TECHNICAL PAPER ON CATEGORY-WISE COST OF SERVICE STUDY

(DELIVERABLE [4 (1)])

ANNEXURE 12

Submitted By

FEEDBACK INFRA

Making Infrastructure Happen

ENERGY DIVISION

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1. INTRODUCTION

1.1 Company Profile of TANGEDCO

1.1.1 Tamil Nadu Electricity Board, a State Electricity Board was constituted under section 5 of the Electricity (Supply) Act, 1948 and was in the business of Generation, Transmission and Distribution of Electricity in the State of Tamil Nadu.

1.1.2 The Government of Tamil Nadu vide G.O Ms No 114 dated 08.10.2008, accorded in-principle approval for the re-organization of TNEB by establishment of a holding company, by the name TNEB Ltd and two subsidiary companies, namely Tamil Nadu Transmission Corporation Ltd (TANTRANSCO) and Tamil Nadu Generation and Distribution Corporation Ltd (TANGEDCO).

1.1.3 The first provisional Transfer Scheme was notified by the State Government vide G.O. (Ms.) No.100, Energy (B2) department, dated 19th Oct 2010 issued under Tamil Nadu Electricity (Reorganization and Reforms) Transfer Scheme, 2010 for the purpose of transfer and vesting of property, rights and liabilities of the Tamil Nadu Electricity Board in the State Government and re-vesting thereof by the State Government into corporate entities and also for the transfer of personnel of the Tamil Nadu Electricity Board to corporate entities and for determining the terms and conditions on which such transfer and vesting will be made.

1.1.4 Based on the above G.O. the Tamil Nadu Generation and Distribution Corporation Ltd (TANGEDCO) was registered on 01.12.2009. The Certificate of commencement of business was obtained for the TANGEDCO on 16.03.2010.

1.1.5 The second provisional transfer scheme was notified by the State Government vide G.O. (Ms.) No.2, Energy (B2) department, dated 2nd January 2012 with amendment in the restructuring of Balance Sheet of TNEB for the successor entities i.e. TANGEDCO and TANTRANSCO, considering the audited balance sheet of TNEB for FY 2009-10.

1.1.6 The opening balances of assets and liabilities are transferred based on the FY 2009-

10 audited balances, which was the latest available data at that point of time. TANGEDCO started functioning independently from 1st November 2010 onwards. As per clause 9(1) of the transfer scheme the assets transfer is provisional for a period of one year and employees transfer is provisional for a period of three years from the effective date of transfer, i.e. 1st November 2010.

1.1.7 Subsequently, as per the request of TNEB Limited, the second provisional transfer scheme was notified by the State Government vide G.O. (Ms.) No.2, Energy (B2) department, dated 2nd January 2012 with amendment in the restructuring of Balance Sheet of TNEB for the successor entities i.e. TANGEDCO and TANTRANSCO, considering the audited balance sheet of TNEB for FY 2009-10 and have extended the provisional time for final transfer of assets and liabilities to the successor entities of erstwhile TNEB upto 31.10.2012.

1.1.8 The TNEB limited in its 22nd Board meeting held on 27.09.2012, has approved the proposal to seek 6 months time extension i.e up to 30.04.2013 for final transfer of assets and liabilities to successor entities of erstwhile TNEB and the same has been addressed to the GoTN for approval and notification.

1.1.9 Tamil Nadu Generation and Distribution Corporation Limited has installed generating stations of capacity 10,380 MW which includes State, Central share and Independent power producers and has achieved a consumer base of about 223.44 lakh consumers at the end of FY 2010-11

1.2 Background of the concept

1.2.1 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 the consumers using electricity at high voltages.

1.2.2 A basic principle that has been widely accepted in electricity sector regulation is that the tariffs for various categories of customers should be, as far as practicable, equal to the costs imposed by that category of customers on the system. This is what is currently understood as Cost of Service (CoS).

1.2.3 With the focus now shifting to cost- reflective tariffs, it has now become necessary to compute the cost to serve to individual consumer categories and the 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 customers should be, as far as practicable, equal to the costs imposed by that category of customers on the system.

1.2.4 The focus of the reforms envisaged by the Electricity Act, 2003 (EA 2003) is to establish competitive environment for economical and financial viability of the power sector. The prices at every stage of the value chain of the sector should reflect marginal cost. Cross subsidy which is another form of subsidy affect economic efficiency and environmental performance.

1.2.5 The estimation of cost to supply to category of consumers enables the calculation of cross subsidy. The obligation to reduce cross subsidy comes from the legal, policy and regulatory framework of the power sector. The Electricity Act 2003 requires the Distribution Licensee to reduce cross subsidy and if the State Government requires tariff of any consumer category to be subsidized then it would be required to provide subsidy in advance equivalent to the subsidized amount.

1.2.6 In relation to this, TANGEDCO will be submitting the best possible methodology to be adopted for determining cost of supply taking into account various constraints and various other conditions to the Hon'ble Commission for approval.

2. NEED OF THE STUDY

2.1 Objective of the Study

2.1.1 Cost of service study seeks to allocate all the costs of a utility to each of the customer 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 customer categories requires disaggregating the utility's costs into functions, services and categories.

2.1.2 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.

2.1.3 Objectives of the Cost of Service study:

- Formulate a long-term tariff strategy;
- Establish cross subsidy reduction 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;

2.1.4 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 subsidy 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 all the consumers, including these subsidized category consumers. Consumers shall be liable to bear the cost of supply and the loss levels expressing the efficiency 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 subsidies and cross subsidies. Such determination of actual costs requires apportionment of a utility's costs to the various customer classes it serves.

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

- To attribute costs to different categories of customers based on how those customers 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;

2.2 Key issues

2.2.1 The key issues which is required to undertake the study of CoS and reduction of Cross Subsidies are as follows:

- Initially, the category wise tariff was decided after taking cognizance of socio-economic consideration in line with state government policy.
- Cost of Service (CoS) for agricultural consumers in isolation is not feasible as it involves many other issues like allocation of cost of supply i.e. cheap and costly power purchased by utility;
- The prevailing levels of electricity tariff contain a large degree of cross subsidy, with some categories of consumers paying well above the economic cost of supply. It has to be recognised that low and subsidised tariff inflict inefficient high demand for power, which puts pressure on the system capacity and the quality of service.
- The slab rates are so designed that the affluent customers are paying more and economically weaker consumers paying less for their consumption. The paradox often faced is that while efficiency criterion calls for a cost based tariff, the social criteria may at times call for relief to certain consumer's e.g. low-income group.
-

2.2.2 It is a well known fact that supplying electricity at tariffs less than the actual cost, to various categories of consumers leads to financial losses for Utilities. It is also a well

know fact that the State Utilities have to make the electricity, a basic necessity, available to all poorer citizens who are unable to pay for it at affordable cost price. The following concerns need to be addressed

- Categories of consumers who should be subsidized;
- Quantum of Subsidy including the government subsidy;
- Ability of State Government to bear the burden of Cross Subsidy;
- Mechanism of flow of subsidy from State Govt to Utility

3. STATUTORY & LEGAL PROVISIONS

The current treatment of cross subsidies by State Electricity Regulatory Commission and other options available to address the cross subsidy reduction issue have to be in consonance with the provisions of the Electricity Act 2003, the National Electricity Policy, Tariff Policy and the decisions of Appellate Tribunal for Electricity (ATE). In the following sections the various provisions of the Act, Policies, Regulations, Tariff order and the decisions of the Appellate Tribunal have been quoted and interpreted in order to develop an understanding of the framework which will form the basis for the development of the Methodology for carrying out Cost to Service Calculation.

3.1 Electricity Act 2003

3.1.1 Subsection (g) of **Section 61** of EA 2003 stipulates that the tariff should progressively reflect cost of supply of electricity and also reduces cross subsidies in the manner specified by the Appropriate Commission;

3.1.2 **Section 62(3)** provides for the factors on which the tariffs of the various consumers can be differentiated. Some of these factors like load factor, power factor, voltage, total electricity consumption during any specified period or time or geographical position also affects the cost of supply to the consumer. Due weightage can be given in the tariffs to these factor to differentiate the tariffs;

3.1.3 As per the Section 62 of the EA 2003, the SERC is required to determine the retail tariff to be charged by the Distribution Licensees from its consumers. The Commission while determining the tariffs is required to give considerations to the factors (load factor, power factor, voltage, total consumption of electricity during any specified period or the time at which the supply is required or the geographical position of any area, the nature of supply and the purpose for which the supply is required.) listed in Section 62(3), 61(c) and 61(e) of the EA 2003, which are essentially cost determinants and economically efficient tariffs should consider the cost impact of these factors only without providing for any cross subsidies.

3.1.4 The Tariff may be fixed as per the consumer's load factor, power factor, voltage, total consumption of electricity and should reflect the Cost of Supply to the

concerned consumer category.

3.1.5 The EA 2003 recognizes the fact that tariffs of some consumer categories are presently below cost of supply and tariff shock due to abrupt elimination of subsidy may not be in the interest of such consumers therefore it provides for progressive reduction in cross subsidy. As said earlier, the tariffs must reflect the underlying cost of supply and if the State Government wishes that any particular consumer category is to be charged lower than the cost of supply then as per Section 65 of the EA 2003 the State Government has to provide subsidy to such consumers. The EA 2003 has preferred direct subsidy over cross subsidy. However the amendment to the section 61 replacing the word elimination with reduction provides for some amount of continued cross subsidy.

3.2 National Tariff Policy

3.2.1 The National Tariff Policy (NTP) prescribes the principles to be adopted by the Commission for determining tariffs for generation, transmission, distribution and retail consumers. The clauses dealing with the issue of Cost to Supply are given in the table below:

3.2.2 Section **8.3 (2)** reads -

> *For achieving the objective that the tariff progressively reflects the cost of supply of electricity, the SERC would notify roadmap within six months with a target that latest by the end of year 2010-2011 tariffs are within ± 20 % of the average cost of supply. The road map would also have intermediate milestones, based on the approach of a gradual reduction in cross subsidy;*

3.2.3 The NTP provides that tariffs is required to reflect efficient costs and gradual reduction of cross subsidy inherent in existing tariffs but consumers below poverty line (BPL) for life line consumption can have cross subsidized tariff rates. Also, a direct subsidy support by the State Government to the other poorer categories of consumers for pre-identified level of consumption is allowed.

3.2.4 The clause 8.5 which defines cross subsidy charge as the difference between the (i) tariff applicable to the relevant category of consumers and (ii) the cost of the

distribution licensee to supply electricity to the consumers of that category provides an indication how to compute cross subsidy.

3.2.5 The NTP recognizes data and other issues in the determination of cost of supply consumer category wise and alternatively provides that tariff should be within ± 20 % of the average cost of supply.

3.3 National Electricity Policy

3.3.1 The Commission while discharging its functions as required by the Electricity Act 2003 is to be guided by the National Electricity Policy (NEP). The NEP provides guidance and clarifications on issues which either have not been or have been inadequately addressed in the EA 2003. The relevant clauses in the context of this study are:

3.3.2 Clause **5.5.1** reads that there is an urgent need for ensuring recovery of cost of service from consumers to make the power sector sustainable;

3.3.3 Clause **5.5.2** stipulates that consumers below poverty line, who consume below a specified level, say 30 units per month, may receive a special support through cross subsidy. Tariffs for such designated group of consumers will be at least 50% of the average cost of supply. This provision will be re-examined after five years;

3.3.4 Further, the National Electricity Policy provides for reducing the cross subsidies progressively and gradually. The gradual reduction is envisaged to avoid tariff shock to the subsidized categories of consumers. It also provides for subsidized tariff for consumers below poverty line for minimum level of support. Cross subsidy for such categories of consumers has to be necessarily provided by the subsidizing consumers

3.3.5 The thrust of the NEP is that the tariffs should reflect cost and existing cross subsidies should progressively and gradually reduce. However there can be cross subsidy support for very poor categories of consumers.

3.4 TNERC Tariff Regulations

3.4.1 **Clause 23(e)** of MYT Regulations 2009 reads that application for determination of

Tariff under MYT framework shall be accompanied with –

a statement showing cost to supply for electricity to different category of consumers at different voltage level with the allocation of Transmission and Distribution loss and consumer wise cross subsidy at the existing tariff

3.4.2 As per the **Tariff Regulation 7 (c) (iii)** of the State Commission, it stipulates that the cross subsidy has to be computed as difference between cost-to-serve a category of consumer and average tariff realization of that category;

3.5 TNERC Order dated 30th March 2012

3.5.1 As highlighted in the Tariff order dated 30th March 2012, the Cost to serve, Average Cost of supply and Cross Subsidy are inter-related issues which are extensively covered in the Order of the Hon'ble Appellate Tribunal of Electricity dated 11th January2012 in Appeal Nos. 57 of 2008, 155 of 2007, 125 of 2008, 45 of 2010, 40 of 2010, 196 of 2009, 199 of 2009, 163 of 2010, 6 of 2011 and 144 of 2010.

3.5.2 Following is the opinion of the APTEL on the issue related to Cost to Serve and Average Cost of Supply:

- If strict commercial principles are followed, then the tariffs have to be based on the cost to supply a consumer category. However, it is not the intent of the Act after the amendment in the year 2007 (Act 26 of 2007) that the tariff should be the mirror image of the cost of supply of electricity to a category of consumer.
- The cross subsidies may gradually be reduced but should not be increased for a category of subsidizing consumer.
- APTEL has advised to initiate a simple formula which could take into account the major cost element to a great extent reflecting the cost of supply. There is no need to make distinction between the distribution charges of identical consumers connected at different nodes in the distribution network. It would be adequate to determine the voltagewise cost of supply taking into account the major cost element which would be applicable to all the categories of consumers connected to the same voltage level at different locations in the distribution system.
- As segregated network costs are not available, all the costs such as Return on Equity, Interest on Loan, depreciation, interest on working capital and O&M costs

can be pooled and apportioned equitably, on pro-rata basis, to all the voltage levels to determine the cost of supply.

- Segregating Power Purchase cost taking into account voltage-wise transmission and distribution losses will be a major step in the right direction for determining the actual cost of supply to various consumer categories.
- All consumer categories connected to the same voltage will have the same cost of supply.

3.5.3 Based on the above points as specified in APTEL order, it is very clear, that the cross subsidies needs to be reduced and not to be eliminated. Also, even though the accurate data is not available, a simple formulation based on certain assumption can be carried out to calculate Cost to Serve of different categories of consumers. However, there is no clarity that the Cost to serve and Cross subsidy impact to be calculated needs to be at macro level or at micro level, i.e. to be determined at category of consumers level or at sub-category level also.

3.5.4 Also, Clause **2.1.46** of **Issue 6** (Cost of Supply) of the Tariff Order for TANGEDCO dated 30.03.12 reads-

"*The Tariff may be fixed as per the consumer's load factor, power factor, voltage, total consumption of electricity and should reflect the Cost of Supply to the concerned consumer category*"

3.5.5 Further, Clause **2.1.47** of **Issue 6** (Cost of Supply) of the Tariff Order for TANGEDCO dated 30.03.12 reads-

"*TANGEDCO should furnish a statement showing the Cost to Serve for each category of consumers at different voltage level with allocation of Transmission & Distribution loss and consumer wise cross subsidy at the existing tariff while submitting ARR.*"

3.6 Summary conclusion on the Applicable Legal and Policy Framework

3.6.1 Following conclusions can be drawn from the above discussion on the legal and policy framework applicable to cross subsidy determination and its reduction

- Consumer tariffs to reflect efficient cost of supply but can be differentiated only on grounds specified in Section 62(3).

- Cross subsidies to reduce gradually with out tariff shock to consumers
- SERC is required to notify a road map along with intermediate milestones for cross subsidy (reduction) to be within ± 20 % of the average cost of supply.
- The cross subsidies can exist for BPL categories of consumers for life line consumption but consumption in excess of this lifeline consumption is to be charged at full cost. Paying capacity can be one of the factors for determination of tariff payable by BPL categories. The tariffs payable for this lifeline consumption should be 50% of the average cost of supply.
- The State Government can provide subsidy to any disadvantaged consumer groups for increased access to electricity provided that this subsidy amount is provided in advance as per the Section 65 of the EA 2003.

4. METHODOLOGY FOR DETERMINATION OF COST OF SERVICE

4.1 Linkage of Tariffs with Cost of Supply

4.1.1 The amount of cross subsidy received/contributed by various consumer categories is dependent on the way the cost of supply is defined. Accordingly Cost of supply can be defined as:

- Average cost of supply;
- Cost of supply voltage wise; and
- Cost of supply to various consumer categories

4.1.2 Depending upon the definition adopted for cost of supply, the cross subsidy reduction may accordingly be different. The EA 2003, the NEP and the NTP requires the tariffs to reflect efficient cost of supply and while determining tariff as required by section 61(c) of the EA 2003 the SERC needs to consider factors which would encourage competition, promote efficiency, economical use of the resources, good performance and optimum investments section.

4.1.3 Though the term Cost of Supply has not been defined explicitly in the legal and policy framework but from the simultaneous reading of the Electricity Act 2003, NEP and particularly the clause 8.5 of the TP, the cost of supply can be construed to mean the cost of supply to the relevant consumer category. It has also been proven in economic theory that tariffs that reflect the cost of supply to the consumer category provide economic signals for the optimum use of electricity and investment in the sector. Further cost reflecting prices will be fair to consumers receiving the supply at higher voltages as the cost of supply at higher voltages is lower than the cost of supply at lower voltages, on account of higher distribution losses at lower voltages, and the incidence of costs getting passed on to the lower voltages since energy flows from higher to lower voltages.

4.1.4 The cost of supply to consumer categories can be determined either on the Embedded (Historical) cost or marginal cost approach basis. Usually, the approach adopted by many SERC's and utilities is to consider the average cost of supply method to calculate the Cross Subsidy as the data required to calculate the cost of

supply category wise and voltage wise is not available. However, the average cost of supply is not the efficient way of determination of cost of supply.

4.1.5 Every approach has its Pros and Cons whereby the Embedded cost based methodology uses the historical accounting information for cost determination whereas the marginal cost based methodology uses the future costs to determine tariffs. The first methodology ensures that all the prudent costs of the Licensees are allocated but does not provide any economic signal to the consumers of the future costs. The second methodology based on marginal cost provides economic signal for economically efficient investments and optimum use of electricity but it does not ensure the recovery of entire costs (particularly when the past costs are higher than the future costs) and may require some adjustment in the tariffs for recovery of the actual cost.

4.1.6 Given the current regulatory regime (MYT framework is based on historical cost), lack of reliable information and generation & system planning studies, it would be desirable to use historical costs for cost of supply determination in the near future. The interim period (during the period embedded cost approach is used) to conduct studies so that marginal cost can latter be used. The switch from embedded cost to marginal cost approach will be easier as the two approaches have similar cost allocation principles.

4.1.7 It is submitted that for calculation of voltage wise cost it is important that the accounting system of the Licensees are sufficient enough to capture the costs voltage wise at the point of origin as and when these are incurred. However, since at current stage it is not possible, an assumption is considered for the allocation of expenses and calculation of diversity factor.

4.1.8 To determine the cost of supply voltage wise, getting voltage wise cost right is the first step in determining consumer wise costs. However, the availability of voltage wise accurate data is one of the key issues and again a certain assumption has been carried out.

4.1.9 Usually, the traditional approach adopted for calculation of cost of supply is using 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.

4.1.10 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. However, it suffers from the lacunae of not accounting for the inflation and also true economic cost of the electricity delivered to consumer.

4.1.11 Considering the above highlighted issues, a systematic approach to the CoS study shall involve three steps of functionalisation, classification and allocation of costs to various customer categories.

4.2 **Functionalisation of Costs:**

4.2.1 The first stage of a cost of service study shall involve functionalisation of all the costs of the TANGEDCO to various functions such as power generated, purchased and distribution (termed as “Functionalisation”).

4.2.2 It is relatively easy to capture these costs from the books of accounts as the chart of accounts maintained by the company would provide for capture of these assets/costs separately. Within the assets and costs it is however, difficult to capture the voltage class wise assets and costs as the accounts of company does not capture this information. But TANGEDCO has carried out the assessment of the fixed assets voltage wise and therefore a data will be collected on a sample basis based on the information available. This will enable TANGEDCO to bifurcate its assets and costs as relating to LT network and HT network. This logic has been largely used for functionalization of assets and costs for this exercise

4.2.3 The power purchase costs include the costs of transmission of power from the generating stations to the transmission-distribution interface point. Also, though TANGEDCO is carrying the generation and distribution function, the expenses related to State own Generating station such as Fuel is considered as variable charges in

power purchase cost and the other cost has been added with the expenses of distribution. Also, the transmission cost has been considered in the fixed cost of power purchase for last 5 months of FY 2010-11 and an initial expense during the time of erstwhile TNEB has been considered in the respective head of account.

4.3 **Classification of Costs:**

4.3.1 The costs are classified as being demand, energy or customer/service related. Such a classification is done on the basis of the cause of such costs, as specified below:

- Costs which are triggered by peak demands imposed on the system are classified as "demand related";
- Cost related to level of power purchase as "energy related" and
- Cost related to number and type of customers as "customer related".

4.3.2 *Classification of Generation and Power Purchase Costs*

4.3.2.1 Generation Costs and Power Purchase cost are identified to be energy as well as demand related as TANGEDCO shall not only supply the energy required over a period of time but shall generate or purchase sufficient capacity to meet the peak demand of the system.

4.3.2.2 Power purchase cost generally will have two elements i.e., fixed cost and variable cost. The fixed cost include costs associated with the plant capacity i.e. depreciation, interest relating to capital investment for the plant, income tax, rate of return etc. They are treated as demand related. Fuel cost, fuel related costs are treated as variable or energy related costs.

4.3.2.3 The method to be adopted for generation cost classification is explained below:

- System Load Factor Approach - treats all the generation costs in proportion to the system load factor as energy related and the remaining as demand related.
- Average Approach - classifies fixed costs of generation into demand and energy related using an arbitrary ratio, say 50:50. The variable costs are classified as energy costs.
- Marginal Cost Approach - usually takes into account market prices of capacity and energy to classify fixed as well as variable costs.

- Specific Resource Approach - uses different classification approach for each resource (or plant); say 100% demand related for peaking units.
- Specific Expenditure Approach - classifies each expenditure item using one of the above methods.

4.3.2.4 However, the method to be adopted will be finalised based on the availability and the quality of the data.

4.3.3 *Classification of Transmission Costs*

4.3.3.1 The transmission system is designed to handle certain peak demand and as such the costs are fixed in nature & as such they can be entirely treated as demand related. the methods of classification are as follows –

- 100% Demand Related – Simple but ignores that some of the transmission investment is made partly to facilitate energy transfer from generating stations or import/export of energy ;

4.3.4 *Classification of Distribution Costs*

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

- Distribution related components like meters could be considered 100% consumer related;
- Distribution assets that are used by a single consumer (e.g., Service Lines) and cost associated with it could be classified as entirely consumer related;
- 100% Demand Related - classifies all other costs as entirely demand related on the rationale that distribution networks are set up to meet the local maximum demands;
- Partly Demand and Customer Related - attempts to work out appropriate ratios for each component of distribution costs for classification into demand related and customer related costs;

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

4.3.4.3 The distribution costs such as repair and maintenance, employee cost & administrative and general expenses have been equally apportioned (50:50) into customer cost and demand related costs, as these vary with the number and the type of customer 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 cater and not on number of consumers.

Table 1: Cost Classification and Functionalisation

Cost Classification	Explanation
Demand	Triggered by peak demands and Fixed in nature
Energy	Vary with volume of energy increased
Customer	Depend on number and type of consumer served

Functions	Cost Classification
Power Purchase	Demand Related Energy Related
Transmission	Demand Related
Distribution	Demand Related Consumer Related

4.3.5 Demand related costs will include a major portion of deprecation, interest on capital borrowings, income tax, RoR etc. Customer related costs generally include R&M expenses, Employee costs, A&G expenses, Bad debts, interest on consumer security deposits & other debits that are directly attributable to consumers.

4.3.6 Unless a detailed study of each these costs and their relation to demand, energy and customer functions are identified, true classification of costs may not possible. However, for the purpose this study, given the constraints, an effort has been made to properly classify the costs. Classification of fixed assets is generally made on the basis of nomenclature of the fixed assets and judgement.

4.3.7 It is submitted that there are no set of prescribed rules for functionalisation and classification of costs. It depends on the experience and judgement of the utility to classify costs in the best manner possible.

4.4 **Allocation of Costs:**

4.4.1 The functionalised and classified costs are then allocated to various customer classes of the utility based on allocation factors derived from demand, consumption of energy and number of customers such as Energy usage and a measure of demand (peak, average etc.), Load Pattern, etc. Such allocation arrives at the cost of service for each customer class.

4.4.2 The classified costs may be allocated on the basis on time differentiated allocation factors. The energy and demand related costs are split into several costing periods. The energy usage and a measure of demand (peak, average etc.) within such periods form the basis for allocation of costs.

4.4.3 The total revenue from each of the customer 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.

4.4.4 **Load profile of each category of consumers**

4.4.4.1 In developing the profile, the following activities are required to be considered:

- Identification of typical load curves for each consumer category across the company. This will be done on the basis of selection of statistically significant samples to eliminate geographical bias. This would be used to analysis the load curves, duration and consumption pattern, which can then be extrapolated to the population.
- Based on load curves, load duration and consumption of particular feeder, a profile of a particular consumer category is assessed.
- Determination of coincident peak demands for various categories will be carried out. This is a method wherein the coincidences of the consumer category peak demand to that of TANGEDCO coincident demand at the time of system peak for the State as a whole.

4.4.5 **Diversity Factor**

4.4.5.1 Diversity factor is the ratio of peak demand to connected/contracted load.

4.4.5.2 The sample feeders need to be identified for arriving at diversity factors for Residential, LT Industrial, Public Water Works and Agricultural categories. The diversity factor has been assumed for many categories based on the number of hours of consumption and the power supply position.

4.4.6 *Allocation of Demand Related Costs*

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

4.4.6.2 Range of Methods-

- Co-incident Peak Contribution

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

- Non-Coincident Peak

  The non - coincident demand may be defined as the demand in MW for each category of customer 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 customer category will be greater than the peak demand of the system.

- Average and Excess

  This method allocates demand related cost to the customer 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.

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/ S Category Excess Demand) * (1 – System Load Factor)

4.4.6.3 Choice of Methods

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

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, in case the data with regards to the category co-incident peak are not available, the Average and Excess method as discussed earlier will be considered as a suitable alternative.

Demand related other distribution costs

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

Demand related Total Distribution costs

- Allocation factors for demand related total distribution costs will be worked out based on weightages of power purchase and other distribution costs.

4.4.7 *Allocation of Energy Related Costs*

Energy related costs shall be allocated in the ratio of energy consumed by the customer classes. The energy consumed shall include sales to categories and allocated losses to such categories.

4.4.7.1 **Allocation of Losses**

Though sales to each of the classes shall be easily available, but allocation of losses shall require considerable judgment. The allocation of technical losses is largely dependent upon the voltage at which a customer category is connected. However, before allocating technical losses, commercial losses shall be allocated to various categories. The technical losses shall then be allocated in the ratio of sales plus commercial losses for a category.

Determination of Technical & Commercial Losses

The total transmission and distribution losses of TANGEDCO for FY 2010-11 were 20.91% including both technical and commercial losses. Distribution Losses (Total Losses -Transmission Losses) shall be broken up into technical and commercial losses. Technical Losses shall be further broken up into HT and LT level losses.

Allocation of Commercial Losses

Commercial losses are determined as the difference between total losses and technical losses. The commercial losses shall be allocated to the customer categories in ratio of sales. Thus, no commercial losses shall be allocated to the energy transferred at lower voltage level as the consumers using such energy are not responsible for commercial losses at the higher voltage.

Allocation of Technical Losses

Technical losses at HV and LV levels are allocated to the categories in ratio of sales to customer categories connected at that voltage and energy transferred to the

immediate lower voltage level.

The above method for allocation of technical losses shall be done in two steps.

- Firstly, the losses shall be 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 shall be allocated to the respective categories in the ratio of category sales.

4.4.8 *Allocation of Customer related Costs*

Customer 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 customers in a particular category, vary significantly with across categories. For instance, the per customer servicing costs for HT Industrial category will be much higher than that for a Residential category customer.

Category-wise Customer Weightages

4.4.8.1 To address the variance in per customer service costs across categories, category wise weight-ages shall be derived to determine allocation factors for customer-related costs.

4.4.8.2 The weight-ages shall be a function of two parameters - Sales per Customer and Load per Customer.

4.4.8.3 The average of these two ratios for each category shall give the 'Category Wise Customer Weightage'.

4.4.8.4 The minimum & maximum limit for such ratios will be set at 1 and 200 respectively. The average of these two ratios for each category gives the 'Category Wise Customer Weightage'.

4.5 **Approach for segregation of cost**

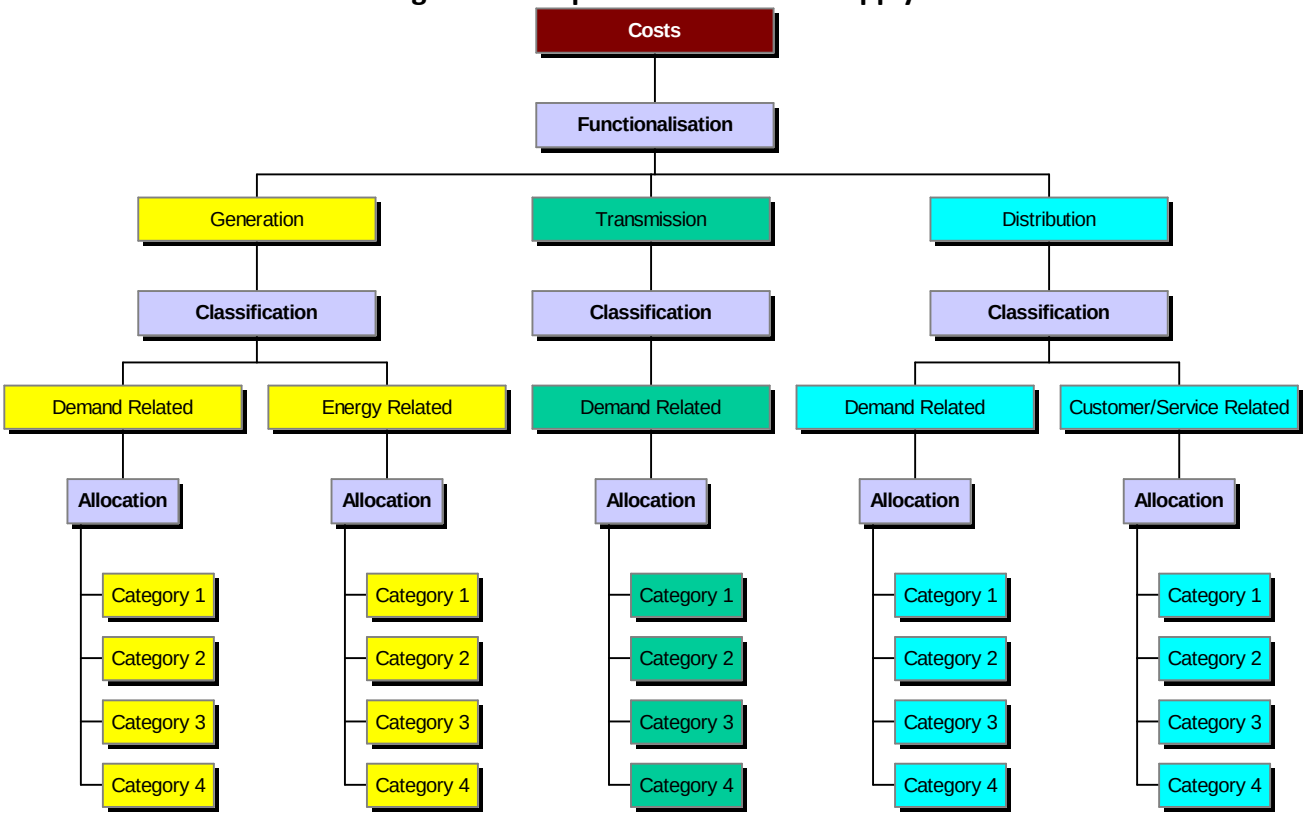
4.5.1 Cost of service study may also be conducted using forecasts for costs, customer data

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.

4.5.2 The methods for functionalisation, 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.

4.5.3 The Figure given below indicates the flowchart for Cost of Service study;

Figure 1: Computation of Cost of Supply



4.6 Basis for determination of Cost to Service

4.6.1 Cost for FY 2010-11

4.6.1.1 Even though TANGEDCO has come into existence from 1st November 2010 due to segregation of erstwhile TNEB and as per the provisional transfer scheme notified by GoTN on 19th October 2010 and 2nd January 2012, for calculation of

Cost of Supply, the financial data related to whole FY 2010-11 is considered by clubbing Profit & Loss account for 7 months and 5 months.

4.6.1.2 Costs as per audited accounts of FY 2010-11 shall be taken as the base for determination of category wise cost of service for TANGEDCO;

4.6.1.3 The revenue from sale of power to other States and Puducherry has been adjusted in the variable cost of power purchase and therefore the Revenue from such sale of power to Other States and Puducherry has been deducted from variable cost to determine the exact cost to be allocated to consumers.

4.6.1.4 Such costs shall be broken up into Generation, Power Purchase, Transmission and Distribution costs. The details of the cost to be allocated for FY 2010-11 has been identified as below:

Table 2: Profit & Loss Statement for FY 2010-11

PROFIT & LOSS STATEMENT

(Rs. in Crores)

Sr. No.	Particulars	MUs	2010-11
	INCOME		
1	Revenue	58,446.15	20,644.42
2	Non-Tariff Income		544.29
3	Other Income		452.33
4	Sale to Other States and Puducherry		
	Total Income	**58,446.15**	**21,641.04**
	EXPENDITURE		
5	**Cost of Power Purchased**	**73,961.57**	**25,143.15**
	'- Fixed Power Purchase Cost		3,453.91
	'- Variable Power Purchase Cost		21,901.43
	Less: Sales to Other States and Puducherry		(212.18)
6	**Other Expenditure**		**8,914.53**
	Operation & Maintenance Expenses		4,495.89
	Depreciation		786.14
	Interest and Financial Charges		3,591.15
	Provision for bad debt		41.34
	Income Tax		
	Expenses Capitalized		351.17
7	**Total EXPENDITURE (4+5)**		**33,706.51**
8	Return on Equity		356.69
	Net prior period charges/Credit		848.66
9	**Profit/Loss before tax (6-11)**		**(13,270.82)**

4.6.2 Category wise sales and revenue

4.6.2.1 The tariff categories wise sales have been regrouped in the following categories –

Table 3: Consumer Category of TANGEDCO

Particulars	
HT	Category
I-A	Industries
I-B	Railway Traction
II-A	Govt. Educational Institution etc.
II-B	Private Educational Inst. Etc
II-C	Place of Worship
III	Commercial
IV	Lift Irrigation
LT	Category
I-A	Domestic
I-C	LT bulk supply
II-A	Public Lighting and Water Supply
II-B-1	Govt. & Govt. Aided Education Institutions etc.
II-B-2	Private College etc
IIC	Places of Public Worship
IIIA 1	Cottage and Tiny Industries
IIIA 2	Power Looms
IIIB	L.T. Industries
V	L.T. Commercial
VI	Temporary supply

4.6.3 Transmission and Distribution Losses

4.6.3.1 Transmission and Distribution losses will be bifurcated into technical and commercial losses as explained in para 4.4.7.1.

5. DEFINITIONS

5.1 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.

5.2 Co-incident Peak Demand[1]

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

5.3 Non Co-incident Peak Demand[2]

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.

5.4 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 customer categories.

5.5 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.

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[1] **Coincident Peak Demand for each category** – TANGEDCO 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).

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

5.6 **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.

5.7 **Category Load Factor**

The ratio of the average demand to non co-incident 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.

5.8 **Diversity Factor**

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

6. CALCULATION OF EXPENSES

Classification of costs involves identification of costs as demand related, energy related and customer 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. Customer costs vary according to the number and type of customers.

6.1 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 TANGEDCO comprises of fixed and variable charges whereby the cost of generation of own generating station as specified in the profit & loss account has been considered as variable cost. Also, the power purchase cost has been segregated in variable cost and the fixed cost of the total power purchase cost[3]. The fixed cost is classified as demand related whereas the variable as energy related.

Table 4 – Classified Power Purchase Expenses for FY 2010-11

Rs. in Crores

Particulars	Power Purchase Cost	Demand Related	Energy Related	Customer Related
Power Purchase Cost				
- Fixed Cost	3,454	3,454	-	-
- Variable Cost	21,689	-	21,689	-
Classified Power Purchase Costs	**25,143**	**3,454**	**21,689**	**-**

6.2 Classification of Other Distribution Expenses

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

[3] 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 2010-11.

customer related.

Distribution costs other than those entirely customer 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 demands.

- Partly demand and partly customer related approach attempts to work out appropriate ratios for each component of distribution costs for classification into demand related and customer 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 customers. Hence, a component of customer related distribution cost exists.

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

Table 5: Classified Distribution Expenses

Rs. in Crores

Categories	2010-11	Classification		
		Demand Related	Energy Related	Customer related
Low Tension				
Operation & Maintenance Expenses	4,495.89	2,247.95	-	2,247.95
Depreciation	786.14	786.14	-	
Interest and Financial Charges	3,591.15	3,591.15	-	
Provision for bad debt	41.34	41.34	-	
Income Tax	0.00	0.00	-	
Total Expenditure (1 to 5)	8,914.53	**6,666.58**	**-**	**2,247.95**
Return on Equity	356.69	356.69		
Expenses Capitalized	**351.17**	**175.59**	**-**	**175.59**
Classified Distribution Costs	8,920.05	6,847.69	-	2,072.36

The distribution costs such as repair and maintenance, employee cost & administrative and general expenses have been equally apportioned (50:50) into customer cost and demand related costs, as these vary with the number and the type of customer 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

6.3 Allocation of demand related cost

6.3.1 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 6: Category-wise Average & Excess Demand (MW)

MW

Categories	Non Coincident Demand	Average Demand	Excess Demand
Low Tension	22,333.46	5,862.21	16,471.25
LT I A- Domestic, handloom,Nutirition centres etc.	11,240.84	2,495.43	8,745.41
LT I B-Huts services	72.22	54.52	17.70
LT I C -LT Bulk supply,Railway colonies, Defence colonies etc.	2.73	2.28	0.45
LT II A- Local body(Village panchayat,town panchayat, Muncipality &corporation)	336.52	247.16	89.37
LT II B(1)-Govt.Educational Instititions	44.09	31.33	12.76
LT II B(2)-Private Educational Institutions	94.49	47.00	47.49
LT II C-Place of public worship	48.04	15.11	32.93
LT III A(1)-Cottage &tiny Industries	116.04	104.03	12.01
LT III A(2)-Power loom	289.53	126.29	163.24
LT III B- Industries	3,981.21	623.81	3,357.40
LT IV-Agriculture	2,688.84	1,445.10	1,243.74
LT V-Commercial	3,414.01	667.09	2,746.93
LT VI-Temporary supply	4.89	**3.07**	**1.82**
High Tension	5,387.76	2,575.18	2,812.58
Industries	4,374.69	2,116.83	2,257.86
HT I B-Railway Traction	186.58	47.32	139.27
HT II A-Govt.educational Institutions	49.65	45.99	3.67
HT II B-Private EducationalInstitutions, Hostels	173.78	107.30	66.48
Worship	5.71	4.53	1.18
HT III - Commercial	591.76	251.00	340.77
HT IV- Lift Irrigation and cooperative societies	5.58	2.22	3.36
Total	27,721.22	8,437.39	19,283.83

Based on the above allocation of category-wise average and excess demand, the allocation factor has been determined for demand related power purchase costs as outlined in the following table:

Table 7 - Allocation Factors for Demand Related Power Purchase Costs

Categories	Average Demand Component for Allocation (%)	Excess Demand Component for Allocation (%)	Total Allocation Factor (%)
Low Tension	**56.78%**	**15.62%**	**72.39%**
LT I A- Domestic, handloom,Nutirition centres etc.	24.17%	8.29%	32.46%
LT I B-Huts services	0.53%	0.02%	0.54%
LT I C -LT Bulk supply,Railway colonies, Defence colonies etc.	0.02%	0.00%	0.02%
LT II A- Local body(Village panchayat,town panchayat, Muncipality &corporation)	2.39%	0.08%	2.48%
LT II B(1)-Govt.Educational Instititions	0.30%	0.01%	0.32%
LT II B(2)-Private Educational Institutions	0.46%	0.05%	0.50%
LT II C-Place of public worship	0.15%	0.03%	0.18%
LT III A(1)-Cottage &tiny Industries	1.01%	0.01%	1.02%
LT III A(2)-Power loom	1.22%	0.15%	1.38%
LT III B- Industries	6.04%	3.18%	9.22%
LT IV-Agriculture	14.00%	1.18%	15.18%
LT V-Commercial	6.46%	2.60%	9.07%
LT VI-Temporary supply	0.03%	0.00%	0.03%
High Tension	**24.94%**	**2.67%**	**27.61%**
Industries	20.50%	2.14%	22.64%
HT I B-Railway Traction	0.46%	0.13%	0.59%
HT II A-Govt.educational Institutions	0.45%	0.00%	0.45%
HT II B-Private EducationalInstitutions, Hostels	1.04%	0.06%	1.10%
Worship	0.04%	0.00%	0.04%
HT III - Commercial	2.43%	0.32%	2.75%
HT IV- Lift Irrigation and cooperative societies	0.02%	0.00%	0.02%
Total	**81.72%**	**18.28%**	**100.00%**

6.3.2 Demand related other distribution costs

The distribution network services local maximum demands and investments are triggered by the local (in other words, non co-incident) peaks in demand. Therefore, the category wise non co-incident peak demand for each class is the most appropriate basis for allocation of demand related other distribution costs. The same is outlined in Table 8.

Table 8 - Allocation factors for Demand Related Other Distribution Costs

Particulars	Allocation Factors
Low Tension	**80.56%**
LT I A- Domestic, handloom,Nutirition centres etc.	40.55%
LT I B-Huts services	0.26%
LT I C -LT Bulk supply,Railway colonies, Defence colonies etc.	0.01%
LT II A- Local body(Village panchayat,town panchayat, Muncipality &corporation)	1.21%
LT II B(1)-Govt.Educational Instititions	0.16%
LT II B(2)-Private Educational Institutions	0.34%
LT II C-Place of public worship	0.17%
LT III A(1)-Cottage &tiny Industries	0.42%
LT III A(2)-Power loom	1.04%
LT III B- Industries	14.36%
LT IV-Agriculture	9.70%
LT V-Commercial	12.32%
LT VI-Temporary supply	0.02%
High Tension	**19.44%**
Industries	15.78%
HT I B-Railway Traction	0.67%
HT II A-Govt.educational Institutions	0.18%
HT II B-Private EducationalInstitutions, Hostels	0.63%
Worship	0.02%
HT III - Commercial	2.13%
HT IV- Lift Irrigation and cooperative societies	0.02%
Total	**100.00%**

6.3.3 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 Table 9.

Table 9 - Allocation factors for Demand Related Total Distribution Costs

Particulars	Demand Related Allocation
Low Tension	**77.93%**
LT I A- Domestic, handloom,Nutirition centres etc.	37.94%
LT I B-Huts services	0.35%
LT I C -LT Bulk supply,Railway colonies, Defence colonies etc.	0.01%
LT II A- Local body(Village panchayat,town panchayat, Muncipality &corporation)	1.62%
LT II B(1)-Govt.Educational Instititions	0.21%
LT II B(2)-Private Educational Institutions	0.39%
LT II C-Place of public worship	0.17%
LT III A(1)-Cottage &tiny Industries	0.61%
LT III A(2)-Power loom	1.15%
LT III B- Industries	12.71%
LT IV-Agriculture	11.46%
LT V-Commercial	11.27%
LT VI-Temporary supply	0.02%
High Tension	**22.07%**
Industries	17.99%
HT I B-Railway Traction	0.65%
HT II A-Govt.educational Institutions	0.27%
HT II B-Private EducationalInstitutions, Hostels	0.78%
Worship	0.03%
HT III - Commercial	2.33%
HT IV- Lift Irrigation and cooperative societies	0.02%
Total	**100.00%**

6.4 Allocation of Energy related cost

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

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 customer 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.

6.4.1 Determination of Technical and Commercial Losses

The total distribution loss of TANGEDCO is 20.91% including both technical and commercial losses which are considered in line with the tariff petition and includes transmission and distribution loss. The technical losses of TANGEDCO distribution system are 18.12%. The technical losses on the basis of actual network data are broken up into HT and LT level

losses whereby balance LT technical loss is considered as 80% of the balance loss and accordingly the HT losses are 6.95% and LT losses are 11.17%. The remaining losses are taken commercial distribution losses. The breakup of the same is as below –

Table 10 – Losses at TANGEDCO for FY 2010-11

Total Technical Losses	**18.12%**
HT	6.95%
LT	11.17%
Total Commercial Losses	**2.79%**
Total Losses in the system	**20.91%**

6.4.2 Allocation of Commercial Losses

Commercial losses are determined as the difference between total losses and technical losses. The commercial losses are allocated to the customer categories in ratio of the number of units assessed in theft (category wise). In other words, no commercial losses are allocated for the energy transferred to the lower voltage level, as the consumers using such energy are not responsible for commercial losses at the higher voltage.

Table 11 – Allocation of Commercial Losses

Categories	Sales (MU)	Allocation Factor for Commercial Losses	Commercial Losses (MU)
Low Tension	**38,173**	**65.31%**	**1,348.71**
LT I A- Domestic, handloom,Nutirition centres etc.	16,249	27.80%	574.12
LT I B-Huts services	355	0.61%	12.54
LT I C -LT Bulk supply,Railway colonies, Defence colonies etc.	15	0.03%	0.53
LT II A- Local body(Village panchayat,town panchayat, Muncipality &corporation)	1,609	2.75%	56.86
LT II B(1)-Govt.Educational Instititions	**204**	0.35%	7.21
LT II B(2)-Private Educational Institutions	**306**	0.52%	10.81
LT II C-Place of public worship	98	0.17%	3.48
LT III A(1)-Cottage &tiny Industries	677	1.16%	23.93
LT III A(2)-Power loom	822	1.41%	29.06
LT III B- Industries	4,062	6.95%	143.52
LT IV-Agriculture	9,410	16.10%	332.47
LT V-Commercial	4,344	7.43%	153.48
LT VI-Temporary supply	**20**	0.03%	0.71
High Tension	**20,273**	**34.69%**	**716.30**
Industries	16665	28.51%	588.80
HT I B-Railway Traction	372.5	0.64%	13.16
HT II A-Govt.educational Institutions	362.037	0.62%	12.79
HT II B-Private EducationalInstitutions, Hostels	844.753	1.45%	29.85
Worship	35.65	0.06%	1.26
HT III - Commercial	1976	3.38%	69.82
HT IV- Lift Irrigation and cooperative societies	17.47	0.03%	0.62
Total	**58446.15**	**100.00%**	**2,065.01**

6.4.3 Allocation of Technical Losses

Technical losses at HV and LV levels are allocated to the categories in ratio of sales to customer 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 HV 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.

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 12 – Allocation of Technical Losses

MUs

Particulars	HT	LT	Total
Percent	6.95%	11.17%	**18.12%**
Losses to be allocated	5,140.33	8,260.03	**13,400.36**
LT System			
Sales	0.00	38,172.74	**38,172.74**
Commercial losses	0.00	1,348.71	**1,348.71**
Technical losses	0.00	8,260.03	**8,260.03**
Input to LT System	0.00	47,781.48	**47,781.48**
Allocation of LT Technical Losses	0.00	8,260.03	**8,260.03**
HT System			
Sales	20,273.41	0.00	**20,273.41**
Commercial losses	716.30	0.00	**716.30**
Input to LT System	0.00	47,781.48	**47,781.48**
Input to HT System	20,989.71	47,781.48	**68,771.19**
Technical losses in HT system	5,140.33	0.00	**5,140.33**
Allocation of HT Technical Losses	1,568.88	3,571.45	**5,140.33**
-			
Technical Losses Allocated to Customer Categories	**1,568.88**	**11,831.47**	**13,400.36**

Based on the above allocation of technical and commercial losses, the detailed allocation of losses to each category of consumers is outlined below:

Table 13 – Allocation of Losses to categories

Categories	Sales (MU)	Commercial Losses (MU)	Technical Losses (MU)	Total Energy Input into the system (MU)
Low Tension	**38,172.74**	**1,348.71**	**11,831.47**	**51,352.93**
LT I A- Domestic, handloom,Nutirition centres etc.	16,249.41	574.12	5,036.43	21,859.96
LT I B-Huts services	355.00	12.54	110.03	477.57
LT I C -LT Bulk supply,Railway colonies, Defence colonies etc.	14.86	0.53	4.61	19.99
LT II A- Local body(Village panchayat,town panchayat, Muncipality &corporation)	1,609.40	56.86	498.83	2,165.09
LT II B(1)-Govt.Educational Instititions	204.02	7.21	63.24	274.47
LT II B(2)-Private Educational Institutions	306.04	**10.81**	**94.85**	**411.70**
LT II C-Place of public worship	98.36	3.48	30.49	132.32
LT III A(1)-Cottage &tiny Industries	677.42	23.93	209.96	911.32
LT III A(2)-Power loom	822.35	29.06	254.88	1,106.29
LT III B- Industries	4,062.06	143.52	1,259.02	5,464.60
LT IV-Agriculture	9,410.00	332.47	2,916.59	12,659.06
LT V-Commercial	4,343.84	153.48	1,346.35	5,843.67
LT VI-Temporary supply	19.98	**0.71**	**6.19**	**26.88**
High Tension	**20,273.41**	**716.30**	**1,568.88**	**22,558.59**
Industries	16,665.00	588.80	1,289.64	18,543.45
HT I B-Railway Traction	372.50	13.16	28.83	414.49
HT II A-Govt.educational Institutions	362.04	12.79	28.02	402.85
HT II B-Private EducationalInstitutions, Hostels	844.75	29.85	65.37	939.97
Worship	35.65	1.26	2.76	39.67
HT III - Commercial	1,976.00	69.82	152.92	2,198.73
HT IV- Lift Irrigation and cooperative societies	17.47	0.62	1.35	19.44
Total	**58,446.15**	**2,065.01**	**13,400.36**	**73,911.52**

6.4.4 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 14: Allocation Factors for Energy Related Costs

Particulars	2010-11 Allocation Factors
Low Tension	**69.48%**
LT I A- Domestic, handloom,Nutirition centres etc.	29.58%
LT I B-Huts services	0.65%
LT I C -LT Bulk supply,Railway colonies, Defence colonies etc.	0.03%
LT II A- Local body(Village panchayat,town panchayat, Muncipality &corporation)	2.93%
LT II B(1)-Govt.Educational Instititions	0.37%
LT II B(2)-Private Educational Institutions	0.56%
LT II C-Place of public worship	0.18%
LT III A(1)-Cottage &tiny Industries	1.23%
LT III A(2)-Power loom	1.50%
LT III B- Industries	7.39%
LT IV-Agriculture	17.13%
LT V-Commercial	7.91%
LT VI-Temporary supply	0.04%
High Tension	**30.52%**
Industries	25.09%
HT I B-Railway Traction	0.56%
HT II A-Govt.educational Institutions	0.55%
HT II B-Private EducationalInstitutions, Hostels	1.27%
Worship	0.05%
HT III - Commercial	2.97%
HT IV- Lift Irrigation and cooperative societies	0.03%
Total	**100.00%**

6.5 Allocation of Customer Related Costs

Customer 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 customers in a particular category, vary significantly with across categories. For instance, the per customer servicing costs for HT Industrial category will be much higher than that for a Residential category customer.

6.5.1 Category Wise Customer Weightages

To address the variance in per customer service costs across categories, category

wise weight-ages have been derived to determine allocation factors for customer-related costs. The weight-ages are a function of two parameters - Sales per Customer and Load per Customer. 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 Customer Weightage'.*

Table 15: Category wise Customer Weightage

Categories	Connected Load (MW)	Consumers	Sales	Weight (sales/ consumer)	Weight (load/ consumer)	Average Weight
Low Tension	**39,395.13**	22,611,491	**38,173**	-		
LT I A- Domestic, handloom,Nutirition centres etc.	18,734.74	15,056,087	16,249	1.00	1	1.00
LT I B-Huts services	120.36	1,467,708	355	1.00	1	1.00
LT I C -LT Bulk supply,Railway colonies, Defence colonies etc.	4.56	1,010	15	5.69	1	3.35
LT II A- Local body(Village panchayat,town panchayat, Muncipality &corporation)	807.65	466,024	1,609	1.34	1	1.17
LT II B(1)-Govt.Educational Instititions	151.18	45,973	204	1.72	1	1.36
LT II B(2)-Private Educational Institutions	226.77	68,960	306	1.00	1	1.00
LT II C-Place of public worship	144.12	131,869	98	1.00	1	1.00
LT III A(1)-Cottage &tiny Industries	198.93	**57,077**	**677**	**4.59**	**1**	2.80
LT III A(2)-Power loom	496.33	124,026	822.3518	2.57	1	1.78
LT III B- Industries	5,308.29	359,819	4062.064	4.37	1	2.68
LT IV-Agriculture	8,066.53	1,999,237	9409.997	1.82	1	1.41
LT V-Commercial	5,121.02	2,820,301	4343.84	1.00	1	1.00
LT VI-Temporary supply	14.66	13,400	19.98068	1.00	1	1.00
High Tension	**6,612.52**	6,940	**20273.41**			
Industries	5,146.70	5,091	16665	200.00	1	100.50
HT I B-Railway Traction	219.51	21	372.5	200.00	1	100.50
HT II A-Govt.educational Institutions	99.30	127	362.037	200.00	1	100.50
HT II B-Private EducationalInstitutions, Hostels	231.71	297	844.753	200.00	1	100.50
Worship	14.26	6	35.65	200.00	1	100.50
HT III - Commercial	887.64	1,387	1976	200.00	1	100.50
HT IV- Lift Irrigation and cooperative societies	13.39	11	17.47	200.00	1	100.50
Total	**46,007.65**	22,618,431	**58446.15**			

6.5.2 Allocation of Customer Related Costs

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

Table 16 – Allocation Factors for Customer related Costs

Particulars	Allocation Factors
Low Tension	**97.21%**
LT I A- Domestic, handloom,Nutirition centres etc.	60.14%
LT I B-Huts services	5.86%
LT I C -LT Bulk supply,Railway colonies, Defence colonies etc.	0.01%
LT II A- Local body(Village panchayat,town panchayat, Muncipality &corporation)	2.17%
LT II B(1)-Govt.Educational Instititions	0.25%
LT II B(2)-Private Educational Institutions	0.28%
LT II C-Place of public worship	0.53%
LT III A(1)-Cottage &tiny Industries	0.64%
LT III A(2)-Power loom	0.88%
LT III B- Industries	3.86%
LT IV-Agriculture	11.27%
LT V-Commercial	11.27%
LT VI-Temporary supply	0.05%
High Tension	**2.79%**
Industries	2.04%
HT I B-Railway Traction	0.01%
HT II A-Govt.educational Institutions	0.05%
HT II B-Private EducationalInstitutions, Hostels	0.12%
Worship	0.00%
HT III - Commercial	0.56%
HT IV- Lift Irrigation and cooperative societies	0.00%
Total	**100.00%**

7. COST OF SERVICE

7.1 Cost of Service of each Category

Based on the above allocation factors, the cost of service each category has 3 elements, namely –

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

Table 17 - Category wise Total Cost of Service (Rs. Crs)

Particulars	2010-11			
	Demand Related	Energy Related	Customer Related	Total
Low Tension	**7,764.75**	**15,701.35**	**1,807.41**	**25,273.51**
LT I A- Domestic, handloom,Nutirition centres etc.	3,481.62	7,040.30	810.42	11,332.34
LT I B-Huts services	58.43	118.16	13.60	190.20
LT I C -LT Bulk supply,Railway colonies, Defence colonies etc.	2.42	4.89	0.56	7.87
LT II A- Local body(Village panchayat,town panchayat, Muncipality &corporation)	265.84	537.57	61.88	865.29
LT II B(1)-Govt.Educational Instititions	33.85	68.44	7.88	110.17
LT II B(2)-Private Educational Institutions	53.65	108.49	12.49	174.63
LT II C-Place of public worship	19.04	38.50	4.43	61.98
LT III A(1)-Cottage &tiny Industries	109.29	221.00	25.44	355.74
LT III A(2)-Power loom	147.79	298.85	34.40	481.05
LT III B- Industries	989.44	2,000.78	230.31	3,220.53
LT IV-Agriculture	1,627.68	3,291.39	378.88	5,297.96
LT V-Commercial	972.31	1,966.15	226.33	3,164.79
LT VI-Temporary supply	3.37	6.82	0.79	10.98
High Tension	**2,961.18**	**5,987.90**	**689.28**	**9,638.35**
Industries	2,428.62	4,911.00	565.31	7,904.94
HT I B-Railway Traction	63.31	128.03	14.74	206.08
HT II A-Govt.educational Institutions	48.15	97.36	11.21	156.71
HT II B-Private EducationalInstitutions, Hostels	118.23	239.08	27.52	384.83
Worship	4.82	9.75	1.12	15.70
HT III - Commercial	295.39	597.33	68.76	961.48
HT IV- Lift Irrigation and cooperative societies	2.65	5.35	0.62	8.62
Total	**10,725.93**	**21,689.24**	**2,496.69**	**34,911.86**

The above provides the total cost of service of each category. However for calculation of Cost to Serve per consumer, the same is derived on the basis of Per unit (energy, demand or customer as unit) cost of service for each category as under.

Table 18 – Category wise per unit Cost of Service

Particulars	2010-11			
	Demand Related (Rs/Kwh)	Energy Related (Rs/Kwh)	Customer Related (Rs/Kwh)	Total Cost (Rs/Kwh)
Low Tension				
LT I A- Domestic, handloom,Nutirition centres etc.	2.14	4.33	0.50	***6.97***
LT I B-Huts services	1.65	3.33	0.38	***5.36***
LT I C -LT Bulk supply,Railway colonies, Defence colonies etc.	1.63	3.29	0.38	***5.29***
LT II A- Local body(Village panchayat,town panchayat, Muncipality &corporation)	1.65	3.34	0.38	***5.38***
LT II B(1)-Govt.Educational Instititions	1.66	3.35	0.39	***5.40***
LT II B(2)-Private Educational Institutions	1.75	3.55	0.41	***5.71***
LT II C-Place of public worship	1.94	3.91	0.45	***6.30***
LT III A(1)-Cottage &tiny Industries	1.61	3.26	0.38	***5.25***
LT III A(2)-Power loom	1.80	3.63	0.42	***5.85***
LT III B- Industries	2.44	4.93	0.57	***7.93***
LT IV-Agriculture	1.73	3.50	0.40	***5.63***
LT V-Commercial	2.24	4.53	0.52	***7.29***
LT VI-Temporary supply	1.69	3.41	0.39	***5.49***
High Tension				
Industries	1.46	2.95	0.34	***4.74***
HT I B-Railway Traction	1.70	3.44	0.40	***5.53***
HT II A-Govt.educational Institutions	1.33	2.69	0.31	***4.33***
HT II B-Private EducationalInstitutions, Hostels	1.40	2.83	0.33	***4.56***
Worship	1.35	2.74	0.31	***4.40***
HT III - Commercial	1.49	3.02	0.35	***4.87***
HT IV- Lift Irrigation and cooperative societies	1.52	3.06	0.35	***4.93***

7.2 Conclusion

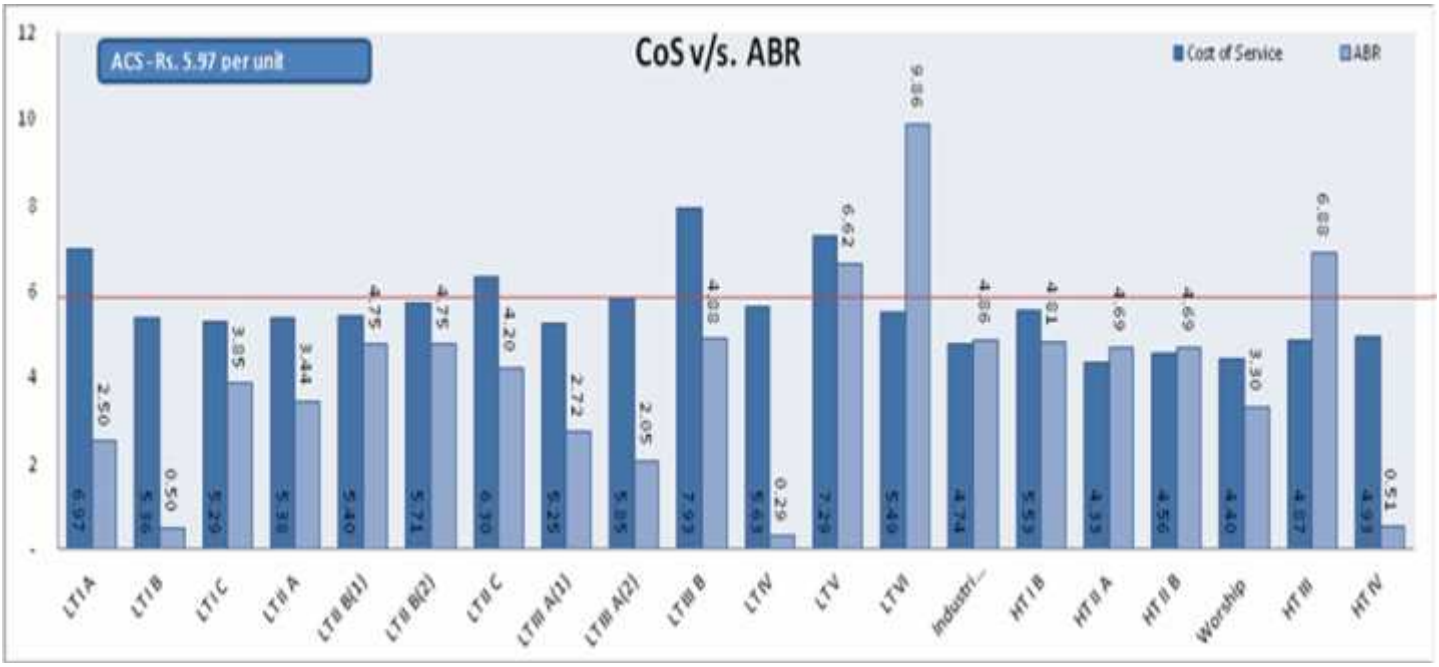
The cost of service study seeks to establish the adequacy of tariffs, category wise cross subsidy in the system and provide a path for elimination of the same. The results of the study also establish the cross subsidy surcharge applicable to open access consumers. The table below compares the cost of service and average realisation.

Table 19 – Cost of Service against Average Realisation

Particulars	Cost of Service (Rs/Kwh)	Average Realisation (Rs/Kwh)	Gap (Rs/Kwh)	Gap %
Low Tension				
LT I A- Domestic, handloom,Nutirition centres etc.	*6.97*	2.50	4.47	178.67%
LT I B-Huts services	*5.36*	0.50	4.85	961.17%
LT I C -LT Bulk supply,Railway colonies, Defence colonies etc.	*5.29*	3.85	1.44	37.45%
LT II A- Local body(Village panchayat,town panchayat, Muncipality &corporation)	*5.38*	3.44	1.94	56.51%
LT II B(1)-Govt.Educational Instititions	*5.40*	4.75	0.65	13.72%
LT II B(2)-Private Educational Institutions	*5.71*	4.75	0.96	20.18%
LT II C-Place of public worship	*6.30*	4.20	2.10	49.94%
LT III A(1)-Cottage &tiny Industries	*5.25*	2.72	2.53	93.28%
LT III A(2)-Power loom	*5.85*	**2.05**	**3.80**	185.16%
LT III B- Industries	7.93	4.88	3.05	62.36%
LT IV-Agriculture	5.63	0.29	5.34	1814.85%
LT V-Commercial	7.29	6.62	0.67	10.08%
LT VI-Temporary supply	5.49	9.86	(4.37)	-44.29%
High Tension				
Industries	4.74	4.86	(0.11)	-2.32%
HT I B-Railway Traction	5.53	4.81	0.72	14.97%
HT II A-Govt.educational Institutions	4.33	4.69	(0.36)	-7.68%
HT II B-Privat+B2e EducationalInstitutions, Hostels	4.56	4.69	(0.13)	-2.84%
Worship	4.40	3.30	1.10	33.38%
HT III - Commercial	4.87	6.88	(2.01)	-29.28%
HT IV- Lift Irrigation and cooperative societies	4.93	0.51	4.42	858.16%

The graph below shows category-wise cost of service and average realisation of TANGEDCO for FY 2010-11.

Figure 2 - Category Wise COS and Average Realization



8. WAY FORWARD

8.1 Way forward

Considering the study undertaken to determine the Cost to Serve categorywise and voltagewise, the following conclusion will be able to be derived:

- Result into a movement towards the actual cost to serve pricing principle and will introduce transparency in rate designing and hence in subsidy/ cross subsidy assessment;
- Special attention may be shifted for allocating power purchase costs;
- Modify the total cost of power purchase on account of agriculture consumers considering the average voltage deviations beyond permissible limit
- Aggregating the penalty levied on licensees due to poor quality supply and, thereby, moderating the power purchase cost
- Will be useful for use of appropriate load curves and load research study for assessment of power demand of consumer class
- Need to change the assets/expenditure accounting practices whereby Utilities will have to maintain the voltage wise inventory of assets

ANNEXURE A - Category Wise Non Coincident Demand

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

Table A1 – Category Wise Non-coincident Demand

Categories	Connected Load (MW)	Diversity Factor (%)	Non Coincident Peak Demand
Low Tension	**39,395.13**		**22,333.46**
LT I A- Domestic, handloom,Nutirition centres etc.	18,734.74	60.00%	11,241
LT I B-Huts services	120.36	60.00%	72.22
LT I C -LT Bulk supply,Railway colonies, Defence colonies etc.	4.56	60.00%	2.73
LT II A- Local body(Village panchayat,town panchayat, Muncipality &corporation)	807.65	41.67%	336.52
LT II B(1)-Govt.Educational Instititions	151.18	29.17%	44.09
LT II B(2)-Private Educational Institutions	226.77	41.67%	94.49
LT II C-Place of public worship	144.12	33.33%	48.04
LT III A(1)-Cottage &tiny Industries	198.93	58.33%	116.04
LT III A(2)-Power loom	496.33	58.33%	289.53
LT III B- Industries	5,308.29	75.00%	3,981.21
LT IV-Agriculture	8,066.53	33.33%	2,688.84
LT V-Commercial	5,121.02	66.67%	3,414.01
LT VI-Temporary supply	14.66	33.33%	4.89
High Tension	**6,612.52**		**5,387.76**
Industries	5,146.70	85.00%	4,374.69
HT I B-Railway Traction	219.51	85.00%	186.58
HT II A-Govt.educational Institutions	99.30	50.00%	49.65
HT II B-Private EducationalInstitutions, Hostels	231.71	75.00%	173.78
Worship	14.26	40.00%	5.71
HT III - Commercial	887.64	66.67%	591.76
HT IV- Lift Irrigation and cooperative societies	13.39	41.67%	5.58
Total	**46007.65**		**27,721.22**