Regulatory Accounting for Transmission Tariff Calculation

Knowledge Sharing Program

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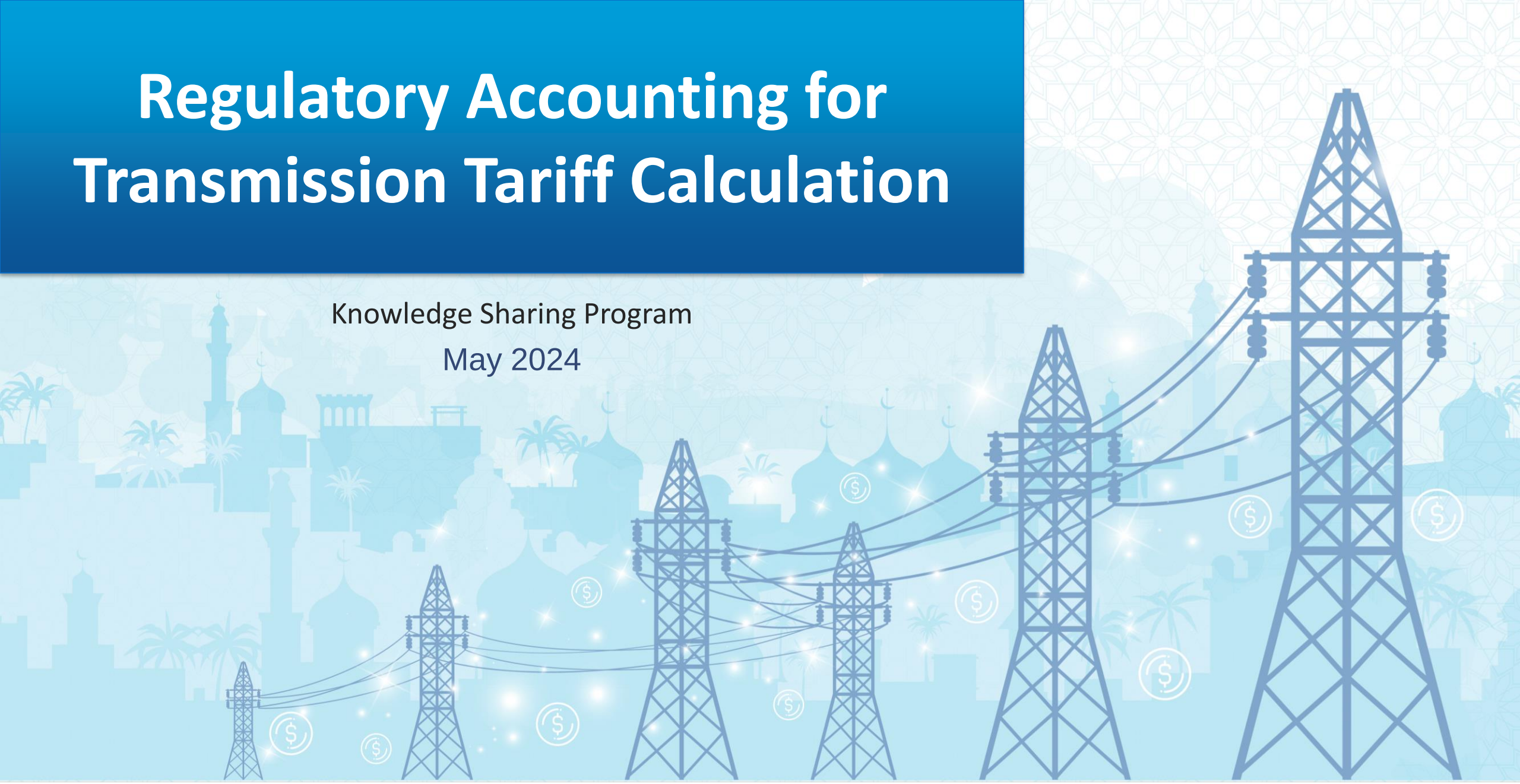


WORLD BANK GROUP
Energy & Extractives

ESMAP
Energy Sector Management Assistance Program

ARAB FUND FOR ECONOMIC & SOCIAL DEVELOPMENT

AGENDA

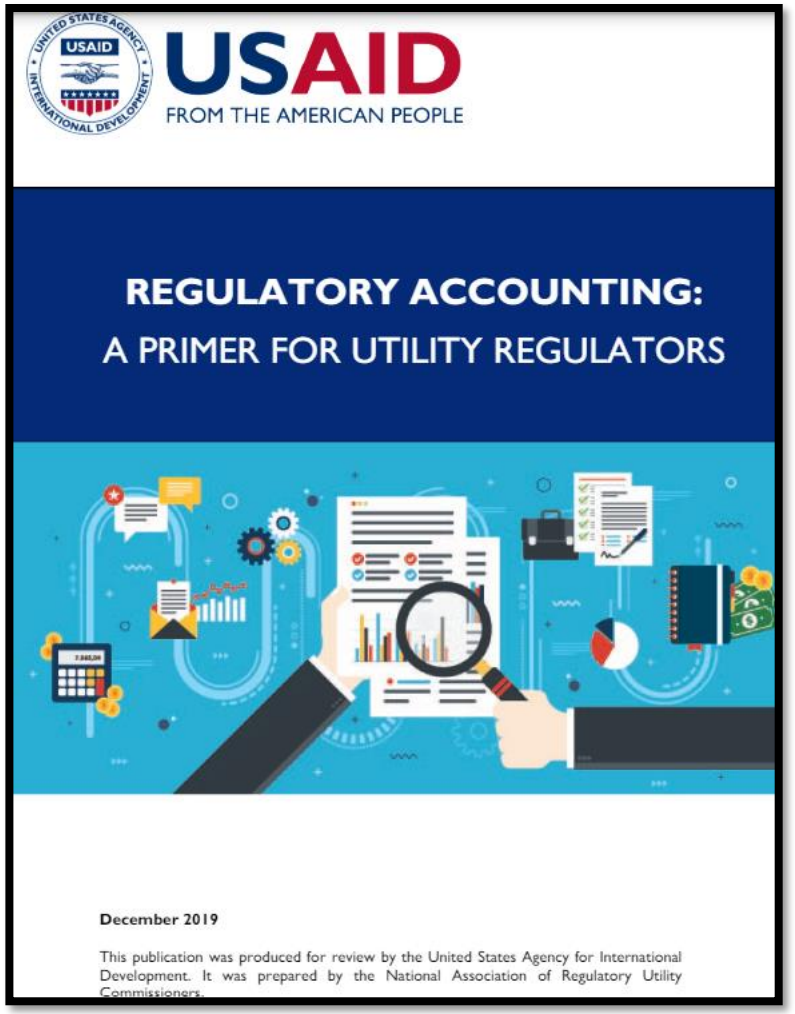
1. Before We Start
2. Importance of Regulatory Accounting
3. Cost Components to be Recovered in Transmission Tariff
4. Application of Regulatory Accounting for Transmission Services Tariff Calculation

Before We Start

- A Regulator cannot perform its function without accurate, verifiable and comprehensive accounting data collected via a well understood, and time-tested, accounting system; e.g., a Uniform System of Accounts

- Costs should be tracked and accounted for using internationally accepted methodologies to accommodate auditing and promote private-sector investment

- One of the useful references in this area is: *Regulatory Accounting: A Primer for Utility Regulators*, NARUC, December 2019 (https://pubs.naruc.org/pub.cfm?id=EE6402E5-155D-0A36-31F8-36FEBB6D4E44)



Importance of Regulatory Accounting

- A uniform system of accounts:
  - Ensures transparency,
  - Enables proper allocation of costs to customer classes in proportion to the costs imposed on the utility's services
  - Takes on added importance in a regional electricity market such as the PAEM where consistency of application is vital
- A regulatory accounting system must be:
  - Verifiable
  - Sufficiently detailed,
  - Consistent across time,
  - Relevant to service-type
  - Able to track spending and income from source documents to categories
  - comprehensive to capture all regulated activities while permitting separation of non-utility financial activities from those necessary to provide the service→ Electricity services must be unbundled from an accounting perspective

Cost Components to be Recovered in Transmission Tariff

- Costs attributable to transmission can include:
- Capital (capex) expenses associated with transmission infrastructure including depreciation and return on capital invested
- Operating and maintenance costs (opex) associated with transmission infrastructure
- Transmission losses
- TSO costs including services such as dispatch
- System/ancillary services costs including reserves, voltage control/reactive power and black start
- Balancing (often referred to as inadvertent flows in the Arab countries)
- Congestion management, both internal and on interconnections
- Inter-TSO compensation costs/revenues
- Other

Cost Components to be Recovered – Europe Case

- In Europe, all of these costs are generally recovered in the transmission tariff, with some exceptions
- Balancing costs in Europe are most often paid directly by market participants on the basis of their imbalances and the costs of balancing energy purchased in the balancing market.
- ITC costs (Inter-TSO costs) are based on the Inter-TSO Compensation Agreement which is a multi-party agreement between ENTSO-E and member countries. It is designed to compensate parties for costs associated with losses resulting from hosting transit flows on networks.
- EU countries often include “other costs” in their transmission tariffs. These relate to regulatory charges such as incentives to promote development of renewable energy and conservation, stranded costs, etc.

Application of Regulatory Accounting for Transmission Services Tariff Calculation

Assumptions

- In the following example, it is assumed:
  - Transmission service providers are allowed recovery of:
    - Infrastructure costs (opex and capex), including depreciation and return on capital
    - Losses
    - System/ancillary services costs such as dispatch, reserves, voltage control, etc. as they are the responsibility of the TSO
    - Congestion management
  - Balancing costs, or inadvertent flows, are recovered directly from the party responsible for the inadvertent flow, and are not included in the transmission services tariff
  - Inter-TSO compensation (ITC) costs are ignored
  - This postage stamp transmission tariff design is generally consistent with practice in Europe

Assumptions (continued)

- Transmission charges apply only to loads and not generation
- There is no geographic variation
- There is no time variation
- The billing determinant is energy consumed
- Ancillary services, losses and congestion management are all recovered in the transmission tariff

Step 1 – Define Transmission Assets and Values

- Identify all transmission network assets in the country (excludes connections that benefit only one of a few customers) → *Regulated Asset Registry*
- Transmission assets should be based on a common definition such as - all network facilities operated at voltage levels above 33 kV. Network facilities below this threshold would be considered distribution assets → The Arab TSOs Committee shall provide guidelines in this regard
- The asset base could include existing international interconnection facilities that are under the control of the national TSO

Step 1 – Define Transmission Assets and Values (continued)

Assets will include:

- Transmission lines identified by voltage level, length, number of circuits, overhead or underground, conductor type (copper, aluminum, size), tower type (wood pole, steel)
- Transformers including size and voltage level
- Switchgear including type and voltage
- Other equipment; e.g., reactive power support facilities such as capacitor banks

Step 1 – Define Transmission Assets and Values (continued)

- The commercial operating date and cost of each asset is needed along with the expected remaining asset life
- The asset base will require annual updating to reflect remaining life, and to incorporate any asset additions, life extensions or retirements
- In cases where the historical cost of many of the assets is not known, it may be desirable to determine the replacement value of the assets
- Replacement values, if used, would result in higher costs for the regulated asset base, and higher transmission tariffs

Step 2 – Calculate Annual Revenue Requirement for Infrastructure

- The revenue requirement owing to the asset base includes capex (capital cost of transmission network assets) and opex (operating and maintenance costs of transmission network assets)
- The capex value is annualized using depreciation techniques applied to either historical (actual) costs or replacement costs (the current value of the asset)
- In Europe, Estonia is an example of a jurisdiction that uses historical costs to value assets while Finland uses replacement, or re-valued, assets
- Typical lifetimes of transmission assets are:
- Transmission lines – 50 years
- Transformers – 25 years
- Substations/switchgear – 25 years
- Other equipment – varies depending on the type of equipment

Step 2 – Calculate Annual Revenue Requirement for Infrastructure (continued)

- Germany uses a life of 50 years for lines and cables (2% annual depreciation) and 25 years for substations (4% annual depreciation)
- Great Britain uses 45-year asset lives, with some exceptions
- A single asset value of 30 years might be used in the PAEM for all asset types in an effort to simplify the calculation

Calculation of opex component

- O&M costs would reflect actual costs when data exist
- When data are not readily available, they might be calculated as a percentage of the annual capital cost. Experience varies internationally, but is typically in the range of 2% to 5%
- The PAEM Committees are expected to collaborate and provide guidance on what can be included in the O&M component, including how losses are treated and recovered through the tariff.

Step 2 – Calculate Annual Revenue Requirement for Infrastructure (continued)

Revenue requirement calculation for infrastructure

The annualized revenue requirement for transmission network infrastructure is the sum of the annualized cost of all network assets. The total revenue requirement for infrastructure is calculated as:

Revenue requirement = RAB * WACC + D + O&M

Where:

- RAB is the regulated asset base (gross investment less accumulated depreciation. Usually take the average of start and end values in the relevant year);
- WACC is the weighted average cost of capital;
- D is the depreciation expense in the relevant year; and
- O&M is the operation and maintenance costs for the transmission network in the relevant year.

Step 2 – Calculate Annual Revenue Requirement for Infrastructure (continued)

WACC Calculation

WACC is based on the weighting of debt and equity (e.g., Portugal uses 55% debt and 45% equity, and the cost of each (e.g., 7% on debt and 10% on equity) used to finance capital by the transmission service provider. Using this example,

$$WACC = (0.55*0.07 + 0.45*0.1) = 0.0385 + 0.045 = 8.35\%$$

- Guidelines for calculating WACC for use in the tariff calculation would be provided by the Regulator
- WACC values depend on factors such as investment and foreign exchange risks which are likely to vary widely among PAEM countries, suggesting that a single WACC value used across the PAEM may not gain the support of all Member States
- Even in European countries returns vary widely (see table on next slide)

Step 2 – Calculate Annual Revenue Requirement for Infrastructure (continued)

	Rate of return on Equity (before tax)
Great Britain	4.3%
Sweden	5.52%
Germany	6.91%
Portugal	7.9%
Slovakia	10.92%
Albania	15.29%

Step 2 – Calculate Annual Revenue Requirement for Infrastructure (continued)

- The formula for WACC allows for company taxation on profits
- Each PAEM transmission company will be subject to tax policy in its country
- Consideration should be given to harmonizing taxation policies on transmission businesses across the PAEM to avoid confusion and claims of unfairness
- Again, the PAEM Committee could provide guidance.

Depreciation

- Depreciation is normally calculated using the straight-line method. For example, if the original investment cost of an asset is US$ 50,000,000 and the asset has a 50-year life and is now 10 years old, the regulated asset (depreciated) value is US$ 40,000,000 and the annual depreciation expense is US$ 1,000,000 (US$ 50,000,000/50 years)
- This calculation assumes that the asset has no residual value
- Iceland, Ireland and Italy are examples of jurisdictions that use straight-line depreciation

Step 3 – Calculate the Billing Determinant and Transmission Losses

- The transmission services tariff used in this example is a one-part tariff with an energy billing determinant; e.g., charge is based on the amount of energy delivered
- Therefore, for the year in question, it is necessary to determine the total kWh delivered by the national transmission network including deliveries to distribution companies, large customers directly connected to the transmission system and exports
- The calculation might be based on a previous year or a forecast year as being representative of the year in question. True-ups could be included in the subsequent year to reflect the difference between actual and forecast figures

Step 3 – Calculate the Billing Determinant and Transmission Losses (continued)

- For losses, it is assumed that the average losses on the national transmission system will be used.
- This figure is divided by the energy delivered to determine the percentage losses on the transmission system
- Transmission losses in Europe vary between 0.5% and 3%

Step 4 – Calculate the Costs of System Services and Losses

- The cost of procuring system/ancillary services can be complex
- System services charges in Europe range from a low of (-1.42) €/MWh (Albania) to a high of 18.7 €/MWh (Northern Ireland)
- On average, system services account for 35% of the total cost of transmission in European countries
- System services might be procured in a market, or might be procured directly from providers via a bilateral contract between the TSO and the service provider
- In an unbundled power sector, system services costs are tracked by the TSO responsible for procuring system services, so are for the most part readily identifiable. In effect, system services are part of the annual revenue requirement of the TSO including capital, labor and procurement costs to supply system services and losses

Step 4 – Calculate the Costs of System Services and Losses (continued)

- It is somewhat more difficult to estimate costs of ancillary services in a vertically-integrated market structure such as that in most PAEM countries where system services costs are not tracked or paid for separately
- It may be a time-consuming exercise for PAEM Member States to determine actual costs of providing system services, so it might be worthwhile using a fixed percentage in the early years until better information can be compiled.
- The Arab TSOs Committee could provide guidance in this regard.
- Using the European experience as a measure, a fixed percentage of 35% of the total revenue requirement used in the transmission tariff calculation might prove to be a suitable approximation.

Step 4 – Calculate the Costs of System Services and Losses (continued)

- With respect to the cost of losses, it might be assumed that the marginal generating plant supplies losses , for example, a gas plant. Therefore, the cost of supplying losses might be calculated as follows:

  Cost to supply losses =
  Total system losses (MWh) * production cost of gas-fired generation (US$/MWh)

- For example, if the losses are 50,000 MWh, and the marginal cost of production from a gas plant based on international fuel prices is US$ 50/MWh, the cost of losses included in the revenue requirement would be US$ 2.5 million

Step 5 – Calculate Transmission Services Tariff

- The total revenue requirement to be collected by the transmission services tariff would be:

the annualized infrastructure cost + the cost to provide system services + the cost to supply losses

- If there is more than one transmission service provider in the country, the total revenue requirement to be collected in the transmission services tariff would be the sum of the revenue requirement of each transmission service provider
- The total revenue requirement would then be divided by the total kWh delivered by the transmission network to delivery points in the country to derive the transmission services tariff in US $/MWh

Example Calculation of Transmission Services Tariff

In the tariff year, the national transmission service company has a revenue requirement associated with infrastructure of US$ 100,000,000. The company is forecast to deliver 6,000,000 MWh to off-take points including distribution companies, large customers directly connected to the transmission system and exports. Losses on the transmission system are 2%, or 120,000 MWh.

Total Revenue requirement (TRR) to be collected by tariff

TRR requirement = infrastructure + system services + losses

Assuming losses are supplied by gas turbines with a production cost of US$ 50/MWh:

Cost of losses = 120,000 MWh * US$ 50/MWh = US$ 6,000,000

Cost of system services:

Assuming system services make up 35% of the total revenue requirement, then the infrastructure and losses contribute to 65% of the TRR:

Total revenue requirement to be collected by the tariff = (106,000,000)/0.65 = US$ 163,076,923

Revenue requirement owing to system services is US$ 163,076,923 – 106,000,000 = US$ 57,076,923 (i.e. 35% of the total Revenue Requirement of 163,076,923 USD).

Example Calculation of Transmission Services Tariff (continued)

Total revenue requirement is US$ 100,000,000 + 57,076,923 + 6,000,000 = US$ 163,076,923

Transmission services tariff

Transmission services tariff = US$ 163,076,923 / 6,000,000 MWh = US$ 27.18/MWh

Application

If Country A makes a sale to Country B of 100 MW for 10 hours per day for 5 days and Country C provides third-party wheeling services, Country C would be paid:

(100 MW * 10 * 5) = 5000 MWh delivered at a charge of US$ 27.18/MWh

Country C would be paid 5000 MWh * US$ 27.18/MWh = ***US$ 135,900***

Thank You!