OILING THE WHEELS

Implementing Virtual Wheeling with tradeable Electricity Credit Tokens to eliminate payment risk and extend its reach

Concept Note

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HIGHLIGHTS:

- "Wheeling" is an important energy accounting framework that enables customers to access power from off-site distributed generators to meet their price hedging and decarbonisation objectives.
- Currently, wheeling models in South Africa suffer from significant implementation and financial risk exposure problems for Eskom, customers and generators.
- This limits the reach of wheeling and therefore the scale and rate of distributed generation expansion that can be viably financed and implemented.
- Implementing an Electricity Credit Token system could overcome many of these challenges and unlock much greater distributed generation investment in South Africa.
- In addition to enabling customers to meet their objectives, this will also expedite the resolution of load shedding and avoid further pressure on municipal and national public finances.

EXECUTIVE SUMMARY

South Africa's current power crisis requires a rapid and unprecedented ramp-up in generation investment. One of the quickest and most effective levers to unlock large-scale investment in generation is creating new opportunities for thousands of commercial, industrial, and other electricity consumers to procure their own power. Unlocking such opportunities will require streamlined and effective "wheeling"[1] procedures to allow for flexibility in the buying and selling, aggregation, and reallocation of power across multiple players. Aggregators and traders will play a crucial role in facilitating power supply to the commercial and industrial market by pooling generation and offtake, enabling the provision of more flexible power purchase agreement (PPA) terms to customers and mitigating investment risks. However, existing wheeling frameworks present several core barriers which will need to be resolved to maximise the large-scale uptake of non-utility power.

This concept note is designed as a contribution to ongoing discussions around new wheeling models that are easy to implement, will significantly boost generation investment and, in the context of ongoing market reforms, pave the way toward a new competitive market structure.

The note offers an evaluation of the core challenges associated with the current "traditional" wheeling framework and highlights those associated with Eskom's new and promising "Virtual Wheeling" model. It proposes the further evolution of the Virtual Wheeling concept by means of introducing an **Electricity Credit Token (ECT) System**. By reconfiguring payment flows, lowering barriers to entry, and increasing the ease of secondary trading, the ECT system is designed to address some of the sector's current challenges, mitigate risks and thereby extend the reach of the system to unlock generation investment at scale. We hope to stimulate further investigation into and refinement of this and/or other potential Virtual Wheeling models to propel progress in this critical domain.

SA's current "conventional" wheeling context

Most wheeling arrangements to date have been implemented on the Eskom network between individual generators and large Eskom-connected customers. Generally based on long-term bilateral transactions, these PPAs have been premised on the basic

[1] *Wheeling refers to a financial transaction that accounts for the transmission of power from a generator in one part of an interconnected grid system to an end-user connected to a different part of that system.*

infrastructure and (currently still manual) procedures of Eskom's traditional wheeling framework. However, this framework is not well suited to rapid growth in the market and is not designed to easily facilitate more complex "*many-to-many*" arrangements involving wheeling from multiple generators to multiple smaller customers.

There are key challenges that highlight the need for the conventional wheeling model used in the South African power sector to be updated:

- Firstly, **wheeling frameworks are in general not yet nimble enough to allow for easy reallocation of power across multiple off-takers.** This has the effect of limiting options for power supply and consumption to be optimised across portfolios of generators and customers. It also increases the risk for customers in situations when there are unexpected deviations in supply or demand, such as during load shedding, network events, wind or solar generation variations, or when consumption decreases due to lower production.
- Secondly, **wheeling power into municipal networks** (within which many commercial and industrial customers are located) **in most cases proves to be challenging at a practical level.** Key factors here are the absence of adequate wheeling policies and tariffs (and lack of political will to implement them), skills and capacity constraints, and debt issues across many municipalities. This prevents many potential customers from accessing wheeled power supply from Independent Power Producers (IPPs) or aggregators and traders of power.
- Thirdly, the **current legislative environment presents hurdles to the operations of parties that buy and sell third-party energy (traders)**. These include the requirement to firstly, obtain a trading licence from the National Energy Regulator of South Africa (NERSA) and then to be subject to onerous reporting requirements.
- Fourthly, **the need to alter Electricity Supply Agreements** (ESA) between Eskom and municipalities – as is required to implement wheeling to customers in municipal networks – is a **challenging process.**

These challenges currently make the procurement of power from private projects difficult to implement from a wheeling and financing perspective.

Virtual Wheeling as a potential "game changer"

Acknowledging the challenges of "traditional" wheeling and difficulties in reaching municipal customers, Eskom has recently unveiled plans to introduce a Virtual Wheeling product. This product aims to enable many-to-many wheeling transactions for recipients both within and outside municipal networks.

The product will require a Virtual Wheeling Platform and smart metering infrastructure which enables the aggregation of generation and load data across multiple sites across the country. Municipal and other distributors continue to issue normal electricity accounts to their customers (electricity "off-takers") who pay their bills as normal. However, customers have also purchased the wheeled power from a "buyer" (buyers are essentially aggregators, matching a portfolio of generation and off-taker allocations) and have thus in effect double paid for the wheeled kWhs. Eskom therefore pays a cash refund to the buyers who settles with the off-takers. Eskom will not pay the refund if the respective distributor (mostly municipal) is in arrears on their bulk account. A Virtual Wheeling pilot is currently underway, driven by Vodacom (buyer),

Mezzanine (Virtual Platform provider) and Eskom.

The Virtual Wheeling proposal represents a promising step forward in South Africa's wheeling landscape. However as demonstrated in this concept note, the Virtual Wheeling model still suffers from three important disadvantages:

- Firstly, **the model poses high credit risk associated with the Eskom refund**. This risk stems from the fact that initially a double payment is made for the power being wheeled, whereafter a refund must be made to the buyers after the cash has been paid over to Eskom by the (mostly municipal) distributors. The growing problem of municipalities defaulting on their Eskom bulk accounts means this creates a significant risk for buyers. Furthermore, Eskom itself is also not a creditworthy counterparty and, because Virtual Wheeling IPPs will not benefit from government off-take guarantees as is the case with REIPPPP[2] projects, buyers will also be exposed to Eskom risk. Therefore, both Eskom and municipal payment risks permeate the model and will hinder the ability to finance Virtual Wheeling transactions.
- Secondly, **the model still has the effect that buyers selling to third parties[3] have to be licensed by NERSA,** which is not an easy process and exposes traders to onerous reporting requirements, especially as transaction volumes increase.
- Thirdly, **it will tend to concentrate bargaining power in the hands of buyers**, relative to the ultimate off-takers, as each off-taker will be beholden to its buyer especially with respect to adjusting for over- or undersupply.

Oiling the Wheels: Electricity Credit Tokens (ECTs)

This concept note investigates ways to enhance Eskom's current Virtual Wheeling model by (a) removing municipal and Eskom payment risks; and (b) further de-risking the contractual commitment for customers (formerly "off-takers")[4], and therefore ultimately also for the underlying IPPs themselves by making it easy for customers to adjust their positions each month.

The primary contribution of this note is the proposal for an **Electricity Credit Token (ECT)** system as a modified approach to implementing Virtual Wheeling. Instead of paying their full distributor/municipal bill with cash (to be refunded to the buyer later), customers can obtain a credit on their municipal accounts on presentation of appropriate ECTs in lieu of cash payments, and municipalities will do so in turn with the aggregated ECTs, on their Eskom bulk accounts.[5]

At its core, **Electricity Credit Tokens (ECTs) are *enforceable claims to a credit on an electricity account and are therefore a financial instrument*. ECTs do not represent the ownership of electricity.** ECTs are issued at the generator's connection to the network (busbars) when the power is injected into the grid, tracked, and reconciled at various levels of electricity account payment (customer to distributor, and distributor to Eskom) by a Virtual Wheeling Platform. In this way, the use

[2] *Renewable Energy Independent Power Producer Procurement Programme*
[3] *Where buyers are a different legal entity to the ultimate off-taker(s)*
[4] *We use the term "off-taker" in accordance with Eskom's terminology for both conventional wheeling and virtual wheeling when we refer to a wheeling customer that is deemed to take ownership of the power and on whose behalf the power is "transported" over the grid. We use the term "customer" when we refer to a buyer of electricity credit tokens who therefore does not take ownership of the associated electricity.*
[5] *In this respect the ECT system has some resemblance to conventional wheeling, but there are important differences and advantages.*

of ECTs alters Virtual Wheeling payment flows and eliminates the credit risk associated with the dependence on Eskom to provide a cash refund.

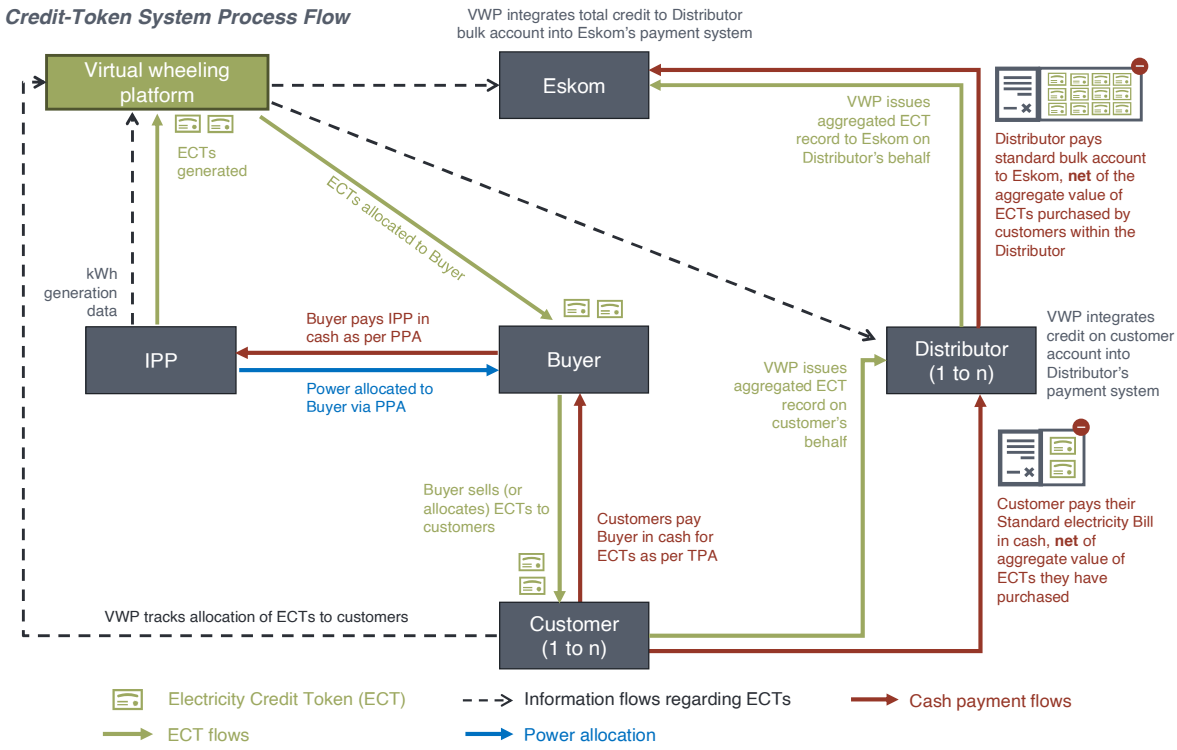
At a high-level, the ECT system operates as follows:

- IPPs generate power and feed it into the interconnected national power grid.
- Buyers (traders, aggregators, or individual customers) pay the IPPs for an agreed volume of power at an agreed price, based on conventional PPAs.
- A verified Virtual Wheeling Platform (VWP), acting as a service provider to the buyer, receives the metered IPP generation data and generates unique Electricity Credit Tokens (ECTs) containing all the relevant information of the kWh that each Token is associated with, including that required to prove its green attributes if applicable. The credit value of an ECT is determined and recorded in term of the rules set by its guarantor, in this case either the Eskom Central Purchasing Agency or the Eskom Distribution Group. The current rules are the Eskom Wholesale Electricity Pricing Scheme (WEPS) c/kWh rate in each time-of-use period (peak, standard, off-peak), "excluding losses" (or any other future basis for its valuation).
- ECTs are allocated by the VWP to each buyer in accordance with matching instructions from the IPPs and the buyers under their PPAs.
- Buyers then sell (or allocate) these ECTs to customers based on the Token Purchase Agreements (TPAs) concluded between them.
- Customers can re-sell tokens as necessary to adjust their positions in relation to their monthly electricity bills (buyers can facilitate this).
- Tokens are tradeable nationally between customers located in participating distributors.
- Customers pay their electricity bills to their distributors *net* of the aggregate value of the ECTs they have purchased. For this they rely on information provided by the VWP (on behalf of the buyer). The VWP will also implement the customer's ECT value for the month as a credit in the distributor's account payment system (In practice the VWP can implement the entire bill payment process on behalf of customers). For this VWP can piggyback on the services provided by the numerous payment services that are already implementing pay services for municipalities and implementing credits on customer accounts. Even poorly performing municipalities are able to receive payments.
- Distributors in turn pay their bulk electricity bills to Eskom, *net* of the aggregate value of ECTs purchased by customers within the distributor's network. Again, the necessary information is provided by the VWP, who can also implement it into the Eskom account payment system.
- At the guarantor level (Eskom in this case) an ECT is only valid for the settlement of a bill covering the period in which the ECT was generated. The necessary matching can be performed by the VWP.
- Distributors can make their own matching rules for customers. Depending on their objectives and their ability to absorb ECTs in each monthly Time of Use (TOU) period on their Eskom bulk account they can either follow the Eskom wheeling rules, or they can offer a different regime that still enables them to meet their Eskom-level obligations but offer greater incentives or flexibility to customers. The

VWP can apply these rules when calculating the credits to be applied.

- ECTs can be implemented as a distributed ledger system[6] which will have many long-term benefits, or by means of a conventional, centrally controlled database. In either case the information will be verifiable and auditable by any interested party.

Figure 1: High level process flow for the ECT system



Benefits of the ECT system

The ECT system introduces significant improvements to the 'traditional' Wheeling and Virtual Wheeling models, offering two primary advantages for large-scale distributed generation investments:

1. The system facilitates easy Credit Token (ECT) and Token Purchase Agreement (TPA) trading to manage supply imbalances. Customers, buyers, and traders can adjust their ECT supply based on their requirements. This can be done by trading current ECTs for the current billing cycle or by trading long-term TPAs, offering flexibility for both short and extended periods. This reduces the risk for customers, buyers and IPPs.
2. The system mitigates the payment risks associated with municipalities and Eskom for buyers, and consequently for the IPP and its financiers. This stems from modifying the current Virtual wheeling model to eliminate the "double payment" issue. With ECTs, the need for cash refunds to buyers is eliminated, preventing potential payment delays or defaults by Eskom or municipalities. The

[6] *See a short description of distributed ledger systmems in Appendix A. The following distributed ledger (block chain-based) implementations are already being used in the power sector: https://www.energyweb.org/, https://www.powerledger.io/, https://suncontract.org/*

ECT model avoids payments between the guarantor (Eskom), distributors, and buyers.

By incorporating these features, the ECT system, which is built upon existing Wheeling concepts, addresses core barriers to the traditional and Virtual Wheeling models, thereby de-risking investments and facilitating the flows of finance by banks and other financial institutions. This will enable more and larger generation projects to be built. This Token-based model will not be a silver bullet as there may be initial challenges in requiring that distributors (Eskom or municipalities) accept Credit Tokens for account settlement. However, from our perspective, if backed by Eskom, the ECT system best harmonises the goals of simplifying distributor implementation and expanding Virtual Wheeling accessibility and bankability (i.e., lowering barriers to entry).

The table below summarizes the key benefits of the proposed ECT system:

Table 1: Key benefits of the proposed ECT system

Key Benefits		Details
Enhances power project viability and bankability	*Eliminates municipal and Eskom payment risk*	**By avoiding the initial double payment for power,** the system **removes exposure to the risk of Eskom not providing a cash refund** due to default (either by Eskom or a municipality). Removing this risk enhances the bankability of Virtual Wheeling transactions.
	Liquid Credit Token trading reduces supply and off-take risks	**Facilitating the easy trade or reallocation of ECTs and TPAs mitigates risks for buyers, customers, and generators** by allowing these parties to flexibly adjust their supply and off-take positions as needed. Core benefits arising from this flexibility include: • Customers can commit to purchasing larger amounts of tokens (thereby supporting larger generation projects), knowing they can trade out of excess supply if necessary, either directly or through a trader or buyer. • Counterparty risk is diminished for IPPs across the long lifespan of their projects by ensuring a liquid market for ECTs (which are essentially the financial obligations that "back" the longer-term buyer PPA payments), even if buyers or customers opt for shorter-term TPAs. • These factors make it easier for buyers and customers to enter into PPAs and TPAs and further enhances the possibility of projects to be financed. An additional benefit is that **the standardisation of the system allows for ECT trading between all customers of participating distributors** (facilitated by VWPs). This flexibility means that trades can occur even across municipal boundaries, which is a significant advancement over previous models.

Key Benefits		Details
Lowers barrier to entry for buyers (including "traders")	*Limited licensing, commercial and regulatory requirements*	ECTs, as financial products, represent a tradeable claim to credit against Eskom, not the trading of electrons. Therefore, **the ECT system does not require buyers selling Tokens to third parties to obtain trading licenses from NERSA.** Furthermore, **the model does not require the modification of Electricity Supply Agreements** (ESAs) because ESA payment terms are sufficiently generalised, and the Guarantor agreement will place a specific, enforceable obligation on Eskom to accept valid Tokens as settlement on distributor bulk accounts. These factors offer an edge over traditional and Virtual Wheeling, removing the trading licence and other legal barriers.
	Initially avoids the need to install smart meters for customers	Depending on the rules applied by the relevant distributor the ECT system does not necessarily require the installation of smart meters for all customer categories from the outset. Eskom applies time-of-use metering at the distributor level for bulk account purposes. For certain customer categories distributors can, based on standardised data about customer load profiles, implement rules relating to the percentage of Peak, Standard and Off-peak ECTs to allow. This offers an edge over Virtual Wheeling for which Eskom currently requires the installation of smart meters.
Presents tangible cost savings opportunities for customers	*Financial Hedging strategy for Customers*	**Purchasing ECTs under a TPA offers a hedge against future electricity tariff hikes**. Under a TPA, customers can achieve financial savings due to the price difference between the stream of ECT purchase payments (which could be inflation indexed) and the ECT credit face value that will inflate with Eskom energy tariff increases.
Allows customers to decarbonise their power consumption	*Green Attribute Tracking*	As part of their unique identifier properties, **ECTs contain verified information regarding the technological source of generation and the carbon content of the energy produced.** This feature is particularly beneficial for various reporting requirements, the issuance of Renewable Energy Certificates (RECs) and ensuring transparency and accountability in green energy transactions. Depending on the business strategies buyers will be able to provide customers with ECTs for a portion, or all their electricity kWh consumption, which could enable customers to both fully decarbonise their power consumption and completely hedge against increases in the kWh portion of their tariffs.
Reduces financial and operational pressure on Eskom		The ECT system will facilitate the rapid uptake of additional generation capacity, reducing load shedding and expensive diesel-fired generation costs for Eskom. It removes the need for Eskom to pay out cash refunds. Furthermore, over time it will reduce Eskom's credit risk exposure to municipal distributors as the portion of Token-backed power supplied to each municipality increases. Over time it will reduce Eskom's risk of non-payment by municipal distributors by reducing their exposure to municipalities.

Key Benefits	Details

Municipalities remain at least Revenue Neutral and benefit in other ways	• Municipalities will at a minimum remain **revenue-neutral** under the ECT system (the working capital implications will depend on the timing of customer and Eskom bulk account payments).
	• The ECT system will protect and grow the municipal margin on power sales through the following effects:
	  ○ **Reduced customer input costs.** By giving its customers access to Token-based TPA price hedging, municipalities will enable its customer base to soften the blow of above inflation Eskom tariff increases (input costs). This leaves more room for municipalities to generate appropriate margins on their electricity sales on a per kWh basis.
	  ○ **Protects sales volumes.** Lower input costs and the ability to achieve decarbonisation by means of ECTs will, all things being equal, enable customers to maintain their municipal power consumption and mediate their incentives to lower their demand by installing solar panels. This will therefore protect the Rand value of the municipal margin earned on these sales.
	• Municipalities can offer to credit surplus customer ECTs at a discount and benefit financially at the full Gen Wheeling tariff on their Eskom bulk accounts.
	• Municipalities can themselves procure ECTs by means of TPAs (rather than only signing conventional long-term PPAs) and benefit from the trade-ability of ECTs and TPAs (they can act as "Buyers" or as customers).
	• If municipalities want to allow inter-municipal trading, the VWP can simply implement the relevant debits and credits for the respective municipalities in the guarantor (Eskom) bulk accounts.

Sets up trading practices and supporting infrastructure that will facilitate the transition to SA's future Power Market	The ECT system will set up the power generation tracking and customer load reconciliation systems that will be critical for the functioning of the future SA power market. The ECT system and the valuation of Credit Tokens can also **be linked into future multi-market** mechanisms (a change of guarantor) that are envisaged in legislation currently before Parliament. Adopting the system in the near-term will familiarise a large cohort of stakeholders with early-stage commercial power trading practices in preparation for further power market developments.

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GLOSSARY

Terminology	Definition
Busbar	A system of electrical conductors in a generating or receiving station on which power is concentrated for distribution.
Buyer	A term used in describing the Virtual Wheeling and ECT systems respectively. It refers to an entity that buys power from an IPP and either allocates the power (for VW) or the related ECTs to different related off-take sites, or sells power (for VW) or Credit Tokens (ECTs) to third parties. Such an entity could be a corporate with multiple disaggregated off-take sites, a trader or an unlicenced aggregator selling ECTs.
Customer	A distributor's electricity consumers and, in the context of the ECT system is also used to refer to distributor electricity consumers who also purchase ECTs (in the context of ECTs "customer" is used in contrast to the term "off-taker" in the Virtual Wheeling system).
ECT	Electricity Credit Token
ECT System	Electricity Credit Token System
ESA	Electricity Supply Agreement
Guarantor	The party who has the ultimate binding and enforceable obligation to recognise Credit Tokens as valid claims to a credit on electricity accounts and are at the point in the value chain where the tokens are redeemed.
Hedge	An offsetting position in a related asset or investment to reduce the risk of adverse price movements. Hedges reduce potential losses but typically also chips away at potential gains.
IPP	Independent Power Producer
Off-taker	An entity to whom ownership of electricity has passed and who physically takes the power from the grid. (Relevant to conventional and Virtual Wheeling)
PPA	Power Purchase Agreement
ToU period	Time-of-use period, refers to a specific timeframe (typically in a day) during which electricity prices vary based on demand, encouraging consumers to use less power during some times of the day and more in others.
TPA	Token Purchase Agreement
Trader	Buyer and seller of power and/or Credit Tokens
VWP	Virtual Wheeling Platform
WEPS	Wholesale Electricity Pricing Scheme

1 INTRODUCTION AND CONTEXT

South Africa faces a pressing trilemma comprised of energy security constraints, escalating electricity tariffs and mounting decarbonisation pressures. These drivers have triggered the rapid adoption of onsite rooftop solar PV and battery storage solutions by many power consumers across the country in their efforts to secure greener, cheaper, and more reliable power. However, many customers remain unable to generate power sufficient to meet their needs on their own premises.

"Wheeling" presents a way for consumers to access alternative power supply from off-site generation plants. Wheeling describes a financial transaction that accounts for the transmission of power from a generator in one part of an interconnected grid system to an off-taker connected to a different part of that system.

Recent regulatory reforms in SA's power sector have paved the way for wheeled power transactions involving Independent Power Projects (IPPs) and private power customers[7]. These reforms have also unlocked opportunities for private trader and aggregator entities to connect and facilitate transactions between multiple generators and smaller customers who are unable to invest in their own large-scale wheeled power projects.

Eskom, the national power utility, already facilitates wheeling within its network between generators and customers connected to medium- or high-voltage systems operating under time-of-use tariffs. South Africa has seen a surge in interest from many Eskom-connected large industrial customers to initiate wheeled power transactions. Though Eskom's "traditional" wheeling model has proven sufficient for bilateral wheeled power transactions, the utility acknowledges that the model is ill-equipped to seamlessly manage transactions between multiple generators and multiple buyers of power, which would be characteristic of a competitive market model (Rantwane and Eskom, 2023).

Several metros and municipalities including the City of Cape Town (CoCT), George Municipality and Nelson Mandela Bay Municipality (NMBM) have established wheeling frameworks to guide transactions that involve the utilisation of their municipal distribution networks[8]. However, most other municipalities are still in the early stages of considering such policies and frameworks – if at all. A National Wheeling framework is currently under development within the wheeling workstream of the National Energy Crisis Committee (NECOM), which intends to provide a standardised mechanism for implementing wheeling in municipalities across the country. However, there is scepticism surrounding its practical implementation.

Even with a standardised framework in place, wheeling power into municipalities will likely remain challenging due to current skills and capacity deficits to manage wheeling transactions and integrate these into municipal billing systems. Implementation will also remain difficult due to the fraught relationship between Eskom and the many municipalities that are in arrears on their bulk electricity accounts. This issue makes it difficult to implement amendments to existing Electricity Supply Agreements (ESA) between Eskom and municipalities, as is required to

[7] *A significant shift includes the amendment of Schedule II of SA's Electricity Regulation Act (2006) published in October 2021 to remove the market licencing requirements for large generators, and allowing generators to sell to multiple private customers.*

[8] *Much of this progression has resulted from efforts by various institutions and organisations – including Sustainable Energy Africa (SEA) in cooperation with the South African Local Governments Association (SALGA) – to build capacity within municipalities to engage with wheeling.*

enable wheeling from Eskom's grid into any municipal grid.

The above factors limit the potential impact that wheeling can have on unlocking urgently required large-scale private investment in power generation in South Africa. The challenges are particularly significant within the emerging trading and aggregation sector, negatively impacting the ability of traders and aggregators to connect generators with the next "tier" of smaller- to medium-sized customers located within municipal boundaries.

Eskom's proposed Virtual Wheeling model offers a promising solution to some of the challenges with the "traditional wheeling" model highlighted here. The Virtual Wheeling model will involve a Virtual Platform and smart metering infrastructure that will enable the aggregation of generation and load data across multiple sites across the country. The final off-taker – in addition to procuring power from an independent generator or trader (buyer) – continues to pay its municipal electricity bill as usual (leaving the municipality's revenue unaffected) and is in turn issued a cash refund from Eskom for power purchased from independent sources. The model thereby avoids the need for municipal involvement and negates the need for an updated ESA. A Virtual Wheeling pilot is currently underway, driven by Vodacom, Mezzanine and Eskom.

However, we observe several issues with the current version of the Virtual Wheeling model that may impede the scale of its implementation, including but not limited to the requirement for an effective "double payment" for power and reliance on a cash refund to realise value.

This concept note begins by outlining the current "traditional" wheeling framework. It then continues to describe Eskom's proposed Virtual Wheeling solution, illustrating the key barriers that the solution aims to address. The note then highlights the opportunities associated with Virtual Wheeling as well as key challenges and risks associated with the current proposed framework. Finally, the note proposes a modified alternative model for implementing Virtual Wheeling in the form of a system that implements tradeable Electricity Credit Tokens (ECT).

2 "TRADITIONAL" WHEELING IS NO LONGER SUITED TO SA'S RAPIDLY EVOLVING POWER MARKET

Although the wheeling of power is currently possible within Eskom's network and into the networks of a select few municipalities, a vast improvement in current wheeling modalities will be required to unlock private and renewable power supply to a wider, deeper customer base in South Africa.

2.1 ESKOM-TO-ESKOM WHEELING

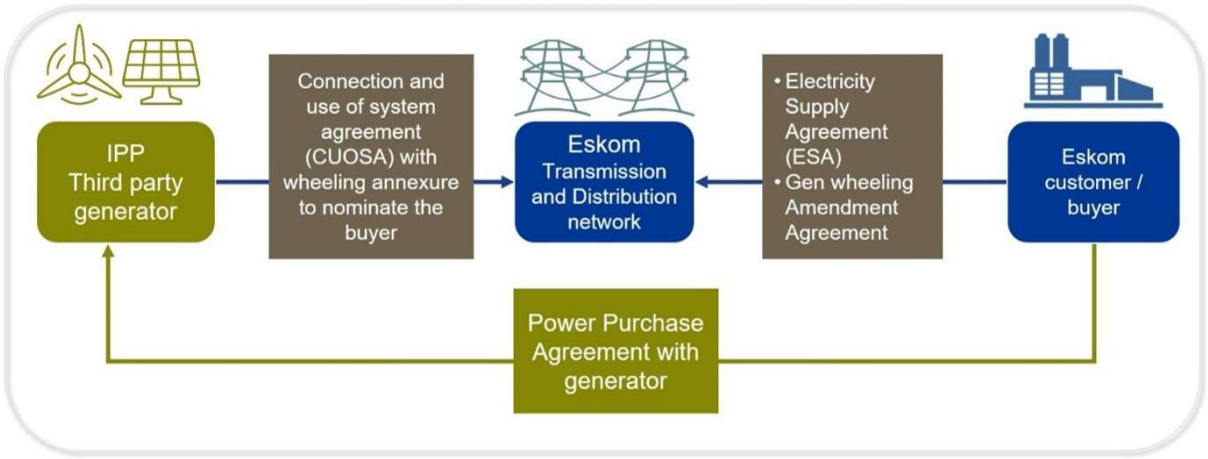
Eskom's current wheeling framework and reconciliation methodology (Eskom, 2022) has been reported to be adequate for long-term, bilateral wheeling arrangements between large generators and Eskom-connected customers. Many of these transactions are being performed on a one-to-one basis and are reconciled manually by Eskom every month. The system is still in the process of becoming automated. The current approach is not suitable for the administrative requirements associated with multiple generators wheeling power to a large number of buyers.

2.1.1 Wheeling contractual arrangements

Figure 2 depicts the contractual agreements involved in "traditional" wheeling:

- IPPs need to secure a **power purchase agreement (PPA)** with an Eskom-connected off-taker of power.
- IPPs require connection and **Use of System (UoS)** agreements with Eskom and must nominate the customer(s) they intend to wheel power to. IPPs also need to notify Eskom if they intend to make any adjustments to the purchase arrangements (i.e., sell to different customers instead or adjust the amount of power sold, etc).
- The off-taker needs to amend its **Electricity Supply Agreement (ESA)** with Eskom, to ensure that wheeling credits are reflected on the off-taker's electricity bill (Pienaar, 2023).

Figure 2: Contractual agreements involved in Eskom Wheeling transactions



Source: Eskom (2022)

2.1.2 Eskom's wheeling tariff is a credit mechanism

Eskom's existing "Gen-Wheeling" tariff structure is designed so that the customer is credited on its monthly electricity bill for the energy (kWh) supplied to it by an independent, non-Eskom generator via a wheeling transaction (Eskom, 2023). The core components of the Gen-Wheeling tariff for customers are[9] (Table 2):

- A credit for the volume of power purchased from an independent generator, valued at Eskom's prevailing Wholesale Electricity Pricing Scheme (WEPS) c/kWh rate in each time-of-use period (peak, standard, off-peak), "excluding losses". WEPS reflects Eskom's cost of producing power at different times of the day, and "excluding losses" means that the rate does not include the cost of losses incurred during the transmission of the power to the customer. In effect, the customer's bill is credited at a rate that only reflects Eskom's avoided cost of *generating* power and *not* the cost of the losses incurred during the transmission of that power. Therefore, the cost of transmitting power to the customer via Eskom's grid remains recoverable. Losses are calculated based on where the customer is located within the grid. Eskom's

[9] *See a detailed breakdown of the Gen-wheeling tariff structure for different customer types (non munic urban, non munic rural, munic urban and munic rural) on p.37 of Eskom's 2023/2024 Tariff Book.*

Transmission and distribution Use of System Charges for generators include positive or negative adjustments, depending on their location on the grid, to "locate" all generators in Gauteng for the purposes of calculating the losses charged to customers.

- An administration charge for the management of the wheeling transaction.
- For Eskom-connected urban customers, a credit for the c/kWh Affordability Subsidy Charge they would be liable for if purchasing power via Eskom's tariff.

The issuance of the wheeling credit is subject to a reconciliation process by Eskom of *energy* produced by the generator and consumed by the designated customer over a set period (currently monthly). The credit is determined based on the lesser volume of energy generated and consumed during each time-of-use period over each month.

Customers remain liable for a series of other fixed network charges and charges for the balance on their energy (kWh) usage.

Table 2: Eskom WEPS Energy charge 2023/24, excluding losses (VAT excl.)

Energy Charge (c/kWh)	Low Demand Season	High Demand Season
Peak	153.93	478.93
Standard	104.82	142.63
Off-Peak	65.23	75.88

2.2 WHEELING INTO MUNICIPAL NETWORKS

Where a customer is located within a municipal network, wheeling is possible in cases where the municipality has adopted a formal wheeling framework, inclusive of a tariff and billing policy. A handful of metros and municipalities have now established wheeling systems, including CoCT, City of Ekurhuleni, City of Tshwane, George Local Municipality and NMBM[10]. However, there are still only a limited set of examples of wheeling transactions between generators and end-customers located in municipal networks.

2.2.1 Wheeling contractual arrangements

Contractual arrangements for wheeling to customers located in municipal networks bring an additional layer of complexity. In these cases, the municipality becomes the effective Eskom-customer that receives a credit on its bill for *energy (kWhs)* consumed but not produced by Eskom, valued at the WEPS rate (excluding losses) applicable to local authorities (Eskom, 2023). The municipality in turn will enable the final off-taker to offset their wheeled energy purchased based on the municipality's wheeling tariff structure.

Additional contractual arrangements include:

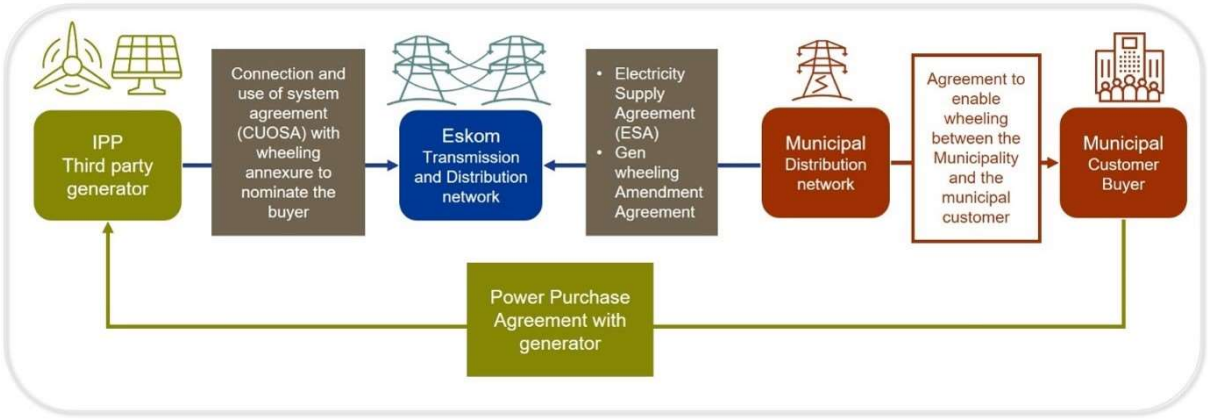
- **An amendment to the ESA between Eskom and the municipality** (since the municipality will purchase less power from Eskom) is required. Amending these ESAs has proven to be a major hurdle. Generally, Eskom requires a security

[10] *City of Cape Town Wheeling Pilot Project; City of Ekurhuleni Wheeling Policy; George Local Municipality Wheeling Guideline; and Nelson Mandela Bay Municipality Renewable Energy Guideline*

deposit prior to signing a new or amended ESA, meaning that municipalities will need to pay up (sometimes very large amounts). Whilst announcements have been made that this requirement will be waived for municipalities in good financial standing, very few municipalities will be able to demonstrate this position.

- The final off-taker will need to enter into an agreement with the municipality recognising that it will be wheeling power over the municipal grid.

Figure 3: Contractual agreements involved in Eskom and municipality wheeling transactions.



Source: Eskom (2022)

2.2.2 Municipal wheeling charges

Sustainable Energy Africa (SEA) and the South African Local Governments Association (SALGA) have recently released a joint report on the status of wheeling in SA municipalities, highlighting that there are still very few municipalities with operational wheeling frameworks (SALGA, 2023). Based on the current set of municipal frameworks, the report identifies two main means of implementing wheeling charges:

1. Explicit use-of-system (UoS) charges
2. Wheeling energy credit mechanisms

Like Eskom, municipalities are regulated entities and therefore any new tariff methodologies and charges would need to be approved by the National Energy Regulator of South Africa (NERSA). The approval process for an explicit wheeling / UoS charge would require detailed Cost of Supply (CoS) analysis by the municipality to disaggregate the key cost elements associated with providing power supply to end-users (energy costs, distribution network costs, ancillary services, etc). Most municipalities lack updated CoS studies, which limits their ability to correctly separate out tariff components for the use of the network versus energy consumption, etc. The CoCT's current wheeling pilot is one that uses the explicit UoS approach.[11]

Due to its relatively simpler billing requirements, municipalities that have begun

[11] *Tariffs are designed so that the customer pays an explicit UoS charge (which includes fixed costs, distribution costs etc.) and for any energy that is consumed by the customer, but which is not provided by an independent generator/trader but by the City. Unlike Eskom which reconciles energy credits monthly, CoCT will reconcile energy generated and consumed on a half-hourly basis. When the customer consumes more energy than was wheeled by the IPP or trader during any half hour, it will pay the regulated municipal price for that energy. When the customer does not consume all the energy fed into the grid by a generator or allocated to it by a trader during any half-hour, the customer is paid for this excess power at a feed-in tariff (the value of which is yet to be determined).*

to engage with wheeling have tended to opt for an energy credit approach, which credits the customer bill instead of charging the customer a specified wheeling tariff (i.e., the same approach as Eskom). The crediting approach involves the customer being charged its full standard usage bill, but with a credit applied for the value of the *energy* it has purchased from an alternative supplier. This value should effectively be in line with the Eskom WEPS rate, i.e., the rate at which the municipality will in turn be credited by Eskom on its bulk account for the wheeled power.

2.2.3 Key municipal wheeling challenges

As highlighted, only a handful of municipalities have wheeling frameworks in place and few examples of projects in municipalities exist. The following factors appear to be the most pressing barriers to municipal wheeling:

- The absence of a standardised wheeling framework to guide municipal engagement with wheeling;
- The absence of CoS studies in most municipalities, preventing appropriate wheeling tariffs from being set;
- Skills and capacity deficits at the municipal level for administering wheeling transactions and integrating transactions into their billing systems.
- Debt and payment challenges from municipalities to Eskom, making the amendment of ESA between the parties as required for wheeling very difficult.

These challenges make it hard to finance IPPs targeting municipal customers. Generally, banks are hesitant about financing projects wheeling power into municipal networks. This is unless they deal with the few large, stable metros or municipalities, which are in good financial standing and have clear wheeling frameworks. Consequently, the practice of wheeling is predominantly confined to customers directly connected to Eskom's network in South Africa, and specifically to bilateral arrangements between large generators and customers. This situation means that, in general, a significant segment of South Africa's accessible commercial and industrial market is precluded from accessing alternative sources of wheeled power supply.

3 ESKOM'S PROPOSED VIRTUAL WHEELING MODEL AIMS TO ADDRESS CURRENT BLOCKAGES

Acknowledging the complexities of wheeling power into municipal networks and from various generators to multiple customers (including those with dispersed off-take sites), Eskom has recently announced plans to introduce a "Virtual Wheeling" solution. This initiative aims to amplify the potential for wheeling throughout the country.

3.1 WHAT IS VIRTUAL WHEELING?

Like with conventional wheeling, the Virtual Wheeling mechanism involves the matching of power generated and consumed by customers, per consolidation interval (which is currently monthly) and within each time-of-use period. Against this data, a *cash refund* is issued by Eskom for the wheeled energy on a consolidated basis to a "Buyer" – an intermediary between the generator and off-takers (final consumers). Although the concept is currently in the design phase, ongoing interactions with Eskom indicate a strong motivation within their Market Services team to realise the operational implementation of Virtual Wheeling.

A catalyst in this area has been the Vodacom, Mezzanine, and Eskom partnership to incubate a Virtual Wheeling pilot. Vodacom is responsible for 80% of the Vodafone group's emissions and consequently is facing

growing pressures to decarbonise and achieve net zero, like many other corporates. This has forced them to assess the green power opportunities at their numerous sites across various municipalities in South Africa – especially their towers. Virtual Wheeling presents a way of facilitating the transactions from an Eskom-connected generator (or generators) to all these entities without needing to implement distributor billing system energy credits for each individual customer[12] - and without running up against the constraints highlighted in section 2.2.3.

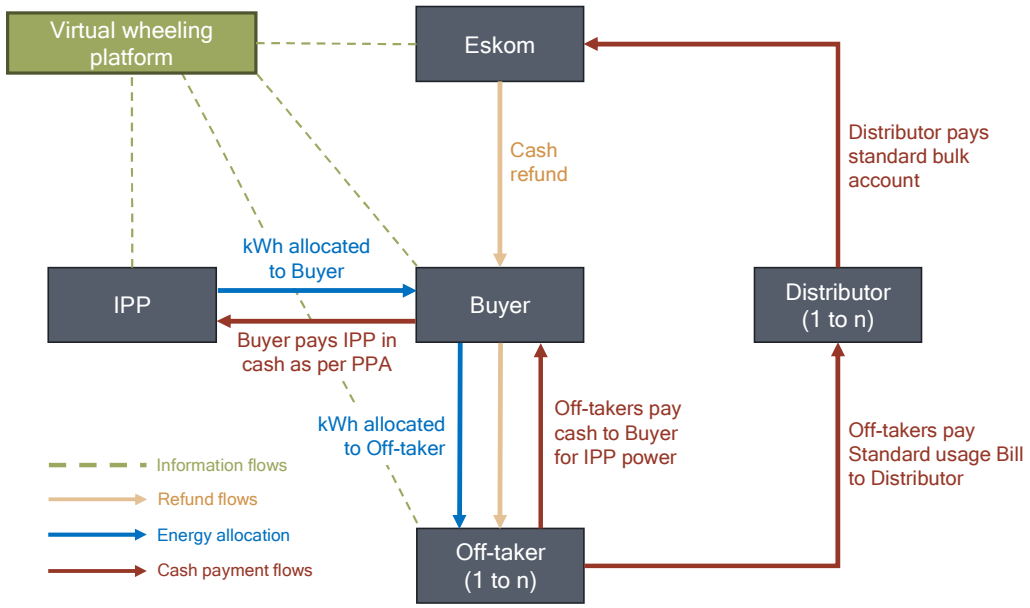
Eskom's current Virtual Wheeling proposal involves the following key entities:

- *IPP* generator
- *Off-taker(s)* (The final consumer)
- *Buyer* (the buyer could be a trader or aggregator, a corporate entity with multiple disaggregated off-take sites, or it could be the same entity as the final off-taker)
- *Distributor* (municipal, Eskom or private)
- *Virtual Wheeling Platform*
- *Eskom*

In Figure 4 we have depicted a simplified Virtual Wheeling transaction.

Figure 4: Simplified depiction of a Virtual Wheeling transaction

Current Eskom Virtual Wheeling proposal



The figure depicts payment flows and energy (kWh) allocations under the current Virtual Wheeling model. In this example, we assume that the buyer is a trader with a set of individual off-takers located in municipal networks. The following describes how the transaction would work:

1. The **IPP** delivers power onto the Eskom network.
2. The **buyer** pays the **IPP** in cash for power delivered in accordance with the PPA between the IPP and the buyer.
3. The **buyer** aggregates time-of-use generation data from the IPPs and

[12] https://www.engineeringnews.co.za/article/vodacom-working-with-eskom-on-virtual-wheeling-platform-to-enable-firms-with-distributed-demand-to-buy-renewable-power-2023-05-22

allocates it to its customers (off-takers) based on the metered load data using a Virtual Wheeling platform (VWP). A VWP is a digital service that is used to collect, aggregate, process, and report time-of-use data for both energy generation at the IPP sites and the consumption allocated to final off-takers. The buyer must establish a Virtual Wheeling Agreement with Eskom. In conjunction with this, the buyer should also finalize a "back-to-back" Virtual Wheeling Platform agreement. This agreement, known as the VWP agreement, should be with a VWP vendor. Multiple VWPs may exist at the same time. Importantly, the VWPs will need to integrate seamlessly into Eskom's system interface and provide generation and consumption data to Eskom in a prescribed format. It is essential that this vendor, chosen by the buyer, has certification from Eskom, ensuring their capability to interoperate with Eskom's systems.

4. The final off-takers will pay the buyer in cash for power purchased. The off takers *also* continue to pay their standard monthly bills to the municipality for *all* their metered power consumption in full. At this point, the off-takers have effectively double-paid for their power.
5. The municipal payment process remains unchanged. The municipality settles its monthly bulk electricity account with Eskom as usual, for all power consumed within its network.
6. Eskom utilises the data provided by each VWP to calculate a Wheeled Energy Refund for each buyer. The refund is issued because the buyer's off-takers have effectively overpaid for their power. This refund is provided in cash to the buyer, based on the consolidated volume of energy generated by IPPs providing power to the buyer and consumed by the buyer's off-takers. The refund amount will be calculated monthly (based on the lesser volume of power produced and consumed) at Eskom's Gen-Wheeling tariff (the same as "traditional" wheeling outlined in section 2.1.2). Eskom reserves the right to withhold a refund or a portion of a refund to the buyer if an off-taker is itself in arrears on its account with Eskom or is located in a municipality which is in arrears on its bulk electricity account with Eskom. Buyers can reallocate power between off-takers monthly to take account of these constraints. All excess energy (i.e., that which is produced by an IPP but not allocated to an off-taker by the buyer) will be ignored for purposes of the refund, but could be sold to another entity, including to Eskom on its Standard Offer programme.

An administration charge will be levied to the buyer by Eskom. Virtual Wheeling requires Eskom-accredited smart meters to monitor power generation and consumption at the relevant sites.

3.2 THE POTENTIAL VALUE OF VIRTUAL WHEELING

In theory, Eskom's Virtual Wheeling proposal has a set of core advantages over "traditional" wheeling:

- By establishing the necessary system architecture for processing aggregated generation and consumption data, Virtual Wheeling facilitates easier administration of wheeling transactions between multiple generators and multiple dispersed off-takers.
- The Virtual Wheeling model is contractually less complex, removing the requirement for ESAs to be updated between Eskom and a municipality, or

Eskom and an Eskom-connected customer.

- By leaving the final off-taker's payment flows (and therefore municipal revenue) unchanged, the model eliminates the requirement for municipalities to set up their own wheeling frameworks, tariffs and secure agreements with off-takers. This will in theory **remove a core practical barrier to setting up wheeling transactions for off-takers in municipalities**. This in turn unlocks a significant opportunity for aggregators and traders to play a role in the market – which can design more flexible power products for smaller municipal off-takers with insufficient balance sheet capacity to invest in long-term PPAs.

In sum, through establishing data architecture and minimising contractual amendments particularly on the municipal side, a key advantage of the Virtual Wheeling model is in theory enabling access to a broader and more diverse customer base. Besides allowing traders to sell electricity more effortlessly to small-scale commercial and industrial clients within municipal networks, the model will also assist big corporations with distributing power to various decentralised off-take points. By enabling IPP project to provide power to this extended group of customers, the model could significantly alleviate the strain on Eskom's current resources, thereby playing a crucial role in addressing South Africa's severe power deficits.

3.3 RISKS IN IMPLEMENTING VIRTUAL WHEELING

Although the current Virtual Wheeling model has great potential in theory, it still contains core risk factors which are likely to limit the scope for financing Virtual Wheeling projects in practice.

The first critical risk factor has to do with the credit risk associated with Eskom cash refunds. Buyers with off-takers in municipal distribution areas are exposed to two sources of default risk on their refunds from Eskom:

- If the municipality is in arrears on their Eskom bulk account, Eskom will not process a refund for the buyer until such a time that the arrears have been resolved. This specification therefore excludes a significant segment of off-takers because many municipalities are either already in arrears on their Eskom bulk accounts or could possibly be at some point in the future. Buyers with off-takers in currently compliant municipal areas could therefore be exposed to non-payment of Eskom refunds in future.
- Given its severe financial crisis, Eskom could fail to pay the refund on its own accord, exposing buyers to Eskom's credit risk. Without government guarantee support, Eskom is not a creditworthy counterparty.

These risks emerge since the Virtual Wheeling system initially demands a **double payment** for the wheeled IPP power before the final refund payment from Eskom. The buyer compensates the IPP for electricity, while the off-taker (receiving power from the buyer) settles its bill with the local distributor, be it Eskom or a municipality, for the total electricity used. Therefore, significant credit risk is presented in terms of buyers (and their off-takers) not receiving their appropriate refund. This will affect the bankability of generation projects undertaking Virtual Wheeling transactions – most likely limiting it to the number of buyers who would be prepared to take on this risk.

Based on engagements with commercial banks, we understand that there is particular concern around Eskom withholding refunds in

cases where off-takers are located within municipalities that are already in or could go into arrears on their electricity accounts. Most of the Virtual Wheeling power will be allocated to Eskom-connected sites. This indicates that the Eskom refund is viewed as more reliable in cases where customers are not connected to municipal networks – i.e., Virtual Wheeling is not yet fully solving the issues related to wheeling power into municipalities.

The **second disadvantage with Virtual Wheeling** (which pervades 'traditional' wheeling as well) **is that buyers that sell power to off-takers that are separate legal entities will have significant NERSA-related regulatory requirements to comply with**. Since Virtual Wheeling involves the buying and selling of power, buyers must currently secure a trading license from NERSA. They also need to adhere to the extensive ongoing reporting mandates whenever they incorporate new customers or generators. As an alternative, buyers can register with NERSA as a "Reseller" and establish a service agreement with the pertinent local authority under the Municipal Systems Act, or a comparable contract with Eskom in regions where it serves as the distributor.

The process to obtain trading licenses appears to be equally onerous on big and small trading entities, but possibly more prohibitive to smaller potential aggregators who want to aggregate power across multiple sites (e.g., property owners, etc.).

4 ADDRESSING VIRTUAL WHEELING RISKS THROUGH AN ELECTRICITY CREDIT TOKEN SYSTEM

This section outlines a proposal for mitigating the risks outlined above by implementing Virtual Wheeling by means of an **Electricity Credit Token (ECT)** system in place of relying on physical cash refunds.

4.1 OVERVIEW OF THE ECT SYSTEM

The primary aim of the ECT concept is to replace and avoid the initial double payment for wheeled power inherent in the existing Virtual Wheeling model and thereby eliminate the refund risk. An ECT is a tradeable, standardised, contractually recognised **claim to a credit on an electricity account.** The relevant account could either be a distributor's bulk account with Eskom, or a customer's account with a participating distributor.

As with Eskom's Virtual Wheeling model, under the ECT system Eskom will generate distributor bulk accounts as usual for all the power delivered to the distributor busbars, irrespective of the deemed source of the power. Distributors will also generate customer electricity accounts as usual, for all the power delivered to them.

However, instead of paying their total accounts with cash, customers can settle part of their accounts by "presenting" the distributor with appropriate ECTs. The distributor can, in turn, also settle part of its Eskom bulk account by claiming a credit for the total value of the ECTs that were redeemed by its customers (or ECTs that it purchased itself). Eskom will credit the distributor's Bulk account upon receiving proof of the validly issued ECTs relating to the relevant time-of-use billing periods and allocated to the relevant distributor.

This arrangement eliminates the refund payment risk embedded in Eskom's current Virtual Wheeling model. In most other respects the model remains the same as the Virtual Wheeling proposal by Eskom.

Like other wheeling models, the ECT system will not be a silver bullet – in solving one problem (eliminating payment risk) it creates additional practical challenges by requiring

that distributors and Eskom accept Credit Tokens for account settlements. However, from our perspective, when backed by distributor support, the ECT system best harmonises the goals of simplifying distributor implementation and expanding Virtual Wheeling reach to maximise the potential market that can be unlocked.

4.2 THE PROCESS FLOW

Further details of the proposal are as follows (see Figure 5 below):

1. The **IPP** produces power and feeds it into busbars at the point of connection to the interconnected national power grid.
2. The **buyer** pays cash to the **IPP** for an agreed volume of power at a price specified in the PPA between these two parties. The ownership of the power passes to the buyer.
3. An Eskom-approved **VWP** [13] **generates matching Credit Tokens (ECTs)** based on each kWh produced by the IPP and allocates these to the buyer in accordance with matching instructions from the IPPs and buyers. ECTs will have a face value determined by the "WEPS non-local authority" rate "excluding losses" applicable at the time in which that kWh is produced (see section 4.4.3).
4. **Buyers conclude Token Purchase Agreements (TPAs) with customers in terms of which they then sell (or allocate)** ECTs to customers as they are generated.
5. **Distributors** (municipalities or Eskom Distribution) issue monthly electricity bills to their customers as normal for all their power consumption, and Eskom also issues bulk accounts to distributors as usual.
6. Customers settle part of their electricity bills from their distributors with ECTs and pay the difference in cash. For this they rely on information provided by the VWP (on behalf of the buyer).
7. Distributors in turn pay their bulk electricity bills to Eskom, *net* of the aggregate value of ECTs purchased by customers within the distributor's network (and those that it possibly purchased itself). Again, the necessary information is provided by the VWP, who can also implement the credit into the Eskom account payment system.
8. As part of the service provided by the buyer to its customers, it can contract the VWP to:
   a. track the ECTs that each customer purchases;
   b. automatically provide the full ECT records in the formats required by the utilities, including summary reports appropriately aggregated (i.e., per customer and per distributor);
   c. implement the appropriate credits into the relevant utility account payment system (i.e. the distributor's bulk account with Eskom, and customers' accounts with their distributor).[14]
   d. In practice the VWP can implement the entire bill payment process on behalf of customers.
9. Each ECT is only valid for settlement of a bill covering the period in which the ECT was generated.
10. A VWP will perform time-of-use matching between a customer's actual or deemed load profile and the time-of-use slot ECTs

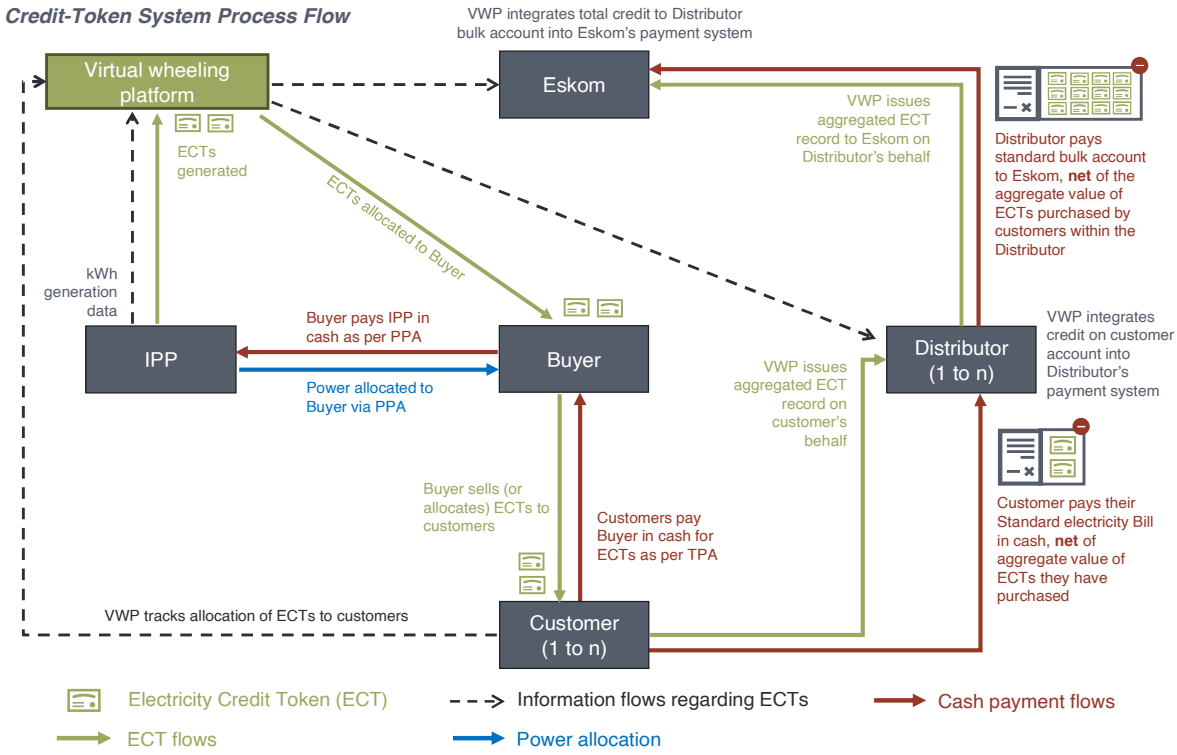
[13] *VWPs will either be central repositories of ECTs, reallocating them to the new owners as they change hands, or if they are implemented as distributed ledgers, can function as token exchanges and service providers. This role is similar to that of Strate which "…serves the financial market through the safekeeping of the legal, digital record of securities ownership, enabled through registry, settlement and asset services, and through facilitating the reuse of securities for the benefit of the South African economy." (https://www.strate.co.za/)*

[14] *It might well be possible to utilise the services of existing payment service providers to implement the necessary credits in the relevant accounts at both the Distributor and Eskom Bulk supply level.*

are associated with. At the Eskom to distributor level this will be done in accordance with the applicable Eskom wheeling rules, and at the distributor to customer level this will be in accordance with the distributor's rules. If deemed load profiles can be used it will not be necessary to install smart meters at the outset. ECTs can only be used for settling billing charges in accordance with these rules.

11. ECTs can be implemented as a distributed ledger system [15] which will have many long-term benefits, or by means of a conventional centrally controlled database. In either case the information will be verifiable and auditable by any affected party.

Figure 5: High level process flow for the ECT system



4.3 THE HIGH-LEVEL COMMERCIAL STRUCTURE

The commercial structure for this system will have many similarities with the proposed Virtual Wheeling system and, at a high level, is expected to be constructed as follows:

- The buyer (a central corporate entity, an aggregator, or a trader) signs an **ECT Guarantor Agreement** with the party who will be the *ultimate guarantor of the ECT value* – in most cases this will be Eskom (This agreement replaces the similar "Virtual Wheeling Agreement" envisaged

[15] *See a short description of distributed ledger systmems in Appendix A. The following distributed ledger (block chain-based) implementations are already being used in the power sector: https://www.energyweb.org/, https://www.powerledger.io/, https://suncontract.org/*

under the current Eskom Virtual Wheeling proposal that commits Eskom to providing a cash refund for wheeled energy to the buyer).[16] The ECT Guarantor Agreement places a binding and enforceable (including by affected third parties such as municipalities) obligation on the guarantor to recognise the ECTs as valid claims to financial credits on any bulk electricity account in accordance with an agreed valuation basis (in this model that will be the "WEPS non-local authority energy charges excluding losses" tariff published in their tariff book) and for an agreed validity period. It will specify the circumstances under which Eskom will recognise the presentation of ECTs as valid claims to a credit on its electricity supply accounts. The ECT Guarantor Agreement is the commercial foundation on which the ECT system is built.

- The buyer also signs a **Distributor ECT Agreement** with participating electricity distributors. (This agreement is *not* required in the current Eskom Virtual Wheeling proposal.) The agreement places a binding and enforceable obligation on the participating distributor to recognise the Credit Tokens presented to them by customers as credits on their customer's electricity accounts on the basis that the same ECTs can be presented to the guarantor for credits on the distributor's bulk account.[17] The agreement will also specify the rules applicable to the reconciliation / matching of the customer's electricity consumption and the ECTs presented. Reconciliation for the time-of-use load of different classes of customers could be accounted for either based on a standardised load profile for each class or can require the installation of smart meters to enable more accurate matching.
- A buyer will sign **Power Purchase Agreements** (PPAs) with IPPs for certain volumes of power at an agreed price. The buyer "receives" the power at the busbars where it is supplied into the utility grid.
- The buyer signs short- or long-term **Token Purchase Agreements** (TPAs) with end-customers located in municipal or Eskom Distribution networks for the supply of Credit Tokens. Buyers could offer different types of TPAs, e.g. 3-5 year TPAs, monthly TPAs (which could be more expensive), TPAs which ramp up in volume over time (e.g. to be aligned to the transition pathways of energy intensive customers), TPAs with different price trajectories, etc.
- The buyer signs a **Virtual Wheeling Platform Agreement** with an Eskom- (or municipality-) approved Virtual Wheeling Platform (VWP) provider and an Eskom- (or municipality-) approved smart metering service provider to facilitate the collection, aggregation and processing of generation and consumption data across its portfolio of IPPs and customers.
- In terms of the above agreements the VWP exchanges data with:
  - *IPPs and customers:* to enable the VWP to access and process smart metered generation and consumption data.
  - *Eskom:* the VWP provides data (in a format compliant with Eskom's

[16] *Currently this will be Eskom, or possibly a municipality if the power is injected on a municipal grid. In future this could also be a central buyer in an alternative market, such as the Eskom load shedding reduction mechanism, Standard Offer, or the System Operator in a Balancing Market.*

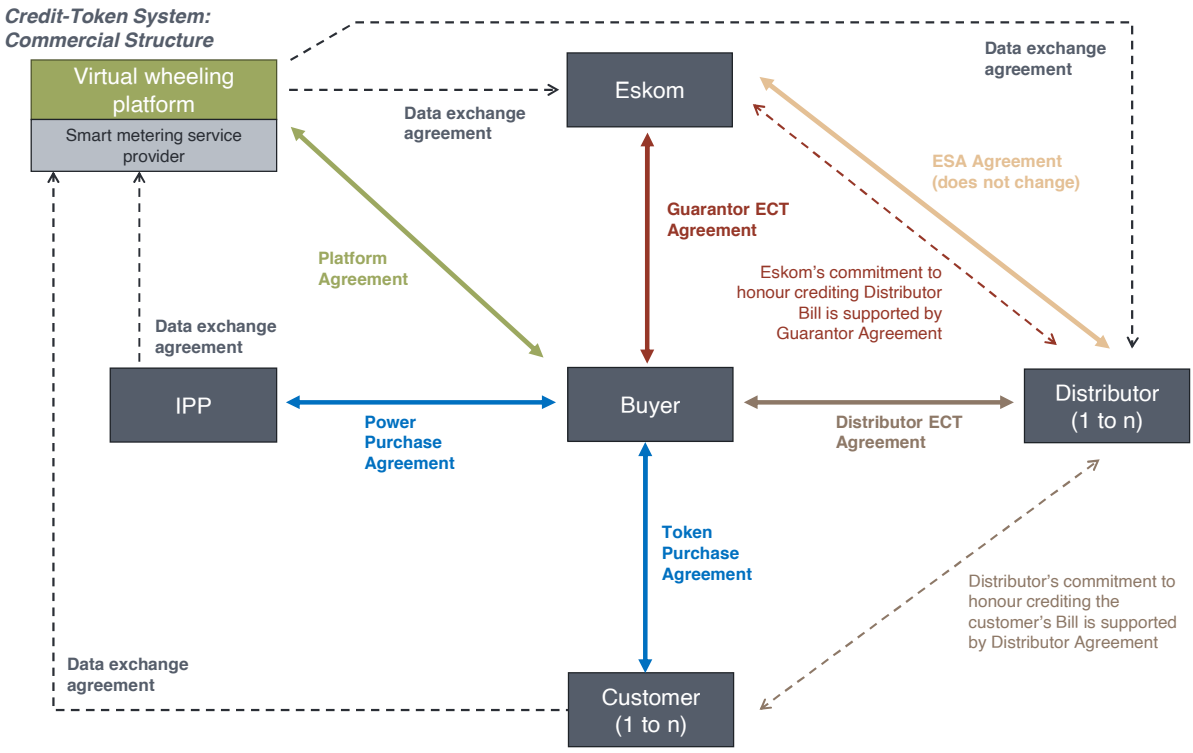
[17] *In the case where the IPP is connected to the Distributor's network the Distibutor could be the final guarantor, or could agree to Eskom implementing corresponding debits in its bulk account if these ECT's are being sold to customers outside of its network.*

requirements) on the aggregated ECTs allocated to each distributor to enable the appropriate credit to be applied to the distributor's bulk electricity account.

- *Distributors (e.g., municipalities):* the VWP provides data on aggregated ECT allocations per customer (in a format that is compliant with the distributor's requirements), to enable the appropriate credit to be applied to each customer's account.
- Eskom, distributors and the VWP could "piggyback˜" on the services proved by the current payment service providers to implement the necessary credits in the customer accounts.

- As with Eskom's Virtual Wheeling proposal, an **administration charge** will be levied, probably on the VWP and/or the buyer (who can pass on the costs), to recover the costs of maintaining the ECT system and Virtual Wheeling infrastructure. This can be passed through to the customers in a manner deemed appropriate by the buyer. The nature of this administration charge and how it relates to or accounts for existing administration charges to customers, needs to be determined.

Figure 6: High level commercial structure of the ECT system



4.4 THE NATURE OF ELECTRICITY CREDIT TOKENS

It is important to clarify the exact proposed nature of the Electricity Credit Tokens (ECTs). ECTs are tradeable financial instruments that *consist of a claim to a credit on an electricity supply account*. While ECTs relate to a specific generated kWh at a specific point in time, the ECT Guarantor Agreement will specify the timeframe over which the validity of the claims to a credit on an electricity supply account will be recognised.

4.4.1 ECTs are not proof of ownership of electricity

In contrast to the other versions of wheeling, after the buyer has purchased the IPP power the ECT system does *not* entail the on-sale of the power to customers. The buyer takes ownership of the IPP generated power where it is injected into the grid and receives the associated stream of ECTs issued by the VWP. The buyer in effect utilises the purchased power to "produce" the ECTs (verified and issued on its behalf by the VWP). It is the sale of the ECTs that provides the necessary value stream to enable its business model – it does not need to on-sell the power.[18] ECTs therefore do not need to be proof of ownership of electrical energy by any party.

4.4.2 The information recorded on an ECT

Each ECT has a one-to-one matching to – and is uniquely associated with – the metered kWh based on which it has been issued. In order to ensure that no double counting occurs with other energy being wheeled, the Guarantor Agreement will have to require that none of the power injected at each individual ECT metering point cannot be wheeled by conventional means or directly sold to Eskom. ECTs will contain unique, immutable records and proof of at least the following:

- ✓ the generation of each separate unit of energy (kWh) with which it is associated.
- ✓ the exact universal time of generation to a high level of precision (for the purposes of calculating its value and determining uniqueness).
- ✓ the credit value of the unit of energy calculated at the prevailing time-of-use Eskom (WEPS) rate excluding losses (or any future valuation basis accepted by the parties).
- ✓ the technological source of generation (e.g., wind, solar, battery, diesel generator, etc.).
- ✓ the carbon content of the associated kWh of energy produced.

4.4.3 The face value of ECTs

The ECT's face value will be determined by the appropriate Eskom "WEPS *non-local authority,* excluding losses" time-of-use rate – irrespective of where the ECT is ultimately redeemed[19]. The reason for this is that WEPS "excluding losses" reflects Eskom's incremental cost of producing power, normalised for the differences in the energy losses related to the location of the generator,[20] and "before" losses are incurred in the transmission of power to the customer. The benefit of this approach is that it results in a standardised valuation for tokens in the

[18] In this case a stream of procured electricity enables the buyer to produce a stream of ECTs that are sold in terms of a TPA. This is equivalent to a case where a factory uses a stream of procured electricity to produce a stream of widgets that can be sold under a supply agreement.

*[19] In the initial phase, there will be **three** different ECTs in circulation at any period, each representing the credit value for a kWh at peak, standard and off-peak times, respectively. Different set of three ECTs will circulate in High season (June to August) and Low season (September to May).*

[20] Generators are debited or credited separately for their impact on network energy losses as part of their Eskom Transmission and Distribution use of system charges, depending on where they are located in the network. Losses related to customer loads are subsequently recovered through published tariff structures.

three different time-of-use periods which makes it tradeable across the entire network supplied by Eskom bulk power.

In future, alternative market mechanisms could be used as a valuation basis.

4.4.4 Green attributes

If they are based on the generation of *green* power, the information recorded in ECTs will also represent a verified basis for generating proof of the green attributes of the power (e.g., RECs).[21] This proof can be used in different reporting requirements, be it for RECs, carbon taxes such as the Carbon Border Adjustment Mechanism (CBAM) or Environmental Social and Governance (ESG) requirements.

4.4.5 The scope of ECT trading

Within their validity timeframe, ECTs can be traded between all customers of participating distributors that receive their primary electricity supply from the same guarantor. For instance, all customers supplied by municipal distributors that are supplied by Eskom can trade with each other – even across municipal boundaries. In practice most of these reallocating trades can be handled by the buyer on behalf of the customers and participating municipalities (and implemented by the VWP). ECTs relating to a particular billing period can be traded from the time that they are generated during the period, up to the point in time during the subsequent billing period when the accounts relating to the previous period must be settled.

4.5 ENTITY AND TEMPORAL MATCHING FOR THE ECT SYSTEM

By definition all wheeling systems entail the matching or reconciliation of supply and demand. Two key matching concepts appear to be important for Eskom across all currently discussed wheeling approaches, namely:

1. The Matching Entity: the wheeled power injected by the IPP is matched to a specific entity's loads to enable the billing credit (in the case of traditional wheeling) or refund (in the case of Virtual Wheeling) to be calculated and allocated.
2. Temporal matching: For each matching entity the wheeling rules require the temporal (a) aggregation and (b) matching (reconciliation) of generation and consumption *monthly, within each time-of-use period*. A wheeling credit or refund is calculated based on the lower of the energy consumed and the energy generated in each ToU period. If there is an oversupply of generated power on this basis within each time-of-use period, it will have to be sold to a third party or forfeited to Eskom.

   Over time, as load shedding is resolved and the legislative power market reforms are established, this requirement could tighten to place shorter-term reconciliation obligations on parties. Temporal matching is necessary for two key reasons:

   a. it supports system operations (balancing)[22]; and
   b. it allows the value (avoided cost) of energy injected into the system at different times to be reflected in the value of the credit recognised or

[21] *The details of REC certification and issuance, their ownership, trade and retirement is beyond the scope of this note.*

[22] *The degree to which market participants are incentivised to be in balance (and therefore the remaining balancing task for the system operator is reduced) depends on the aggregation period (shorter creates stronger incentives) and the penalty for being out of balance. The current WEPS-based monthly aggregation is permissive, but is commensurate with the high levels of load shedding reflecting around the clock energy shortages on the system.*

refund implemented (as specified by the pricing mechanism in use) and therefore sends critical market pricing signals.

The design of any wheeling and trading system will have to consider these principles.

The current practice is that Eskom treats the case of "traditionally" wheeled power from the Eskom network to a customer in a distributor network as if the distributor is the off-taker of the power – i.e., the distributor is the relevant *Matching Entity* against whose load the *temporal matching* of the wheeled power is applied. Eskom does not "look into" the distributor grid, but of course, the distributor's load is the total of the diversified physical customer load on its network – whether customers wheel power or not. If wheeled power makes up a minority portion of the total energy consumed in the distributor, it should always be the case that at the distributor-level the wheeled power is less that the total consumption in each time-of-use slot – even if the final wheeling customer consumed less than the power it wheeled in that slot.

With Virtual Wheeling, the *Matching Entity* for reconciliation purposes will be the buyer and the refund will be calculated on that basis. Eskom will not "look beyond" the buyer to the individual "off-takers". The buyer's load will be the sum total of all its off-takers' load and will therefore have to be metered and the information aggregated as they will not necessarily be on the same physical network or the same distributor.[23] Virtual Wheeling buyers will not benefit from being able to diversify wheeled load across non-wheeled load (in order to increase their capacity to absorb wheeled energy), as is the case for municipalities under conventional wheeling.

The ECT-based system will not refund buyers but will implement credits on distributor bulk accounts. The *Matching entity* is therefore the distributor – as is the case with traditional wheeling. *Temporal matching* (i.e., the time-period-related reconciliation rules) for the ECT system will be the same as with traditional and Virtual Wheeling.

As with conventional wheeling, the ECT system also benefits from the greater diversification over non-ECT customer loads and therefore increases distributor-level capacity to absorb wheeled energy in the respective time-of-use periods, compared to Virtual Wheeling. However, to eliminate the risk of an oversupply of Credit Tokens per time-of-use period for a distributor on their bulk account a conservative approach can be adopted in the rules governing how many ECTs can be claimed by customers per ToU period.

For instance, a distributor can limit customers to not claiming credits for more Credit Tokens associated with the time-of-use slot than their actual use in that slot, over the full billing period. This can be implemented by either using standardised load profiles (as is standard practice when calculating tariff structures for customers that are not on time-of-use metering) or by installing time-of-use meters and using the actual data.

While this approach will eliminate the possibility of an oversupply of monthly time-of-use slot Credit Tokens for the municipalities, it will be over-conservative during the period when ECT uptake is still a smaller portion of total distributor load. If a distributor wants to encourage the uptake of ECTs it can initially allow customers to "overpay" with ECTs, while monitoring the

[23] *The buyer in effect constitutes a virtual distributor that will have to compile its aggregated virtual demand*

situation and tightening the rules as it becomes necessary.

4.6 POLICY, REGULATORY AND COMMERCIAL IMPLICATIONS

There are important differences between the systems with respect to the Eskom ESA and whether buyers will be subject to NERSA regulation.

4.6.1 Traditional Wheeling:

Traders that are buying and selling power and utilising the conventional wheeling model, are currently required to obtain a trading license from NERSA. Additionally, they must comply with comprehensive ongoing reporting requirements when adding new customers or generators. In the case of an Eskom-connected customer, an amendment to its ESA with Eskom is required. In the case of a municipal-connected customer, an amendment to the ESA between Eskom and the municipality is required, and a wheeling agreement between the municipality and the customer must be established.

4.6.2 Virtual Wheeling:

Virtual Wheeling will still require buyers to obtain a trading license from NERSA as it still involves the buying and selling of power. No ESA amendments are required.

4.6.3 ECT System:

The ECT system **does not require an amendment to distributor ESAs** because the payment terms contained therein are generally specified, and the guarantor agreement will place a specific, enforceable obligation on Eskom to accept valid ECTs as settlement on distributor bulk accounts.

Furthermore, the ECT system **does not require buyers to obtain NERSA trading licenses** because the system does not involve the buying *and* selling of electricity. (ECTs are tradeable financial instruments consisting of a claim to a credit on an electricity supply account – they do not represent the ownership of electricity).

Initial research and engagements with the financial sector indicate that ECTs TPAs will not be subject to financial sector regulation (derivatives thereof might well be).

The ECT system can initially be implemented on a voluntary basis. However, should it be desired from a national policy perspective to make it compulsory for Eskom and distributors, this can be achieved by promulgating a ministerial regulation in terms of the Electricity Regulation Act which requires NERSA to amend the respective licences accordingly.

An industry-wide technical standard for Credit Tokens will be required to ensure that tokens are credible, standardised and tradeable, and meet the needs and the requirements of stakeholders (including different guarantors). Tokens also must survive and slot into the envisaged future market reforms. ECT Guarantor Agreements ultimately bring the standard into force.

Given the limited resources at Eskom and its high workload to respond to load shedding, engage with market reforms, and manage its unbundling process it is unlikely that it would be able to drive the development of an ECT standard and the details of the functioning of the system. Rather we propose that business stakeholders with an interest in implementing the ECT system establish a stakeholder task team under NECOM in collaboration with Eskom and willing municipalities to advance the process. Its first task could be to develop a Technical White Paper setting out the details of the ECT standard and confirming how the system will be implemented.

4.7 VALUE PROPOSITION OF THE ECT SYSTEM

The ECT system brings important and possibly critical enhancements to the traditional and Virtual Wheeling models that will "oil the wheels" to benefit many stakeholders. It will unlock key obstacles for customers to access distributed generation and for banks and other financial institutions to finance new projects.

By implementing Credit Token-based trading, the ECT system establishes two core prerequisites for unlocking distributed generation investment at scale:

Firstly, **it enables ECT and Token Purchase Agreement (TPA) trading** to resolve over- and under "supply" situations. Customers, buyers, and traders can easily adjust their positions if it turns out that they need less or more ECTs for a specific period – for example, in a case where a customer needs to shut down operations for a few weeks which will put them in a surplus ECT position. Buyers, including traders, can also do this on behalf of customers. They can do this by buying or selling ECTs for the current billing period (or by reallocating them within their customer base) up to a specified due date (which would typically be ±two to three weeks into the following billing period), or by trading TPAs (a term-based ECT supply agreement) to change their positions over a longer period – even for many years.

Secondly, **it eliminates municipal and Eskom ("intermediary") payment risk** for buyers (and therefore also for IPPs and their financiers). This risk is a key limitation of the current Virtual Wheeling system and arises due to the initial "double payment" for power: once by the customer (to the distributor) and the second time by the buyer (to the IPP). The use of ECTs eliminates the need for cash refunds to buyers and thus removes the risk that this payment will be delayed or not occur due to default by Eskom, or because the municipalities in which customers are located defaulted on their payments to Eskom. The ECT system does not require that there to be any payments between the guarantor (e.g., Eskom) or distributors on the one hand, and buyers on the other.

The two central characteristics of the ECT system, along with the fact that it is an evolution of existing Wheeling and Virtual Wheeling concepts, unlocks further important value propositions for stakeholders:

- **Easy trading or reallocation of ECTs and TPAs gives rise to two important spin-offs:**
  - Rather than limiting how much variable generation renewable energy they purchase under standard wheeling and Virtual Wheeling contracts to ensure that they are always absorb it under the reconciliation rules, customers can now contract for larger commitments knowing that they can always trade out of over- supply positions if necessary (or they can rely on a trader or buyer to do so on their behalf).
  - It substantially reduces the counterparty risk for IPPs over the long asset life of their projects because even if buyers or customers can only sign shorter-term contracts (PPAs or TPAs) there will be a ready, liquid market for the resale of the financial obligations backing the buyer payments under PPAs (i.e., there will be a market for TPAs and ECTs)
- **TPAs represent a financial hedge against future electricity price increases.** Currently, most commercial and industrial customers have limited options to hedge themselves against rising Eskom and municipal electricity Tariffs – and are

exposed to large uncertainties in relation to future tariff trajectories. Traditional Wheeling and Virtual Wheeling provide such a hedging option – but, as argued above, their reach will be limited. Purchasing ECTs under a Token Purchase Agreement (TPA) allows many more customers to lock in a pricing arrangement, enabling customers to have some foresight on a portion of or the entire energy component of their electricity bills for the term of the agreement. Box 1 below demonstrates how this works.

- **The ECT system makes it easier for customers to access green power and decarbonise their operations.** The kWh tagging property of ECTs allow for verification of green energy attributes throughout the system. Each ECT is unique and will be an immutable proof of a specific kWh generated by a specific (renewable) generator at a specific point in time. The system ensures that there will be no double counting of ECTs and provides the basis for the same assurance for the associated green attributes. The ECT system can support renewable attribute certification proposals under consideration in the SA power sector (e.g. "Study EAC SA"[24])
- By avoiding NERSA and other regulatory red tape the **ECT system will encourage market entry by more aggregators and trading entities.** This will in turn increase competition and innovation in the market, increasing the likelihood of faster uptake of and investment in new generation and related resources, especially for the large untapped commercial and smaller industrial market segment in urban areas.
- **The ECT system offers faster and easier implementation than conventional wheeling.** As is the case with Virtual Wheeling, utility customers receive their normal monthly accounts. The system does not "touch" the tariff calculation or the preparation and issuing of the monthly account. ECT claims are implemented as a credit entry on the customer's account as a part settlement of the account. All distributors and Eskom already process electronic payments and implement credits on customer accounts – typically by making use of payment service providers. The process will be facilitated by the VWP who can piggyback on the third-party payment infrastructure already in place.
- **Municipal / distributor benefits:**
  - **The ECT system will at a minimum keep distributors revenue-neutral** (working capital implications will depend on the timing of customer and Eskom bulk account payments).
  - Furthermore, Virtual Wheeling via the ECT system has **potential to protect and grow municipal margins on power sales** by means of the following:

1. **Reducing customer input costs.** By giving its customers access to Token-based TPA price hedging, municipalities will enable its customer base to soften the blow of above inflation Eskom tariff increases (input costs). This leaves more room for municipalities to generate appropriate margins on their electricity sales on a per kWh basis.
2. **Protecting sales volumes.** By facilitating an easy way for municipal customers to hedge against future Eskom tariff increases and decarbonise their operations (all

[24] *See for instance the SAGEN (2023) study on the implementation of an Energy Attribute Certification system for Renewable Energy and Green Hydrogen in South Africa: sagen.org.za/publications/energy-policy-regulation/188-energy-attributes-certification-study/file*

things being equal) customers are able to maintain their municipal power consumption and are less incentivised to reduce their demand via behind-the-meter installations. This can therefore protect the value of the municipal margin earned on these sales.
    - Municipalities could additionally offer to credit surplus customer ECTs at a discount and benefit financially at the full 'Gen Wheeling tariff' on their Eskom bulk accounts.
    - Municipalities can themselves procure ECTs by means of TPAs (rather than only signing conventional long-term PPAs) and benefit from the trade-ability of ECTs and TPAs (they can act as "buyers" or as customers).
    - If municipalities want to allow inter-municipal trading, the VWP can simply implement the relevant debits and credits for the respective municipalities in the guarantor (Eskom) bulk accounts.
- **The successful roll-out of the ECT system will reduce financial, administrative, and operational pressure on Eskom.** The main advantages of the ECT system to Eskom are that:
    - It removes the requirement for Eskom to physically pay out cash refunds.
    - Eskom does not need to run most of this system. As with the Virtual Wheeling proposal the VWPs will do most of the heavy lifting and make the data available to Eskom in the formats it requires. All information will be auditable.
    - As ECT uptake increases it reduces Eskom's exposure to non-payment by municipal distributors on their bulk electricity bills. Participating municipalities will ultimately owe Eskom less cash.
    - Ultimately, by reducing IPP financing risks, the ECT system will facilitate rapid uptake of additional generation capacity with no impact on Eskom's balance sheet or need for further state guarantees or bailouts. This will decrease the levels of load shedding, reduce pumped-storage cycling and free up more capacity, and reduce expensive diesel-fired generation required.
- **The ECT system paves the way for an easy segue into a new competitive power market structure**.
    - New aggregating data platforms (VWPs) will be established, and real-time smart-metering infrastructure will be installed.
    - The system is flexible, once infrastructure is set up, the valuation basis for ECTs can be changed if necessary from the WEPS-based structure to a pricing signal provided by a particular market mechanism with the relevant counterparty acting as the guarantor (e.g. a future day-ahead market, a balancing market, or Eskom's current dynamic pricing or feed-in tariffs under its Standard Offer. Credit Tokens can be tagged/earmarked for any one of these markets, until such time as markets become integrated)
    - The system will start off by implementing monthly time-of-use crediting but due to the data infrastructure in place can easily switch to hourly reconciliation.

Box 1: A TPA provides a financial hedge against Eskom and municipal tariff increases

The customer realises financial value based on the differential between the price that it pays for its Electricity Credit Tokens (ECTs) and the credit value each ECT represents when applied to the customer's electricity Bill.

1. Each ECT is *associated* with a kWh of power. The price that the customer pays the buyer for each ECT will mostly be linked to the cost of generating that kWh by independent generators (likely with a margin applied by the buyer).
2. The ECT's value on the other hand will in almost all cases be *higher* than the price the customer paid for the ECT (this is what makes the business case for the customer). The ECT will be valued at the appropriate peak, standard or off-peak "WEPS non-local authority excluding losses" rate, reflective of Eskom's avoided cost of providing power at the point in time in which the ECT is generated. Importantly, ECT value will also increase along with Eskom tariff increases (for the primary use case where Eskom is the guarantor).

For example, in a particular month, the customer might purchase a certain amount of ECTs in each time-of-use period from a buyer in accordance with the Token Purchase Agreement (TPA) between these parties.

The customer pays the buyer for ECTs at a price that is fixed in real terms (e.g., 150c per ECT in peak periods, 70c per ECT in standard periods and 50c per ECT in off-peak periods). This purchase price is *less* than the value that each ECT represents to the customer – which is a claim to a credit to the value of the appropriate WEPS rate when that ECT was produced (e.g., 157c, 108c, and 68c in peak, standard, and off-peak periods respectively).

The customer would then pay:

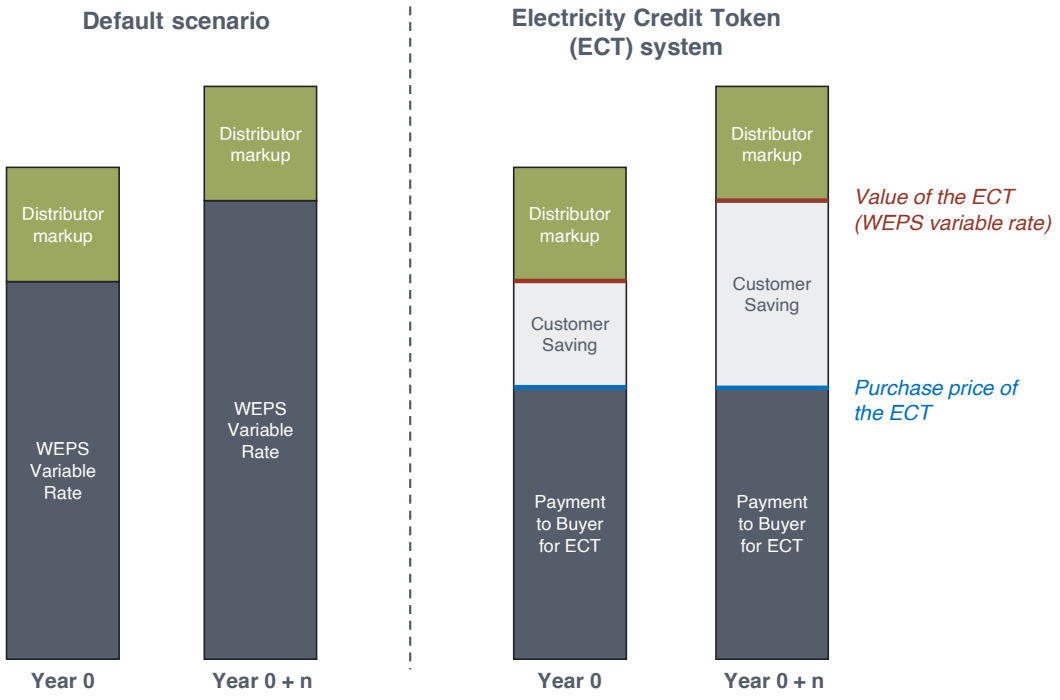
$$\text{Payment (cents)} = (150 \times n_{ECT[peak]}) + (70 \times n_{ECT[std]}) + (50 \times n_{ECT[off\text{-}peak]})$$

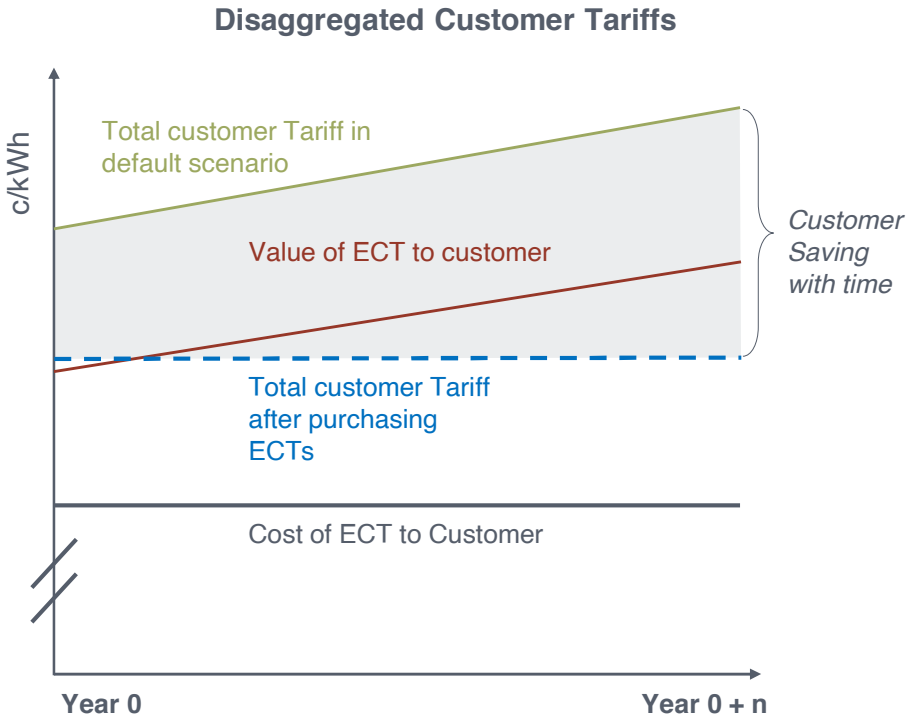
The credit implemented on the customer's account would be:

$$\text{Credit (cents)} = (157 \times n_{ECT[peak]}) + (108c \times n_{ECT[std]}) + (68c \times n_{ECT[off\text{-}peak]})$$

The customer's TPA could effectively **lock in** a fixed price trajectory for a portion of the *energy* that the customer purchases each month, for the term of the TPA. The counterfactual would be that the customer continues paying the standard (higher) distributor tariff charges for that same portion of energy on its electricity account, which is expected to increase at a rate above inflation.

If, as expected, the WEPS rate increases in real terms over time, the customer payments for ECTs remain constant in real terms – allowing savings to grow over time. The following graphic example depicts how savings on the energy charges of a customer's electricity account (fixed charges not shown) can be realised if it enters into a TPA for inflation indexed ECTs (assuming the municipal energy charge markup stays constant in real terms).


Default scenario
Electricity Credit Token (ECT) system
Distributor markup
WEPS Variable Rate
Customer Saving
Payment to Buyer for ECT
Value of the ECT (WEPS variable rate)
Purchase price of the ECT
Year 0
Year 0 + n


Disaggregated Customer Tariffs
c/kWh
Total customer Tariff in default scenario
Value of ECT to customer
Customer Saving with time
Total customer Tariff after purchasing ECTs
Cost of ECT to Customer
Year 0
Year 0 + n

4.8 COMPARISON OF KEY QUESTIONS IN RELATION TO THE THREE SYSTEMS

Below is a summary table of key questions that are compared across traditional Wheeling, Virtual Wheeling and the Credit Token system.

Characteristic	Traditional Wheeling	Eskom Virtual Wheeling	Credit Token system
Ease of implementing wheeling to municipal customers: billing and/or settlement	Difficult	Easy	Moderate
Impact of municipal credit risk on the viability of the wheeling system	Uncertain	High	Low
How is the end-customer's monthly account affected?	An active energy credit is applied based on the applicable tariff	Not affected. Customer pays full account to distributor.	Account is not affected. Settled with a combination of cash payments and ECTs
Requires distributor / municipal cooperation?	Yes	No	Yes
Does the system leave the distributor / municipal financial position unaffected?	Not necessarily	Yes	Yes. (Working capital implications will depend on the timing of customer and Eskom bulk account payments).
Requires renegotiation of Eskom – distributor Electricity Supply Agreements?	Yes	No	No
Does it provide a hedge against tariff increases?	Yes	Yes	Yes
Does the buyer have to be licenced by NERSA and be subject to ongoing reporting compliance?	n/a Traders do have to be licenced	Yes (No, if buying for own account)	No
Is the buyer exposed to Eskom and municipal payment risk?	Municipal payment risk	Yes	No
Does this allow many-to-many wheeling?	Not easily	Yes - but with serial payment risk exposure	Yes

Can the system allow for Virtual Wheeling out of municipal networks to Eskom customers?	N/A	**Difficult.** Municipalities would have to refund the buyer as the municipalities are the ones which receive the energy injection onto their networks.	**Yes.** Tokens allows Eskom to debit municipal accounts and credit its customer for the wheeled energy.
Are grid costs and losses incorporated into the model?	Still recoverable in balance of customer electricity bill	Still recoverable in balance of customer electricity bill	Still recoverable in balance of customer electricity bill
Who is the matching entity from Eskom's (the guarantor) point of view?	The distributor	The buyer	The distributor

5 AREAS FOR INVESTIGATION

The intention of this paper is to highlight the possibilities that can be unlocked with the introduction of a Credit Token system. Some of the areas that require further investigation to operationalise this system include the following:

1. The process for securing the necessary political, Eskom and municipal support.
2. The details of a single industry-wide technical standard for the issuance of ECTs.
3. How the ECT system can be used to underpin Environmental Attribute Certification systems (e.g. RECs)?
4. The principles for its implementation: a central database and trusted authority design, or distributed ledger technology?
5. The accounting treatment and implications for distributors and Eskom.

6 CONCLUSIONS AND NEXT STEPS

The pressing need to address South Africa's power crisis necessitates innovative solutions for ramping up distributed generation investment. A critical lever would be unlocking supply to the large number of commercial and industrial consumers who are currently not able to access wheeled power or do so adequately.

The Electricity Credit Token system, as explored in this note, aims to overcome these challenges and introduce further benefits. By altering payment flows and eliminating the need for cash refunds, it offers a more streamlined and less risky model. Credit Tokens, while not representing the trading of power, are tradeable financial instruments that enable customers to meet their decarbonisation objectives, procure tariff hedges (TPAs) and adjust their positions in each monthly electricity billing period. Furthermore, the ECT system's ability to bypass the need for a trading licence makes it a more inclusive and equitable solution, catering to both large and small players in the market.

The following are **next steps** that would be required to develop this concept into an implementable solution:

1. **Establish a Business-led stakeholder task team under NECOM:** Given the limited resources at Eskom and its high workload to respond to load shedding, engage with market reforms, and manage its unbundling process it is unlikely that it would be able to drive the development of an ECT standard and the details of the functioning of the system. Rather we propose that *business stakeholders with an interest in implementing the ECT system establish a stakeholder task team* in collaboration with Eskom and willing municipalities to drive the process. Ideally this team should report into the NECOM structure.
2. **Technical White Paper:** Develop a formal ECT Technical White Paper to address the remaining gaps, and refine the key process flows, commercial structure and ECT standards. The intention would be to provide clarity to the market and facilitate endorsement of the ECT system. This will also be the basis for a new Eskom Policy that supports the ECT system.
3. **Investigate options to incorporate ECTs into the Virtual Wheeling pilot** recently launched by key players (Vodacom, Mezzanine, Eskom) as a trialling mechanism.
4. **Based on the findings from the steps above, proceed to full implementation and roll-out.**

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APPENDIX: DISTRIBUTED LEDGERS

DISTRIBUTED LEDGERS

A distributed ledger is a database that is shared and synchronised across multiple computers or nodes. Each node maintains a copy of the ledger, and all nodes agree on the current state of the ledger. This makes distributed ledgers secure and tamper-proof, as it would be very difficult to change the ledger without the collusion of a majority of the nodes.

Distributed ledgers are often used to record financial transactions, but they can also be used to record other types of data, such as supply chain information, medical records, or voting results. A distributed ledger token (DLT token) is a digital asset that is recorded on a distributed ledger.

Some of the key benefits of distributed ledgers include:

- Security: Distributed ledgers are very secure because it is very difficult to tamper with the ledger without the collusion of most of the nodes.
- Transparency: All nodes in the network have access to the same ledger, so everyone can see all the transactions that have been recorded.
- Efficiency: Distributed ledgers can be very efficient for processing transactions, as there is no need for a central authority to authorise or validate transactions.
- Scalability: Distributed ledgers can be scaled to handle many transactions, as each node in the network can process transactions independently.

Some examples of distributed ledgers include:

- Blockchain: Blockchain is the most well-known example of a distributed ledger. Blockchains are used to record cryptocurrency transactions, but they can also be used to record other types of data.
- Hyperledger Fabric: Hyperledger Fabric is a distributed ledger platform that is designed for enterprise use cases. Hyperledger Fabric is used by a variety of companies to record supply chain information, medical records, and other types of data.
- Corda: Corda is a distributed ledger platform that is specifically designed for financial use cases. Corda is used by banks and other financial institutions to record and settle transactions.

Distributed ledgers are a relatively new technology, but they have the potential to revolutionize many industries. As the technology continues to develop, we can expect to see more and more applications for distributed ledgers in the years to come.

Examples of digital ledgers implemented for power sector applications include:

https://www.energyweb.org/

https://www.powerledger.io/

https://suncontract.org/