network. This must be coupled with the need for municipalities to conduct cost of supply studies. Despite national government policy (Electricity Pricing Policy, 2008) requiring licensees to perform a COS study every 5 years, uniform COS studies and tariff setting remain a challenge for most municipalities. This renders it difficult to compare costs across municipalities and extremely challenging to regulate.

The world has experienced restructuring in the energy supply industry. This restructuring’s primary goal is to create competition in the electricity supply sector to improve service quality and efficiency. Although many countries worldwide have engaged in some deregulation, the concept does not adhere to a standard model and is frequently viewed and executed based on each country’s unique conditions and needs. Therefore, some adjustments must be made in the municipal sector to meet the challenge and fully use the potential presented by the continuous deregulation. In addition, each party’s rights and obligations must be clear in a competitive setting. As a result, municipalities will be encouraged to make better investments, enhancing system performance. In South Africa, wheeling has been progressively liberated through the ongoing amendments to regulations, acts, and policy, primarily driven by the notion of creating a competitive generation sector. However, as can be seen above, there is still a need to introduce standardisation across multiple aspects related to tariff setting and ensuring non-discriminatory access to municipal distribution networks.

4.1.5. Network/Grid Risk in a Wheeling Transaction

One of the key challenges that Independent Power Producers (IPPs) are facing when concluding bilateral Power Purchase Agreements (PPAs) with private off-takers, where the generation facility and off-taker facility are not co-located, is the issue of Network Risk.

In mature, liberalised electricity markets, the Network Service Provider (NSP) guarantees a minimum level
of network availability which is an essential enabler of wheeling transactions. This principle is also defined in the Regulatory Rules on Network Charges for Third-Party Transportation of Energy published by NERSA in March 2012. However, Eskom has indicated that they will not provide any performance guarantees or take any financial liabilities for the availability of the network. This is a major bankability issue and leaves the network risk with the IPP/off-taker even though neither party is in a position to manage it.

The principle defined in NERSA’s Regulatory Rules should be enforced and should be legally binding on Eskom or any other NSP. This will remove one of the major risks in the project and streamline the negotiations of bilateral PPAs with wheeling enabling a sustainable investment for all parties. As discussed above, a good example of such enforcement is found in Morocco where the Grid Access agreement, signed with the Moroccan TSO (ONEE) and the SPV, regulate the mechanism of the Energy Not Delivered” (or “ENL, Energie Non Livrée), as described in the box below. A similar provision/mechanism should be considered for South Africa in order to provide generators with greater security in case of forced curtailment from Eskom.

Examples of African electricity sector reform

The “Energy Not Delivered” Mechanism in Morocco:

Morocco’s experience with power sector reforms has been distinct. The country had strong political objectives around rural electrification and decarbonization. Morocco has reached almost 100% rural electrification and is also a leading performer in implementing a renewable energy strategy. More than half of electricity is from private generation plants and there is significant private participation in the distribution sector as well. Amidst the reformation, the country has retained a strong, state-owned and vertically-integrated national power utility, Office National de l’Electricité et de l’Eau potable (ONEE). Additionally, Morocco pursued reforms in a selective and incremental manner in an environment where legacy entities (similar to Eskom In South Africa) can obstruct far-reaching reforms. For instance, policy makers were selective in their approach to privatising electricity distribution, through concessions. There are 11 distribution companies comprising seven public municipal utilities and four private concessions. These concession contracts typically relate to the management and maintenance of the electricity, water and sewerage assets, thereby minimising the impact of revenue losses on municipalities and enabling cross-subsidisation. The PPA agreements contracted under the renewable legal framework, between producers and final consumers, include a wheeling fee for the transmission of electricity. Tariffs are modulated for consumers of low incomes in a typical model of cross subsidisation following a social policy.

In Morocco, the Renewable Energy Law 13-09 authorises Independent Power Producers to sell their power generation directly to industrial clients connected to high voltage networks and more recently to medium voltage networks. The law also sets the possibility for IPPs to use, for their own interest, the national grid to transport electricity in the framework of a contract (Grid Access Agreement to be signed with the Transmission System Operator and - ONEE). According to the Grid Access Agreement, ONEE, upon payment of a wheeling fee, shall guarantee access to the National Electricity Network in accordance with the Law and its implementing regulations and ensure the wheeling of the produced electricity from the Production Site to the Delivery Points of the Consumption. In case of “Energy Not Delivered” (or “ENL, Energie Non Livrée), for various reasons including the unavailability of the network, the electricity will be delivered to the final consumer directly by ONEE on behalf of the IPP. In case the TSO is unable to supply the electricity directly to the final consumer on behalf of the IPP, the ENL will be paid directly to the IPP in accordance to the terms and conditions stated in the agreement.
ONEE set a threshold of 2% of the monthly production to ensure proper maintenance of the line, within this threshold there are no penalties. Exceeding the threshold, the SPV needs to estimate the ENL on a monthly basis based on the energy that was supposed to be produced by the wind farm during the disconnection/grid constraint period. This is done for energy not delivered but committed to for both peak and off-peak periods. The compensation for unsupplied energy, during a given month, if not contested by either Party, is carried out for each hourly period (peak and off-peak) by adding to the production of that month an amount of energy equal to the compensation for the same hourly period.

4.1.6. Wheeling Framework and Charges

In a wheeling transaction, both the generator and the off-taker are required to compensate the NSP for access to and use of the network i.e. Use of System (UoS) Charges. These charges are regulated by NERSA and the principles for tariff setting are clearly defined in the Electricity Regulation Act (ERA) and associated regulations. However, these principles need to be revised to reflect the evolution of the electricity market. The typical term of renewable energy PPAs is 20 years and both IPP and off-taker require a reasonably accurate forecast of all the costs.

A revision of the framework for the calculation of (UoS) charges that would provide guidance to the market as to how these tariffs would evolve in the medium to long-term would allow IPPs and off-takers to better define their business cases and enable the conclusion of bilateral PPAs.

4.2. Tariff-setting guidelines

Reliable wheeling tariffs and the competitiveness of wheeling going forward are fundamental to creating an open energy market in the municipal space. The formulation of the tariff is largely dependent on the customer base within the municipality who would benefit from wheeling the most.

<table>
<thead>
<tr>
<th>Residential Category</th>
<th>Business Category</th>
<th>Industrial Category</th>
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<tbody>
<tr>
<td>Most customers within municipalities are residential customers that procure electricity on the low voltage on either credit or prepaid electricity. The retail price of electricity is 182.37c/kWh. Therefore, wheeling to this customer base would make an excellent financial case; however, consumption is relatively low to attract wheelers. Therefore, it is not recommended that the sector would be targeted for wheeling at this stage. There is little prospect of large-scale wheeling in this sector; therefore, this sector has been excluded from the tariff setting recommendations.</td>
<td>Business customers are primarily serviced via low voltage credit metres. The retail price of electricity is 274.62 c/kWh. Therefore, wheeling to this customer base would make an excellent financial case. However, individual consumption is relatively low to attract wheelers at a large scale. Therefore, it is unlikely that this sector would be targeted for individual wheeling. Traders and aggregators may find it lucrative to wheel to multiple customers within this sector. Customers within this sector may also have set renewable energy targets, and wheeling external energy might be the only way to achieve them.</td>
<td>Industrial users in municipalities typically make up the largest portion of energy consumption. Industrial entities typically purchase electricity through the Industrial Time of Use (ITOJ) tariff structure. Due to extensive electricity requirements at higher voltage levels and high load factors, this sector typically contributes a large portion of revenue to municipal revenue streams. This sector is the most likely to be targeted for wheeling electricity due to the customer sizes. Further, companies within this category are progressively setting renewable energy goals, which may only be met through wheeling arrangements.</td>
</tr>
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</table>

13 Based on average residential price for Johannesburg for FY23 for households consuming 350kWh or less.
14 Based on average business price for Johannesburg for FY23 for households consuming 500kWh or less.
Methodologies to calculate these tariffs can be complex and difficult to implement. South Africa has relatively well developed guidance that covers the principles for calculating use of system charges. These are defined in the following documents:

- The Distribution Tariff Code, which is a subchapter of the Distribution Grid Code. As stated above, there is a need to introduce a standard methodology for tariff setting and this would require amendments to the Distribution Tariff Code.

- The Transmission Tariff Code, which is a subchapter of the Transmission Grid Code. Unlike the Distribution Code, the Transmission Tariff Code includes a calculation procedure for each tariff component to be followed (whereas the Distribution Code contains “guidelines” in its Appendix).

NERSA also publishes a “Cost of Supply Framework” which sets out high-level principles for rate setting and makes specific reference that tariffs should be developed in line with the principles and formulas in the Distribution Tariff Code. However, as stated in the regulatory analysis above, the 2012 Third Party Network Charges Rules have become irrelevant to a certain extent. As such, there is a need to amend the Rules to expressly set out a distributor’s obligation to afford non-discriminatory access in accordance with section 21 of ERA. Additionally, the Rules must expressly provide for the appropriate tariff framework, taking cognizance of what is set out in the Electricity Regulation Act, the Grid Code, the 2008 Pricing Policy and the Tariff Code. Additionally, it is necessary to make the distribution tariff methodology, as set out in the Distribution Code, a requirement rather than a “guideline” and unbundle the retail component of tariffs from other components.

Secondly, Eskom would need to develop an imbalance pricing regime similar to the system used in India. Such a mechanism must reflect the costs to Eskom in balancing deviations between the energy scheduled to be injected into or withdrawn from the network on an hourly basis and the actual energy injected or withdrawn. To efficiently despatch its own generation fleet and reserves, Eskom will require increased visibility and forecasting accuracy from private generators and their customers. The cost of balancing energy should reflect Eskom’s actual costs and also incentivise accurate scheduling, as well as the market code which will govern competitive markets in the future.¹⁵

A market code which will govern competitive markets in the future must also be developed. The code would go hand-in-hand with third party access regulation and would include for example, the rules for scheduling for each of the markets: day ahead, balancing, imbalance pricing methodology, specific congestion management rules, various charges that the TSO could invoice, etc. It is understood that Eskom is already developing such code.

There is no fully correct methodology for implementing imbalance regimes. The aim is to set an imbalance charge that is sufficiently high to encourage participants to contract as closely as possible to their demand, while not over-penalising errors (which are largely unavoidable) in order not to discourage new entrants to the market. The methods can be divided into two broad types:

- Two-price systems: the rate for providing additional capacity to cover shortfalls are charged differently (higher) than the case where there is overgeneration/spills.

¹⁵ Based on a discussion with Eskom, it has been mentioned that Eskom is considering the introduction of an imbalancing mechanism, but work is still being undertaken in this regard.
• One-price systems: shortfalls and spills charged at the same price within each trading period.

Based on the assessment of Namibia, the first phase of the proposed Namibian market will not include an electricity balancing market. For this reason, participants who are out of balance will pay regulated imbalance prices. A tolerance band has been defined for lower and upper limits with no penalties on deviations. Only imbalances outside of the tolerance zone will attract a balancing payment, i.e. if a generator under-produces or an eligible consumer overconsumes, they will be penalised. Using Namibia as a best practice example, it is recommended that the best approach to a South African imbalance regime be investigated further as the market develops (more information in box below).

Examples of African electricity sector reform

Jurisdictions in Africa have also introduced good examples of enabling regulatory frameworks to support wheeling. One such example is Namibia, as outlined below:

The Namibian Modified Single Buyer (MSB) Model is a new market reform for the electricity sector in Namibia. It builds incrementally on the existing Single Buyer Model, i.e. it represents a modification (evolution) of their existing market structure. There is no legal unbundling or privatisation of existing utilities. However, MSB will be a ringfenced entity within NamPower with separate financial statements. MSB will hold licences for:

Market Operation, Imports and Export. MSB will also carry out the following key functions: Market Operations, Planning & Procurement, SAPP Trading and System Operations support. Following the principles, the main features of MSB are:

• Opening of the market in a stepwise approach outlined in the Market Code to promote competition and choice in a phased and structured way to manage exposure to potential market risks.
• Unbundling of existing tariffs and development of new products and services to facilitate bilateral transactions and wheeling of energy.
• In the first phase of the proposed Namibian market, there will be no balancing market. Participants who are out of balance will pay regulated imbalance prices. A tolerance band has been defined for lower and upper limits with no penalties on deviations.
  – Only negative deviations will attract a balancing payment, i.e. if a generator under-produces or an eligible consumer overconsumes, they will be penalised. However, if a generator overproduces, they will not receive any payment. Similarly, if an eligible consumer/supplier under-consumes, they will still have to pay the full payment to the GENCO (based on the bilateral contract) and will not receive any credit from the market operator.

Currently, municipalities employ the wheeling credit methodology to recover the UoS charge, which uses existing tariffs. The customer is charged the full tariff for all wheeled and non-wheeled electricity used, and a rebate is given later on the wheeled electricity. This avoids the need to implement a new tariff for the wheeled electricity as municipalities find it difficult getting their wheeling UoS tariffs approved by NERSA, due to the lack of a wheeling framework to base approvals on. From discussions with Eskom, it is
developing a virtual wheeling tariff, with the same refund approach, and a proof of concept with a large customer has been agreed on to test this. Virtual wheeling is not recommended with the current billing mechanisms available and an unbundled tariff structure would be the ideal. Implementation of systems to manage wheeling remain a challenge and Eskom have plans to create a dedicated function to deal with this, however the timeline to implement could take up to 18 months.

As stated in the Electricity Pricing Guideline clause 2.6 (b) the total cost to operate the networks should be reflected in the various connection and use of system charges and no additional charges for wheeling electricity should be levied unless the wheeling action introduces incremental costs. This can be interpreted to mean that municipalities should unbundle their tariffs into the associated cost reflective tariff elements and charge a wheeling tariff which recovers the costs associated with wheeling, and that municipalities may add a reasonable margin onto these costs. Different interpretations of the regulatory framework have led to different approaches to constructing wheeling tariffs. The two approaches explained below are the revenue neutral approach and cost-neutral approach.

The wheeling credit method also known as the Implicit Use-of-System Charges approach, is the revenue neutral approach. This currently aligns with Eskom’s existing wheeling methodology where the off-taker’s electricity account is credited to the value of the wheeled electricity received. The wheeling electricity credit is to the value of the wholesale electricity pricing structure (WEPS) less losses. For generators connected to Eskom’s network, these credits will be passed onto the Municipal account which will then be relayed onto the off-taker’s account. For generators connecting to the Municipal grid, the Municipality will generate the wheeling credits based on the amount of electricity metered at the Generator’s supply point. This method is a simpler billing process and does not require an introduction of a new UoS tariff charge which is already recovered through normal prices, and the billing system is adjusted to credit the customer at the WEPS less losses credit rate for all electricity wheeled less losses.

An unbundled tariff, or Explicit Use-of-System Charges approach, is the cost neutral approach that requires an understanding of the costs involved with maintaining a distribution network, that is determined through a cost of supply study. The Electricity Pricing Guideline mandates distributors to perform cost of supply studies every 5 years to inform their tariff determinations. Under this approach, customers that receive wheeled electricity, pay an explicit UoS charge for each unit of wheeled electricity. This charge should equate to the municipality’s existing retail tariffs less Eskom’s electricity purchase costs. The UoS charge includes all approved fixed charges, demand charges and energy charges including contribution to regulated surpluses and subsidies.

4.3. Other considerations to promote wheeling in South Africa

In India, the introduction of subsidisation schemes for the vulnerable and poor were introduced. This is an important aspect to consider within the South African context, as municipal stakeholder engagement has revealed that A similar subsidisation model could be considered for municipalities who actively take action to facilitate wheeling within their distribution networks. Where non-discriminatory access to the grid and wheeling is supported within such municipalities, National treasury could possibly introduce subsidy mechanisms where municipal revenue is impacted by wheeling arrangements within a municipal distribution network.

Another key lesson from the Indian example is in India where energy generators do not incur transmission charges where the electricity is used for the production of hydrogen. Given South Africa’s commitment towards the development of our Green Hydrogen economy, a similar provision could be introduced whereby electricity is wheeled without incurring the relevant use of system charges if the electricity is generated for the purpose of producing green hydrogen.

Incentives introduced in the US also increased the volumes of renewable energy to be wheeled in the country. The combination of regulatory requirements and fiscal incentives stimulated the deployment of energy storage systems, improving grid flexibility, and facilitating the transition to a cleaner and more sustainable energy future. Such incentives may not directly be linked to wheeling, but the incentives increase the attractiveness of renewable energy generation, thereby creating the commensurate demand of renewable electricity and the need for wheeling to transfer the electrons from the generation point to the offtake point.

A further consideration is the treatment of wheeled energy injected by a generator which cannot be consumed by the intended customer, for example as a result of that customer being subject to load shedding or an issue affecting the physical grid connection of the customer. As the electricity has entered the grid and been used somewhere in the system, it would seem appropriate for that power to be ‘credited’ to the customer account (or to the trader’s account in the case of a trading transaction) such that an equivalent volume of electricity can be consumed by the customer / sold by the trader at another time.

4.4 What is next for South Africa?

Based on the analysis of the current regulatory framework pertaining to wheeling, and the examples of India and the US, there are a few key actions that can be taken in order to facilitate wheeling and incorporate the key principles set out above. The actions below are prioritized in order to provide a logical sequence of events that need to occur in order to facilitate wheeling. It must be noted that although the promulgation of the Electricity Regulation Amendment Bill will create a wholesale market that will necessitate and encourage wheeling, the reality remains that it is unlikely that the Bill will be passed within the next year. It will also take at least another 5 years for a truly competitive market to be developed once the Bill is promulgated. As such, there are more immediate actions that can be addressed before the Bill and its associated intentions are realised.
<table>
<thead>
<tr>
<th><strong>Actions associated with municipal participation</strong></th>
<th><strong>Actions related to market reform</strong></th>
<th><strong>Actions related to Tariff setting</strong></th>
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<tbody>
<tr>
<td>1. Amend the Third-Party Network Charges Rules to include a framework for the non-discriminatory access by third parties to the Eskom transmission network and the Eskom and municipal distribution networks.</td>
<td>1. Expedite the unbundling of Eskom and skills development in Eskom</td>
<td>1. Ensure that wheeling charges are based on entry/exit charges rather than linked to a theoretical wheeling ‘path’.</td>
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<tr>
<td>2. Amend Municipal distribution licences to explicitly require municipalities to provide non-discriminatory access to third parties.</td>
<td>2. Introduce incentives to increase renewable energy deployment and wheeling.</td>
<td>2. Amend the Third-Party Network Charges Rules expressly provide for the appropriate tariff framework which include unbundled tariff setting.</td>
</tr>
<tr>
<td>3. Introduce subsidies to enable cross subsidisation where wheeling has resulted in reduced municipal revenue to benefit poor and vulnerable communities</td>
<td>3. Consider the necessity and role of the IRP within the planned wholesale electricity market.</td>
<td>3. Development by Eskom and approval by NERSA of regulated imbalance prices.</td>
</tr>
<tr>
<td></td>
<td>4. Promulgate the Electricity Regulation Amendment Bill and elaborate on the role of the NERSA in relation to the Wholesale market. This must include the regulation of billing principles and NERSA’s authority in this regard.</td>
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<td></td>
<td>5. Publish the necessary Rules and Regulations associated with the operation and operationalising of the wholesale electricity market and the associated electricity trading platform</td>
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The question must be asked how these actions must be taken forward. The answer to this lies in a holistic and collaborative approach by the relevant government agencies, led by the National Energy Crisis Committee (NECOM). As stated above, the NECOM committee took ownership of the development of the National Wheeling Framework, which will be key to realise objective 2 of the Energy Action Plan which aims to enable and accelerate private investment in generation capacity. The committee has made considerable progress during the past year as communicated in the Energy Action Plan One Year Progress Report of August 2023.17 Given the proven commitment of the Committee to the alleviation of the energy crisis and its involvement in the development of the Wheeling Framework, it is recommended that NECOM take ownership of these actions with the necessary engagements with NERSA and municipalities.
