CATEGORY WISE COST OF SERVICE STUDY FOR GUJARAT URJA VIKAS NIGAM LIMITED

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1 Background

With the advent of the Electricity Act 2003 and various policy initiatives thereof, it has now become mandatory for the Electrical utilities to gradually reduce the cross subsidy and move the tariffs in the State towards the "Cost of Supply". Traditionally, in the Indian context, tariffs for domestic and agricultural consumers have been heavily subsidised either by the state through subsidies and subventions or through cross subsidisation by other consumer categories, primarily by industrial and commercial category of consumers.

With the focus now shifting to cost- reflective tariffs, it has now become necessary to compute the cost to serve for individual consumer categories and the have a road map for gradual reduction of the cross subsidies existing between the consumer categories today. A basic principle that has been widely accepted in electricity sector regulation is that the tariffs for various categories of consumers should be, as far as practicable, equal to the costs imposed by that category of consumers on the system.

As per Section 61 (g) of Electricity (amendment) Act, 2007,
"that the tariff progressively reflects the cost of supply of electricity and also, reduces cross-subsidies in the manner specified by the Appropriate Commission;"

The Electricity Act, 2003 (hereinafter referred to as "Act") envisages non-discriminatory open access to transmission and distribution networks of the licensees. As per the Act, open access may be allowed before the cross subsidies are eliminated on payment of a surcharge in addition to the charges for transmission / wheeling of power as may be determined by the State Commission. The Act also envisages progressive reduction of cross subsidies in a manner as may be specified by the State Commission.

In relation this, Gujarat Urja Vikas Nigam Limited (GUVNL) has mandated Meghraj Capital Advisors Private Limited to conduct and update the cost of service study for each distribution company namely – Madhya Gujarat Vij Company Limited (MGVCL), Dakshin Gujarat Vij Company Limited (DGVCL), Paschim Gujarat Vij Company Limited (PGVCL), Uttar Gujarat Vij Company Limited (UGVCL) and also combined report of all the four Discoms. Accordingly, the present report covers the details pertaining to the cost of service for GUVNL.

2 Objectives

Cost of service (CoS) study seeks to allocate all the costs of a utility to each of the consumer classes it serves. Such allocation reflects the costs attributable to electricity supplied and related services provided to categories. The costs can then be used as an input into tariff design or to determine cross subsidy, if any, existing in tariffs. The determination of cost of service for each of the consumer category requires disaggregating the utility's costs into functions, services and categories.

In setting tariffs, cross-subsidies have been retained with the ostensive objective of balancing the effect of price increase on certain categories of consumers who have been paying lower tariffs historically. Efforts to make the reforms successful in power sector will have to take note of the need to reduce and eventually phasing out cross-subsidies.

Objectives of the Cost of Service study:

- Formulate a long-term tariff strategy;
- Establish cross subsidy elimination path;
- Provide right signals for efficient use of energy;
- Provide price signals for rendering specific services especially in the competitive markets;
- Facilitate directed and transparent administration of subsidies to the deserving classes;

There is a need that the tariff of all subsidized categories of consumers would need to be rationalised in phased manner, such that the consumers who are enjoying subsidised tariffs for years accept the tariff increase supplemented with improved quality of supply. It will also have to be ensured that there is no disparity in quality & quantity of power supply amongst the consumers, including these subsidized category consumers. Consumers shall be liable to bear the cost of supply and the loss levels pertaining to the efficiency level of the respective consumer category only. Cost of Supply shall be determined on the actual cost to supply to each of the consumer class without considering any subsidies. Such determination of actual costs requires apportionment of a utility's costs to the various consumer categories it serves.

Therefore, to achieve the aforementioned objectives, the Cost of Service Study needs to be carried out for the following purposes:

- To attribute costs to different categories of consumers based on how those consumers cause costs to the utility;
- To provide a comparison of the allocated costs with revenues from existing tariff;
- To illustrate the extent of existing cross-subsidisation between consumer categories;

3 Basic Methodology

Usually, the traditional approach adopted for calculation of cost of supply is using the Embedded Cost Method. The embedded cost based approach allocates the total revenue requirement to various categories of consumers based on an analysis of the embedded or historic costs of the utility. In such an analysis, the revenue requirement is allocated to classes of service to fix tariff based on various allocation factors. The factors can be the contribution of classes to the peak demand, the energy purchased by each class as a percentage of total sales, the number of consumers in the class etc.

The advantage of the embedded cost approach is that embedded costs and allocation factors can be measured based on data that is recorded in the books of the utility.

Therefore, a systematic approach to the CoS study involves two steps of Classification and Allocation of costs to various consumer categories.

3.1 Classification of Costs:

3.1.1 The costs are *classified* as being demand, energy or consumer/service related. Such a classification is done on the basis of the cause of such costs, i.e., the costs which are triggered by peak demands imposed on the system are classified as *"demand related"*; those related to level of power purchase as *"energy related"* and those by number and type of consumers as *"consumer related"*.

3.2 Allocation of Costs:

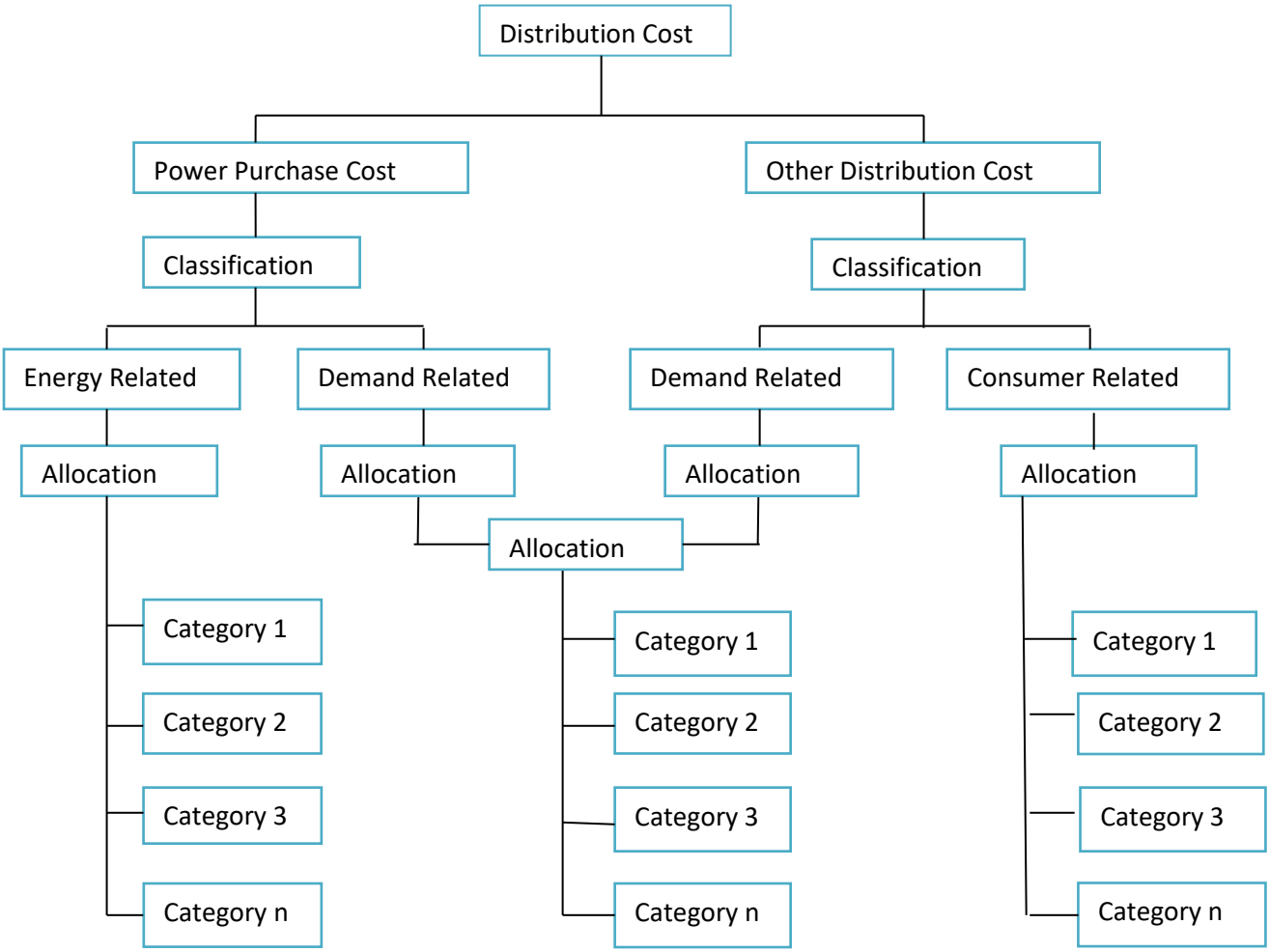
3.2.1 The classified costs are then *allocated* to various consumer classes of the utility based on allocation factors derived from demand, consumption of energy and number of consumers. Such allocation helps in arriving at the cost of service for each consumer class.

3.3 Approach for segregation of cost

3.3.1 Cost of service study may also be conducted using forecasts for costs, consumer data and load patterns. The cost of service so derived may provide an input into tariff design. Together with the desired level of tariffs for each category, cost of service can clearly define the level of subsidies required for each category and the system as a whole.

3.3.2 The methods for classification and allocation of costs are as varied as there are utilities each producing a different result. The fact that there is no set methodology requires careful selection and regular update of the same in line with the changing characteristics of the utility and objectives of the study.

Figure 1: Flow Chart for Cost of Service Study



3.3.3 The total revenue from each of the consumer classes together with the cost of service so derived reflects upon the adequacy of current tariffs and the level of cross subsidies between classes existent in the utility's system.

3.4 Basis for Determination of Cost of Service

3.4.1 Costs for FY 2019-20

The ARR costs as per audited annual accounts of FY 2019-20, have been considered as the base for determination of category wise cost of service for GUVNL. Such costs have been broken up into various heads of distribution costs to determine cost of supply of each category of consumers. It is submitted that during the determination of tariff, the Hon'ble Commission considers value of ARR which is worked out based on normative parameters prescribed in the MYT Regulations, 2016.

3.4.2 Category wise sales and revenue

The tariff categories wise sales have been regrouped in the following categories:

1. **Low Tension Categories**

a. RGP
b. GLP
c. Non RGP and LTMD
d. Street Light
e. Irrigation Agricultural
f. Public Water Works and Sewerage Pumps

2. High Tension Categories

a. Industrial High Voltage
b. Railway Traction

All the Low Tension Tariff Categories were easily mapped to the above-mentioned low-tension categories. Amongst the high-tension categories, Railway Traction has been retained as a separate tariff category and all other categories have been clubbed under Industrial High Voltage category.

3.4.3 Distribution Losses

Distribution losses have also been bifurcated into technical and commercial losses. Technical losses have been further bifurcated at HT and LT voltage levels.

Based on the above methodology, the cost and the losses are allocated to individual category of consumers and the cost of service for each of the category is worked out.

4 Definitions

4.1 System Peak Demand (Restricted)

Maximum demand (MW), in the utility's system, during a period measured as the sum of generation from all the sources.

4.2 Co-incident Peak Demand

Co-incident peak demand or contribution to system peak demand is the demand for a consumer category (Domestic, Industrial, etc.) occurring at the time of system peak demand. The sum of co-incident peak demands of all consumer categories is equal to the system peak demand.

4.3 Non Co-incident Peak Demand

Non co-incident peak demand is the peak demand for a category during a period. Such a peak may or may not occur at the time of system peak demand. Hence, the non-coincident peak demand may be greater than or equal to the co-incident peak demand for a category.

4.4 Connected Load

Connected load is the sum of all the electricity consuming items (Appliances, machines, motors, etc.) connected to the distribution system of the utility. Connected load may be defined for the entire system, a particular unit of the utility or for consumer categories.

4.5 Contracted Demand

Contracted demand is agreed upon by the buyer as the maximum demand that the buyer will have at any point in time during the contract period. The seller agrees to make power available to serve such demand.

4.6 System Load Factor

The ratio of the average demand to system peak demand, it is calculated as the ratio of total number of units consumed in the system during a period to that had the demand been at system peak throughout the same period.

4.7 Category Load Factor

The ratio of the average demand to non-coincident peak demand, it is calculated as the ratio of total number of units consumed by the category during a period to that had the category demand been at non co-incident peak throughout the same period.

4.8 Diversity Factor

Usually measured at the feeder level, it is the ratio of non-coincident peak to connected load.

5 Classification of Expenses

Classification of costs involves identification of costs as demand related, energy related and consumer related, based on some notion of cost causation. Demand-related costs are those triggered by peak demands imposed on the system. Energy-related costs are related to the level of energy production. Consumer costs vary according to the number and type of consumers.

5.1 Classification of Power Purchase Expenses

Power purchase costs are identified to be energy as well as demand related as the utility should not only be able to supply the energy required over a period of time but must also install or purchase sufficient capacity to meet the peak demand of the system. The power purchase cost of GUVNL comprises of fixed and variable charges which are taken in the ratio of 37.37:62.63 of the total power purchase cost.[1] The fixed cost is classified as demand related whereas the variable as energy related.

Table 1 – Classified Power Purchase Expenses

Rs. In Crores

Particulars	Power Purchase Cost	Demand Related	Energy Related	Customer Related
Power Purchase Cost				
- Fixed Cost	17,021	17,021	-	-
- Variable Cost	28,526	-	28,526	-
Classified Power Purchase Costs	**45,547**	**17,021**	**28,526**	**-**

5.2 Classification of Other Distribution Expenses

Other distribution costs are classified as either demand related or consumer related or a combination of the two. Other distribution costs related components like meters and Distribution assets that are used by a single consumer (e.g., Service Lines) could be classified as 100% consumer related. The costs associated with such items can also be classified as entirely consumer related.

Distribution costs other than those entirely consumer related may be classified using the following methods –

- 100% demand related approach classifies all other costs as entirely demand related on the rationale that distribution networks are set up to meet the local maximum demand.

- Partly demand and partly consumer related approach attempts to work out

[1] The power purchase is classified as demand and energy based on the structure of fixed charges and energy charges in power purchase bill of FY 2019-20.

appropriate ratios for each component of distribution costs for classification into demand related and consumer related costs. The rationale for this approach is that the extent of distribution lines, especially in a Universal Service Obligation scenario, depends upon the location and number of consumers. Hence, a component of consumer related distribution cost exists.

The distribution system apart from serving the demand also provides various services to the consumers such as metering, billing, break down repair etc. Hence, other distribution costs need to be classified as partly demand related and partly consumer related.

Table 2 – Classified Distribution Expenses

Rs. In Crores

S.No	Particulars	GUVNL	Classification		
		FY 2019-20	Demand Related	Energy Related	Customer related
1	Repairs & Maintenance	399	200	-	200
2	Employee Costs	2,914	1,457	-	1,457
3	Administation & General Expenses	467	233	-	233
4	Depreciation & Related Debits (Net)	1,757	1,757	-	-
5	Interest & Financial charges	843	843	-	-
6	Other Debits	-	-	-	-
7	Extra-ordinary Items Debit/(Credit)	93	93	-	-
8	Tax	53	53	-	-
9	Net Prior Period Expenses/(Income)	-	-	-	-
10	Less: Expenses Capitalized	507	507	-	-
11	**TOTAL EXPENDITURE (Sum (1 to 9) - 10)**	**6,020**	**4,130**	**-**	**1,890**
12	Return on Equity	1,114	1,114	-	-
13	Less: Non-Tariff Income	826	826	-	-
14	**Classified Distribution Costs (11 + 12-13)**	**6,308**	**4,418**	**-**	**1,890**

As can be seen from the above, the distribution costs such as repair and maintenance, employee cost & administrative and general expenses have been equally apportioned (50:50) into consumer related cost and demand related costs as these vary with the number and the type of consumer as well as with their demand. Rest of the distribution expenses are classified into demand related as they are only dependent on how much demand needs to be catered and not on number of consumers.

6 Allocation of Demand Related Costs

The choice for allocation criteria for demand related costs presents a number of options that may have significant impact on the cost allocation to various classes of consumers. The choice will depend upon data availability, characteristics of the utility and the objectives of the study. The following are the allocation criteria for demand related costs –

6.1 Range of Methods

6.1.1 Co-incident Peak Contribution[2]

The category coincident demand or contribution to the system peak demand may be defined as the demand in MW for each category of consumer that occurs at the time of the system's peak demand. The sum of all such demand for every consumer category plus losses will be equal to the peak demand of the system.

6.1.2 Non-Coincident Peak[3]

The non - coincident demand may be defined as the demand in MW for each category of consumer regardless of when it happens. This non-coincident demand will be greater than or equal to the category's contribution to the system's maximum demand. Thus, the sum of all such demand for every consumer category will be greater than the peak demand of the system.

6.1.3 Average and Excess

This method allocates demand related cost to the consumer category using factors that combine the category average demand and excess demand. Excess demand for a category is defined as –

Category Excess Demand = Non-Coincident Demand – Average Demand

The method uses two factors for allocation. The first component, or contribution to average, is the proportion of category's average demand to the system average demand times the system load factor.

*Contribution to Average = (Category Average Demand/System Average Demand) * System Load Factor*

[2] **Coincident Peak Demand for each category** – MGVCL serves the customers through feeders with mixed load, i.e., a feeder may serve customers from various categories. Such a situation makes it difficult to determine Coincident peak demand (Contribution to system peak demand).

[3] N**on-coincident peak demand** can be estimated applying the diversity factor to the connected load for each category. Calculations are provided in Annexure 2.

The second component, or contribution to excess, reflects the proportion of the excess demand (non-coincident peak demand minus the average demand) of the category to the sum of excess demand of all categories. The advantage of the said approach is that coincident peak demand for a category is not required.

*Contribution to Excess = (Category Excess Demand/ΣCategory Excess Demand) * (1 – System Load Factor)*

6.2 Choice of Methods

All energy related costs have been allocated on the basis of the consumer class-wise energy consumption. All consumer related costs have been allocated on the basis of number of consumers with category wise weights. The appropriate allocation criteria for demand related costs are as follows:

6.2.1 Demand related power purchase costs

The power purchase, serves the entire system and further investments are triggered by increase in the peak demand of the system as a whole. Hence, category co-incident peak demand is the appropriate criteria for allocation of such costs. However, due to non-availability of the data with regards to the category co-incident peak, the Average and Excess method as discussed earlier is a suitable alternative.

Table 3– Category Wise Average & Excess Demand (MW)

MW

Categories	Non Coincident Demand	Average Demand	Excess Demand
Low Tension		**(Sales Plus Losses)/ No. of Hrs in an year**	
RGP	5,983	1,581	4,403
GLP	164	40	123
Non-RGP & LTMD	5,222	1,721	3,501
Street Light (Public Lighting)	134	33	101
Irrigation Agricultural	9,127	2,447	6,680
Public Water Works & Sewerage Pumps (PWW)	450	259	191
Total LT	**21,080**	**6,081**	**14,999**
High Tension			
Industrial High Voltage (Ind. HT)	12,649	4,025	8,623
Industrial High Voltage (Ind. EHT)	-	-	-
Railway Traction	5	1	4
Licensees	-	-	-
Others (incl. Inter-State Sales)	-	-	-
Total HT	**12,654**	**4,026**	**8,628**
Total Demand (HT+LT)	**33,733**	**10,107**	**23,627**

Table 4 – Allocation Factors for Demand Related Power Purchase Costs

Categories	Average Demand Component for Allocation (%)	Excess Demand Component for Allocation (%)	Total Allocation Factor (%)
Low Tension			
RGP	9.70%	7.07%	16.78%
GLP	0.25%	0.20%	0.45%
Non-RGP & LTMD	10.56%	5.63%	16.19%
Street Light (Public Lighting)	0.20%	0.16%	0.36%
Irrigation Agricultural	15.02%	10.73%	25.75%
Public Water Works & Sewerage Pumps (PWW)	1.59%	0.31%	1.90%
Total LT	**37.32%**	**24.10%**	**61.42%**
High Tension			
Industrial High Voltage (Ind. HT)	24.71%	13.86%	38.56%
Industrial High Voltage (Ind. EHT)	0.00%	0.00%	0.00%
Railway Traction	0.00%	0.01%	0.01%
Licensees	0.00%	0.00%	0.00%
Others (incl. Inter-State Sales)	0.00%	0.00%	0.00%
Total HT	**24.71%**	**13.86%**	**38.58%**
Total Demand (HT+LT)	**62.04%**	**37.96%**	**100.00%**

6.2.2 Demand related other distribution costs

The distribution network services local maximum demands and investments are triggered by the local (in other words, non-coincident) peaks in demand. Therefore, the category non-coincident peak demand for each class is the most appropriate basis for allocation of demand related other distribution costs.

Table 5 – Allocation factors for Demand Related Other Distribution Costs

Particulars	Allocation Factors
Low Tension	
RGP	17.74%
GLP	0.49%
Non-RGP & LTMD	15.48%
Street Light (Public Lighting)	0.40%
Irrigation Agricultural	27.06%
Public Water Works & Sewerage Pumps (PWW)	1.33%
Total LT	**62.49%**
High Tension	
Industrial High Voltage (Ind. HT)	37.50%
Industrial High Voltage (Ind. EHT)	0.00%
Railway Traction	0.01%
Licensees	0.00%
Others (incl. Inter-State Sales)	0.00%
Total HT	**37.51%**

6.2.3 Demand related Total Distribution costs

Allocation factors for demand related total distribution costs is worked out based on weightages of power purchase and other distribution costs. The allocation factors for demand related total distribution costs are as given in below table:

Table 6 – Allocation factors for Demand Related Total Distribution Costs

Sr. No.	Particulars	Demand Related Allocation
	Low Tension	
1	RGP	16.97%
2	GLP	0.45%
3	Non-RGP & LTMD	16.04%
4	Street Light (Public Lighting)	0.37%
5	Irrigation Agricultural	26.02%
6	Public Water Works & SeweragePumps (PWW)	1.78%
	Total LT	**61.64%**
	High Tension	
7	Industrial High Voltage (Ind. HT)	38.34%
8	Industrial High Voltage (Ind. EHT)	0.00%
9	Railway Traction	0.01%
10	Licensees	0.00%
11	Others (incl. Inter-State Sales)	0.00%
	Total HT	**38.36%**

7 Allocation of Energy Related Costs

Energy related costs are allocated in the ratio of energy consumed by the consumer classes. The energy consumed includes sales to categories and allocated losses.

7.1 Allocation of Losses

Though sales to each of the classes are easily available, allocation of losses requires considerable judgement. The allocation of technical losses is largely dependent upon the voltage at which a consumer category is connected. However, before allocating technical losses, commercial losses are allocated to various categories. The technical losses are then allocated in the ratio of sales plus commercial losses for a category.

7.1.1 Determination of Technical and Commercial Losses

The total distribution loss of GUVNL is 10.40% including both technical and commercial losses. The technical losses of GUVNL distribution system are estimated to be 4.73%. The EHT losses are estimated to be 0.01%, HT losses are estimated to be 1.97% and LT losses are 2.75%. The remaining losses are considered as commercial distribution losses. The breakup of the same is as below:

Table 7 – Losses at GUVNL

Total Technical Losses	**4.73%**
EHT	0.01%
HT	1.97%
LT	2.75%
Total Commercial Losses	**5.67%**
Total Losses in the system	**10.40%**

7.1.2 Allocation of Commercial Losses

Commercial losses are determined as the difference between total losses and technical losses. The commercial losses are allocated to the consumer categories in ratio of sales.

Table 8 – Allocation of Commercial Losses

Categories	Sales (MU)	Allocation Factor for Commercial Losses	Commercial Losses (MU)
Low Tension			
RGP	12,169	15.34%	770
GLP	312	0.39%	20
Non-RGP & LTMD	13,250	16.70%	838
Street Light (Public Lighting)	253	0.32%	16
Irrigation Agricultural	18,836	23.75%	1,191
Public Water Works & SeweragePumps (PWW)	1,995	2.52%	126
Total LT	**46,815**	**59.02%**	**2,961**
High Tension			
Industrial High Voltage (Ind. HT)	32,506	40.98%	2,056
Industrial High Voltage (Ind. EHT)	-	0.00%	-
Railway Traction	6	0.00%	-
Licensees	-	0.00%	-
Others (incl. Inter-State sales)	-	0.00%	-
Total HT	**32,512**	**40.98%**	**2,056**
Total	**79,327**	**100.00%**	**5,016**

7.1.3 Allocation of Technical Losses

Technical losses at HV and LV levels are allocated to the categories in ratio of sales to consumer categories connected at that voltage and energy transferred to the immediate lower voltage level. For instance, if at HV level sale to HV Industry is 20 MU while the sales to other categories at LV level is 5 MU and the transfer to LV level is 75 MU – 20% of the losses at HV level will be allocated to HV Industry category. Similar practice is followed for LV category.

The above method for allocation of technical losses is done in two steps. Firstly, the losses are allocated to various voltages levels in the ratio of voltage level sales and transfer (to next category). Then, the losses allocated to various voltage levels are allocated to the respective categories in the ratio of category sales.

Table 9 – Allocation of Technical Losses

MUs

	EHT	HT	LT	
Percent	0.01%	1.97%	2.75%	4.73%
Losses to be allocated	13	1,744	2,435	4,192
LT System				
Sales	-	-	46,815	46,815
Commercial losses	-	-	2,961	2,961
Technical losses	-	-	2,435	2,435
Input to LT System	-	-	52,210	52,210
Allocation of LT Technical Losses	-	-	2,435	2,435
HT System				
Sales	-	32,506	-	32,506
Commercial losses	-	2,056	-	2,056
Input to LT System	-	-	52,210	52,210
Input to HT System	-	34,562	52,210	86,772
Technical losses in HT system	-	1,744	-	1,744
Allocation of HT Technical Losses	-	694	1,049	1,744
EHT System				
Sales	6	-	-	6
Commercial losses	-	-	-	-
Used by HT System	-	35,256	-	35,256
Used by LT System	-	-	53,259	53,259
Input to EHT System	6	35,256	53,259	88,522
Technical losses in EHT system	13	-	-	13
Allocation of EHT Technical Losses	0	5	8	13
Total energy input on the system				88,535
Technical Losses Allocated to Customer Categories	**0**	**700**	**3,492**	**4,192**

Table 10 – Allocation of Losses to Categories

Categories	Sales (MU)	Commercial Losses (MU)	Technical Losses (MU)	Total Energy Input into the system (MU)
Low Tension				
RGP	12,169	770	908	13,846
GLP	312	20	23	355
Non-RGP & LTMD	13,250	838	988	15,076
Street Light (Public Lighting)	253	16	19	288
Irrigation Agricultural	18,836	1,191	1,405	21,432
Public Water Works & SeweragePumps (PWW)	1,995	126	149	2,270
Total LT	**46,815**	**2,961**	**3,492**	**53,267**
High Tension				
Industrial High Voltage (Ind. HT)	32,506	2,056	700	35,262
Industrial High Voltage (Ind. EHT)	-	-	-	-
Railway Traction	6	-	0	6
Licensees	-	-	-	-
Others (incl. Inter-State sales)	-	-	-	-
Total HT	**32,512**	**2,056**	**700**	**35,268**
Total	**79,327**	**5,016**	**4,192**	**88,535**

7.2 Allocation of Energy Related Costs

Energy related costs are allocated to categories in the ratio of energy consumed. The energy consumed includes not only the sales but also the losses allocated to the respective categories.

Table 11 – Allocation Factors for Energy Related Costs

Particulars	GUVNL Allocation Factors
Low Tension	
RGP	15.64%
GLP	0.40%
Non-RGP & LTMD	17.03%
Street Light (Public Lighting)	0.33%
Irrigation Agricultural	24.21%
Public Water Works & Sewerage Pumps (PWW)	2.56%
Total LT	**60.17%**
High Tension	
Industrial High Voltage (Ind. HT)	39.83%
Industrial High Voltage (Ind. EHT)	0.00%
Railway Traction	0.01%
Licensees	0.00%
Others (incl. Inter-State Sales)	0.00%
Total HT	**39.83%**

8 Allocation of Consumer Related Costs

Consumer related costs, primarily, include the costs of providing servicing other than supply of electricity, namely – metering, billing, collection, fault repair etc. These costs, though directly relate to the number of consumers in a particular category, vary significantly with across categories. For instance, the per consumer servicing costs for HT Industrial category will be much higher than that for a Residential category consumer.

8.1 Category Wise Consumer Weightages

To address the variance in per consumer service costs across categories, category wise weight-ages have been derived to determine allocation factors for consumer-related costs. The weightages are a function of two parameters - Sales per Consumer and Load per Consumer. Category wise parameters have been divided by average of such parameter for arrive at a ratio. The minimum & maximum limit for such ratios has been set at 1 and 200 respectively. The average of these two ratios for each category gives the *'Category Wise Consumer Weightage'.*

Table 12 – Category Wise Consumer Weightage

Categories	Connected Load	Consumers	Sales	Weight (sales/ consumer)	Weight (load/ consumer)	Average Weight
Domestic	12,679	11,897,919	12,169	1	1	1
Commercial	347	98,420	312	1	1	1
Industrial Low & Medium Voltage (Ind. LT)	10,126	1,859,972	13,250	1	2	2
Street Light (Public Lighting)	134	43,372	253	1	1	1
Irrigation Agricultural	14,910	1,778,939	18,836	2	3	2
Public Water Works & Sewerage Pumps (PWW)	954	96,029	1,995	4	3	4
Industrial High Voltage (Ind. HT)	12,649	16,868	32,506	200	200	200
Industrial High Voltage (Ind. EHT)	-	-	-	-	-	-
Railway Traction	5	1	6	200	200	200
Licensees	-	-	-	-	-	-
Total	**51,803**	**15,791,520**	**79,327**			

8.2 Allocation of Consumer Related Costs

Consumer related as arrived at after Classification of Distribution Cost is allocated as per the weight-ages derived.

Table 13 – Allocation Factors for Consumer Related Costs

Particulars	Allocation Factors
Low Tension	
RGP	52.24%
GLP	0.45%
Non-RGP & LTMD	12.57%
Street Light (Public Lighting)	0.21%
Irrigation Agricultural	18.21%
Public Water Works & SeweragePumps (PWW)	1.51%
	0.00%
Total LT	**85.19%**
High Tension	
Industrial High Voltage (Ind. HT)	14.81%
Industrial High Voltage (Ind. EHT)	0.00%
Railway Traction	0.00%
Licensees	0.00%
Others (incl. Inter-State Sales)	0.00%
Total HT	**14.81%**

9 Computation of category wise Cost of Service

The cost of service each category has 3 elements, namely –

1. Demand Related Costs;
2. Energy Related Costs; and
3. Consumer Related Costs;

Table 14 – Category Wise Total Cost of Service

Rs. In Crores

Particulars	GUVNL			
	Demand Related	Energy Related	Customer Related	Total
Low Tension				
RGP	3,639	4,461	988	9,088
GLP	97	114	8	220
Non-RGP & LTMD	3,439	4,858	238	8,534
Street Light (Public Lighting)	80	93	4	176
Irrigation Agricultural	5,578	6,906	344	12,828
Public Water Works & Sewerage Pumps (PWW)	382	731	29	1,142
Total LT	**13,216**	**17,163**	**1,610**	**31,989**
High Tension				
Industrial High Voltage (Ind. HT)	8,220	11,361	280	19,862
Industrial High Voltage (Ind. EHT)	-	-	-	-
Railway Traction	3	2	-	4
Licensees	-	-	-	-
Others (incl. Inter-State Sales)	-	-	-	-
Total HT	**8,223**	**11,363**	**280**	**19,866**
Total Costs (HT+LT)	**21,439**	**28,526**	**1,890**	**51,855**

The above provides the total cost of service of each category. Per unit (energy, demand or consumer as unit) cost of service for each category is derived as under.

Table 15 – Category Wise per Unit Cost of Service

Particulars	GUVNL			
	Demand Related (Rs/kWh)	Energy Related (Rs/kWh)	Customer Related (Rs/kWh)	Total Cost (Rs/kWh)
Low Tension				
RGP	2.99	3.67	0.81	7.47
GLP	3.13	3.67	0.27	7.06
Non-RGP & LTMD	2.60	3.67	0.18	6.44
Street Light (Public Lighting)	3.14	3.67	0.15	6.96
Irrigation Agricultural	2.96	3.67	0.18	6.81
Public Water Works & Sewerage Pumps (PWW)	1.91	3.67	0.14	5.72
Total LT	**2.82**	**3.67**	**0.34**	**6.83**
High Tension				
Industrial High Voltage (Ind. HT)	2.53	3.50	0.09	6.11
Industrial High Voltage (Ind. EHT)	-	-	-	-
Railway Traction	4.25	3.22	-	7.47
Licensees	-	-	-	-
Others (incl. Inter-State Sales)	-	-	-	-
Total HT	**2.53**	**3.50**	**0.09**	**6.11**
Total Costs (HT+LT)	**2.70**	**3.60**	**0.24**	**6.54**

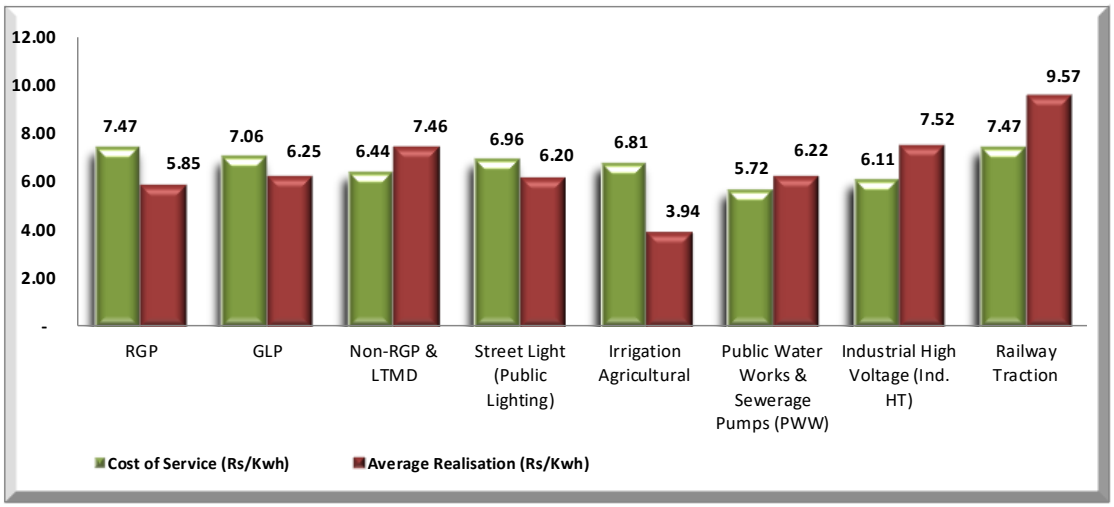
10 Conclusion

The cost of service study seeks to establish the adequacy of tariffs, category wise cross subsidy in the system and provide a path for elimination of the same. The results of the study also establish the cross subsidy surcharge applicable to open access consumers. The table below compares the cost of service and average realisation. The average realisation is worked out by dividing the sum of category wise revenue from sale of Power and Non-tariff Income (apportioned category wise based on its sales) by the category wise sales. The Agriculture subsidy is also added to the revenue while working out Average realisation for Agriculture category.

Table 16 – Cost of Service against Average Realisation

Particulars	Total Cost (Rs/kWh)	Average Realisation (Rs/kWh)	Gap (Rs/kWh)
Low Tension			
RGP	7.47	5.85	1.62
GLP	7.06	6.25	0.81
Non-RGP & LTMD	6.44	7.46	(1.02)
Street Light (Public Lighting)	6.96	6.20	0.77
Irrigation Agricultural	6.81	3.94	2.87
Public Water Works & Sewerage Pumps (PWW)	5.72	6.22	(0.49)
High Tension			
Industrial High Voltage (Ind. HT)	6.11	7.52	(1.41)
Industrial High Voltage (Ind. EHT)	-	-	-
Railway Traction	7.47	9.57	(2.09)
Licensees	-	-	-
TOTAL	**6.54**	**6.36**	**0.17**

The graph below shows category-wise cost of service and average realisation of GUVNL for FY 2019-20.



11 Annexure 1– Category Wise Diversity Factors

Diversity factor is the ratio of peak demand to connected/contracted load. An assessment of category wise diversity factors was made using a sample of feeders that predominantly serve a particular category. The feeders considered for arriving at diversity factors were selected from all circles of MGVCL for RGP, LT Industrial, Public Water Works and Agricultural categories. For street lighting, diversity factor of 100% has been taken. For GLP category, the diversity factor has been taken to be the same as that for RGP Category. Similarly, Further, where two types of feeders for the same category have been considered – Residential Rural and Residential Urban, for instance – weighted average of the same has been considered. For HT categories, namely – HT and Traction diversity factor is considered as 100%.

Table 17 – Sample Diversity Factors for LT Categories

Type	Connected Load (KVA)	Max Load (KVA)	Diversity Factor (%)
GIDC	723,299	351,558	48.60%
Industrial	844,225	523,850	62.05%
Irrigation Agriculture	909,372	556,640	61.21%
Residential – Rural	685,479	342,374	49.95%
Residential – Urban	1,247,750	569,938	45.68%
HT -EX	601,930	633,953	105.32%

12 Annexure 2– Category Wise Non Coincident Demand

The diversity factors derived from the sample of feeders and from available records are then applied to the total connected load of the respective categories to arrive the non-coincident peak.

Table 18 – Category Wise Non-coincident Demand

Categories	Connected Load(MW)	Diversity Factor (%)	Non Coincident Peak Demand
Low Tension			
RGP	12,679	47.19%	5,983
GLP	347	47.19%	164
Non-RGP & LTMD	10,126	51.57%	5,222
Street Light (Public Lighting)	134	100.00%	134
Irrigation Agricultural	14,910	61.21%	9,127
Public Water Works & Sewerage Pumps (PWW)	954	47.19%	450
Total LT	**39,150**		**21,080**
High Tension			
Industrial High Voltage (Ind. HT)	12,649	100.00%	12,649
Industrial High Voltage (Ind. EHT)	-	100.00%	-
Railway Traction	5	100.00%	5
Licensees	-	100.00%	-
Others (incl. Inter-State Sales)	-	0.00%	-
Total HT	**12,654**		**12,654**
Total Connected Load (HT+LT)	**51,803**		**33,733**

13 Annexure 3– Average Cost of Service (+/- 20%) for FY 2019-20

Table 19 – Average Cost of Service (+/- 20%) for FY 2019-20

Particulars	Total Cost (Rs/kWh)	Average Realisation (Rs/kWh)	(+20%) of ACOS (Rs./kWh)	(-20%) of ACOS (Rs./kWh)
Low Tension				
RGP	7.47	5.85	7.84	5.23
GLP	7.06	6.25	7.84	5.23
Non-RGP & LTMD	6.44	7.46	7.84	5.23
Street Light (Public Lighting)	6.96	6.20	7.84	5.23
Irrigation Agricultural	6.81	3.94	7.84	5.23
Public Water Works & Sewerage Pumps (PWW)	5.72	6.22	7.84	5.23
High Tension				
Industrial High Voltage (Ind. HT)	6.11	7.52	7.84	5.23
Industrial High Voltage (Ind. EHT)	-	-	7.84	5.23
Railway Traction	7.47	9.57	7.84	5.23
Licensees				
TOTAL	**6.54**	**6.36**	**7.84**	**5.23**