ELECTRICITY SUPPLY INDUSTRY

NAMIBIA WHEELING FRAMEWORK

(DRAFT V2.0)

29 September 2019

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1 DEFINITIONS

The definitions for the Model calculations can be found in the Appendices.

Balancing Charge	The charge used to determine the Balancing Payment to be made to the MO by an Eligible Producer that is out of balance.
Balancing Energy	Has the meaning given to that term in section **Error! Reference source not f ound.**.
Balancing Service	The action of providing Balancing Energy.
Bilateral Transaction	A transaction that is negotiated and entered into between a willing Buyer and a willing Seller, to trade electricity, under mutually acceptable terms, including price and quantity, for a specified period of time.
Board	Means the Electricity Control Board established by the Electricity Act, Act No 4 of 2007, or its successor in title.
Buyer	See Contestable Customer.
Contestable Customer (CC)	Means any of: • Contestable End Consumer • Contestable Distributor • An Exporter • A Trader
Contestable Distributor	Means a Distributor that is connected to - and purchases electricity at - a Contestable Supply Point.
Contestable End Consumer	Means an End Consumer that is connected to - and purchases electricity at - a Contestable Supply Point.
Contestable Quantity	Refers to the maximum quantity of electricity a Contestable End Consumer or Contestable Distributor is allowed to purchase from an Eligible Seller.
Delivery Point	A physical point on the electrical network, agreed with the MO, where energy shall be metered and delivered by a Generator or Importer.
Distributor	A legal entity that is licenced to own, operate and maintain a Distribution system.
ECB	The Electricity Control Board of Namibia or it's successor.
Eligible Generator (EG)	A legal entity licenced to generate electricity and which is registered with the MO and which can enter into bilateral wheeling transactions with Contestable Customers in the MSB market.
Eligible Producer (EP)	Means any of: • Eligible Generator, or • Importer
Eligible Seller (ES)	Means any of: • Eligible Generator, or • Trader, or • Importer
End Customer	A user of electricity that is connected to either the Transmission or Distribution systems.

Energy Imbalance	The difference between Delivered Energy and Final Dispatch Schedule.
Exporter	A legal entity with a license to export power from Namibia, registered with the MO, complying with Market Rules for the MSB Market.
Generator	A legal entity holding a valid generation license to operate a power station.
Grid Code	Grid Code refers to a document (or set of documents) that legally establishes technical and other requirements for the connection to and use of an electrical system by all Market Participants in a manner that will ensure reliable, efficient, and safe operation.
Importer	A legal entity with a license to import power to Namibia, registered with the MO, complying with Market Rules for the MSB Market.
Levies	Charges imposed on end-customers via the regulated electricity Tariff to recover costs not directly related to the supply of electricity services. In Namibia this includes an Electricity Control Board levy and a National Electrification Fund levy.
Loss Factor	A factor for a particular network applied as a multiplier on consumption (withdraw) to determine delivery (injection) to the same network taking losses into account.
Losses/ Technical Losses	The technical or resistive energy Losses incurred on Transmission and Distribution networks due to the characteristics of the physical equipment usually associated with dissipation.
Market Operator/ Market Operations (MO)	NamPower, operating as the Market Operator, is responsible to carry out the following functions: Dispatch & Balancing, Market Operations, Planning & Procurement and Trading.
Market Participants (MP)	See Section **Error! Reference source not found.**
Market Rules	Rules which govern the operation and management of the MSB Market.
Modified Single Buyer (MSB)	The "Modified Single Buyer" is the new market structure, adopted by the Government of the Republic of Namibia, in April 2019.
Nominated Percentage	Means the percentage of energy from each Eligible Seller to be sold to each Contestable Customer in every Trading Period.
Reliability Service	The action of providing ancillary and related services.
Schedule Unit	Means one of the following: • A single generating unit that forms part of a centrally-dispatched Generator • A single power station if it is a self-dispatched Generator • A single substation identified by the MO as the point of power entry for an Importer.
Seller	See Eligible Seller.
Supply Point	A physical point on the electrical network where energy shall be metered and supplied to Distributors, End-Consumers and Exporters.
System Operator/ Systems Operations (SO)	The entity responsible for the integrity of the system, including restoration and back-up.

Tariff	A Tariff is a combination of charges applied to recover measured quantities such as consumption and capacity costs, as well as unmeasured quantities such as service costs.
Trader	A legal entity with a licence to buy electricity from Eligible Producer(s) and sell to Contestable Customer(s). A trader only facilitates energy trades and has no entitlement to the energy. A Trader is not permitted to buy from or sell to a Trader.
Use of System charges	The regulated Tariff charged for the use of the system, which excludes Connection Charges and which includes network, reliability, Losses and/or service and administration charges. These can be levied as Transmission Use of System (TUoS) charges or Distribution Use of System (DUoS) charges. UoS charges also often contain Levies and subsidies which may be embedded or unbundled.
Wheeling	The act of transporting electricity across an electrical network.
Wheeling Charges	A family of charges to recover the cost of transporting electricity across an electrical network.

2 INTRODUCTION

The Electricity Control Board (ECB) is the statutory regulatory authority for the electricity sector, established in terms of Electricity Act (Act 2 of 2000) repealed by (Act 4 of 2007).

The ECB has the core responsibility of exercising control over the electricity supply industry (ESI); which entails regulation of generation, transmission, distribution, supply, use, import and export of electricity in Namibia. In particular Part II, sections (4)(a) and (4)(b) of the electricity Act - 2007, empowers the Regulator, subject to certain conditions, to establish an electricity market, issue licenses to persons operating in the market and to publish Market Rules and regulations to govern the market.

In 2016, the Namibian ECB decided to re-assess the suitability of an exclusive Single Buyer market model for Namibia, due to several factors, including: engagements with IPPs, the emergence of different market structures, funding requirements for new supply, significant cost reductions in photovoltaic and wind costs and the emergence of new storage technologies. In April 2019, a new Modified Single Buyer Market Model was approved by Cabinet.

In order to support the implementation of the Modified Single Buyer (MSB) model, the ECB has requested that New Energy Consulting develop a Wheeling Framework to guide market participants that enter into new transactions in the MSB.

3 OPEN ACCESS

The Electricity Act of 2007[1] states:

"*A licensee who is licensed to transmit or distribute electricity, as the case may be, must within its licensed area provide access to all existing and potential users of the transmission and distribution networks…"*.

The ability to access and make use of the integrated transmission and distribution networks for bilateral wheeling between an Eligible Seller and a Contestable Customer, is fundamental to the operation of the MSB. Without non-discriminatory access to - and fair pricing for the use of - the integrated network, the MSB will not reach its full potential. This already forms a principle tenet of Namibia's enabling regulatory environment.

[1] The prevailing legislation when the Wheeling Framework was developed in July 2019.

4 PURPOSE

The main purpose of the Wheeling Framework is to support the operationalisation of the MSB market in Namibia by providing a transparent, fair and practical framework for the determination and implementation of wheeling services and charges for the use of Namibia's transmission and distribution networks.

The MSB, supported by the wheeling Framework, will intensify competition, provide for more customer choice and increase generation self-sufficiency while lowering the cost of electricity by enabling Bilateral Transactions across Namibia's integrated electricity system.

5 PRINCIPLES

The Wheeling Framework is based on the following principles:

1) Economic Efficiency: The framework strives to achieve economic efficiency to encourage the optimum use of scarce resources.
2) Network Revenue Neutrality: The framework must protect the regulatory allowed revenue requirement of the network licensee.
3) Fairness: The framework aims to treat all Bilateral Transactions in a consistent and fair manner.
4) Non-discriminatory: The framework aims to prevent discrimination between Bilateral Transactions. In practise this means that similar transactions will attract similar charges.
5) Transparency: The wheeling methodology and charges are open and transparent which means it can be followed and if needed replicated by any interested party. A copy of the latest revision can be obtained from the ECB's web portal.
6) Simplicity: Avoid overly complex calculations and methodologies.
7) Ease of implementation: Where possible the wheeling framework builds on existing tariff methodologies and charges.

6 CHALLENGES

It is difficult to develop a wheeling framework that meets all the stated principles and objectives in equal measure. Inevitably the wheeling framework incorporates trade-offs in order to find a balance that is appropriate for the Namibian electricity industry. The following specific challenges are noted:

1) In many instances, the recommended charges reflect average costs which means that some customers will pay more and some will pay less than the customer specific cost of supply charges. This is a general observation/challenge which applies to current regulatory tariffs and is not specific to the wheeling framework only.

2) A major challenge is that utilities aim to recover the fixed network investment cost (which is a sunk cost) but, this is in conflict with efficient economic signals which require that charges are based on future marginal cost and hence exclude sunk costs. It is therefore important that charges, meant to recover sunk costs, are implemented in a way that minimises its influence of investments decisions.

3) Before the introduction of Bilateral Wheeling transactions customers essentially pay all the charges for the recovery the cost of the network. If Bilateral Transactions are introduced a key decision is whether private generators will pay for the use of the network? If so then the follow-up questions are what charges and how much will they?

4) Network costs are "lumpy" in nature which means that a relatively small marginal increase in network usage may trigger a significant investment which will create excess network capacity for a number of years before the next "lumpy" investment is triggered.

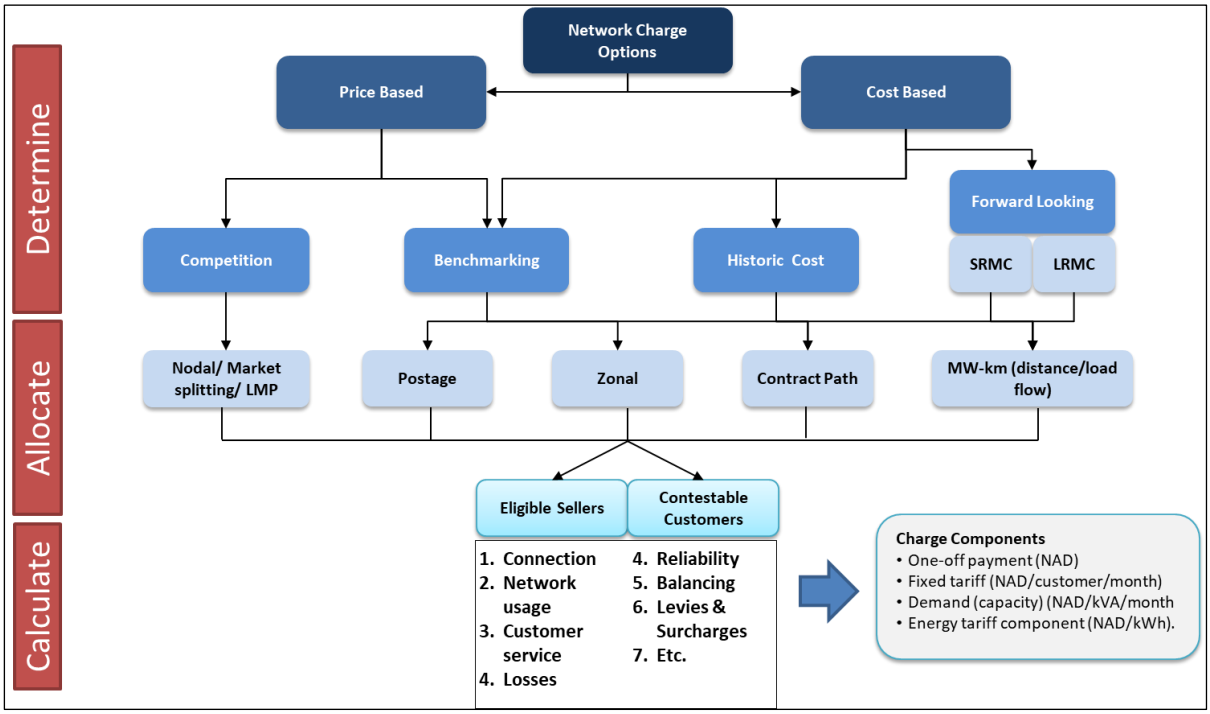
5) Network flows are dynamic making it difficult to accurately forecast network usage.

6) Commercial energy "flows" in agreements are different from technical energy "flows" in the network.

7 METHODOLOGY

There are numerous network charge options that can form the basis of wheeling charges. The figure below illustrates the main options

Figure 1: Examples of Network Charge Options



The purpose of this wheeling framework is not to provide a detailed assessment of the options considered however, a brief description with the key attributes of each of the options are summarised in the table below for context.

Table 1: Wheeling Framework Components

Methodology	Brief Description	Key Attributes
Postage Stamp	• All users pay the same charge irrespective of distance or location	• Simple and easy but does not send good investment signals
Zonal	• Similar to postage stamp but region is divided into zones (same charges within a zone but different charges between zones)	• Sends better investment signal than Postage Stamp but also more complex
Contract Path	• Specific charges are determined based on a specific start and end points	• Suitable if specific costs must be recovered from only some customers.
MW-km	• Charges are based on the distance between start and end points drives the cost	• Fairly popular but discriminates sometimes unfairly against long-haul transactions.
Short-run Marginal Cost	• Annualised charges to reflect the SRMC of the network usually consisting of forward looking losses and variable O&M, etc	• Economically efficient but not does not recover full revenue requirement of the utility
Long-run Marginal Cost	• Annualised charges to reflect LRMC of the network usually consisting of forward looking investments, O&M, staff, losses, etc.	• Requires complex modelling • Good investment decision signal • Meets future cost but ignores historic cost
Nodal	• Prices are determined following market splitting due to congestion	• Complex and is more suited for a competitive market

As can be noted from the above table all the methodologies have strengths and weaknesses. In keeping with the principles and objectives listed above the Namibian Wheeling Framework is based on a combination of the different methods as summarised below. and are summarised below:

1) Contract Path method in combination with LRMC way of determining costs to send an appropriate investment decision for cost recovery of specific assets (e.g. Connection or sharing of specific assets by an identifiable group of users).
2) Postage Stamp approach to recover regulatory allowed historic cost (simple, non-discriminatory but not efficient).
3) Benchmarks I used where the above approaches will either be too complex or not send economic efficient investment decisions.

8 NOTABLE FEATURES OF THE NAMIBIA WHEELING FRAMEWORK

Based on the above discussion, the key features of Namibia's Wheeling Framework include:

1) The selling and buying of electricity between EGs and a CCs are based on commercial arrangements however, the actual flow of electricity on the network follow natural laws. To ensure that financial settlement results align with commercial arrangements, meter reading adjustments are needed to reconcile physical flows and commercial flows. The meter reconciliation process involves increases ("Add Back") and decreases ("Rebates") at

the relevant metering points by licensee. The adjustment quantities will be determined by the MO in accordance with the trading nomination process under the Market Rules.

2) Where possible Contestable Customers will pay for the use of the network including losses. This approach has the following advantages:
   a) It is consistent with the current tariff methodology in Namibia where customers pay for the use of the network.
   b) It does not discriminate between energy purchases from a utility or energy purchased from and IPP via Bilateral Transactions.
   c) It reduces the number of network charges payable by an ESs and there minimises price risk.
3) In principle, ignoring the impact of incremental losses which as addressed below, neither an EG nor a CC pay any additional charges for the wheeling of power, except under the following instances:
   a) When a transmission connected EG exports power (via an Exporter) from Namibia. In this instance the EG will pay a Transmission Export charge for the use of the transmission network.
   b) When distributed connected EG sells power to a CC connected to either the transmission or another distributor's network or to an Exporter. Again, in this instance the EG will pay a Distribution Export charge for the use of the distribution network.
   c) An EG is required to pay a Network Capacity Reserve charge in the event that it requires compensation (e.g. deemed energy payments) in the event the network is unable to evacuate the power. Note this charge is negotiated between the EG and the relevant network company(ies) and is optional.
4) The wheeling framework takes into account the EG's incremental impact losses (increase or decrease) into account. However, any claim of a loss increase or decrease must be supported by an appropriate technical study by a reputable organisation and accepted by the network licensee.

9 TARIFF UNBUNDLING

Since its establishment, the ECB has been working towards more cost reflective tariffs. Tariff unbundling is a key step towards developing and implementing a wheeling methodology that is fair and that will ensure revenue recovery of services provided. Namibia have already taken the necessary steps to unbundle its transmission tariffs.

A recent cost-of-supply study is helping the distribution industry in moving closer to cost reflective tariff structures with the appropriate separation between energy, capacity and fixed charges. Further tariff unbundling at distribution level is needed to ensure that customers pay for the services they use (e.g. network usage, reliability and losses) and that they contribute appropriately to approved levies and surcharges (e.g. ECB levy, NEF levy and LA surcharges).

The fact that some of these charges and levies are currently "escapable" creates two significant and undesirable outcomes. Firstly, other customers still have to pay for these services, resulting in a cross-subsidy. Secondly, when customers are considering an offer from an IPP, they are making a comparison with the bundled energy -tariff which includes all of these costs and charges – this results in an incorrect economic signal and could lead to customers making poor choices regarding energy purchases.

The following two tables summarise the various services and charges that are payable EPs, CCs and Traders for the use of the transmission and distribution systems respectively.

Table 2: Unbundled Transmission Services and Charges

Unbundled Transmission Services & Charges			
Unbundled Service & Charges	Applicability		
	Eligible Producer	CC (non-Exporter)	CC (Exporter)
Connection charges	✓	✓	✓
Energy from NP		✓	✓
Tx losses charge		✓	✓
Reliability charge		✓	✓
Use of System charges		✓	
Service charges	(✓)	✓	✓
ECB Levy		✓	✓
NEF Levy		✓	
Incremental losses		✓	✓
Tx Network Export charge			✓
Network Capacity Reserve charge	(✓)		
Balancing penalty	✓		
Energy from EG / Trader		✓	✓

✓= applicable (✓) = applicable under certain conditions ☐ Unbundled/new services & charges

Table 3: Unbundled Distribution Services and Charges

Unbundled Distribution Services & Charges		
Unbundled Service	Applicability	
	Eligible Producer	Contestable Customer
Connection charges	✓	✓
Energy from Utility		✓
Dx average losses charge		✓
Reliability charge		✓
Use of System charges		✓
Network charge		✓
Service charges	(✓)	✓
Levies (ECB, NEF, LAS)		✓
Incremental losses charge/rebate	(✓)	✓
Dx/Tx Export charges	(✓)	
Network Capacity Reserve charge	(✓)	
Balancing penalty	✓	
Energy from EP / Trader		✓

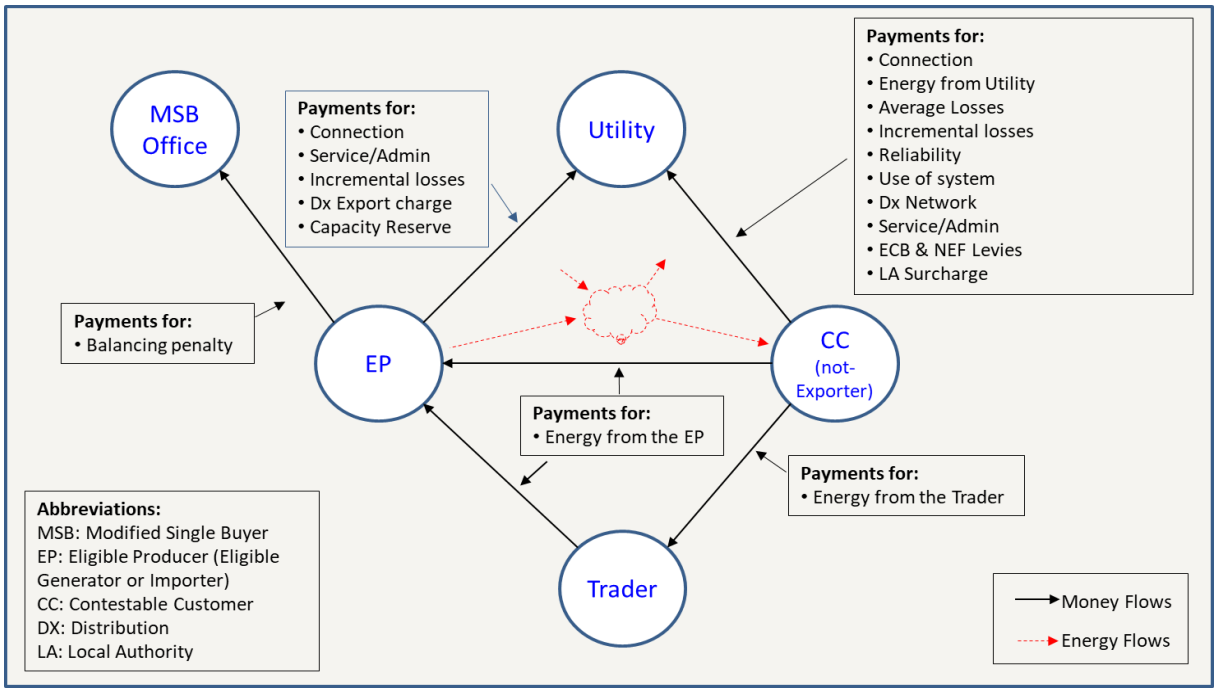
✓= applicable (✓) = applicable under certain conditions ☐ Unbundled/new services & charges

The following section provides a more detailed discussion of each of the charges and the conditions under which they apply.

10 COMMERCIAL RELATIONSHIPS

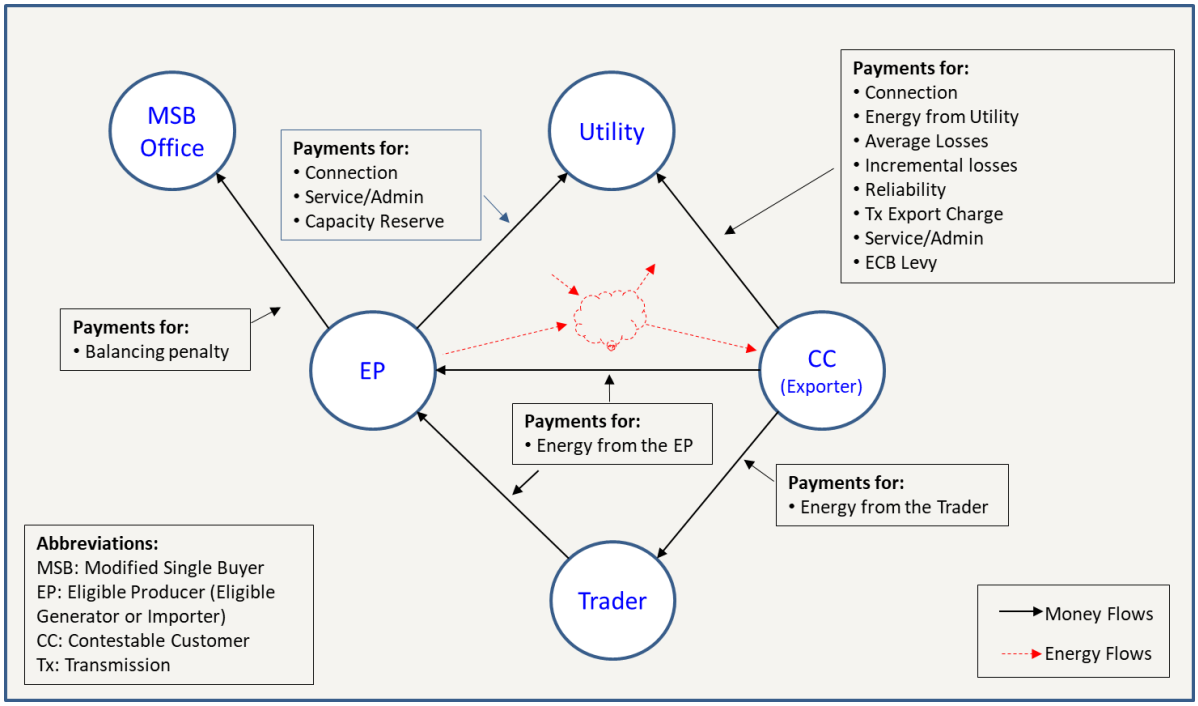
This section summarises the typical commercial relationships in the MSB by identifying who will invoice whom and for what services. The services offered are slightly different depending on whether an ES sells power to a CC for use in Namibia (CC is not an Exporter) and when iit is sold to an Exporter for use outside of Namibia (CC is an Exporter).

Figure 2: Typical Commercial Relationships Assuming the CC is not an Exporter



The same relationships are shown below assuming the Contestable Customer is an Exporter.

Figure 3: Typical Commercial Relationships Assuming the CC is an Exporter



11 WHEELING & OTHER CHARGES

11.1 Connection Charges

The purpose of Connection Charges is to recover the cost of connecting and integrating an Eligible Seller or Contestable Customer to the integrated transmission or distribution systems in Namibia. The cost will be calculated on a project by project basis in accordance with the transmission or distribution licensee's Connection Charge Policy.

11.2 Utility Energy Charge

This charge applies as follows:

1) This an energy-based charge (NAD/kWh) and applies to Contestable Customers.
2) This charge relates to the volume of energy metered (in kWh) at the CC's Supply Point.
3) The charge is in accordance with the energy component (excluding losses) of the appropriate regulatory approved tariff.

11.3 Energy Rebate

The Energy Rebate applies as follows:

1) This an energy-based charge (NAD/kWh) and applies to Contestable Customers and relevant metering points between network licensees.
2) This charge relates to the volume of energy metered (in kWh) at the Supply Point but not purchased from the utility (i.e. energy purchased from an Eligible Seller via a Bilateral Transaction).
3) The rebate is in accordance with the energy component (excluding losses) of the appropriate regulatory approved tariff.

See section 13 for example of the need for and application of the Energy Rebate.

11.4 Energy Add-back Charge

This charge applies as follows:

1) This an energy-based charge (NAD/kWh) and applies to Contestable Customers.
2) The charge adds back the cost for energy purchased from the utility but not metered (energy which was offset by a bilateral transaction(s) due to network configuration).
3) The charge is in accordance with the energy component (excluding losses) of the appropriate regulatory approved tariff.

See section 13 for example of the need for and application of the Energy Add-back Charge.

11.5 Average Losses Charge

Average losses charges shall apply as follow:

1) This an energy-based charge (NAD/kWh) and applies to Contestable Customers connected to the transmission or distribution system.
2) This charge relates to the volume of energy metered (in kWh) at the CC's Supply Point irrespective whether the energy was bought from the utility or an ES.
3) The charge is in accordance with the regulatory approved unbundles losses charge which in turn is based on regulatory approved loss factor.
4) For the sake of clarity, a CC that buys electricity from a co-located embedded EG will not pay the average losses charge for energy purchased.

11.6 Reliability Charge

The Reliability Service Charge shall apply as follow:

1) This is an energy-based charge (NAD/kWh) and applies to Contestable Customers connected to the transmission or distribution system.
2) The charge is intended to recover the cost of procuring and supplying ancillary services and the to operate the market.
3) This charge relates to the total volume of energy purchased by the CC's including purchases from a co-located embedded EG.
4) The charge is in accordance with the regulatory approved unbundled charges.

11.7 Use of System Charges

The Use of System charge shall apply as follow:

1) This is a demand-based charge (NAD/kVA/mo) and applies to CCs connected to the transmission or distribution system.
2) The charge is intended to recover the cost of providing network infrastructure.
3) This charge relates to the demand (in kVA) at the CC's Supply Point irrespective whether the energy was bought from the utility or an ES. The demand shall be measured in accordance with the utility's criteria.
4) The charge is in accordance with the regulatory approved unbundled charges.
5) For the sake of clarity, a CC that buys electricity from a co-located embedded EG may escape a portion of this charge.

11.8 Distributor Network Charge

The Distributor Network Charge shall apply as follow:

1) This is an energy-based charge (NAD/kWh) and applies only to CCs connected to the distribution system.
2) Revenue from the charge contributes to the revenue requirement of the utility and should not be escapable through wheeling or embedded generation. Through tariff unbundling the charge will be made visible and “non-escapable”.
3) This charge relates to the total volume of energy purchased by the CC’s including purchases from a co-located embedded EG.
4) The charge is in accordance with the regulatory approved unbundled charges.

11.9 Service Charges

The Administration and Service Charge shall apply as follows:

1) This is a fixed-monthly-based charge (NAD/month) and applies to Contestable Customers and Eligible Sellers connected to the transmission or distribution systems.
2) The charge does not apply to an embedded EG that is co-located and directly connected to a CC.
3) The charge is intended to recover the cost of providing administration related services including metering, billing and customer support.
4) The charge is in accordance with the regulatory approved unbundled charges.

11.10 Levies and Surcharges

The Levies and Surcharges shall apply as follow:

1) The ECB Levy is an energy-based charged (NAD/kWh) and applies to all Contestable Customers (including Exporters) connected to the transmission and distribution systems.
2) The NEF Levy is an energy-based charged (NAD/kWh) and applies to all Contestable Customers (excluding Exporters) connected to the transmission and distribution systems.
3) The LA surcharge is an energy-based charged (NAD/kWh) and applies to all Contestable Customers (excluding Exporters) connected to only the distribution system.
4) The charges are intended to contribute towards varies causes as set out in the various legislation and regulation.
5) This charge relates to the total volume of energy purchased by the CC’s including purchases from a co-located embedded EG.
6) The relevant levies and surcharges are in accordance with the regulatory approved unbundled charges.

11.11 Incremental Losses Charge

The purpose of the Incremental Losses charge (or rebate) is to reflect the impact of an EG on the increase or decrease in system losses:

1) This an energy-based charge (NAD/kWh) and applies to:
    a) A CC connected to the transmission or distribution system subject to the following exception.
    b) An EG if the EG is connected to a distribution system and wheels power to a CC that is connected to another licensee's network.
2) This charge relates to the volume of energy produced by the EG and sold to a CC and adjusted using the relevant transmission or distribution loss factor.
3) The charge is in accordance with the regulatory approved unbundled charges.
4) The default value of the incremental loss factors is one. This indicates that the EG does not cause system losses to increase or decrease. An incremental loss factor can only be different from the value one if it was:
    a) Determined by a reputable entity,
    b) Accepted by the network licensee
    c) Approved by the ECB

11.12 Network Export Charge

The Network Export Charge shall apply as follow:

1) This an energy-based charge (NAD/kWh) and applies to:
    a) An Exporter connected to the transmission. This charge is also referred to and the Tx Export Charge
    b) An EG if the EG is connected to a distribution system and wheels power to a CC that is connected to another licensee's network. This charge is also referred to as the Dx Export Charge.
2) Revenue from the charge contributes to the revenue requirement of the utility and should not be escapable.
3) This charge relates to the total volume of energy purchased by the Exporter or the volume of energy sold by a distribution connected EG selling to a CC in another network.
4) The charge is in accordance with the regulatory approved unbundled charges.
5) For the avoidance of doubt if a distribution connected EG sells power to a transmission connected Exporter both the Dx Export and the Tx Export charges shall apply.

11.13 Network Capacity Reserve Charges

The Network Capacity Reserve Charge shall apply as follows:

1) This is a fixed monthly charge (NAD/mo) and applies to an Eligible Generator.
2) The charge allows the EG to receive compensation (deemed energy payments) under certain conditions if the EG is unable to deliver power due to network performance.
3) The charge is intended to recover the cost of additional the network infrastructure and to make deemed energy payments when required.
4) The relevant charge, conditions and compensation will be negotiated between the EG and the relevant network licensee(s).
5) The charge is voluntary.

11.14 Balancing Charge

The Balancing Service Charge shall apply as follow:

1) This is an energy-based charge (NAD/kWh) and applies to Eligible Sellers connected to the transmission or distribution or a customer's system.
2) The charge is intended to recover the cost of providing balancing services.
3) This charge relates to the total balancing energy volume calculated by the MO in accordance with the Market Rules.

4) The relevant charge is in accordance with the regulatory approved balancing mechanism.

It should be noted that NamPower as the supplier of last resort is not required to balance generators that sell power to Exporters unless the relevant parties have entered into agreement for the provision of such services.

12 WHEELING SPREADSHEET MODELS

Four different MS Excel-based *Wheeling Models* have been developed for the ECB in order to allow market participants to test the results of different supply and customer configuration options. The models differ depending on where the Eligible Generator connects, namely:

1) ES connected to the transmission system
2) ES connected to a customer who is connected to the transmission system
3) ES connected to the distribution system
4) ES connected to a customer who is connected to the distribution system

Based on the user's input assumptions, the models will demonstrate the financial impact for the specific transaction scenario.

The impact of each transaction scenario is shown in two areas in the model:

1) The set of simulated invoices from MO/ Distributors/ Generator, to the other parties
2) A "before wheeling" and "after wheeling" comparison for the Customer – to show the net benefit as well as which specific charges will vary

Each spreadsheet has been designed to allow the user to choose multiple offtakers (Contestable Customers) for a specific EG connection. Contestable Customers can be:

1) Co-located with the Generator
2) Connected to the same Distribution network as the EG
3) Connected to another Distribution network as the EG
4) Connected to the Transmission network

The models also allow a ES to sell to any Distributor as well as the MO

12.1 Disclaimer

Market Participants and prospective Market Participants may use the current version of the wheeling spreadsheets (v2.0) to estimate the relevant wheeling and related charges. Please keep in mind that the model was developed before the unbundling of distribution tariffs and as such, the model simulates the unbundling of these tariffs. It follows that the ECB approved values (and not the model values) should be used when assessing the various wheeling charges and their impact. Furthermore, the actual amounts will be based on actual metered

values and not the simulated values in the spreadsheets model. Therefore, any wheeling charges and values derived from the model are indicative only and should not be used in any financial decision-making or contractual arrangements. The ECB approved unbundled charges and actual metered values should be the only reference for decision-making.

12.2 Model Structure

The model has five main sections:

1) Inputs
2) Workings
3) Invoices
4) Gross Margin
5) Transaction

12.2.1 Administration Section

This section contains two sheets. The first is a Disclaimer that clearly states that the model results are indicative only and should not be used for investment decisions. Only the ECB approved unbundled charges and the actual metered values should be used as a reference. The second spreadsheet lists a number of common abbreviations that are used in the workbook.

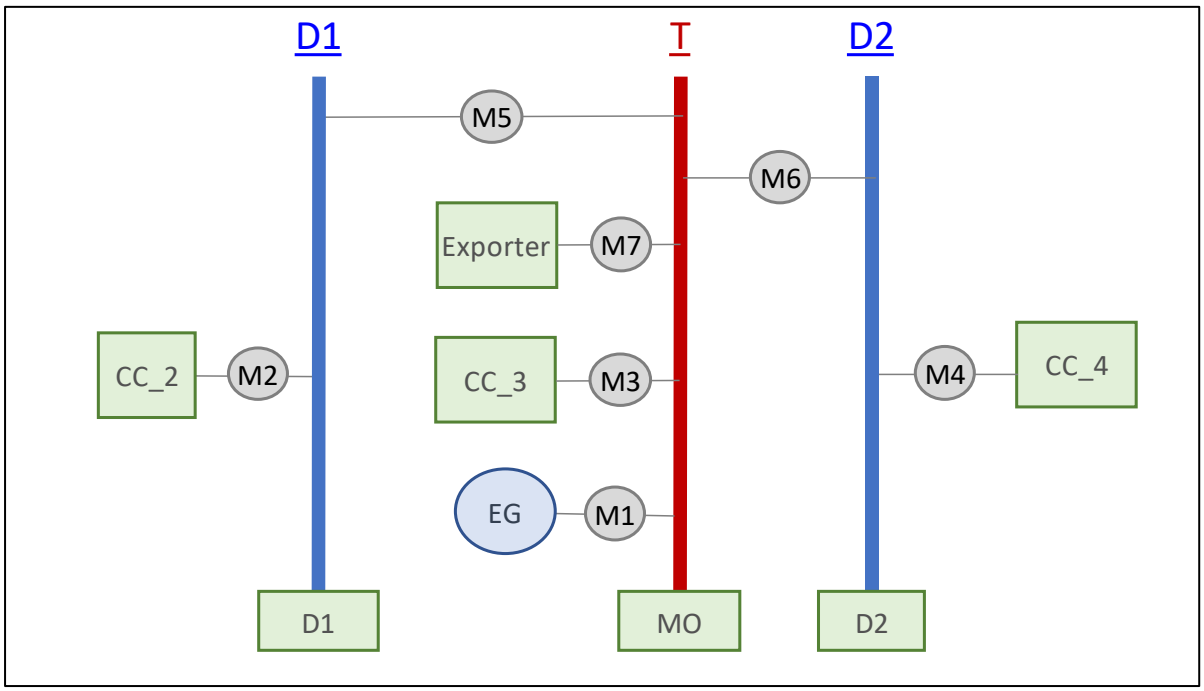
12.2.2 Inputs Section

There are five sheets in the Inputs Section, which are described below. It should be noted that the models have been protected/ locked in order to prevent unwanted changes to data and formulas which do not require user inputs. The user inputs sections are freely accessible to allow users to change inputs and test different scenarios.

Config

The Config sheet contains a diagrammatic representation of the transactions that can be tested in the specific model. The configurations for each spreadsheet model are discussed in more detail in section x.

Figure 4: Example of Wheeling Configuration Diagram in Wheeling Model



Users can also simulate an Export transaction by choosing to sell to an Exporter. The main difference between and CC connected to the transmission system and an Exporter is that the Exporter pays a Transmission Export charge instead of a Use-of-System Charge. In the MSB, Generators and Exporters are considered as separate entities, therefore they are invoiced separately. Where an Exporter is also a Generator, they will need to combine the costs of both the Generator and the Exporter, in order to test the viability of a transaction. It should be noted that Exporters do not have to pay the NEF levy.

Scenarios

This sheet in the models lists all of the potential scenarios and the associated assumptions.

Tariffs

This sheet is used to input the tariffs for the: (i) MSB, (ii) Distributor 1 and (iii) Distributor 2. The user can update these charges to reflect the specific charges depending on the location of the Generator and Customer.

The charges listed are:

Table 4: Tariff Inputs into Wheeling Model

Charges	Units
1. Fixed Charges	
a. Service Charge	N$/customer/mo
b. Point of Supply	N$/POS/mo
2. Network Charges	
a. Network Access Charge	N$/kVA/mo
b. Maximum Demand Charge	N$/kVA/mo

Charges	Units
c. "Export" Charge	NAD/kWh
3. Bundled Energy Charges	
a. Low Season	
i. Peak	N$/kWh
ii. Standard	N$/kWh
iii. Off-Peak	N$/kWh
b. High Season	
i. Peak	N$/kWh
ii. Standard	N$/kWh
iii. Off-Peak	N$/kWh
4. Supplemental Charges	
a. Reliability	N$/kWh
5. Levies & Surcharges	
a. ECB Levy	N$/kWh
b. NEF Levy	N$/kWh
c. LA Surcharge	N$/kWh
6. Technical Losses	
a. For customers	%
b. For generators (if applicable)	%

The user can adjust these charges, as appropriate for their transaction configuration. All transactions require the user to input MSB tariffs. The user can also set the assumed loss percentage for customers and generators in the transmission and distribution networks.

EG_CCs

The user can adjust the assumptions for the Eligible Generator (EG) and the Contestable Customer (CC) on this sheet.

The Eligible Generator parameters include Capacity assumptions, Production assumptions, Commercial Assumptions and specifying the percentage of total production that will be sold to each Contestable Customer. The user can specify sales for up to four Contestable Customers, as well as sales to D1, D2, Exporter and the MSB.

The user can also set specific consumption assumptions for all of the potential consumers, including D1, D2, Exporter and MSB.

Values are set for each scenario in the model (S1-S7), by inputting data into columns F-O. There is also a dropdown selector in cell D2, which allows you to specify which scenario you will have selected for assessment. This dropdown scenario selector is also available on various other sheets. The model is designed so that only the results from one scenario are shown at a time.

Figure 5: Example of Eligible Producer Input Data

Selected Scenario -->	To CC_1	To CC_1	To CC_2	To CC_3	To CC_4	To MO	To D1	To D2	S8	S9	S10
Eligible Producer											
Parameters	Units	Values	Values	Values	Values	Values	Values	Values	Values	Values	Values
Capacity Assumptions:											
Peak Production	kW	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000
Net Installed Capacity	kW	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000
Peak Coincidence Factor (Capti	#	-	-	-	-	-	-	-	-	-	-
Peak Coincidence Factor (Dx)	#	-	-	-	-	-	-	-	-	-	-
Production Assumptions:											
Avg Annual Load Factor	%	23.4%	23.4%	23.4%	23.4%	23.4%	23.4%	23.4%	23.4%	23.4%	23.4%
Total Monthly Net Production	kWh	8,196,609									
TOU Production (% of total production)											
Low Season (9 months)											
Low: Peak	%	29.0%	29.0%	29.0%	29.0%	29.0%	29.0%	29.0%	29.0%	29.0%	29.0%
Low: Standard	%	31.2%	31.2%	31.2%	31.2%	31.2%	31.2%	31.2%	31.2%	31.2%	31.2%
Low: Off-Peak	%	17.1%	17.1%	17.1%	17.1%	17.1%	17.1%	17.1%	17.1%	17.1%	17.1%
High Season (3 months)											
High: Peak	%	8.2%	8.2%	8.2%	8.2%	8.2%	8.2%	8.2%	8.2%	8.2%	8.2%
High: Standard	%	9.3%	9.3%	9.3%	9.3%	9.3%	9.3%	9.3%	9.3%	9.3%	9.3%
High: Off-Peak	%	5.2%	5.2%	5.2%	5.2%	5.2%	5.2%	5.2%	5.2%	5.2%	5.2%
Imbalanced Energy (% of pro	%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
Commercial Assumptions:											
Selling Price (at gen busbar)	N$/kWh	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Bilateral Sales to C. Customers (% of production)											
Contestable Customer 1	%	100.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	14.3%	0.0%	14.3%
Contestable Customer 2	%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	14.3%	100.0%	14.3%
Contestable Customer 3	%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	14.3%	0.0%	14.3%
Contestable Customer 4	%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	14.3%	0.0%	14.3%
MO	%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	14.3%	0.0%	14.3%
Distributor 1	%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	14.3%	0.0%	14.3%
Distributor 2	%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	14.3%	0.0%	14.3%
Check			-	-	-	-	-	-	-	-	-	-

Figure 6: Example of Contestable Customer Input Data

Selected Scenario -->	To CC_1	To CC_1	To CC_2	To CC_3	To CC_4	To MO	To D1	To D2	S8	S9	S10
Contestable Customer 1											
Parameters	Units	Values	Values	Values	Values	Values	Values	Values	Values	Values	Values
Technical Assumptions:											
Monthly Peak Demand	kVA	4,000	4,000	-	-	-	-	-	-	-	-
Annual/Notified Peak Demand	kVA	4,000	4,000	-	-	-	-	-	-	-	-
Consumption Assumptions:											
Avg Load Factor	%	65.0%	65.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total Monthly Consumption	kWh	22,776,000									
TOU consumption (% of total consumption)											
Low Season (9 months)											
Peak	%	17.9%	17.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Standard	%	21.0%	21.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Off-Peak	%	36.2%	36.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
High Season (3 months)											
Peak	%	6.0%	6.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Standard	%	7.0%	7.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Off-Peak	%	12.1%	12.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

12.2.3 Workings Section

This section of the spreadsheet contains two sheets – "Unbundled Tariffs" and "Calcs". There are no user inputs required on these sheets. They are used for certain intermediary calculations that are then applied in other sheets of the model.

12.2.4 Invoices Section

This section of the spreadsheet simulates the invoices for each of the participants in a transaction. Depending on the transaction, there may be invoices from: (i) MSB; (ii) Distributor

1; (iii) Distributor 2 and (iv) the Eligible Generator. There is no user input required for these sheets.

In order to allocate the various charges appropriately, the invoices show the impact of the metering and offsetting across the entire value chain. This can become relatively complex depending on the location of the Generator and Customer.

For example, if a Distribution embedded generator, sells energy to a Transmission connected customer:

1) The MSB will invoice the customer for the total energy measured through their meter – as if all of it was purchased from the MSB
2) The MSB will also rebate the customer for the energy produced by the Generator
3) Furthermore, the MSB will need to add-back the energy produced by the Generator to the consumption of the Distributor – the Distributor's consumption appeared to have been reduced by the Generator's production

The invoices sheets show these offsetting arrangements, as well as other issues, on each stakeholders' invoice.

12.2.5 Gross Margin Section

This section has three sheets: (i) MSB; (ii) Distributor 1 and (iii) Distributor 2. The Gross Margin section is designed to show the Net financial impact on these three parties, before and after a wheeling transaction. Each of the sheets shows the change in revenue and the change in the cost of sales for the MSB and the Distributors. This section can be used to demonstrate the value of supporting these transactions for each party and the net financial impact from a wheeling transaction.

12.2.6 Transactions Section

The Transaction section shows the before and after impact for a scenario where the Generator sells to (i) each of four potential Contestable Customers, (ii) or the Distributors or (iii) the MSB.

Note - the location of the Customers is shown diagrammatically in the Inputs Section "Config" sheet i.e.:

1) CC_1 is in Distributor 1's network and co-located with the Generator
2) CC_2 is in Distributor 1's network
3) CC_3 is Transmission connected
4) CC_4 is in Distributor 2's network

For each sheet in this section, columns F to AC show the impact from a numerical perspective. There is also a graphical perspective which shows the impact visually via waterfall graphs depicting the increase or decrease in specific charges, due to each transaction. The first graph (at the top of the page column AG-AT), shows the relevant charges before the wheeling

transaction i.e. this is what the customer currently is paying before entering into a wheeling transaction.

The second graph shows the relevant charges paid by the Contestable Customer after entering into a wheeling transaction i.e. this is what the customer will pay after wheeling. The third graph shows the net impact on specific charges due to the transaction i.e. the difference in the charges before wheeling and after wheeling.

12.3 User Guide

12.3.1 Model Set-up

This section describes the high-level steps required in order to test a transaction in the Wheeling Model.

1. Select the correct spreadsheet based on your Generator's location. These are:

Table 5: List of Wheeling Models

	Model	Description
MS Excel Wheeling Models	Transmission Connected Generator	This model is to be used in the case of a transaction where the generator is connected directly to the Transmission network.
	Transmission Customer Connected Generator	This model is to be used in the case of a transaction where the generator is connected behind the meter of a customer connected to the Transmission network
	Distribution Connected Generator	This model is to be used in the case of a transaction where the generator is connected directly to the Distribution network
	Distribution Customer Connected Generator	This model is to be used in the case of a transaction where the generator is connected behind the meter of a customer connected to the Distribution network

NB: An Importer will be seen as a Transmission Connected generator. An Exporter will be seen as a Transmission connected customer.

2. Go to the **Tariffs sheet** in the Inputs section of the spreadsheet:
    a. Input the appropriate tariffs for MSB (Column E); for Distributor 1 (Column F) and for Distributor 2 (Column G).
    b. MSB tariffs must be input for all transactions, even where the generator and distributor are in the same Distribution network
    c. D1 and D2 will be used depending on the specific transaction – the user can check the transaction configuration on the Config Sheet, in the Inputs Section.

3. On the **EG_CCs sheet**:
    a. Input Capacity and Production assumptions for the Eligible Producer
    b. Input Contestable Customer assumptions – can be for up to four customers, D1, D2 and MSB (check the config sheet for location of customer)
    c. The sheet has option for up to x10 scenarios with different assumptions
    d. The dropdown at the top of sheet (cell D2) will allow user to switch between scenarios

The model has now been configured and will automatically calculate the results shown in the Invoices, Gross Margin and Transactions section i.e. there are no macros to run in this model.

12.3.2 Interpreting the Results

The model has outputs which can be viewed in the three sections mentioned above:

Table 6: Model Results Sections

Section	Relevance
Invoices	• Shows the invoices for the selected scenario from either the MSB, Distributor 1 (D1), Distributor 2(D2) or the Eligible Generator (EG) – to all the other participants in the transaction • Select the scenario by using the dropdown at the top of the page (cell M2)
Gross Margin	• Shows the impact of the transaction on both the revenue and costs of the MSB and Distributors • The impact is shown with wheeling and without wheeling
Transactions	• Shows the impact on the Customer before and after a wheeling transaction • Graphical representation shows each charge as it contributes to total charges • 1st Graph at top of page is for before the transaction (i.e. the as is without wheeling) • 2nd graph in middle is for after the transaction (i.e. with wheeling) • 3rd graph at bottom shows the difference in charges for before vs. after

13 APPENDIX 1 – EXAMPLE OF ENERGY REBATE AND ENERGY ADD-BACK CHARGE

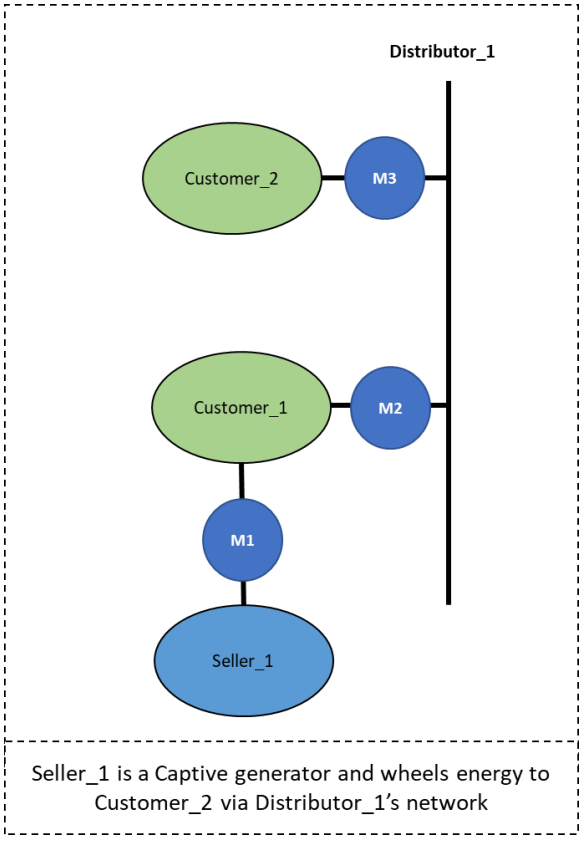
The energy rebate and add-back charges are necessary to reconcile commercial and technical energy flows. This example assumes a case where a customer connected generator (Seller_1) wheels power to Customer_2 which is located elsewhere in the same Distribution network. See Figure 7: Energy Add-Back Example 1 for more detail. From the figure it can be noted that:

1) Seller_1 enters into a PPA with Customer_2
2) Seller_1 produces energy which is metered by M1
3) Customer_1's meter at M2 is reduced by the amount of energy produced by Seller_1, even though Customer_1 is not buying the energy.
4) Meter M3 measures the Customer_2's total consumption which includes purchases from the utility as well as Seller_1.

In order to allocate the charges fairly:

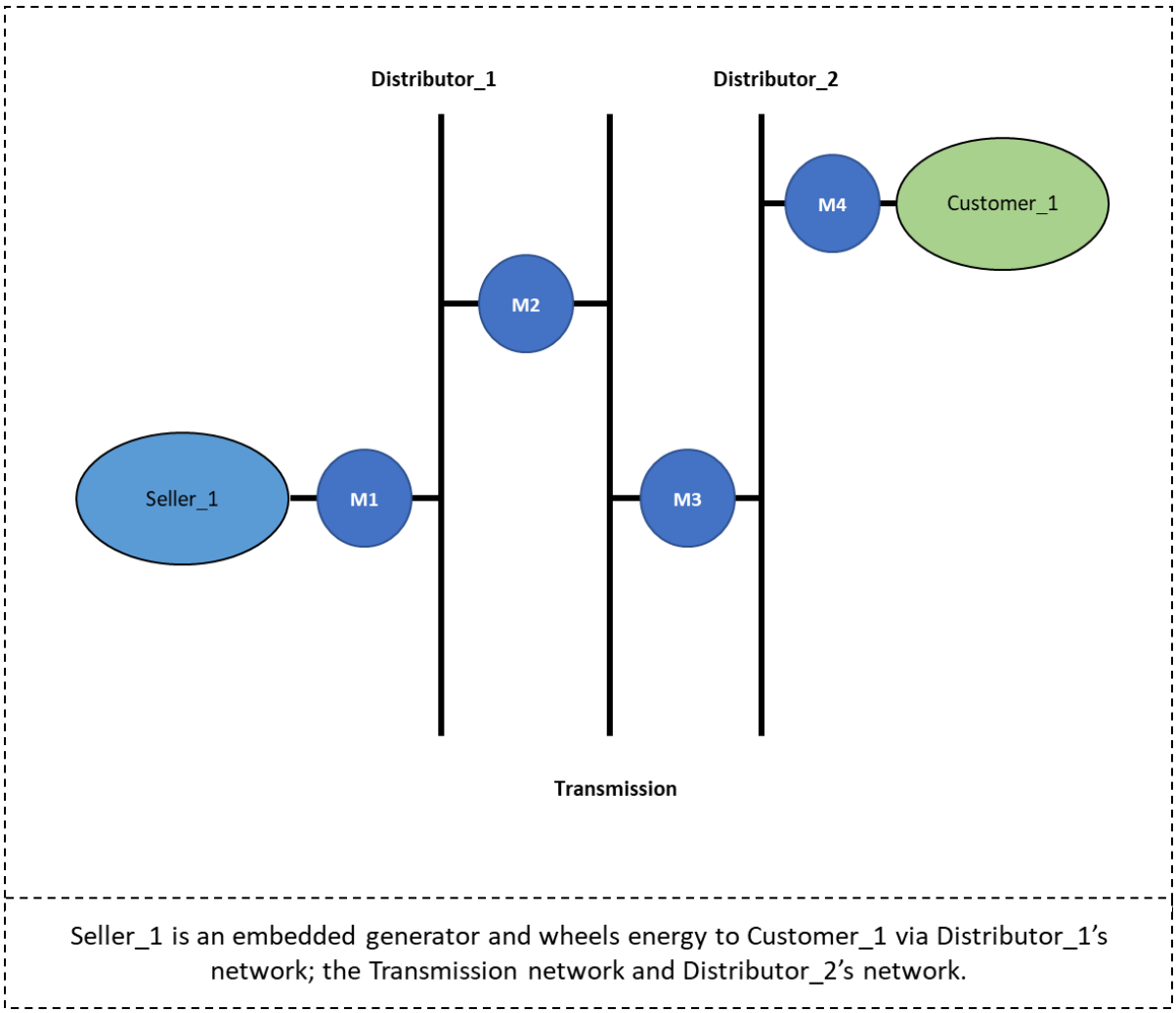
1) Distributor_1 will rebate Customer_2 for the energy metered by M3 but not purchased from the utility (this is the energy purchased from Seller_1),
2) Distributor_1 will add-back the volume of energy that Customer_1 purchased from the utility but that was not metered by meter M2 (the amount of energy Seller_1 sold to Customer_2).

Figure 7: Energy Add-Back Example 1



An add back could also be required in the event that a Distribution connected generator, wheels through the transmission network to another Distribution network. See figure below.

Figure 8: Energy Add-Back Example 2



Seller_1 is an embedded generator and wheels energy to Customer_1 via Distributor_1's network; the Transmission network and Distributor_2's network.

In the figure above, the following can be noted:

1) Seller_1 enters into a PPA with Customer_1
2) Seller_1 produces energy which is metered by M1
3) Distributor_1's purchases from MSB are reduced by the volume produced by Seller_1 i.e. it appears as if Dsitributor_1 has a reduced demand as measured at M2
4) Distributor_2 purchases energy from the MSB to supply Customer_1, with no apparent impact from Seller_1's production i.e. M3 and M4 reflect Customer_1's total consumption

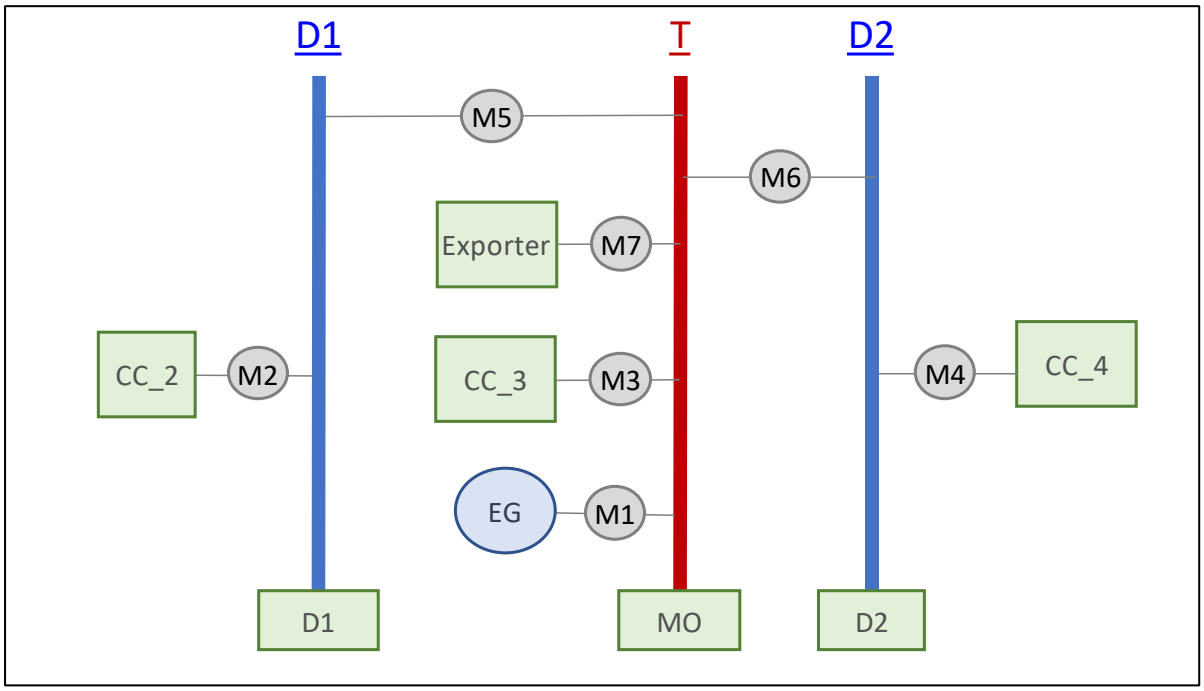
In order to allocate the charges fairly:

1) The MSB must add-back the energy metered at M1, to Distributor_1's demand as measured at M2 i.e. Distributor_1 should not receive the benefit of lower purchases from the MSB due to the embedded generator displacing MSB energy
2) The MSB must also rebate Distributor_2 with the same amount of energy metered at M1 (M3-M1) and Dsitributor_2 must pass this rebate through to Customer_1 (i.e. M4-M1)
3) In this way Distributor_2 and Customer_1's supply is reduced to reflect the impact of Customer_1's wheeling purchases from Seller_1
4) Customer_1 will also receive a separate invoice for the energy produced by Seller_1

14 APPENDIX 2 – NETWORK CONFIGURATIONS OF MODELS

14.1 Transmission Connected EG Model

Figure 9: Transmission Connected EG

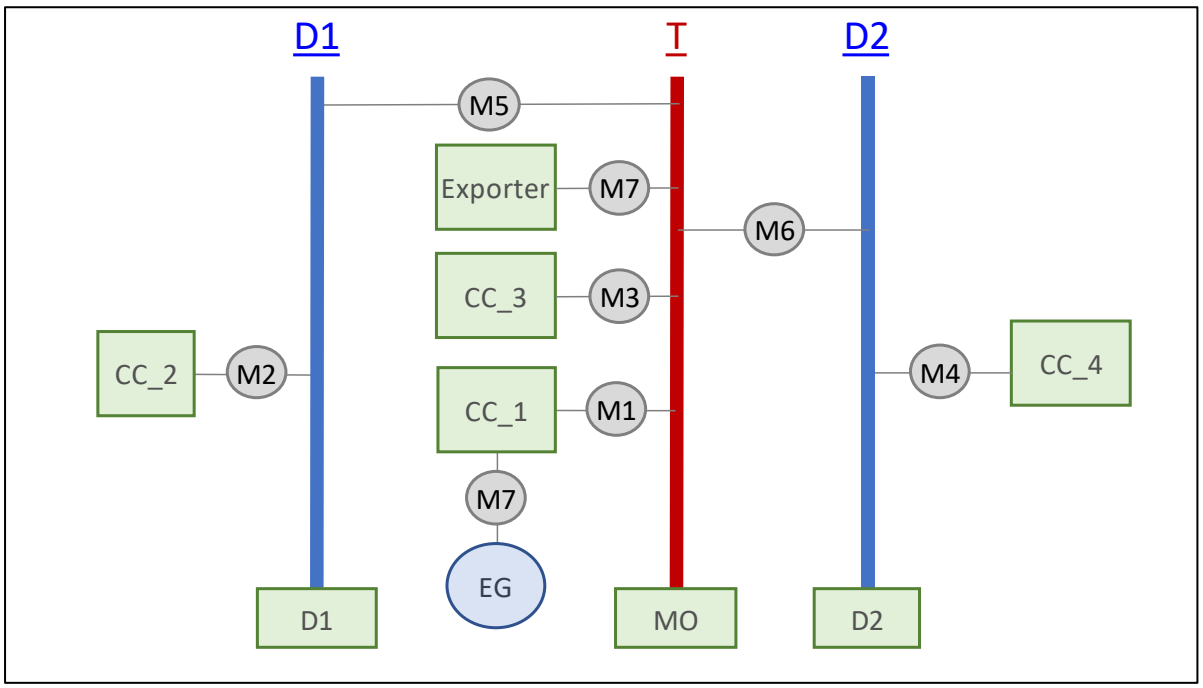


The following can be noted from the diagram:

1) The Generator is shown as the light blue oval, labelled *EG* (Eligible Generator) – in this example, connected via meter "*M1*" to "*T*" the Transmission network
2) Metering points are represented as small grey circles with labels "*M1…M7*"
3) Potential Customers are shown as green blocks with labels "*CC_1…CC_4*" (Contestable Customer1…4) as well as an Exporter.
4) Networks are shown as blue lines with *"D1" and "D2"* for Distribution and a red line "*T*" for Transmission

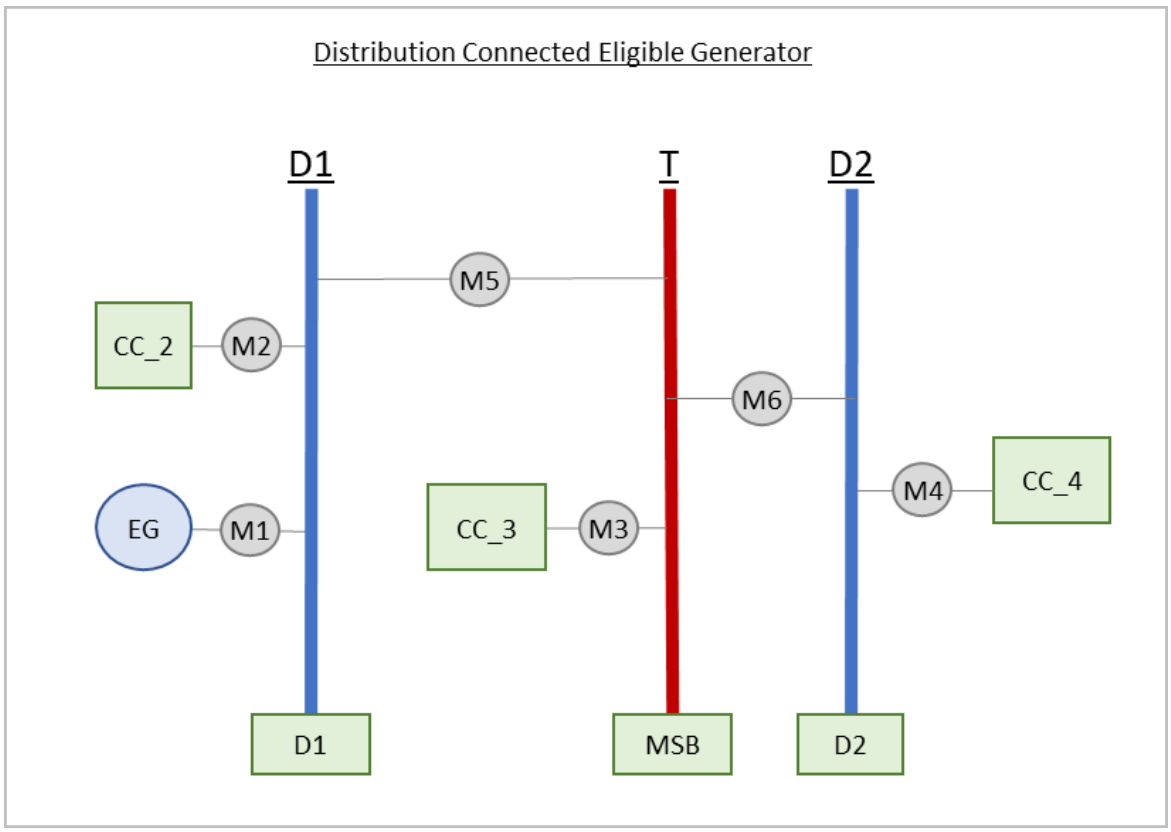
14.2 Transmission Customer-Connected EG

Figure 10: Transmission Customer Connected EG



14.3 Distribution Connected EG

Figure 11: Distribution Connected EG



14.4 Distribution Customer Connected EG

Figure 12: Distribution Customer Connected EG