

Transmission Network Wheeling Charge Cost of Service Methodology

Introduction:

The development of the electricity sector in Egypt comprises the gradual opening of the electricity market in order to achieve a competitive market, where the costs of different activities such as generation, operation and maintenance of the transmission and distribution networks, and energy trade are totally split up, in addition to the plan to increase the share of new and renewable energy in the Egyptian energy mix, which was initiated by the issuance of the Egyptian electricity law.

The gradual opening of the electricity market requires the regulator to issue rules, regulations, and templates of contracts that allow EgyptERA to grant the eligible customers the freedom to choose their electricity trader/retailer using bilateral contracts, where the Egyptian Electricity Transmission Company provides wheeling services between the points of connection of the power producers until the points of consumption, in addition to designing an energy balancing mechanism.

EgyptERA has been issuing an annual transmission wheeling charge since 2007/2008 that is revised annually based on the annual audited financial budgets of EETC, this wheeling charge has been used in the electricity transmission contracts between EETC and each of Italgas and Midlec.

In 2011/2012, the contract of consultancy services "Institutional Capacity Building" funded by the European Commission was implemented for EgyptERA by a global consultancy agency, this contract involved the revision of the regulator's cost of service methodology including all the stages of electricity generation, transmission, and distribution.

The revision led to some recommendations that were taken into consideration in the cost of service methodology starting in 2012.

The Electricity Law 87/2015 in the fourth article stated "The Egyptian Electric Utility and Consumer Protection Regulatory Agency is assigned to issue the economic rules and regulations to calculate the electricity tariff for non-eligible customers, the electricity transfer prices in the regulated market, and both the transmission and distribution networks wheeling charges in a fair and transparent manner. These rules and regulations are accredited by the Egyptian Cabinet of Ministers and announced by EgyptERA".

Following the issuance of this law, EgyptERA has presented to the Egyptian Cabinet of Ministers the cost of service calculation methodology which is used to calculate the average cost of service based on the voltage level at which the customer is connected.

This report is based on the aforementioned methodology that EgyptERA uses to calculate the transmission network wheeling charge.

First: Transmission Network Wheeling Charge Cost of Service Methodology

The calculation of the transmission network wheeling charge is based mainly on the Cost of Service Model owned by EgyptERA, which was designed by the American consultant IRG, and developed by other Egyptian consultants based on the recommendations of other foreign consultants in order to align with the current status of the Egyptian electricity market.

The bases of wheeling charge calculation:

1. The revenues should cover both the operation and maintenance costs, and the capital costs of the transmission network.
2. A proper return on net assets should be considered.
3. The wheeling charge on each voltage level is calculated in a way where the customers of a certain voltage level pay for their share in the costs of this voltage level and the higher voltage levels.
4. The cost on each voltage level is allocated based on the contribution of the customers of this voltage level to the system peak in the instance of occurrence of the peak.
5. The wheeling charge applied in bilateral contracts between energy producers and customers should comprise the cost of losses from thermal generating plants on all voltage levels.
6. A postage stamp is applied where all customers on a certain voltage level are charged with the same wheeling charge regardless of their position from the generating plant.

Second: The Calculation Methodology

The following equation is used to calculate the transmission network wheeling charge:

$$\text{Revenue Requirement} = \text{Operating Expenses} + \text{Depreciation} + \text{Regulatory Assets Base} \times \text{Rate of Return}$$

The data required to calculate each figure of the aforementioned equation are collected from the audited financial budget of EETC based on the templates designed by EgyptERA.

Now we'll explain the bases of calculation of each figure of the aforementioned equation:

1. The Operating Expenses:

The operating expenses are divided into:

- A. Operation and maintenance costs
- B. Cost of losses
- C. Ancillary services cost
- D. Any other costs stated by EgyptERA

A. Operation and Maintenance Costs:

These include wages, maintenance costs, administrative costs, other costs, divided on all voltage levels (EHV, HV, and MV).

B. Cost of Losses:

Cost of losses is calculated on the EHV and HV using the following equation:

Average cost of losses on each voltage level =

$$\frac{(\text{amount of energy lost on the considered voltage level} * \text{average cost of kWh generation in thermal power plants})}{\text{amount of energy transmitted and sold on the same voltage level}}$$

And this is to incentivize EETC to minimize its losses in order to increase their revenues from the wheeling service.

EgyptERA calculates the percentages of energy losses on each voltage level based on the energy balance in the technical report of EETC, where the total amount of energy lost on all

voltage levels equals the difference between the total energy available/purchased on all voltage levels and the total energy sold on all voltage levels.

D. Other costs stated by EgyptERA such as license costs and renewable energy incentives:

No other costs are stated by EgyptERA, since the renewable energy incentives are added to the generation costs.

2. Depreciation

EETC calculates depreciation on its assets using straight line depreciation method using the following depreciation percentages:

Network Component	Annual Depreciation
Substations	2.5%
Overhead transmission lines	3.33%
Underground cables	4%

3. Return on net assets

The return on net assets calculated by the regulator takes the following considerations into account:

- To provide enough cash liquidity for EETC to cover its liabilities, in order to provide its services and to fund its new capital investments
- To align with the investment risks that face EETC
- To attract new investments
- To guarantee that EETC doesn't benefit from exaggerated profits

The return on net assets is calculated using the weighted average cost of capital (WACC) using the following equation:

$$\text{WACC (nominal, pretax)} = \left(\left(\frac{E}{D + E} \right) * \frac{R_e}{1 - T} \right) + \left(\left(\frac{D}{D + E} \right) * R_d \right)$$

Where:

WACC%	Weighted average cost of capital	calculated from the aforementioned equation
R_e%	Return on equity	To be explained later
E	Equity	calculated according to the financial budget
D	Total long term loans	calculated according to the financial budget
R_d%	Weighted average cost of debt	calculated from the data collected from EETC
T%	Corporate tax rate	depends on the current taxation rates
$\frac{D}{D + E}$	Gearing Ratio	calculated according to the financial budget

Return on Equity Calculation (R_e):

The following equation which is used by countries in Eastern Europe is also used by EgyptERA:

$$R_e = \text{Risk Free Rate} + \text{Equity } \beta \text{ (MMRP + CRP)}$$

Where:

R_e	Return on Equity
Risk Free Rate	Interest on long term governmental bonds (10 years and longer) with no risk and credit rating AAA (the German bonds were taken as a base) which has a risk free rate of 0.5% based on the latest statistics.
Asset β	A factor that measures the change in the market value of the assets of a certain company based on the change in the market, and it is taken as the average of similar companies (0.35) since it was not calculated for electricity companies in Egypt.
Equity β	Calculated using the following formula: $\text{Equity } \beta = \text{Asset } \beta * \left(1 + \left(\frac{D}{E}\right)\right)$
Mature Market Risk Premium (MMRP)	Calculated using the study of Aswath Damodaran. "Risk Premiums for Other Markets" on the following link: http://pages.stern.nyu.edu/~adamodar/ .
Country Risk Premium (CRP)	The extra risk premium that investors require in order to invest in Egypt, and it's calculated based on the credit rating of the Egyptian governmental bonds using Moody's

The previous equation includes many assumptions, and it determines the extent by which the revenues of the company cover its monetary liabilities by applying the following equation:

$$WACC * \text{Regulatory Asset Base} = \text{Equity} + \text{Debt} - \text{Depreciation}$$

Regulatory Asset Base:

Regulatory asset base on each voltage level is calculated using the following equation:

$$\text{Regulatory Asset Base} = \text{Net fixed assets} + \text{inventory of spare parts} + \text{cash working capital (estimated as 45 days of the operating and maintenance costs which covers the duration between payment of liabilities and collection of dues)}$$

Third: Wheeling Charge Calculation on Different Voltage Levels

Cost allocation steps:

Wheeling charge costs are divided into fixed and variable costs as follows:

- **Fixed Costs:**
 - 1) Operating costs excluding cost of losses
 - 2) Depreciation
 - 3) Return on net regulatory assets

- **Variable Costs:**

Include the cost of energy losses on each voltage level of the transmission network.

Fixed costs are allocated on voltage levels as follows:

Voltage Level	Fixed Costs
EHV (132, 220, 500 kV)	<ul style="list-style-type: none"> • 500 kV substations • EHV overhead lines (132, 220, 500 kV) • National Control Center Administrative Costs • 35% of the costs of 132 and 220 kV substations
HV (33, 66 kV)	<ul style="list-style-type: none"> • HV overhead lines (33, 66 kV) • Regional Control Centers Administrative Costs • 65% of the costs of 132 and 220 kV substations • 50% of the costs of 33 and 66 kV substations
MV (11, 22 kV)	50% of the costs of 33, 66 kV substations

Costs allocation on voltage levels of customers:

Transmission network wheeling charge on a certain voltage level is calculated in a way where the customers pay a wheeling charge that covers the wheeling cost on their voltage level and the higher voltage levels as follows:

Voltage Level	Cost
EHV	Wheeling cost on EHV
HV	Wheeling cost on EHV + HV
MV	Wheeling cost on EHV + HV + MV

- The fixed cost on each voltage level is allocated based on the contribution of the customers of this voltage level to the system peak in the instance of occurrence of the peak
- The cost of losses on each voltage level is allocated based on the amount of transmitted/consumed energy on this voltage level.

Wheeling Charge per Voltage Level:

Wheeling Charge on a Certain Voltage Level	=	$\frac{\text{The share of this voltage level in (Fixed Costs + Cost of Losses)}}{\text{Amount of energy sold on this voltage level}}$
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Fourth: Settlement Rules

The electricity power producer which concludes bilateral power purchase agreements with eligible customers is supposed to sign a use of network contract with EETC that comprises a wheeling charge as follows:

- The wheeling charge for the energy sold between a certain power producer and its customers is paid for according to the wheeling charge issued by EgyptERA, which is a fixed value for each voltage level regardless of the distance between the point of connection of the power producer and the point of consumption, and in case the two points are on different voltage levels, the wheeling charge of the lower voltage level is chosen.

- The settlement is based on the total energy transmitted without an adjustment for the lost energy because the customer already pays for the lost energy as a part of the wheeling charge.
- In case the amount of energy sent from the generation station is more than the amount of energy that has been paid for during the contractual year, the power producer is required to pay for the difference in the amounts of energy using the wheeling charge of the same year.
- In case of the use of the wheeling charges in studies developed by EETC, the cost of losses shouldn't be included since it is already paid for as part of the energy purchased from generation companies.

The wheeling charge is paid for based on the following equation:

Total wheeling charge during the settlement period = Total amount of energy sold from the power producer to the customer x the average wheeling charge (depending on the voltage level of transmission)

Fifth: Recommendations

In order to calculate an accurate wheeling charge, it is recommended to conduct detailed studies on the following:

1. The contribution of each customer group to the system peak in the instance of occurrence of the peak.
2. The disconnected capacities and energies in case of load shedding per customer and distribution company.
3. The percentage of energy losses on each voltage level.
4. The substation fixed cost allocators on different voltage levels.

It's also important to note that EETC is required to send the data requested by EgyptERA based on the given templates by the end of October of each financial year.