

# Electricity Pricing and the Willingness to Pay for Electricity in India

Current Understanding  
and the Way Forward

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## TABLE OF CONTENTS

• Executive Summary .....	7
1 Background .....	8
2 Findings & Analysis .....	10
2.1 Literature Review	
2.2 Observations from Stakeholder Interactions	
2.3 Willingness to Pay, Existing Tariffs and Discom Losses	
2.4 Tariff Schedule Analysis	
3 Key Recommendations .....	22
• Annexures .....	24
• Annexure 1: Research Framework	
• Annexure 2: MVVNL, Uttar Pradesh – Calculations	
• Annexure 3: MSEDCL, Maharashtra – Calculations	
• Annexure 4: Tariff Schedule Analysis	
• Bibliography .....	34

## LIST OF FIGURES

Figure 1 Distribution of Given Sample in Selected WTP Studies .....	10
Figure 2 Average WTP: Rate of Increase .....	11
Figure 3 Average Electricity Sales and Revenues: 2014/15 .....	15
Figure 4 State-wise Distribution of Sales .....	16
Figure 5 Calculated Average Per Unit Price .....	16
Figure 6 MVVNL: Average Electricity Sales and Revenue, 2014/15 .....	19
Figure 7 MSEDCL: Average Electricity Sales and Revenue, 2014/15 .....	20

## LIST OF TABLES

Table 1 Estimated Actual and WTP Costs .....	11
Table 2 Willingness to Pay Decision Influencers .....	12
Table 3 Average WTP - Uttar Pradesh .....	17
Table 4 Estimated Reduction in Gap - MVVNL, UP .....	18

## LIST OF ABBREVIATIONS

ACS	Average Cost of Supply
APL	Above Poverty Line
ARR	Average Revenue Requirement
AT&C	Aggregate Technical and Commercial (AT&C)
ATP	Ability to Pay
BPL	Below Poverty Line
BRPL	BSES Rajdhani Power Ltd, Delhi
CERC	Central Electricity Regulatory Commission
CGH	Cooperative Group Housing
DDUGJY	Deen Dayal Upadhyaya Gram Jyoti Yojana
DERC	Delhi Electricity Regulatory Commission
DGVCL	Dakshin Gujarat Vij Company Ltd
DIAL	Delhi International Airport Ltd
DISCOM	Distribution Company
DMRC	Delhi Metro Rail Corporation
HT	High Tension
HH	Household
₹	Indian Rupee
JVVNL	Jaipur Vidyut Vitran Nigam Ltd, Rajasthan
kV	Kilo Volt
kW	Kilo Watt
kWh	Kilo Watt Hour
LMV	Low and Medium Voltage
LT	Low Tension
MERC	Maharashtra Electricity Regulatory Commission
MSEDCL	Maharashtra State Electricity Distribution Company Ltd
MVVNL	Madhyanchal Vidyut Vitran Nigam Ltd, Uttar Pradesh
NDS	Non-Domestic Service
PFC	Power Finance Corporation
PLF	Plant Load Factor
PWW	Public Water Works
RGGVY	Rajiv Gandhi Grameen Vidyutikaran Yojana
SCL	Substation Configuration description Language
SECC	Socio-Economic and Caste Census
SERC	State Electricity Regulatory Commission
SL	Service Level
T&D	Transmission and Distribution
TPDDL	Tata Power Delhi Distribution Ltd, Delhi
UDAY	Ujwal DISCOM Assurance Yojana
WTP	Willingness to Pay

## EXECUTIVE SUMMARY

The issue of energy access and the associated willingness to pay (WTP) for energy services has been extensively researched and studied globally as well as in India. In order to provide useful recommendations for future electricity-pricing debates, this study undertook a meta-analysis of existing WTP studies in the electricity sector and stakeholder interviews to examine and quantify the evidence on the willingness to pay for electricity supply in India. It compared these findings with the current electricity-pricing mechanisms to derive recommendations on future electricity pricing and subsidy policies.

The need for this study emerged in the backdrop of the structural changes that are currently underway to ensure the viability of electricity distribution companies (discoms) in India, specifically to understand how much consumers would be willing or able to pay for electricity services, in favour of tariffs that reflect the ‘cost to serve’, and whether such willingness to pay alone can fill the revenue shortfall gap for electricity distribution companies.

### Key Recommendations

**Prioritize agricultural electricity subsidy reforms**, especially in the states of Punjab, Haryana, Maharashtra, Karnataka, and Madhya Pradesh, to offset the heavy cross-subsidization.

**Initiate reforms in the domestic sector to justify increases in tariff**, especially in Bihar, Tamil Nadu, and Uttar Pradesh. For example, invest to improve the availability, reliability, and quality of supply, and at the same time, improve the operational efficiency of discoms.

**Rationalize tariffs across the electricity value chain, based on evidence**, to allow discoms to charge cost-reflective tariffs. For example, subsidy reforms that ensure services can be afforded by the poorest without creating perverse incentives, or move to direct benefit transfers rather than power subsidies.

**Cross subsidization needs to be phased out gradually** with all consumers paying for electricity, at least to the extent of cost incurred to generate and supply the same. Alternate electricity pricing mechanisms may also be explored, where tariffs for units consumed beyond a threshold decrease for large consumers who are regular in payments and their tariffs are not cross-subsidized. This will encourage such consumers to increase their consumption and the country will be able to utilize the present surplus.

**Create awareness and public education on the costs of energy generation**, the need for investment to improve service levels, and the benefits of energy efficiency to support the transition to cost-reflective pricing.

**Undertake studies, at the state level** on tariff schedules to establish how tariffs can be simplified and consolidated to improve revenue generation, transparency, and reduce transaction costs.

**Electricity needs to be considered as a service independent of its source**—On grid or off grid, the best-suited infrastructure should be employed to provide reliable electricity and affordable and sustainable energy for all at the same price and at the same level of service.

**Develop ‘willingness to provide’ training for supply-side stakeholders** (specifically discoms) to change the attitudes and skill sets of staff and increase their willingness to ensure the provision of reliable, affordable, and sustainable electricity for all.

## 1 BACKGROUND

There has been significant progress in the electricity access scenario in the last five years in India. Statistics show that around 40 million households were connected to the grid under the National Rural Electrification Programmes during 2011 to 2016.<sup>1</sup> On the flip side, however, nearly 45 million<sup>2</sup> households are still waiting to get connected to the grid or gain access to some source of reliable and affordable electricity. Further, based on recent literature and field surveys, it has been observed that the supply of electricity across India, in most areas, is not only inadequate but also lacks quality and reliability, characterized by a poor record of outages, high levels of transmission and distribution losses, and an overall need for extended and improved infrastructure.<sup>3</sup> Another key gap is the non-availability of three phase connections, essential for micro and small industries, in many villages where the electricity grid may have been extended or intensified under the National Rural Electrification Programme. The absence of reliable electricity supply also forces consumers to invest in coping solutions that invariably increases their overall expenditure.

In terms of per capita electricity consumption in India, this has been increasing continuously over the last decade (46%), mainly due to a significant improvement in the electrification of villages as well as continuous economic growth in the last decade, and stands at 1075 kWh in 2015/16. However, there is a wide variation in the electricity consumption pattern across Indian states, as per the latest available consumption data (for 2012/13).<sup>4</sup> For instance, the per capita consumption in Puducherry, Goa, Punjab, Gujarat, Haryana, and Delhi is much higher than the national average. In all north-eastern states and in West Bengal, Madhya Pradesh, Kerala, Uttar Pradesh, and Jharkhand, the per capita consumption is below the national average, with Bihar having the lowest (1/6th of the national average). Overall, India's average per capita electricity consumption is still 1/3rd of the world's average and the lowest among the BRICS nations.<sup>5</sup> The Ministry of Power attributes this low per capita consumption average to India's large population, low per capita income, and to the sections of the population that have extremely low / poor access to electricity.<sup>6</sup>

Undoubtedly, demand for reliable electricity supply in the country is significant. This is especially true for large parts of rural India where access to reliable and affordable electricity continues to pose challenges. Electricity here is extremely crucial to support income-generating activities, to allow the utilization of modern appliances and agricultural equipment, and to replace inefficient and polluting lighting options. While electrification of villages has been one of the key action areas of the government through its commitment to provide 24X7 affordable electricity to all by 2019, the goal appears to be a significant challenge, with over 220 million<sup>7</sup> people to reach, who currently have no or very limited access to electricity.

While, on the one hand, there is inadequate and unreliable supply of electricity in most of the villages in addition to a growing consumer demand, on the other hand, India's existing generation capacities are not being fully utilized; coal-based generation plants were operating at around 62% PLF<sup>8</sup> in 2016/17. The electricity distribution companies are unable to purchase the quantum of energy they require to supply electricity to all their consumers. Most discoms in India are undergoing a severe financial crisis due to the high level of investments required

1 As per Census of India 2011, number of households with electricity was 9,28,08,181. This has increased to 13,39,87,404 (as on April 2017). Link: <http://www.garv.gov.in/garv2/dashboard/garv>.

2 45 million as per Grameen Vidyutikaran (data as on April 2017). Link: <http://www.garv.gov.in/garv2/dashboard/garv>

3 Access to Clean Cooking Energy and Electricity: Survey of States. CEEW Report, September 2015. Link: <http://ceew.in/pdf/CEEW-ACCESS-Report-29Sep15.pdf>

4 Lok Sabha Annex. Link: [http://164.100.47.132/Annexture\\_New/lsq16/2/au5250.htm](http://164.100.47.132/Annexture_New/lsq16/2/au5250.htm)

5 India's Per Capita Electricity Consumption lowest among BRICS nations. Link: <https://factly.in/indias-per-capita-electricity-consumption-lowest-among-brics-nations/>

6 Lok Sabha, Un-starred Question No.2001, To Be Answered On 05.05.2016, Per Capita Consumption of Power. Link: <http://164.100.47.190/loksabhaquestions/annex/8/AU2001.pdf>

7 As per GARV Dashboard, accessed on 25 May 2017. Link: <https://garv.gov.in/garv2/dashboard/garv>

8 Central Electricity Authority Executive Summary - Power Sector Feb-2017, Ministry of Power, Government of India  
PLF - Plant load factor

in infrastructure development, high Aggregate Technical and Commercial (AT&C) losses and accumulating issues of governance and inconsistent pricing and subsidy policies. There are also inherent issues of operational inefficiencies augmented by old infrastructure (except those that have been set up under RGGVY / DDUGJY) that are resulting in extremely high national Transmission & Distribution (T&D) and AT&C losses,<sup>9</sup> which stand at an average of 21.46% and 22.70%, respectively.

This has been a growing concern over the last few years and the Government is making efforts to improve the situation by introducing various schemes, such as UDAY,<sup>10</sup> to decrease AT&C losses. The State Electricity Regulatory Commissions (SERCs) are also attempting to set more realistic retail consumer tariffs to improve the financial health of discoms. The Government is also reportedly contemplating increasing the pace of household connections by financing these connections to make them more affordable. State Governments are taking proactive action to increase the rate at which connections are provided to households, enable discoms to cope with the high level of transmission needs and become more financially stable. It is evident that unless revenues increase and profitability of power suppliers and distributors is ensured, further investments in the sector remain uncertain, resulting in an extended supply lag in meeting the unmet, latent, and suppressed demand.

The provision of reliable electricity therefore depends on various factors, including cost of generation, adequate transmission and distribution infrastructure, cost-reflective tariffs and targeted subsidies, reduction in power theft, and improvement in service delivery by the discoms. It also requires that the discoms' efforts and schemes are reciprocally taken up by the consumer to translate into actual benefit and it is in this context that the consumer's willingness to pay for improved electricity services becomes very relevant.

The 'Understanding Willingness to Pay for Electricity in India' research project therefore attempted to analyse the existing understanding on consumer's willingness to pay for electricity services across various contextual situations in India and comprehend how important and useful it is for the SERCs to consider it as a factor in electricity pricing and tariff setting. The overall objective was to examine and quantify the existing evidence on willingness to pay for electricity services in India, and co-relate these findings with current electricity pricing mechanisms to formulate recommendations on future pricing policies. The key research questions were:

- **What is the current range of willingness to pay** for electricity services across consumer categories and socio-economic profiles?
- **What factors affect variations in willingness to pay** across scenarios such as, the electricity delivery infrastructure (grid/off-grid), geographical location, socio-economic factors, reliability of electricity, intended use of electricity, time of supply, etc.?
- **What role do politico-economic factors play** in the determination of tariffs and subsidies in electricity service delivery and how can this be associated with demand-side willingness to pay assessments?

The methodology involved a comprehensive meta-analysis and aggregation of distributed research on WTP and electricity pricing in India; consultations with key stakeholders in electricity supply to validate facts; a study of representative state tariff schedules; and ARR analyses to understand cost to serve electricity and pricing dynamics in identified states. The research methodology is detailed in Annexure 1.

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<sup>9</sup> Government of India, Executive Summary, Power Sector February-16: Ministry of Power, Central Electricity Authority, New Delhi. Link: [http://www.cea.nic.in/reports/monthly/executivesummary/2016/exe\\_summary-02.pdf](http://www.cea.nic.in/reports/monthly/executivesummary/2016/exe_summary-02.pdf)

<sup>10</sup> Ujwal DISCOM Assurance Yojana

## 2 FINDINGS & ANALYSIS

### 2.1 Literature Review

Various definitions and measurement techniques for willingness-to-pay (WTP) emerged across studies. Primarily, a clear distinction was found between ability to pay (ATP) and willingness to pay. While the “ability” to pay mainly depends on the income level of the household, drawing a close relation to extent of affordability; “willingness” to pay depends on a variety of factors, including income levels, price of substitute fuels, the level of electrification or scope for electrification, real or perceived availability of alternatives for electrification, value provided to the service and primarily household budget for energy expenditure. According to Twerefou (2014), WTP can be measured by the extent to which utility to the individual changes via the consumption choice. That is, the higher the utility derived from a service or good, the higher the amount a consumer would be willing to pay.

From a research perspective, the available studies provided a fairly detailed insight in regard to the socio-economic and geographical profiles of consumers and the factors that affected their WTP decisions. It appears that more research exists on the rural consumer’s willingness to pay due to a perception that they are more averse to paying for improved electricity services. Several studies were also carried out as a business viability exercise to assess the capacity and readiness of rural consumers to pay for off-grid or other alternative electricity solutions, a key factor for increasing penetration of off-grid solutions. Limited literature sources were available on willingness to pay for improved electricity services in the industrial and urban context.

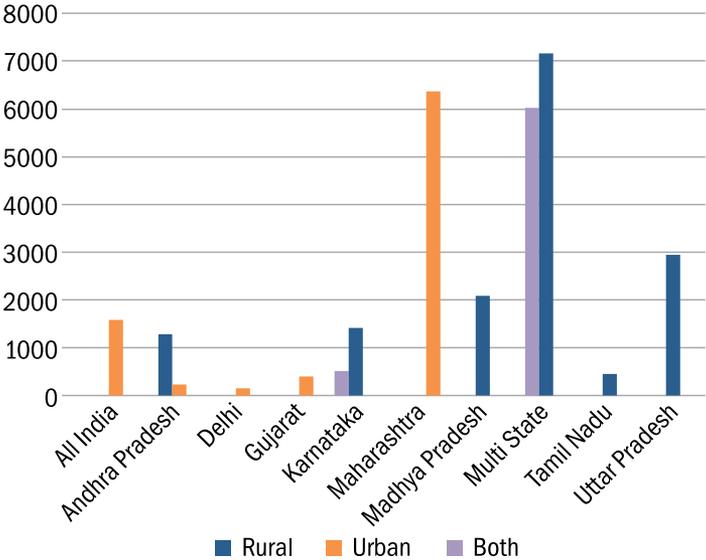


Figure 1 Distribution of Given Sample in Selected WTP Studies

Source: Authors’ calculation

#### 2.1.1 Observations: Domestic Consumers

In most cases, **willingness to pay for better services was equal to the consumer’s budgeted monthly expenditure for electricity / lighting.** This was especially true for those who had poor/no access to electricity and depended on kerosene as a primary lighting source. Their expressed willingness to pay for a better basic lighting solution was high as long as the cost of the service was within their budgeted expenditure for lighting.

Beyond the budgeted expenditure, **willingness to pay for 'lighting plus' services was found to be contingent on the consumer's disposable income.** Therefore, as consumers moved from basic lighting to paying for additional services (like fans, TV, etc.), the slope of their WTP curve reduced because income levels appear to have come into play (Figure 2).

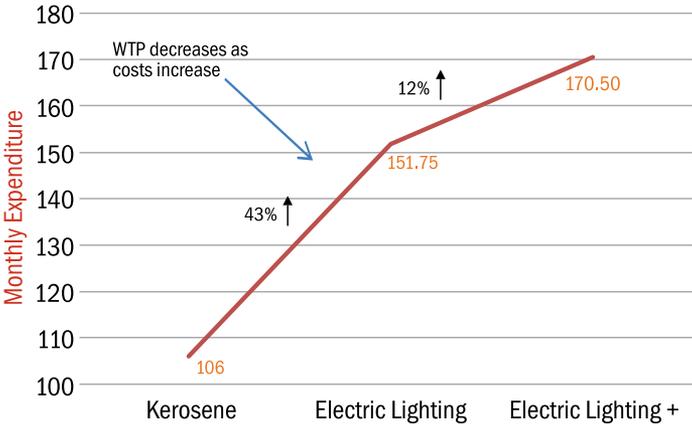


Figure 2 Average WTP: Rate of Increase

Source: Authors' calculation

Based on the surveys conducted in these studies, the calculated average monthly income of rural households was ₹6714, which is higher than the Census 2011 average.<sup>11</sup> Budgeted expenditure for lighting was estimated at 2.98% of the calculated average monthly income, which works out to approximately ₹200 a month. More specifically, rural households were paying an average of ₹168/month for grid electricity. Further, households with poor or no supply also bore a cost of ₹119/month for kerosene, paraffin candles, etc., which is essentially the 'coping cost' incurred due to lack of grid supply or unreliable grid supply (Table 1). Against the above actual costs incurred, the average estimated rural domestic consumer's willingness to pay, for an off-grid basic lighting and mobile charging alternative was found to be ₹110/month and that for grid electricity supporting all facilities (including appliances) was ₹290/month. In per unit terms, **with the assurance of reliable grid electricity services, consumers expressed a willingness to pay a rate nearly double of what they were paying for their current grid connections.** On the other hand, **their coping cost due to unreliable electricity was extremely high for a much poorer level of service, when they had to rely on kerosene for their lighting needs.**

		Kerosene (actual)	Grid (actual)	WTP for Grid	Unit
1	Per day connected load <sup>12</sup>	30	300	300	Watt
2	Monthly consumption <sup>13</sup>	3.6	45	45	kWh
3	Monthly expenditure	119	168	290	₹
4	Average tariff (3/2)	~ 33.00	3.74	6.44	₹/kWh

Table 1 Estimated Actual and WTP Costs

Source: Authors' calculation

11 As per the socio-economic and caste census (SECC) 2011, two-thirds Indians have an average monthly income of ₹5000. The difference between the two may be attributed to the fact that most of the WTP studies have been done with a very specific consumer group (in some cases those with productive energy use), raising their average income as compared to the average from the data collected by the Census, which would include all income groups.

It may be noted that the reviewed WTP studies represent a very limited and specific rural household consumer spectrum and their findings may not be generalized / extrapolated to represent the income profile of rural household consumers at the national level.

12 Calculations have been made for max load / consumption equivalents

(i) For grid = 1 Fan + 1 TV + 1 Tube + 2 CFL bulbs; (ii) For kerosene = Two 15 watt bulbs

13 Calculated on the basis of = (per day connected load \* 5 hours of electricity \* 30 days)/1000

WILLINGNESS TO PAY DECISION INFLUENCERS	
Positive Influencers	Negative Influencers
Improved <b>quality and reliability</b> of electricity supply	Lack of adequate <b>disposable income</b>
Lighting for <b>productive use</b> in the marketplace and at the HH level	<b>Rostering</b> —Electricity supplied for least productive hours for half the month, forcing HHs to use alternative source of energy, thus, they end up paying for both
Better quality of light for eyesight, <b>safety</b>	<b>Expensive connection charges</b> —Fragmented HHs have to incur high upfront costs for legal connections
Households with legal connections recognised electricity as an important <b>development priority</b>	<b>Metering</b> —Legal connections remain un-metered to evade the cost of a meter, expecting a government scheme to install them for free
<b>Education</b> - positive and statistically significant relationship to WTP for improved electricity services	<b>Billing Systems</b> —Non-generation and distribution of bills on a regular basis result in high cumulative bills—leading to delays and defaults in payments

Table 2 Willingness to Pay Decision Influencers

The current evidence on willingness to pay for electricity services in India tells us that:

- **Rural domestic consumers bear significant coping costs (primarily on kerosene) in the absence of reliable electricity supply.** Even though on an absolute basis this amount may appear small, but on a per unit basis, for the poor level of service kerosene provides, this is a significantly more expensive alternative.
- Beyond the basic level of electricity services (basic lighting), **willingness to pay becomes a factor of income (in)elasticity** and therefore of affordability or the ability to pay. Disposable income has to be taken into account for the lowest consumer groups.
- **Education and productive use of electricity have a significant positive co-relation to willingness to pay** for better services. Such users attribute a higher value to electricity services and see it as a development priority.
- **For electricity service providers (off-grid and grid), willingness to pay can be an important indicator of consumer attitudes and the role of the state.**
- **Infrastructural and systemic challenges on the supply side negatively affect WTP**, even in areas where willingness may exist. For example, electricity scheduling and rostering practices, high connection costs, metering and poorly managed billing systems diminish the true value of electricity services and its optimum and appropriate consumption.

### 2.1.2 Observations: Industrial Consumers

While studies on WTP by industrial consumers were found to be very limited, the ones that were surveyed indicated that industrial consumers have expressed a willingness to pay more for reliable and better quality electricity.

In a study<sup>14</sup> conducted in 2012, 650 companies were surveyed across 25 industrial cities in India, representing zones in the north, east, west, and south to understand how industries in different sectors are affected by and

<sup>14</sup> BRIEF - Bureau of Research on Industry & Economic Fundamentals. (2012). Lack of Affordable and Quality Power: Shackling India's Growth Story. New Delhi: FICCI

cope with power cuts and shortage in electricity supply, and its impacts on cost and production. Even though the study did not quantify willingness to pay expressed by the companies, it found that overall, firms generally did not suffer a major shortfall in production due to erratic power supply and had adapted themselves by making adequate back up arrangements. They did, however, suffer cost escalations due to the regular use of power backups to support their production activity.

According to the study, the average tariff paid by these companies ranged from ₹5 to ₹8.50, with monthly expenditures on grid electricity ranging from under ₹0.1 million to over ₹2.5 million, based on the nature of the company. The per day revenue losses incurred to mitigate power shortage interruptions ranged from ₹1000–₹40000. Fuel was the main driver for captive power generation and played an important role in the decision to use captive sources for power generation. The cost of electricity from captive sources ranged between ₹12–₹16 per kWh. However, this cannot be considered as a proxy for WTP, as it is the only alternative and that too for a limited time. Of the total companies surveyed in the study, **61% were willing to pay more for reliable and uninterrupted power supply**. More than 85% in Andhra Pradesh, Tamil Nadu, and Odisha; and more than 70% in Jharkhand, Madhya Pradesh, and West Bengal, were willing to pay more for uninterrupted power supply.

### 2.1.3 Observations: Urban Consumers

Even though limited studies assessed willingness to pay for the urban context, they provided general contextual insights. Urban consumers without proper electricity access (primarily those residing in illegal settlements / slums) suffer due to the absence of legal recognition of their settlements, structural gaps (brick/concrete homes, distance from nearest electricity pole, etc.), location-specific barriers and the lack of proper planning and coordination at the discom level regarding their growing consumption needs.

In a study<sup>15</sup> conducted by TERI in 2014, 106 HHs from five geographically representative slums across Delhi were surveyed. The average monthly income of these households was ₹8000. Of the total surveyed HHs, 70% had access to legal metered electricity connections. On the other hand, almost half of the total surveyed HHs (48%) indulged in hooking malpractices (obtaining electricity illegally from a nearby electricity pole, etc.).

Willingness to pay in these slums was affected by factors, such as lack of affordability, overbilling, and lack of awareness on energy-efficient practices. Consumers dwelling in slums also faced other issues related to electricity access such as:

- **Lack of tenure-ship:** As it is a critical condition for discoms to be able to provide energy services, the absence of legal recognition of settlements was an impediment to supply.
- **Absence of infrastructure:** Provision of electricity requires laying of infrastructure (electricity poles, etc.) which is a challenge for urban slums given the nature of their development (e.g. temporary structures).
- **Location-specific barriers:** Many slum settlements are located close to railway tracks and may interfere with the signaling and communication system of railway lines. The Railway Department, thus, prohibits the electrification of these settlements.
- **Lack of proper planning and coordination at the discom level:** While considering expansion plans, discoms do not account for rising slum populations and increasing income and consumption levels. This results in major interruptions in power and a reduction in the general quality of service to these consumers.
- **Bill defaults / surcharges:** More than 90% HHs complained about over billing. High bill amounts were a result of past bill defaults and surcharges, faulty meters and incorrect meter readings.

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15 Singh, R. (2014). Energy poverty in developing countries' urban poor communities: Assessments and recommendations. GNESD Technical Synthesis Report.

## 2.2 Observations from Stakeholder Interactions

To fully comprehend the electricity pricing and supply perspective, interactions with stakeholders from the power sector were also carried out<sup>16</sup>. Representatives from central and state electricity regulatory commissions, public and private distribution companies, as well as independent power sector experts and consumer advocacy groups were interviewed. Care was taken to identify representative stakeholders from diverse geographies and with varied financial and performance contexts.

Several stakeholders interviewed opine that approved **tariffs in India are not cost-reflective** and that state regulators are not inclined to grant certain logical allowances. However a counter view stated that as discoms usually failed to fulfil their performance commitments, the Regulator was reluctant to pass on the cost of their inefficiencies to the consumer by approving higher tariff petitions. This was further strengthened by the fact that the Regulator duly took into consideration past performance records of the discoms at the time of setting tariffs.

There was, however, unanimity with regard to the fact that the **accumulating financial losses** of discoms were a result of inefficiencies at various levels (infrastructure / maintenance / operations / metering / billing / collections) coupled with the increasing rate of borrowings required to fund these inefficiencies. Concern was expressed on the interest component of these loans being unfairly burdened onto the consumer in the tariff. At the same time, no clear roadmap has been framed by the Regulator to the discoms on how such accumulating losses could be recovered.<sup>17</sup>

Some stakeholders questioned the rationale on which state governments decided their subsidy component for electricity, while others did not as they felt that it was purely the state government's prerogative to provide subsidy to different consumer groups as it deemed fit. There was, however, a general consensus that using **evidence-based subsidy calculation mechanisms would be helpful in providing more targeted benefits to the appropriate consumer groups**.

All stakeholders expressed concern with regard to cross-subsidy<sup>18</sup> levels, especially on industrial consumers, and again the **need for a clear roadmap to minimize cross-subsidies** was evident. Even though the Electricity Act, 2003, and the erstwhile as well as new Tariff Policy suggest a cap and duration of cross-subsidization beyond a point, industrial consumers continue to pay extremely high tariffs, with possibly no potential left to charge more. Many large industrial consumers are also moving to procurement from other sources and energy exchanges through 'open access' for more competitive electricity prices (despite having to pay an open access surcharge to the discom), which would significantly impact the distribution company's sales and revenue share.

Contrary to what WTP studies revealed, stakeholders strongly felt that **political economy factors dictate electricity pricing in India**. A sense of entitlement has been created in the consumers' mind which has led to an expectation of receiving electricity services nearly free or at a nominal cost. It was stated that while electricity would always be part of the larger political development agenda, its pricing needs to be economically decided, independent of all political implications—especially since the willingness to pay for better quality and reliable services exists and is evident.

With regard to the consumer's '**willingness to pay**' and the need to consider it, from a regulator's perspective, this had a limiting or no influence on tariff and pricing decisions, since the regulators opined that the current tariff structure is already designed to be as inclusive as possible. It would also not be feasible to assess the willingness to pay for such a diverse set of consumers and tailor the tariff according to each consumer category. The regulator, however, does take into account willingness to pay indirectly through the public hearings

<sup>16</sup> The study was conducted from April 2016 to February 2017.

<sup>17</sup> The Government of India has however launched the UDAY scheme in 2015 to shift a large component of the debt from the discoms to the state government, which is expected to partially reduce the discom's losses due to interest burden.

<sup>18</sup> Cross subsidization is the practice of charging higher prices to one group of consumers to subsidize lower prices for another group.

that are organized before every tariff revision. One view also expressed that with the combined back-up and recurring electricity costs borne by the consumers on account of unreliable supply, the appetite for higher tariffs was extremely low and there was a need for discoms to target providing quality and uninterrupted electricity supply and improve their operational efficiencies through the use of better technologies.

### 2.3 Willingness to Pay, Existing Tariffs and Discom Losses

#### 2.3.1 Electricity Sales and Revenue Shares

To understand the extent to which consumer’s willingness and ability to pay more for electricity services can contribute to a reduction in the revenue losses of distribution companies, an overview of the share of sales and corresponding revenues across major consumer groups was taken for the year 2014/15. From the published data,<sup>19</sup> a clear inference can be drawn on the disproportionate electricity consumption and revenue shares among the three largest consumer groups of electricity services in India.

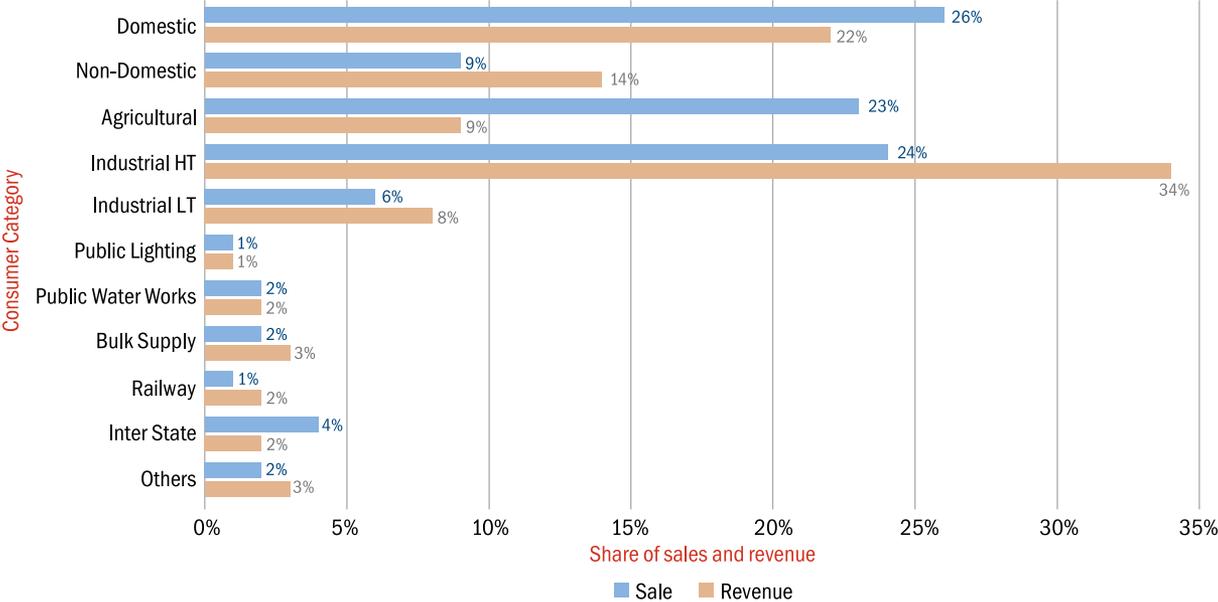


Figure 3 Average Electricity Sales and Revenues: 2014/15

Source: Calculations based on data from Power Finance Corporation Report on Performance of State Power Utilities, 2016

At the all-India level (Figure 3), while domestic and agriculture consumers together account for nearly half (49%) of the total electricity sales, their contribution to revenues was just about one-third (31%). This is nearly inversely true for industrial consumers, whose total consumption is 30% of total electricity sales in the country and their revenue contribution was 42%.

**Notably, the gap between the agriculture sales and revenue shares is a clear depiction of the cross-subsidy component that is loaded on the industrial consumer to make electricity affordable, and in several states nearly free, for agricultural consumers as well as domestic lifeline consumers.**

<sup>19</sup> Power Finance Corporation, Report on Performance of State Power Utilities, 2015

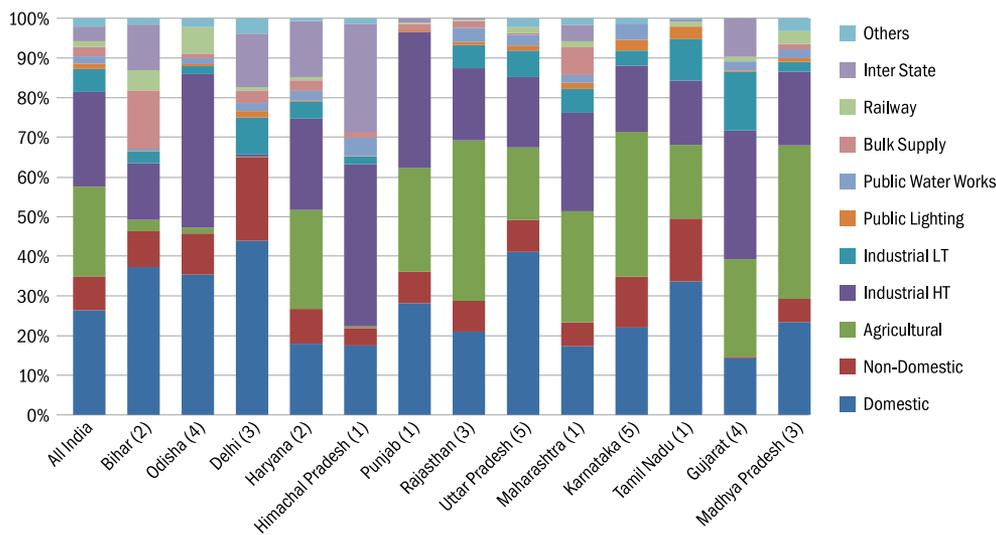


Figure 4 State-wise Distribution of Sales\*

Source: Calculations based on data from Power Finance Corporation Report on Performance of State Power Utilities, 2016

Note: The numbers in the parentheses indicate the number of discoms considered for each state

\*Data has been collated and analysed only from major discoms of the respective states.

Figure 4 shows the distribution of electricity unit sales across consumer groups in 11 key states of India. Most states have higher sales in domestic, agricultural, and industrial HT (high tension) sectors. The top three industrial LT (low tension) sales have been recorded in Delhi, Tamil Nadu, and Karnataka. Notably, inter-state sales have also been observed in some of the states, mainly, Himachal Pradesh, Haryana, Delhi, Bihar, and Gujarat. Finally, Rajasthan, Himachal Pradesh, and Karnataka have significant demand from Public Water Works when compared to other states in the country.

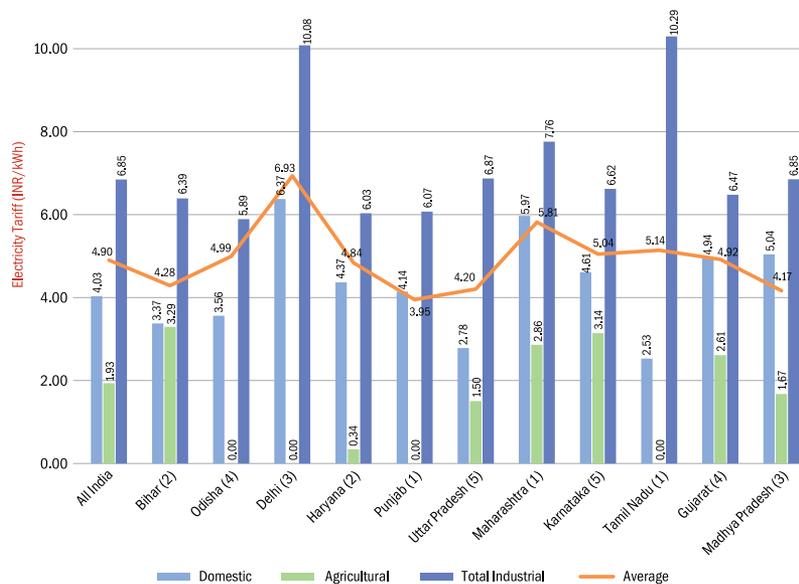


Figure 5 Calculated Average Per Unit Price

Source: Calculations based on data from Power Finance Corporation Report on Performance of State Power Utilities, 2016

Note: The numbers in the parentheses indicate the number of discoms considered for each state

A **state-wise per unit average price comparison** was also done for domestic, agricultural, and industrial consumers across the 11 states (Figure 5), mainly to understand the relationship between the share of sales and revenues of each of these categories at the state level and in each state's context.

It was observed, that **several primarily agricultural states**, such as Punjab, Haryana, Uttar Pradesh, Tamil Nadu, and Madhya Pradesh, **were charging very low or no electricity tariffs from farmers**, and in all of these states the industrial consumers were paying per unit tariffs much higher than the average per unit tariff in the state—especially in Punjab, Uttar Pradesh, and Tamil Nadu.

Further, while **in some states, the domestic tariff ranged between 8%–14% below the average tariff**, in a few states it was significantly lower (20%–51%), resulting in a corresponding spike in the industrial per unit rate as compared to the state average tariff (e.g. Bihar, Uttar Pradesh, and Tamil Nadu).

**Even in better disposed states** such as Maharashtra, Karnataka, and Gujarat, **there is a significant cross-subsidization for agricultural consumers** who consume a larger share of electricity than industrial consumers. However, these states have a healthy sales and revenue distribution for their domestic consumers, with domestic tariffs equal to or above the average tariff in the state. The distribution companies in **these states have been able to remain profitable or much more financially sound than other state discoms due to the high billing and collection efficiencies and metering practices.**

**Co-relating Estimated Willingness to Pay with Existing Tariff Structures: Is consumer's willingness to pay more enough to close the cost of service and revenue gap?**

As the majority of available WTP studies were conducted in Uttar Pradesh, majorly with rural 'lifeline' consumers (with poor / no electricity), their estimated WTP was considered for a more detailed comparison with the existing tariff structure of MVVNL<sup>20</sup> in order to analyse **how far could the consumer's willingness to pay more contribute to closing the cost of service and revenue gap for distribution companies.**

The evidence from Uttar Pradesh showed that consumers were willing to pay ₹106/month for kerosene, ₹145/month (27% more) for basic lighting services (2 bulbs + 1 mobile charger), and ₹150/month for proper grid electricity services (Table 3).

		Kerosene	Grid	Unit
1	Average Willingness to Pay	106	150	₹
2	Service received	Basic lighting for 4 hrs	Lighting + fan + TV for 5 hrs	
3	Average Per day Consumption	30	300	Watt
4	Average Monthly Consumption	3.6 ((30x4x30)/1000)	45 ((300x5x30)/1000)	kWh
5	Average per unit cost (1/4)	~ 21.25 (normalised - 5 kWh)	3.33 (150/45)	₹ / kWh

Table 3 Average WTP - Uttar Pradesh

Source: Authors' calculation

While there is an implied acceptance of the increased amount for better basic lighting services (because of the lack of any other alternative), the willingness to pay drops significantly for grid services as income insufficiency comes into play.

Table 3 reiterates that in Uttar Pradesh, **per unit WTP for grid electricity as expressed by lifeline consumers**

20 Refers to Madhyanchal Vidyut Vitran Nigam Ltd., Uttar Pradesh, a state discom covering central Uttar Pradesh.

(₹3.33) is still lower than the average approved domestic tariff of ₹3.93 for 2015/16 by approximately 15%. It must be taken into account, that these HHs also bear additional coping costs in the absence of or due to unreliable electricity services (on kerosene), where the cost of receiving such a low level of service turns out to be very high in per unit terms. However, **while consumers do bear an additional coping cost, a higher WTP is not explicit**, as this additional cost is borne due to the lack of any other alternative.

So, in the specific case of MVVNL, the per unit gap between the discom's overall average cost of supply and realized revenues (for 2015/16, Table 4) is not recoverable based on the existing WTP assessments (which are primarily for lifeline domestic consumers) in the state. Therefore, **willingness to pay more may not be the sole solution to significantly reducing the discom's overall revenue gap for this consumer segment because of constrained income levels that restrict the willingness to pay beyond a point, and calls for other simultaneous measures that need to be taken to effectively reduce the gap.** Accordingly, three key measures at the discom level have been identified and demonstrated in Table 4. In the current scenario, with no change in the approved tariff structure, discoms may take parallel action across three main gap areas with respect to lifeline domestic consumers and enable a marked reduction in their overall average revenue gap. The assumptions considered for this analysis are detailed in Annexure 1.

S. No.	Parameter	2013/14	2014/15	2015/16
		₹/kWh	₹/kWh	₹/kWh
1	Average Cost of Supply (ACS)	6.18	5.49	6.46
2	Average Revenue (without subsidy)	3.32	3.37	5.16
3	Gap without subsidy (1 – 2)	2.86	2.12	1.30
4	Subsidy received	0.57	0.80	0.57
5	Gap after subsidy received	2.29	1.32	0.73
6	Gap (actual realised revenues + subsidy)	1.87	1.80	1.98
7	Gap after reduced AT&C Losses <sup>20</sup>	1.75	0.98	0.78
8	Gap after unmetered to metered	1.31	0.38	0.06
9	Gap after increased hours of supply	1.37	0.41	-0.09
10	<b>% reduction in Gap</b>	<b>26.79%</b>	<b>77.31%</b>	<b>104.56%</b>

Table 4 Estimated Reduction in Gap - MVVNL, UP (Refer Annexure 2 for detailed calculations)

Source: Calculations based on data from Power Finance Corporation Report on Performance of State Power Utilities, 2016

**Reduction in AT&C losses** is a direct step towards improving efficiencies and reducing losses and also a requirement under the UDAY scheme that state discoms can benefit from. Here, after accounting for subsidies, a per unit gap of ₹1.98 between the average cost of supply and revenue, in 2015/16, will still remain. If MVVNL can reduce its AT&C losses to below 11%,<sup>22</sup> the revenue gap can be reduced significantly, effectively meeting 60% of the existing gap between average cost of supply and average revenue (Table 4, Row 7).

The **conversion of existing unmetered connections to metered ones can enable the discom to recover nearly three times the revenue that it receives for flat rated unmetered connections.** This is primarily due to the fact that an average flat rate tariff of ₹180 a month recovers only approximately ₹1.20 per kWh (normalized for 5 hours of supply for a max load of 150 units) at the lowest slab. However, when metered, the same connections would recover around ₹3.60 per kWh on an average due to the exact measurement of units consumed for the same slab. The calculation in Table 4 accounts for the ratio of unmetered connections to the total number of connections in this consumer slab to calculate the reduction in overall gap (Table 4, Row 8). It is important to

21 MVVNL's AT&C losses in 2013/14, 2014/15, and 2015/16 were 14.32%, 35.18%, and 21.03%, respectively.

22 This benchmark is based on Dakshin Gujarat Vij Company Ltd's (DGVCL) performance standards (a discom in Gujarat), taking a realistic estimation of possible percentage reduction in AT&C losses.

note that the ratio of unmetered households as recorded in 2015/16 has been reducing as more households are brought into the metered network every year.

**Increasing hours of supply:** In the current scenario, consumption by grid-connected consumers is restricted by the designated hours of supply (average 5 hours a day)<sup>23</sup>, which means their consumption will typically remain under 150 kWh/month (which keeps them in the bottom most slab); so, even if they want to consume more electricity, they cannot. Based on average consumption levels, the existing infrastructure can allow for increased hours of supply (up to a minimum of 10 hours). Increasing the hours of supply from say 5 to 10 hours a day, even at existing tariffs, will result in higher total revenues and contribute towards meeting the revenue gap. In MVVNL's case, this last measure resulted in neutralizing the gap between average cost of supply and revenue and the generation of a surplus (Table 4, Row 9).

**Together, with all three measures and the incremental contribution from increased willingness to pay with the assurance of reliable and quality supply, it is possible for a distribution company to recover its average cost of supply, at the prescribed tariff rates. In real terms, it is possible for the discom to effectively achieve a reduction in gap between cost to service and revenues by 60%–80%.**

*While this analysis has been done only for the lifeline domestic consumer segment to co-relate it to the WTP evidence, it would be useful to conduct a similar analysis for other consumer categories and income levels as well for each discom, taking into account their local, financial and performance contexts.*

### 2.3.2 Comparing the case of MVVNL with MSEDCL

A similar analysis for estimated reduction in gap was carried out for the second largest discom in the world and the largest in the country, MSEDCL<sup>24</sup> (Annexure 3). A quick comparison of the electricity sales and revenue shares of MSEDCL and MVVNL (Figures 6 and 7) show the contrast in consumption and revenue contributions across major consumer categories.

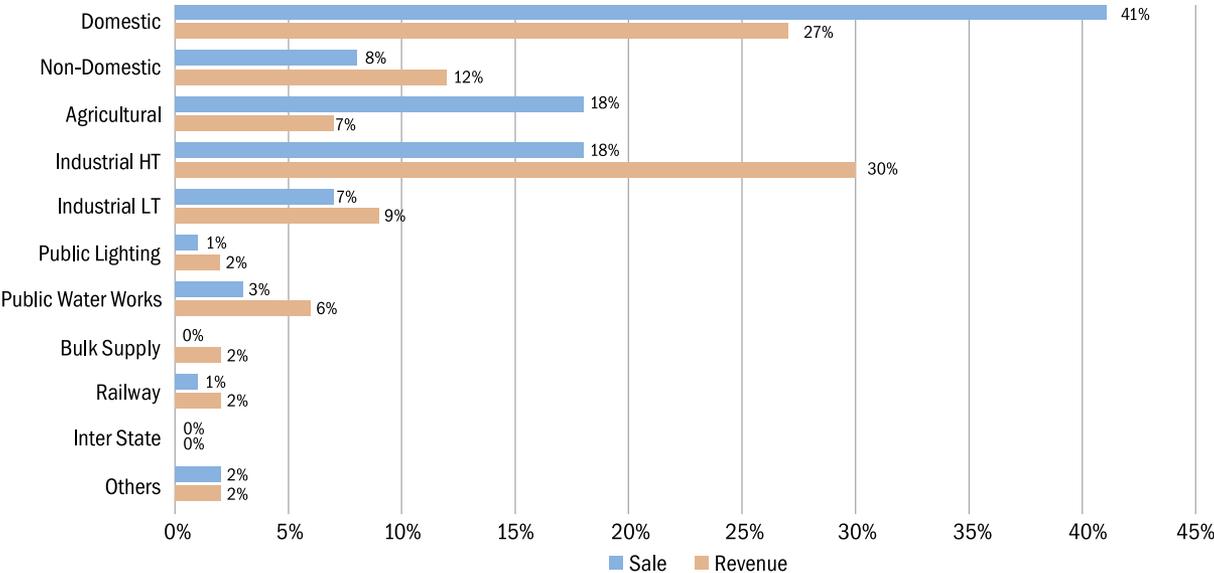


Figure 6 MVVNL: Average Electricity Sales and Revenue, 2014/15

Source: Calculations based on data from Power Finance Corporation Report on Performance of State Power Utilities, 2016

For MVVNL (Figure 6), the domestic category has a significantly larger share in units sold, although revenues from this segment are comparatively lower, which could be due to relatively lower tariff for this consumer group

<sup>23</sup> The study was conducted from April 2016 to February 2017  
<sup>24</sup> Maharashtra State Electricity Distribution Company Ltd

or inefficiencies in collection. Agriculture and industrial HT consume the same amount of units, though there is a stark difference in their revenue contributions—indicative of government subsidies to agricultural consumers and the cross-subsidies loaded on mostly large industrial consumers.

On the other hand, for MSEDCL (Figure 7), even though agriculture is the largest consumer group in the state and lags in contribution to revenue by half its share, most other consumer categories have balanced consumption and revenue levels, with a comparatively lower burden of cross subsidization<sup>25</sup> on industrial consumers.

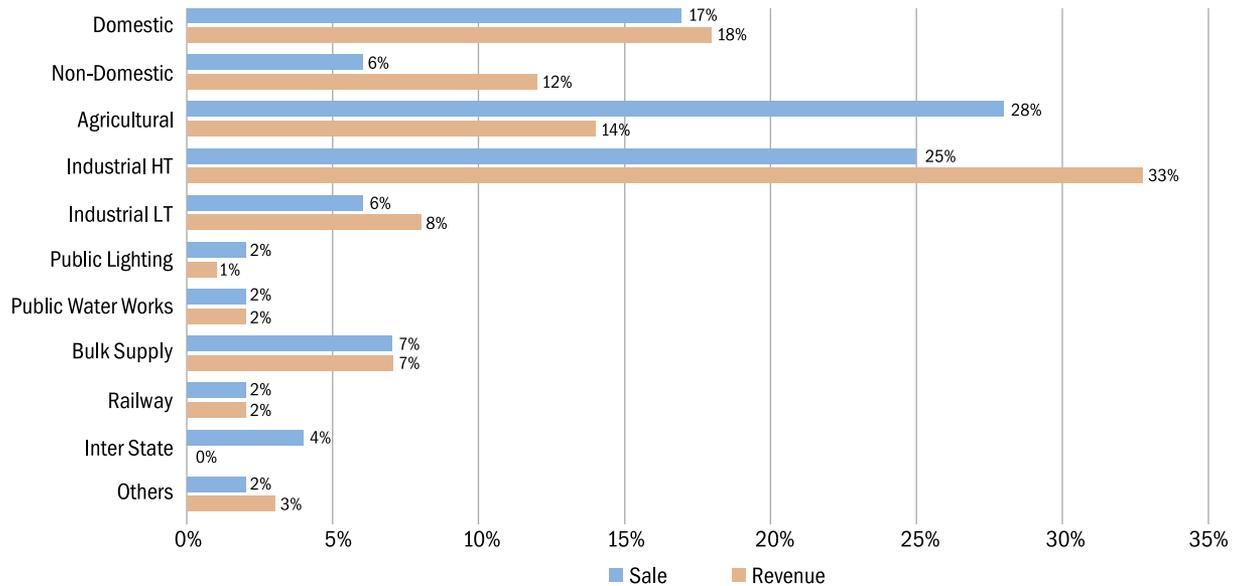


Figure 7 MSEDCL: Average Electricity Sales and Revenue, 2014/15

Source: Calculations based on data from Power Finance Corporation Report on Performance of State Power Utilities, 2016

From the cost-revenue analysis, following are the key differences that emerged between the two discoms:

- **Revenue Gap:** MSEDCL had a significantly lower (approx. 10 percentage points) gap without subsidy, when compared to MVVNL.
- **Subsidy:** Even though MSEDCL received no subsidy, its overall cost-revenue gap was substantially lower than that of MVVNL which received subsidies from 15%–25% of its overall per unit revenue.
- **Collection efficiency:** MSEDCL demonstrated 100% collection efficiency in 2015/16, whereas MVVNL actually showed an increase in its gap, even after receiving the benefit of subsidies directly from the state government.
- **Unmetered tariffs:** MSEDCL has developed a mechanism to charge a flat rate for its unmetered agricultural consumers. Even though they charge a flat tariff, the per unit recovery of tariff is effectively similar to that of metered connections. This is done by mapping the consumption pattern of the metered and unmetered connections in the same area and setting flat tariffs accordingly.
- **AT&C Losses:** Even though both discoms show nearly equal percentage of losses in 2015/16, MSEDCL demonstrates a more efficient reduction in gap between average cost of supply and average revenue.

<sup>25</sup> Cross Subsidization: The practice of charging higher prices to one group of consumers to subsidize lower prices for another group.

## 2.4 Tariff Schedule Analysis

Analysis of tariff schedules of five representative discoms (MVVNL, JVVNL, MSEDCL, TPDDL, and BRPL)<sup>26</sup> were studied to understand how tariffs are structured and targeted across consumer classes, especially for the lowest consuming category. It was observed that **only 3 had dedicated rates for below poverty line (BPL) consumers** (MSEDCL, JVVNL and MVVNL), and **except JVVNL, no other discom provisioned for low consuming APL households** (0–50 units, subsidized). In all states, except Maharashtra, government subsidy was provided to the lowest domestic consumer category. However in the case of Delhi, a 50% tariff subsidy is given to all domestic consumers whose consumption is below 400 units, irrespective of their consumption class.

An overall examination of the tariff schedules revealed that the total number of consumer categories ranged from 10 to 25, and tariff slabs within these categories ranged from 45 to 66. In the domestic consumer category, these slabs ranged from 10 (MVVNL) to 19 (TPDDL / BRPL), though **more slabs did not necessarily mean more targeted tariffs**. Even with the least number of slabs, MSEDCL appears to have the most targeted and inclusive structure (Annexure 4).

While Delhi's current subsidy mechanism needs to be better targeted<sup>27</sup> as it benefits even those consumers who do not necessarily require the subsidy, it does however favour energy efficiency. Under the subsidy condition, only those consumers who maintain consumption levels below 400 units a month receive the 50% subsidy benefit from the government and any consumption beyond 400 units disqualifies consumers from receiving the same. This does make a regular middle class consumer more conscious of their consumption levels and promotes energy efficiency.

**Overall, tariff structures for all discoms are complex.** It may be useful to conduct a detailed study of tariff schedules to see how they can be simplified and consolidated under larger heads. It is appreciated that tariff schedules have been designed to target different consumer categories as specifically as possible, though this makes them extremely complex with numerous slabs within consumer groups and categories.

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26 MVVNL - Madhyanchal Vidyut Vitaran Nigam Ltd, Lucknow, UP  
JVVNL - Jaipur Vidyut Vitran Nigam Ltd, Rajasthan  
MSEDCL - Maharashtra State Electricity Distribution Co. Ltd, Maharashtra  
TPDDL - Tata Power Delhi Distribution Ltd, Delhi  
BRPL - BSES Rajdhani Power Ltd, Delhi

27 Since the upper bound threshold for availing subsidies is so high that on an average nearly 80% of connected households in Delhi qualify for a 50% taxpayer subsidy.

### 3 KEY RECOMMENDATIONS

- **Prioritize agricultural electricity subsidy reforms to offset heavy cross-subsidization on industrial consumers, especially in Punjab, Haryana, Maharashtra, Karnataka, and Madhya Pradesh**

Major agricultural sector reforms may be considered, specifically in the states of Punjab, Haryana, Maharashtra, Karnataka, and Madhya Pradesh, to offset the heavy cross-subsidization impact of electricity tariffs on industrial consumers. Cross-subsidy was intended to be an interim mechanism to alleviate financial pressures on the agricultural sector, especially marginal farmers. Electricity regulatory commissions may consider phased tariff revisions for agricultural consumers taking into account factors such as, farm-holding size, cropping patterns, irrigation requirements, etc., and accordingly adjust cross-subsidy levels. Discoms may work in parallel to ensure the provision of efficient and reliable electricity services to agricultural consumers.

- **Initiate reforms in the domestic sector to justify increases in tariff, especially in Bihar, Uttar Pradesh, and Tamil Nadu**

For instance invest to improve the availability, reliability, and quality of supply, and at the same time promote improvements in the operational and collection efficiency of distribution companies (through domestic and feeder metering, improving billing / collections efficiency, converting unmetered to metered connections, increasing hours of supply, etc.).

- **Rationalize tariffs across the electricity value chain based on evidence, to allow discoms to charge cost-reflective tariffs**

For example, subsidy reforms that ensure services can be afforded by the poorest without creating perverse incentives and moving to direct benefit transfers rather than power subsidies. Restructuring tariffs and subsidies based on evidence could enable regulators and the state to ensure that they benefit those who are unable

to afford even basic electricity services, but charge appropriate rates based on consumption from those who are able to afford it and willing to pay for it. This would also help regulators provide more cost-reflective tariffs to discoms.

- **Cross-subsidization needs to be phased out gradually, with all consumers paying for electricity, at least to the extent of cost incurred to generate and supply the same.**

Alternate electricity pricing mechanisms may also be explored where tariffs for units consumed beyond a threshold becomes less for large consumers who are regular in payments and their tariffs are not cross-subsidized. This will encourage such consumers to increase their consumption and the country will be able to utilize the present surplus.

- **Create awareness and public education on the costs of energy generation**

Consumers (especially domestic and agricultural) need to be made more aware and conscious of what it costs to deliver quality electricity services. Interactions with key supply-side stakeholders and research showed that in some cases consumers expressed lower willingness to pay even for better grid-connected services, perhaps due to a sense of entitlement and the expectation of receiving electricity services at a nominal rate or at no cost from the government. If cost-reflective tariffs are to be charged, the expectation of the state as a low-cost / nearly free provider also needs to be changed by helping consumers understand the true cost of supplying electricity, making electricity pricing more independent and by making subsidy policies more transparent and better targeted.

- **Undertake studies on tariff schedules at state level to establish how tariffs can be simplified and consolidated to improve revenue generation, transparency, and reduce transaction costs**

It may be useful to conduct a detailed study of tariff schedules to see how they could be simplified and consolidated under larger heads, such as, domestic, commercial, public service, industrial, and agricultural, to improve revenue generation and transparency as well as reduce transaction costs to make the electricity distribution sector viable and vibrant.

- **Electricity needs to be considered a service independent of its source**

Be it grid or off-grid, the best-suited infrastructure should be employed to provide reliable electricity at an affordable price, for the same level of service. Currently, grid-connected electricity is seen as the highest level of service in terms of reliability and quality. But for remote locations, where the grid will not be able to supply in the next few years, an equally supportive mechanism must be developed to make off-grid/mini-grid solutions more sustainably and affordably available.

- **Develop ‘willingness to provide’ training for supply-side stakeholders**

A ‘willingness to provide’ training across supply-side stakeholders (specifically discoms) may be done to change the attitudes and skills of staff and increase their willingness to ensure the provision of reliable, affordable, and sustainable electricity.

- **Conduct a pan-India cross-sectional WTP study in consultation with state electricity regulatory commissions**

Since existing evidence on willingness to pay for electricity services in India is extremely fragmented, available primarily for rural areas, and there too representative of very small and specific consumer groups, it may be useful to conduct a pan India cross-sectional WTP study that is geographically inclusive and comprehensive, to acquire a holistic demand-side perspective that serves as relevant input for regulators in making pricing decisions. Assessing WTP for electricity services can be made more relevant for pricing if such studies can be designed in consultation with the regulator to enable evidence-based pricing decisions—feeding into future pricing reforms and policies that enable a reduction in the cross-subsidy share, and inform the government on setting a viable subsidy range. It may be useful to also consider standardizing a consistent methodology to assess WTP, and conduct regular WTP surveys to capture changes (in Willingness to Pay) with respect to better services and change in income levels.

## ANNEXURES

### Annexure 1: Research Framework

The studies and surveys covered under the project were selected in the context of the ‘willingness to pay’ approach, that investigates the value assigned to electricity services based on consumer categories (domestic, commercial, industrial, agricultural, etc.), location (urban / rural), and infrastructure supplying the electricity (grid / off-grid).

Based on this, a total of 98 ‘willingness to pay’ reports and studies, pertaining specifically to electricity, were sourced from online<sup>28</sup> and offline sources. Through a title and abstract screening process, 59 studies were shortlisted for detailed review and analysis, the completion of which revealed that in terms of the project’s objective and relevance, a total of 33 studies satisfied the overall research requirements / criteria. It was observed that most studies concentrated on the rural household consumer spectrum, with very limited perspectives available on any other category of consumers, thus, making it difficult to generalize / extrapolate the analyses of the few studies that did examine industrial and urban household consumer categories.

The research project also attempted to put together a repository of primary data on willingness to pay for electricity services in India, as well as other relevant surveys that captured this aspect. In addition to the individual authors and institutions whose studies were analysed, requests and enquiries were also made to over 35 independent organizations, including academic institutions, consultancy organizations, distribution companies, practitioners, and state and central electricity regulatory commissions for relevant survey information. At the end of the project, a total of 10 primary survey data sets were procured after consistent follow ups and requests and used in the analysis. While in some cases the primary survey data had become untraceable and therefore unavailable, in most others there was an evident unwillingness to share data, primarily due to IPR issues.

Since ‘willingness to pay’ studies tended to capture more on the consumer’s (demand-side) perspective on electricity services and costs incurred, an analysis of the tariff setting process in India was also carried out along with detailed interviews with key persons in government and Regulatory Commissions as well as private sector electricity supply stakeholders to acquire a more comprehensive perspective encompassing policy, tariff as well as consumer perceptions. Representatives from central and state electricity regulatory commissions, public and private distribution companies as well as independent power sector experts and consumer advocacy groups were interviewed. Care was taken to identify stakeholders representative of diverse geographies and financial and performance contexts.

Accordingly, the research attempted to draw a correlation between the findings of the ‘willingness to pay’ studies and the supply-side pricing norms to arrive at a set of recommendations. A state-wise comparison was done to get an overview of the distribution of sales and revenues across consumer groups. Detailed analysis was done for discoms in two states, Uttar Pradesh and Maharashtra, as most WTP studies and findings were from these two states. The discoms identified in both the states were chosen based on their electrification and efficiency status, financial status, and distribution practices. The discom in Uttar Pradesh was chosen specifically because the area covered by this discom was common with the sample covered in the procured WTP studies.

#### **Assumptions considered for the analysis:**

- Hours of supply have been normalized to 5 hours for lifeline consumers – keeping the UP scenario as a standard, as derived from the studies in UP
- Average monthly consumption of lifeline consumer = 150 units
- Calculations have been made on conservative estimates (max load / consumption)

<sup>28</sup> Google Scholar was the main search engine used. Keywords used are: willingness to pay for electricity in India, electricity pricing in India, willingness to pay survey, consumer’s electricity demand and supply, electricity pricing and affordability, willingness to pay for improved services, assessment of consumer’s ability to pay for electricity, farmer’s willingness to pay, willingness to pay of urban consumers, etc.

- Service from grid connection (SL 3)= 1 fan + 1 TV + 1 tube + 2 CFL bulbs
- Service from off-grid (SL 2) = 2 LED bulbs + 1 mobile charging
- Service from kerosene (SL 1) = 4 hours of lighting in a day (coping cost of replacing lighting from two 15 watt bulbs, in the absence of electricity)

The findings were also shared with key electricity sector stakeholders at a roundtable meeting in Delhi on 26 October, 2016, to solicit their comments, opinions, agreements / disagreements, and thereby, further strengthen the recommendations.

## Annexure 2: MVVNL, Uttar Pradesh—Detailed Calculation for Estimated Reduction in Gap

S. No.	Parameter	2013/14	2014/15	2015/16
		₹ / kWh	₹ / kWh	₹ / kWh
1	Average Cost of Supply (ACS)	6.18	5.49	6.46
2	Average Revenue (without subsidy)	3.32	3.37	5.16
3	Gap without subsidy	2.86	2.12	1.30
4	Gap after subsidy received	2.29	1.32	0.73
5	Subsidy received	0.57	0.80	0.57
6	Gap (actual realised revenues + subsidy)	1.87	1.80	1.98 <sup>27</sup>
7	AT&C Losses of Discom (in %)	14.32	35.18	34.07
8	Benchmark AT&C Losses that year (in %) (DGVCL) <sup>28</sup>	10.83	10.81	10.81
9	Improvement (in %)	3.49	24.37	23.26
10	Effective reduction in Gap	0.12	0.82	1.20
11	Gap after reduced AT&C Losses (6–10)	1.75	0.98	0.78
12	Average Lifeline Consumer Tariff (metered) for 5 hours of electricity	2.63	2.90	3.60
13	Average Lifeline Consumer Tariff (unmetered) (flat rate consumer)	1.20	1.20	1.20
14	Differential (what the discom can recover if it meters unmetered connections)	1.43	1.70	2.40
15	Ratio of unmetered connections to total connections	0.31	0.35	0.30
16	Actual reduction in Gap (w.r.t. ratio of unmetered connections)	0.45	0.60	0.72
17	Gap after unmetered to metered (11–16)	1.31	0.38	0.06
18	Average Life Line Consumer Tariff (metered) for 5 hours of electricity	2.63	2.90	3.60
19	Average Life Line Consumer Tariff (metered) if hours of electricity are extended from 5 hours to 10 hours at the existing slabs	2.57	2.88	3.75
20	Effective reduction in Gap	-0.06	-0.02	0.15
21	Gap after increased hours of supply (17–20)	1.37	0.41	-0.09
22	<b>% reduction in Gap (21/6*100)</b>	<b>26.8</b>	<b>77.3</b>	<b>104.6</b>

Source: Calculations based on data from Power Finance Corporation Report on Performance of State Power Utilities, 2016

### Notes:

- Figures for 2015/16 are tariff order figures, as trued up details were not available at the time of analysis.
- Figures highlighted in yellow in Rows 8, 13, and 18 are assumptions –replicated from the previous year due to non-availability.
- Figure highlighted in yellow in Row 16, is the ratio of unmetered households in 2015/16, which is reducing as more households are brought into the metered network every year.

<sup>29</sup> The gap has been calculated by taking an average of the previous years. It has been assumed that the subsidy booked is also the actual subsidy realised.

<sup>30</sup> This benchmark is based on DGVCL's performance standards (a discom in Gujarat), taking a realistic estimation of possible percentage reduction in AT&C losses.

The table represents the various gaps (with / without subsidy) and the actual recovered amount for the period 2011/16. The explanation is as follows:

- Row 3: Is the Stated Gap, which is the difference between the average cost of supply and average revenue requirement
- Row 4: Is the Gap after taking into account subsidy received / booked (which is the official approved subsidy amount). However, it is to be noted that the subsidy booked amount need not necessarily be realised in the same year.
- Row 5: Is the calculated subsidy booked / received amount (the difference between gap before and after subsidy).
- Row 6: Final stated gap (after revenue and actual subsidy realisation). The subsidy realised may include subsidy pending from previous years.
- Row 7: Captures AT&C losses claimed by MVVNL.
- Row 8: Shows the lowest AT&C losses incurred by DGVCL (Gujarat discom), that have been considered as a benchmark for reducing AT&C losses to a realistic level
- Row 9: Is the calculated % improvement in AT&C losses for MVVNL, if it achieves the benchmark stated above
- Row 10: Is the calculated effective reduction in Gap (Row 6), that can be achieved by reducing losses and therefore contributing to the average revenue.
- Calculation for Row 10:  $\text{Benchmark (\%)} \times \text{Average Revenue (without subsidy)}$
- Row 11: The reduced gap achieved after reduction in AT&C losses.
- Row 15: Is the ratio of unmetered connections to the total number of connections in this consumer slab. This has been taken into account because only a percentage of the gap would be recovered by the conversion of these unmetered connections.
- Row 16: Is the calculated reduction in gap, with respect to the ratio of unmetered connections.
- Row 20: While it indicates that there is a marginal increase in the Gap (from 2011/15) instead of a reduction, however, the significant increase in consumption of electricity (due to increased hours of supply) will result in a higher realisation of total revenue.
  - $\text{Total revenue (\uparrow)} = \text{Price (\downarrow)} \times \text{Quantity (\uparrow)}$
  - The rate of reduction in price per unit is marginal compared to the high rate of increase in units of consumption

## Annexure 3: MSEDCL, Maharashtra—Detailed Calculation for Estimated Reduction in Gap

S. No.	Parameter	2013/14	2014/15	2015/16
		₹ / kWh	₹ / kWh	₹ / kWh
1	Average Cost of Supply (ACS)	5.34	5.15	6.87
2	Average Revenue (without subsidy)	5.22	5.11	6.03
3	Gap without subsidy	0.12	0.04	0.84
4	Gap after subsidy received	0.12	0.04	0.84
5	Subsidy received	0.00	0.00	0.00
6	Gap (actual realised revenues + subsidy)	0.20	0.30	0.84
7	AT&C Losses of Discom (in %)	14.39	19.75	17.45
8	Benchmark AT&C Losses that year (in %) (DGVCL) <sup>29</sup>	10.83	10.81	10.81
9	Improvement (in %)	3.56	8.94	6.64
10	Effective reduction in Gap	0.19	0.46	0.40
11	Gap after reduced AT&C Losses (6–10)	0.01	-0.16	0.44
12	Average Lifeline Consumer Tariff (metered) for 5 hours of electricity	4.52	5.24	5.24
13	Average Lifeline Consumer Tariff (unmetered) (flat rate consumer)	0.00	0.00	0.00
14	Differential (what the discom can recover if it meters unmetered connections)	4.52	5.24	5.24
15	Ratio of unmetered connections to total connections	0.00	0.00	0.00
16	Actual reduction in Gap (w.r.t. ratio of unmetered connections)	0.00	0.00	0.00
17	Gap after unmetered to metered (11–16)	0.01	-0.16	0.44
18	Average Life Line Consumer Tariff (metered) for 5 hours of electricity	4.52	5.24	5.24
19	Average Life Line Consumer Tariff (metered) if hours of electricity are extended from 5 hours to 10 hours at the existing slabs	5.29	6.23	6.23
20	Effective reduction in Gap	0.76	0.98	0.98
21	Gap after increased hours of supply (17–20)	-0.75	-1.14	-0.54
22	<b>% reduction in Gap (21/6*100)</b>	<b>474.6</b>	<b>480.1</b>	<b>164.7</b>

Source: Calculations based on data from Power Finance Corporation Report on Performance of State Power Utilities, 2016

### Notes:

- Row 4: Since MSEDCL does not provide subsidy, gap before and after subsidy remains the same
- Figure highlighted in yellow in Row 8 is replicated from the previous year due to non-availability

<sup>31</sup> This benchmark is based on DGVCL's performance standards (a discom in Gujarat), taking a realistic estimation of possible percentage reduction in AT&C losses.

## Annexure 4: Tariff Schedule Analysis

Discom	Total Consumer Categories	Types	Sub-category	Slabs per sub-category	No. of slabs
BRPL, Delhi	12	Domestic	1.1 Domestic	Upto 2 kW connected load	5
				2kW-5kW connected load	5
				> 5 kW	5
				1.2 Single Delivery Point for CGHS	
		Non-domestic	2.1 Non domestic LT		3
			2.2 Non-domestic HT		1
		Industrial	3.1 Small Industrial Power	< 200kW / 215 kVA	3
			3.2 Industrial Power on 11 kV single point delivery for group of SIP consumers		1
			3.3 Large industrial power (supply at 11 kV and above)		1
		Agricultural			1
		Mushroom Cultivation			1
		Public Lighting	6.1 Metered		2
			6.2 Unmetered		2
		Delhi Jal Board	7.1 Supply at LT		3
			7.2 Supply at 11 kV and above		1
		Delhi International Airport Ltd (DIAL)			1
		Railway Traction			1
		DMRC			1
		Advertisements / Hoardings			1
		Temporary Supply	12.1 For a total period of	Less than 16 days / More than or equal to 16 days	2
			12.2 For residential CGH connections and other residential connections		1
			12.3 For religious functions of traditional and established characters and cultural activities		1
			12.4 For major construction projects		1
12.5 For threshers			2		
<b>TOTAL</b>				<b>49</b>	

TPDDL, Delhi	12	Domestic	1.1 Domestic	Up to 2 kW connected load	5
				2kW-5kW connected load	5
				> 5 kW	5
				1.2 Single Delivery Point for CGHS	4
		Non-domestic	2.1 Non-domestic LT	3	
			2.2 Non-domestic HT	1	
		Industrial	3.1 Small Industrial Power	< 200kW / 215 kVA	3
			3.2 Industrial Power on 11 kV single point delivery for group of SIP consumers		1
			3.3 Large industrial power (supply at 11 kV and above)		1
		Agricultural		1	
		Mushroom Cultivation		1	
		Public Lighting	6.1 Metered	2	
			6.2 Unmetered	2	
		Delhi Jal Board	7.1 Supply at LT	3	
			7.2 Supply at 11 kV and above	1	
		Delhi International Airport Ltd (DIAL)		1	
		Railway Traction		1	
		DMRC		1	
		Advertisements / Hoardings		1	
		Temporary Supply	12.1 For a total period of	2	
			12.2 For residential CGH connections and other residential connections	1	
			12.3 For religious functions of traditional and established characters and cultural activities	1	
			12.4 For major construction projects	1	
12.5 For threshers	2				
<b>TOTAL</b>		<b>49</b>			

# ANNEXURES

MSEDCL, Maharashtra	2	HT	1.1 Industrial		3		
			1.2 Commercial		2		
			1.3 Railways		1		
			1.4 PWW		2		
			1.5 Agriculture		1		
			1.6 Bulk Supply		1		
			1.7 Residential (newly proposed)		1		
			1.8 Temporary		2		
			1.9 Public Service		2		
			1.10 Port		1		
			1.11 Govt. Schools / Hospitals (newly proposed)		2		
			LT	2.1 Domestic	BPL (0–30 units)		1
					APL (0–125 units)		2
		126–300				2	
		301–500				3	
		501–1000				1	
		> 1000				1	
		3 phase connection				1	
		2.2 Non-Domestic		0–20 kW		2	
				> 20–50 kW		1	
				> 50 kW		1	
		2.3 PWW			3		
		2.4 Agriculture		Unmetered		6	
				Metered		1	
		2.5 Industrial			2		
		2.6 Street Light		2			
		2.7 Temporary		2			
2.8 Advertising / Hoardings		1					
2.9 Crematoria / Burial Ground		1					
2.10 Public Services		4					
2.11 Ports (newly proposed)		1					
2.12 Govt. Schools / hospitals (newly proposed)		1					
<b>TOTAL</b>				<b>57</b>			

JVNL, Rajasthan	10	LT-1 Domestic (Subsidised)	BPL	0–50 units	1
			Small Domestic	0–50 units	1
		LT-1 Domestic (General)	General Domestic -1	0–150 units	2
			General Domestic -2	150–300 units	3
			General Domestic -3	300–500 units	3
			General Domestic -4	> 500 units	5
		HT 1 - Domestic (General)	HT Domestic	For contract demand over 50 kVA	1
		Non-domestic Category (LT2 & HT2)	NDS upto 5kW of SCL	NDS Type 1	1
				NDS Type 2	2
				NDS Type 3	3
				NDS Type 4	4
			NDS > 5kW of SCL	LT 2	4
				HT 2	1
		Public Lighting (LT3)			2
		Agriculture (LT 4 )	Metered		2
			Flat Rate		2
		Small Industries (LT5)			2
Medium Industries	LT 6		1		
	HT 3		1		
Bulk Supply for Mixed Load	LT 7		1		
	HT 4		1		
Large Industries	HT 5		1		
<b>TOTAL</b>			<b>44</b>		

<b>MVVNL, Uttar Pradesh</b>	14	LMV 1 - Domestic Light, Fan, Power	Consumers getting supply as per 'Rural Schedule'	Unmetered (load upto 2kW and > 2kW)	2
				Metered	1
			Supply at Single point of bulk load	50 kW and above	1
			Other metered domestic consumers	Life line consumers (Loads of 1 kW, 0 to 50 kWh / month)	1
				Life line consumers (Loads of 1 kW, 51 to 150 kWh / month)	1
				Others (All loads, 0-150 kWh)	1
				Others (All loads, 151-300 kWh)	1
				Others (All loads, 301-500 kWh)	1
				Others (All loads, > 501 kWh)	1
		LMV 2 - Non-domestic Light, Fan, Power	Consumers receiving supply as per 'Rural Schedule'	Unmetered	1
				Metered	1
			Private Advertising / Sign Posts / Sign Boards / Glow Signs / Flex* In all other cases		1 3
		LMV 3 - Public Lamps	Unmetered	Gram Panchayat	1
				Nagar Palika	1
				Nagar Nigam	1
			Metered	Gram Panchayat	1
				Nagar Palika	1
				Nagar Nigam	1
		LMV 4 - Light, Fan, and Power Supply for Public and Private Institutions	Public Institutions		3
			Private Institutions		2
		LMV 5 - Small Power for Private Tube wells, Pumping Sets for Irrigation	Consumers receiving supply as per 'Rural Schedule'	Unmetered	1
				Metered	1
			Consumers receiving supply as per 'Urban Schedule'	Metered	1
PTW consumers of Bundelkhand Area located in Gram Sabha	Unmetered			1	
LMV 6 - Small and Medium Power	Consumers receiving supply other than 'Rural Schedule'		3		

	LMV 7 - Public Water Works	Consumers receiving supply other than 'Rural Schedule'	1
		Consumers receiving supply as per 'Rural Schedule'	1
	LMV 8 - State Tube wells / Panchayati Raj Tube well and Pumped Canals	Metered	1
		Unmetered	1
	LMV 9 - Temporary Supply	Un-metered Supply for Illumination / Public Address / Temporary Shops in Melas	2
		Metered Supply for all other purposes	2
	LMV 10 - Departmental Employees and Pensioners	LMV 1 Rates applicable	1
	HV 1 - Non industrial bulk loads	Commercial Loads / Private Institutions / Non domestic bulk power consumer with contracted load 75 kW & above and getting supply at Single Point on 11 kV & above	4
		Public Institutions, Registered Societies, Residential Colonies / Townships, Residential Multi-Storied Buildings including Residential Multi-Storied Buildings with contracted load 75 kW & above and getting supply at Single Point on 11 kV & above voltage levels	4
	HV 2 - Large and Heavy Power		4
	HV 3	Railway Traction	2
		Metro Rail	1
	HV 4 - Lift Irrigation		3
<b>TOTAL</b>			<b>61</b>

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