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Association of  
Regulatory  
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Commissioners

# **NARUC Partnership Program**

**Public Utilities Commission of Ohio**

**Ministry of Energy of Ghana**

**Energy Commission of Ghana**

and

**Public Utilities Regulatory Commission of Ghana**

sponsored by

**United States Agency for International Development**

## **EMBEDDED COST OF SERVICE**

Kim Wissman  
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On behalf of NARUC



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## Purpose of Cost Studies

- Attribute costs to different categories of customers based on how those customers cause costs to be incurred
- Determine how costs will be recovered from customers within each class
- Calculate costs of individual types of service based on the costs each service requires to utility to expend
- Determine revenue requirement for the services offered
- Separate costs between different regulatory jurisdictions



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## **Revenue Requirement Formula**

**In determining the total revenues a utility should receive through electric service rates, the PUCO, by law, uses the following general formula:**

$$\begin{aligned} &\text{Revenue Requirement} \\ &= \\ &\text{Expenses} + \text{Depreciation} + \\ &\text{Taxes} + (\text{rate of return} \times \text{Rate Base}) \end{aligned}$$



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The Commission computes the gross annual revenues to which a utility is entitled by adding the dollar amount of a fair and reasonable rate of return on the valuation of its property to the cost of rendering the public service for the test period.



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## Basic Sources

Utilities accounting records

- Plant investment data
- Detailed property records
- Balance sheets
- Operating expenses
- Performance of generating units
- Load research
- System maps

Operating results for a particular 12-month period

Normalization



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## Key terms:

**Test period** = unless otherwise ordered by the Commission, the *test period* shall be the 12-month period beginning the six months prior to the date the application is filed and ending six months subsequent to that date. In no event shall the test period end more than nine months subsequent to the date the application is filed. The revenues and expenses of the utility shall be determined for the test period.

**Date Certain** = the *date certain* shall fall within the test period, but be no later than the date of the application. The valuation of the used and useful property of the public utility shall be determined as of the date certain.



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## Key terms:

**Expenses** = the day-to-day costs of providing customers with electricity.

Expenses generally include operation and maintenance expenses (e.g. fuel, labor) and administrative and customer-service-related expenses.

Depreciation and taxes are also “expenses,” but are generally broken out separately in the revenue requirement calculation.

**Rate Base** = the amount of money invested in plants and equipment needed to supply electricity, and a working capital allowance. Rate base items generally include Gross Plant (plant = production, transmission, distribution and general facilities and equipment), the Accumulated Depreciation on those facilities and equipment, Construction Work In Process (CWIP) and Working Capital.



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## Key terms:

**Return on Rate Base** = the amount of money needed to cover the cost of funds invested in rate base.

**Revenues** = the amount of money the utility receives from charging the approved rates.

**Net Operating Income** = Rate Base X rate of return

**Gross Revenue Conversion Factor (GRCF)** = The factor which shows the relationship between increases in revenue and expenses used in order to calculate the corresponding increase in “expenses” (primarily due to tax effects) due to an increase in “revenues.”



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FIRST, the “total” revenue requirement for a utility is determined;  
THEN, the revenue requirement for individual classes of customers (i.e. Residential, Commercial, Industrial and “other” – street and traffic lighting) must be determined; and,  
THIRD, rates must be designed such that each class pays for its own costs.

The total revenue received from all the classes equals the total revenue requirement. The most important step in determining the revenue distribution between and among the classes and in developing rates is the cost of service study.



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## **The Cost of Service Study (COSS)**

- Provides cost information that allows the rate analyst to allocate costs to the various classes of customers.
- Provides cost information that is functionalized, classified, and allocated to various customer classes for a particular utility company.



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## Applicant Responsibility

- The cost of service study is provided by the utility company with its rate application filings.
- The schedule should an account by account detail of all expenses and revenues over the twelve-month test year period.



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## Functionalization

The costs are functionally separated into

- Production related;
- Transmission related; and,
- Distribution related costs.



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Some examples are

- general plant and common plant investment
- administrative and general expenses

No direct relationship to the service characteristics

Conveniently divided among functions



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# Production Costs

Costs related to the production of electricity such as

- the electric generating plant in service
- variable costs such as
  - ☐ fuel
  - ☐ operation and
  - ☐ maintenance
- Can also include purchase of power (wholesale)
- And delivery INTO the bulk system
  - at the bus-bars of the power stations
  - interconnection points





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# Transmission Costs

- Predominantly fixed costs
- Does not vary with the quantity of energy transmitted
- Associated with the transmitting of the energy from the generating plant to the distribution facilities
- Transmission of power to and from interconnected utilities
- Transfer of power from one geographical location to another, various regions or load centers





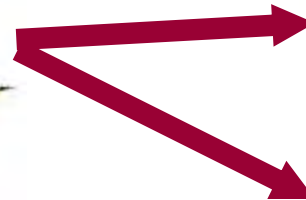
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## Distribution Costs

- ❑ Costs associated with plant, equipment, maintenance and operation required to move the energy from the transmission system to the customer's premises.
- ❑ Affected primarily by demand and number of customers





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## Classification

Once the costs are functionalized, they can then be classified into Demand, Energy, and Customer related costs.

Service characteristics

- Demand usage
- Energy consumption
- Number of customers



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## Demand Costs

Demand costs are generally the fixed costs related to plant in service.

Rate base and expense items –related to PEAK  
USAGE of electric power

Basis of demand (KW) imposed on the system during  
specific peak hours

Most generation and transmission supply facilities fall  
into this category



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- Demand costs are generally allocated to various customer classes based on the coincident demand of the class during the utility system peak period.
- This could be anything from a 1 C.P. (coincident peak) to a 12 C.P., depending on the operating characteristics of the utility company



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## Energy Costs

- Energy costs are generally variable costs
- Allocated among customer classes on the basis of energy (KWH) which the system must supply to serve the customers
- Rate base and expense items related to total kilowatt-hours consumed during a period of time
- Fuel and operation/maintenance



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- Energy costs are allocated to the various classes based on each class' energy usage compared to the total energy usage from all classes.
- For example, if Residential customers use 33% of the total energy consumed then the residential class will be assigned 33% of all energy related expenses.



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# Customer Costs

- Customer costs are generally fixed
- Customer costs are allocated to the various classes based on the number of customers in those classes.
- Directly related to an individual customer taking service from the utility, such as meter expense or service drop





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# Typical Cost Classifications

## Typical Cost Function

- ☐ Production
- ☐ Transmission
- ☐ Distribution
- ☐ Customer Service

## Typical Cost Classification

- Demand Related
- Energy Related
- Demand Related
- Energy Related
- Demand Related
- Energy Related
- Customer Related
- Customer Related
- Demand Related



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## Allocation

- Once the costs are classified they can then be allocated to the various customer classes such as Residential, Commercial, Industrial, and Other.





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- Certain costs are directly assignable to specific customers or classes. For example, a residential customer uses a much different meter (and less expensive) than an industrial customer, therefore, the costs associated with meters are directly assigned to the appropriate classes, otherwise the residential customers (which number thousands more than industrials) would be paying a disproportionate share of meter expenses.



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## Rate Design

- Once all costs have been allocated to the classes you can design rates for the classes.
- Each customer class generally has several different rate schedules in an attempt to provide appropriate rate designs to meet individual customer characteristics.
- Each rate schedule can have a separate rate for Customer, Demand and Energy
- Not all rate schedules have all three rate components. If there is not a separate demand charge, the demand costs are likely included in the energy charge. Often, Residential and Small Commercial schedules are designed this way, since such customers generally have inexpensive kWh-only metering.



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The customer charge is determined by taking the amount of customer-related costs that were allocated to this class and dividing the amount by the number of customers in the class.

- ✓ \$100,000 of customer-related costs
- ✓ class of 100 customers
- ✓ divide the \$100,000 by the 100 customers and then divide by 12 to get a monthly customer charge.  
 $((\$100,000/100)/12) = \$83.33$



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- The demand charge is calculated by dividing the total demand related costs allocated to a class by the total class demand (kW).
- Rates may be “blocked” (different rates for different blocks of demand) to reflect variations in costs due to a customer’s demand pattern.



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- The energy charge is calculated by dividing the total energy related costs allocated to a class by the total kWh's used by that class.
- Rates may also be “blocked” (different rates for different blocks of usage) to reflect variations in costs due to a customer's usage patterns.



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## A typical tariff schedule will look like the following:

### Schedule A

- Customer Charge \$83.33/mo.
- Demand Charge
- First 50 kW/kW \$10.00
- Over 50 kW/kW \$8.00
- Energy Charge
- First 1,000 kWh/kWh \$ 0.085
- Next 1,000 kWh/kWh \$ 0.045
- Over 2,000 kWh/kWh \$ 0.025



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While it is practical to design rates as described above,  
other criteria must be considered

Some other non-cost causation generally accepted  
principles of rate design are:

- gradualism
- continuity
- resulting customer bills
- ease of understanding



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“Regulation is an art, not a science.”



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