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Project Report

Facilitating Transparent Retail Tariff Design for the Electricity Sector

Module A:
Developing an optimal methodology to determine accurate costs of power supply

Module B:
Providing a scientific framework for Power Utilities and Regulators to make an informed decision on tariff revisions for residential consumers by factoring in social impact & tariff affordability

28 Februray 2019

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Executive Summary

In 2017-18, India's GDP growth rate was estimated to be 6.7%, making it one of the leading emerging economies in the world. The increasing contribution of each of the sectors has created a unique challenge for the energy sector, especially electricity, to satisfactorily cater to its demands in a sustainable fashion. In 2017, the electricity sector accounted for more than 40%[1] of the overall primary energy resources consumed in the country. This share is likely to increase further. Thus, it is quintessential for the electricity sector to be viable and attractive for the overall sustainability of the economy.

The current Stakeholders of the electricity sector i.e. Policy makers, regulators, utilities and consumers are therefore faced with a gamut of opportunities and challenges. Electricity tariff structures for end users play a critical role in the sustainability of the whole power sector as proper revenue recovery from the consumers for the services availed ensures smooth functioning of the value chain i.e. Distribution, Transmission and Generation.

However, today it is observed that, despite achieving significant progress in other aspects of the power sector, the issues of legacy tariff determination mechanisms such as dependency on average cost of supply, influence of socio-political factors, lack of data availability, high levels of cross-subsidy and imbalanced tariffs have resulted in the inability of DISCOMs to recover sufficient revenue from consumers, resulting in overall financial distress for the sector.

There is an urgent need to determine costs attributable to every consumer category for cost reflective tariff design. For this, there is a pressing need to shift to more advanced methodologies to determine cost of supply from the current practice of Average Cost of Supply, which burdens industrial and commercial consumers. Thus, Module A of the report addresses this issue.

Simultaneously, to ensure that tariffs do not overburden the poorer section of consumers by making the tariffs cost reflective, there is a need to balance the tariffs with the ability to pay. Therefore, Module B of this report discusses approaches to assess the social impact of electricity tariff expenditure on household expenditure. The measurement of appropriate tariff levels that ensure affordability of electricity shall help in better tariff designs for these consumers.

The report concludes with the suggested way forward for all Stakeholders at a National level, State-level and consumer level. The final take-away suggests that there is a strong need for harmonization of policies and Acts and clear directions to States to progress towards cost reflective and affordable tariff. Finally there needs to be a robust action plan which is constantly monitored and evaluated by not only the DISCOM, Regulators and Govt. but also by independent bodies to ensure overall balance.

[1] Source: Energy Statistics 2018, Central Statistics Office-MOSPI

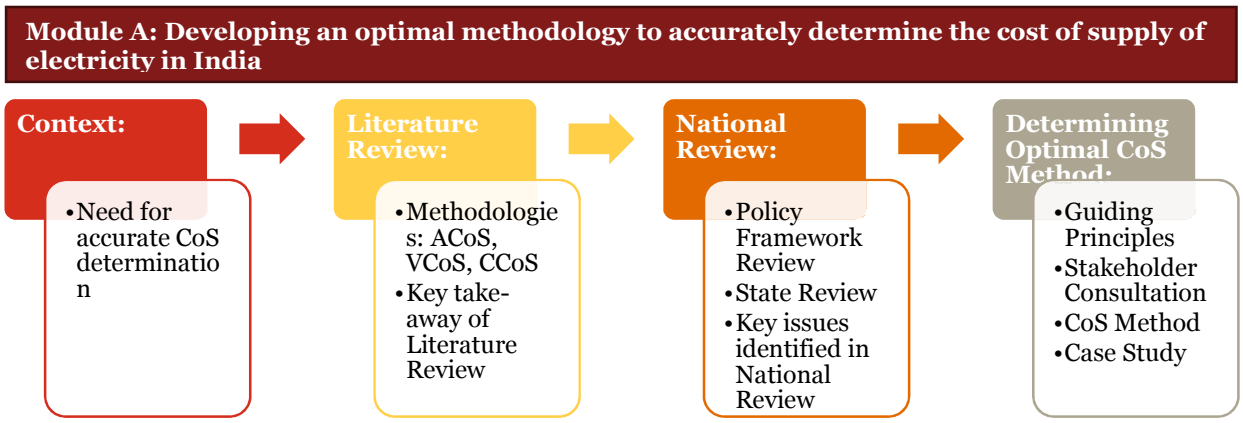


Exhibit 1: Module A-Structure

The following two sections summarize the key activities and take-aways of Module A and Module B:

Module A of this report discusses on developing an optimal methodology to accurately determine the cost of supply of electricity in India. It is structured in the following way:

Literature Review:

The section begins with a review of the currently used methodologies internationally and in India, to ascertain the cost of supply of electricity. Three popular methods emerge from the review:

- **Average Cost of Supply (ACoS)**: The predominant method where the total cost incurred by DISCOM for electricity supply, also known as Annual Revenue Requirement (ARR) is divided by the total energy sale. This method is currently proposed by the National Tariff Policy, and because of its simplicity, most State Commissions direct DISCOMs to set tariffs using this parameter as a benchmark

- **Voltage-wise Cost of Supply (VCoS):** In this method, the power purchase costs and other costs (such as network costs, wheeling costs etc.) are allocated to various consumer categories based on energy input or energy sales (as considered appropriate by the State Commission). This approach factors in the voltage level differentiation based on losses, however, it does not factor in asset utilization at different voltage levels.

- **Category-wise Cost of Supply (CCoS):** This method addresses the issue that at same voltage levels, the cost of supplying electricity may be different, hence Embedded Cost of Supply methodology populates the historical costs incurred by a DISCOM and then assigns costs to categories. This method has three steps to it:
    - ***Cost Functionalization:*** Separates cost data into the functional activities performed in the operation of a utility system - power generation/supply, transmission, distribution and retail supply
    - ***Cost Classification:*** Determines the portion of the cost that is related to specific cost-causal factors, such as those that are demand-related, energy-related, or customer-related.
    - ***Cost Allocation:*** step assigns the costs to specific customer categories based on key driver of the classified cost

On weighing each of the methods for their benefits and challenges, it is evident that theoretically, the most progressive method going forward shall be the CCoS method. The major challenge of this method is that there is a need for extensive data.

National Review: As-Is analysis:

To understand the feasibility of implementing CCoS in the India, an As-Is analysis review of the current policy framework and a State-wise review has been conducted across select Indian States. The policy review includes

studying pertinent Acts and Policies of the electricity sector, including its drafts and amendments, such as Electricity Act 2003, National Electricity Policy and National Tariff Policy. For state-wise review, based on consumer mix, cost coverage levels of tariff and equal geographical representation, twelve States have been selected for review. Each of the States are benchmarked on their preparedness for transitioning to CCoS based on regulatory and data readiness.

The policy review reveals that policy makers have recognized the need for an urgent tariff reform to reflect the cost incurred by the utilities in supplying electricity to consumers. The existing policy frameworks and Acts direct Commissions and utilities to design tariffs in a manner to efficiently recover the costs incurred to supply electricity. However, the acts do not clearly mention methodologies to be adopted by State Regulatory Commissions for determination of these costs.

Simultaneously, the following take-aways emerge from the state review:

- Indian States are in various stages of progression with respect to advanced CoS determination regimes and could be grouped as follows:

Groups	States	Approach for CoS determination	Approach for tariff setting
Group 1 States	Andhra Pradesh, Telangana, Punjab	Category wise CoS using embedded methodology	Taking category-wise CoS into consideration
Group 2 States	MP, Gujarat, Maharashtra	Have determined Voltage-wise CoS based on simplified APTEL methodology; and attempted to determine category-wise CoS based on assumptions	Tariff determination progressively reflecting ACoS; indications for moving towards VCoS
Group 3 States	Rajasthan, TN, Haryana, Bihar	Have determined voltage-wise CoS based on simplified APTEL methodology	Tariff determination progressively reflecting ACoS
Group 4 States	Tripura, Arunachal Pradesh, Uttar Pradesh	Have not attempted to determine voltage-wise costs of supply	Tariff determination on historical trends & inadequate reflection of ACoS

- Few States like Telangana and Andhra Pradesh have attempted to determine CCoS, although with several assumptions. However, most of the States have to overcome the following hurdles to progress to more efficient methods of CoS determination:

    1. Inconsistent or incoherent Policy and Regulatory directives
    2. Unavailability of Gross Asset registers
    3. Delay in conducting and completion of energy audits
    4. Lack of detailed studies pertaining to data for category wise CoS

Determining optimal CoS method:

Guiding Principles & CoS Methodology:

An overall set of guiding principles such as: reliability, flexibility accuracy, adaptability etc. is developed which has been adhered to in the framework developed for CoS determination in Indian States. The literature review for ideal CoS determination methodology and the As-Is review of the current situation of States and the existing policies prove that the embedded methodology to determine CCoS is not only progressive and beneficial on a long term basis but also satisfies the principles determined.

Stakeholder Consultation:

However, before going forward and finalizing the above methodology, it is pertinent to discuss the proposed methodology along with the issues surrounding CoS determination with all concerned Stakeholders. The various Stakeholder representatives including distribution utilities, regulatory bodies, ministries, industries, research think tanks and not-for-profit organizations were asked to share their opinion on the proposed approach towards CoS determination, required policy and regulatory interventions needed for enforcing determination of true Cost of Supply, current readiness and ability of DISCOMs to determine CoS, and enablers for a developing scientific approaches to CoS determination.

The outcomes of the discussion revolved around themes such as, harmonization of the Acts/Policies/Drafts, institutional strengthening for policy making and implementation, standardization of methodologies/ approaches through formats, gradual progression from VCoS to CCoS and establishment of benchmarks to measure progress/impact.

Case Study: Telangana

To demonstrate the effectiveness of the determined category-wise Cost of Supply methodology, it is pertinent to apply the methodology on a sample State in India. Of the four groups of States reviewed for preparedness, a State of Group A has been chosen. Group A states appeared appropriate not only due to data readiness for calculation of CCoS, but also because carrying out the exercise in a regulatory-wise progressive State shall have a greater impact going forward in setting an example for other States. Hence, the methodology has been applied in the State of Telangana which is a newly formed State with relatively lesser legacy issues pertaining to tariffs. Currently the Telangana State Electricity Regulatory Commission (TSERC) has outlined a methodology of determination of category wise CoS based on an initial proposal by the State DISCOMs. The current methodology, while progressive as compared to other States has a lot of assumptions in the three stages of CCoS determination. A detailed review of the methodology followed by the Commission has been carried out and recommendations are suggested to further improve the process. A few of the recommendations for select stages

Cost Classification

- Need for classification of fixed and variable costs to ensure appropriate translation of the costs into tariffs
- Classification of costs into customer costs as well, the current approach classifies all costs as demand or energy related

Cost Allocation

- Demand related costs should be appropriately allocated, either on the basis of co-incident peak demand, non co-incident peak demand or using the average and excess method, instead of only Non Co-incident peak demand
- To allocate energy related costs, there must be studies to determine both, technical and commercial losses at a category level instead of only at voltage level
    - Customer related costs must be on the basis of number of actual number of consumers and weight of each consumer category

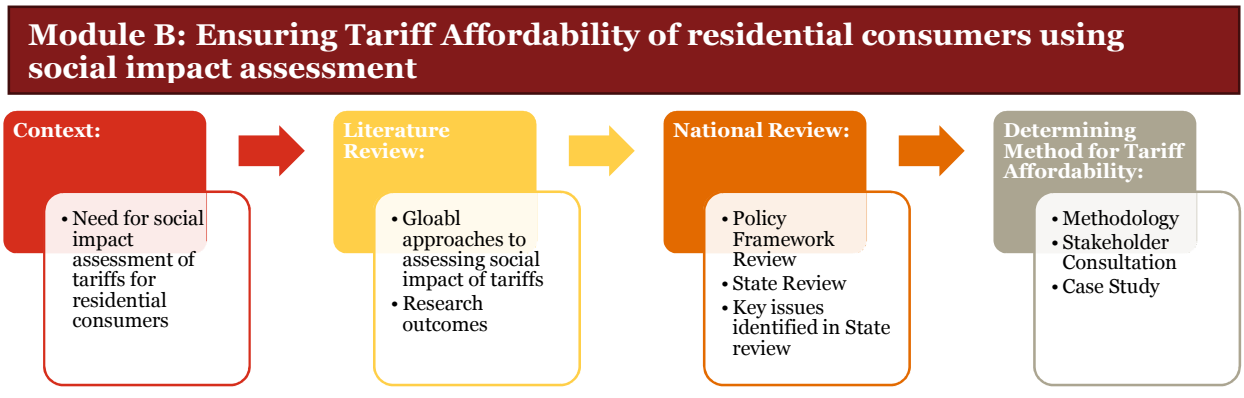


Exhibit 2: Module B-Structure

of CCoS determination have been illustrated below:

Module B of this report discusses on the need for a social impact assessment of tariffs for residential consumers. A study of the global practices and international benchmarks have been discussed followed by developing a suitable methodology for the Indian context and finally to demonstrate the derived methodology, a case study has been presented for Bihar. The module is structured in the following manner:

Literature Review:

This section highlights the approaches followed across the world for social impact assessment of electricity tariffs on consumers. The aim of this section is to refine and finalize an approach for carrying out the social impact assessment of electricity tariffs in India. The following reports have been studied and summarized:

1. Implementing Energy Subsidy Reforms An Overview of the Key Issues, World Bank 2012
2. Climate Change and the World Bank Group, Phase 1: An Evaluation of World Bank Win-Win Energy Policy Reforms, World Bank, 2008
3. Household fuel and energy use in developing countries, World Bank, 2003
4. European Bank for Reconstruction and Development (EBRD), Working paper No. 92, 2005
5. Residential Electricity Burden, an Investigation of American Community Survey Data 2006 – 2008, Austin Energy, 2010
6. World Bank Assessment of Household Energy Deprivation in Tajikistan, World Bank 2014
7. Analysis of the Kyrgyz Republic's Energy Sector, World Bank 2017
8. Power Tariffs Caught between Cost Recovery and Affordability, African Region, World Bank, 2011
9. Balancing Act: Cutting Energy Subsidies vs Affordability, World Bank 2013
10. District Heating and Electricity Tariff and Affordability Analysis, Republic of Moldova, World Bank, 2015
11. Beyond Connections : Energy Access Redefined, World Bank 2015

The reports have been studied with a perspective to derive answers for key questions pertaining to the subject of affordability. The key take-aways are as follows:

Issue	Research Outcome
How do we measure affordability in a scientific manner?	The literature review establishes **Tariff Affordability Ratio (TAR)** as a reliable parameter to measure affordability of electricity in households
How do we map the parameters of affordability across income groups and access levels?	Affordability can be mapped by measuring TAR across: • Income / household expenditure levels (deciles/quintiles etc.) • Energy access levels
What are the benchmark ranges of affordability?	The acceptable range of electricity tariff affordability in households of developing economies has been established in the range of **~3% - 5%**
What is the appropriateness of current lifeline tariffs?	Studies suggest the need to critically evaluate the effectiveness of lifeline tariffs; • Income / household expenditure levels: in many countries it is found that poorest 20% have the highest TAR • Energy access level: adequacy of lifeline kWh limit vis a vis access tiers
Targeting and quantification of	Studies suggest quantification of subsidies from the point of view of

Issue	Research Outcome
subsidies	bringing TAR within an acceptable range for consumers across various income / expenditure levels

National Review:

Similar to the exercise in Module A, a national policy framework review has been carried out to ascertain the current policy provisions regarding the subject of affordability of tariffs. The review reveals that the current policy makers are aware of the need to ensure balance of tariffs for the poorer sections of the society and have enlisted in their policy, special provisions have been mentioned to ensure that all needy sections of the society benefit from subsidized tariffs. However, gradually the policy makers have grasped that creating subsidies within the tariffs may defeat the purpose of channelized benefits and there may be leakage of benefits, hence there has been a suggestion to shift from building in subsidies within the tariffs to direct transfer of benefits to the needy consumers.

Following the policy framework review, a state review has been carried out for States selected to ensure homogenous representation from geographies and poverty levels. Fifteen states have been selected: **Delhi, Haryana, Punjab, Uttar Pradesh (U.P), Telangana, Andhra Pradesh (A.P), Tamil Nadu, Madhya Pradesh (M.P), Rajasthan, Maharashtra, Gujarat, Bihar, Orissa, Tripura and Assam**. Due to the lack of clear methods for measuring the current state of tariff affordability, the states are reviewed based on the following three parameters: lifeline categories, cross-subsidies for domestic categories and the quantum of direct subsidy with respect to the Annual Revenue Requirement of the State.

The outcome of the research indicates that the current system of subsidy allotment is insufficient. Additionally, there is an urgent need to rationalize subsidy levels for resident consumers in general and redesign the legacy tariff slabs to ensure correct channelizing of benefits.

Determining Method for Tariff Affordability:

The national review of the policy framework and select States indicates that currently there is no definite method for determination of the social impact of tariffs and no scientific way to identify the needy consumers and how much of support needed by them. From the literature review, it emerges that the most common methodology followed by international agencies in developed and developing countries is TAR. Keeping in mind India's current demographic profile and the availability of data, the TAR methodology seems appropriate and implementable.

Tariff Affordability Ratio –Methodology:

The first part of this section discusses the step by step methodology for determining TAR for consumers.

The first step is to determine the TAR for a consumer. It is determined by:

$$Tariff\ Affordability\ Ratio\ = \frac{Household\ Expenditure\ on\ Electricity}{Total\ Household\ Expenditure}$$

For the Indian context, the two sources for household expenditure on electricity and total household expenditure are the DISCOM data and latest National Sample Survey Office report on Household Consumption of Various Goods and Services in India respectively. The data if outdated, has been adjusted to reflect the current expenditure levels of a household.

The second step is to carry out the social assessment of the electricity tariffs using TAR as a metric, in the following way:

- Identifying an Acceptable TAR by benchmarking TARs across countries from the studies

- Developing an Affordability Matrix which illustrated TAR metric for different levels of household expenditure
- Weighted average Affordability Matrix illustrating the overall affordability of a tariff slab based on the proportion of consumers in each slab and their respective TAR

Stakeholder Consultation:

Since the above methodology is new to the Indian context and has the potential to have a wide-spread impact on all Stakeholders, a discussion was conducted to take into account their opinion and views on the matter as a whole and the proposed methodology. The Stakeholders involved were similar to those who were consulted for Module A and were asked questions in the areas pertaining to enshrinement of tariff affordability principles in the Acts/Policies, capacity building at the Govt. and SERC level, need for customized affordability frameworks for each State etc.

The outcomes of the discussion hinted at the need for amendments to align the Policies and Acts with respect to tariff affordability, national level pilot studies for determining appropriateness of affordability methodology/approaches and need for independent committees who shall steer all Stakeholders towards determining and incorporating tariff affordability into the tariff design process. The discussion concluded with a general agreement on Tariff Affordability Ratio as an appropriate metric for measuring the affordability of tariffs.

Case Study: Bihar

Bihar has three sub-categories of consumers under the domestic category based on income group and development level of location. The three groups are Kutir Jyoti (the below poverty line consumers), Domestic Supply-I (DS-I) for rural consumers and Domestic Supply-II (DS-II) for urban consumers. The TAR methodology of social assessment of tariff has been applied on the latest slab-wise tariffs for residential consumers. On applying Step 1 and Step 2, the following weighted average TAR levels are obtained:

Slab	Weighted Average Tariff Affordability in 2018
Kutir Jyoti	
Unmetered	9.31%
Metered (0-50)	4.12%
DS-I (Rural)	
Unmetered	11.02%
Metered	
First 50 Units	4.39%
51 - 100 Units	5.43%
Above 100 Units	16.39%
DS-II (Urban- Demand Based)	
1-100 U/Month	7.23%
101 - 200 U/Month	13.60%
201 -300 U/Month	15.41%
above 300 U/Month	13.00%

Based on the above matrix, the following recommendations were compiled:

- Need for metering of KJ and DS-I to improve cost recovery and understand the true affordability
- Inclusion of unmetered consumers shall increase affordability of tariffs for consumers within 0-50 units, giving leeway for upward tariff revisions
- Need for simplifications of tariff slab and structures to accurately identify needy consumers and accordingly quantify the benefit requirement.
- Although a futuristic in nature and if not completely shifting to direct benefit transfer method, tariffs could be simplified to the following three slabs:
    - Life-line consumers: Consumers who have concessionary tariffs
    - Top-consumption consumers: The consumers subsidizing the lifeline consumers
    - Remaining consumers: Consumers who are charged as per the cost of supply

1. Introduction

1.1. Background

India is growing at an unprecedented pace and its rapidly expanding economy is making a significant impact on the world. Its GDP growth rate in FY 2017-18 was estimated to be 6.7%[2], making it one of the emerging economies. The high growth rate achieved is due to an increasing contribution of each sector of the economy. One of the most critical components for the welfare of the economy is the power sector. Hence, its health and sustainability is essential for the overall development of the nation.

There are several mechanisms to ensure the sustainability of the power sector, appropriate tariffs is one of them. Adequate revenue recovery through right electricity tariffs ensures a smooth functioning of all functions of the power sector, starting from the generation sector to the end-service providers of electricity i.e. Electricity Distribution Companies (DISCOMs). However, in today's scenario, as aptly highlighted by The Economic Survey for FY 2015-16, legacy end-consumer tariffs are slowing the turnaround of the power sector. The current tariff structure's dependency on inefficient cost identification & allocation mechanism, poor data availability and influence of socio-political factors have resulted in the inability of DISCOMs to recover sufficient revenue from consumers, resulting in financial and operational distress across the entire value chain.

The policy framework for electricity, through Electricity Act 2003 and National Tariff Policy 2016, mandates the DISCOMs and Electricity Regulatory Commissions (ERCs) to be guided by the principles of cost reflectivity and non-discrimination while determining tariffs. However, cross-subsidies within consumer categories have led to vast deviations in tariffs with respect to the actual cost of supply of the electricity to that category. The high industrial tariffs and variable quality of electricity have adversely affected the ability of industries to grow, impeding initiatives to bolster the manufacturing sector. At the same time the inverted tariff structure and high Aggregate Technical & Commercial (AT&C) losses, is causing the DISCOM to be unable to bridge the revenue-cost gap from its biggest consumer group, i.e. the domestic consumers.

Overall, Stakeholders across the spectrum have voiced an imminent need to bring in a uniform, scientific and sustainable framework for initiating tariff reforms, and to ensure that other initiatives undertaken by the Central and State Governments (Govt.) enhance the quality levels of consumer service and revive the overall health of the sector.

The end user tariffs are a function of the input costs for a DISCOM, the methodology of allocation of costs to different functions of the DISCOM and its appropriate reflection in tariffs across the various consumer categories. The above can be divided into four phases as illustrated below:

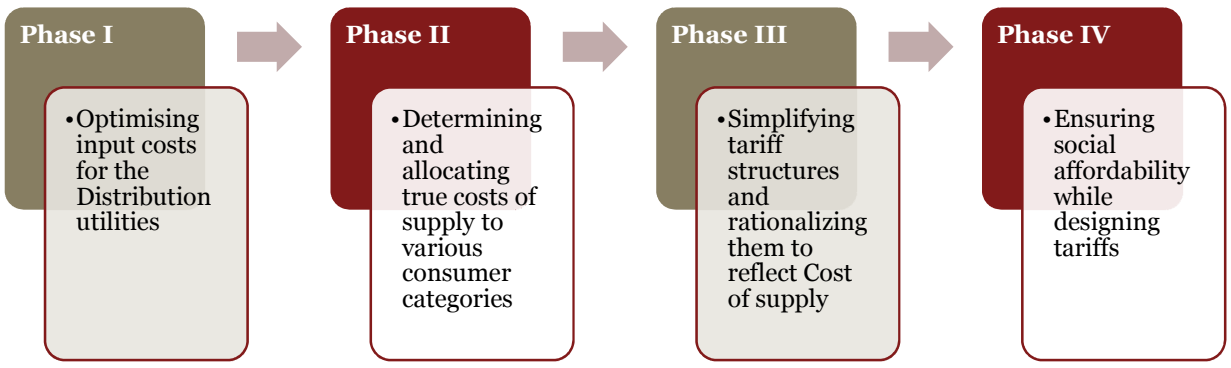


Exhibit 3: The tariff reform value chain

The Govt. is taking crucial measures for Phase 1 viz. Optimizing input costs for the Distribution utilities, including the introduction of UDAY for improving financial efficiency through reduction in debt obligations and

[2] Source: Press Note on First Advanced Estimates of National Income 2018-19

improving operational efficiency. The improved operational efficiency shall help bring down losses and therefore bring down the cost of supplying electricity at the consumer's doorsteps. Other measures for optimizing input costs include rationalizing coal supply through increased domestic production and allowing for linkage swaps directly reducing the cost of power generation etc.

To tackle Phase III, the Ministry of Power (MoP), Shakti Sustainable Energy Foundation (SSEF) and PricewaterhouseCoopers Pvt. Ltd. (PwC), based on the recommendations of the Economic Survey of FY 2015-16 on tariff design, and in response to industry perspective on tariffs through Federation of Indian Chambers of Commerce & industry (FICCI), have taken up an initiative for designing a framework for simplifying tariff structures to eliminate complexity for consumers as well as rationalizing electricity to enhance cost recovery.

With respect to Phase II and Phase IV, in May 2018, the MoP proposed amendments to the Tariff Policy, 2016 which stressed on the linking of tariffs to cost of service to not only to ensure viability of the DISCOMs but also to better channel support and benefits to the needy consumers. The draft also directed the SERCs to endeavor to determine cost of supply for each category/sub-category of consumers so that more effective policies and programmes are framed in the future (Section 8.3 A (7)).

Subsequently, the Draft Electricity (Amendment) Act, 2018 circulated in September, 2018 reiterated the views of the amended Tariff policy regarding cost reflectivity of tariffs. The draft proposed refining existing provisions of tariff determination to highlight the responsibilities of the appropriate Regulatory Commissions to determine tariffs in a manner to recover cost of electricity, service cost and capital cost incurred by licensees to provide electricity to its consumers.

While both, the Proposed Amendments in Tariff Policy, 2016 and Draft Electricity (Amendment) Act, 2018 focused on designing tariff to reflect cost incurred to provide supply of electricity, they also highlighted the need to design tariffs in a fashion such that the balance between cost recovery and the consumers' interest is maintained. The current structure of tariff builds in subsidies for needy consumers to ensure affordability. However, going forward, the policy makers feel that direct transfer of benefits to the customers shall be more beneficial than restructuring of tariff.

Given the above, there was a need to ensure adequate recovery of prudent costs and at the same time ensure that tariffs do not burden certain consumers and favour others. The thrust was also on determining classes of customers, starting with the domestic category, which needed subsidy support and the appropriate levels of subsidy through a detailed social impact assessment.

1.2. Objectives

In light of the proposed amendments by the MoP to revisit the cost of supply of tariffs in India and the future target to channelize subsidies by means of direct benefit transfer, SSEF in collaboration with PwC is developing optimal methodologies for determining costs of supply to consumer categories and for measuring the affordability of tariffs for residential consumers through a social impact assessment. The findings of this study would be assessed by the MoP and all other relevant stakeholders to re-evaluate the current framework of tariff determination.

The study has been conducted in two modules and their objectives are as follows:

Module A: Developing an optimal methodology to determine accurate costs of power supply (Determining Accurate Cost of Supply of Electricity)

1. To move towards fully cost reflective tariffs;
2. To understand the behaviour of various costs to help develop better strategies and policies to reduce costs;
3. To provide for a transparent understanding of subsidies, to regulators and policy makers
4. To assist the utilities & regulator to understand the fixed and variable cost structure and accordingly structure the tariffs;

5. To ensure that a certain category or a group of categories are not unnecessarily burdened with higher tariffs in order to subsidize consumer categories with comparatively lower tariffs in spite of incurring higher or comparable costs of supply

Module B: Providing a scientific framework for Power Utilities and Regulators to make an informed decision on tariff revisions for residential consumers by factoring in social impact & tariff affordability (Ensuring tariff affordability of residential consumers using social impact assessment)

1. To determine appropriate benchmarks for affordability of tariffs among residential consumers
2. To understand which consumer groups may require government support for electricity
3. To discover if some head room exists for more cost reflective tariff for a certain set of residential consumers.
4. To provide a framework for Power Utilities and Regulators to make decisions on tariff revisions by factoring in social impact and tariff affordability

1.3. Overall Approach

The approach for developing optimal methodologies to determine accurate costs of power supply for consumer categories and to assess social impact of tariffs for residential consumers warrants the need for reviewing of current regulatory frameworks, studying international best practices, understanding the existing progress of States followed by coordination with states to collect data, framing of a methodology and undertaking sample implementation exercises. The broad approach employed, comprising of tactics to be pursued to achieve the same, has been illustrated below:

	Literature Review	National Review	Determination of Optimal Methodologies	Sample Case Study
Module A: Determining Accurate Cost of Supply of Electricity	•Identification and study of different methodologies of CoS determination •Analysis of the advantages and disadvantages of each studied methodology	•Review of current policy framework and relevant regulations •Selection of 12 states having adequate representation of Indian scenario •As-Is study of regulatory progression & data readiness w.r.t CoS determination methods	•Formulation of general guiding principles for framework of CoS determination •Development of CoS determination methodology •Stakeholder consultation for views/opinions/recommendations of the developed methodology	•Sample case study for advanced state such as Telangana on ideal implementation of the determine CoS methodology
Module B: Ensuring tariff affordability of residential consumers using social impact assessment	•Study of global approaches to assessing best practices on Tariff Affordability •Assemble the research outcomes of study to obtain clarity on key issues surrounding measurement of social impact of tariffs	•Review of current policy framework and relevant regulations •Selection of 15 states having adequate representation of Indian scenario •As-Is study of current exercised approaches to ensure affordability of tariffs	•Determination of approach for measuring social impact of tariffs by assessing its affordability •Stakeholder consultation for views/opinions/recommendations of the developed methodology	•Sample exercise for measuring current affordability of domestic in Bihar using developed methodology

2. Module A: Developing an optimal methodology to determine accurate costs of power supply

2.1. Context

In India, tariff determination across States and categories is a complex process due to the varied types of consumers, their usages and socio-economic backgrounds. As electricity is a crucial utility item for all consumers, over the period of time, various issues have been factored in to determine the end user's tariffs. This has unfortunately led to severe imbalance between the tariffs levied vis-a-vis the cost of supply of the electricity, causing distress to the DISCOM. For example, in order to ensure that tariffs are kept in check for residential consumers, while still allowing cost recovery for DISCOMs, cross subsidy is built in between categories. The tariffs so determined, are skewed, with tariff for industrial and commercial consumers being higher and for other categories being lower than their respective costs of supply. The implications of this imbalance in tariffs is twofold – uncompetitive industries owing to higher input costs and inability of DISCOMs to recover sufficient tariffs from domestic consumers, resulting in financial distress. The issue is more pronounced for rural supply where tariffs are highly subsidized, actual cost of supply is higher and revenue recovery is poor.

It is thus essential that tariffs reflect the true cost to service a category of consumer. As a crucial first step towards cost-reflective tariffs, it is important for distribution utilities to determine the costs of supply (which cascades from generation to transmission and finally to distribution and retail supply of power) that should be prudently recovered from each consumer category. By determining consumer category wise costs of supply, the DISCOM would be in a better position to allocate costs where relevant and determine how tariff can be levied fairly on each category.

2.2. Literature Review: Methodologies for determination of Cost of Supply

International literature and best practices across countries were reviewed to understand various methodologies currently in place, that are used to ascertain costs incurred in supplying of electricity to consumer categories. Simultaneously, literature present in India in the form of Regulations, research studies, Appellate Tribunal of Electricity (ATE) judgements were also studied.

Three broad methodologies of determining the cost of supply (CoS) were identified from the study:

- Average Cost of Supply (ACoS)
- Voltage-wise Cost of Supply (VCoS)
- Category-wise Cost of Supply (CCoS)

2.2.1. Average Cost of Supply (ACoS):

The most commonly used approach for determining the cost of supply of electricity for tariff determination is the Average Cost of Supply method. The ACoS is computed by dividing the Annual Revenue Requirement (ARR) determined by the Commission for recovery through tariffs by the total energy sales for the year.

$$ACoS = \frac{Annual\ Revenue\ Requirement\ of\ Distribution\ Licensee}{Total\ Energy\ Sales\ for\ the\ year}$$

Thus, the ACoS is the average cost imposed by all consumers on the system irrespective of their individual cost of supply in order to supply electricity. It is easy to determine since it requires minimum amount of data. However, this methodology does not indicate the costs incurred by consumers at different voltage levels as the

consumers at different voltage levels use different sets of assets of the network. Therefore, it is not an accurate methodology of determining the tariffs for particular consumer class, eventually resulting in insufficient cost coverage.

2.2.2. Voltage-wise Cost of Supply (VCoS):

As stated above, the most commonly used method for tariff determination is the ACoS method. Since losses at high voltage levels are lower than losses at lower voltage levels, the cost of supply at higher voltage tends to be lower than cost of supply to consumers at a lower voltage. Also, whereas high voltage consumers utilize high voltage assets, the low voltage consumers also utilize the high voltage assets in addition to specific low voltage assets. Thus, as a next logical step, the voltage wise cost of supply method provides a better reflection of cost to supply to consumers at different voltage levels.

On reviewing the domestic literature, a simplified version of the detailed approach emerged. The simplified version was suggested by ATE in 2010, to determine VCoS in the absence of all necessary data.

Simplified Approach

Taking into account the difficulties faced by the state commissions, to determine accurate cost of supply of electricity, the ATE in its judgment in Appeal Nos. 102 of 2010, in the matter of Tata Steel Ltd. Vs. Orissa Electricity Regulatory Commission & Another, suggested the following method:

> *"In our opinion, it will* ***not be prudent to wait indefinitely for availability of the entire data*** *and it would be advisable to initiate a simple formulation which could take into account the major cost elements. 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 voltage-wise 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."*

Exhibit 4: Excerpt of VCoS-APTEL Judgment

In this method, the power purchase costs and other costs (such as network costs, wheeling costs etc.) are allocated to various consumer categories based on energy input or energy sales (as considered appropriate by the State Commission). This approach factors in the voltage level differentiation based on losses, however, it does not factor in asset utilization at different voltage levels.

Detailed Approach

This approach uses three parameters for allocating various costs to voltage levels – energy input at each voltage level, energy sales and asset allocation to voltage levels. The losses segregated voltage wise (as percentage of input energy) are to be allocated to different voltage levels based on energy input to each voltage level (as explained in subsequent sections). Subsequently, the cost elements such as power procurement costs, employee expenses, administrative and general expenses and income tax can be allocated to each voltage levels based on

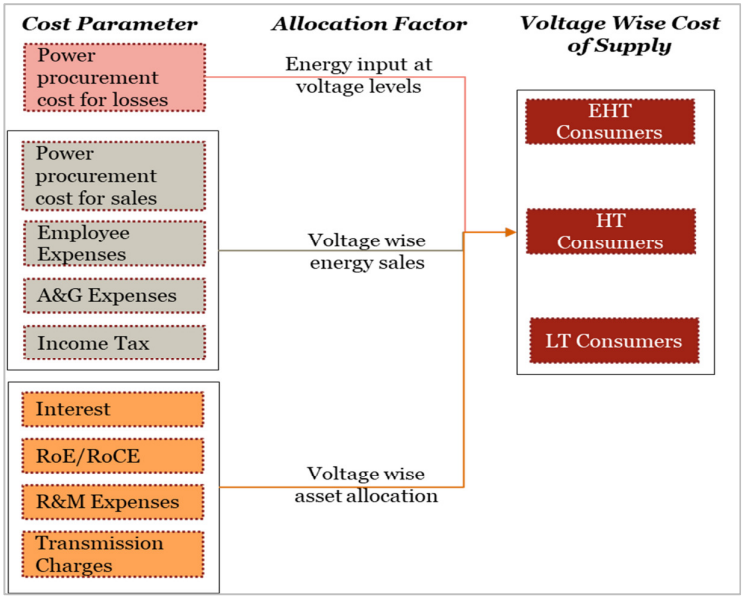


Exhibit 5: Detailed approach of Voltage Wise Cost of Supply

total sales at each voltage level. The cost elements, which are dependent on assets such as depreciation, interest costs, return allowed to utility etc. are allocated in ratio of assets allocated to each voltage level. The sum of all the cost components at each voltage level is the cost to supply the particular voltage (EHT/HT/LT). **Exhibit 8** shows the methodology of detailed approach for computing voltage wise cost of supply.

2.2.3. Category-wise Cost of Supply (CCoS)

VCoS differentiates cost allocation based on voltage levels, however, it does not factor in category level differentiation. For instance, at the same LT level, cost of supplying electricity to a Commercial consumer may be different from that of a Residential consumer. In order to determine Cost of Supply at category level, the Category wise Cost of Supply method needs to be explored. One of the popular methods of determining CCoS is the Embedded Cost of Supply methodology. The embedded cost method identifies and assigns assign the historical or accounting costs that make up a DISCOM's revenue requirement and is popular among developing nations with energy access situations like India's.

This method involves three steps:

- Cost Functionalization
- Cost Classification
- Cost Allocation

Cost functionalization separates the cost data into the functional activities performed in the operation of a utility system - power generation /supply, transmission, distribution and retail supply.

Classification determines the portion of the cost that is related to specific cost-causal factors, such as those that are demand-related, energy-related, or customer-related. Demand related costs are associated with meeting the peak demand of consumers and overall peak of the utility. Energy related costs are variable by nature and change with the quantum of output. Customer related costs depend on the number and types of consumers served.

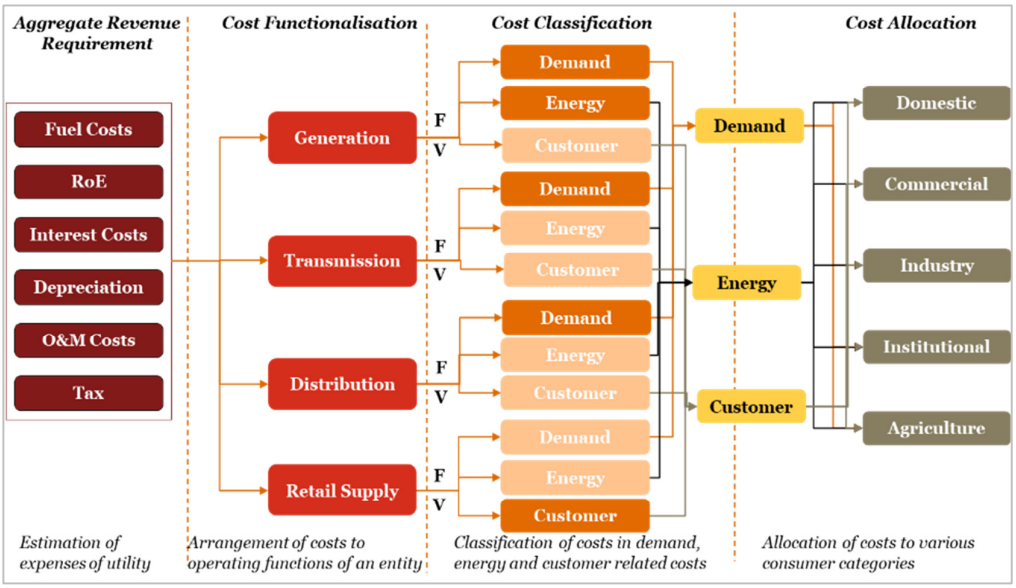


Exhibit 6: Category-wise Cost of Supply

Finally, the cost allocation step assigns the costs to specific customer categories based on the customer's contribution to the specific classifier selected. For example, the demand costs are allocated based on each consumer category's contribution to peak co-incident/non co-incident demand over a time-period. Alternatively, the average & excess method[3] could also be used for cost allocation. Similarly, the energy related costs can be allocated by allocation factors based on energy input/sales to each category. Finally customer related costs could be allocated by actual number of consumers/ weighted number of consumers based on category average meter/billing/service costs. **Exhibit 9** shows the flow of process for cost of supply assessment using 'Embedded Cost of Supply' methodology.

[3] Put ref

Once, the costs have been allocated to each category, the total of demand related, energy related and customer related costs represents the total cost to serve the category. The costs may be determined per unit of sales by dividing the category cost of supply by sales to the particular category.

2.2.4. Key take-away of Literature Review

On reviewing the three methodologies, it is evident that each methodology has its unique features that help in determining the cost of supply of electricity to consumers. The advantages and challenges of each of the three methodologies have been summarized below:

	Advantages	Disadvantages
ACoS	• Simple as it requires minimum data • Indicates overall cost imposed by customers on system, allowing DISCOM to estimate required average billing rates for complete revenue recovery	• Too simplistic as it does not help the DISCOM determine the cost of serving each category which is highly differentiated in nature • Does not provide clarity in tariff determination for categories which are costly to serve
VCoS-Simplified	• Allocates major cost elements to customers based on voltage-wise losses • Differentiates between customers who use lesser assets of the network vs those who utilise more	• Does not factor in asset utilization at different voltage levels.
VCoS-Detailed	• Integrates energy input, sales and asset allocation factors to provide more accurate estimate of cost of supply	• Does not indicate cost of supply to different categories within the same voltage level. For ex. Domestic vs Commercial customers • Requires extensive data on asset utilisation
CCoS	• Determines costs imposed by each category of consumer on the overall system by accounting for demand, energy and customer cost parameters • Segregated allocation methods using the cost drivers helps utilities understand reasons for cost variations	• Requires extensive studies on load profile studies using sample feeders • Degree of estimation/exits exists in final cost of supply figures due to dependency on sample feeders/ assumptions

Exhibit 7: Comparison between CoS methodologies

From the above comparison, it is evident that determining category wise cost of supply is the most progressive methodology for cost estimation and going forward DISCOMs shall benefit in implementing the outputs of this methodology to determine appropriate tariffs. Linking the category-wise cost of supply to the final slab wise tariff shall not only ensure recovery of revenue but also help Govt. and DISCOMs to quantify the subsides for the needy consumers. The challenge to adopt this methodology for determination of CoS is in the availability and accuracy of necessary data.

Therefore, the final optimal framework for determination of CoS in the Indian context can only be ascertained based on a review of the current level of progress across Indian states, the thrust being received from the respective State Commissions and the technological tools available to the sector for determination of costs.

2.3. National Review: As-is Analysis

As concluded in the previous section, to derive the optimal framework for CoS determination it is important to review the currently implemented methodologies for cost of supply and tariff determination in the States of India. The current practices across States is not only driven by the nature of the overarching State and Central Regulations but also by the data availability, consumer mix and consumption patterns. Therefore, a review of the journey of the relevant policies and regulations at the Centre and State level followed by a state-by-state

review of selected states, of the approaches of electricity tariff determination using various CoS frameworks is important to identify prevalent issues and accordingly identify solutions.

2.3.1. Review of Policy framework

The policy framework concerning determination of Cost of Supply and tariffs is formed by the Electricity Act, 2003, the National Tariff Policy, judgments of Appellate Tribunal of Electricity, the National Electricity Plan etc. **Exhibit 18** depicts an evolution of the policy stand on determination of Cost of Supply and tariff

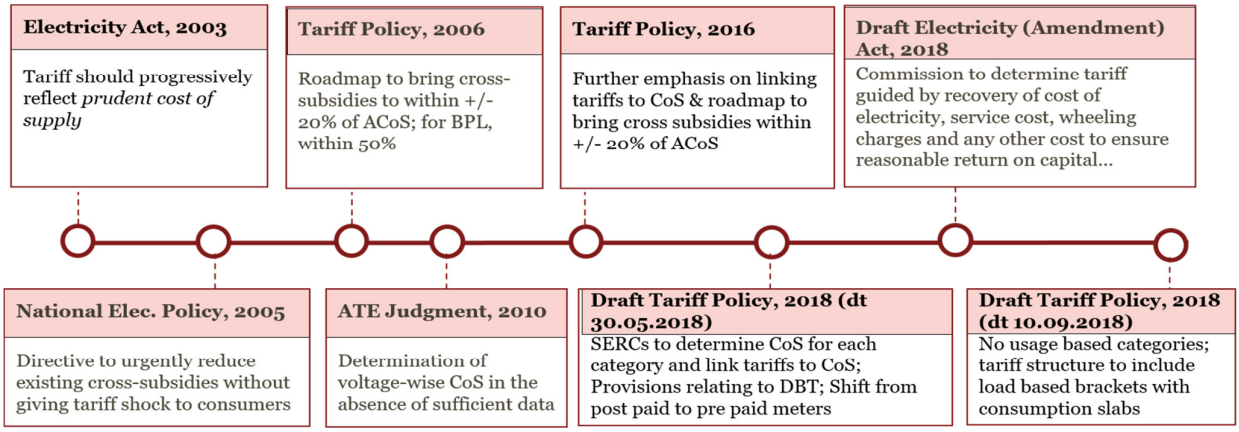


Exhibit 8: Evolution of Policy on CoS and Tariff determination

determination:

2.3.2. Review of As-Is Scenario of States

Initial Selection of States

In order to review existing methodologies for determination of Cost of Supply for identifying various issues such as data availability, regulatory progression, methodology for end tariff determination, twelve states were selected for this study for an adequate and diverse representation of Indian context. Geographical representation, diversity in consumer mix and current cost coverage levels of tariffs were the parameters for shortlisting of States. These selected states are **Andhra Pradesh (A.P), Telangana, Punjab, Madhya Pradesh (M.P), Maharashtra, Gujarat, Rajasthan, Bihar, Tamil Nadu, Haryana, Assam and Uttar Pradesh (U.P).**

Review of the As-Is scenario

To understand the current scenario of the States with respect to determination of CoS and the corresponding tariff determination, the states have been reviewed on external parameters influencing the CoS determination process ie. Regulatory progression and the internal preparedness of the State ie. Data readiness.

Regulatory progression measures the thrust level placed by the respective State Commissions with respect to mandates on progressive methods of determination of Cost of Supply (CoS), directives to DISCOMs on adopting the method and the successful enforcement of the method while developing tariffs.

Data readiness assesses the availability and adequacy of data pertaining to generation costs, transmission costs and distribution costs, voltage wise losses and category wise demand profile which, as discussed in the earlier sections, are crucial inputs to accurate determination of CoS.

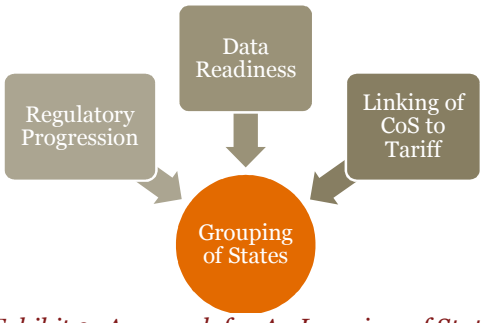


Exhibit 9: Approach for As-Is review of States

Thereafter, based on the two assessments and the final approach of the State towards tariff determination, the States have been grouped. The grouping buckets the States in order of overall progression based on the methodology of CoS determination and the linkage in the final tariffs to the determined CoS.

Regulatory Progression

Approach:

To measure the regulatory progression of a State towards determination of CoS, a three step framework has been adopted as follows:

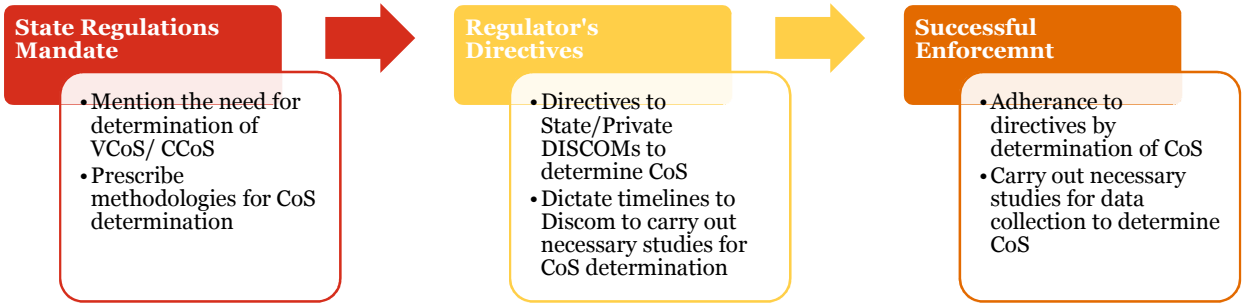


Exhibit 10: Framework for measuring Regulatory Progression for CoS determination

The three steps have been outlined such that achievement of each of the step indicates the stage at which the State Commission and its DISCOMs is in the journey of accurate CoS determination. An understanding of the current scenarios in the selected States is crucial to form the basis of recommendation to MoP and other policy making authorities regarding the optimal methodology for CoS determination across India and realistic timelines for its implementation in end-user tariff determination.

Data Readiness

Approach:

While ACoS is simple to determine due to requirement for minimal data, for VCoS and CCoS it is imperative for a DISCOM to have more detailed data pertaining to the consumers such as consumption, connected load, slab-wise consumers etc. Similarly, it is necessary to segregate the assets of the network on the basis of voltage and category of consumers served since asset costs form a significant portion of costs incurred to supply electricity. Lastly, the asset utilization by a category is crucial in order to accurately attribute the cost to serve the category at different seasons/hours. Therefore, to assess the data readiness of the DISCOM, the data required has been broadly divided based on the functions of generation, transmission and

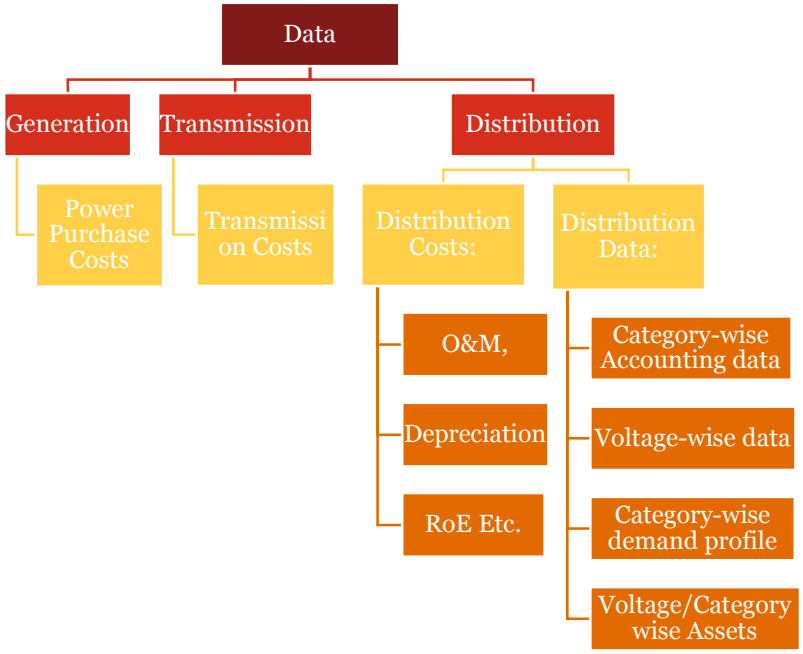


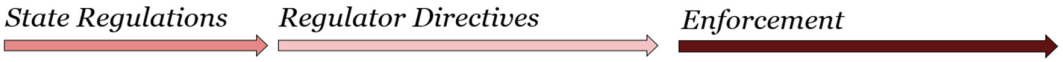
Exhibit 11: Measurement of Data Readiness for CoS determination

distribution as per **Exhibit 9**.

Findings of As-Is Review:

The review revealed that, under the directive of the National Tariff Policy, 2016 and other policies, all State Commissions have mandated the need for tariffs to be cost reflective. Further, the broad guideline of the Commissions to the respective DISCOMs, is to ensure that tariff must at least cover the ACoS.

However, certain selected states such as Andhra Pradesh and Telangana are leading in nature where the State Commission and the DISCOM have adopted CCoS, albeit with a lot of assumptions on the demand profiles and category wise AT&C losses. State Commissions of Madhya Pradesh, Maharashtra, Gujarat etc. have directed the DISCOMs to adopt VCoS/CCoS and the DISCOMs are accordingly underway the process. Most States have completed or are underway in Voltage-wise losses study indicating that they intend to refer to VCoS in the future to determine tariffs. However, a majority of States have not undergone a detailed load research study, which is crucial to determine the asset utilization of the consumer at various seasons and progress from the



current regime of ACoS. A snapshot of the regulatory progression of the selected states are as follows:

State	State regulations mandate		Tariff Order directives to adopt:			Successful enforcement of :		
	Voltage-wise CoS	Category-wise CoS	Average CoS	Voltage-wise CoS	Category-wise CoS	Voltage-wise losses study	Load research study	Attempt to calculate category-wise CoS
Andhra Pradesh		√	√	√	√	√ (S.F)	√	√
Telangana		√	√	√	√	√ (S.F)	√	√
Punjab			√	√	√	√	√ (S.F)	√
Madhya Pradesh			√	√	√	Underway		√
Maharashtra			√	√	√	Underway		
Gujarat			√	√	√	Underway		
Rajasthan			√	√	√	Underway		
Bihar	√	√ (Embedded)	√	√	√	√ (Sample)		√
Tamil Nadu	√	√ (Embedded)	√	√		√		
Haryana	√	√	√	√	√	Underway (LT- 11 kV)		
Tripura	√	√ (Embedded)	√	√	√	Underway		
Uttar Pradesh			√				Submitted	

Exhibit 12: Regulatory progression of States regarding CoS determination

Similarly, the review of the data available with the twelve states showed that the cost data elements for generation, transmission and distribution are available, due to its necessity in determination of the Annual Revenue Requirement of the DISCOM. Similarly, the category wise energy sales, consumers and connected load is also available for most States. However, the further slab wise data in each category for sales, load and consumers for the reviewed states are not available or are not accurate. Regarding voltage-wise technical and commercial losses, it has been observed that the most State Commissions have directed the DISCOMs to conduct these studies. As a result most States have completed or are underway the process.

States like Andhra Pradesh and Telangana have conducted data collection for voltage wise losses and category wise demand profiles using sample feeders. Some states such as Punjab and Madhya Pradesh have also estimated voltage or category wise assets. The data readiness of selected States for Cost of Supply determination is depicted in the figure below:

State	Generation	Transmission	Distribution	Distribution Data								
				Category-wise accounting data			Voltage-wise data			Category-wise demand profile		Voltage/ Category wise assets
	Power Purchase Costs	Transmission Costs	O&M, Dep, ROE, etc.	Energy Sales	No. of consumers	Connected load	Energy Sales	Voltage-wise T&D losses	Commercial losses	Coincident Peak	Non-Coincident Peak	
Andhra Pradesh	√	√	√	√	√	√	√	√ (Sample Feeders)	√	√ (Avg. Peak)	√	
Telangana	√	√	√	√	√	√	√	√ (Sample Feeders)	√	√ (Eve. Peak)	√	
Punjab	√	√	√	√	√	√			√	√ (Est.)	√ (Est)	√ (Est.)
MP	√	√	√	√	√	√	√	√ (Est.)	√			√ (Est.)
Maha.	√	√	√	√	√	√	√	√ (Est.)	√			√ (Est.)
Gujarat	√	√	√	√	√	√	√	√ (Est.)	√			√ (Est.)
Rajasthan	√	√	√	√	√	√	√	√ (Est.)	√			
Bihar	√	√	√	√	√	√	√	√ (Sample)	√			
Tamil N	√	√	√	√	√	√	√	√	√			
Haryana	√	√	√	√	√	√	√	√ (Est.)	√			
Assam	√	√	√	√	√	√	√	√ (Est.)	√			
U.P	√	√	√	√	√	√	√ (Est)					

Exhibit 13: Data Readiness for CoS determination for selected states

Grouping of States

On studying the methodology adopted by the states to determine CoS and the final approach for tariff setting, the states have been grouped indicating the degree of progressiveness. The States which have adopted a category CoS determination method and have utilised the output to set tariffs are the most advanced States.

Groups	States	Approach for CoS determination	Approach for tariff setting
Group 1 States	Andhra Pradesh, Telangana, Punjab	Category wise CoS using embedded methodology	Taking category-wise CoS into consideration

Groups	States	Approach for CoS determination	Approach for tariff setting
Group 2 States	MP, Gujarat, Maharashtra	Have determined Voltage-wise CoS based on simplified APTEL methodology; and attempted to determine category-wise CoS based on assumptions	Tariff determination progressively reflecting ACoS; indications for moving towards VCoS
Group 3 States	Rajasthan, TN, Haryana, Bihar	Have determined voltage-wise CoS based on simplified APTEL methodology	Tariff determination progressively reflecting ACoS
Group 4 States	Tripura, Arunachal Pradesh, Uttar Pradesh	Have not attempted to determine voltage-wise costs of supply	Tariff determination on historical trends & inadequate reflection of ACoS

Exhibit 14: Grouping of States based on approach towards Cost of Supply and tariff determination

2.3.3. Key Tariff Issues Identified based on National Review

Reviewing existing policies, regulations and implementation methodologies for twelve states in India has brought into light several issues. These factors are contributing to the inability to accurately determine the cost incurred by the DISCOM to supply of electricity to its consumers.

The key issues observed in the as-is review have been summarized below:

1. *Inconsistent or incoherent Policy and Regulatory directives*

There has been no mandate for a clear methodology to be implemented for determination of CoS from the central policies as well as State regulations. Even the prescribed outlines of methodologies are being unable to be implemented accurately due to the unavailability and unreliability of the available data.

2. *Legacy mechanism of maintaining Asset registers*

States are yet to implement the concept of Gross Asset Register at each voltage level, which shall accurately determine assets costs utilized at each voltage/category level. The dichotomy between the working of the Chartered Accountants and the authorities in the power sector, makes the auditing of data difficult.

3. *Delay in conducting and completion of energy audits*

The work for energy audits assigned along with validation of energy audit figures from third party agencies is taking time to implement, resulting in mismatch and inaccuracies in the input data for losses and consumption. Additionally the lack of 100% metering at different voltage levels is creating an impediment is estimating the overall technical and commercial loss levels

4. *Lack of detailed studies pertaining to data for category wise CoS*

It has been observed that the States are slow in conducting important studies for voltage/category CoS determination such as demand profile studies, voltage loss studies etc. The absence of the study followed by the unreliability of the outputs create a barrier to determine CoS for different voltages/categories

2.4. Determining Optimal CoS Method

The previous sections have presented a review of policy framework and the current scenario of CoS determination in India. The prevalent practices and methodologies of CoS determination have also been enlisted in the Literature review section. Several challenges and issues related to the current environment in different States with respect to data readiness, regulatory environment have been identified.

This section presents an optimal framework for CoS determination for the Indian context using an overall set of guiding principles and the methodologies discussed in the previous sections. The developed framework along with the key issues highlighted at the end of the As-Is scenario of States has been presented to various Centre and State level stakeholders for their views and opinions. Thereafter, a case study of Telangana is presented, a leading State in the process of determination of CoS, with recommendations drawn from the final framework developed for CoS determination.

2.4.1. Guiding Principles

To develop a framework to accurately determine the Cost of supply of electricity to consumers the following principles must be adhered to:

- **Reliable**: The data gathered at every stage must be updated, accurate and reliable, hence States must conduct regular studies and maintain databases of consumer and network data
- **Flexible**: The framework should be robust enough to accommodate new categories of consumers, changes in charges, addition of assets to the network
- **Accurate**: The framework should be accurate in not only capturing every cost element but should be properly enable attributing the cost to the respective consumer group
- **Adaptable**: The framework developed should be able to adapt to the different States of India which are highly differentiated in terms of Regulations, consumer patterns, data availability etc.

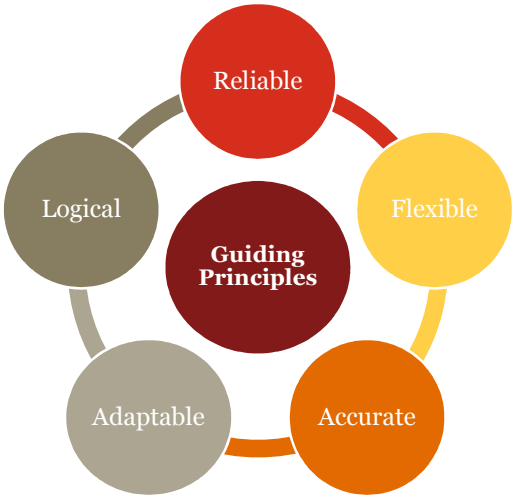


Exhibit 15: Guiding principles for CoS framework

- **Logical**: The framework must follow a clear set of logic with strong reasoning for cost attribution, and ensure no conflict at the time of implementation

2.4.2. Methodology for CoS determination

Based on the methodologies studied in the Literature Review section and the progress of advanced States like Telangana and Andhra Pradesh regarding current practices of CoS determination, it is evident that the most suitable methodology for the Indian context going forward is the embedded cost method to determine Category-wise Cost of Supply method. Additionally, the embedded cost of supply methodology satisfies the guiding principles outlined in the previous section.

As discussed, this method includes three steps – cost functionalization, classification and allocation. The cost functionalization step involves segregation of cost into generation, transmission and distribution. Utilities may separate retail supply costs from distribution with a plausible advent of retail supply competition. The functionalized cost components are then classified into demand, energy and customer related costs. The last step involves allocation of the cost to different consumer categories, which may be done using several methods such as coincident peak demand approach, non-coincident peak demand approach etc.

2.4.3. Stakeholder Consultation

In light of the impact of the CoS determination process on final tariffs, it is clear that it is important to take cognizance of the views of all Stakeholders involved before finalizing an ideal approach. This is because, the CoS determination process and its implementation shall deeply affect consumers, DISCOMs, Regulators and the Government in its decisions/laws in the following ways:

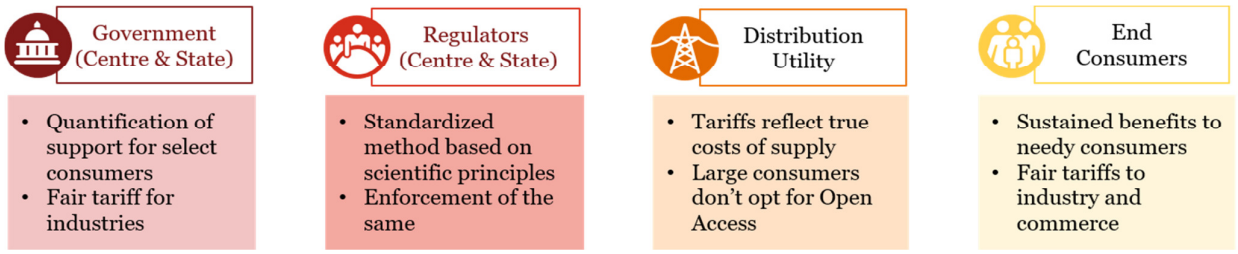


Exhibit 16: Stakeholder wise impact of CoS determination

The stakeholder discussion revolved around issues such as need for policy and regulatory interventions with respect to CoS determination, current ability and readiness of DISCOMs, the possible approaches of Cos Determination and ecosystem enablers to support in development of a robust scientific methodology to determine CoS.

The outcomes of the discussion points revolved around themes such as, need for harmonization of the current Acts/Policies/Drafts, institutional strengthening for policy making and implementation, standardization of methodologies/ approaches through formats and establishment of benchmarks to measure progress/impact.

2.5. Case Study: Telangana

Section 2.4.2 highlighted that in order to effectively determine the cost incurred by DISCOMs to serve its customers, it was necessary to identify the costs imposed on the system by each consumer category. Preceding this, the As-Is review in Section 2.3.2 revealed that in order to proceed with determination of CoS, it is important to take into the consideration, the regulatory progression and data readiness of a State.

The review helped in grouping the selected States into buckets of overall progression. The grouping serves the purpose of determining a model State where the progressive methodology of Category-wise CoS could be fully implemented and be then cited as an example for the remaining States of India. Hence, out of the Group 1 states (refer to Exhibit 25), the State of Telangana was selected for a detailed analysis. The current scenario has been illustrated below briefly followed by a set of recommendations as per the methodology devised in this report.

2.5.1. Current Scenario

The Commission outlined the determination of category wise CoS in the Tariff Order (**Exhibit 42**) while mentioning the assumptions, as follows:

- The Licensee computed CoS, considering two peak demands i.e. morning and evening peak. However, Commission considered only the evening peak demand, since it is a natural peak demand.
- The Class Load Factor and Maximum Coincident factor of peak demand for each category has also been utilized to arrive at the CoS.

Cost Functionalisation:

- Functionalization of cost under the heads of Generation, Transmission, Distribution and Retail Supply. PGCIL and ULDC charged are included under the Transmission cost category.

Cost Classification:

- Post functionalization, all the costs are classified into demand related and energy related costs based on the nature of the cost components.

Cost Allocation:

- Further these three categories of costs are allocated to individual consumer categories based on the specific allocation factor mentioned below.

Demand Related Costs	Energy Related Costs
• Generation fixed (capacity) cost has been	• Variable cost of Generators have been allocated

Demand Related Costs	Energy Related Costs
allocated using Coincident Peak Demand (Evening).	in the proportion of sales to respective customer categories by duly grossing up sales at each voltage level with the approved voltage wise technical and commercial losses.
• Transmission costs consists of Inter State and Intra State transmission costs, which include SLDC and ULDC charges. • These costs have been allocated using factors such as Contract Maximum Demand for categories where available and Non-Coincident demand for the remaining categories. • Further, the costs have been allocated considering the approved transmission losses.	• Retail supply costs such as Interest on consumer security deposits, other costs and Supply margin have been allocated in the proportion of sales to respective customer categories by duly grossing up sales at each voltage level with the approved voltage wise technical and commercial losses.
• Distribution cost has been allocated in two stages as follows: ○ The cost has been first allocated based on voltage wise assets proportion i.e. 33kV, 11kV and LT voltage. ○ The costs have been allocated based on the voltage wise approved losses, which consists of technical and commercial losses. ○ Further cost has been allocated to categories based on Contract demand and Non-Coincident demand as done in the case of transmission costs.	• Post such allocation of all cost components to the individual consumer categories, per unit CoS is arrived at by dividing such cost by the category approved sales.

Exhibit 17: Telangana: Methodology adopted for CoS determination

The final cost allocation parameters of each cost and its allocation to consumer categories are as below:

Generation		Transmission	Distribution					
Power Purchase Cost		Transmission Costs	O&M		ROCE	Depreciation	Interest on consumer security	Other Costs
Fixed	Variable	Fixed	Fixed & Variable		Fixed	Fixed	Variable	F & V
Demand	Energy	Demand	Demand	Customer	Demand	Demand	Energy	Demand
Coincident Demand (adjusted by 40% for Agriculture since supply kept optimal when capacity is idle)	Loss-adjusted category energy consumption	LT: Non-coincident demand HT: Contracted demand	80% of costs LT: Non-coincident demand HT: Contracted demand	20% of costs Bases on number of consumers	LT: Non-coincident demand HT: Contracted demand	LT: Non-coincident demand HT: Contracted demand	Energy consumption grossed up for losses	LT: Non-coincident demand HT: Contracted demand

Exhibit 18: Telangana: Allocation of costs among categories

2.5.2. Recommendations

The Commission and DICSOMs have attempted to accurately classify the Category-wise Cost of Supply using a number of assumptions. Though the methodology adopted directs to broadly appropriately allocate costs to customer categories, the following stage-wise recommendations shall help achieve finer results:

Cost Classification:

- ***Absence of Classification into fixed and variable costs:*** In the methodology adopted by the Licensees, only selected cost such as Power purchase Costs have been classified as fixed or variable. There could be a difference in the nature of costs while incurred, however at the time of determining tariffs, they could be interpreted differently. For. E.g: the costs of transmission function is translated as fixed costs to

the retail supply function. However, in the present context, not all the fixed costs are transferred to consumers as fixed component in the tariff. Some of the fixed costs are translated as variable costs for recovery from consumers**.**

- ***Inappropriate classification:*** All the functionalized costs have been classified as either 100% demand or 100% energy based. The sample classification matrix for Retail Supply Costs is illustrated below:

Retail Supply ARR	Demand	Energy	Customer
O&M Costs	0.00%	100.00%	0.00%
Depreciation	0.00%	0.00%	0.00%
Advance Against Depreciation (AAD)	0.00%	0.00%	0.00%
Special Appropriations	0.00%	100.00%	0.00%
Supply Margin	0.00%	100.00%	0.00%
Other Expenditure - Interest on CSD	0.00%	100.00%	0.00%
Less: IDC & Expenditure Capitalised	0.00%	0.00%	0.00%

Exhibit 19: Cost Classification approach in Telangana

However, costs such as O&M and Interest on CSD are not entirely energy related. The costs currently have not been attributed to customers. For correct classification across all functions, the underlying cost drivers for each cost head must be reviewed periodically and classified accordingly.

Cost Allocation:

- ***Demand related:*** Currently all demand related costs have been allocated based on the Non-Coincident Peak Demand at relevant interfaces for Generation, Transmission and Distribution demand costs. In the Literature Review section, three methods of allocation of demand costs emerged, which could be considered:
    - Co-incident Peak Demand
    - Non-Co-incident Peak Demand
    - Average and Excess

  The DISCOMs of Telangana have conducted load research studies to capture non-coincident peak demand as well as co-incident peak demand in the morning and evening hours. To refine the allocation, we recommend to use a mixture of co-incident peak demand and non co-incident peak demand allocation factors to classify costs, for example:
    - **Generation-Demand Costs:** Non-Coincident Peak Demand allocation factor
    - **Transmission-Demand Costs:** Non-Coincident Peak Demand allocation factor
    - **Distribution-Demand Costs:** 12 Coincident Peak Demand allocation factor
- ***Energy Related:*** While the technical losses at each voltage level have been determined and thereafter appropriately proportioned across categories based on sales and asset utilization, the commercial losses have been identified only up to the voltage level and then estimated category-wise. The DISCOM needs to strengthen its ERP and metering systems to grasp the exact commercial losses to be able to appropriately allocate costs
- ***Customer related:*** As suggested above, there must be costs classified as customer related and the allocation factor could be on the basis of number of actual number of consumers and weighted number of consumer methods. Given the data availability with the DISCOM, the weights could be on the basis of category average meter costs. Eventually, the DISCOM could progress to category average service costs.

3. Module B: Providing a scientific framework for Power Utilities and Regulators to make an informed decision on tariff revisions for residential consumers by factoring in social impact & tariff affordability

3.1. Context

Low-income households in India spend a substantial share of their income on utility services such as electricity, heating and water. The difficulty these socially vulnerable households have in affording further tariff increases is often used as an argument against tariff reforms. Further, improvements in the quality and supply of electricity services require that the underfunded energy utilities are put back on a sound financial footing. In practice, this will mean higher capital expenditure by utilities which translates into higher electricity tariffs for consumers, further deteriorating their affordability. The Govt. recognizes this and has measures such as cross-subsidies and tariff subsidies for the needy consumer groups. However, the current process is not scientific in approach and is heavily influenced by socio-political factors leading to a gap between the intended benefits and the actual beneficiaries. To prevent this and to ensure proper targeting of subsidies, it is necessary to develop a scientific methodology to assess the social impact of electricity tariff. On determining the actual needy group of consumers and the amount of benefit appropriate for them, the Govt. shall be able to better frame policies and schemes to help these households.

Therefore, in this section, we shall first review the methodologies adopted globally for social impact assessment of electricity tariffs on households by studying international research reports. Following which, we then perform an as-is review of the current practices in India regarding social impact of electricity tariffs and methodologies used to address it. Thereafter, we finalize the approach to be adopted for social impact assessment on consumers and the methodology for implementing the approach. To understand the acceptability of the proposed methodology a Stakeholder Consultation is conducted and based on the suggestions and modifications, we finally apply our derived framework on a State and provide our recommendations through a Case Study.

3.2. Literature Review: Global approaches to assessing best practices on Tariff Affordability

The objective of this section is to develop a view on approaches followed across the world for social impact assessment of electricity tariffs on consumers. The key takeaways from the literature surveys can then be used to refine and finalize an approach for doing the social impact assessment of electricity tariffs in India. In order to achieve this with an all-round perspective, we reviewed the methodologies followed for social impact assessment in following international research reports of past –

12. Implementing Energy Subsidy Reforms An Overview of the Key Issues, World Bank 2012
13. Climate Change and the World Bank Group, Phase 1: An Evaluation of World Bank Win-Win Energy Policy Reforms, World Bank, 2008
14. Household fuel and energy use in developing countries, World Bank, 2003
15. European Bank for Reconstruction and Development (EBRD), Working paper No. 92, 2005

16. Residential Electricity Burden, an Investigation of American Community Survey Data 2006 – 2008, Austin Energy, 2010
17. World Bank Assessment of Household Energy Deprivation in Tajikistan, World Bank 2014
18. Analysis of the Kyrgyz Republic's Energy Sector, World Bank 2017
19. Power Tariffs Caught between Cost Recovery and Affordability, African Region, World Bank, 2011
20. Balancing Act: Cutting Energy Subsidies vs Affordability, World Bank 2013
21. District Heating and Electricity Tariff and Affordability Analysis, Republic of Moldova, World Bank, 2015
22. Beyond Connections : Energy Access Redefined, World Bank 2015

Each of these reports studies the tariffs across a wide spectrum ranging from standalone electricity tariff, water tariff to overall energy tariff with the perspective of impact of current levels of tariffs or hike in tariff on society in general and consumers in particular.

3.2.1. Research Outcomes

On studying the research reports, a clarity was obtained on key issues surrounding the ideal approach and measurement of social impact of tariffs:

Issue	Research Outcome
How do we measure affordability in a scientific manner?	The literature review establishes **Tariff Affordability Ratio (TAR)** as a reliable parameter to measure affordability of electricity in households
How do we map the parameters of affordability across income groups and access levels?	Affordability can be mapped by measuring TAR across: • Income / household expenditure levels (deciles/quintiles etc.) • Energy access levels
What are the benchmark ranges of affordability?	The acceptable range of electricity tariff affordability in households of developing economies has been established in the range of **~3% - 5%**
What is the appropriateness of current lifeline tariffs?	Studies suggest the need to critically evaluate the effectiveness of lifeline tariffs; • Income / household expenditure levels: in many countries it is found that poorest 20% have the highest TAR • Energy access level: adequacy of lifeline kWh limit vs access tiers
Targeting and quantification of subsidies	Studies suggest quantification of subsidies from the point of view of bringing TAR within an acceptable range for consumers across various income / expenditure levels

Exhibit 20: Research outcomes on Affordability on International Literature review

3.3. National Review: As-Is Analysis

On reviewing the international literature conducted by organizations such as World Bank in multiple geographies, it is evident that there exist multiple methodologies to assess the social impact of tariffs on residential households. However, it is important to study the scenario in India with respect to existing Policies/Regulations and its adherence by States to understand the possible way forward. This section shall review the existing Policy framework, study the existing practices across selected States to address affordability of tariffs and identify the key issues prevalent across the country.

3.3.1. Review of Policy Framework

The review of the existing Regulations such as the Electricity Act, 2003 and its draft amendments, the National Electricity Policy, 2005 and the National Tariff Policy, 2006 & amendments reveal that the Govt. is aware of the implications of unaffordable tariffs for residential consumers especially the marginalized households. While the Govt. is concerned about tariff recovery, almost all States have provisions for subsidized electricity for low consumption categories. However, a major assumption evident is that low electricity consuming households are necessarily low income households, hence the benefits. While there is a strong co-relation between the two, it is not sufficient a conclusion to draw and accordingly decide a certain consumption band for which benefits are provided.

The review also suggested that going forward, the Govt. is in favour of opting the direct benefit transfer route to ensure plugging of leakages and channelized subsidies, thus giving scope to policy makers to use other aspects such as income/expenditure levels to decide on the beneficiaries. Additionally, it clarified the definition of needy customers by quantifying a basic consumption level of electricity rather than overall income/expenditure levels

3.3.2. Initial Selection of States

In order to review existing approaches towards handling affordability of tariffs among residential consumers, fifteen state were selected for this study. These include the states of **Delhi, Haryana, Punjab, Uttar Pradesh (U.P), Telangana, Andhra Pradesh (A.P), Tamil Nadu, Madhya Pradesh (M.P), Rajasthan, Maharashtra, Gujarat, Bihar, Orissa, Tripura and Assam**. The selection of these states was influenced by the criteria of adequate regional representation, poverty levels and current provisions to address affordability of tariffs.

3.3.3. Review of the As-Is Scenario

The National policy review in the earlier section revealed that there are no clear methodologies or benchmarks associated with determination of tariff affordability. Additionally there is also no linkage to income levels of a household, instead there is a co-relation between electricity consumption levels and the subsidies received. Keeping this in mind the tariff structures in each of the selected States have been reviewed based on the following three parameters to assess the level of affordability considered by the Govt. and DISCOM presently for the low consumption households.

- **Lifeline Categories:** Defined by the basic consumption level of a household per month. It differs from State to State. The cost coverage of these lifeline categories is analyzed to measure the implicit benefit.

- **Cross Subsidies**: The levels of tariff deviation from the cost of supply to the levied tariffs, in order to reduce the burden of the consumers perceived to have lower capacity to bear electricity expenditures i.e. Residential consumers. An analysis of the cross-subsidy levels vis-à-vis the Average Billing Rate (ABR) has been carried out

- **Direct Subsidy levels:** Direct subsidies to needy consumers by the Govt., either through subsidized tariffs or direct benefit transfers. An analysis of the subsidy amount to consumer categories vis-à-vis the overall ARR of the DISCOM has been done to quantify the burden on the Govt. exchequer.

Lifeline Categories:

State	T.O Year	Tariff Category	CoS (A/V/C)[4]	Tariff ABR @ 30 kWh		Subsidized ABR @ 30 kWh		Description
				ABR	Coverage	ABR	Coverage	
				(₹ /unit)	%	(₹ /unit)	%	
Delhi (BRPL)	FY 2018-19	Domestic	7.47	7.17	95.94%	5.67	75.86%	FC: ₹ 125/kW/Month up to 2 kW EC: ₹ 3/kWh up to 200 Units consumption Subsidy: 50% of EC up to 200 Units / Month
Haryana	FY 2018-19	Domestic	7.58	3.83	50.57%	3.83	50.57%	Energy Charges: ₹ 2.7/kWh up to 50 Units consumption Minimum Charge: ₹ 115/Month
Punjab (PSPCL)	FY 2018-19	BPL	6.68	0.00	0.00%	0.00	0.00%	Free supply up to 200 units with connected load up to 1000W to Non-SC/ BPL consumers
Uttar Pradesh	FY 2018-19	Lifeline	6.73	4.67	69.34%	4.67	69.34%	FC: ₹ 50/kW/Month up to 1 kW EC: ₹ 3/kWh up to 100 Units consumption
Telangana	FY 2018-19	LT I(A)	7.31	1.45	19.84%	1.45	19.84%	Energy charges at ₹ 1.45/unit for <50 units consumption Minimum Charge: ₹ 25/Month for contracted load of 1000W and below
A.P	FY 2019-20	Domestic (Group A)	6.28	1.45	23.09%	1.45	23.09%	Energy charges at ₹ 1.45/unit for <50 units consumption Minimum Charge: ₹ 25/Month for contracted load up to 500W
Tamil Nadu	FY 2018-19	Domestic	5.85	3.00	51.28%	0.00	0.00%	FC: ₹ 15 / Consumer EC: ₹ 2.50 / kWh Subsidy: Free supply up to 50 Units per Month

[4] The most progressive CoS value has been considered ie. CategoryCoS where available followed by VCoS and lastly ACoS.

State	T.O Year	Tariff Category	CoS (A/V/C)[4]	Tariff ABR @ 30 kWh		Subsidized ABR @ 30 kWh		Description
				ABR	Coverage	ABR	Coverage	
				(₹ /unit)	%	(₹ /unit)	%	
MP	FY 2018-19	LV 1.1 (SC/ST BPL Consumers)	6.03	3.10	51.41%	0.00	0.00%	FC: NIL EC: ₹ 3.1 / kWh for up to 30 Units / Month Subsidy: 1. SC/ST BPL Consumers - Free up to 25 Units per Month 2. Other Consumers - Subsidy of ₹ 1.10 / Unit up to 30 Units / Month
		LV 1.1 (Other Consumers)	6.03	3.10	51.41%	2.00	33.17%	
Rajasthan	FY 2018-19	Lifeline	7.02	6.83	97.34%	3.93	56.03%	FC: ₹ 100 / Consumer EC: ₹ 3.50 / kWh Subsidy: FC-Rs 30 per consumer; EC-Rs. 1.9/Unit
Maharashtra	FY 2018-19	LT 1(A)	7.40	1.73	23.33%	1.73	23.33%	FC: ₹ 20 / Consumer EC: ₹ 1.06 / kWh Subsidy: NIL
Gujarat	FY 2018-19	Lifeline	5.23	3.16	60.41%	3.16	60.41%	FC: ₹ 5 / Consumer for BPL EC: ₹ 1.50 / kWh up to 30 Units / Month FPPPA: ₹ 1.49 / kWh Subsidy: NIL
Bihar (NBPDCL)	FY 2019-20	Kutir Jyoti (metered) (BPL)	6.91	6.48	93.83%	6.48	93.83%	FC: ₹ 10/Month/Connection EC: ₹ 6.15 / kWh up to 50 Units / Month
Orissa	FY 2018-19	Kutir Jyoti	4.88	2.67	54.64%	2.67	54.64%	FC: ₹ 80 / Month EC: NIL up to 30 Units consumption Subsidy: NIL
Tripura	FY 2014-15	Kutir Jyoti	6.16	4.13	67.10%	3.60	58.44%	FC: ₹ 62/ month for up to 15 kWh Consumption / Month EC: NA Subsidy: ₹ 8 / Month

State	T.O Year	Tariff Category	CoS (A/V/C)[4]	Tariff ABR @ 30 kWh		Subsidized ABR @ 30 kWh		Description
				ABR	Coverage	ABR	Coverage	
				(₹ /unit)	%	(₹ /unit)	%	
Assam	FY 2018-19	Jeevan Dhara	7.35	5.34	72.65%	5.00	68.03%	FC: ₹ 20/ month up to 1 kW EC: ₹ 4.60 / kWh up to 30 kWh / Month Subsidy: ₹ 8 / Month

Exhibit 21: Coverage levels of Lifeline Categories in select States

Cross Subsidies:

State	Tariff Category	ABR	ACoS	VCoS	Category CoS	ABR to CoS (%)	Cross Subsidy Level (%)
Delhi (BRPL)	Domestic	6.01	7.47	-	-	80.5%	19.5%
Haryana	Domestic	5.06	-	7.58	-	66.7%	33.27%
Punjab (PSPCL)	Domestic	6.66		-	6.68	99.7%	0.29%
Uttar Pradesh	Domestic	5.09	6.73	-	-	75.6%	24.37%
Telangana	LT Domestic	4.30	6.04	-	7.31	58.9%	41.12%
A.P	LT-I Domestic	3.81	6.06	6.28	-	60.7%	39.26%
Tamil Nadu	Domestic	4.32	5.85	-	-	73.8%	26.2%
MP	LV-1 Domestic	6.07	6.03	6.08	-	99.8%	0.2%
Rajasthan	Domestic	6.81	7.02	-	-	97.0%	3.0%
Maharashtra	LT 1: Residential	7.22	7.4	-	-	97.6%	2.4%
Gujarat	RGP	5.36	5.23	-	-	102.6%	-2.6%
Bihar	Domestic- I	6.62	7.35	7.72	-	85.8%	14.2%
Orissa	LV	3.99	4.88	-	-	81.8%	18.2%

State	Tariff Category	ABR	ACoS	VCoS	Category CoS	ABR to CoS (%)	Cross Subsidy Level (%)
Tripura	Domestic	5.64[5]	6.5	-	-	86.80%	13.20%
Assam	Domestic-A	6.11	7.35	7.56	-	80.8%	19.2%

Exhibit 22: Cross-subsidy levels of domestic consumers in select States

Direct Subsidies:

State	Category	Year	Subsidy (₹ Cr)#	ARR (₹ Cr)	Subsidy/ ARR (%)
Delhi (BRPL)	Subsidy exists on energy charges for all domestic consumers up to 200 units of consumption, quantification not available				
Haryana	Agriculture	-	7139.72	27960.72	25.5%
Punjab (PSPCL)	Non-SC BPL, agriculture	-	8949.37	29942.69	29.9%
Uttar Pradesh	Rural- LMV-1	-	3760	62095	6.1%
Telangana	Poultry, Domestic, Agriculture	-	4984.3	31137.99	16.0%
A.P	Agriculture, Domestic	-	6938	27764	25.0%
Tamil Nadu	Multiple Categories	FY 2018-19	7693.92	51815.07	14.8%
MP	Multiple Categories	FY 2018-19	10428.69	31767	32.8%
Rajasthan	Multiple Categories	FY 2017-18	10115.65	42597	23.7%
Maharashtra	Agriculture	FY 2016-17	7,780.81	58,955	13.20%
Gujarat	Agriculture	FY 2018-19	536	10365.5	5.2%
Bihar	Multiple Categories	FY 2018-19	3834	16240.41	23.6%
Orissa	-	-	-	-	-
Tripura	Kutir Jyoti	FY 2018-19	0.06	756.89	0.0%
Assam	-	-	-	-	-

Exhibit 23: Direct Subsidies borne by Govt. of select State

[5] Avg. of energy charges for domestic consumers

Research Outcomes

The methods adopted in Indian States for ensuring tariff affordability are restricted to Lifeline Categories, Cross Subsidies and Direct Subsidies. A summary analysis of the 15 Indian states is presented below.

Lifeline Categories	Cross Subsidies	Direct Subsidies
• In 9 out of 15 states reviewed, cost coverage of lifeline categories is below 60% • Haryana, Telangana, AP and 2 other states consider <50 units consumption as lifeline category • UP, M.P, Maharashtra and Bihar consider <30 units consumption as lifeline category • 5 of the 15 states have ~ 25% cost coverage for lifeline categories	• For 5 out of 15 states, cost coverage of Residential consumers is out of +/-20% limit • For 3 states, the cross subsidy level is >30%, and goes as high as 41% • 4 states have cross subsidy level of <10% • Majority of the states use ACoS method to determine cost of supply, although they have been directed to conduct VCoS/CCoS studies	• The 15 states in total have been identified having atleast ~72,000 Cr, of direct subsidies amounting to 18% of respective ARR are given by 15 states • 6 out of the 15 states have significant fiscal burdens i.e. >20% of their ARR • 5 states have <5% of direct subsidies as a % of their ARR • Direct subsidies are mostly directed at Domestic and Agriculture categories, followed by Poultry

3.3.4. Key Issues Identified in National Review

The key takeaways from the National Review of the selected States on the three parameters along with a perspective on the current Policy frameworks highlights the following issues:

1. *Inefficient Allotment of Subsidies*

The current practices award subsidies to certain customer categories not in the basis of the need or quantified burden but by perception and influence of socio-economic and political factors. As result, the State and Central Governments are excessively burdened with fiscal deficit. For instance in Madhya Pradesh, for FY 2018-19, the estimated budget expenditure for the state was Rs. 1.86 Lakh Cr of which tariff subsidy to MP DISCOMs was Rs. 10,365 Cr. i.e. ~5% of the total budget expenditure. Thus there is strong need to adopt a logical approach to determine the subsidy beneficiaries and amounts

2. *Rationalize Subsidy levels for Resident Consumers:*

States currently by default design tariffs such that domestic consumers are cross-subsidized by industrial consumers. There is also a high degree of internal slab level cross-subsidization especially in the domestic category. This practice makes it difficult for DISCOMs to recover revenues. Moreover, there is a need to establish the category of domestic consumers who need affordable tariffs. Thus there is a strong need to ensure sustainable cross-subsidy levels to keep all the consumer categories satisfied

3. *Redesigning needed in legacy tariff slabs*

Current tariff slabs need to be revisited and redesigned to ensure that correct benefits are channelized. Similarly the slabs must accommodate growth in consumption without giving tariff shocks.

3.4. Determining Optimal Methodology to ensure Tariff Affordability using Social Impact Assessment

As observed in the Literature review section, on reviewing the two methodologies of Tariff Affordability Ratio and Energy access level to assess tariff affordability, the optimal approach appears to be the Tariff Affordability Ratio methodology. This methodology is suitable to the Indian context keeping in mind the data availability and the existing regulatory frameworks. Since India is a large country with different sub-economies and expenditure patterns, it is appropriate to adopt a State wise approach to analyze affordability of tariffs through social impact assessment.

3.4.1. Tariff Affordability Ratio – Methodology

The methodology for determining TAR is discussed below:

Step 1: Tariff Affordability Ratio (TAR) is calculated for residential consumer categories of a State in India using the formula below.

$$Tariff\ Affordability\ Ratio\ = \frac{Household\ Expenditure\ on\ Electricity}{Total\ Household\ Expenditure}$$

- **Household Expenditure** is determined using data of fractile wise monthly per capita consumption and average household size in rural and urban areas of a State as per the latest available National Sample Survey Office report on Household Consumption of Various Goods and Services in India
- **Household expenditure on Electricity** is calculated using slab wise electricity consumption data of the desired State for which affordability needs to be assessed.

Step 2: Social Assessment of electricity tariffs by developing:

- **Benchmarking** of Affordability Ratio from studies conducted to determine a 'Acceptable Tariff Affordability Ratio'
- **Affordability Matrix** which illustrates TAR metric for different levels of household expenditure
- **Weighted average Affordability Matrix** which illustrates the overall tariff affordability of a particular tariff slab

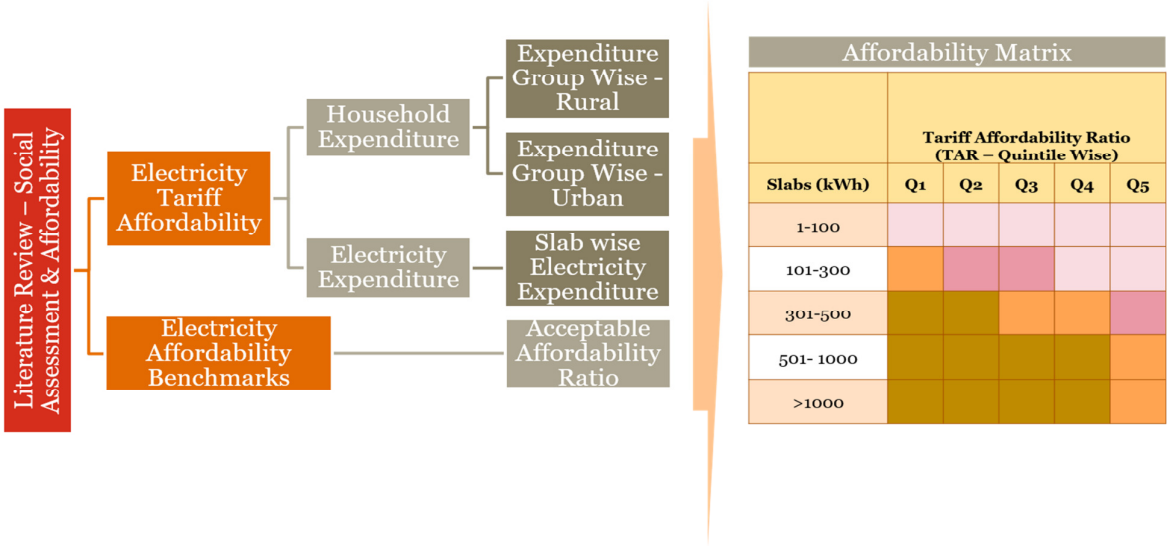


Exhibit 24: Tariff Affordability Matrix

3.4.2. Stakeholder Consultation

The methodology proposed above intends to serve a crucial purpose to all Stakeholders associated in the power distribution sector. For example, the Government's stimulus for an effective affordability framework would be to ensure that effective targeting of subsidies is done i.e. appropriate level of subsidy is given and it is targeted towards the needy consumer segments. Electricity being affordable would also help complement the improvement in electricity access levels. Regulators would prefer a scientific tool for assessing affordability, which can not only help in calibrating tariff hikes, but also in framing principles of tariff slab designs. On the other hand, from a DISCOM's point of view, a scientific assessment of affordability shall help them in building their case for better recovery of revenue from customers within boundary conditions of acceptable affordability benchmarks. Finally, the end consumer shall get benefited if the framework builds in consideration of differential impact across various income groups, while ensuring relief to needy consumers.

The stakeholder discussion revolved around issues such as modification of policies to define linkage between tariff and affordability, need for enshrinement of scientific principles of affordability, required capacity building activities for subsidy quantification, need for State-wise tailored affordability metrics based on consumer's needs.

The outcomes were mostly in agreement to the solutions suggested. Additionally, there was actionable suggestions such as need for State-wise pilot studies for determining affordability of tariffs, introduction of 'policy cost' in Utilities to generate funds for capacity building for measuring subsidy needs, formation of independent committees to mandate and monitor studies on instrumentalities that would facilitate tariff design and provide oversight and formulation of standardized templates for data collection across States with respect to affordability.

3.5. Case Study: Bihar

3.5.1. Current Scenario

The Government of Bihar gives a resource gap grant to the DISCOMs to be used for subsidy to agriculture and rural domestic and non-domestic consumers. Additionally, a tripartite MoU of UDAY scheme which was signed by the Government of India, Government of Bihar and the DISCOMs provides for State Government support towards subsidy to BPL and rural consumers beginning from FY 2015-16 to FY 2019-20. In this arrangement, the DISCOMs receive financial support from the State Government on a monthly basis, which is reflected in the electricity bill of the consumer. The Commission considers this amount as part of revenue. The DISCOMs are directed to apprise the State Government at the end of every month, category-wise details of energy sales billed amount with approved tariff rate, subsidy amount and total subsidy amount to be adjusted to the DISCOM by the Government.

The Commission opines that it has increased the tariff of the BPL, rural domestic and agricultural consumers to the extent possible of recovering the cost of supply of electricity. However, it is conscious of the fact that sudden shift to fully cost reflective tariff rates would cause undue hardship to these erstwhile subsidized categories of consumers. Hence the Commission has considered cross subsidization of tariffs of these customers to the extent possible. However, the Commission observes that the category of cross-subsidizing consumers is small and with the current policy (cross-subsidization within +/- 20% of ACoS), the cushion available to provide benefit to the needy customers is limited.

3.5.2. Recommendations:

The current methodology adopted by the Commission heavily relies on cross-subsidization and direct subsidy from the Govt. to the whole category of BPL, rural domestic and agricultural consumers. This blanket approach of tariff leniency on consumers without studying their capacity to bear the expenditure is a suboptimal way to allocate the State resources. It is highly probable that there are many consumers at the higher spectrum of income within each category, who are reaping undue benefits of the intentions of the Govt. to support the needy.

To understand the impact of tariffs and measure the current affordability of it, a study on the domestic consumers of Bihar has been carried out using the methodology of Tariff Affordability Ratio as outlined in the earlier sections.

3.5.2.1. Analysis of Household Expenditure

Household Expenditure information for Bihar was obtained from the report by NSSO on Household Consumer Expenditure across Socio-Economic Groups, 2011-12 as part of its 68th round of surveys. The information has been organized and compared fractile wise where the first fractile (F1) refers to the bottom 5% population and the twelfth fractile refers to the top 5% of the population in terms of household consumption / expenditure. The third to the tenth fractile bucket the population in batches of 10%. The information for monthly consumption per capita for rural and urban areas of Bihar is as follows –

Fractile		Monthly Consumption per capita (Rs.) in 2011-12		Monthly Consumption per household (Rs.) 2011-12[6]	
		Rural	Urban	Rural	Urban
F1	0%-5%	525	559	2781	2838
F2	5%-10%	656	654	3475	3320
F3	10%-20%	741	800	3925	4061
F4	20%-30%	844	927	4471	4706
F5	30%-40%	927	1044	4911	5300
F6	40%-50%	1001	1185	5303	6016
F7	50%-60%	1073	1302	5684	6609
F8	60%-70%	1167	1494	6182	7584
F9	70%-80%	1299	1800	6881	9137
F10	80%-90%	1521	2289	8057	11620
F11	90%-95%	1800	2894	9535	14691
F12	95%-100%	2413	4352	12782	22092

Exhibit 25: Analysis of monthly household expenditure in Bihar for 2011-12

As can be seen from the table above, there is a wide disparity in the household consumption across the State between the consumption fractiles, in both rural and urban areas. This clearly demonstrates the need to study impact of tariff increase on various socio-economic strata of the State.

3.5.2.2. Projection of household expenditures in future

The information on household expenditure discussed in the section above pertains to data of 2011 – 12 and needs to be projected to 2018-19 to ascertain the current affordability scenario. Since no latest study on household expenditure / consumption was available post the 68th round of surveys conducted by NSSO, it was decided to carry out projections based on historical inflation to arrive at current levels of the expenditure / consumption while assuming that the expenditure patterns over the time period shall remain constant.

Inflation – Consumer Price Index

In order to project the household expenditure, determination of overall is required. Consumer Price Index since 2011-12 for Bihar was obtained from the monthly publications of Ministry of Statistics and Programme

[6] Multiplied with the Average Household(HH) Size; Avg. Rural HH Size-5.30; Avg. Urban HH Size-5.08 (Source: Household Consumer Expenditure across Socio-Economic Groups, 2011-12)

Implementation (MOSPI) Central Statistics Office NSSO. The CAGR of annual averages for 6 year, 5 year and 3 year periods is as follows:

Period	Method	Rural	Urban
6 years (2012 – 2018)	CAGR - Annual Avg.	6.4%	5.4%
5 years (2013 – 2018)	CAGR - Annual Avg.	5.3%	4.6%
3 years (2015-2018)	CAGR - Annual Avg.	3.9%	3.6%

Exhibit 26: 3 years, 5 years and 7 years rural and urban inflation in Bihar

For the purpose of this analysis, the 5 year CAGR for household expenditure projection was considered. The result is demonstrated in the section below.

Projection of household expenditure

Based on the fractile wise breakup of household expenditure (**Exhibit 64**) and historical inflation **(Exhibit 65 & 66)**, the projections of household expenditure were carried out for Rural and Urban areas for overall Bihar.

Rural Expenditure: *all values in Rs. per month*

Fractile	2012- 13	2013- 14	2014-15	2015-16	2016-17	2017-18
F1	2929	3084	3248	3420	3602	3793
F2	3659	3854	4058	4274	4501	4740
F3	4133	4353	4584	4827	5084	5353
F4	4708	4958	5222	5499	5791	6098
F5	5172	5446	5735	6040	6361	6698
F6	5585	5881	6193	6522	6868	7233
F7	5986	6304	6638	6991	7362	7753
F8	6510	6856	7220	7603	8007	8432
F9	7246	7631	8036	8463	8912	9385
F10	8485	8935	9410	9909	10435	10989
F11	10041	10574	11136	11727	12350	13005
F12	13461	14175	14928	15720	16555	17434
Average Monthly Consumption per Household (Calculated)	6166	6493	6838	7201	7583	7986

Exhibit 27: Household Expenditure projection in Rural Bihar from 2012-13 to 2017-18

Urban Expenditure: *all values in Rs. per month*

Fractile	2012- 13	2013- 14	2014-15	2015-16	2016-17	2017-18
F1	2968	3104	3246	3395	3551	3714
F2	3472	3631	3798	3972	4154	4344
F3	4247	4442	4645	4858	5081	5314
F4	4922	5147	5383	5630	5888	6158
F5	5543	5797	6063	6341	6631	6935
F6	6292	6580	6882	7197	7527	7872
F7	6912	7229	7560	7907	8269	8648
F8	7932	8295	8675	9073	9489	9924
F9	9556	9994	10452	10931	11432	11956
F10	12153	12710	13292	13901	14538	15205
F11	15364	16069	16805	17575	18381	19223
F12	23105	24163	25271	26429	27641	28907

Average Monthly Consumption per Household (Calculated)	8539	8930	9339	9767	10215	10683

Exhibit 28: Household Expenditure projection in Urban Bihar from 2012-13 to 2017-18

It can be observed from the above sections, that the overall household expenditure in urban areas is higher than that of rural areas, however, as per historical data, the yearly average inflation in rural Bihar is significantly higher than that of urban Bihar.

3.5.2.3. Analysis of electricity expenditure

In order to estimate the electricity expenditure of residential consumers, the average monthly consumption of consumers in a particular tariff slab has been multiplied with its respective energy charge and adjusted for fixed charge. For instance, an urban consumer with a 1kW connection paying tariff under 0-50 kWh slab consumes an average of 30 units of electricity in a month. Therefore 30 units multiplied by Rs. 6.15 plus Rs 20 as fixed charge gives us the average monthly electricity expenditure of a consumer falling in lowest slab of 0-50 units consumption in a month. The average monthly consumption in each tariff slab has been calculated as follows –

We obtained data from SBPDCL for number of consumers and energy sales in each tariff slab and the corresponding fixed and energy charges[7] for the year 2018-19[8], as follows –

Slab	Total Connected Load (kW)	Total Consumers (No.)	Total Energy Sales (MU)	Fixed Charge		Energy Charge (Rs. / kWh)
				Rs./conn/ month	Rs/kW/month	
Kutir Jyoti(KJ)						
Unmetered	7,204	70,895	97.7	350.00	-	-
Metered (0-50)	659,973	6,218,914	3,667.0	10.00	-	6.15
Total - KJ	**667,177**	**6,289,810**	**3,764.7**			
DS-I (Rural)						
Unmetered	915,211	867,414	1,033.8	500.00	-	-
Metered						
First 50 Units	4,321,970	4,160,338	3,146.6	-	20.00	6.15
51 - 100 Units	493,924	474,807	705.0	-	20.00	6.40
Above 100 Units	297,274	286,295	1,426.2	-	20.00	6.70
Total – DS-I	**6,028,380**	**5,788,854**	**6,311.6**			
DS-II (Urban- Demand Based)						
1-100 U/Month	2,664,831	1,312,922	986.2	-	40.00	6.15
101 - 200 U/Month	2,034,501	774,207	1,638.4	-	40.00	6.95
201 -300 U/Month	1,104,061	415,033	1,528.3	-	40.00	7.80
above 300 U/Month	326,449	142,736	660.7	-	40.00	8.60
Total - DS II	**6,129,842**	**2,644,897**	**4,813.6**			
Total - Domestic	**12,825,398**	**14,723,561**	**14,889.9**			

[7] Fixed and Energy Charges values taken from Tariff Order for SBPDCL dated 21st March 2018
[8] Actuals for first six months of FY 2018-19, thereafter projected values for consumers, connected load and energy sales

Exhibit 29: Consumer, energy and revenue data for FY 2018-19 for Bihar

The data signifies for instance, that in the slab of 101-200 units of DS-II, a total of 1,638.4 MU are estimated to be billed in FY 2018-19. However, the tariff slabs of EDL are telescopic in nature i.e. a consumer who consumes more than 300 units of electricity in a month in DS-II category, pays an energy charge of Rs. 6.15 for its first 100 units of consumption, Rs. 6.95 for its next 100 units of consumption (101 to 200 units) and so on. Therefore the 774,207 consumers in the slab of 101-200 units in addition to the energy charge of Rs. 6.95 for units falling in this slab, have been billed as per the tariffs of previous slabs for the 1-100 units. Also, the 1,638.4 MU billed in this slab include units from the higher slabs i.e. 201-300 units and > 300 units and will also be billed in greater slabs for the 100 units of 101-200 slab.

For our analysis we require that for instance, if there are 100 consumers which consume between 101 to 200 units in a month i.e. one consumer consumes 122 units, another consumes 150 units and yet another consumes 199 units and so on, what is the average usage of these consumers in a month. For calculating this figure using the data provided by SBPDCL (combined data for FY 2018-19 has been used in the analysis below) the following two adjustments have been made:

- **Addition of units from preceding slabs** –This has been done by multiplying the number of consumers in a slab with the lower limit of their slab. For instance, 774,207 consumers of slab 101-200 units used 774,207 *100 units of energy in the preceding slabs which will get added to their total consumption.
- **Deduction of units for succeeding slabs** – the addition which has been made in the above calculation for consumers of slab 101-200 would entail corresponding reduction in usage from preceding slabs. To calculate that, the number of units in a slab have been multiplied with the number of consumers in the succeeding slabs, and deducted from the slab under consideration. For instance 100 units of slab 101-200 units have been consumed by 415,033 consumers of slab 201-300 units and 142,736 consumers of slab >300 units also. This energy would be added to their respective consumers on account of calculating 'addition of units from preceding slabs' and therefore needs to be deducted from consumption of slab 101-200 units.

After making the above two adjustments to the data provided by SBPDCL, the total consumption of a slab is divided by its total number of consumers to calculate the average monthly consumption in each slab, as follows:

Slab	Total Consumers	Total Energy Sales	Addition of units from preceding slabs	Deduction of units for succeeding slabs	Effective no. of units in slab	Average Monthly Consumption – Slab wise
	(Number)	(MU)	(kWh)	(kWh)	(kWh)	(kWh)
Kutir Jyoti(KJ)						
Unmetered	70,895	97.7	-	-	97,682,821	114.8
Metered (0-50)	6,218,914	3,667.0	-	-	3,666,975,503	49.1
DS-I (Rural)						
Unmetered	867,414	1,033.8	-	-	1,033,838,432	99.3
Metered						
First 50 Units	4,160,338	3,146.6	-	38,055,112	3,108,523,617	62.3
51 - 100 Units	474,807	705.0	23,740,343	14,314,769	714,416,293	125.4
Above 100 Units	286,295	1,426.2	28,629,538	-	1,454,860,483	423.5
DS-II (Urban- Demand Based)						
1-100 U/Month	1,312,922	986.2	-	133,197,562	852,959,111	54.1
101 - 200 U/Month	774,207	1,638.4	77,420,718	55,776,844	1,660,032,168	178.7
201 -300 U/Month	415,033	1,528.3	83,006,529	14,273,580	1,597,071,357	320.7

Slab	Total Consumers	Total Energy Sales	Addition of units from preceding slabs	Deduction of units for succeeding slabs	Effective no. of units in slab	Average Monthly Consumption – Slab wise
above 300 U/Month	142,736	660.7	42,820,739	-	703,559,024	410.8

Exhibit 30: Calculation of average monthly consumption in each tariff slab of Bihar

From the data derived above it can be observed that for certain tariff slabs, the average consumption lies outside the slab limits. For instance for the tariff slab for 0-50 units of DS-I consumers, the average monthly consumption is 62.3 units. This could be attributable to errors or approximations at the time of recording the units for consumers.

Hence, for the purpose of calculation of slab-wise electricity expenditure, in cases where the average monthly consumption crosses the slab limits, the value has been capped to the upper limit of the slab. As an illustration, the average monthly consumption for the tariff slab for 0-50 units of DS-I consumers has been capped to 50 units for further calculation purposes.

Based on the derivation of Average Slab-wise Consumption from the SBPCL data, the average monthly electricity expenditure for households in each slab have been calculated as shown in table below. The fixed charges have been added to the monthly consumption data. To draw a comparison, the monthly electricity expenditure for both capped and actual consumption values have been illustrated.

Based on the total fixed and energy charges as illustrated in **Exhibit 70**, the overall average billing rate (ABR) for a tariff slab has been computed. The ABR has been used to measure the cost coverage based on the overall Cost of supply of domestic consumers the utility:

				Actual			Capped		
Slab	Revenue from Fixed Charges[9]	Revenue from Energy Charge (A)	Revenue from Energy Charges (C)	Est. Monthly Electricity Expenses (A)	ABR (A)	Cost Coverage (A)[10]	Est. Monthly Electricity Expenses (C)	ABR (C)	Cost Coverage (C)[9]
	i	ii	iii	iv=i+ii			v=i+iii		
	(Rs./month)	(Rs./month)	(Rs./ month)	(Rs./ month)	Rs/ kWh	%	(Rs./ month)	Rs/ kWh	%
Unmetered	350.00	-	-	350.00	3.05	39%	350.00	3.05	39%
Metered (0-50)	10.00	302.20	302.20	312.20	6.35	82%	312.20	6.35	82%
Unmetered	500.00	-	-	500.00	5.03	65%	500.00	5.03	65%
First 50 Units	20.78	382.93	307.50	403.71	6.48	84%	328.28	6.57	85%
51 - 100 Units	20.81	802.48	640.00	823.28	6.57	85%	660.81	6.61	86%
Above 100 Units	20.77	2,837.27	2,837.27	2,858.04	6.75	87%	2,858.04	6.75	87%
1-100 U/Month	81.19	332.95	332.95	414.14	7.65	99%	1,346.95	7.65	99%

[9] Calculated depending on type of connection: Average connected load per consumer(As per Exhibit 70) or charges per connection

[10] VCoS for LT Category combined for SBPDCL and NBPDCL: Rs 7.72 /kWh

				Actual			Capped		
Slab	Revenue from Fixed Charges[9]	Revenue from Energy Charge (A)	Revenue from Energy Charges (C)	Est. Monthly Electricity Expenses (A)	ABR (A)	Cost Coverage (A)[10]	Est. Monthly Electricity Expenses (C)	ABR (C)	Cost Coverage (C)[9]
101 - 200 U/Month	105.11	1,241.83	1,241.83	1,346.95	7.54	98%	2,446.41	7.54	98%
201 -300 U/Month	106.41	2,501.24	2,340.00	2,607.65	8.13	105%	3,624.01	8.15	106%
Above 300 U/Month	91.48	3,532.52	3,532.52	3,624.01	8.82	114%	414.14	8.82	114%

Exhibit 31: Average monthly electricity expenditure for households in each tariff slab of Bihar in FY 2018-19

Based on the monthly electricity expenses and its cost coverage, it can be observed that there is a severe cross-subsidization happening within various tariff slabs within the domestic category. While the lifeline tariff has only 39% cost coverage, the consumers consuming more than 300 units per month in urban areas are covering around 114% of the cost to serve the LT consumers. Thus, to ensure that the intended support benefits are meted out to strictly those who are in need of it an analysis of the impact of these expenditures on each socio economic group within the State is important.

3.5.2.4. Social Assessment

Benchmarking

In order to carry out Social Assessment of electricity tariffs, a threshold needs to be defined to determine what constitutes an acceptable level of electricity utility expenditure. In order to define this threshold, a reliance has been taken on the comprehensive Literature Review completed in Section 3.2 of this report. An attempt has been made to gauge an acceptable range of this benchmark by comparing the tariff affordability ratios / electricity burden / budget share of electricity as illustrated across reports for developing countries. It can be observed that Tariff Affordability Ratio for Electricity is in the range of 2.5% to 5% for most countries. Based on this observation, a benchmark of 5% is selected as an acceptable level for Tariff Affordability Ratio (TAR). Further, World Bank defines a TAR of greater than 10% to be a sign of energy poverty.

From the discussions above, therefore, following can be inferred for *'Acceptable TAR'* benchmarking purpose:

- TAR in the range of 2.5% to 5% is most comfortable range across households
- TAR of less than 2.5% would imply room for tariff hike
- TAR in the range of 5% - 10% would become unaffordable for majority of households *and*
- TAR of more than 10% should be considered as he highest degree of unaffordability, which should be acceptable, if at all necessary, for select few in the affluent bracket

Current Affordability Matrix

In order to carry out the social assessment of electricity tariffs in Bihar, the concept of Tariff Affordability Ratio viewed in light of Acceptable TAR is applied. Affordability Matrix is drawn using TAR metric for different levels of household expenditure. The matrix has been drawn considering average electricity expenditure for each slab and dividing it by household expenditure across expenditure fractiles for urban and rural areas respectively. The procedure is repeated for electricity expenditure across all slabs and for all expenditure fractiles to formulate a final Affordability Matrix for Bihar, across rural and urban areas, as illustrated below:

Slabs	**Affordability Ratio in 2018 – Rural and Urban**											
	F1	**F2**	**F3**	**F4**	**F5**	**F6**	**F7**	**F8**	**F9**	**F10**	**F11**	**F12**
Kutir Jyoti												

Slabs	Affordability Ratio in 2018 – Rural and Urban											
	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12
Unmetered	9.3%	7.6%	6.6%	5.7%	5.2%	4.7%	4.4%	4.0%	3.5%	2.9%	2.4%	1.7%
Metered (0-50)	8.3%	6.7%	5.8%	5.1%	4.6%	4.2%	3.9%	3.5%	3.1%	2.6%	2.1%	1.5%
DS-I (Rural)												
Unmetered	13.2%	10.5%	9.3%	8.2%	7.5%	6.9%	6.4%	5.9%	5.3%	4.5%	3.8%	2.9%
Metered												
First 50 Units	8.7%	6.9%	6.1%	5.4%	4.9%	4.5%	4.2%	3.9%	3.5%	3.0%	2.5%	1.9%
51 - 100 Units	17.4%	13.9%	12.3%	10.8%	9.9%	9.1%	8.5%	7.8%	7.0%	6.0%	5.1%	3.8%
Above 100 Units	75.3%	60.3%	53.4%	46.9%	42.7%	39.5%	36.9%	33.9%	30.5%	26.0%	22.0%	16.4%
DS-II (Urban- Demand Based)												
1-100 Units	11.2%	9.5%	7.8%	6.7%	6.0%	5.3%	4.8%	4.2%	3.5%	2.7%	2.2%	1.4%
101 – 200 Units	36.3%	31.0%	25.3%	21.9%	19.4%	17.1%	15.6%	13.6%	11.3%	8.9%	7.0%	4.7%
201 -300 Units	65.9%	56.3%	46.0%	39.7%	35.3%	31.1%	28.3%	24.7%	20.5%	16.1%	12.7%	8.5%
above 300 Units	97.6%	83.4%	68.2%	58.9%	52.3%	46.0%	41.9%	36.5%	30.3%	23.8%	18.9%	12.5%

Exhibit 32: Tariff Affordability Ratio Matrix in 2018

Weighted Average Affordability Matrix

Based on the analysis done in previous section, it is pertinent to find out the exact pattern of household electricity consumption, which can help us in determining the slab wise tariff affordability from the point of view of tariff path. From the data of slab wise number of consumers of SBPDCL, the distribution of consumers across slabs is calculated. Distribution within each of the tariff slabs has been scaled to a 100% and been considered on a standalone basis to compute the distribution of customers.

For instance, in DS-I, it can be seen that ~72% of the metered consumers consume less than 50 units, ~8% consume between 51 and 100 units while only ~5% consume more than 100 units. As we have calculated affordability ratios across fractiles, we need to portray this consumption pattern across the socio-economic fractiles, as shown in table. For example, out of 15% consumers in unmetered of DS-I, first 5% will have household expenditure in line with first fractile (F1) while 5% will be in line with second fractile (F3) while the remaining 5% will be in line with third fractile(F3). For the next slab, ie. 0-50 units, the first 5% will be in line with F3 and so on.

Slabs	% (actual)	% scaled	Affordability Ratio in 2018 – Rural and Urban											
			F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12
Kutir Jyoti														
Unmetered	0.5%	1.1%	1.1%	-	-	-	-	-	-	-	-	-	-	-
Metered (0-50)	42.2%	98.9%	3.9%	5.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	5.0%	5.0%
DS-I (Rural)														
Unmetered	5.9%	15.0%	5.0%	5.0%	5.0%	-	-	-	-	-	-	-	-	-
Metered														
First 50 Units	28.3%	71.9%	-	-	5.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	6.9%	-	-
51 - 100 Units	3.2%	8.2%	-	-	-	-	-	-	-	-	-	3.1%	5.0%	0.1%
Above 100 Units	1.9%	4.9%	-	-	-	-	-	-	-	-	-	-	-	4.9%
DS-II (Urban- Demand Based)														
1-100 Units	8.9%	49.6%	5.0%	5.0%	10.0%	10.0%	10.0%	9.6%	-	-	-	-	-	-
101 - 200 Units	5.3%	29.3%	-	-	-	-	-	0.4%	10.0%	10.0%	8.9%	-	-	-
201 -300 Units	2.8%	15.7%	-	-	-	-	-	-	-	-	1.1%	10.0%	4.6%	-
Above 300 Units	1.0%	5.4%	-	-	-	-	-	-	-	-	-	-	0.4%	5.0%

Exhibit 33: Weightages of fractiles for calculation of weighted average tariff affordability ratio

Using these weightages, a weighted average tariff affordability ratio is calculated as follows for each tariff slab. As per this method, the current weighted average tariff affordability for various tariff slabs are as follows –

Slab	Weighted Average Tariff Affordability in 2018
Kutir Jyoti	
Unmetered	9.28%
Metered (0-50)	4.17%
DS-I (Rural)	
Unmetered	11.02%
Metered	
First 50 Units	4.39%
51 - 100 Units	5.43%
Above 100 Units	16.39%
DS-II (Urban- Demand Based)	
1-100 U/Month	7.23%
101 - 200 U/Month	13.60%
201 -300 U/Month	15.41%
above 300 U/Month	13.00%

Exhibit 34: Weighted Average Tariff Affordability in 2018

3.5.2.5. Summary

From the weighted average tariff affordability ratios and the tariff structures of each slab, the following can be concluded:

- **Unmetered Consumers:** The tariff structures for both Kutir Jyoti and DS-I appear to be unaffordable, this is perhaps because the utility charges a high one time fix charge per month to protect itself from potential losses in revenue. To ensure the affordability of this tariff, it is recommended to convert all such connections to metered connections and bring them under the tariff slab of 0-50 units.
- **0-50 units:** Across KJ and DS-I categories, the tariff affordability appears to be within the acceptable range of 2.5%-5%, however, the affordability shall be higher on inclusion of the unmetered low income consumers. This shall help the DISCOM to revisit the current tariff structures and propose revisions through appropriate tariff hikes, thereby increasing the revenue recovery from such consumers
- The affordability for remaining consumers appear to be higher than the acceptable ranges due to inappropriate slab designs. The differentiation is based on the economic situation, geographic development and consumption. Having more number of tariff slabs has following disadvantages –
    - Complexity in tariff design
    - Disparity among consumers
    - Difficulty in understanding their bills among consumers
    - Misuse of lower tariffs in bottom slabs by taking multiple connections

In an ideal approach, all the consumers of residential category would pay same tariff rate which is linked to their average cost of supplying power. The consumers who need subsidies should be supported through the direct benefit transfer route by ascertaining the exact quantum of subsidy. However, discarding the current system and shifting to the direct benefit transfer method shall take time to be implemented given the current socio-political scenario and public opinions. Hence as a transitionary measure, the current system could be modified in the following manner before completely shifting to a cost reflective tariff regime. A simplistic method for defining slabs of residential consumer category could be therefore as follows –

- **Lifeline consumers –** a slab of 0 to 30 units in a month would be sufficient for consumers below poverty line would use electricity for very basic needs such as two CFL light bulbs of 20W for 8 hours in a day (~6 units), a fan of 60W for 8 hours in a day (~15 units) , a 22 inch LED TV of 30W for 4 hours in a day (~4 units) and two mobile of 4W each for 4 hours a day (~2 unit)

An alternative approach to decide the size of lifeline tariff slab, could be using the data for poverty. For e.g. As per the poverty headcount of Bihar, ~34% people are below poverty line. An analysis would need to be performed on the consumer base of utility to identify a suitable range of tariff slab such that close to 34%[11] consumers i.e. the BPL consumers, fall in this slab.

- **Defining top consumption slab –** in order to recover the shortfall in revenue for lifeline consumers, a slab above say 500 units in a month maybe defined with marginally higher tariffs than remaining consumers
- **Cost recovery from remaining consumers –** the remaining consumers would be charged the average cost of supplying power at their voltage level

[11] As observed in Exhibit 59

4. Conclusion

4.1. Summary

While the sector has seen several reforms for the players in Generation, Transmission and Distribution, tariffs continue to remain a sensitive topic for all Stakeholders. The reason for this is the current socio-economic structure of the country, which is evident in the guidelines of our policies and Act mandates. However, it is pertinent to understand that the whole power sector can only become financially sustainable and progress forward is if the end consumers play their role in ensuring adequate payment for the service consumed. The current tariff schedules are complex with numerous categories and sub-categories, which continue to be difficult with respect to comprehension of charges. Further, as observed in the review sections of this report, there is a heavy distortion between the cost incurred to serve the category and the actual revenue recovery from it. Additionally, keeping in mind the ability of consumers to pay, several Commissions, Governments and DISCOMs have set up a complex structure of subsidies, with little or no scientific approach.

In the first module, this report attempts to develop a methodology to ascertain cost of supply of electricity in a scientific way. Thereby providing pointers to DISCOMs and Commissions to adopt this approach before designing tariffs. It applied the theoretical approach on a progressive State and provided recommendations for further improvement.

In the second module, the report focusses on improving the current system of subsidies and urges the Stakeholders to revisit the current approach. The report highlights the extensive research carried out to understand better ways to measure the social impact of tariffs and how to build that assessment into tariffs to ensure that the right consumers receive the right benefits. Since, most of the current States of India have a blanket approach wherein all consumers of a category are entitled to receiving subsidy benefits, this report took up a State to elucidate on the suggested methodology for identifying tariff slabs which deserved cushioning from electricity expenditure.

4.2. Way forward

There is an urgent need for intervention at a **National Act level** for both the issues i.e. Determination of cost of supply and measuring social impact of tariffs. It has been observed that the current States are resistant to adopting progressive measures, since the present Acts and Regulations do not strictly mandate these measures. Therefore, there is a need for collaborative efforts between the MoP and the State Govts. To modify and develop progressive provisions in relevant Acts.

Since electricity is classified under the Concurrent List, there is a need for **State specific actions plans** which customizes the National Act to suit the State's consumers, socio-economic level, budget and regulatory frameworks. The State specific action plan must be prepared after a thorough assessment and discussion with all Stakeholders and an independent assessment of the needs of each of the Stakeholder needs to be ascertained. This shall ensure a holistic development of the overall sector.

Lastly to ensure that the action plans are translated into impactful end-results, there needs to be a robust implementation strategy followed by a stage wise monitoring and review plan in each State along with a feedback system for continuous improvement.



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