Office of Utilities Regulation

Electricity Wheeling Tariff Methodology

Determination Notice

OFFICE OF UTILITIES REGULATION

2020 July 31

DOCUMENT TITLE AND APPROVAL PAGE

1. DOCUMENT NUMBER:2020/ELE/013/DET.002

2. DOCUMENT TITLE: Electricity Wheeling Tariff Methodology Determination Notice

3. PURPOSE OF DOCUMENT:

This document lays out the methodology for determining transmission and distribution use of system charges for electricity wheeling. It also outlines the methodology for the computation of connection charges for the transmission and distribution network if applicable.

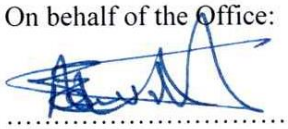
4. ANTECEDENT DOCUMENTS

Document Number	Publication Title	Publication Date
2019 /ELE/019/CON.001	Electricity Wheeling Tariff Methodologies Consultation Document	2019 November 4
2020/ELE/007/RES.001	OUR's Comments on Responses to Electricity Wheeling Tariff Methodologies Consultation Document	2020 March 27

5. Approval

This document is approved by the Office of Utilities Regulation and Determination herein become effective on 2020 July 31.

On behalf of the Office:



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Ansord E. Hewitt
Director-General

Date: 2020 July 31

Abstract

Condition 12 paragraph 1 of the Licence stipulates that the Jamaica Public Service Company Limited ("JPS") shall implement an Electric Power Wheeling service for customers with an annual average demand in excess of 1 MVA in accordance with such terms and conditions as are approved by the Office. The Wheeling service shall be for firm capacity. The Licence further stipulates in Condition 12 paragraph 2 that the use of system charge, as defined in the Electricity Act, 2015 (the "EA") shall be determined by the Office. It also indicates that JPS may prepare and submit to the Office, a cost of service study for determining the use of system charge.

It is in this context that the OUR published a Consultation Document on 2019 November 4 entitled "Electricity Wheeling Tariff Methodologies Consultation Document" (Document No. 2019 /ELE/019/CON.001) (Consultation Document) to solicit comments on the various methodologies available to the Office of Utilities Regulation ("OUR" or "Office") for consideration in the setting of tariffs for electric power wheeling.

Having received feedback from stakeholders on the methodologies and after weighing the strengths and weaknesses of the methodology the OUR has decided on the matter. This Determination Notice sets the OUR decisions regarding the methodology that is to be applied by the JPS in calculating wheeling charges on the electricity grid in keeping with the provisions of the *Electricity Licence, 2016* (the "Licence") and the EA.

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1. Executive Summary

1.1 The development of the wheeling framework in Jamaica has its basis in the Electricity Act, 2015 (EA) and the Electricity Licence, 2016 (Licence) which makes specific provisions for the wheeling of electricity by self-generators across the grid. The intent of the provisions in the EA and the Licence is to increase the degree of competition in the electricity market.

1.2 The OUR published a Consultation Document on 2019 November 4 entitled "Electricity Wheeling Tariff Methodologies Consultation Document" (Document No. 2019 /ELE/019/CON.001) (Consultation Document) to solicit comments on the various methodologies available to the OUR for consideration in the setting of tariffs for electric power wheeling.

1.3 Consistent with the thrust to create a more competitive electricity sector and in keeping with the provisions of Condition 12 of the Licence, the Office, after taking into account the peculiarities of the Jamaican electricity industry, and the views of key stakeholders in the sector, has made the following determinations:

1) The Postage Stamp methodology shall be used to determine Wheeling Charges on the transmission network.
2) The Postage Stamp methodology shall be used to determine Wheeling Charges on the distribution network.
3) The annual transmission costs derived from the OUR's analysis of the Jamaica Public Service Company Limited's (JPS') Cost-of-Service study shall be used to determine the transmission cost in the calculation of Wheeling Charges.
4) The annual distribution costs derived from the OUR's analysis of the JPS' Cost-of-Service study shall be used to determine the distribution cost in the calculation of Wheeling Charges.
5) The transmission and distribution costs derived from a JPS' Cost-of-Service Study at the time of each 5-year Tariff Review shall be adjusted annually by the same factor applicable to non-fuel rate under the PBRM specified in the Licence.
6) To take proper account of losses impacting wheeling transactions in the calculation of wheeling charges the calculation of transmission and distribution losses shall be based on the latest System Losses Spectrum as approved by the OUR.
7) Wheelers shall be billed monthly in Jamaican dollars for wheeling and other associated services. The bills shall be subject to the same Base Exchange rate, Billing Exchange rate and foreign exchange adjustment factor applicable to JPS' regular customers.
8) In connecting to the electricity network, self-generators shall do so in compliance with the Electricity Sector Book of Codes.

9) The Ministry of Science, Energy and Technology (MSET) shall determine the regulatory instruments that constitute the Wheeling Framework later.

10) Qualified individuals and organizations may apply to the Minister with responsibility for energy for Wheeling Licences.

11) To qualify for a Wheeling Licence, the applicant for the service must be a Self-Generator providing firm capacity and possesses an average annual demand of 1MVA.

The above decisions shall become effective on **2020 July 31.**

2. Definitions

"Base Exchange rate" means the reference foreign exchange rate at which Wheeling Charges are established on an annual basis, expressed in terms of the Jamaican dollar equivalent to one US dollar.

"Billing Exchange rate" means the daily weighted average exchange rate at which financial institutions in Jamaica sell the US dollar on the spot market in the given billing month.

"Cost-of-Service Study" means an in-depth analysis of the utility cost structure in order to identify the cost of providing service to various rate classes or a specific category of customer as a function of load and service characteristics.

"Force Majeure" means as stated in the Licence "any event or circumstance or combination of such events or circumstances that (i) occurs inside Jamaica, except as provided in clause (h) below; (ii) is outside the reasonable control of the Licensee; (iii) cannot be prevented or overcome by the exercise of reasonable diligence; and (iv) materially and adversely affects the performance by the Licensee of its obligations under this Licence, to the extent that such event(s) or circumstance(s) meet the foregoing requirements (i) through (iv), including:

(a) acts of God, fire, explosion, chemical contamination, earthquakes, flood, lightning, drought, tsunami, torrential rain, storm, cyclone, typhoon, tornado, pestilence or other natural catastrophes, epidemics or plague, or any strikes, work to rule, goslows or other labour disturbances that directly affect the Assets of the Licensee;

(b) any failure or inability by the Licensee to obtain or renew any licences (other than this Licence), concessions or permits or other Governmental Requirements that are necessary for the Licensee to conduct its business on terms and conditions at least as favourable as those contained in the original licence (and not this Licence), concession or permit after the submission of an application that fulfils all the applicable requirements of the relevant Governmental Requirements and the exercise of due diligence to obtain such licence (other than this Licence), concession or permit;

(c) any strikes, work-to-rule, go-slows or other labour disturbances that extend beyond the Assets of the Licensee, are widespread or nationwide or are of a political nature, including labour actions associated with or directed against a ruling political party, or those that are directed against the Licensee (or its contractors or suppliers) as part of a broader pattern of labour actions against companies or facilities with foreign ownership or management;

(d) expropriation, requisition, confiscation, nationalization or compulsory acquisition by a Governmental Authority of the Licensee or any substantial portion of the Assets;

(e) acts of war (whether or not declared), invasion, blockade or embargo;

(f) acts of threats of terrorism or threat from terrorists, widespread riot, widespread violent demonstrations, widespread armed insurrection, widespread rebellion or revolution;

(g) the closing or drastic reduction in capacity of public harbours, ports, docks, canals, roads, airports or other infrastructure, the rationing thereof or any import or export restrictions; or

(h) to the extent that they result in disruption of the Licensee's ability to receive shipments of fuel, major equipment or critical spare parts, any strikes, work-to-rule, go-slows or other labour disturbances that occur outside of Jamaica".

"Foreign Exchange Adjustment Factor" means the factor used by JPS in adjusting the Wheeling Charges computed at the Base Exchange rate to the Billing Exchange rate in a given month. This factor reflects the proportion of foreign-related cost in its total nonfuel cost.

"GDP" means gross domestic product. This is a measure of the total economic output of an economy over a one-year period.

"Grid or National Grid" means an interconnected network of transmission and distribution facilities for the delivery of electricity from suppliers to consumers.

"IPP" means Independent Power Producer. This refers to an entity that owns an electricity generation facility and is licensed to sell its output exclusively to the operator of the National Grid.

"Jamaica Public Service Company Limited or JPS" means the Licensee under the Electricity Licence, 2016 which has been granted the right to generate, and the exclusive right to transmit, distribute and supply electricity for public and private purposes in all parts of the island of Jamaica.

"Licence" means the Electricity Licence, 2016 which authorizes JPS to generate, transmit, distribute and supply electricity in Jamaica.

Load Loss Factor (LLF) means the ratio of average power loss over power loss at maximum demand.

"LV" means low voltage and refers to secondary distribution voltage levels below 12kV.

"MWh" means Megawatt-hours, which is the unit of energy used for electricity production or consumption. A MWh is the product of electrical power and time.

"MV" means medium voltage and refers to primary distribution voltage classified at the 24kV, 13.8kV and 12kV levels.

"MW" means Megawatt, which is the unit of electrical power equivalent to one million watts.

"Office/OUR" means the Office of Utilities Regulation as constituted pursuant to the OUR Act.

"Off-peak load condition" means the period of the day during which minimum demand occurs on the electricity grid. This typically occurs on the Jamaican grid between 10:00 p.m. and 6:00 a.m.

"On-peak load condition" means the period of the day during which maximum demand occurs on the electricity grid. This typically occurs on the Jamaican grid between 6:00 p.m. and 10:00 p.m.

"OUR Act" means the Office of Utilities Regulation Act, 1995 and amendments thereto.

"O&M" means the activities associated with Operation and Maintenance of the utility plant, which is necessary to ensure the safe and reliable supply of electricity.

"Partial-peak load condition" means the period of the day during which demand on the electricity grid is between the minimum condition and the maximum condition. This typically occurs on the Grid between 6:00 a.m. and 6:00 p.m.

"Regulatory Fee" means the amount payable to the OUR by the Self-Generator to recover costs associated with the provision of user information, its enforcement, as well as policy and rule making.

"***Self-Generator***" means a person who generates electricity for that person's own exclusive use, and shall include a person who has entered into a net billing or wheeling arrangement.

"Self-Generator Licence" means a formal permit issued by the Minister with responsibility for the electricity sector to Self-Generators authorizing access to the Grid for the purpose of electricity wheeling.

"System Losses" means the difference between total net generation (including IPPs) and energy sales on the system expressed as a percentage of net generation.

"Transmission and Distribution (T&D) system" means poles, lines, transformers, insulators, substations along with protective devices and monitoring equipment, for overhead and underground installations, owned by the utility company and are actively engaged in the movement of electric power from generating stations to consumers. The transmission and distribution system does not include equipment or plant employed in power generation, general administration or customer service.

"Weighted Average Cost of Capital (WACC)" means the opportunity cost of capital proportionally weighted to reflect the expected return on debt and equity.

"Wheeling" means the transportation of electricity across the Grid by an independent party other than the owner or operator of the Grid.

"Wheeling Charges or Wheeling Rates" means the amount that the Office determines that is to be charged by JPS for the transportation of electricity across the Grid by an independent party other than JPS.

3. Introduction

3.1 The Government of Jamaica (GOJ) had recognized that the power sector was evolving and took the view that electricity wheeling could play a positive role in the development of the electricity sector. Consequently, an amendment to the Electricity Licence granted to the JPS in 2011 August paved the way for the introduction of electricity wheeling in Jamaica. The change, which was codified in the Amended and Restated All-Island Electric Licence, 2011 (the "2011 Licence"), provided for the movement of electricity across the national grid by self-generators "on a basis that is cost reflective and consistent with tariffs and the Price Controls as approved by the Office." The aim of this amendment was to promote greater competition in the electricity sector and provide more options with regard to the source of electricity to the consumers of electricity.

3.2 The provision for electric power wheeling was maintained, with some adjustments, when the Electricity Licence, 2016, replaced the 2011 Licence. The requirement for JPS to offer a power wheeling service was carried forward in the Licence, which stipulates that JPS shall implement an electric power wheeling service for customers with an annual average demand in excess of 1 MVA, in accordance with such terms and conditions as approved by the Office. The Licence also states that the wheeling service must be for firm capacity. This is a departure from the related provisions in the 2011 Licence, which did not include the demand and type of capacity restrictions now included in the Licence.

3.3 The Licence further stipulates that the use of system charge as defined in the EA shall be determined by the Office. It also states that JPS may prepare and submit to the Office, a cost of service study for the purpose of determining the use of system charge.

3.4 On 2019 November 4, the OUR published a consultation document entitled "Electricity Wheeling Tariff Methodologies Consultation Document" (Document No. 2019 /ELE/019/CON.001) to solicit comments on the various methodologies for consideration in the setting of tariffs for electric power wheeling in keeping with the provisions of the Licence and the EA. The deadline for receipt of comments was first set for 2019 December 9. JPS requested an extension of the deadline to 2020 January 03. The OUR granted the extension and published its response to stakeholder comments on 2020 March 27, OUR's Comments on Responses to Electricity Wheeling Tariff Methodologies Consultation Document (Document No. 2020/ELE/007/RES.001). Comments were received from Jamaica Broilers Limited, the National Irrigation Commission and the Consumer Advisory Committee on Utilities (CACU).

3.5 This Determination Notice prescribes the tariff methodology that will be used to determine the power wheeling use of system charge on the transmission and distribution network.

4. Legal Framework

4.1 The OUR is a multi-sector regulatory agency which was established in 1995 by the Office of Utilities Regulation Act (the "OUR Act"). Section 4 of the OUR Act sets out several of the functions and powers of the Office. Pursuant to Section 4(1)(a) of the OUR Act, the OUR has authority to regulate the provision of prescribed utility services. "Prescribed utility services" is defined in the First Schedule of the OUR Act to include the provision of telecommunications, electricity, water and sewerage services.

4.2 Section 4(3) of the OUR Act provides, inter alia, that the Office in the performance of its functions shall "undertake such measures as it considers necessary or desirable to:

a) encourage competition in the provision of prescribed utility services;

b) protect the interests of consumers in relation to the supply of a prescribed utility service;

c) encourage the development and use of indigenous resources; and

d) promote and encourage the development of modern and efficient utility services…"

4.3 Section 4(4) of the OUR Act provides:

"*The Office shall have power to determine, in accordance with the provisions of this Act, the rates or fares which may be charged in respect of the provisions of a prescribed utility service."*

4.4 The OUR is also empowered to regulate the electricity sector generally pursuant to section 4(d) of the EA.

4.5 The EA defines the Jamaican electricity market as a "Single Buyer" model and designates JPS as the Single Buyer. Section 18(9) of the EA requires that, "[t]he Single Buyer shall implement an electric power wheeling service in accordance with such terms and conditions as are approved by the Office". The EA promotes open access to the electricity network by wheeling customers as section 6(2) where it stipulates that:

"The Single Buyer shall not show any undue preference to or unduly discriminate against any person (whether or not it is any other business of the Single Buyer or an affiliate of the Single Buyer) or class of persons as respects the sale or purchase of any goods (including electricity), service (including connections and use of System) or opportunity and access to the same."

4.6 The EA further states at section 18(6) that:

"A self generator, who is the holder of a generation licence and has paid the use of system charge may engage in wheeling for its or his own exclusive use and, in the event that a market study conducted by the Office determines the need for additional capacity, that self generator may engage in wheeling to an entity in which it or he owns more than fifty percent interest."

4.7 Section 2 of the EA defines a self-generator as follows:

"…a person who generates electricity for that person's own exclusive use, and shall include a person who has entered into a net billing or wheeling arrangement."

4.8 Section 6(4) of the EA is pertinent to the establishment of wheeling rates where it states that:

"The published tariffs shall be cost reflective, unless otherwise directed by the Office and each tariff category will apply uniformly across the Island and there will be no discrimination to customers on the tariff charged based on location."

4.9 In addition to the legislation cited above, the Licence is an instrument that also establishes the legal framework within which JPS operates. Condition 2 paragraph 3 of the Licence requires that JPS "…shall provide an adequate, safe and efficient service based on modern standards, to all parts of the Island of Jamaica at reasonable rates so as to meet the demands of the Island and contribute to economic development."

4.10 Condition 2 paragraph 4 of the Licence provides that several players in the industry may carry out the generation of electricity. However, JPS, the sole owner of the national grid, has the exclusive right to transmit, distribute and supply electricity island-wide until 2027. Condition 2 paragraph 4 a. of the Licence provides in part that "…the Licensee shall have the right together with other outside person(s) to compete for the right to develop new generation capacity to satisfy demand growth."

In addition, Condition 2 paragraph 4 b. of the Licence stipulates as follows:

"the Licensee shall have the exclusive right to transmit, distribute and supply electricity throughout Jamaica from the effective date of this Licence (that is, March 30 2001) until July 8, 2027.

Provided that no firm or corporation or the GOJ or other entity or Person shall be prevented from providing a service for its or his own exclusive use."

4.11 Condition 12 of the Licence mandates JPS to implement a power wheeling service. Condition 12 provides:

1. "The Licensee shall implement an Electric Power Wheeling service for customers with an annual average demand in excess of 1 MVA in accordance with such terms and conditions as are approved by the Office. The Wheeling service shall be for Firm Capacity.

2. The use of system charge, as defined by the EA, shall be determined by the Office. The Licensee may prepare and submit to the Office, a cost of service study for the purpose of determining the use of system charge."

5. The Electricity Wheeling Tariff Methodology Determination

5.1 The Electricity Wheeling Tariff Methodology Determination Notice prescribes the methodology that will be used to determine wheeling charges on the transmission and distribution network for the 2019 – 2024 Rate Review period. It also prescribes the methodology for determining connection charges and the process for the allocation of system losses to self-generators involved in wheeling transactions.

5.2 While the Determination Notice prescribes the methodology that will be used to determine wheeling charges, it will not specify the wheeling charges as these will be determined after the 2019 – 2023 Rate Review Determination Notice has been issued. The decision to postpone the determination of the wheeling charges until after the Rate Review was to enable the OUR to utilize the cost of service study prepared by JPS and the outcome of the Rate Review to guide it in its determination of wheeling charges.

5.3 It is the view of the OUR that the electricity wheeling tariff methodology prescribed herein is the simplest and most practical to implement at this time, especially given that the regulatory framework for electricity wheeling is yet to be finalized by the Ministry of Science, Energy and Technology (MSET).

6. Wheeling Pricing Principles & Methodologies

6.1 The OUR is of the view that the formulation of the price component of the framework must be informed by certain core regulatory principles, which include:

a) **Economic Efficiency:** Cost allocation results should be efficient in the sense that, they promote efficiency in the use, operation of and investment in the network, so that costs are minimised in the end. It refers to how well prices reflect marginal cost. This is achieved by providing appropriate price signals to incentivise economically efficient decisions.

b) **Cost Recovery:** The revenues recovered through the charges should be sufficient to sustain the transmission and distribution businesses and allow for appropriate expansion of the networks.

c) **Cost Reflectivity:** Prices should reflect the cost of providing a service as far as possible based on the relative utilisation of the networks. In other words, charges should be appropriately targeted, such that the cost of grid investment and system operation are borne by market participants that are responsible for these costs.

d) **Transparency:** It should be clear to users how network prices are determined.

e) **Non-discriminatory access and fairness:** Promotion of the ability of customers to access and use the transmission and distribution networks. In the allocation of costs among customers, equivalents are treated equally. This is to avoid perverse incentives.

f) **Simplicity, predictability and ease of implementation:** Prices must be simple, transparent and readily understood. Many tariffs should be avoided and the number of discretionary rulings should be minimised. Customers should also be protected from unusually large fluctuations in charges. The administrative burden of implementing the methodology should also be low.

g) **Consistency:** The methodology should be consistent with existing price controls in Jamaica.

6.2 The OUR is aware that trade-offs between these principles may be necessary since they may embody conflicting objectives. For instance, simple and predictable wheeling charges may run counter to the objective of efficient pricing, which may require that wheeling charges change hourly reflecting the load dynamics of the network. These considerations have informed the process of selecting the methodology used for wheeling in the Jamaican electricity market.

6.3 In determining the wheeling pricing methodology, various methodologies were examined and the following issues, which were discussed in the Electricity Wheeling Methodologies:

Consultation Document (Document No. 2019 /ELE/019/CON.001) dated 2019 November 4, were deemed critical:

1) Is simplicity in the administration of Wheeling Charges more appropriate in the Jamaican context than efficient price signaling?
2) Should Wheeling Charges be constructed based on a historic cost methodology or a future cost approach?
3) Given the level of losses on the Grid, how could it be reasonably addressed in the construction of Wheeling Charges?

6.4 Based on the survey of the literature, wheeling costs are usually recovered through three (3) main charges:

- Connection Charges
- Use of System Charges
- Operation Charges (Ancillary Services Charge)

6.5 Connection charges are typically used to charge transmission/distribution system users for physical connection to the network. Broadly, there are two alternative approaches to setting such charges:

- "Shallow" Connection Charges: These are usually based on recovering the costs related to the physical connection assets between the connected party (generator or load) and the nearest network connection point (recovery of connection costs only). This approach is used in the UK, Australia and elsewhere.
- "Deep" Connection Charges: These are based on a combination of shallow charges, plus the costs related to any additional "downstream" network reinforcement required to support the load of the wheeler (recovery of connection and reinforcement cost). This approach is used in the Pennsylvania, New Jersey, Maryland Interconnection pool (PJM) in the US, and for wheeling loads (not generation) in Germany.

6.6 Use of system charges is typically used to charge wheelers for the shared network infrastructure. However, in some cases, when connection charges are shallow, the use of system charge also covers the reinforcement cost, and may include the system operating cost and opportunity cost.

6.7 Operation charges cover the system operating and opportunity costs. In many cases, these charges are not separated from the use of system charge or may be recovered through other

means, depending on the electricity market structure. The use of system and operation charges are usually combined into a single use of system charge.

6.8 The various methodologies examined for use of system charges and their relative complexity is shown in Table 1 below.

Table 1 – Historic & Forward Wheeling Methodologies versus Relative Complexity

	Historic Cost Techniques	Forward Look Techniques
Degree of Complexity →	Postage Stamp	Short Run Marginal Cost
	Contract Path	Short Run Incremental Cost
	MW-km (Distance-based)	Long Run Marginal Cost
	MW-km (Load Flow-based)	Long Run Incremental Cost
	Nodal Pricing	

6.9 Of the methodological approaches identified above, four are considered to merit more than a cursory examination, because either they were considered candidates for the model building exercise or they yielded insight into the degree of sophistication that may be attained in wheeling pricing.

6.10 Postage Stamp Methodology

6.10.1 The postage stamp approach is generally regarded as the simplest to implement. The methodology allocates network costs between users based on their share of total peak load on the grid. It therefore results in a flat wheeling charge per unit of demand equal to the total network costs divided by peak load. The postage stamp method is often supported with reference to the fact that, in power transactions, electrons do not actually travel from the seller to the buyer and the system is operated on an integrated basis.

6.10.2 Among the advantages associated with this methodology are its simplicity, transparency and the degree to which it facilitates the investor's recovery of historical cost. On the other hand, this methodology is inefficient at price signalling since it does not reflect the actual usage of the network by each wheeler. Furthermore, since all users face the same wheeling tariff, the postage stamp methodology discriminates against low-cost transmission users in favour of higher-cost users.

6.11 MW-km (Distance-based) Methodology

6.11.1 This methodology is an extension of the concept behind the postage stamp except that it introduces the notion of distance in the formulation. The distance travelled by the energy transmitted under a specific transaction is assumed to be either on a 'straight-line' basis between the points of entry and exit to the network, or on a contract path basis agreed by the parties involved. The MW-km of the transaction is then determined and the ratio of this to the total system MW-km determined. This ratio is then used to determine the cost of the transaction.

6.11.2 As an enhancement of the postage stamp method, this methodology enjoys the majority of the former's advantages. It is strong on cost recovery. In addition, the relatively simple and clear nature of the methodology makes it easy for the users to understand the system of wheeling prices. However, the actual operation and costs incurred on the system are not fully considered in the development of prices. Although the distance between the delivery and receipt does provide some indication of actual use of the system, it still fails to take account of the flow of electricity through the network. Thus, the distance-based approach does not provide the correct economic signals to users, leading to reduced allocative efficiency and discrimination between users.

6.12 MW-km (Load Flow-based) Methodology

6.12.1 The load flow-based MW-km methodology reflects, to some extent, the actual usage of the power system. Wheeling prices are determined in relation to the proportion of the network used by individual transactions, as determined by load flow studies.

6.12.2 In determining wheeling rates based on this methodology, a power flow model is used to calculate the flow caused by the transaction on each circuit of the transmission and distribution system. The ratio of the power flow due to the transaction and the circuit capacity is then determined. This ratio is multiplied by the circuit cost to obtain a cost for the transaction on each circuit. The share of the total system costs for the transaction is the sum of the costs for each circuit.

6.12.3 While this approach is not as simple as the previous methodologies discussed, it is a transparent and practical way of calculating network charges. In addition, the problems of prices not being cost-reflective, which is common to the distance-based methodology is reduced by making users face prices that more closely relate to their use of the network. Consequently, this results in decreased discrimination between users and increased allocative efficiency.

6.12.4 Notwithstanding, the load flow-based MW-km approach will fail to signal the costs of future investment caused by individual users' decisions if it is based on the recovery of historic costs. Additionally, congestions attributable to wheeling may be priced by way a refinement of the basic load flow model. This facilitates proper signalling to generators relative to locational efficiency of the siting of plants.

6.13 Nodal Pricing Methodology

6.13.1 The nodal pricing methodology is based on the premise that a node can be any point in the network. This is often seen as the economically 'ideal' network pricing system as wheeling rates are calculated to accurately reflect the costs imposed on the system by the transaction. The difference in charges at each node on the system (which is equal to the network charge between these nodes) is set based on the marginal cost of losses and congestion at that node. In other words, wheeling prices are derived from the cost of injecting one additional unit of energy at that node. Nodal prices obviate the issue of which assets are used for wheeling purposes by not defining the path followed by flows between nodes. Instead, prices are set based on the marginal impact on the system as a whole.

6.13.2 The nodal pricing methodology is the most sophisticated and accurate approach to pricing signalling on a network. For nodes located in areas with surplus generation there will be a comparatively high cost for additional generation, and conversely for nodes located in areas with a deficit of generation the price for additional load will be high. In this regard, entities considering electricity trading can obtain an indication of the price of power transfers between nodes on the network. Similarly, potential investors in transmission lines can obtain an indication of the returns they might make on investments in different parts of the network.

6.13.3 In its simplest form, nodal pricing system solves the dispatch problem in a decentralised market by ensuring the marginal cost at all supplying nodes is equal to the marginal benefit at all consuming nodes. This results in users consuming electricity up to the point where their marginal value of power is equal to the marginal cost of supply, the nodal price, ensuring that both allocative and dynamic efficiency is maximised.

6.13.4 Although nodal pricing methodology leads to maximum efficiency benefits, there are two major issues associated with it that have resulted in the system being rarely adopted in practice. First, this methodology may result in under-recovery of fixed costs, as pricing is a function of marginal costs.

6.13.5 Second, to set the prices, the transmission system operator would require constant real-time information about all loads, generators, bids and the condition of all equipment. Prices would not only vary over different nodes, but also over time as elements such as supply, demand and transmission constraints change. This creates significant instability and complexity in implementation, requiring advanced information technology and communications, often resulting in countries adopting different pricing systems or simplifications of full nodal pricing.

6.14 Methodologies Selected

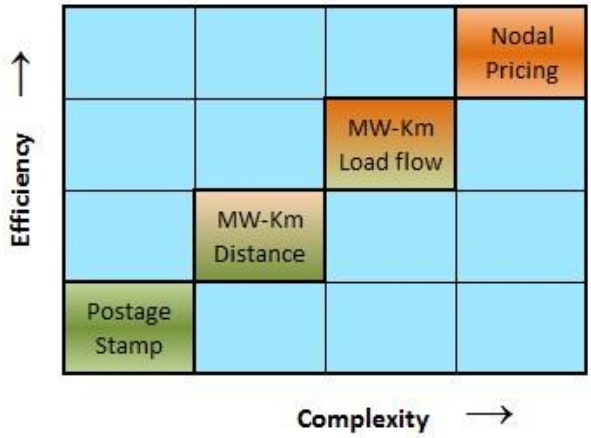
6.14.1 In recommending a wheeling tariff methodology for Jamaica, the OUR considered a number of factors, including local legislation, the size of the network, existing electricity supply rate structures, how transmission and distribution costs are recovered by the utility from existing rate payers and tariff design principles.

6.14.2 After assessing the methodologies available for wheeling, the OUR has taken the view that given that electricity wheeling is just being introduced in the Jamaican electricity market, the principle of simplicity in administration and consistency with existing pricing should be given priority in the first instance. Figure 1 below ranks the various methodologies in a matrix based on complexity and efficiency.

6.14.3 The OUR is of the view that the postage stamp methodology in conjunction with deep connection charges for connection on the transmission network will provide the simplicity and pricing efficiency that is desired. A deep connection charge provides locational price signals for transmission investments.

6.14.4 The determination of connection charge will require the System Operator to conduct a wheeling impact assessment. From the result of that assessment, JPS will be required to provide a connection charge quotation to the Wheeler, which will be reviewed and approved by the OUR.

Figure 1- Comparison of Wheeling Methodologies Efficiency versus Complexity



Determination 1:

With respect to the wheeling methodology applicable to JPS' grid, the Office has determined that:

a) The postage stamp methodology shall be used to determine Wheeling Use of System Charges on the Transmission network.

b) Payment for connection on the transmission network shall be via deep connection charges.

c) The calculation of the connection charges shall be approved by the Office. Further, the approved connection charges shall be based on a quotation from the System Operator after having conducted a Wheeling Impact Study.

Determination 2:

With respect to the wheeling methodology applicable to JPS' grid, the Office has determined that:

a) The postage stamp methodology shall be used to determine Wheeling Use of System Charges on the Distribution network.

b) Payment for connection on the distribution network shall be via shallow connection charges.

c) Payment for connection on the distribution network shall be via shallow connection charges. The calculation of the connection charges will be based on a quotation from the System Operator after having conducted a Wheeling Impact Study. The quotation and wheeling impact study will be reviewed and approved by the Office.

6.15 Cost Recovery

6.15.1 One of the key principles involved in the development of rates is the concept that the utility should be compensated fairly for the service it provides. Condition 12 of the Licence states that with regard to the determination of wheeling charges, JPS may submit a cost of service study.

6.15.2 Since the postage stamp methodology will be used to determine the use of system charge, the cost of service study is the most suitable method to determine the cost to be recovered from the wheeling customer.

6.15.3 Given that Wheeling Charges are to be updated annually in keeping with the practice now applicable to electricity tariffs in Jamaica, a mechanism is required to ensure that the Cost-of-Service Study from which these charges are derived keep pace with foreign exchange movements and inflation. In addition, since wheeling will take place over the same Grid that JPS sells electricity to customers, the same efficiency and quality of service adjustments applicable annually to other customers should be applied to wheelers.

Determination 3:

In respect of the cost to be used for determination of Wheeling Charges, the Office has determined that:

a) The transmission costs derived from the Cost of Service analysis shall be used to determine the Transmission cost in the calculation of Wheeling Use of System Charges

b) The distribution costs derived from the OUR's Cost-of-Service analysis shall be used to determine the Distribution cost in the calculation of Wheeling Use of System Charges.

c) The Transmission Distribution Costs derived from a JPS' Cost-of-Service Study at the time of each 5-year Tariff Review shall be adjusted annually by the same factor applicable to non-fuel rate under the PBRM specified in the Licence.

6.16 The Treatment of Losses

6.16.1 Although there are instances where system losses may be reduced by wheeling activities, in general, losses on a power transaction tend to occur when electricity is moved across the Grid. It therefore means that if losses occur in the process and a wheeler consumes exactly the same amount of electricity that he places on the Grid, the gap caused by losses would have to be filled by the Grid operator. It may therefore be argued that a Self-Generator should compensate the Grid operator for replacing his electricity losses. On the other hand, in the event that the wheeler, by virtue of his transaction, contributes to the reduction of system losses, the Grid operator should compensate him.

6.16.2 The practise of assigning the cost of losses to the wheeler and interconnector is accepted in many countries. For example, in the Nord Pool[1] transmission losses are recovered by a standard trading fee and in Ireland, it is done by way of a Transmission Loss Adjustment Factor.

6.16.3 Total system losses in Jamaica currently stand at approximately 26.27% of net generation (see Table 2 below). The latest system losses spectrum for JPS indicates that 7.94% of total

[1] Nord Pool covers six countries in Europe: Denmark, Finland, Sweden, Norway, Estonia and Lithuania.

losses are attributable to technical while the remaining 18.33% is caused by non-technical factors such as theft and billing errors.

Table 2 – Technical & Non-technical System Loses

System Segment	Losses (%)		
	Technical	Non-Technical	Total
Transmission Network	2.24	-	**2.24**
Primary Distribution Lines	2.80	-	**2.80**
Secondary Distribution Lines	2.90	18.33	**11.7**
Total System Losses	**7.94**	**18.33**	**26.27**

6.16.4 Therefore, it may be argued that if a Self-Generator wheels electricity on the Grid there is no way that the wheeler can be insulated from the losses on the system. However, the losses on the transmission lines can be calculated from the power transactions. These calculations are based on the DC load-flow modelling, which uses inputs from JPS' AC load-flows simulations.

6.16.5 Regarding distribution losses, an unbiased calculation of the losses requires that technical and non-technical losses be taken into consideration.

6.16.6 This means that 2.80% technical losses is to be assigned to wheeling on the primary distribution circuits, and 2.90% technical losses is to be allocated on the secondary distribution circuits. The amount of non-technical losses that is to be assumed by the wheeler is to be determined by the average value of the losses assigned to Rate 40, 50 and 70 customers in the approved system losses spectrum. The average of losses for the Rate 40 to Rate 70 customers is used because based on the qualifying criteria; the wheeling customer will come from one of these rate categories.

Determination 4:

To take proper account of losses affecting wheeling transactions the Office has determined that the calculation of:

a) Transmission Losses shall be done by the modeling of the load-flows
b) Distribution Losses shall be based on technical losses of 2.8% on the primary distribution circuits, and where applicable technical losses of 2.9% on the secondary distribution circuits.
c) The average of non-technical losses attributed to Rate 40, 50 and 70 based on the approved system losses spectrum shall be used to compute the non-technical losses.

In addition, the calculation of distribution losses shall be based on the latest System Losses Spectrum and the prevailing System Loss Target established by the OUR.

6.17 Billing

6.17.1 While Wheeling Charges are to be adjusted annually, for consistency with the current billing practice, it seems only reasonable that Self-Generators should be billed monthly in Jamaican dollars.

6.17.2 Further, to avoid rate shocks attributable to foreign exchange volatility, it would not be prudent to have significant time lapses between the reconciliation of a Base Exchange rate and the market exchange rate in any billing exercise. Therefore, it may be argued that the monthly bills prepared by JPS for the use of the Grid by Self-Generators should incorporate the same foreign exchange adjustment mechanism applicable to monthly bills now rendered by the company to its regular electricity customers.

Determination 5:

The Office has determined that Self-Generators shall be billed monthly in Jamaican dollars for wheeling and other associated services. The bills shall be subject to the same Base Exchange rate, Billing Exchange rate and foreign exchange adjustment factor applicable to JPS' regular customers.

6.18 Reactive Power

6.18.1 The issue of reactive power caused by the operation of Self-Generators on the Grid was raised in a public consultation meeting and merits consideration. Active power measured in MW is what is actually consumed. However, the Self Generators and their associated loads are likely to create reactive power demand on the Grid. Reactive power uses up capacity on the Grid but is not consumed. Consequently, it is important to minimize the level of reactive power produced by Self-Generators.

6.18.2 In this regard, it is reasonable that the range of operation for Self Generators be consistent with the existing norm as prescribed by the existing JPS Generation Code.

Determination 6:

The Office has determined that in order to minimize the amount of reactive power produced on the network by the Self-Generator, an individual/organization involved in wheeling shall have the capability of producing full rated MW output at a power factor between 0.8 lagging and 0.99 leading, in keeping with the Electricity Sector Book of Codes.

Equation 1:

$$\textit{Transmission Charge} = \frac{\textit{Transmission Cost of Service}}{\textit{Peak Demand}}$$

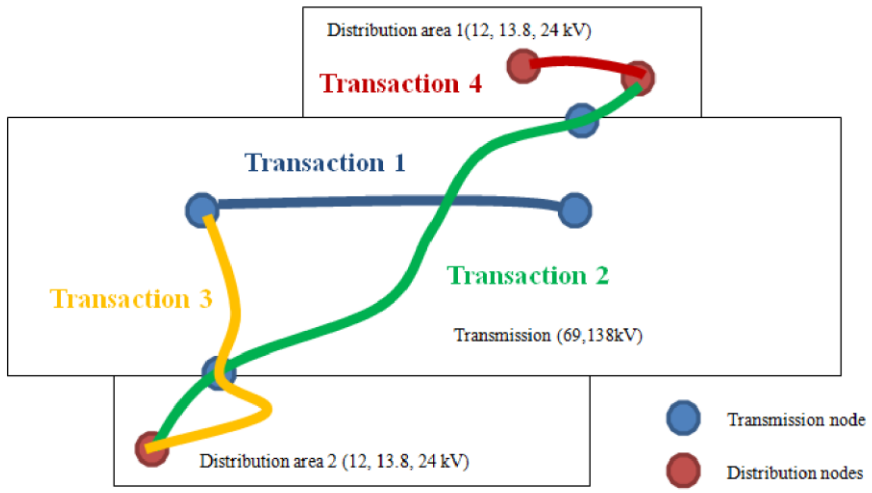
7. Computation of Wheeling Charges

7.1 Introduction

7.1.1 When the use of the transmission and distribution network is taken into account, there are four ways in which a wheeling transaction may be configured from the locational perspective as indicated in Figure 2 below:

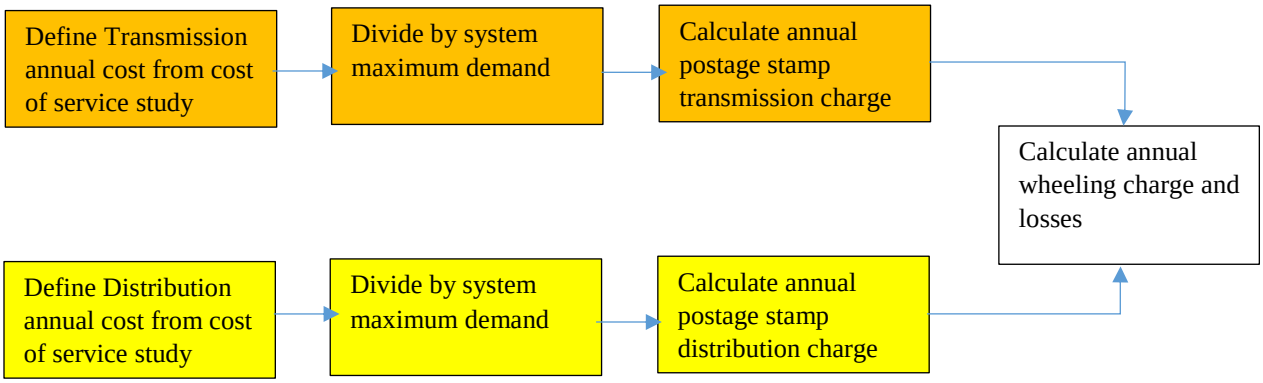
- *Transaction #1*: services for which only the transmission lines are involved.
- *Transaction #2*: services for which the Self-Generator and the load are at the end of distribution lines, but the transmission lines must also be used to move power between the two points.
- *Transaction #3*: services for which either the Self-Generator or the load (but not both) are at the end of distribution lines and of necessity transmission lines must be used. This is so because either the Self-Generator or the load is at the end of a transmission line.
- *Transaction #4*: services for which both the Self-Generator and the load are at the end of distribution lines and no transmission lines are required for transportation of power. Therefore, wheeling takes place exclusively on distribution lines.

Figure 2 _ The Four Different Types of Locational Transactions



7.1.2 Since only the postage stamp methodology will be used on both the transmission and the distribution networks, whether only the transmission network is utilised or only the distribution network or both will determine the extent of the wheeling charges. Figure 3 below provides a graphical depiction of the calculation.

Figure 3: Depiction of the Computation of Wheeling Charges



7.2 Capacity Based Charges

7.2.1 An important feature underpinning the calculation of Wheeling Charges relates to their application to Self-Generators based on the capacity being wheeled. Capacity is the key criterion that determines the quantity of network assets that is required for the transportation by the conductors and transformers on each circuit. Consequently, the Wheeling Charges that are calculated are applied based on US Dollars per MW per year (USD/MW/yr), and related to the capacity that is reserved by the Self-Generator in the process of entering into a wheeling contract at the start of each year.

7.3 Transmission Calculation

7.3.1 The calculation of wheeling charges on the transmission network includes:

- Postage Stamp charge on the 138kV and 69kV networks.

7.3.2 The annual charges are derived by dividing the cost of service for transmission circuit by the system peak demand.

7.3.3 The cost of wheeling for transmission network is calculated as shown below:

Equation 1:

$$Transmission\ Charge = \frac{Transmission\ Cost\ of\ Service}{Peak\ Demand}$$

7.4 Distribution Calculation

7.4.1 The calculation of wheeling charges on the distribution network involves two components:

- Postage Stamp charge on the primary distribution circuits: this is the charge for wheeling on the 12KV, 13.8KV or 24 KV circuits.
- Postage Stamp charge on the secondary distribution circuits: this is the charge for wheeling on the distribution circuits at voltage levels below 12KV.

7.4.2 The annual charges are derived by dividing the cost of service for the relevant segment of the distribution circuit by the system peak demand.

7.4.3 The cost of wheeling for each segment of distribution circuits calculated based on the equation below:

Equation 2:

$$Distribution\ Charge = \frac{Distribution\ Cost\ of\ Service}{Peak\ Demand}$$

7.5 Calculation of Losses

7.5.1 For the purpose of transmission wheeling the calculation of losses is based on the weighted average of the load conditions of the circuit at the On-peak, Partial-peak and Off-peak period. Consequently, the cost of transmission losses might be expressed as:

Equation 3:

$$\text{Cost of losses} = 8760 * \text{Peak Losses} * \text{Load loss factor} * \text{Average electricity price}$$

7.5.2 Where the Peak Losses (in MW) is the maximum increase in transmission losses calculated with the wheeling transaction; and the Load Loss Factor is:

Equation 4:

$$\text{Load Loss Factor} = 0.7 * (\text{Load factor})^2 + 0.3 * (\text{Load factor})$$

7.5.3 The Load Loss Factor (LLF) is the ratio of average power loss over power loss at maximum demand. The LLF above is a generic formula used by the World Bank and other organizations internationally in this type of calculation.

7.5.4 As it relates to distribution losses, it is assumed that losses are experienced by each transaction wheeled on the primary and secondary distribution circuits. Consequently, while the computation of the cost of losses and the LLF are the same as shown in Equations 3 and 4 above, the Peak Losses (in MW) is assumed to be the product of the maximum capacity registered by the Self-Generator and the technical losses (in percentage terms) linked to that segment of the distribution network. This may be expressed as follows:

Equation 5:

$$\text{Peak Losses} = (\text{Maximum Capacity}) * (\%\text{Technical Losses})$$

7.5.5 The losses imputed to wheeling on the primary and secondary segments of the distribution network are 2.8% and 2.9% respectively. With these levels of technical losses, non-technical losses should be added.

Determination 7:

The Office has determined that Equations 1-5 in this Determination Notice should be used as the basis for computing the wheeling charges and the attributable losses.

7.6 Annual Wheel Charge Adjustments

7.6.1 Consistent with the existing tariff regime, which requires annual adjustments to electricity prices and comprehensive review of the underlying utility cost structure every five (5) years, the same procedure shall be applied to Wheeling Charges.

Determination 8:

To ensure that wheeling rates reflect the changes in JPS cost caused by economic variables, the Office has determined that Wheeling rates shall be updated annually and shall coincide with JPS' annual tariff adjustment exercise.