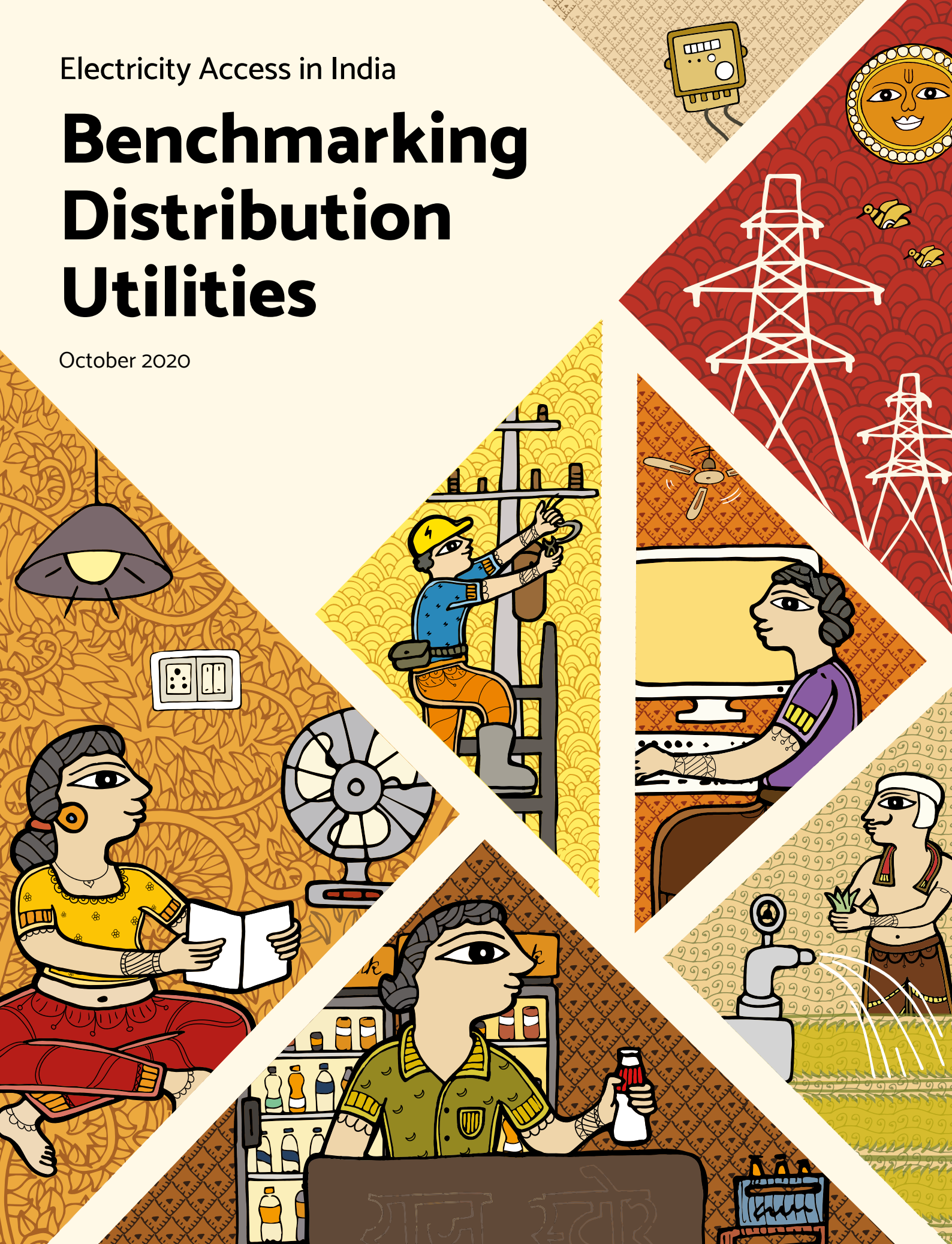


Electricity Access in India

Benchmarking Distribution Utilities

October 2020



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Organisations

National Institution for Transforming India (NITI Aayog)

The National Institution for Transforming India, also called NITI Aayog, was formed via a resolution of the Union Cabinet on January 1, 2015. NITI Aayog is the premier policy 'Think Tank' of the Government of India, providing both directional and policy inputs. While designing strategic and long-term policies and programmes for the Government of India, NITI Aayog also provides relevant technical advice to the Centre and States. The Government of India, in keeping with its reform agenda, constituted the NITI Aayog to replace the Planning Commission instituted in 1950. This was done in order to better serve the needs and aspirations of the people of India. An important evolutionary change from the past, NITI Aayog acts as the quintessential platform of the Government of India to bring States to act together in national interest, and thereby fosters Cooperative Federalism. At the core of NITI Aayog's creation are two hubs – Team India Hub and the Knowledge and Innovation Hub. The Team India Hub leads the engagement of states with the Central government, while the Knowledge and Innovation Hub builds NITI's think-tank capabilities. These hubs reflect the two key tasks of the Aayog. NITI Aayog is also developing itself as a State-of-the-Art Resource Centre, with the necessary resources, knowledge and skills, that will enable it to act with speed, promote research and innovation, provide strategic policy vision for the government, and deal with contingent issues.

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The Rockefeller Foundation advances new frontiers of science, data and innovation to solve global challenges related to health, food, power and economic mobility. As a science-driven philanthropy focused on building collaborative relationships with partners and grantees, the Foundation seeks to inspire and foster large-scale human impact that promotes the well-being of humanity throughout the world by identifying and accelerating breakthrough solutions, ideas and conversations. For more information, visit: www.rockefellerfoundation.org

Smart Power India

Smart Power India (SPI) is the key agency implementing the Rockefeller Foundation's Smart Power initiative. SPI extends power to those without sufficient access, with the goal of ending energy poverty and transforming the livelihoods of the underserved. To this end, SPI works to build and nurture ecosystems which promote sustainable and scalable models for delivering electricity access.

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Benchmarking Distribution Utilities

October 2020

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5th October, 2020



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FOREWORD

India has traversed a long journey since the first set of power sector reforms ushered in with introduction of the Electricity Act in 2003, having emerged from a state of significant electricity deficit to a state of adequate supply to meet its citizens' demands. Today, the country stands proud having provided electricity connections to all households ahead of the target timeline of 2022, a success being globally acknowledged. Led by the Central Government's ambitious vision to electrify everyone in the country and well-designed programs like Deen Dayal Upadhyay Gram Jyoti Yojana, Saubhagya and several State Government schemes, electricity connections have been made available to more than 750 million people over the last two decades.

2. Electricity is set to play a crucial role in the journey of becoming a USD 5 Trillion economy, as a robust electricity supply backbone becomes available to industries and other segments alike. With electricity comprising only 17% of total energy consumption and the target of increasing it to 26% over the next one to two decades, it becomes now imminent to focus on the sustainability of electricity access and enhance demand amongst various consumer sectors. It essentially percolates to expanding access to a wider group of customer categories, as well as to ensure commercial viability of the state-owned electricity distribution companies (DISCOMs)

3. India's electrification sector has historically been marred with challenges of sustaining quality and affordable electricity supply in rural hinterlands due to operational and financial losses, leading to lack of focus on quality of supply and customer services. The government's reform initiatives like Ujwal DISCOM Assurance Yojana (UDAY), Integrated Power Development Scheme System, and Smart Grid Mission etc. are steps being taken in this direction.

4. This study, undertaken as part of NITI Aayog's Statement of Intent with the Rockefeller Foundation and its Indian subsidiary Smart Power India, provides a baseline of performance of DISCOMs on electricity access and their existing capacity to achieve targets. Amongst several findings, the study also finds that at this juncture, focusing on operational and institutional processes are expected to drive better financial performance of the utilities as compared to only prioritizing capital investments. It also captures experiences of relatively better performing DISCOMs in solving few fundamental bottlenecks that can help all other utilities looking for alternative mechanisms to improve performance.

5. This is an opportune time for launching the findings from this study for interested readers, practitioners and policy makers to use this towards implementing the reform agendas being proposed for the electricity distribution and access sector. I congratulate Energy Vertical Team of NITI Aayog, the team at Rockefeller Foundation and Smart Power India for undertaking this critical study. My compliments and sincere thanks to Ministry of Power, all electricity distribution companies (DISCOMs) who participated in this study and shared their data and all partners who contributed towards preparation of this report.

(Rajiv Kumar)



Amitabh Kant
CEO

PREFACE

Government is committed to provide reliable, high-quality, 24*7 grid power supply to all customers. This commitment has introduced a range of challenges for DISCOMs. It is time to map and assess the capacity of DISCOMs for meeting aspirations of their customers and electricity access targets.

Therefore, NITI Aayog conceptualized and executed the Status of Electricity Access & Benchmarking Utilities Study in the partnership with the Rockefeller Foundation USA and Smart Power India to (i) Evaluate the status of electricity access in India across different states and distribution utilities along all dimensions that constitute meaningful access, (ii) Benchmark distribution utilities' capacity to provide electricity access and identify the drivers of viability and (iii) Develop recommendations that help DISCOMs leverage latent capacity and capitalise on drivers of viability.

This study was also designed to capture insights from both the demand side (electricity customers) and the supply side (DISCOMs). It takes a cue from global agency guidelines, such as the United Nations Sustainable Goal 7 and Sustainable Energy for All (SE for All) initiative, and uses the World Bank's Energy Sector Management Assistance Program (ESMAP) Multi-tier Framework (MTF) to enhance understanding of the viability and reliable access of electricity.

The study is relevant as it launches the first ever India-specific framework for comprehensive measurement of electricity access. It provides a rich dataset of 25,000 customers, across 4 customer groups including agriculture spread over 25 DISCOMs and 10 geographic states that constitute 65% of India's rural population.

The finding of the report would be useful of policy makers, think tanks and private sector for preparing efficient road map for sustainable business model for DISCOMs and electricity access.

I would like to commend the Energy Vertical, NITI Aayog, Rockefeller Foundation, USA and Smart Power India officials who worked with passion with States and other stakeholders on the subject. I am sure that this Report would stimulate a healthy debate on some of the most important issues in the power sector.

(Amitabh Kant)



Ashvin Dayal

Senior Vice-President, Power
The Rockefeller Foundation, USA

FOREWORD

Over the course of the 20th century, The Rockefeller Foundation has harnessed the power of science and technology to catalyze pivotal moments in the global effort to eradicate poverty and improve the wellbeing of humanity.

In the 21st century, hundreds of millions of people still remain locked out of opportunity, and in an increasingly inter-connected world, their inability to access and consume sufficient energy is at the heart of the problem. The world is at a critical tipping point - one where energy access and consumption provides the best opportunity for fighting poverty, and improving livelihoods in our lifetimes.

India is on track to end energy poverty for its 1.3 billion people, with electrification rates for households rising from 59.4% in 2000 to 100% in 2019. India's commitment to energy access is exemplified in the Government of India's stated goal of ensuring affordable, reliable electricity for all. Indeed, the Government of India has been working tirelessly on multiple initiatives, such as Ujjwal DISCOM Assurance Yojana (UDAY) to improve the health of public electricity distribution utilities. However, low rural electricity demand, regulated tariffs and stagnant technical & commercial losses (AT&C) continue to hinder public utilities in their efforts to provide reliable electricity to rural communities.

With this challenge in mind The Rockefeller Foundation was honored to partner with the Government of India to better understand bottlenecks and identify innovative solutions, entering into a partnership in early 2019 with NITI Aayog, India's premiere policy think tank. The purpose of our collaboration is to advance rapid improvements in the scale and quality of electricity access across India using primary and secondary data on the performance of utilities in order to present a benchmarking analysis and recommendations for improvement.

We are delighted to present this study, which clearly demonstrates utilities with higher customer satisfaction levels have better financial performance, and are thus able to provide more reliable electricity connections to more people in rural communities - a virtuous performance cycle that can be replicated much more widely. Through this research and a set of innovative ground-level pilots to improve utility performance in rural areas (initially in Bihar and Odisha), new evidence and solutions will be rigorously tested, and will eventually help to advance nation-wide reliable electricity access for all.

I sincerely hope you enjoy reading this report.

(Ashvin Dayal)



Jaideep Mukherji

CEO
Smart Power India

FOREWORD

India in recent years has emerged as one of the leaders in providing access to electricity to its citizens, almost doubling the access rate in the past 20 years from 59.4% to extending grid connections to 100% households in the country. This has been made possible through a multitude of efforts, including enhancing power generation to reduce supply deficits, strengthening the backbone of the electricity supply infrastructure, and ensuring last-mile connectivity for different customer segments. However, impediments to providing reliable and sustainable power supply across the country, still exist. It is therefore now time to focus on sustainability of electricity access and craft an action plan to resolve remaining challenges.

Smart Power India (SPI) established in 2015 by the Rockefeller Foundation works towards advancing the Smart Power program of the Foundation in India and complement the Government of India's efforts in realizing the goals of rural electricity access.

Globally, electricity access is measured through a multidimensional model that goes beyond connections to include various attributes such as available hours of supply, the time of supply, reliability and quality of supply etc. that constitute meaningful access. Based on SPI's work, we have also observed that the underlying capacity of the electricity service providers determines the level of electricity access delivered on the ground. However, when it comes to grid-based electricity access in India, not enough is known about the distribution utilities performance on this multidimensional access model and the capacities driving this performance. SPI and the Rockefeller Foundation in partnership with NITI Aayog, engaged in this study to bridge this gap in understanding. It launches the first ever multidimensional framework for India to measure electricity access and an Access-index to benchmark performance of distribution utilities on electricity access.

This study is unique since it captures insights from both the demand side – the electricity customers and the supply side- electricity distribution utilities. The study covers different customer categories and all 25 public utilities across 10 states have been covered. The report presents several interesting findings. One such finding of this study, through an empirical analysis, is that the state of electricity access and customer satisfaction are closely related to the financial performance of the utility. Focussing on the service component of electricity distribution such as power reliability, quality and customer services by strengthening utility capacity, can therefore enhance the utility's business performance.

We hope this study's data driven findings will prove to be useful in shaping the future of the electricity distribution business in the country and that the stakeholders will appreciate the need to come together with sustained efforts to achieve the reality of a 24*7 power for all.

(Jaideep Mukherji)

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LIST OF ABBREVIATIONS

AAV	Antyodaya Anna Yojana	KPI	Key Performance Indicator
AB	Aerial Bundled	kV	kilo Volt
ACS	Average Cost of Supply	kW	kilo Watt
AG	Agricultural (Customer Category)	kWh	kilo Watt-hour
AMHE	Average Monthly Household Expenditure	lakh	100,000 units
AMI	Advanced Metering Infrastructure	LED	Light-emitting Diode
ANOVA	Analysis of Variance	LPG	Liquefied Petroleum Gas
APDRP	Accelerated Power Development and Reforms Programme	LT	Low Tension
APL	Above Poverty Line	MBC	Metering, Billing, and Collection
AREP	Accelerated Rural Electrification Programme	MNP	Minimum Needs Programme
ARR	Average Revenue Realized	MTF	Multi-tier Framework
AT&C	Aggregate Technical and Commercial	MTF-I	Multi-tier Framework - India
BPL	Below Poverty Line	MU	Million Units
CERC	Central Electricity Regulatory Commission	MVA	Megavolt-ampere
CGRF	Customer Grievance Redressal Forum	MW	Megawatt
CO	Commercial (Customer Category)	NITI	National Institution for Transforming India
CSAT	Customer Satisfaction	NSC	New Service Connection
DBT	Direct Benefit Transfer (of subsidies)	NSS	National Sample Survey
DDUGJY	Deen Dayal Upadhyaya Gram Jyoti Yojana	NTW	Network
DISCOM	Electricity Distribution Utility or Company	O&M	Operations and Maintenance
DSM	Demand-side Management	OBC	Other Backward Classes
DT	Distribution Transformer	PMGY	Pradhan Mantri Gramodaya Yojana
EHT	Extra High Tension	POC	Point of Contact
ERP	Enterprise Resource Planning	PPS	Probability Proportional to Size
ESMAP	Energy Sector Management Assistance Program	R-APDRP	Restructured Accelerated Power Development and Reforms Programme
FGD	Focus Group Discussion	RGVY	Rajiv Gandhi Grameen Vidyutikaran Yojana
GSDP	Gross State Domestic Product	Saubhagya	Sahaj Bijli Har Ghar Yojana
HH	Household (Customer Category)	SC	Scheduled Caste
hp	Horsepower	SCADA	Supervisory Control and Data Acquisition
HT	High Tension	SDG	Sustainable Development Goal
HVDS	High Voltage Distribution System	SEC	Socio-economic Class
IN	Institutional (Customer Category)	SEforAll	Sustainable Energy for All
INR	Indian National Rupee	SERC	State Electricity Regulatory Commission
IPDS	Integrated Power Development Scheme	SHS	Solar Home Lighting Systems
IT	Information Technology	SMP	Standard Maintenance Procedures
KJP	Kutir Jyoti Programme	SMS	Short Message Service
		SoP	Standards of Performance

SOP	Standard Operating Procedures
SPI	Smart Power India
ST	Scheduled Tribe
TAT	Turnaround Time
ToD	Time of Day
UDAY	Ujwal Discom Assurance Yojana
Ujjwala	Pradhan Mantri Ujjwala Yojana
UPI	Unified Payments Interface
WH	Watt-hour

LIST OF ACRONYMS AND ABBREVIATIONS FOR DISCOMS (DISTRIBUTION UTILITIES)

ACRONYM	Abbreviation	Name of the DISCOM
APEPDCL	AP East	Andhra Pradesh Eastern Power Distribution Company Limited
APDCL	Assam	Assam Power Distribution Company Limited
APSPDCL	AP South	Andhra Pradesh Southern Power Distribution Company Limited
BESCOM	Karnataka Bangalore	Bangalore Electricity Supply Company Limited
CESCOM	Karnataka Mysore	Chamundeshwari Electricity Supply Company Limited
DGVCL	Gujarat South	Dakshin Gujarat Vij Company Limited
DVVNL	UP South	Dakshinanchal Vidyut Vitran Nigam Limited
GESCOM	Karnataka Gulbarga	Gulbarga Electricity Supply Company Limited
HESCOM	Karnataka Hubli	Hubli Electricity Supply Company Limited
KeSCO	UP Kanpur	Kanpur Electricity Supply Company
MePDCL	Meghalaya	Meghalaya Power Distribution Company Limited
MESCOM	Karnataka Mangalore	Mangalore Electricity Supply Company Limited
MGVCL	Gujarat Central	Madhya Gujarat Vij Company Limited
MPMKVVCL	MP Central	Madhya Pradesh Madhya Kshetra Vidyut Vitaran Company Limited
MPPKVVCL	MP West	Madhya Pradesh Paschim Kshetra Vidyut Vitaran Company Limited
MPPoKVVCL	MP East	Madhya Pradesh Poorv Kshetra Vidyut Vitaran Company Limited
MVVNL	UP Central	Madhyanchal Vidyut Vitran Nigam Limited
NBPDCL	Bihar North	North Bihar Power Distribution Company Limited
PGVCL	Gujarat West	Paschim Gujarat Vij Company Limited
PSPCL	Punjab	Punjab State Power Corporation Limited
PuVVNL	UP East	Purvanchal Vidyut Vitran Nigam Limited
PVVNL	UP West	Paschimanchal Vidyut Vitran Nigam Limited
SBPDCL	Bihar South	South Bihar Power Distribution Company Limited
UGVCL	Gujarat North	Uttar Gujarat Vij Company Limited
WBSEDCL	West Bengal	West Bengal State Electricity Distribution Company Limited

Executive Summary

India's commitment to provide reliable, high-quality, 24*7 grid power supply to all willing customers has introduced a range of challenges for its electricity distribution utilities (also known as distribution companies or DISCOMs). It is an opportune time to map and assess the capacity of India's DISCOMs to service the needs and aspirations of their customers and meet ambitious electricity access targets.

This benchmark report, **Status of Electricity Access & Benchmarking Utilities** presents the findings of a study commissioned to understand the current state of electricity access. The study was conceptualized and executed as a partnership between NITI Aayog (the Government of India's policy think tank), the Rockefeller Foundation, and Smart Power India, with three objectives:

- ▶ Evaluate the status of electricity access in India across different states and distribution utilities along all dimensions that constitute meaningful access.
- ▶ Benchmark distribution utilities' capacity to provide electricity access and identify the drivers of viability.
- ▶ Develop recommendations that help DISCOMs leverage latent capacity and capitalise on drivers of viability.

India has achieved a 100% connection rate for all its willing households: a considerable achievement resulting from a series of ambitious programs from state and central governments. However, providing reliable power of adequate quality on regular basis is an ongoing and evolving challenge for the Indian power sector.

This study was designed to capture insights from both the demand side (electricity customers) and the supply side (DISCOMs). It takes a cue from global agency guidelines, such as the United Nations Sustainable Development Goal 7 and Sustainable Energy

for All (SEforAll) initiative, and uses the World Bank's Energy Sector Management Assistance Program (ESMAP) Multi-tier Framework (MTF) to enhance understanding of the viability and reliable access of electricity.

The study seeks to support the below listed objectives of three key stakeholders in India's power sector:

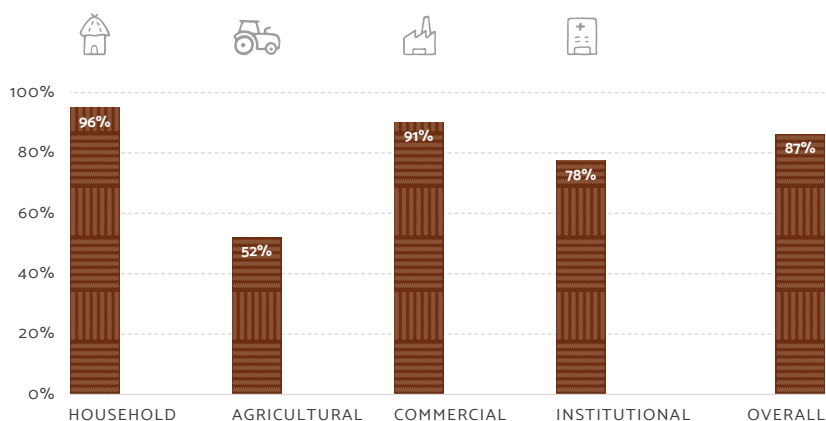
- ▶ **NITI Aayog:** Baselineing of the current status of rural electricity supply and service in terms of quantity and quality for providing policy and directional inputs for progressing electricity access in the country.
- ▶ **Ministry of Power (MoP):** Baselineing the performance of distribution utilities on electricity access to make a case for forthcoming sectoral reforms to enhance viability of DISCOMs.
- ▶ **DISCOMs:** Captures the status of access for all major customer categories, customer satisfaction with services and areas of improvement to enhance access. Additionally, it provides learnings and best practices adopted by leading DISCOMs in delivering sustainable access to its customers.

The study is also relevant as it:

- ▶ Launches the first ever India-specific framework for comprehensive measurement of electricity access.
- ▶ Condenses findings from one of the largest ever surveys on electricity access, following the completion of the Government of India's programme on household electrification - SAUBHAGYA.
- ▶ Provides a rich dataset of 25,000 customers, across 4 customer groups including agriculture spread over 25 DISCOMs and 10 geographic states that constitute 65% of India's rural population.

The study was designed to investigate and establish the relationship between electricity

Figure O-1: Electricity access rate by customer category



access in a given region, the satisfaction of customers, the utility’s capacity to viably deliver electricity access, and the financial performance of the utility. It covers customers’ point of view through an exhaustive survey administered in 10 states, garnering 25,000 responses from households, agricultural, commercial, and institutional customer categories, in both urban and rural areas. It also covers an assessment of the 25 distribution utilities across these 10 states in order to understand their capacity to deliver electricity access.

The study used a mixed design approach that synthesizes primary customer research and secondary research on the electricity distribution utilities serving these customers. For both customers and utilities, primary research included quantitative and qualitative aspects. On-ground observational surveys of substations and feeders further supplemented understanding around key infrastructure challenges.

This report presents findings from the study, discusses recommendations to enhance electricity access, and attempts to underline some best practices adopted by the better-performing electricity distribution utilities in India.

Key Findings

Grid Connectivity

With grid connectivity now reported for all willing households, this study takes a deeper look at other metrics pertaining to the state of connectivity in India. Parameters include availability of infrastructure, alternative sources of lighting and electricity, and reasons for not taking connection from the electricity grid. Results are segregated into household, agricultural, commercial, and institutional customer categories.

A primary parameter in consideration for assessing connectivity is Availability rate. In total, 92% of customers reported availability of electricity infrastructure within 50 meters of their premises. For the Agricultural category, the availability rate reported was about 75%. Interestingly, the Hook-up rate suggests that, even where electricity infrastructure is available, not all customers have a grid connection. Of the customers who reported having electricity infrastructure within 50 meters of their premises, the overall hook-up rate is just 86%. The hook-up rate for agricultural and institutional customers is particularly low, at 70% and 81% respectively.

The near 100% access rate for household customers based on the primary survey, indicates that the Saubhagya scheme has been successful in connecting households to the grid. Grid access however varies across customer categories, utilities, and states.

Having considered electric grid connectivity in the country, the study also focused on finding reasons for customers not having a grid connection. Among the customers who rely on non-grid sources for electricity and lighting, primary reasons for non-connection to the grid include the distance of the nearest electric pole from the customer’s premises (47%), inability to pay for electricity costs and user charges (35%), and poor quality of service (20%). Although as per the Saubhagya scheme¹, electricity connections were delivered at affordable rates, the response from the primary survey indicates a potential lack of customer awareness.

It is interesting to note that, of unconnected commercial customers, almost half stated that the main reason was unaffordability, while 43% of unconnected institutional customers stated that they were either refused a connection or had applied for one but were still waiting.

¹ As per the Saubhagya scheme, there is no upfront fee or charges for obtaining electricity connection. Non-poor households will have to pay 10 instalments of Rs. 50 each along with the bill each month (total Rs. 500). (Source: <https://powermin.nic.in/>)



Electricity Access

For achieving the milestone of 24*7 power for all, certain factors are found to be key determinants of uptake by electricity consumers, as well as their motivation to pay; thus, they represent important drivers in the viability of public distribution utilities. The Ministry of Power has also prioritized the monitoring of performance on some of these parameters, which are being regularly reported utility wise on the National Power Portal. These drivers are investigated in the study as well, and are defined as:

- ▶ Connection capacity is the sanctioned load of the grid electricity connection. The majority

(92%) of household customers with a grid-based electricity connection have a low sanctioned load of 0–1 kW (76% of customers) or 1–2 kW (16% of customers).

- ▶ Power availability is measured by the average number of electricity supply hours each day in the past week. The customer survey shows that over the past few years, with utilities focused on ensuring 24*7 power for all, the hours of supply have increased significantly across customer categories and stands at approximately 17 hours per day as per the survey.
- ▶ Power reliability was measured through (a) the number of power cuts, and (b) prior

Figure 0-2: Tier distribution by customer category

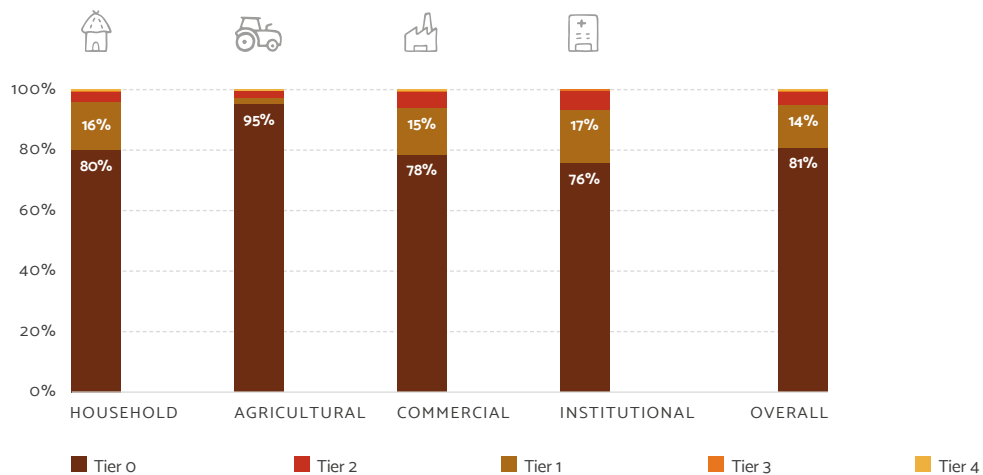


Table O-1: Utilities by access index score (high, medium, and low)

Utility (High Scoring)	Score	Utility (Medium Scoring)	Score	Utility (Low Scoring)	Score
Gujarat North	79	AP East	71	Bihar North	58
Gujarat Central	77	Gujarat South	71	UP Central	58
AP South	76	MP West	70	UP Kanpur	58
Gujarat West	74	Karnataka Mysore	69	UP West	57
Karnataka Bangalore	73	Karnataka Hubli	67	Bihar South	56
		Karnataka Gulbarga	66	UP East	56
		Karnataka Mangalore	66	UP South	54
		Punjab	66		
		MP East	65		
		Meghalaya	64		
		West Bengal	64		
		Assam	62		
		MP Central	62		

notification of upcoming power cuts. Agricultural and institutional customers reported no power cuts during each day of the past week, whereas 70% of household customers reported one or more power cuts in the past week. In addition, around 75% of household customers reported not having any prior notification of upcoming power cuts.

- ▶ Power quality was reported as the number of voltage fluctuations. Overall, 63% of customers reported more than one voltage fluctuation in a week, and 10% reported more than 10 voltage fluctuations per day in the past 1 week.
- ▶ The affordability² factor was assessed for the household category only, where it was measured as the paying capacity of the household customer for electricity as a share of the total monthly expenditure. If the cost incurred on this threshold level of electricity consumption is less than 5% of total household expenditure, access is considered to be affordable. Overall, access to electricity is observed to be affordable for 83% of household customers. Customers are not aware that the electricity tariffs at which they are paying is already subsidized.
- ▶ Safety measures were also analyzed. The study asked customers in all categories to report on any electricity-related accidents in the past year. Overall, 16% of customers reported electrical accidents in the past year.

- ▶ Customer service was the final driver considered in the study, and encompassed customers' expectations of electricity services such as metering, billing frequency, mode of payment, and complaint management.

Having investigated all these drivers, the study constructed an overall access index to facilitate relative comparisons of utility performance.

The study also adapted the World Bank's Multi-tier Framework (MTF) to the Indian context (MTF-I) to outline the Overall performance on access.

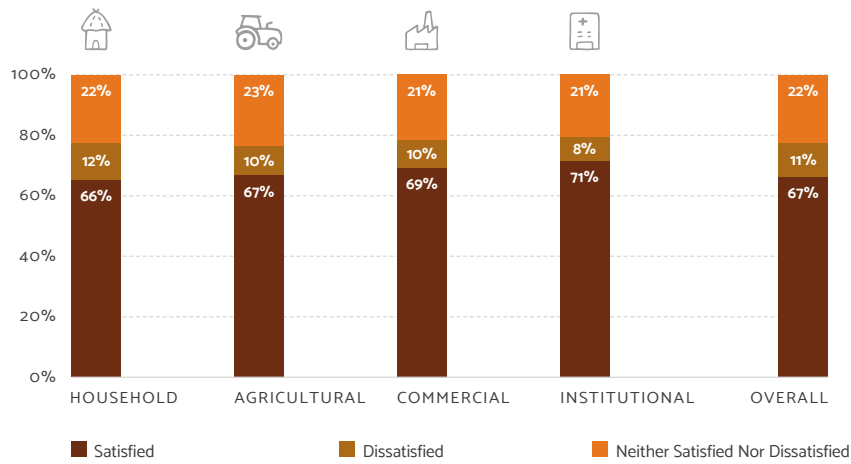
Customers are placed in one of five tiers based on the degree of electricity access. Most of the surveyed customers fall in tier 0, the lowest category. After the tier assignments for each customer were completed, an overall access index score was calculated for each distribution utility for the purposes of comparison.

For example, an access index score between 0 and 25 would indicate that the majority of the utility's customers are still at lower tiers of access, while a score of 75 to 100 would indicate that most customers are at higher tiers of access.

Customer Satisfaction

Customer satisfaction is often considered the end goal of a service-driven industry. This study attempts to gauge customer satisfaction on six

Figure O-4: Customer satisfaction with overall utility services, by customer category



dimensions of electricity service:

- ▶ Process of providing a new connection
 - » The study finds that 81% of surveyed grid users are satisfied with the new connection process, with the highest satisfaction among institutional customers (88%) and the lowest among agricultural customers (74%).
 - » A significant portion of non-users cite complications in the connection process as the primary reason for not being a grid user.

» The figures also suggest that there has been a significant positive impact with the successful implementation of the Saubhagya scheme.



- ▶ Satisfaction with power reliability
 - » Overall, a total of 63% of the surveyed customers are satisfied with the service provided to them.
 - » Among the dissatisfied customers, 31% reported an average power cut duration of no more than 1 hour per day, and 15% reported no power cuts.
 - » As expected, urban (74%) customers are comparatively more satisfied with the reliability of power as compared to their rural (60%) counterparts.
- ▶ Power quality
 - » The study suggested that this is an area which requires improved efforts from the point of view of DISCOMs as compared to other factors.
 - » Only 55% customers were satisfied with the quality of their electricity supply.
 - » Appliance damage in the past one year played an important role for the customers to decide upon the quality of supply of power.
- ▶ Satisfaction with billing and collection process
 - » The study suggests that a total of 65% customers are satisfied with their utility's billing and collection process.
- » The percentage is higher for urban customers (75%) than rural customers (61%).
- ▶ Satisfaction with complaint resolution process
 - » It is found that only 43% of customers are satisfied with their utility's complaint resolution process, with large variation between customers in urban areas (57% satisfied) compared to rural areas (37% satisfied).
 - » This is another area which warrants attention from DISCOMs.
- ▶ Satisfaction with the service provided by utility staff
 - » The study suggests that a total of 62% of customers are satisfied with utility staff service, including 72% of urban customers but only 58% of rural customers.

Based on the above factors, an overall satisfaction with utility services index was calculated. The study suggested that a total of 66% of surveyed customers are satisfied with the overall services from their utility. There were minor differences in satisfaction levels between urban customers (63%) and rural customers (75%). In looking at the drivers of customer satisfaction, power reliability, power

Table O-2: Utilities by customer satisfaction score (high, medium, and low)

Utility (High Scoring)	Score	Utility (Medium Scoring)	Score	Utility (Low Scoring)	Score
Karnataka Bangalore	74	AP East	63	Assam	37
Karnataka Mangalore	66	Karnataka Mysore	61	UP East	36
Gujarat Central	64	Gujarat South	58	UP Central	36
Gujarat West	64	MP East	58	Meghalaya	11
Gujarat North	64	Punjab	56		
		AP South	55		
		MP West	54		
		Bihar North	50		
		Bihar South	48		
		UP Kanpur	48		
		Karnataka Hubli	47		
		West Bengal	42		
		MP Central	41		
		Karnataka Gulbarga	41		
		UP West	41		
		UP South	39		



quality, the billing and collection process, and service provided by utility staff (staff behaviour) seem to be significant contributors to satisfaction for household and commercial customers, while power reliability, complaint resolution process, and service provided by utility staff seem to drive overall satisfaction for agricultural customers.

State of Utilities' Capacity to Deliver

Moving on to the next milestone in order to assess the sustainability of access to electricity, the study focused on a distribution utility's capacity to deliver electricity access sustainably. The parameter is characterized by its internal capacity in two areas: infrastructural capacity and operational and institutional capacity.

The Infrastructural capacity refers to the capacity of a utility's electrical power distribution network to deliver and maintain the required levels of power supply. The study evaluated infrastructural capacity through the following five metrics.

- ▶ Substation capacity ratio: A higher ratio is desirable as it indicates that the network has adequate capacity to absorb peak loads and cater to increasing customer demand for electricity. However, a very high ratio implies the presence of stranded capacity, and inefficient costs passed on to tariffs. An analysis on data from 23 utilities across the 10 states found an average substation capacity ratio of approximately 3.25.
- ▶ High-tension to low-tension (HT:LT) network ratio: A high ratio of HT:LT network length is indicative of lower technical losses and also ensures minimum drops in system voltages at the tail end, as mandated under the Standards of Performance. This study found that the average HT:LT ratio for the surveyed utilities was approximately 0.69.
- ▶ Average 11 kV feeder capacity: The 11 kV feeder capacity reflects the utility's ability to cater to the demand generated by the downstream customer load. This study found that the average feeder capacity of the surveyed utilities is 3.9 MVA.

Table O-3: Utilities ranked by capacity score (high, medium, and low)

Utility (High Scoring)	Score	Utility (Medium Scoring)	Score	Utility (Low Scoring)	Score
Gujarat South	88	Punjab	64	UP South	32
Gujarat Central	83	AP East	56	West Bengal	32
Gujarat West	76	Karnataka Bangalore	54	UP East	31
Gujarat North	73	MP West	54	UP Kanpur	27
		UP Central	53		
		Karnataka Mysore	52		
		AP South	51		
		Karnataka Mangalore	51		
		MP Central	50		
		Karnataka Hubli	50		
		Karnataka Gulbarga	49		
		Meghalaya	46		
		Bihar South	45		
		UP West	45		
		Assam	44		
		MP East	44		
		Bihar North	37		

- ▶ Average distribution transformer (DT) failure rate: The ideal DT failure rate for any utility should be zero, however, available benchmarks suggest that a rate in the range of 1%–2% is acceptable. The surveyed utilities reported an average DT failure rate of 11%. This is another area which needs to be taken care of with immediate effect.
- ▶ Per customer electricity supplied: The average per customer electricity supplied for the surveyed utilities is approximately 3,600 kWh. Typically, sales per customer is lower for utilities with higher numbers of household customers than for utilities with higher numbers of commercial customers.

The second area of consideration is the Operational and institutional capacity. This is linked to a utility’s ability to deliver the required level of service to its customers. The study evaluated operational and institutional capacity through the following seven metrics.

- ▶ Aggregate technical and commercial (AT&C) losses: AT&C losses encompass technical, billing and collection related losses and

indicate the overall health of the utility. The average AT&C losses for the surveyed utilities is 18% for FY 2018–19, mainly accountable to their technical and billing losses of 14%.

- ▶ Employees per 1,000 customers: The ratio of utility staff per 1,000 customers is an indicator of customer services. The surveyed utilities reported an average of 2.47 employees per 1,000 customers. Benchmarking is essential to assess what size staff is adequate and required across various functions, which may be based on the size of the distribution network that a utility operates.
- ▶ DT and 11 kV feeder metering: DT and feeder metering measure energy consumption in a distribution network and indicate a utility’s ability to improve energy accounting, track losses, and take corrective action. The DT meters provide real time information about voltage, power factor, current, harmonics, and phase imbalance from the LV network; and based on this information, utility companies can utilize specific remedies to solve problems as they occur. It is interesting to know that although all utilities except Bihar North,

Assam, and Meghalaya report nearly 100% feeder metering coverage, coverage of DT metering on the other hand is lagging in almost all surveyed utilities with an average level of 55%.

- ▶ Power cuts per month: The number of power cuts indicate the reliability of power supply. The study found discrepancies in the methodology for recording and reporting power cuts. Utilities need to ensure system-based reporting, as detailed in the study recommendations.
- ▶ Complaint resolution: The average complaint resolution of the surveyed utilities is 88%; nine of the surveyed utilities reported 100% resolution. This contrasts to the feedback from the customer survey, which states that only 43% of customers are satisfied with the complaint resolution process.
- ▶ Reported theft cases per 1,000 customers: The average among the surveyed utilities is 11. However, the study's qualitative discussions revealed that most utilities and customers still face a significant challenge in electricity theft, and the low number of reported cases suggests that utilities are not taking adequate measures to report theft and should strengthen their related systems and processes.
- ▶ Institutional capacity: The study considered institutional capacity to be a combination of multiple factors, such as the existence of long-term vision, availability of mandated documentation, and implementation of enterprise resource planning (ERP) processes, among others. All the surveyed utilities were observed to have developed vision documents, but considering the dynamic work environment, another look into company vision is likely essential. From a knowledge and capacity-building perspective, the majority of the surveyed utilities have an unstructured knowledge portal with limited documentation. On random verification, certain crucial documents like Standards of Performance were found to be missing. It was also found that a majority of the surveyed utilities have not established ERP systems.

Based on the above factors, an index of Overall performance on utility's capacity to deliver was developed. Ranking the different utilities on a uniform scale can help to visualize their overall performance. Each of the metrics is weighted equally, and each utility's score across each metric is calculated by multiplying the rank score and the weight. The scores are then aggregated to obtain a consolidated overall score for each utility from 0 (worst) to 100 (best) on its overall capacity to deliver access sustainably.

Drivers of Sustainability for Utilities

After performing detailed analysis of the individual parameters involved in providing and sustaining a reliable and quality electricity supply, the study attempted to explore the relationships between customer satisfaction levels, level of electricity access delivered, and the capacity in place at distribution utilities to deliver it. This exploration can help identify the key drivers for each of these elements and provide insights for accelerating electricity access. It is also important to understand how these aspects may influence a utility's financial performance.

Firstly, the study tried to understand the relationship between level of access and customer satisfaction. Based on the findings, it was observed that a utility's overall access score is strongly correlated with its overall customer satisfaction score ($r = 0.64$).

Second, the study attempted to understand the relationship between level of access and the utility's capacity to deliver. Based on the findings, it was observed that a utility's sustainability of electricity access score is strongly correlated with its capacity to deliver ($r = 0.78$).

Finally, the study tried to understand the relationships between utility performance, customer satisfaction, and capacity to deliver. The fact that the power distribution business is completely regulated to avoid the burden to customers of high tariffs, which essentially means that utility profitability is also regulated, has been considered and analyzed accordingly. The study clarifies that profitability alone may not necessarily give a correct picture of a utility's financial performance. However, it makes it possible to see some of the priorities a utility might focus upon to improve its performance. Some key points of the observation are summarized in the points that follow.

- ▶ There appears to be a moderate correlation between a utility's customer satisfaction score and its profitability ($r = 0.41$).
- ▶ Supply factors like increasing available hours for electricity do not seem to have a significant correlation with financial performance ($r = 0.09$), whereas regular billing ($r = 0.45$) and increasing metering coverage ($r = 0.44$) correlate with positive financial performance.
- ▶ High AT&C losses are strongly negatively correlated with utility profitability ($r = 0.78$).



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Recommendations

Based on the above analysis, the study draws specific recommendations for utilities in order to improve the quality of electricity access in India and subsequently enable economic development. Key recommendations include:

- ▶ Revamp new electricity connection process to enable quick, transparent and easy turnaround, with focus on non-household customers | *Policy and regulatory*
 - » Design utility policies that prioritize the release of new connections for non-household customers
 - » Simplify and standardize the new connection application process and minimize documentation requirements
 - » Institute an online/app-based process for quick release of new connections
- ▶ Prepare for Direct Benefit Transfer implementation for electricity subsidies to consumers by initiating public outreach campaigns that increase customer awareness and ensuring Know Your Customer (KYC) completion by utilities | *Policy and regulatory*
 - » Implement a public awareness campaign
 - » Ensure completion of KYC activities by utilities
 - » Establish a streamlined, on-time, and proactive subsidy transfer / payment process
 - » Enhance reach of banking or incorporate non-banking channels for subsidy disbursement (rural areas)
- ▶ Enable capacity building of regulatory commissions to resolve utility viability challenges on account of widening cost coverage | *Policy and regulatory*
 - » Improve customer perception by implementing tariff rationalization and simplification
 - » Set realistic efficiency benchmarks for utility performance, and calibrate disallowances in case of non-compliance
 - » Tariff determination based on scientific methodology
 - » Strengthen Electricity Regulatory Commission institutions by expanding positions and up-skilling, to enable advanced data and policy analysis
- ▶ Strengthen customer engagement through deployment of standard operating procedures | *Operational and process improvements*
 - » Standardize the customer interface processes
 - » Form customer engagement department
 - » Adhere to the Standards of Performance determined by the State Electricity Regulatory Commission
 - » Use standardized social media interface for customer engagement
- ▶ Implement data-driven planning for all investments in distribution infrastructure, with focus on improving reliability and quality of supply | *Infrastructure*

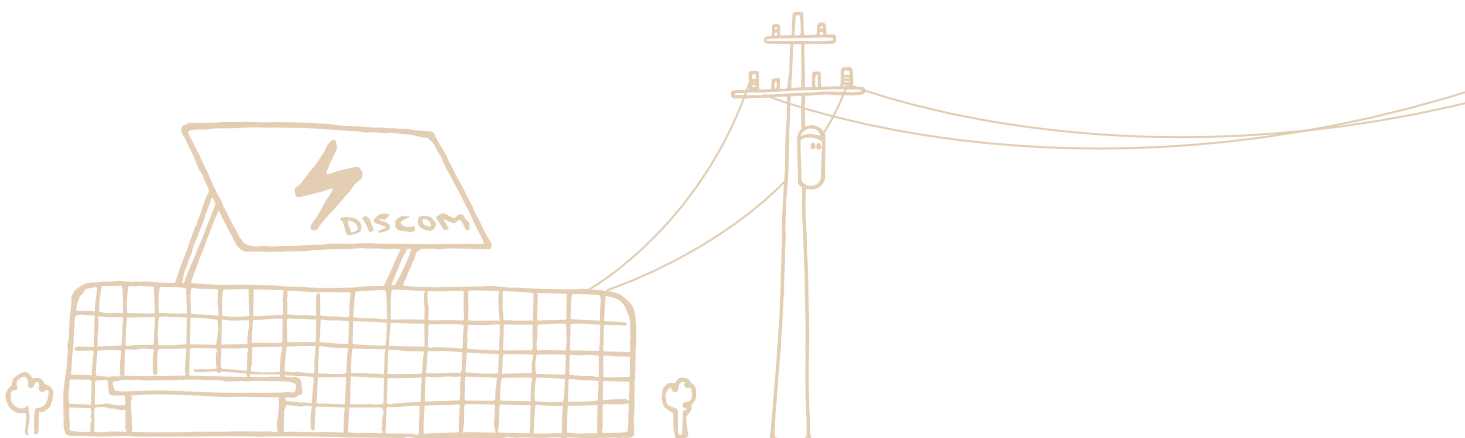


- » Data –
 - * Implement 100% system metering
- » Infrastructure –
 - * Implement customer indexing and fixed asset registers
 - * Segregate agricultural feeders and implement underground and LT ABC
 - * Periodic review and approval of infrastructure plans
- ▶ **Digitalize the metering, billing, and collection (MBC) cycle through implementation of smart metering and demand-side management measures | Infrastructure**
 - » Launch a comprehensive program for conversion to smart metering and increase customer awareness – provide incentive for seamless implementation by utilities
 - » Encourage demand-side management through tariff measures
 - » Implement prepaid metering to allow the customer to optimize electricity consumption
- ▶ **Strengthen utilities' capacity by redesigning organizational structures to reflect evolving market requirements | Capacity-building**
 - » Determine which functions to keep in-house or outsource
 - » Implement performance management systems
 - » Strengthen power procurement and power trading functions
 - » Assess skills and develop need-based training and incentive plans for employees, especially field staff
- ▶ **Enable technology for system-led reporting and decision-making for regulatory filings and reporting on Standards of Performance (SoP) | Governance**
 - » Implement IT systems to enable automated sharing of requisite data by ERCs for tariff determination, to reduce authenticity issues and enable pass-through of genuine costs
 - » Ensure clearly defined processes based upon SoP set by regulators that have system-enabled reporting, along with clear accountability at different execution levels

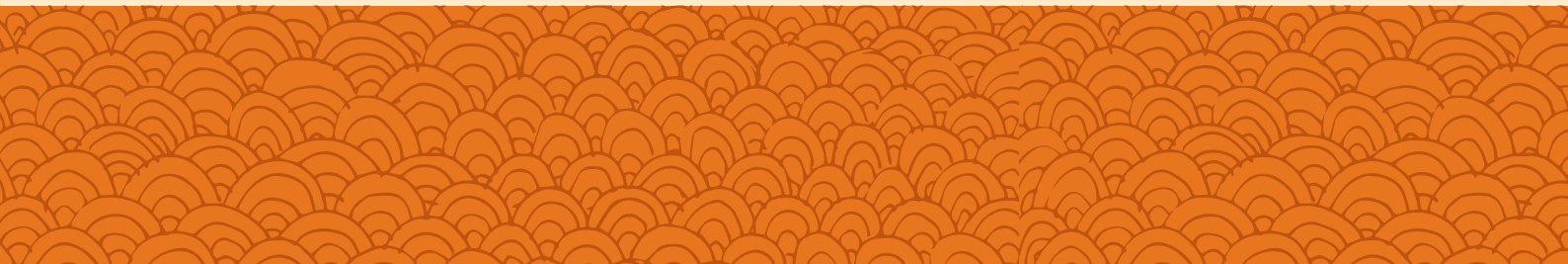
The above recommendations have been brought out to pave the way forward for policy makers and distribution utilities to prioritize interventions. Since the study finds that there does exist a correlation between utility's customer service levels and its performance, the recommendations have also been drawn out accordingly with the objective of covering the critical points related to customer centric interventions. An additional or alternate way forward may be explored through leveraging private sector actors, better capacity planning, and deployment of new technology. This will establish more robust structures—and hence assure greater efficacy—for implementing the recommended solutions.

Disclaimer: The insights presented are a direct outcome of the primary study conducted in 10 states and 25 state owned utilities.

The primary survey of customers was carried out during the months of April to June 2019.



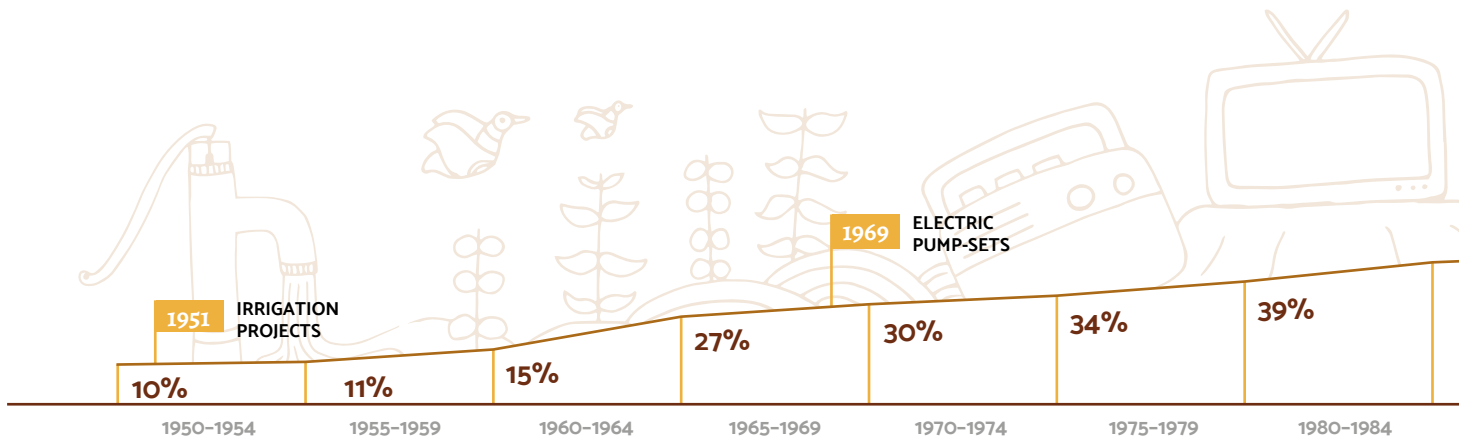
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Introduction

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Introduction



1951 Irrigation Projects Implemented for irrigation and rural electrification

1988 Kutir Jyoti Programme Envisaged extending single-point light connections to households of rural BPL families

2004 Accelerated Electrification Electrified 1 crore households in 5 years with demonstrable performance in terms of sustained loss reduction

1969 Electric Pump-Sets Implemented for village grid connection and irrigation

2000 PMGY Launched for rural development, with electrification in these areas as one of its major objectives

2005 RGGVY Electrified 1 lakh households with a goal of providing access to electricity to all households in the country in 5 years

Chapter 1 serves as an introduction to this report, which outlines a study commissioned by NITI Aayog and the Rockefeller Foundation and conducted by Smart Power India to increase understanding of the state of electricity access in India and benchmark the current capacity of electricity distribution utilities (also known as distribution companies or DISCOMs). The first three sections of this chapter include background information on India's electrification efforts to date, the purpose of the study and why it is needed at this time, and important details about the study's design and sample. The fourth and final section of Chapter 1 outlines how the remainder of the report is organized.

Background: Electrification Efforts In India

India's electrification rate almost doubled in the past 20 years, from 59.4% in 2000³ to 100% in 2019.⁴ The country has now achieved its objective of providing electricity to all willing households in its total population of 1.3 billion.⁵ This has been made possible through a multitude of efforts, including these:

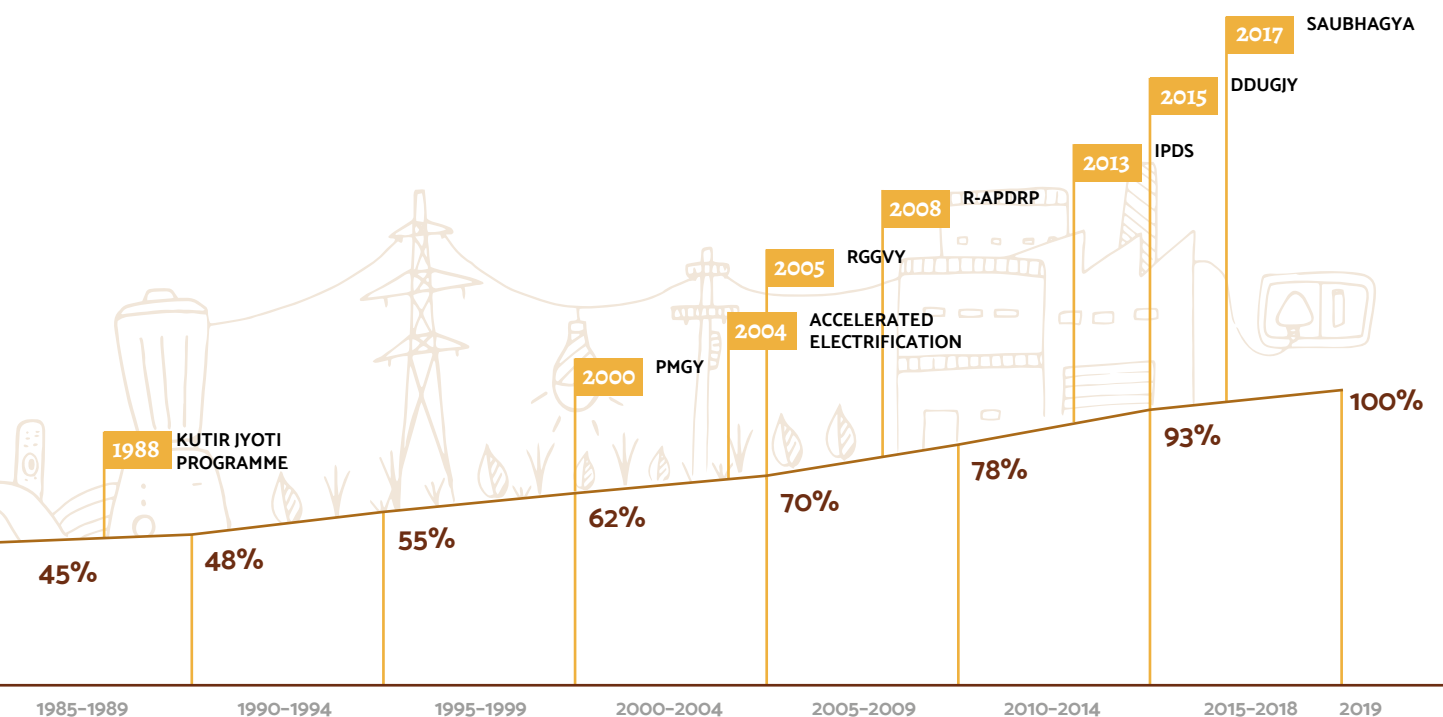
- ▶ Enhancing power generation to reduce the supply deficit from 12.7% in FY 2009–10 to 0.4% in FY 2019–20 (as of October 2019).⁶
- ▶ Strengthening the supply infrastructure backbone in terms of evacuation and transmission systems.

3 Sudeshna Ghosh Banerjee, Douglas Barnes, Bipul Singh, Kristy Mayer, and Hussein Samad, Power for All: Electricity Access Challenge in India, World Bank Study no. 92223 (Washington, DC, World Bank, 2015), <https://openknowledge.worldbank.org/handle/10986/20525>.

4 Ministry of Power, Saubhagya portal, 2019, <https://saubhagya.gov.in>.

5 World Bank data, "India," 2019, <https://data.worldbank.org/country/india>.

6 Central Electricity Authority, Executive Summary of Power Sector, April 2010 & October 2019, <http://www.cea.nic.in/monthlyexesummary.html>.



2008 R-APDRP
Reduced utilities' AT&C losses, improved accountability, and upgraded subtransmission and distribution networks

2014 DDUGJY
Separated agriculture and non-agriculture rural feeders, facilitating judicious rostering of supply to agricultural and non-agricultural customers in rural areas

2014 IPDS
Reduced utilities' AT&C losses, strengthened distribution infra-structure, and improved energy accountability by enabling IT accounting

2017 SAUBHAGYA
Focused on last-mile connectivity to achieve 100% electrification of willing households by 2019

Figure 1-1: India's progress towards full electrification, 1950-2019

- ▶ Ensuring the expansion of last-mile distribution infrastructure and connectivity for different customer populations.

Starting with 1,500 electrified villages at the time of Independence in 1947,⁷ the effort to electrify India continued over seven decades. The majority (93%) of India's urban households were electrified by 2004.⁸ However, large parts of rural India were underserved or completely unserved. To address this, the federal structure of India made efforts to enhance electricity connectivity through implementation of multiple schemes in both state and central governments. Such schemes included the Minimum Needs Programme (MNP), Kutir Jyoti Programme (KJP), Pradhan Mantri Gramodaya Yojana (PMGY), Accelerated Rural Electrification Programme (AREP), Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY),

and Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY).

The final push that achieved household-level electrification was the launch of Pradhan Mantri Sahaj Bijli Har Ghar Yojana (Saubhagya). This scheme, launched in September 2017, focused on providing last-mile connectivity to all willing unelectrified households through an electric grid connection or a stand-alone solar photovoltaic system. The Saubhagya scheme was extended until December 2019 to meet any critical missing gaps, strengthen the last-mile infrastructure, and provide connections with adequate capacity. With these achievements, India has increased its focus on the challenge of ensuring a reliable, quality, 24*7 power supply to all those connected to the grid.

Figure 1-1 shows the progress of India's electrification over the years.

⁷ Banerjee et al., Power for All, 2015.
⁸ Banerjee et al., Power for All, 2015.

However, there continue to be impediments to providing a reliable and sustainable power supply across the country, including poor quality of electricity distribution infrastructure leading to frequent power cuts; improper outage management; inability of electricity distribution utilities to invest in strengthening infrastructure or timely maintenance due to the mismatch between the aggregated cost of supply and revenues; inefficient and insufficient metering and billing leading to poor high commercial losses; and low customer ability and willingness to pay for electricity.

In 2018, the Government of India issued draft amendments to the Electricity Act, 2003. The amendments focus on ensuring quality electricity through multiple provisions, including separation of entities responsible for the electricity distribution infrastructure and for the power flowing through it; Direct Benefit Transfer for subsidies, easing open access through the removal of additional surcharges; limiting cross-subsidy surcharges to 20%; and issuing guidelines to develop regulations for forward contracts.

As India moves the spotlight to the sustainability of its power supply, it is a good time to map, assess, and benchmark the capacity of India's electricity distribution utilities to both service the needs and aspirations of their customers and meet the advanced targets for delivering electricity access. Accordingly, this study – a part of the collaboration between NITI Aayog (the Government of India's policy think tank), the Rockefeller Foundation, and Smart Power India – has the following primary objectives:

- ▶ Evaluate the status of electricity access in India across different states and distribution utilities along all of the dimensions that constitute meaningful access.

- ▶ Benchmark utilities' capacity to provide electricity access and identify the drivers of sustainable access.
- ▶ Develop recommendations based on learnings from leading utilities to formulate solutions for the lagging utilities.

Purpose of the Study

Redefining “Access”

Access to electricity is meaningful and will lead to socio-economic development only when quality electricity is available in a reliable, adequate, and affordable manner. As ingrained as electricity usage is now in the day-to-day life of the customers who are the end users of electricity supply, the definition of access needs to evolve from merely having an electricity connection to a more comprehensive view – one that includes critical aspects such as the capacity, legality, and safety of that connection. The prevailing binary definition of electricity access as having or not having an electricity connection is not just narrow and limiting, it also undermines the breadth of the efforts that electricity distribution utilities need to undertake to meet their business objectives. Further, electricity is primarily a service, and utilities are expected to meet certain standards of robust customer services to achieve the goal of customer satisfaction.

Over the years, through many policies and measures, the definition of electricity access in India has slowly evolved.

However, globally, energy access has a much wider meaning, while the significance of electricity to energy access has increased over time. As per the World Bank's Energy Sector Management Assistance Program (ESMAP), the United Nations Sustainable

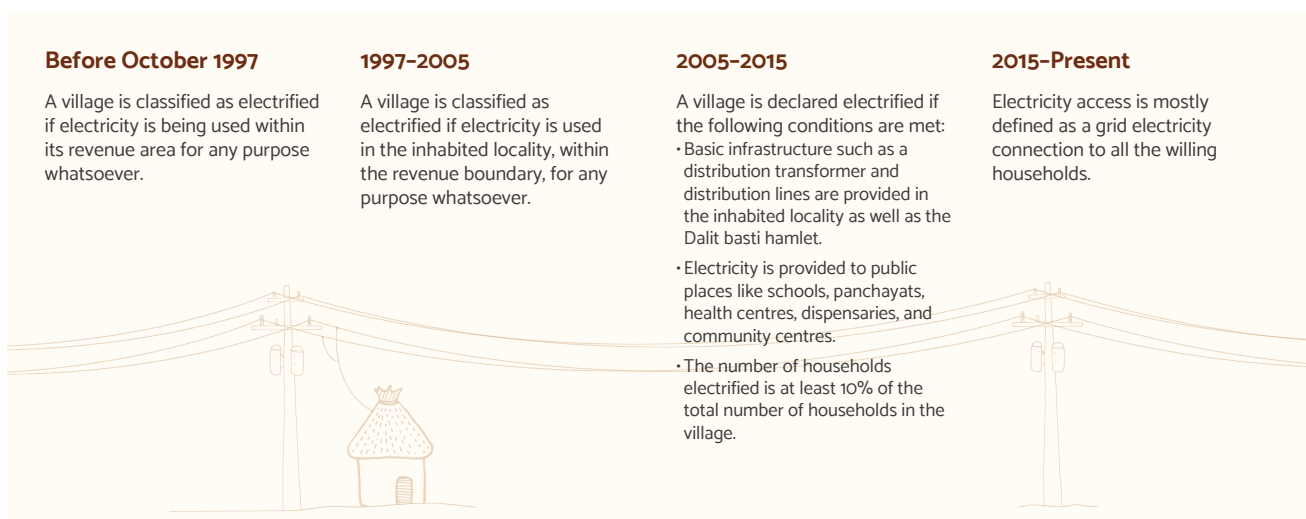
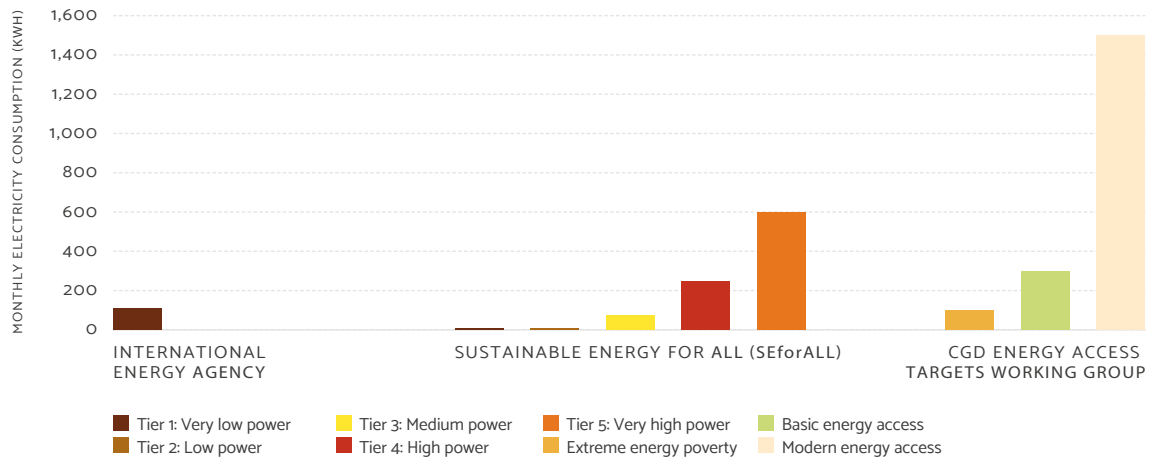


Figure 1-2: Comparison of energy access frameworks



Abbreviations: CGD, Center for Global Development; kWh, kilowatt-hour.

Energy for All (SEforAll) initiative, launched in 2011, aims to achieve universal access to modern energy services by 2030. Similarly, by 2030, providing universal energy access that is affordable, reliable, and sustainable is the target of Sustainable Development Goal 7. The SEforAll Global Tracking Framework was established by ESMAP and the International Energy Agency to measure and oversee progress with respect to these goals. SEforAll outlines procedures to measure baselines and progress towards goals through regular collection of data points. The 2013 Global Tracking Framework report introduced the idea of a multi-tiered framework for measuring energy access and identified ways to do so in a more accurate manner over the medium term. Under the SEforAll initiative, in consultation with multiple partners, and in line with the United Nations Sustainable Development Goals, ESMAP then developed the Multi-tier Framework (MTF) to monitor and evaluate energy access and to capture issues related to properly identifying and addressing access.

The MTF is the guiding tool for this study, as it includes the critical dimensions important for measuring access. Instead of a binary system that measures only the availability or absence of access, the MTF redefines energy access based on capacity, availability/duration, reliability, quality, affordability, legality, health and safety, and customer service. It measures not only whether users receive energy services, but also whether these services are of adequate quality, reliable, affordable, safe, and available when needed. Differentiation based on these parameters allows more detailed information to be collected and analysed, as shown in Figure 1-2.

The MTF has six tiers, ranging from Tier 0 (the lowest level of access) to Tier 5 (the highest level). It provides a path towards universal energy access that can be customized for each country's circumstances and acknowledges progress as households move from lower to higher tiers of access. This approach clearly identifies the areas in which intervention, whether in terms of policy formulation or on-the-ground solutions, is required. The framework presented in Figure 1-3 is adapted from ESMAP's work.

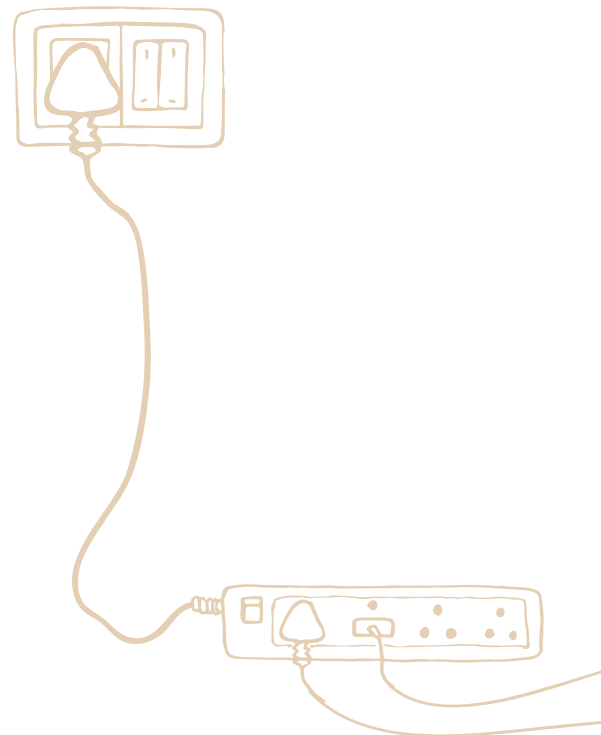
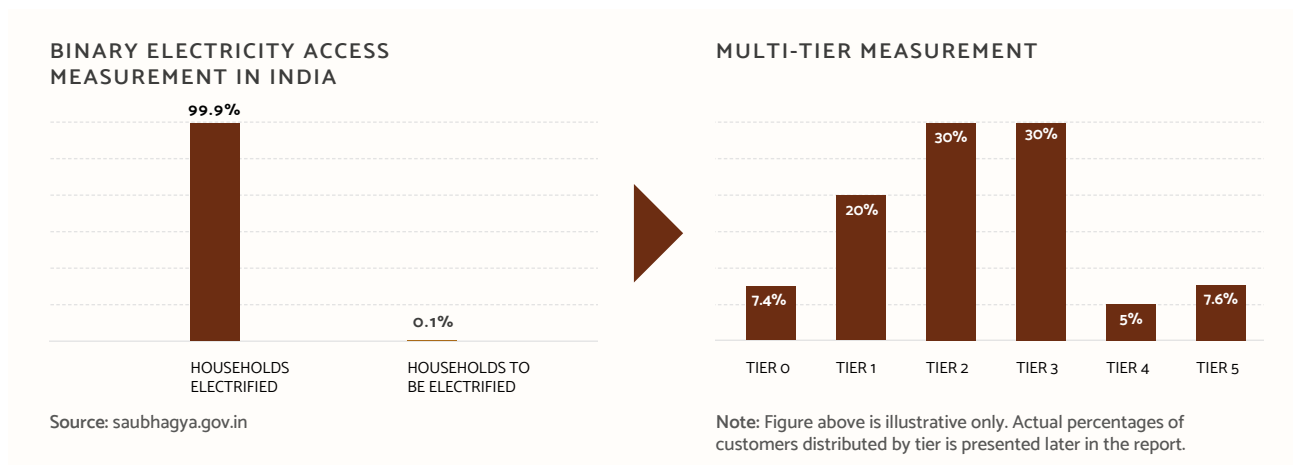


Figure 1-3: Information provided by the MTF tiers of sustainable electricity access



		Tier 0	Tier 1	Tier 2	Tier 3	Tier 4	Tier 5
Capacity	W		Min 3 W	Min 50 W	Min 200 W	Min 800 W	Min 2 kW
	dailyWh		Min 12 Wh	Min 200 Wh	Min 1.0 kWh	Min 34 kWh	Min 8.2 kWh
Availability/ Duration	Hours/day		Min 4 hrs	Min 4 hrs	Min 8 hrs	Min 16 hrs	Min 23 hrs
	Hours/evening		Min 1 hr	Min 2 hrs	Min 3 hrs	Min 4 hrs	Min 4 hrs
Reliability						Max 14 disruptions per week	Max 3 disruptions per week of total duration < 2 hrs
Quality						Voltage problems do not affect the use of desired appliances	
Affordability					Cost of a standard consumption package of 365 kWh/year is less than 5% of household income		
Legality						Bill is paid to utility, pre-paid card seller or authorized representative	
Safety						Absence of past accidents and perception of high risk in future	
Customer Services			Task lighting and phone charging	General lighting, phone charging, television, and fan (if needed)	Tier 2 and any medium power appliances	Tier 3 and any high-power appliances	Tier 2 and any very high-power appliances

Abbreviations: hr, hour; hrs, hours; kW, kilowatt; kWh, kilowatt-hour; max, maximum; min, minimum; MTF, Multi-tier Framework; W, watt; Wh, watt-hour.

The MTF answers the following questions:

- ▶ Is access sufficient to satisfy household and business needs, and to support socio-economic development?
- ▶ Does a “connection” to electricity provide “service” and at the desired levels of quantity and quality?

The MTF’s definition of access is much broader than the concept of access that is currently in use in India. It focuses not only on the presence or absence of access, but also the duration of electricity in hours, reliability in terms of planned power cuts communicated to the customer, quality in terms of the extent of voltage fluctuations, affordability in terms of the expense of electricity as a percentage of monthly income, legality with respect

to the acquisition of electricity connection through legal channels (no wire hook-ups), and health and safety with respect to presence of safety practices and arrangements along the distribution system. However, it is crucial to adequately adapt the MTF to the Indian context. The definitions in the MTF were proposed more than five years ago, and since then India has experienced rapid progress and maturity in the electricity sector, having achieved 100% electrification of willing households. Figure 1-4 further outlines the need to adapt the MTF for India.

Accordingly, the MTF has been adapted for this study as the Multi-tier Framework–India (MTF-I). The MTF-I evaluates the state of electricity access for four categories of customers: household, agricultural,

Figure 1-4: Reasons to contextualize the MTF for India



commercial, and institutional. Unlike the MTF's six tiers, the MTF-I has five tiers, ranging from Tier 0 (the lowest level of access) to Tier 4 (the highest level). As the connected load for the majority of Indian customers under Saubhagya is less than 1 kW, and only a small percentage of household customers (4%) and institutional customers (5%) can be found in the top two of the MTF-I's five tiers, this conceptualization effectively covers all categories of customers in the country. For the household category, each tier's definitions of capacity have been revised to take into account the significantly advanced electricity sector existing in India as compared to other developing economies. Definitions for other tiers have also been revised: reliability considers aspects such as prior notification of power cuts, quality considers the number of voltage fluctuations, and affordability includes cost as a percentage of household expenditure. Figure 1-5 displays the MTF-I's dimensions and tiers for the category of household customers.

Understanding Sustainability of Electricity Access

Post-Saubhagya implementation, the government now aims to achieve 24*7 power for all by strengthening the electricity distribution network, improving network and system efficiencies through technology and best-in-class operation and maintenance (O&M) practices, enhancing energy efficiency, and above all improving the financial health of the electricity distribution utilities. However, a key factor to achieving 24*7 power for all is to leverage the 100% household electrification rate achieved through Saubhagya and provide power in a truly sustainable way to all the connected customers.

The challenge is that electricity distribution utilities are currently focused on meeting their connection targets rather than on sustaining supply. Given the financial and operational issues facing these utilities, there is little guarantee that they will be able to supply quality power on demand for the newly connected customers, many of whom are geographically dispersed and currently consume low quantities of electricity.

To provide power around the clock, cater to increased demand, and complete last-mile delivery, electricity distribution utilities may have to invest further in increasing the technical capability of their distribution networks. Without corresponding additions in network capacity, the quality of the delivered power can dip in some areas due to tripping (isolation of a grid to avoid propagating faults in other parts of the distribution network), brownouts (partial reductions in supply voltage to reduce load on the grid), and blackouts (complete power cut-offs). Further, from an operational standpoint, utilities are likely to find it increasingly difficult to manage and maintain more widely dispersed networks, as dispersion adds to technical losses, results in low voltages due to a longer low-tension (LT) network, increases costs if high-tension (HT) network is laid in the area, and increases labour hours spent on O&M. Depending on the region, extreme weather conditions such as monsoons and cyclones add to the challenge. The difficulties are aggravated by the lack of adequate and skilled labour at the field level to manage the increased burden of metering, billing, and collection and the increased O&M requirements.

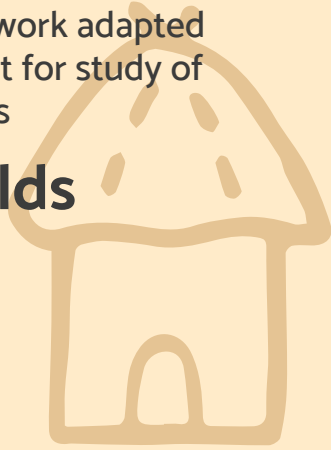
At the same time, India's electricity distribution utilities are already struggling financially due to billing and collection losses, the high cost of procured power, and other challenges, and will not be able to supply quality power to customers in the long term unless the challenges to viability are addressed. The sudden growth in customer base (due to implementation of Saubhagya) is expected to add to their financial stress. The negative gap between revenue collected and costs (to supply power, provide new connections to rural households in remote areas, and upgrade the distribution network to service these new connections) adds to the utilities' financial burden.

Ensuring sustainability of electricity access will directly enhance distribution utilities' financial performance as well as improve customer satisfaction. Two key aspects of access – adequate availability of electricity and reliability of delivered power – would ensure an increase in electricity consumption

Figure 1-5: MTF-I tiers for household customers

Multi-tier framework adapted to Indian context for study of electricity access

Households



Tier 0

Capacity no electricity	Metered Connection non-metered connection
Availability <=8 hrs/day	Billing Process no fixed billing process
Notice Prior to Cut never provided	Mode of Payment through village camps, middlemen, agents
Number of Cuts >=15/day	Maintenance Staff none
Voltage Fluctuation >10 times/day	Time Taken to Resolve Complaints >1 week - never
Affordability <5% of monthly exp	
Health & Safety any accident related to electricity in the past 1 year	

Tier 1

Capacity 0-1 kW	Metered Connection non-metered connection
Availability >8 hrs <=16 hrs	Billing Process bi-monthly billing process
Notice Prior to Cut sometimes provided	Mode of Payment through village camps, middlemen, agents
Number of Cuts >=15/day	Maintenance Staff none
Voltage Fluctuation >10 times/day	Time Taken to Resolve Complaints 1 day - 1 week
Affordability <5% of monthly exp	
Health & Safety any accident related to electricity in the past year	

Tier 2

Capacity 1-2 kW	Metered Connection metered connection
Availability >16 hrs <=20 hrs	Billing Process bi-monthly billing process
Notice Prior to Cut sometimes provided	Mode of Payment through utility office, collection van
Number of Cuts 10-15/day	Maintenance Staff none
Voltage Fluctuation 6-10 times/day	Time Taken to Resolve Complaints 12 hrs - 1 day
Affordability >=5% of monthly exp	
Health & Safety any accident related to electricity in the past year	

Tier 3

Capacity 2-5 kW	Metered Connection metered connection
Availability >20 hrs and <=2 hrs	Billing Process monthly billing process
Notice Prior to Cut sometimes provided	Mode of Payment online, utility office, collection van
Number of Cuts 1-10/day	Maintenance Staff dedicated staff
Voltage Fluctuation 1-5 times/day	Time Taken to Resolve Complaints 3 hrs - 12 hrs
Affordability >=5% of monthly exp	
Health & Safety no electricity related accident in the past 1 year	

Tier 4

Capacity >5 kW	Metered Connection metered connection
Availability 24 hrs	Billing Process monthly billing process
Notice Prior to Cut always provided	Mode of Payment online, utility office, collection van
Number of Cuts no power cuts	Maintenance Staff dedicated staff
Voltage Fluctuation 0 times/day	Time Taken to Resolve Complaints <3 hrs
Affordability >=5% of Monthly Exp	
Health & Safety no electricity related accident in the past 1 year	

by customers. Any increase in revenues from usage at the same overhead cost would enhance operating margins. Ensuring sustainability of power supply in terms of availability, reliability, quality, and affordability, therefore, is the most important challenge to be met not only for customers' needs and socio-economic development but also to impact electricity distribution utilities' business needs.

Understanding Utilities' Capacity to Deliver Access Sustainably

A shift in focus from connectivity alone to sustainable electricity supply and access will require a comprehensive view of the electricity distribution landscape, which is primarily shaped by utilities and their capacity to meet increasing demands over time. This study attempts to measure utilities' capacity in areas that are critical to their business: infrastructure capacity, and operational and institutional capacity.

Infrastructure Capacity

Infrastructure capacity refers to the capacity of the electrical power distribution network to deliver and maintain required levels of power supply. Careful consideration and planning are required to add infrastructure capacity and strengthen the distribution grid. This, however, will help manage supply-side challenges and maintain the smooth functioning of the electrical network. Adequate infrastructure capacity will also ensure that utilities can meet demand-side requirements such as availability, reliability, and quality of power.

- i. Substation capacity per megawatt of peak demand: This measure reflects the adequacy of the current distribution infrastructure to cater to present and future peak load scenarios.
- ii. HT:LT network ratio: The higher this ratio, the lower the technical loss in the network. This is also important for maintaining system voltages at the tail ends of the distribution network.
- iii. Average 11 kilovolt (kV) feeder capacity: This number, measured in megavolt amperes, reflects the feeders' ability to cater to the demand generated due to downstream customer load. Higher-capacity feeders will ensure that larger numbers of customers and their corresponding loads can be connected.
- iv. Average distribution transformer (DT) failure rate: This measure indicates the status of power supply reliability received by the customers, as well as the performance of the utility's DTs.
- v. Per customer electricity supplied: The ratio of total units of electricity supplied annually by total number of customers indicates the total units of electricity consumed by a customer in a year.

Operational and Institutional Capacity

Operational and institutional capacity indicates the ability of the utility to deliver the required service level and an enhanced customer experience to its customers by delivering a 24*7 reliable and quality supply of electricity to all. It also indicates the utility's capacity to perform persistently and cater to customers' growing electricity demand with minimal downtime and very low turnaround time in case of system failures.

- i. Aggregate technical and commercial (AT&C) losses: This measure encompasses both billing and collection efficiencies and quantifies a utility's overall operational losses, which affect profitability.
- ii. Employees per 1,000 customers: This number assesses the labour power deployed by the utility for overall service delivery. A higher ratio allows for higher customer engagement and better quality of service.
- iii. DT and 11 kV feeder metering: Metering is important for energy accounting, allowing utilities' to identify high technical and commercial loss areas and strategically plan activities to reduce these losses.
- iv. Number of interruptions: This number helps to gauge two different aspects of a distribution system: system resilience and electricity deficit.
- v. Complaint resolution: The percentage of complaints resolved is an indicator of staff efficiency. It is also a direct indicator of customer satisfaction, a faster complaint resolution process, and better customer experience.
- vi. Reported theft cases per 1,000 customers: This number indicates the strength and reach of the vigilance systems in place at a utility.
- vii. Institutional capacity: Institutional capacity broadly defines the established processes and competencies to perform a task, as well as the resources and organizational structures in place, to achieve company objectives and manage cost effectively and efficiently.

Figure 1-6: Study design

CUSTOMER RESEARCH



HOUSEHOLD



AGRICULTURAL



COMMERCIAL



INSTITUTIONAL

DISCOM RESEARCH

10
STATES

25
UTILITIES

Status & Sustainability of Electricity Access

Extent of Customer Satisfaction

OBJECTIVES

Priorities to Improve Discom Performance

Recommendations to Enhance Electricity Access

State of Access

Capacity · Availability · Reliability
Quality · Affordability* · Safety
Customer Services

Discom Capacity

Infrastructure Capacity · Operational Capacity
Institutional Capacity · Planned Initiatives

Customer Satisfaction

New Connection Process
Reliability · Billing & Collection
Complaint Resolution · Quality
Staff Behaviour

ELEMENTS OF THE STUDY

Discom Financial Performance

Willingness For Direct Benefit Transfer of Subsidies

Measures Taken to Achieve Access

Structured Questionnaire

Focus Group Discussions

INSTRUMENTS USED

Structured Data Collection

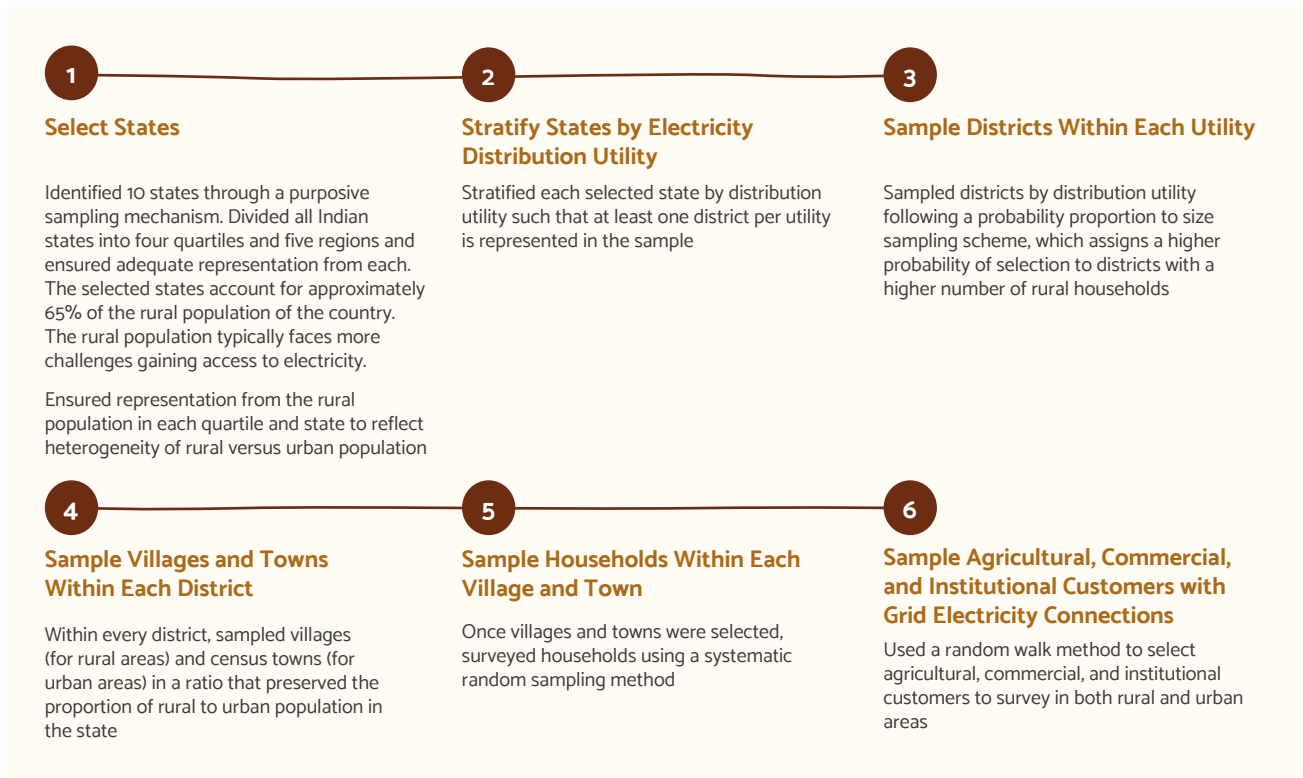
Semi-structured Questionnaire



State of Electricity Access in India and Benchmarking DISCOMs Performance on Access

*Only for Household category customers

Figure 1-7: Step-by-step sampling process for customer survey



Study Design

Methodology

This study used a mixed design approach that included primary research on customers and primary and secondary research on the electricity distribution utilities serving these customers. For both customers and utilities, primary research included quantitative and qualitative aspects. On-the-ground observational surveys of substations and feeders supplemented the understanding gained through the quantitative and qualitative surveys around key infrastructure issues and the challenges faced by the utilities.

Figure 1-6 depicts the overall study design.

Customer Survey

A multistage random sampling design was used for the customer survey, as shown in Figure 1-7. In the first stage, states were divided into quartiles based on rural population percentage, and the number of states selected in each quartile was proportional to the rural population percentage of that state. Also, all quartiles were represented. The use of purposive sampling in this way resulted in the selection of 10 states representing 65% of India's rural population.

In the second stage, each selected state was stratified to ensure that the customer sample included at least one district per electricity distribution utility. In the third stage, a few districts in each utility were sampled. In the fourth stage, a few villages (rural areas) and census towns (urban areas) were randomly sampled within each district. Finally, customer categories (household, agricultural, commercial, and institutional) were sampled within each village and town using a systematic random sampling method.

The final list of states and number of customers selected to be sampled for the quantitative survey are summarized in Figure 1-8. The quantitative survey in each state was supplemented with one or more qualitative focus group discussions in rural and urban areas.



Figure 1-8: States and number of customers sampled in the quantitative customer survey

25,166 PEOPLE SURVEYED

25 UTILITIES COVERED

17,162
HOUSEHOLD

4,230
AGRICULTURAL

2,009
COMMERCIAL

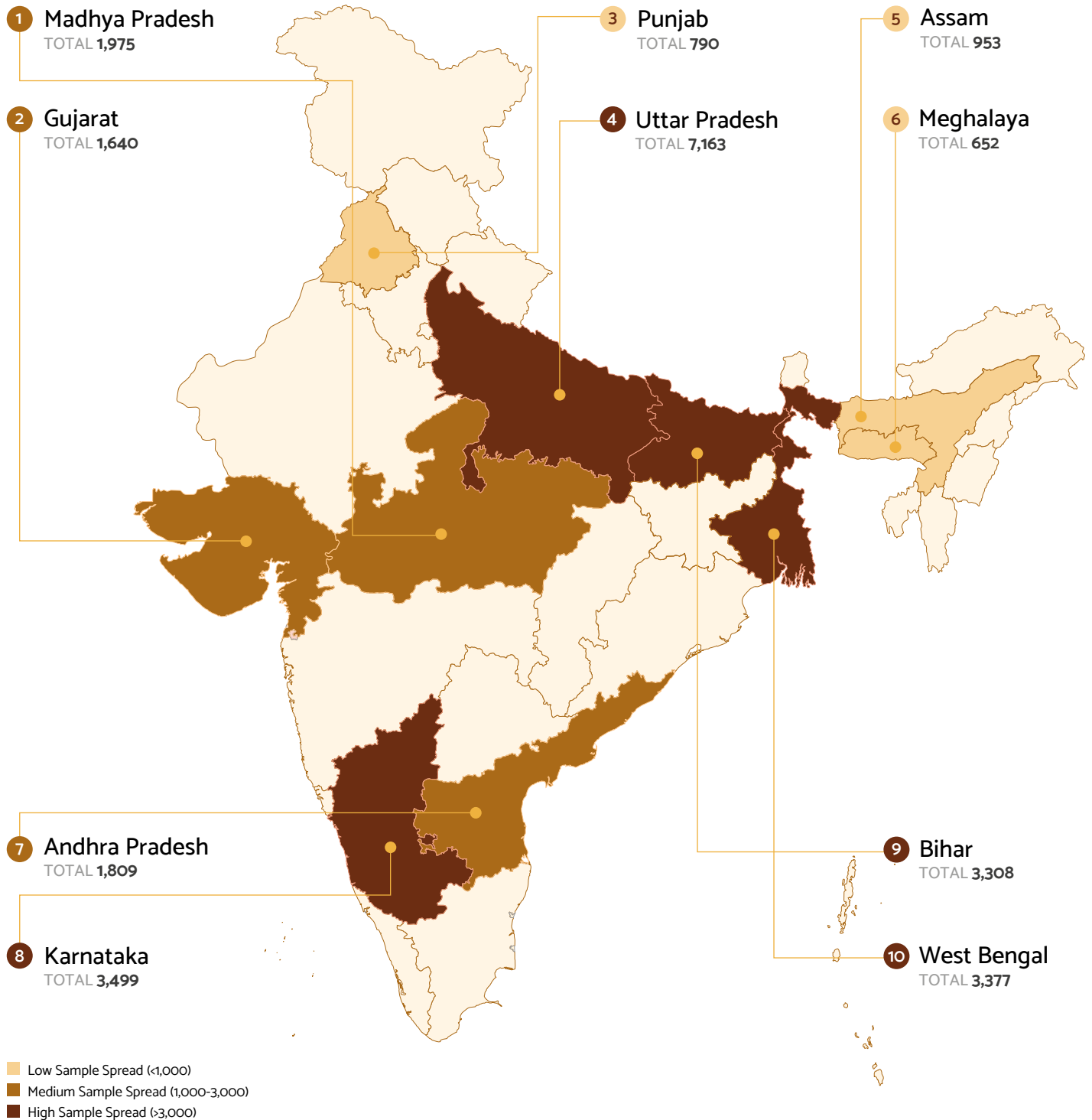
1,765
INSTITUTIONAL

10
STATES

47
DISTRICTS

1,238
VILLAGES

115
TOWNS

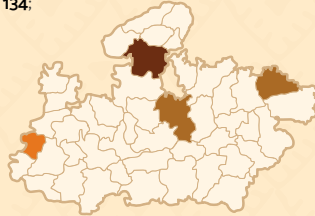


DISCOMs by Districts

Madhya Pradesh

HOUSEHOLD: 1,304; AGRICULTURAL: 395;
COMMERCIAL: 142; INSTITUTIONAL: 134;

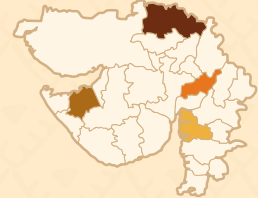
- MPMKVCL
Shivpuri
- MPPOKVVCL
Sagar, Rewa
- MPPKVVCL
Jhabua



Gujarat

HOUSEHOLD: 1,141; AGRICULTURAL: 260;
COMMERCIAL: 124; INSTITUTIONAL: 115;

- UGVCL
Banas Kantha
- PGVCL
Jamnagar
- MGVCL
Kheda
- DGVCL
Surat



Punjab

HOUSEHOLD: 488; AGRICULTURAL: 106;
COMMERCIAL: 98; INSTITUTIONAL: 98;

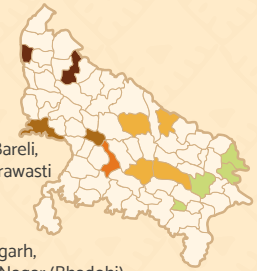
- PSPCL
Kapurthala, Tarn Taran



Uttar Pradesh

HOUSEHOLD: 4,983; AGRICULTURAL: 1,195;
COMMERCIAL: 544; INSTITUTIONAL: 441;

- PVVNL
Moradabad, Baghpat
- DVVNL
Agra, Kannauj
- KESCo
Kanpur Nagar
- MVVNL
Sitapur, Rae Bareilly,
Sultanpur, Shrawasti
- PuVVNL
Kushinagar,
Deoria, Azamgarh,
Sant Ravidas Nagar (Bhadohi)



Assam

HOUSEHOLD: 597; AGRICULTURAL: 155;
COMMERCIAL: 105; INSTITUTIONAL: 96;

- APDCL
Sivasagar, Barpeta



Meghalaya

HOUSEHOLD: 387; AGRICULTURAL: 63;
COMMERCIAL: 104; INSTITUTIONAL: 98;

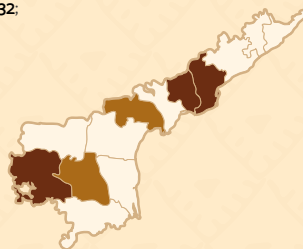
- MePDCL
West Garo Hills



Andhra Pradesh

HOUSEHOLD: 1,270; AGRICULTURAL: 265;
COMMERCIAL: 142; INSTITUTIONAL: 132;

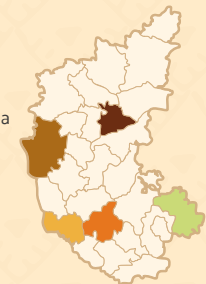
- APEPDCL
East Godavari, West Godavari
- APSPDCL
Guntur, Y.S.R, Anantapur



Karnataka

HOUSEHOLD: 2,250; AGRICULTURAL: 465;
COMMERCIAL: 276; INSTITUTIONAL: 238;

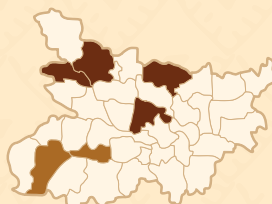
- GESCOM
Koppal
- HESCOM
Uttara Kannada
- CESCO
Hassan
- MESCOM
Dakshina Kannada
- BESCOM
Kolar



Bihar

HOUSEHOLD: 2,122; AGRICULTURAL: 752;
COMMERCIAL: 219; INSTITUTIONAL: 215;

- NBPDC
Purba Champaran, Madhubani,
Gopalganj, Samastipur
- SBPDCL
Rohtas, Jehanabad



West Bengal

HOUSEHOLD: 2,350; AGRICULTURAL: 574;
COMMERCIAL: 255; INSTITUTIONAL: 198;

- WBSEDCL
Jalpaiguri, Koch Bihar, Murshidabad,
Hugli, Paschim Medinipur



Figure 1-9: Household customers, by socio-economic class

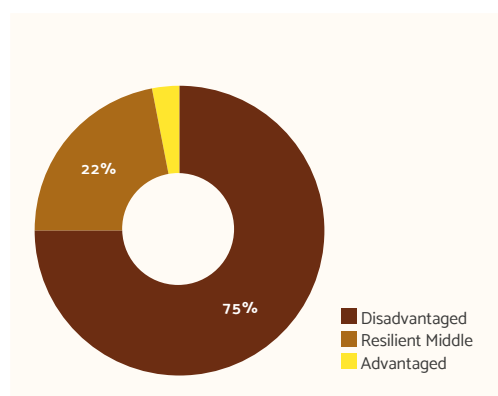
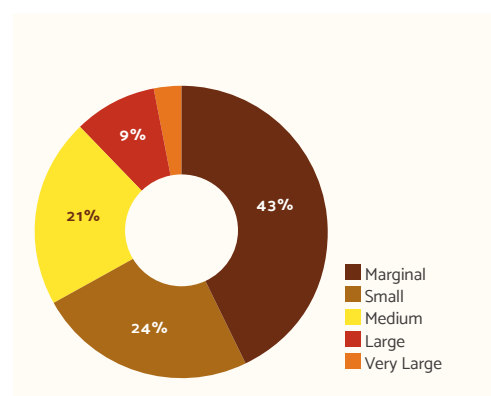


Figure 1-10: Agricultural customers, by land size



Utility Survey

Once the 10 states were identified, all public electricity distribution utilities in those states were included in the sample for the utility survey. Quantitative data collection tools were deployed to collect data on the utilities' capacity to deliver sustainable access. This data was supplemented with interviews with senior utility officials and with on-the-ground observational surveys that used a checklist to randomly assess substations and feeder networks.

Details of the study's statistical sampling procedures and the questionnaires used for the customer and utility surveys are available in Appendix. It should be noted that findings are relevant at the level of the respective utility, and the information or data shared by the electricity distribution utilities was considered correct and analysed as such. A few data points that could not be provided by the utilities were captured through other official sources (e.g., state electricity regulatory commissions, tariff orders, utility websites, or central or state government online portals) for the current or past year, where applicable.

Understanding the Sample

Customer Categories and Segments

Surveys were conducted across 10 states in India that represented all geographic regions – north, south, east, west, and northeast. The sample includes different segments within each of the four customer categories: household, agricultural, commercial, and institutional.

HOUSEHOLD: SEGMENTS BASED ON SOCIO-ECONOMIC CLASS

Socio-economic class profiling is a customer segmentation tool adopted to understand differential consumption of a commodity or

service by different socio-economic classes. It involves creating a wealth index using a multivariate statistical method (principal component analysis) and then classifying households based on the index values.

Household customers constituted approximately 68% of the total sample and are classified into three segments: disadvantaged (low), resilient middle (medium), and advantaged (high). The distribution of household customers by these socio-economic segments is shown in Figure 1-9.

- ▶ **Disadvantaged (low):** These customers have lower social status and are in the Scheduled Caste and Other Backward Class social categories. This group has the largest proportion of illiteracy and includes primarily unemployed or casual labourers who live in kutchha houses. A small percentage have two-wheelers but none have four-wheelers or tractors, while 85% have mobile phones.
- ▶ **Resilient middle (medium):** These customers represent households that don't fall in either high or low socio-economic classes. The largest proportion of this group is educated up to secondary levels, and the majority belong to Other Backward Class or General Class social categories. They depend on non-casual jobs, live in pucca houses, own two-wheelers, and possess televisions, electric fans, and mobile phones.
- ▶ **Advantaged (high):** This class has a higher stratum of social status. The majority have attended graduate school or higher levels of education, are salaried or self-employed, live in pucca houses, and own liquefied petroleum gas (LPG) connections and toilets. Most have two-wheelers, and some have four-wheelers or tractors; they own televisions, refrigerators, LED lights, fans, and mobile phones.

Table 1-1: List of utilities surveyed for this report (for FY 2018-19 or latest as available)

S No.	State	DISCOM	Reference Name	Customer Base (in lakhs)	Energy Sales (MU)	Revenue (INR Crs)	AT&C Losses (%)
1	Andhra Pradesh	APEPDCL	AP East	59.76	19,678	11,005	18%
2	Andhra Pradesh	APSPDCL	AP South	122.78	34,889	22,876	13%
3	Assam	APDCL	Assam	54.22	6,968	5,296	19%
4	Bihar	NBPDCL	Bihar North	93.03	9,362	4,230	27%
5	Bihar	SBPDCL	Bihar South	54.00	9,503	4,842	28%
6	Gujarat	UGVCL	Gujarat North	35.62	23,197	9,960	10%
7	Gujarat	MGVCL	Gujarat Central	31.72	11,262	5,530	9%
8	Gujarat	PGVCL	Gujarat West	52.83	29,657	14,267	19%
9	Gujarat	DGVCL	Gujarat South	32.30	21,258	11,647	7%
10	Karnataka	HESCOM	Karnataka Hubli	50.30	11,760	7,772	12%
11	Karnataka	GESCOM	Karnataka Gulbarga	30.73	7,523	5,005	15%
12	Karnataka	CESCOM	Karnataka Mysore	31.65	6,360	4,126	15%
13	Karnataka	BESCOM	Karnataka Bangalore	118.11	27,736	19,377	5%
14	Karnataka	MESCOM	Karnataka Mangalore	23.69	4,954	3,300	12%
15	Madhya Pradesh	MPMKVVCL	MP Central	43.88	15,032	9,434	37%
16	Madhya Pradesh	MPPoKVVCL	MP East	58.39	14,681	9,386	32%
17	Madhya Pradesh	MPPKVVCL	MP West	53.58	20,599	13,601	15%
18	Meghalaya	MePDCL	Meghalaya	4.21	1,016	566	33%
19	Punjab	PSPCL	Punjab	94.78	47,971	21,496	12%
20	Uttar Pradesh	MVVNL	UP Central	51.77	17,007	11,165	7%
21	Uttar Pradesh	PuVVNL	UP East	68.58	20,795	6,321	47%
22	Uttar Pradesh	PVVNL	UP West	60.81	28,393	15,226	15%
23	Uttar Pradesh	DVVNL	UP South	50.24	19,035	7,241	29%
24	Uttar Pradesh	KeSCO	UP Kanpur	6.13	3,023	2,594	14%
25	West Bengal	WBSEDCL	West Bengal	191.38	27,678	21,653	23%

Abbreviations: AT&C, Average technical & commercial; Crs, crores; DISCOM, electricity distribution utility; INR, Indian rupee; MU, million units.

AGRICULTURAL: SEGMENTS BASED ON LAND SIZE

Agricultural customers represent approximately 17% of the total survey sample. This category is adequately representative at the state level only.

To measure their electricity consumption levels, agricultural customers are further categorized by land size. Our use of five land-size categories, described as follows, is in alignment with the categories considered by the Government of India's Ministry of Agriculture & Farmers Welfare. The percentage of each segment in the agricultural sample is

shown in Figure 1-10:

- ▶ Marginal: Less than 1 hectare
- ▶ Small: 1–2 hectares
- ▶ Medium: 2–4 hectares
- ▶ Large: 4–10 hectares
- ▶ Very large: More than 10 hectares

COMMERCIAL: SEGMENTS BASED ON LOAD TYPE

Commercial customers represent approximately 8% of the total sample. Commercial customers are classified into two segments – productive and other – based on the appliances used in the enterprise.

Figure 1-11: Commercial customers, by load type

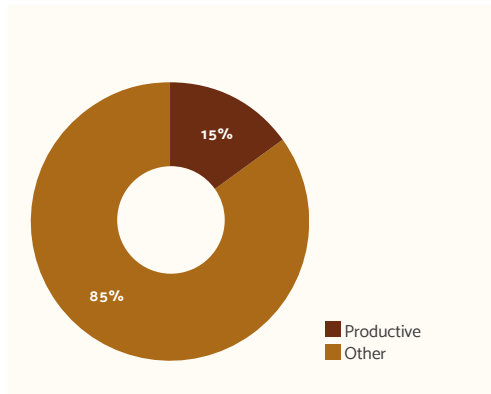
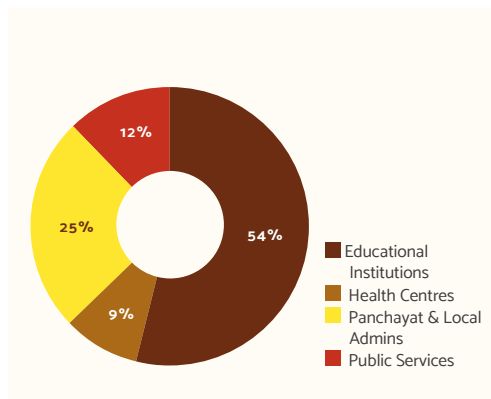


Figure 1-12: Institutional customers, by type of institution



This type of customer segmentation is used because commercial electricity consumption is directly proportional to the equipment that is essential for business operations and is not used only for basic uses like air circulation, cooling, or lighting. Discriminating between customer segments based on commercial uses of electricity also helps in analysing the

role of electricity in livelihood generation and increasing economic activity.

The distribution of the commercial sample is shown in Figure 1-11. Only 15% of commercial respondents used motorized productive loads, and these mainly consisted of electric water pumps, flour mills, oil mills, and electric sewing machines. The rest of the electricity used by commercial customers was primarily for lighting and basic cooling (e.g., fans, desert coolers).

INSTITUTIONAL: SEGMENTS BASED ON TYPE OF INSTITUTION

Institutional customers are classified into four segments: education, health centres, panchayats/local administration, and public services. The distribution of customer segments is shown in Figure 1-12.

Institutional customers represent approximately 7% of the total survey sample. Educational institutions form the largest group in this category, given that every village had at least one school.

Electricity Distribution Utilities

A total of 25 electricity distribution utilities were surveyed for this study. The current size of their customer base, following the Saubhagya scheme, poses questions about these utilities' ability to deliver power satisfactorily. A list of the included utilities along with snapshot profiles (covering customer base, annual energy sales, revenue, and AT&C losses) is provided in Table 1-1. The parameters presented in Table 1-1 demonstrate the comparative size of the operations of each utility.



Organization of the Report

In this report, the five chapters that follow cover the survey findings and analysis in detail. Each chapter discusses a particular part of the study to accomplish an objective that eventually knits into the prime objective of the study, which is to understand the status of electricity access – in the wider sense that includes sustainability – across India and to benchmark electricity distribution utilities' capacities to deliver.

Chapter 2: State of Electricity Access

This chapter outlines the current state of connectivity in India based on the customer survey findings and presents the various drivers of sustainability of access across the surveyed states and utilities. The analysis is based on the MTF-I, adapted from ESMAP's MTF to fit India's specific context. The data collected from customers is the main input for this analysis, and the key output is creation of an access index that makes it possible to understand the relative status of electricity access in different parts of India.

Chapter 3: State of Customer Satisfaction

This chapter analyses the six areas used to measure customer satisfaction, then ranks and compares the 25 utilities based on the access index defined in Chapter 2 and a new customer satisfaction index calculated across these six dimensions. The drivers of customer satisfaction, arrived at through statistical analysis, are also presented in this chapter.

Chapter 4: Capacity to Deliver Electricity Access

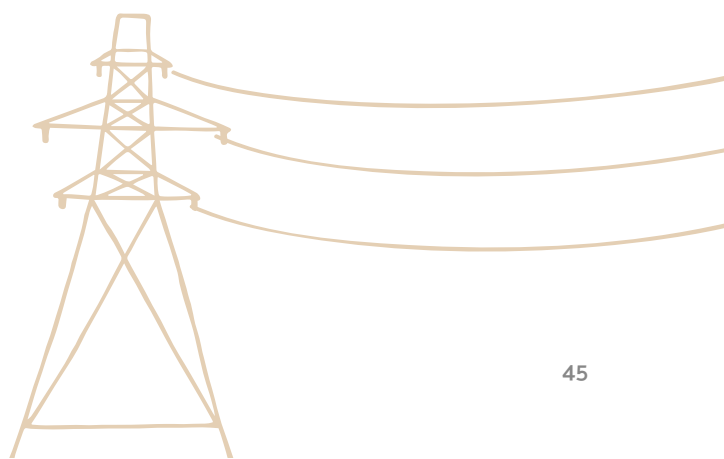
In this chapter, the data shared by the 25 electricity distribution utilities participating in this study is analysed from different viewpoints, and utilities are ranked by their capacity to deliver sustainable access. Capacity is measured in terms of a utility's infrastructure capacity, and operational and institutional capacity.

Chapter 5: Driving Sustainability for Utilities

While the analysis in the previous chapters focuses mainly on the sustainability of electricity access, this chapter looks deeper into the various relationships that drive sustainable performance by electricity distribution utilities. To achieve this, the conceptual framework designed for this study is discussed and used to analyse the various relationships.

Chapter 6: Summary and Recommendations

The concluding chapter of this study synthesizes the study's research, analysis, and insights and concludes with actionable recommendations. This chapter delves into the policy, regulatory, operational, or technical infrastructure; governance; and capacity-building interventions that will be required to improve electricity distribution utilities' performance on sustainable access and customer focus.



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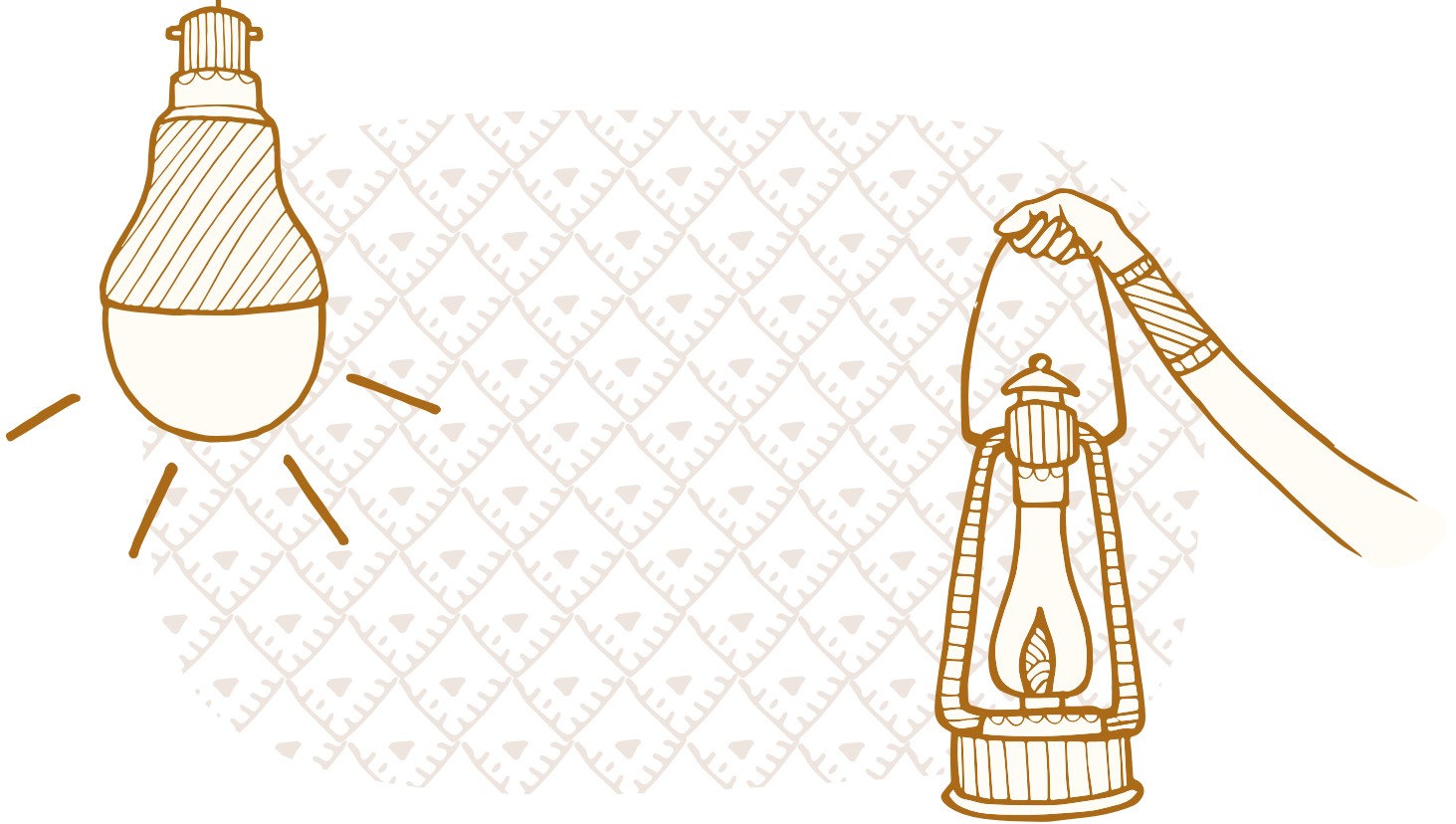


State of Electricity Access

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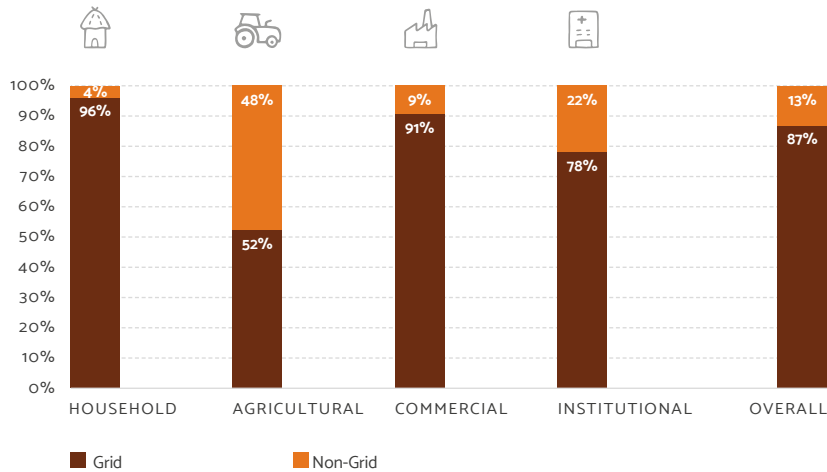
State of Electricity Access



Chapter 2 presents the state of electricity access for four customer segments – household, agricultural, commercial, and institutional – across 25 electricity distribution utilities (also known as distribution companies, or DISCOMs) in 10 states. Connectivity to the electricity grid is the prerequisite for ensuring sustainable and reliable access to energy as defined by Sustainable Development Goal 7. The first section of this chapter provides an analysis of customer survey data on connectivity in the 10 surveyed states, along with an overview of the various other sources of lighting and electricity used. The second section of this chapter presents a more comprehensive analysis of sustainability of access to electricity, an analysis that relies on Smart Power India's adaptation for the Indian context of the

Multi-tier Framework (MTF). The analysis explores each of the various dimensions that are incorporated in the new Multi-tier Framework–India (MTF-I), as described in Chapter 1, and compares distribution utilities by mapping customer reports of levels of access. The third and final section of Chapter 2 summarizes and ranks utility performance using the MTF-I and maps customers into various tiers based on their level of electricity access and its sustainability.

Figure 2-1: Sources of electricity (grid versus non-grid), by customer category



State of Electricity Access: Connectivity

As mentioned in Chapter 1, the Saubhagya (Pradhan Mantri Sahaj Bijli Har Ghar Yojana) scheme has been critical to enabling 100% electric grid connectivity to all households in the country. In order to now pave a road map for 24*7 power for all, it is crucial to also evaluate the state of connectivity for customer categories other than households. The first step is to understand the various sources of lighting and electricity used by customers. The next step in the evaluation is to include three additional metrics⁹ that define access to the electricity grid or distribution infrastructure. These four aspects of evaluating connectivity are summarized below:

- i. Sources of lighting and electricity: Which of various sources of lighting and electricity are used by customers, segregating electricity usage based on whether it relies on connection and consumption from the grid or on consumption of non-grid sources.
- ii. Availability rate: Number of customers who reported an electric pole being within 50 metres of their premises as a proportion of the total number of customers. (Customers who could not answer in terms of 50 metres distance were asked to say whether there was an electric pole within visible distance.)
- iii. Hook-up rate: Number of customers with grid connection from a distribution utility as a proportion of the number of customers who reported an electric pole within 50 metres.

- iv. Access rate: Number of customers with grid electricity connection from a distribution utility as a proportion of the total number of customers.

Sources of Lighting and Electricity

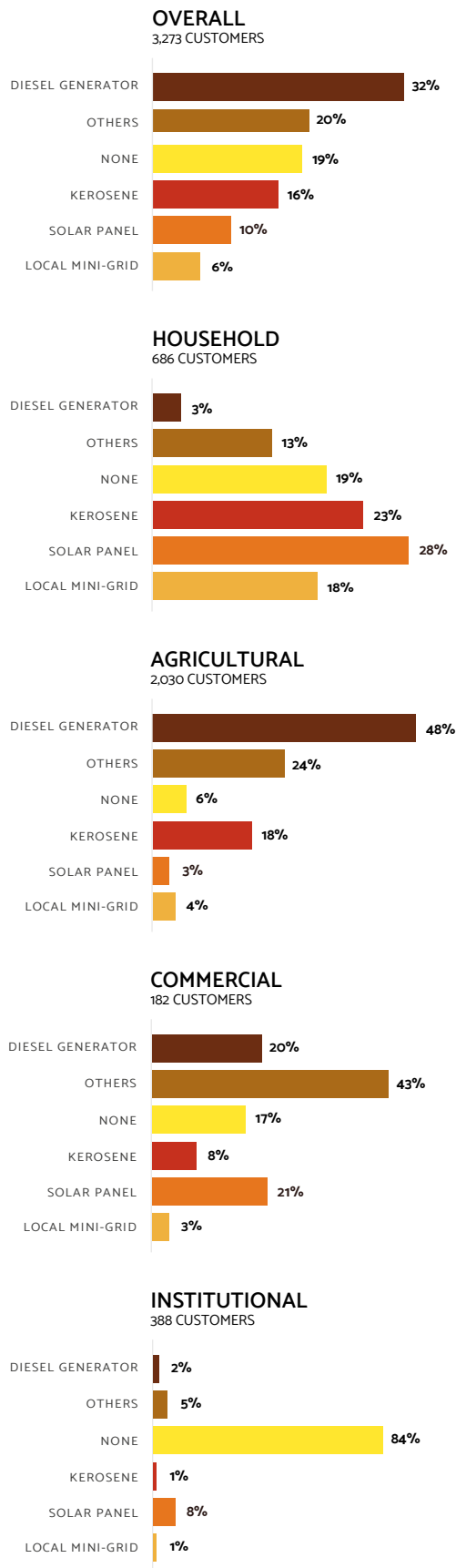
This section presents an analysis of survey responses across the four customer segments (household, agricultural, commercial, and institutional) regarding their sources of lighting and electricity. Overall, 87% of the survey respondents have access to grid-based electricity. The remaining 13% either use non-grid sources for electricity and lighting or don't use any electricity at all. Of all customers using non-grid sources, the majority (62%) are agricultural customers. Only 4% of today's households do not have access to grid-based electricity, while a significant proportion of agricultural customers (48%) do not have access to the grid¹⁰.

This finding is in line with the current focus of India's state governments and distribution utilities, whose first objective has been to ensure electricity access to all households, as households are the largest consumption bracket. With the focus now shifting towards improving quality of supply and system efficiencies, it is anticipated that a renewed focus on system strengthening through feeder segregation programmes will allow more customers in agriculture and other categories to access grid electricity connections. The percentage of customers in each category whose primary source of electricity and lighting is from the grid or from non-grid sources is shown in Figure 2-1.

⁹ The additional metrics are based on a World Bank study: Sudeshna Ghosh Banerjee, Douglas Barnes, Bipul Singh, Kristy Mayer, and Hussein Samad, Power for All: Electricity Access Challenge in India, World Bank Study no. 92223 (Washington, DC, World Bank, 2015), <https://openknowledge.worldbank.org/handle/10986/20525>.

¹⁰ Only agricultural customers who use pump-sets for irrigation were surveyed.

Figure 2-2: Sources of electricity for non-grid users, by customer category



Note: Because customers depend on multiple sources for lighting and electricity, the sum of the responses exceeds 100%. “Other” sources include candles, emergency lights, rechargeable batteries, and hook-ups to a neighbour’s house.

For customers without grid connections, the major sources of electricity and lighting are diesel generators, private solar panels or solar home systems, kerosene, and mini-grids. The non-grid sources in use vary by customer category (Figure 2-2) as well as by the customer’s local distribution utility (Figure 2-3). While households using non-grid sources primarily depend on kerosene and solar panels, agricultural customers prefer diesel generators. The survey responses show that the choice of source of electricity depends not only on cost but also on ease of availability. For example, subsidies for kerosene may be the leading reason for its significant consumption among households, whereas for agricultural customers, easily available diesel-based pump-sets are prominent despite their high cost. Similar trends are observed across utilities, with customers under different distribution utilities using different sources of electricity, as shown in Figure 2-3.

Overall, 2.5% of all customers surveyed do not have access to any source of lighting or electricity. The largest percentage is found among institutional customers – 18.4% of customers in this category reported no access to any source of electricity or lighting. Reasons including daytime hours of operation, limited ability to bear electricity costs, and limited use of electrical and technological tools have acted as barriers to connecting to the electric grid.

From a utility perspective, Meghalaya had the most customers without any source of lighting and electricity (13% of total respondents). This can be attributed to the state’s hilly and challenging terrain, which has limited the development of the electricity infrastructure.



Primary Sources of Electricity

- Connection to an electricity distribution utility is the primary source of electricity used across customer categories. However, the proportion of customers with a utility connection varies across categories.
- Sources of lighting and electricity among non-grid users vary across the customer categories. Household customers mostly depend on solar panels and kerosene, commercial customers prefer rechargeable batteries, and agricultural customers mostly use private diesel generators.
- Almost 1 in 5 institutional customers do not have access to electricity from any source. The majority of such institutions are either primary schools or panchayats and are concentrated in Uttar Pradesh and Bihar.
- Less than 4% of customers access electricity through solar panels, across all customer categories. Interestingly, take-up of solar panels is higher in rural areas (across all customer categories), though only marginally.

Availability Rate and Hook-Up Rate

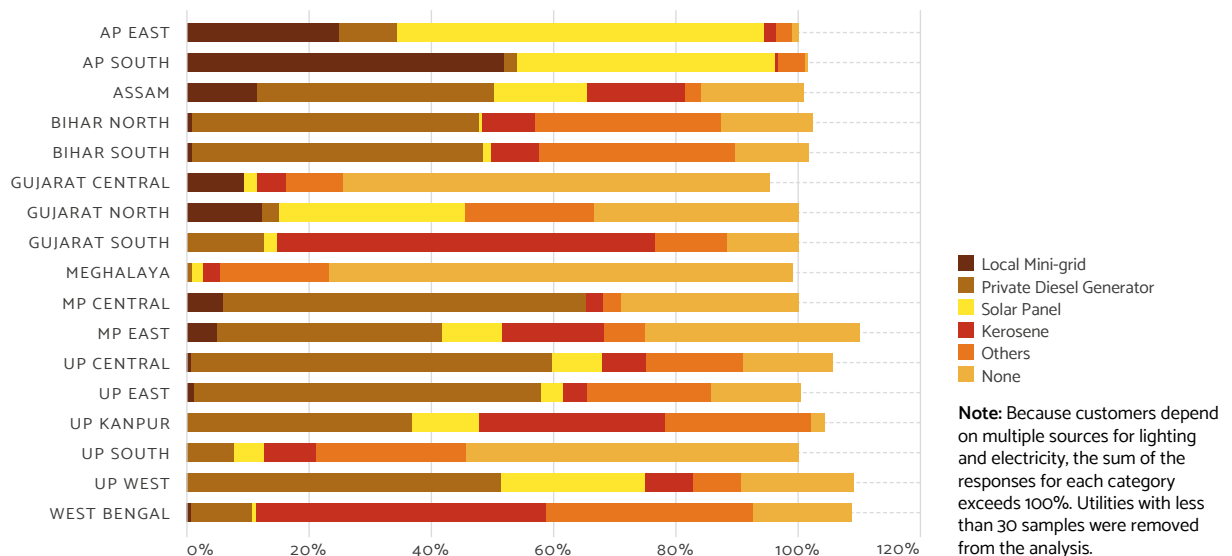
Customers can access electricity from the grid only when there is electricity distribution infrastructure available nearby. The availability of distribution infrastructure can be gauged by the presence of an electric pole near the customer's premises. A last-mile service connection cable can then be extended from the electric pole to the customer. For this study, grid electricity is considered to be available if an electric pole is located within 50 metres of the customer's premises. (Surveyed customers who did not know the exact distance to the nearest electric pole were asked to state whether there was a pole "within visible distance" of their premises.) Figure 2-4 shows the availability rate for each customer category as well as the rate

at which customers are actually connected by that last-mile cable (hook-up rate).

The grid availability rate was found to be typically high (more than 97%) across the household, commercial, and institutional categories. The grid availability rate for the agricultural category is lower, at about 75%. This automatically translates to a lower use of grid electricity and may be the reason why 48% of the surveyed agricultural customers rely on non-grid sources of electricity, particularly diesel generators, for irrigation purposes (see Figure 2-2).

As expected, customers in urban areas have higher availability rates across the three customer categories present in both urban and rural areas,¹¹ as shown in Table 2-1. The availability rates vary across states and utilities, with the extent of dispersion across customer

Figure 2-3: Sources of lighting and electricity for non-grid users, by distribution utility



¹¹ One-way ANOVA tests established the differences to be statistically significant, with an F test value of zero for household, commercial, and institutional customers in both rural and urban areas.

Table 2-1: Grid availability rate in urban and rural areas, by customer category

	Household	Agricultural	Commercial	Institutional
Urban	98.2%	N/A	95.0%	98.9%
Rural	96.5%	75.2%	88.3%	95.3%

categories also varying. The variation in availability rate across both states and utilities, as measured by coefficient of variation, is highest in the agricultural category. Table A2-1 (in Appendix 2.1) presents the availability rate across all customer categories by utility and state. It is crucial to note that availability rate varies across utilities within a state as well as across states. For instance, in Andhra Pradesh, the availability rate for AP South is 90% versus 44% for AP East.

It should be noted also that although the variation in availability rate for the household category is not significant across states or across utilities, the variation across utilities within a state is statistically significant¹² for every state surveyed. This indicates within-state disparities in infrastructure availability for household customers.

The other crucial metric on which performance across utilities and customer categories is evaluated is hook-up rate. This measure analyses grid access for customers with available electricity distribution infrastructure (that is, availability of an electric pole within 50 metres). Despite the fact that more than 90% of customers overall have an electric pole within 50 metres (as highlighted by the availability rate), the hook-up rate among the surveyed customers is lower, at 86% (see Figure 2-4). This indicates the existence of demand-side gaps, or reasons beyond availability which

may prevent customers from accessing grid connections. A comparison across customer categories brings out trends in hook-up rates similar to those observed in availability rates. For institutional customers in particular, there is a significant difference between the availability and hook-up rates. Further, hook-up rates, like availability rates, are higher in urban areas for commercial and institutional customers. However, the hook-up rate for urban households (98.4%) is marginally lower than among rural households (99.2%).

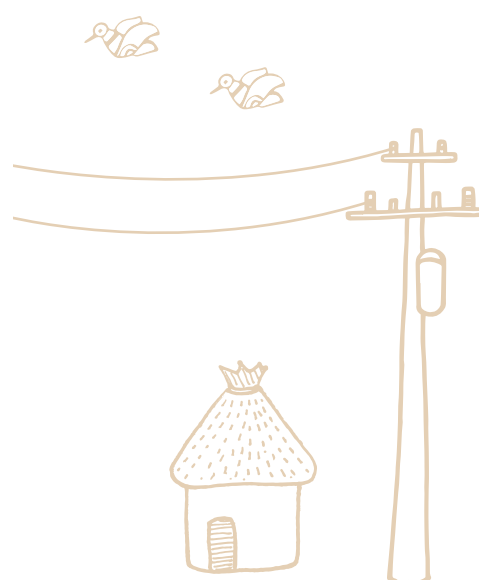
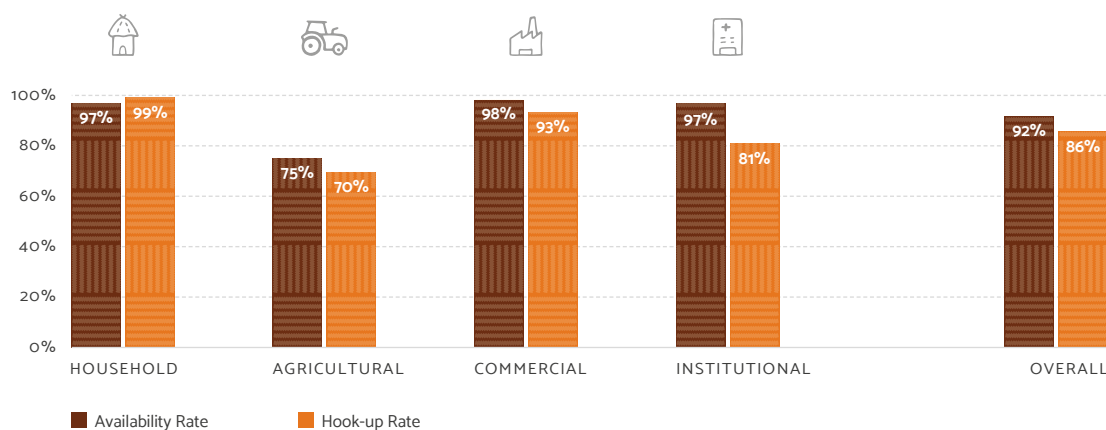


Figure 2-4: Grid availability rate and hook-up rate, by customer category



Note: Availability Rate = (households having electric pole within 50 metres) / (total households). Hook-up Rate = (households having electricity connection) / (households for whom infrastructure is available). Similarly for other customer categories.

¹² One-way ANOVA tests were conducted to assess statistical significance of difference, with a result having a p value of less than 5% (p < 0.05) considered significant.

Availability and Hook-up Rates

	Household	Agricultural	Commercial	Institutional
Availability Rate	97.0%	75.0%	98.0%	97.0%
Hook-up Rate	99.0%	70.0%	93.0%	81.0%

- Availability and hook-up rates are significantly lower for agricultural customers than for the other customer categories. This is also reflected in the low grid connection in the agricultural category.
- Availability rates also show great variation across utilities within the same state across all customer categories.
- Availability rates are higher in urban areas, reflecting the relatively higher rates of infrastructure availability. Lower infrastructure availability in rural areas is a probable reason for lower grid access in rural versus urban areas.

Access Rate

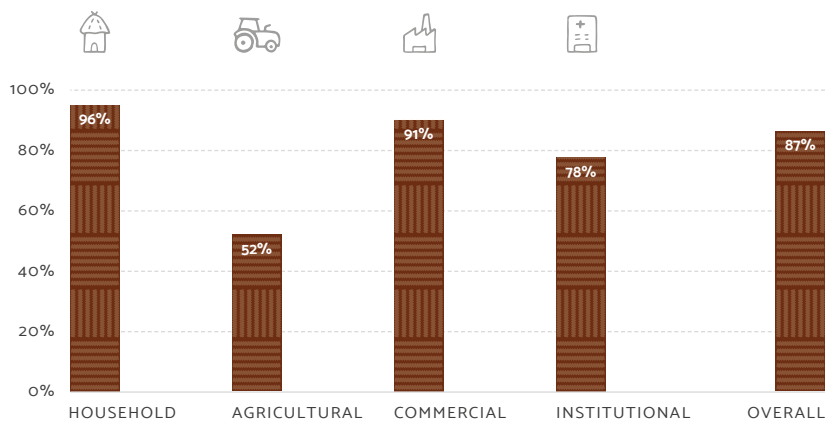
The access rate measures the proportion of customers that have working access to grid electricity connections from a distribution utility. As mentioned previously, the access rate is 87% overall (Figure 2-5). Like the availability and hook-up rates, however, there is significant variation in the access rate across customer categories, utilities, and states.

The customer category with the highest access rate is the household category, at 96%. This correlates with Saubhagya's focus on ensuring electricity access to 100% of households nationally. This was also in sync with insights from the study's qualitative data, in which many respondents claimed to have no access to electricity through any means, meaning that the goal of 100% access is in fact still in progress. The impact of the Saubhagya scheme

on the customer category is seen in the minimal differences between customer segments. For instance, the access rate for households defined as in a disadvantaged socio-economic class is 95%, while households with advantaged socio-economic class have an access rate of 99.5%. Similarly, the access rate for rural households is 95.8% compared to 96.5% in urban areas.¹³

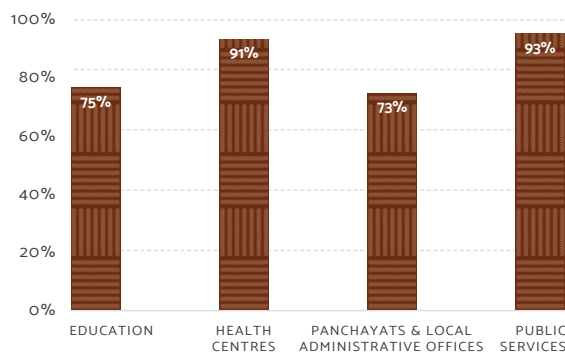
After households, commercial customers have the second highest access rate, at 91% overall, with a rural access rate of 88% and urban access rate of 95%. Access to electricity from the grid allows commercial customers to enhance the output of their establishments. Due to the typically higher tariffs charged to commercial customers, higher access rates in this category also allow distribution utilities to increase their margins.

Figure 2-5: Access rate, by customer category



¹³ One-way ANOVA tests confirmed the differences between household customer segments and between rural and urban households to be statistically significant ($p < 0.05$).

Figure 2-6: Access rate for institutional customers, by type of institution



The 78% access rate for institutional customers is lower than that for households or commercial customers, with a gap between rural and urban institutional customers of 14.6 percentage points. It is crucial to understand that within the institutional category overall, panchayats, local administrative offices, and educational institutes have the lowest access rates, with 1 in 4 customers having no electricity access (Figure 2-6).

Agricultural customers have the lowest access rate, at 52%, mostly owing to non-availability of nearby electricity infrastructure. Farmers thus depend on non-grid power sources like

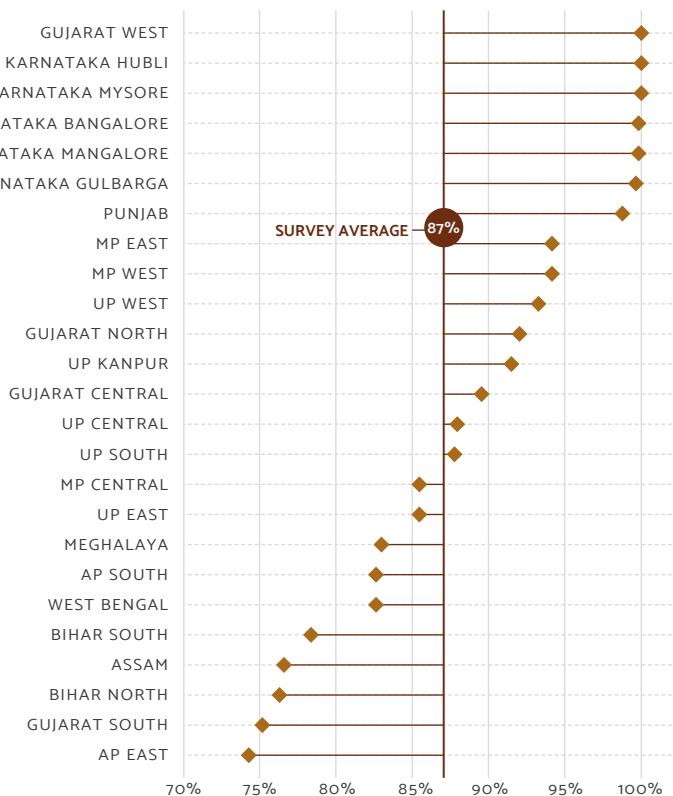
diesel generators (used by 48% of non-grid users) and kerosene (18% of non-grid users). Although only 3% of agricultural customers using non-grid sources reported using solar panels for agricultural purposes, this number is anticipated to increase following the introduction of the Kishan Urja Suraksha evam Utthan Mahabhiyan (Kusum) scheme in the near future, with further emphasis on solar pump-sets.

Access rates for agricultural customers were also analysed based on land size.¹⁴ The access rate for customers with smaller land sizes is 50.8%, while the rate for customers with large land sizes is 68.3%. It is interesting to note that the agricultural access rate also varies significantly across states; in Karnataka it is 99.8%, while in Assam it is only 5.2% (see Table A2-2 in Appendix 2.1). Although electricity distribution infrastructure is one of the factors in this disparity, another reason is that many agricultural customers, especially in rain-fed areas where there are limited groundwater irrigation requirements, choose to use community or group pump-sets.

The findings of the focus group discussions revealed that some utilities have undertaken IT (information technology) initiatives and provided options for customers to utilize numerous services (such as applying for a new connection) online. However, in other cases, the new connection process is still cumbersome and rural customers wait for a long time (2–6 months) for a connection to become active. The documentation requirements for a new connection are also not simple, and many times local utility or contractor staff expect bribes for a quick connection. In other cases, this behaviour on the part of utility staff results in a customer perception that new connections are very costly and hence they would prefer to do without electricity. There were also examples given of customers being provided with meters and submersible pumps (for agricultural customers only) but no wiring to enable the connection to be activated.

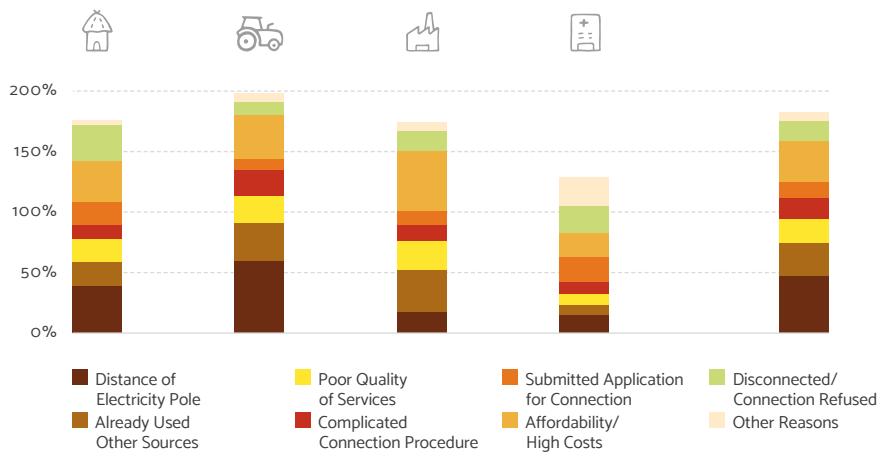
At an overall level, access rates show great variation across utilities as well, with a range of 25 percentage points (see Figure 2-7). Karnataka is at the top, with customers across the state's utilities reporting an access rate of almost 100%, whereas some of the utilities in Assam, Bihar, Gujarat, and Andhra Pradesh lie at the bottom. This also points to intra-state variations in access rates. For example, while the Gujarat West utility has a 100% access rate, Gujarat South customers report an access rate

Figure 2-7: Overall access rate, by distribution utility



¹⁴ Land sizes were classified as follows: small, less than 4 hectares; medium: between 4 and 10 hectares; and large, more than 10 hectares. Agricultural customers whose units of land size could not be standardized were removed from this analysis.

Figure 2-8: Reasons for not connecting to grid electricity, by customer category



Reasons for Not Having Electricity Access

Although good progress has been made towards providing universal electricity access to household customers, the same is not true for the other customer categories. There are multiple and statistically significant variations in access both within and across customer categories, utilities, and states. This section reports customers' reasons for not connecting to grid-based electricity, based on the responses of the customers, in all categories, who still do not have access to electricity from a distribution utility.

Overall, the leading reason is perceived unavailability of infrastructure. Almost half of non-grid users reported that the nearest electric pole is far from their premises and that this is the reason they do not have a connection. This data correlates with the reported availability rate still not reaching 100% (see Figure 2-4). However, inability to pay for electricity costs and user charges are also commonly stated reasons for avoiding a grid connection across the four customer categories. Further, the most common reasons for not accessing electricity from the grid vary by customer category. Household and agricultural customers' major reasons for not accessing electricity

from the grid are availability (39%) followed by affordability and high costs. Commercial customers' most cited reason is affordability and high costs. However, a substantial percentage of non-grid-using commercial customers reported that their reason for not using grid electricity was because they already used alternative sources. Meanwhile, within the institutional category, educational institutes reported that apart from affordability and high cost, being refused connection by a utility was a major reason for not using a grid connection (see Figure 2-8).

Poor availability of grid connections is the key reason constraining agricultural customers from accessing electricity from the grid. Almost 60% of agricultural customers without grid access cited poor availability, while 32% stated that their reliance on other sources was the reason they did not have a utility connection (Figure 2-8).

Commercial customers do not cite poor infrastructure as a reason for not connecting; their biggest reason is established reliance on other sources of power. This, however, probably indicates that other issues – such as affordability, reliability, and quality of electricity supply – are also relevant to their decision not to connect to electricity from the grid. In contrast, among institutional customers, one

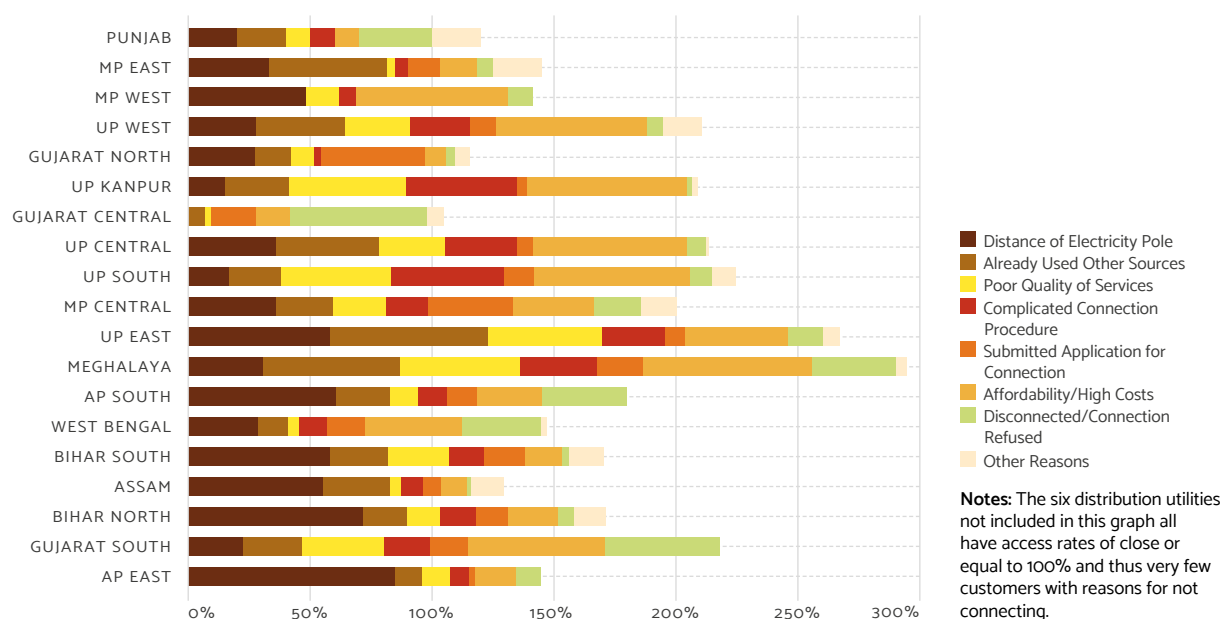
“Dono garam taar mein motor ka connection karte hain to motor chalta hai.”

(The motor runs only when we hook to two live-phase wires [due to less voltage in single-phase wires].)

-Agricultural customer,
Village Kurdaun, Rohtas, Bihar, India

More than 21% of institutions have submitted an application for a grid connection, which suggests future growth in access rate.

Figure 2-9: Reasons for not connecting to grid electricity, by distribution utility



of the biggest reasons given for not accessing grid electricity is that they have submitted an application and are waiting for a new connection. This may lead to a positive trend of increasing access rates among institutional customers in the near future.

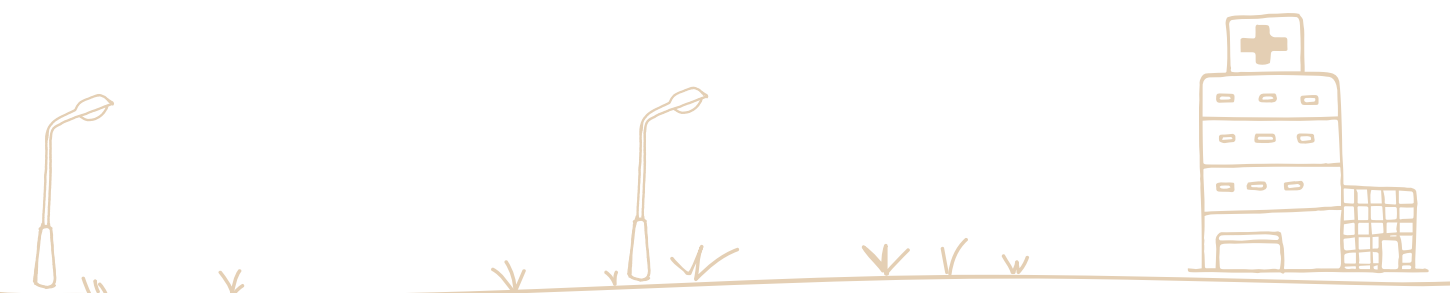
Regarding rural-urban differences in access, the nearest electric pole being far away is the most common reason for both rural (40.3%) and urban (36.8%) households to not have access to utility-supplied electricity. What also stands out is that more than a quarter (25.8%) of urban households stated that their connection request was refused. This probably indicates that these households lack the adequate documents required to get an electricity connection.

Among commercial customers, inability to afford the cost of an electrical connection and high user charges are the leading reasons for lack of access in both urban and rural areas. Commercial customers are in fact charged relatively high connection costs compared to customers in other categories. This could be a leading reason why commercial category customers tend to depend on other sources,

especially in rural areas, where the average costs of grid electricity are higher than in urban areas.

Among institutional customers, unlike households or commercial customers, stated reasons for lack of access differ in rural and urban areas. The majority of urban institutional customers chose “connection refused” and “inability to afford” as the leading reasons for not accessing a utility-supplied electricity connection. In contrast, in rural areas, over 20% of institutional customers have submitted an application and are awaiting a connection, indicating a growth in access rates in the future.

There are also utility-level differences in customers' reasons for not accessing electricity. Unavailability of required infrastructure (e.g., pole within 50 metres) and inability to afford the connection are the leading reasons across most utilities. For the five utilities with the lowest access rates, the most cited reasons for not availing grid connection are availability, affordability, and use of other sources (Figure 2-9).



Key Reasons for Not Connecting to Grid Electricity

- **Unavailability of electricity infrastructure**
This is the top most cited reason for not accessing a utility connection (47% of customers overall). The numbers are especially stark in the agricultural category, where almost 60% of customers cite this reason.
 - **Inability to afford a connection**
Overall, 35% of non-grid users cited affordability and high costs as the reason for not accessing electricity, including more than 30% of customers in the household, agricultural, and commercial categories. This could be a reason that over 35% of commercial customers depend on other sources of power.
 - A high proportion of rural and urban household category customers cited poor infrastructure availability (i.e., of an electric pole) as the reason for not accessing a utility connection.
- Interestingly, over a quarter of urban households without a utility connection chose “Connection refused” as the reason, which may indicate past defaults by these households or lack of adequate documentation.
- A high proportion of commercial customers, both rural and urban, cited high connection and user costs as the leading reason for not accessing electricity via a distribution utility.
 - Unlike household and commercial customers, rural and urban customers in the institutional category have different leading reasons for not accessing a grid connection. The leading reason for rural customers is that they have submitted an application and are awaiting connection. In contrast, 30% of urban customers stated that their connection had been refused.

Summarizing the State of Electricity Access

Table 2-2 reports on indicators of electricity access deficits¹⁵ in each of the four customer categories, using the definitions provided by the World Bank¹⁶ to calculate the values for each indicator. The data show that among household customers, the proportion of deficit attributable to supply-side factors is three times the proportion of deficit attributable to demand-side factors. However, the 99% hook-up rate for household customers indicates that the availability of infrastructure does motivate households to connect to the grid.

There remains a difference of 1% between availability rate¹⁷ and access rate among households. The access deficits are greatest, however, among agricultural customers, whether the focus is on unserved population or lack of infrastructure. In all categories of customers other than commercial, the proportion of the access deficit attributable to supply-side factors is higher than that attributable to demand-side factors.

Based on the survey findings, the key challenges in terms of connectivity are summarized by state and customer category in Table 2-3.

State of Electricity Access: Sustainability

The customer survey data discussed in the first section of Chapter 2 presents access to electricity in terms of connectivity only. However, providing customers with the possibility of connecting to the electrical grid is not enough to ensure full access to electricity and will not suffice to ensure socio-economic development. To serve the needs of customers in all four categories – household, agricultural, commercial, and institutional – electricity must be available at the right time, at an affordable price, and with a reliable and quality supply of power. In other words, it is important to define customers’ access to electricity in a more meaningful manner than through connectivity alone. To be effective, access to electricity must also be sustainable.

In this section, the focus is on better understanding the multiple other access factors that affect the sustainability of electricity access across the surveyed states and utilities.¹⁸ This more comprehensive evaluation of the state of access to electricity uses the MTF-I. Table 2-4 outlines the metrics used to capture the different dimensions of MTF-I, and the subsections that follow present findings on each of these dimensions of access both by utility and by customer category.

¹⁵ Electricity access deficit is defined as 100% minus the actual access rate.

¹⁶ Banerjee et al., *Power for All*, 2015.

¹⁷ Electricity is considered available if there is an electric pole within 50 metres (or, if exact distance is unknown, within visible distance) of the house or customer premises.

¹⁸ Figures used for comparison as the survey average are taken from the aggregate or average of the 10 states surveyed during this study.

Table 2-2: Indicators of electricity access deficits and their values, by customer category

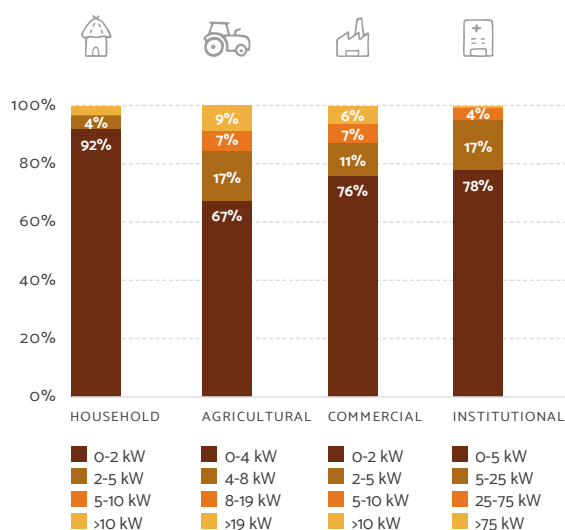
Indicator	Definition	Household	Agricultural	Commercial	Institutional
Availability rate	Calculated as the ratio of households for which electricity is available to the total number of households in the relevant population	97.00%	75.20%	98.00%	96.60%
Hook-up rate	Calculated as the ratio of households using a grid electricity connection to the number of households in communities where connection is available	99.00%	69.70%	93.10%	81.00%
Access rate	Calculated as the ratio of households using a grid electricity connection to the total number of households	96.03%	52.41%	91.24%	78.25%
Unserviced population	Calculated as 100% minus the access rate	3.97%	47.59%	8.76%	21.75%
Pure demand-side gap	Calculated as availability rate minus the access rate	0.97%	22.79%	6.76%	18.35%
Supply-side gap	Calculated as the unserved population minus the pure demand-side gap	3.00%	24.80%	2.00%	3.40%
Pure supply-side gap	Calculated as the supply-side gap multiplied by the hook-up rate	2.97%	17.29%	1.86%	2.75%
Mixed demand- and supply-side gap	Calculated as the supply-side gap multiplied by 100 minus the hook-up rate	0.03%	7.51%	0.14%	0.65%
Proportion of deficit attributable to demand-side factors	Calculated as the pure demand-side gap divided by the unserved population	24.43%	47.88%	77.17%	84.37%
Proportion of deficit attributable to supply-side factors	Calculated as the pure supply-side gap divided by the unserved population	74.81%	36.33%	21.25%	12.66%
Proportion of deficit attributable to mixed demand- and supply-side factors	Calculated as the mixed demand- and supply-side gap divided by the unserved population	0.76%	15.79%	1.57%	2.97%

Note: The definition of indicator in this table is per the 2015 World Bank publication *Power for All: Electricity Access Challenge in India*, by Sudeshna Ghosh Banerjee, Douglas Barnes, Bipul Singh, Kristy Mayer, & Hussein Samad, available at <https://openknowledge.worldbank.org/handle/10986/20525>. The percentages for each indicator were calculated based on the customer survey data collected for this study.

Table 2-3: Key challenges to connectivity, by state and customer category

State	Household	Agricultural	Commercial	Institutional
Andhra Pradesh	Absence of grid connection, infrastructure availability	Infrastructure availability (East)	Absence of grid connection (South), infrastructure availability (East)	Infrastructure availability (East)
Assam		Absence of grid connection, infrastructure availability		Absence of grid connection
Bihar	Infrastructure availability (South)	Absence of grid connection, infrastructure availability		Absence of grid connection, infrastructure availability (South)
Gujarat	Absence of grid connection (South, Central), infrastructure availability (South)	Absence of grid connection (South), infrastructure availability (South)	Absence of grid connection (South), infrastructure availability (South)	Infrastructure availability (Central)
Meghalaya	Absence of grid connection	Absence of grid connection, infrastructure availability		Absence of grid connection
Madhya Pradesh		Absence of grid connection (Central, West), infrastructure availability (Central, West)		Absence of grid connection (Central, East), infrastructure availability (East, Central)
Uttar Pradesh	Infrastructure availability (East)	Absence of grid connection (except West), infrastructure availability (Central, East, Kanpur)	Absence of grid connection (Kanpur, Central)	Absence of grid connection (East, West, South), infrastructure availability (East)
West Bengal		Absence of grid connection, infrastructure availability	Absence of grid connection	Absence of grid connection

Figure 2-10: Capacity of grid electricity connections, by customer category



Capacity – Sanctioned and Effective Connected Loads

Capacity, for this study, is measured by the sanctioned load of the grid electricity connection provided to customers. Information on connected load is typically included in the electricity bill received by the customer or is reported directly by customers. The connected load essentially determines the customer’s demand and their capacity to consume electricity. There are instances wherein customers are unable to increase their energy consumption due to backbone constraints, which adversely impacts the entire economic and cash flow cycle. Because the government’s primary focus so far has been on providing last-mile connectivity to allow basic lifeline consumption, the connected load is typically in the lower range across the board. (See connection capacities by customer category and then by utility in Figure 2-10, Figure 2-11, Figure 2-12, Figure 2-13, and Figure 2-14.) Enhancing connected load and customer capacity may be crucial to driving economic productivity and output going forward.

The majority (92%) of the households with grid-based electricity connection have a sanctioned load of 0–1 kW (76% of customers) or 1–2 kW (16% of customers). Low-capacity connections²⁰ are predominant among institutional customers as well. The agricultural category has a significantly higher percentage of high-

Table 2-4: Dimensions of meaningful access to electricity in the MTF-I

Dimensions	Components
Capacity	• Connected load
Availability	• Supply duration
Reliability	• Power cuts • Prior notification of power cuts
Quality	• Voltage fluctuations
Affordability ¹⁸	
Safety	• Electricity-related accidents
Customer Services	• Metering • Billing frequency • Mode of payment • Complaint management (availability of dedicated maintenance staff) • Complaint management (time to resolution)

capacity connections (>5 kW) than the other three categories.

Results of interest (Figure 2-11):

- ▶ Around 3.2% of household connections carry a sanctioned load of more than 10 kW, and almost all of these households access electricity from one of three distribution utilities: AP South, Karnataka Hubli, or AP East.
- ▶ AP South has the largest percentage of households with a sanctioned load of more than 10 kW, at 64.1% of households, while Karnataka Hubli has 5.4% of households and AP East has 1.5% of households accessing a sanctioned load of more than 10 kW. In each of the other 22 distribution utilities, the percentage of households with a connected load greater than 10 kW is less than 1%.

Results of interest (Figure 2-12):

- ▶ Around 42.5% of agricultural customers with grid-based electricity connection have a connected load of 0–3 hp.
- ▶ The percentage of customers having a connected load of more than 25 hp is largest in AP South compared to any other state, at close to 78%.

Results of interest (Figure 2-13):

- ▶ A little less than half of all commercial customers have a connected load in the class of 0–1 kW.

¹⁹ Affordability of electricity access was analysed for household customers only.

²⁰ Based on the purpose of electricity use in each of the four customer categories, “low capacity” has been defined by category to represent the typical load to satisfy basic demand: Household: 0-2 kW, Agricultural: 0-5 hp / 0-4 kW, Commercial: 0-2 kW, Institutions: 0-5 kW.

Figure 2-11: Percentage of household customers with different grid-connection capacity, by distribution utility

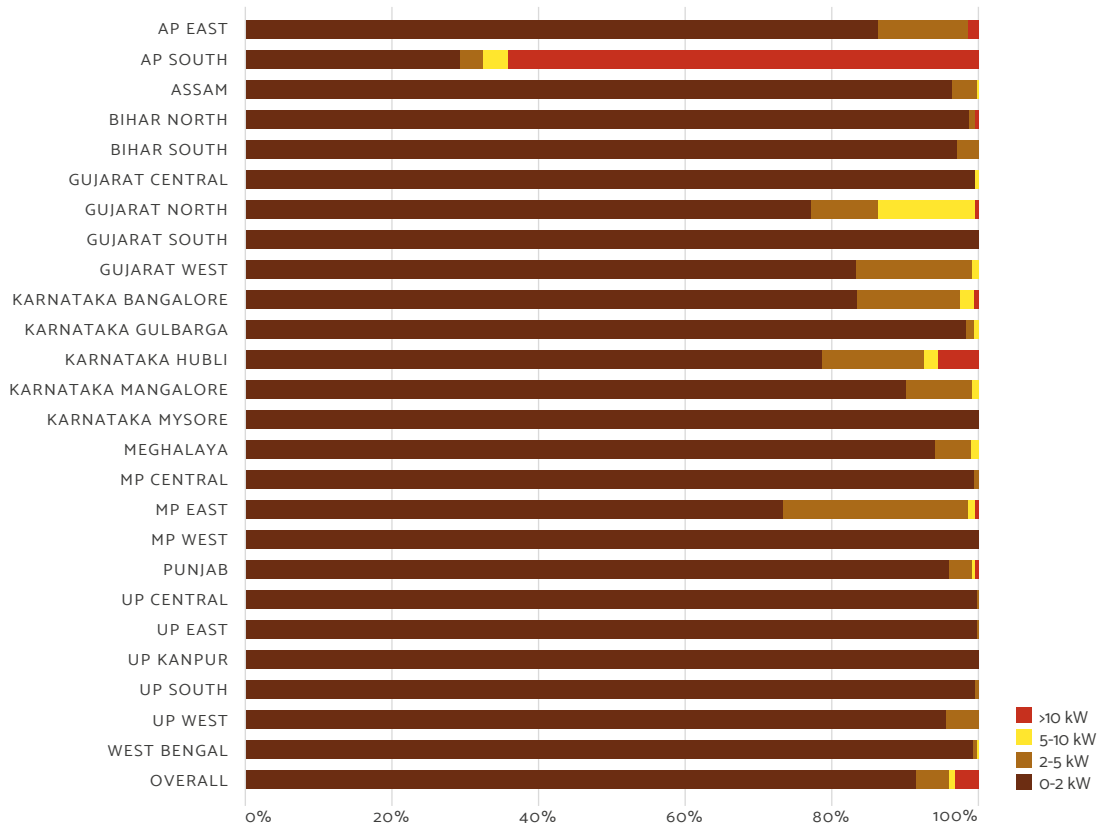


Figure 2-12: Percentage of agricultural customers with different grid-connection capacity, by distribution utility

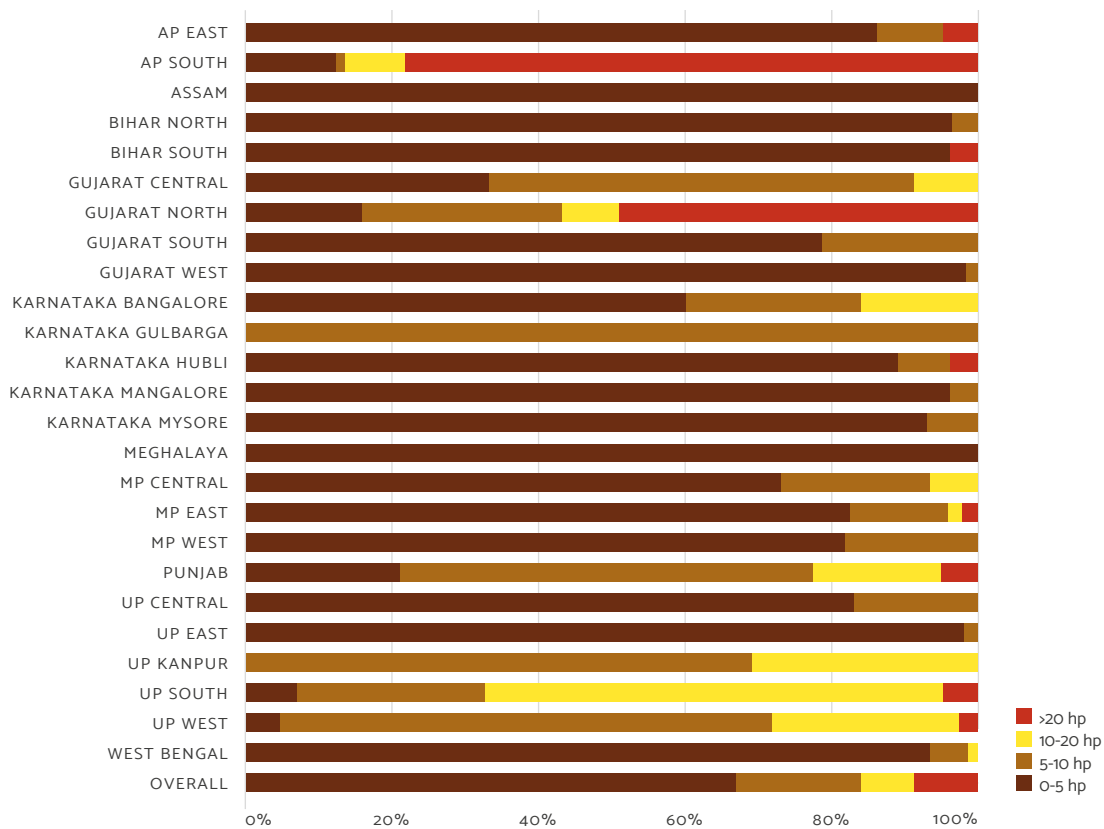


Figure 2-13: Percentage of commercial customers with different grid-connection capacity, by distribution utility

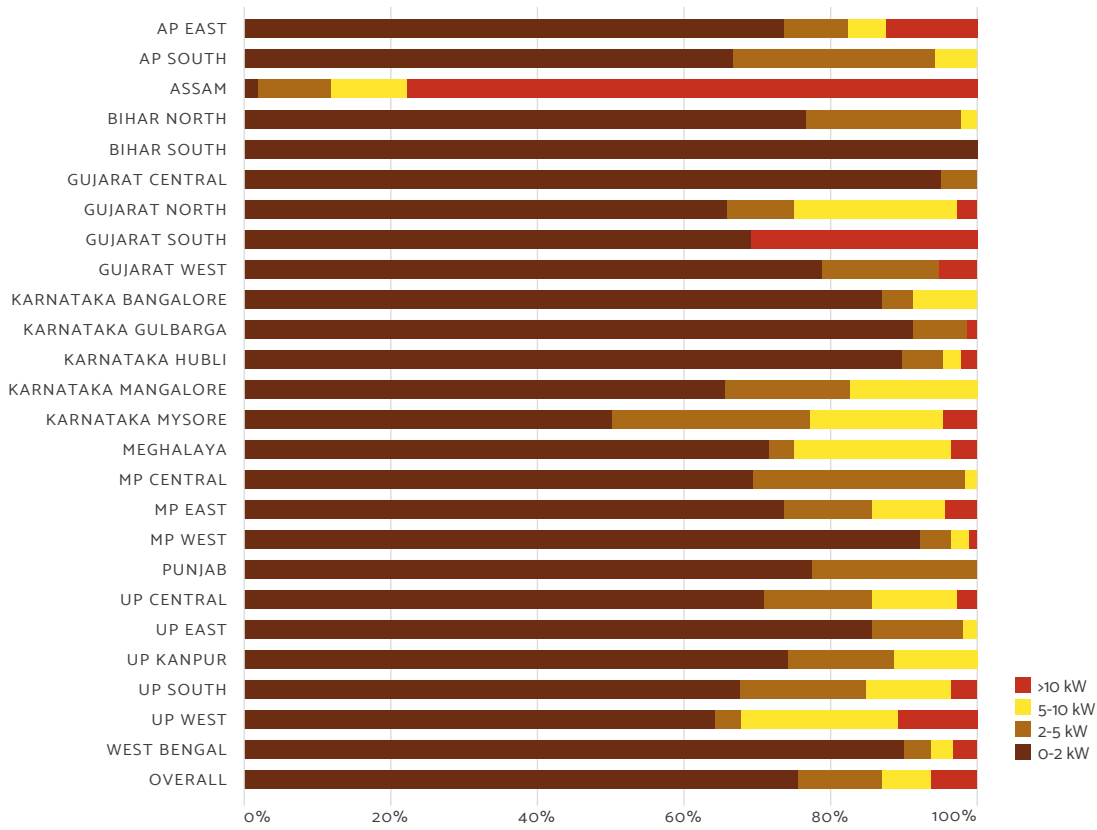


Figure 2-14: Percentage of institutional customers with different grid-connection capacity, by distribution utility

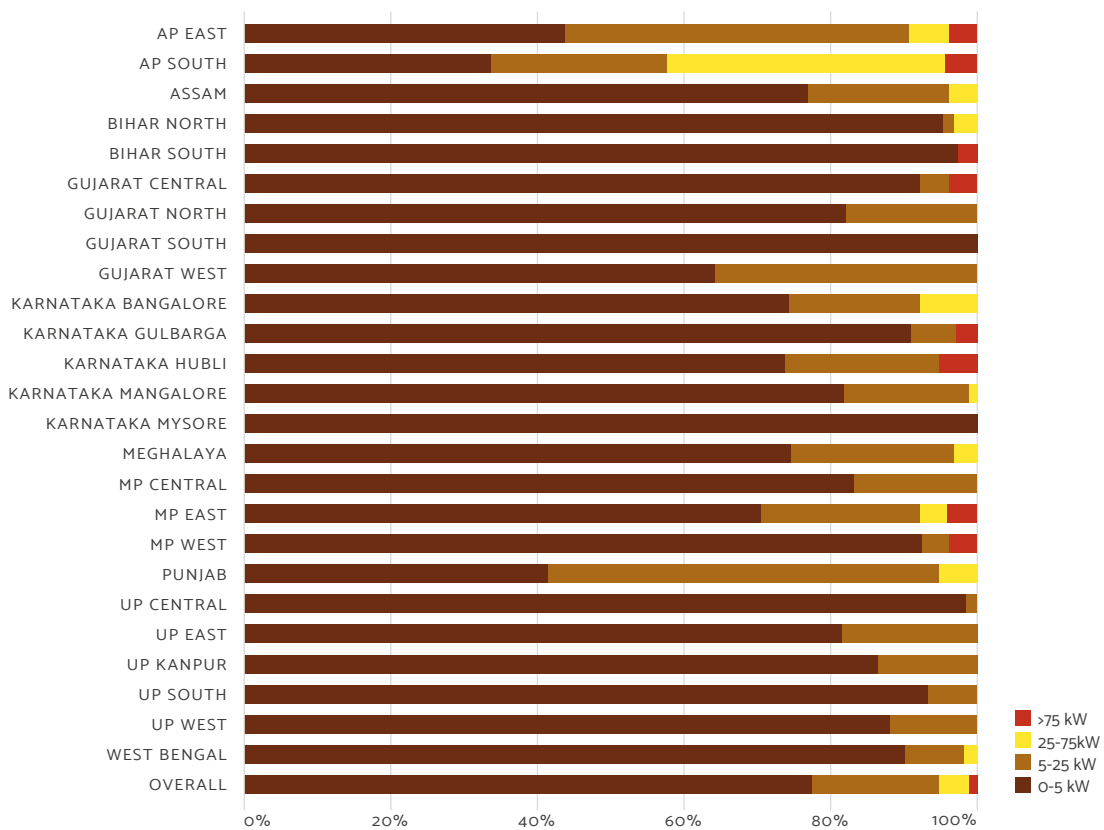


Table 2-5: Capacity of household grid electricity connections, by socio-economic class

Socio-economic class	Capacity of connected load				
	0-1 kW	1-2 kW	2-5 kW	5-10 kW	>10 kW
Disadvantaged	80%	12%	3%	1%	4%
Resilient middle	65%	25%	7%	1%	2%
Advantaged	44%	40%	14%	1%	0%

- ▶ Compared to any other distribution utility, AP South has a significantly lower percentage of customers with a connected load of 0-1 kW.
- ▶ Overall, 6.3% of commercial customers have a connected load of more than 10 kW.

Results of interest (Figure 2-14):

- ▶ A majority of the institutional customers (78%) have a connected load of 0-5 kW, while only 1% of have a connected load in the highest class of wattage (>75 kW).
- ▶ The AP East and Punjab utilities have significantly higher connection loads allotted to their institutional customers compared to the other distribution utilities.

Table 2-5 shows that the surveyed households in the disadvantaged socio-economic class tend to have lower-capacity connections. A correlation coefficient of +0.29 was obtained between the percentage of disadvantaged households and the percentage of households having a connection capacity of 0-1 kW. This data suggests that distribution companies serving higher proportions of customers in disadvantaged socio-economic classes will have higher proportions of households using low-capacity connections.

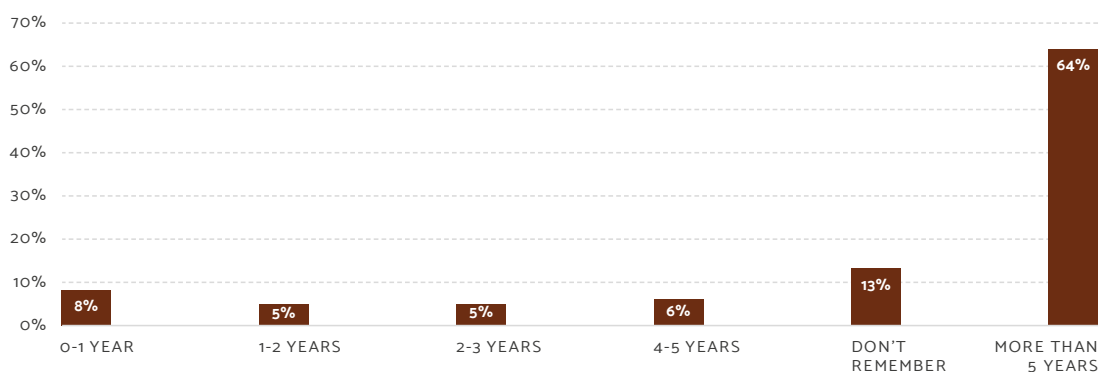
An analysis of difference²¹ was performed between reported sanctioned or connected load and the calculated connected load. The calculated connected load for households' electricity connections was based on the electrical appliances reported in use by household customers.

The results indicate a good match overall. Gujarat North has the highest percentage of household customers (74%) with an effective connected load incommensurate with the sanctioned load. Punjab and Karnataka Hubli followed Gujarat North as the distribution utilities with the second and third highest percentages of mismatch between effective and sanctioned connected load. The analysis of difference also reveals that the majority of households for whom the sanctioned load is less than the calculated connected load have an electricity connection that is at least five years old, as shown in Figure 2-15.

Availability - Duration of Electricity Supply

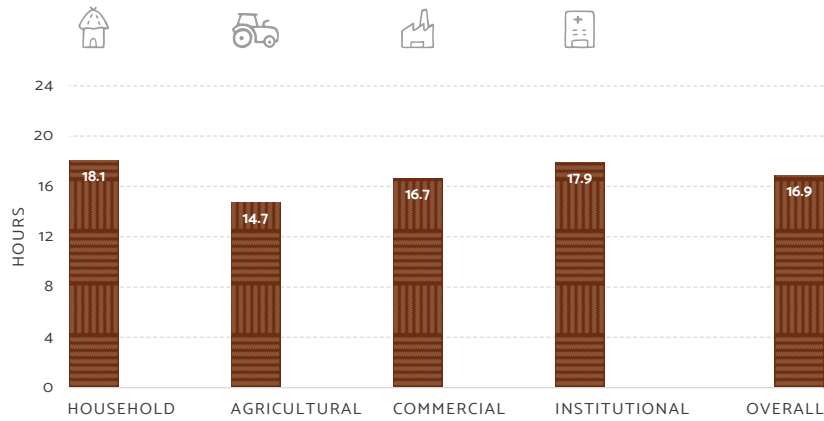
Power availability is indicated by the average number of supply hours each day in the past week. Over the past few years, with the government's focus on ensuring 24*7 power for all, the hours of supply have increased significantly, across customer categories, to approximately 17 hours per day (Figure 2-16). The focus group discussions conducted with customers across various utilities also revealed that overall, electricity access has improved in terms of connectivity and supply hours across the 10 states. Customers have experienced increased supply hours and reduced power cuts. In the household and institutional categories, the average supply hours per day is close to 18 hours. For the agricultural category, on average,

Figure 2-15: Percentage of households with sanctioned load less than calculated connected load, by year since connection



²¹ To test the difference between sanctioned load and effective connected load, a paired t-test was used to compare whether the load values differed significantly.

Figure 2-16: Average number of hours of supply each day in the past 1 week, by customer category



the availability is almost 15 hours per day. This number appears starkly different from the general policy across states of supplying 8 to 10 hours per day to agricultural customers. This is a concern with the emerging priorities of groundwater and energy conservation. Feeder segregation has been a crucial enabler for ensuring optimal supply of power between household and residential customers, which going forward should be extended to all states (see Figure 2-17).

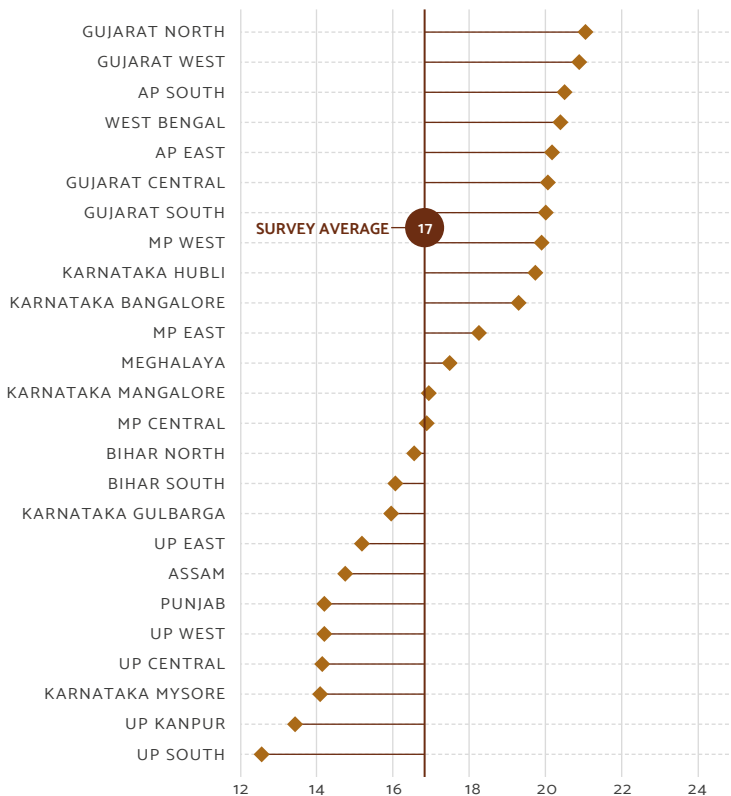
Results of interest (Figure 2-17):

- ▶ Three distribution utilities – Gujarat South, Karnataka Mysore, and Punjab – have the

lowest average number of hours of supply each day for agricultural customers, at 8.0 hours, 6.7 hours, and 7.3 hours, respectively.

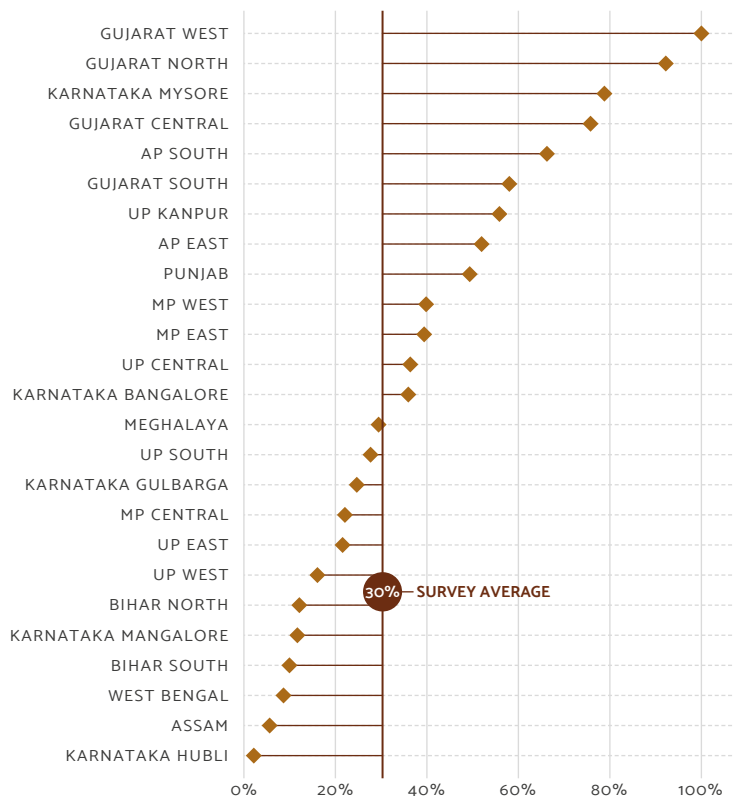
- ▶ For all other utilities, the hours of supply to agricultural customers vary from 8 to 21 hours.
- ▶ West Bengal agricultural customers report the most hours of supply each day, at 20 hours.
- ▶ Gujarat is the only state supplying close to 24 hours of electricity supply to three categories of customer: household, commercial, and institutional. The state’s overall average number of hours of electricity supply drops to 10 hours when including the electricity supply

Figure 2-17: Average number of hours of supply each day in the past 1 week, by distribution utility



Customers in a Gujarat village who participated in a focus group discussion pointed out that their power supply has improved and is now adequate and that they have a reasonable understanding of the subsidies provided for their electricity. However, there are still challenges in the long wait times to get a new connection.

Figure 2-18: Percentage of customers reporting no power cut in each day of the past 1 week, by distribution utility

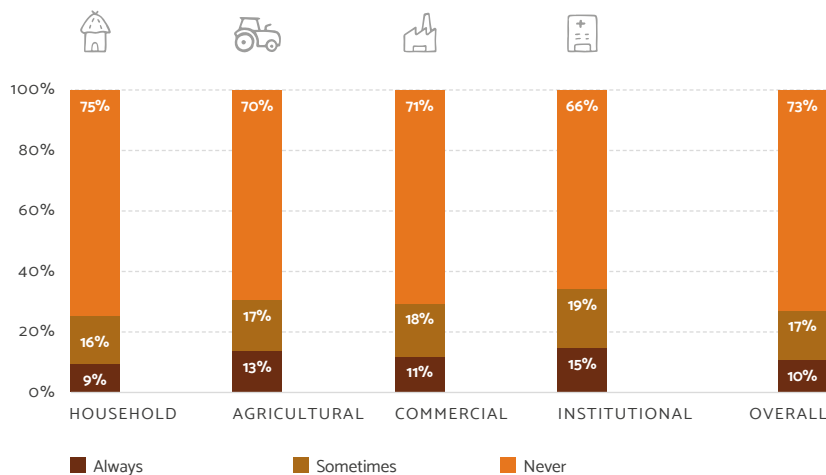


data to agricultural customers for all four Gujarat distribution utilities.

Reliability – Number and Prior Notice of Power Cuts

Reliability of electricity access is summarized through two specific indicators associated with the power supply: (a) number of power cuts, and (b) prior notification of upcoming power cuts. For example, in this study, agricultural and institutional customers reported no power cuts each day during the past 1 week, but 70%

Figure 2-19: Percentage of customers reporting prior notification of power cuts, by customer category



of household customers reported at least one or more than one power cut each day during the past 1 week. Figure 2-18 ranks the distribution utilities by the percentage of customers reporting no recent power cuts.

Results of interest (Figure 2-18):

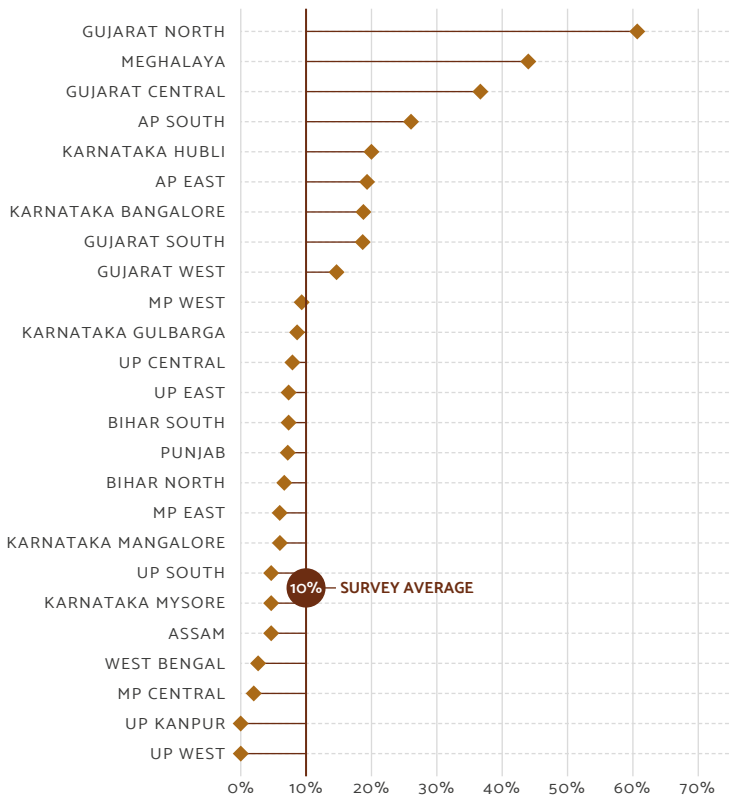
- ▶ Three distribution utilities – UP West, UP South, and Bihar South – delivered the poorest power reliability to agricultural customers, with the percentage reporting power cuts “greater than 15 times per day” in the past 1 week at 61%, 34%, and 42% respectively.
- ▶ A little less than half of commercial customers reported 1 to 10 power cuts per day in the past 1 week.
- ▶ All five distribution utilities in Uttar Pradesh show the lowest power reliability for institutional customers, as more than one third of institutional customers reported power cuts more than 15 times per day in the past 1 week.

Figure 2-19 provides the percentage of customers reporting that they had prior notification of power cuts from their utility, for all four customer categories. Figure 2-20 shows the percentage of each utility’s customers overall who had received prior notification of power cuts.

Results of interest (Figure 2-19):

- ▶ A majority of household customers (74.5%) reported that they never get prior notification of power cuts.
- ▶ This was further corroborated by the qualitative data insights that with regards to power cut notification, many customers claimed no communication from DISCOM.
- ▶ Across all customers, the mean proportion reporting prior notification of power cuts (either always or sometimes) is significantly higher among institutional customers than among the other three customer categories.

Figure 2-20: Percentage of customers reporting prior notification of power cuts, by distribution utility



Results of interest (Figure 2-20):

- ▶ The problem of unscheduled power cuts is most severe at UP West (98.6%), UP Kanpur (97.2%), UP South (92.4%), and MP Central (93.3%).
- ▶ The percentage of institutional customers reporting that they are never informed of power cuts is 100% for the MP Central, UP Kanpur, and UP West utilities.



Quality – Number of Voltage Fluctuations

Power quality is summarized through two key indicators: (a) number of voltage fluctuations, and (b) equipment damage due to voltage fluctuations. Figure 2-21 shows the range of voltage fluctuations reported across different customer categories, and Figure 2-22 ranks the utilities by percentage of customers with no recent voltage fluctuations.

Figure 2-21: Number of voltage fluctuations per day in the past one week, by customer category

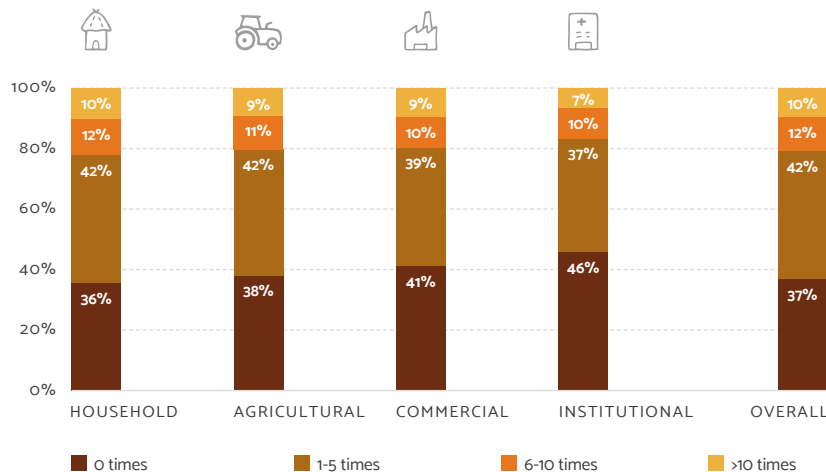
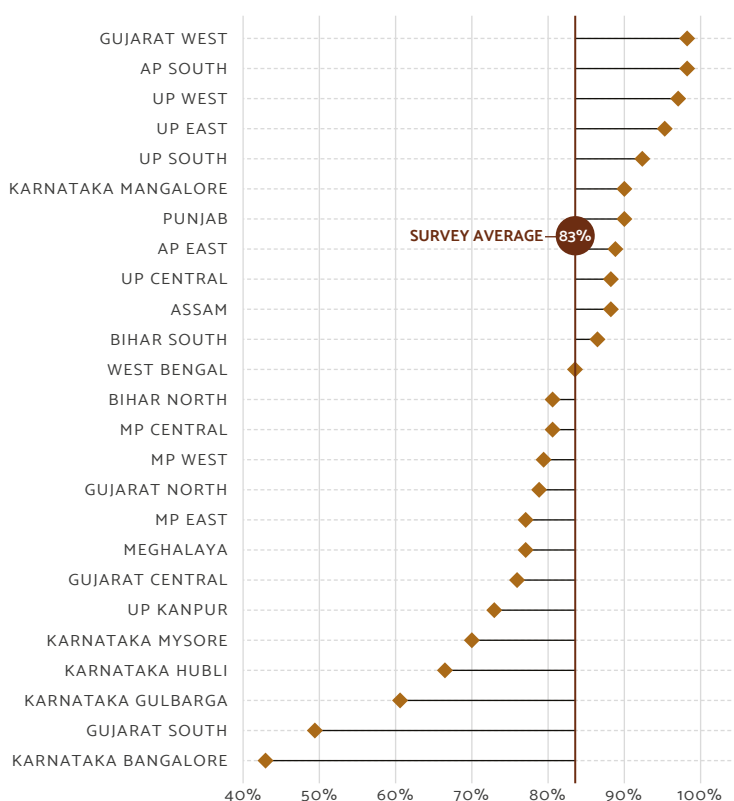


Figure 2-23: Percentage of household customers with affordable access to electricity, by distribution utility



Affordability – Cost as Percentage of Household Expenditure

Affordability is measured by the ability of customers to pay for the electricity in a defined consumption package.²² Following the guidelines in available literature and reports on electricity access and affordability,²³ this study used the threshold level of 30.5 kWh per month consumption for the household category. Effectively, the threshold level is defined as the consumption of 1 kWh per household per day. If the cost incurred on this threshold level of electricity consumption is less than 5% of total household expenditure, access is considered to be affordable. Overall, access to electricity is observed to be quite affordable for the majority of households (Figure 2-23).

Results of interest (Figure 2-23):

- ▶ The Karnataka Bangalore distribution utility is the least affordable, with around half of all household customers in the area reporting unaffordable access to electricity.
- ▶ In addition to Gujarat West and AP South, four utilities in Uttar Pradesh have a higher

percentage of customers with affordable electricity access than the survey average.

Table 2-6 presents the socio-economic class distribution of the surveyed customers who had affordable electricity access.

Safety – Electrical Accidents

Under the context of safety of electricity access, surveyed customers in all customer categories were asked to report on any electricity-related accidents in the past 1 year (see Figure 2-24 and Figure 2-25).

Results of interest (Figure 2-24):

- ▶ Agricultural customers reported the highest percentage (19%) of electricity-related accidents.
- ▶ Reports of equipment damage resulting from voltage fluctuations is also highest among agricultural customers compared to the other customer categories.
- ▶ During focus group discussions, customers pointed out in many cases the absence of proper safety practices around electrical infrastructure (e.g., transformer not surrounded with proper enclosure, wires

²² Affordability of electricity access was reported for only one customer category: household. The costs incurred on electricity consumption were calculated using average billing rate data at the utility level.

²³ Mikul Bhatia and Niki Angelou, Niki. 2015. Beyond Connections: Energy Access Redefined, Energy Sector Management Assistance Program (ESMAP) Paper no. 105054 (Washington, DC, World Bank, 2015), <https://openknowledge.worldbank.org/handle/10986/17456>.

Table 2-6: Percentage of household customers for whom electricity is affordable, by socio-economic class

Distribution utility	Disadvantaged	Resilient middle	Advantaged	Total
AP East	85%	99%	100%	89%
AP South	98%	100%	-	98%
Assam	86%	91%	97%	88%
Bihar North	78%	91%	96%	81%
Bihar South	83%	93%	100%	86%
Gujarat Central	73%	97%	-	76%
Gujarat North	77%	90%	100%	79%
Gujarat South	48%	78%	-	49%
Gujarat West	92%	99%	100%	98%
Karnataka Bangalore	33%	68%	67%	42%
Karnataka Gulbarga	59%	65%	100%	60%
Karnataka Hubli	54%	91%	100%	66%
Karnataka Mangalore	79%	98%	100%	90%
Karnataka Mysore	70%	100%	-	70%
Meghalaya	72%	92%	100%	77%
MP Central	77%	100%	100%	81%
MP East	75%	84%	95%	77%
MP West	77%	85%	100%	79%
Punjab	86%	95%	100%	90%
UP Central	87%	90%	100%	88%
UP East	94%	98%	100%	95%
UP Kanpur	67%	89%	100%	73%
UP South	88%	99%	100%	92%
UP West	95%	98%	100%	97%
West Bengal	81%	99%	100%	83%
Overall	80%	94%	99%	83%

Figure 2-24: Reported occurrence of any electricity-related accident in past one year, by customer category

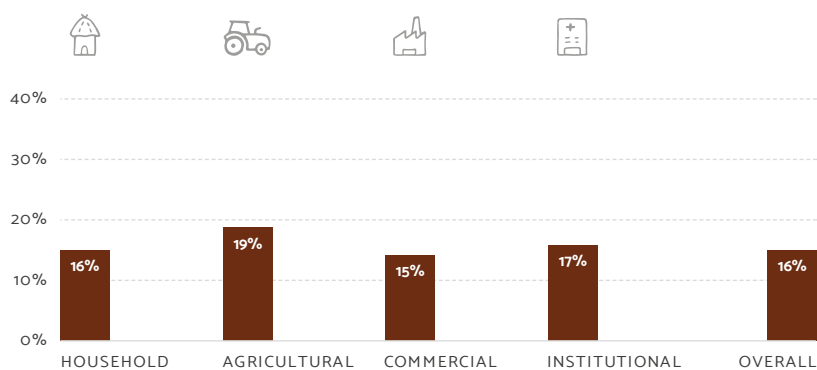
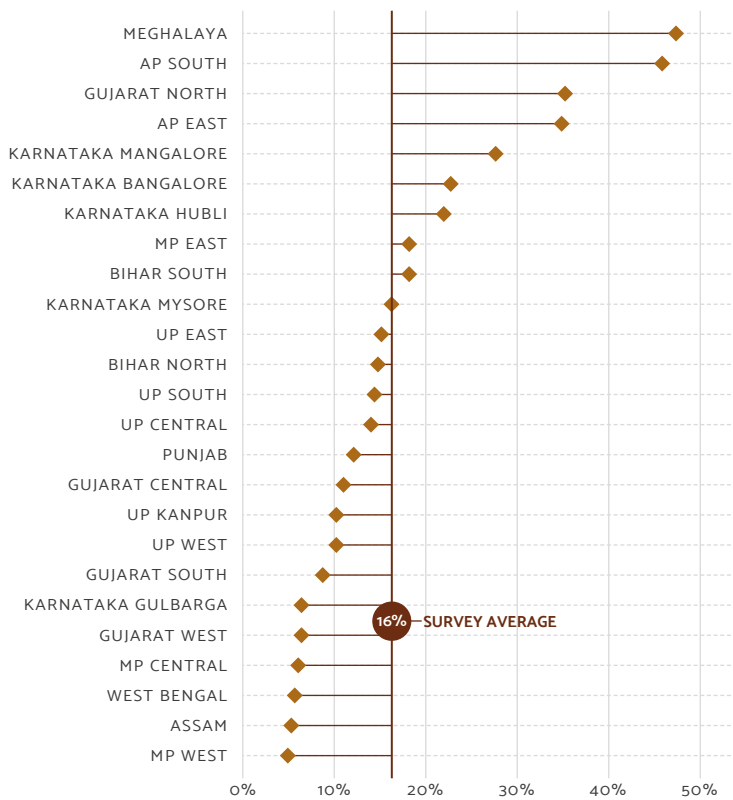


Figure 2-25: Reported occurrence of any electricity-related accident in past one year, by distribution utility

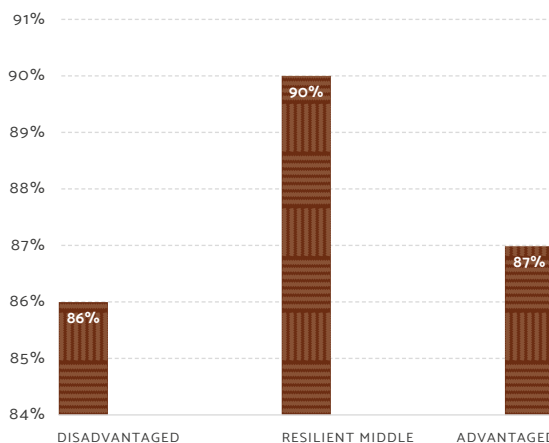


hanging very low, wooden poles used to provide access, poles damaged or falling on the ground during high wind or rains). These customers said this lack of standard practice had led to safety issues including instances of villagers or animals getting electrocuted.

Results of interest (Figure 2-25):

- ▶ In the household category, accidents were most common in the Meghalaya, AP South, and Gujarat North utilities, which had more than 40% of household customers reporting accidents.

Figure 2-26: Percentage of household customers with a metered connection, by socio-economic class



- ▶ For two distribution utilities – AP South and Meghalaya – all four categories of customers reported significantly high percentages of electricity accidents.
- ▶ AP South and Meghalaya are the only two distribution utilities for whom accidents were reported by more than one third of the commercial customers.
- ▶ Gujarat South, Gujarat Central, and MP Central are the only three distribution utilities for whom institutional customers reported zero occurrence of electricity-related accidents.

Customer Services

Metered Connection

A high percentage of customers in all categories reported a metered connection to grid electricity. This is a very positive finding. It indicates that some of the metering programmes have been successfully implemented, which is likely to help pave the way to improving operational efficiencies. Figure 2-26 and Figure 2-27 present the findings on metered connections: among households based on customer socio-economic class, and among all customers based on customer category. The percentage distributions of household customers with a metered connection are in parity across all socio-economic classes.

Results of interest (Figure 2-27):

- ▶ Overall, 85% of customers connected to distribution utilities reported a metered electricity connection.
- ▶ The percentage of customers with a metered connection is higher in the commercial category than in the other three categories.

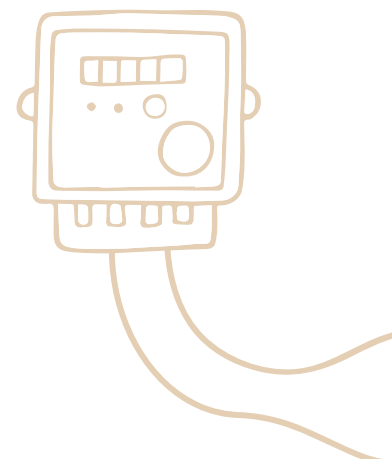
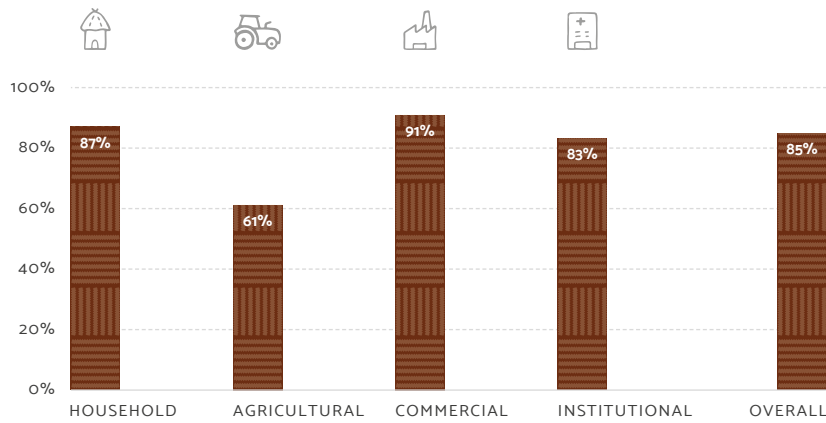


Figure 2-27: Percentage of all customers with a metered connection, by customer category



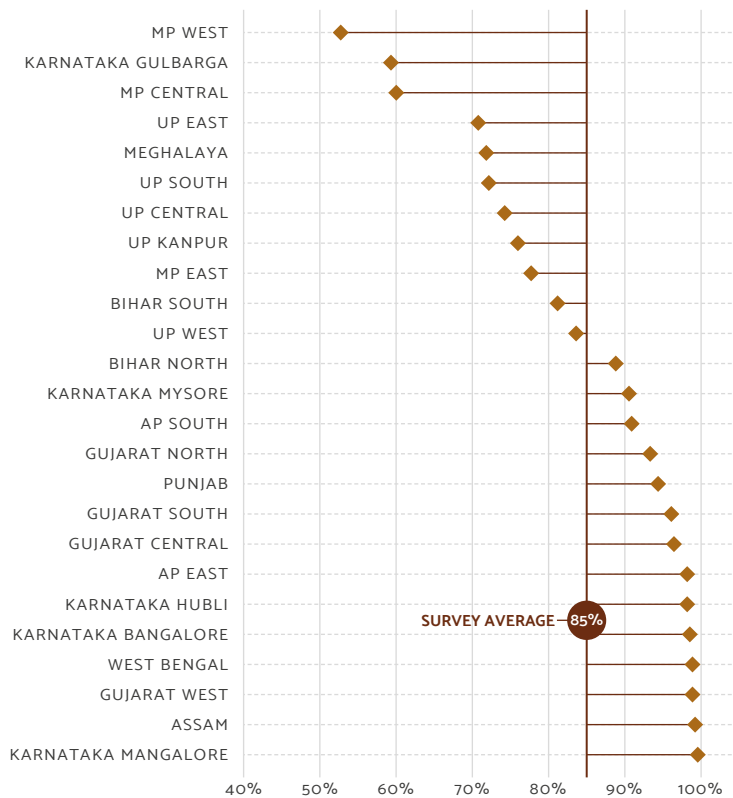
► Agricultural customers lag in metering as well as in overall connectivity to grid electricity connections (see Figure 2-5 for overall connectivity by customer category).

Results of interest (Figure 2-28):

- All 25 distribution utilities were observed to perform well on providing a metered connection for the majority of customers across all categories.
- The three utilities with the lowest percentages of customers with a metered connection – MP West, MP Central, and Karnataka Gulbarga – all had percentages well below the survey average in terms of metered connection.

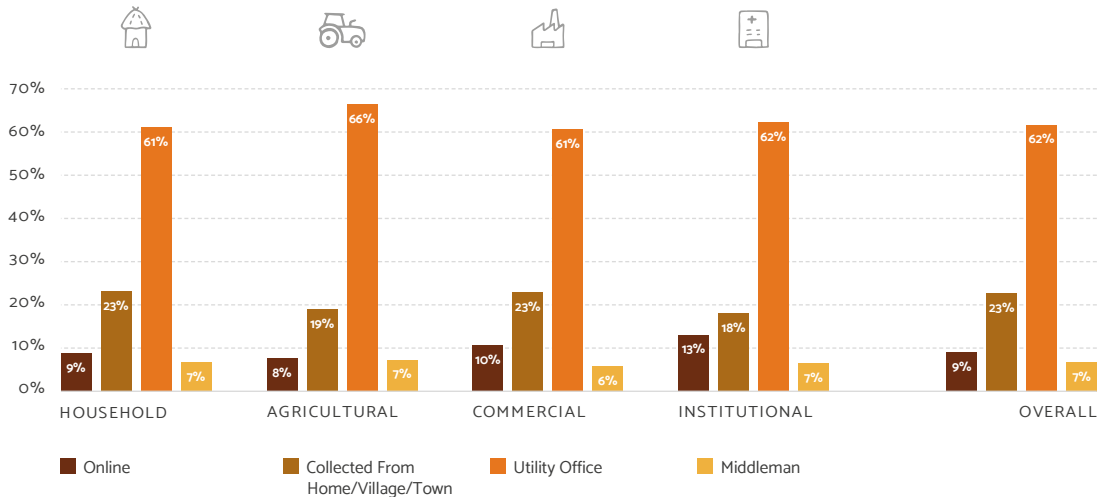
► However, lack of 100% metering coverage is still a challenge for some utilities. It was reported during both qualitative surveys and utility interviews that many customers were not provided with meters. There were also cases (reported by utilities) in which customers (mostly agricultural customers) did not allow utility staff to install meters. In a few other cases in which meters were provided, a hefty amount was charged for meter installation and connection. In some instances, even when meters were installed in the customer’s premises, the wiring was not completed to provide a connection.

Figure 2-28: Percentage of all customers with a metered connection, by distribution utility



Customers in a focus group discussion conducted in Bihar reported issues with their existing meters being a major challenge that, combined with other challenges including infrequent bills and lack of notification of upcoming power cuts, constrained economic activity.

Figure 2-31: Percentage of customers using different modes of payment, by customer category



► During the focus group discussions, many respondents reported that they face problems with bills. For example, bills are not delivered on a regular basis (e.g., monthly, bimonthly, or quarterly), there is no nearby customer payment booth or office, and there are errors in the bills in terms of units of electricity consumed. With irregular bills, it becomes a challenge to pay the high amount that accumulates over time, especially for rural customers who in some cases receive bills generated over a period of more than 6 months. Customers also report the bills are not easily understandable and many times

are not provided in the local language that is easily understood by rural customers.

Results of interest (Figure 2-30):

- Out of five distribution utilities in Uttar Pradesh, only UP West has more customers reporting a fixed billing frequency than the survey average of 85% (Figure 2-30).
- Seven of the 25 distribution utilities in this survey have less than the survey average reporting a fixed billing frequency, and of these seven, six are from Bihar and Uttar Pradesh.

Mode of Payment

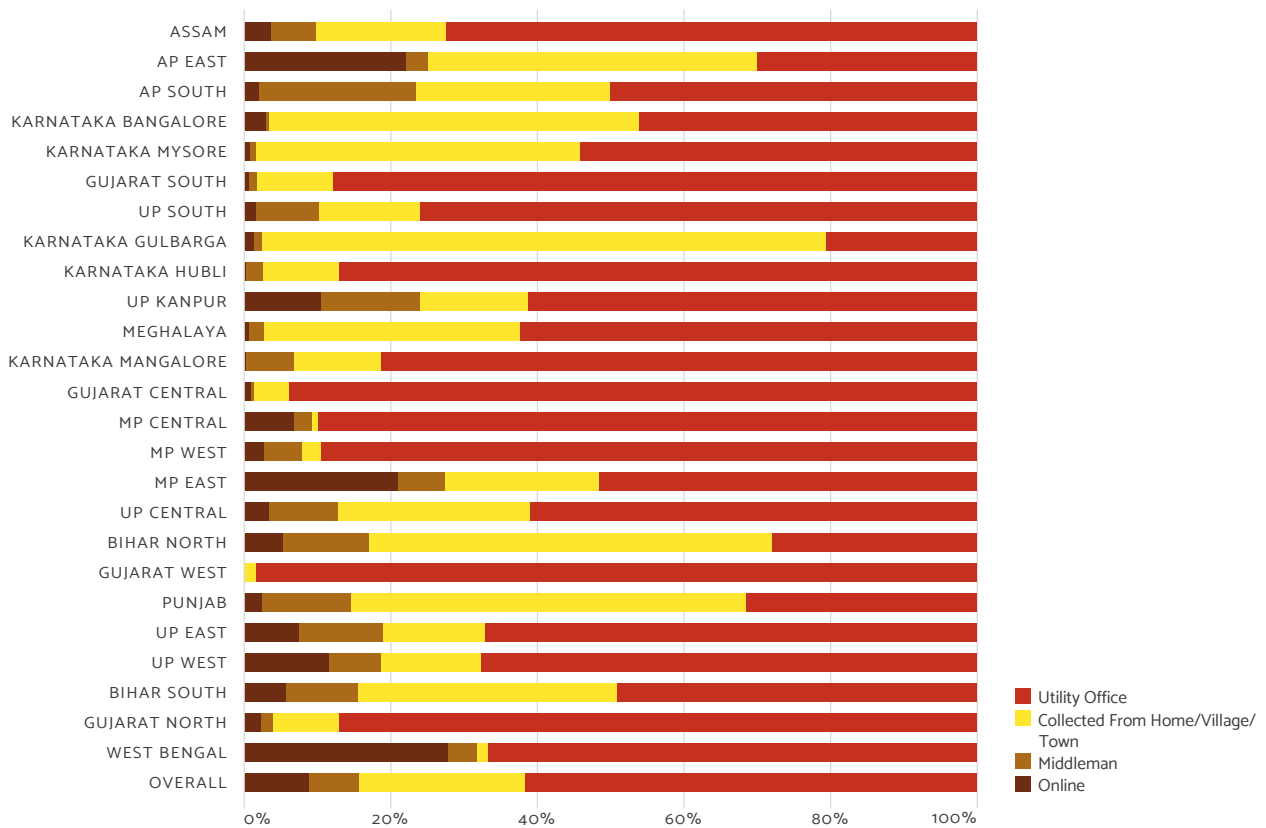
Mode of payment for electricity bills is another important customer service indicator. Survey responses indicate that there is scope for the distribution utilities to smoothen and strengthen the process, including by raising awareness among customers regarding digital literacy and online payment options.

For example, the largest percentage of customers – close to 80% across all categories – pay their electricity bills to an official bill collector, either at the electricity board office or at home. The percentage of customers paying bills online is much smaller and varies by customer category, from 8% to 13%, as shown in Figure 2-31. Around 7% to 8% of customers in all four categories still pay their bills through middlemen or agents. Figure 2-32 shows the percentage of customers at each utility using the different modes of payment.

For efficient collection of fees, it is essential to establish more customized and automated user-friendly systems. Such systems could unburden the distribution utilities from the need to hire and appoint dedicated staff to collect fees physically. There would be indirect effects on the cost of electricity access as well.

Another focus group discussion conducted in Uttar Pradesh revealed that the power supply situation had improved, but that new connection fees are still high and customers prefer to receive an aggregated power bill.

Figure 2-32: Percentage of customers using different modes of payment, by distribution utility



Results of interest (Figure 2-32):

- ▶ Rural and urban customers were found to differ significantly in terms of the proportion of customers paying bills online.²⁴
- ▶ Overall, 7% of customers reported paying electricity bills through informal or unofficial modes of payment.
- ▶ Informal or unofficial modes of payment are most prevalent among customers in Bihar and Uttar Pradesh.

▶ However, the largest percentage of customers making bill payments through unofficial agents or informal channels like middlemen or agents – 22% – were customers connected to the AP South distribution utility.

Complaint Management (Availability of Dedicated Maintenance Staff)

The availability of dedicated maintenance staff for customers to reach out to in case of any complaint is another indicator of customer

“ Pehle paisa yahin gaon main hi jama hota tha and bijli board wale sarpanch ya post office main payment collect karte the par ab woh bhi band ho gaya hai and ab sabko kaafi dur Virpur main jaana padta hai.”

(Previously there was a collection centre in the village and the electricity board official used to collect at the sarpanch office and post office, but now they have stopped, so villagers have to go to Virpur, which is far away.)

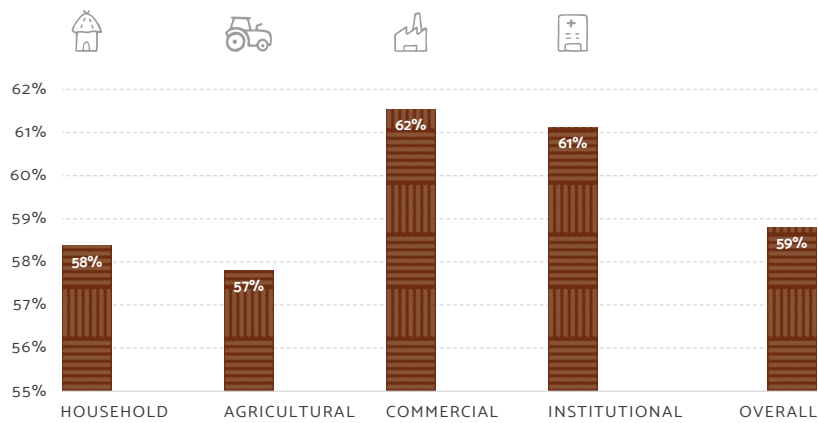
– Customer in Village Saradiya, Kheda, Gujarat, India

“ Due to the high overhead costs of hiring a full-time employee and the corresponding long process to hire permanent staff, over a thousand posts are currently vacant. This results in pressure on existing employees as well as negative impacts on operations. Local utility offices require substantial amounts of staff, and the utility hiring process must be simplified and accelerated.”

– Senior official, APEPDCL (AP East)

²⁴ Results from a two-sample test for equality of proportions using online bill payment among rural and urban customers (X-squared = 7.0836, df = 1, p value = 0.007779) rejected the null hypothesis and concluded that the two groups differed significantly.

Figure 2-33: Availability of dedicated maintenance staff for complaint resolution, by customer category



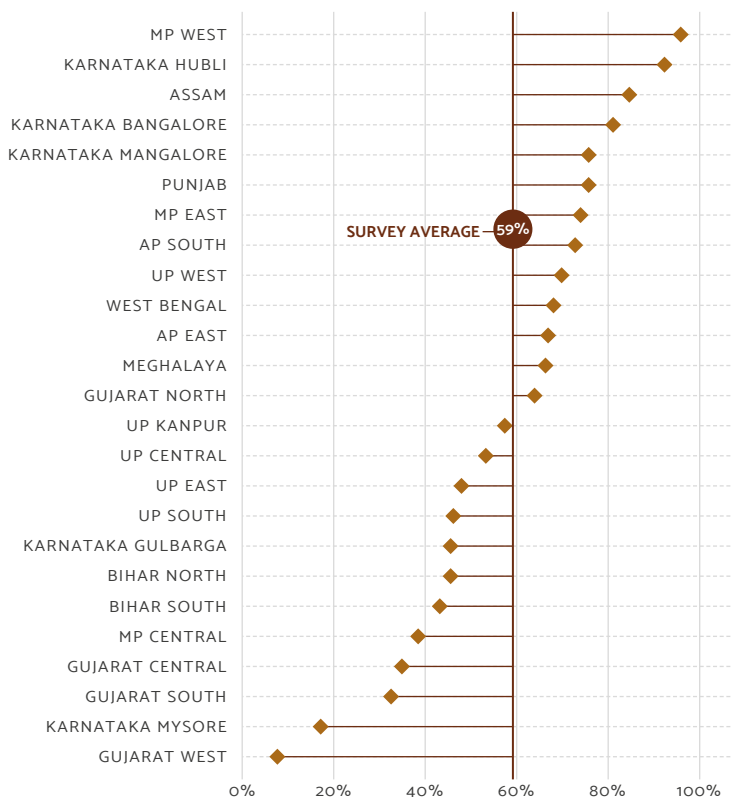
services. Across all customer categories, close to 60% of surveyed customers affirmed availability of maintenance staff to reach out to in case of any complaint. The percentage of commercial and institutional customers who reported availability of dedicated maintenance staff exceeded the reports by household and agricultural customers by around 3% (see Figure 2-33). During the focus group discussions, customers pointed out that some distribution utilities have taken steps such as providing a national customer helpline, easing the new connection process, and reducing the number and complexity of documents required to apply for a new connection. Similarly, IT

initiatives have been undertaken for other services (e.g., complaint redressal, shifting of connection). Despite the initiatives, however, complaint resolution remains a challenge for many utilities and states (e.g., Bihar, Uttar Pradesh). Often the customer helpline is not operational or is not answered, and utilities' customer care staff or local office staff are not responsive enough at most of the utilities. Customers also face issues dealing with customer service staff.

Results of interest (Figure 2-34):

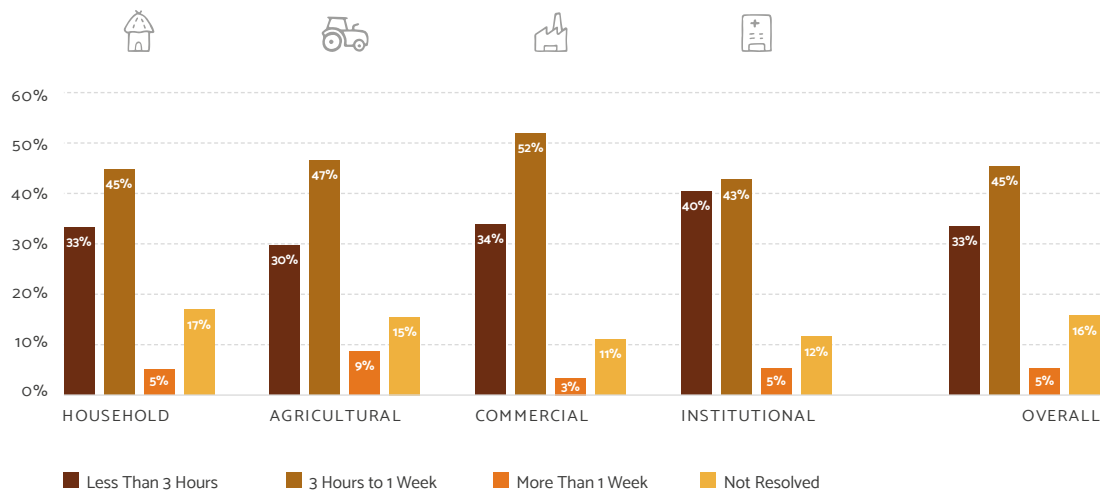
- ▶ As shown in Figure 2-34, the distribution utilities varied significantly in terms of staff capacity, for all customer categories.

Figure 2-34: Availability of dedicated maintenance staff for complaint resolution, by distribution utility



Customers participating in a focus group discussion in Punjab reported awareness of subsidies provided for agricultural customers as well as challenges around water levels. However, they also reported challenges around customer services and complaint resolution.

Figure 2-35: Time taken to resolve a customer complaint over the past one year, by customer category



- ▶ Two distribution utilities – MP West (94.6%) and Karnataka Hubli (93%) – had the highest percentage of household customers confirming availability of maintenance staff.
- ▶ When comparing the percentage of customers reporting availability of maintenance staff, the two distribution utilities with the smallest percentages in all four categories were Karnataka Mysore and Gujarat West.

Complaint Management (Time to Resolution)

Every electricity distribution utility has Standards of Performance defined by the State Electricity Regulatory Commission, which sets the standards to be met for customer services. Although different types of complaints and problems have different timelines, most common complaints should typically be resolved within a few hours or at most a day. The survey asked customers to recall the time taken to resolve complaints over the past 1 year. Figure 2-35 shows the results by customer category.

Results of interest, by customer category (Figure 2-35):

- ▶ Overall, 33% of customer complaints were resolved within 3 hours.
- ▶ Commercial and institutional customers were most likely to have their complaint resolved quickly.
- ▶ The percentage of institutional customers reporting that their complaint was resolved within 3 hours was higher than in the other three customer categories.
- ▶ Around 16% of household customers, 7% of agricultural customers, 10% of commercial customers, and 8% of institutional customers reported that complaints filed during the past 1 year had not been resolved.

- ▶ As revealed during focus group discussions, though some distribution utilities have taken steps such as providing a national customer helpline, easing the new connection process, and implementing IT initiatives for other services (e.g., complaint redressal, shifting of connection), many utilities (e.g. Bihar, UP) still face challenges with the complaint resolution process. Often the customer helpline is not working or is not answered, and the utility customer care staff or local office does not answer the calls as well as when the customer contacts a call centre or dedicated complaint helpline.

Results of interest, by distribution utility (Figure 2-36):

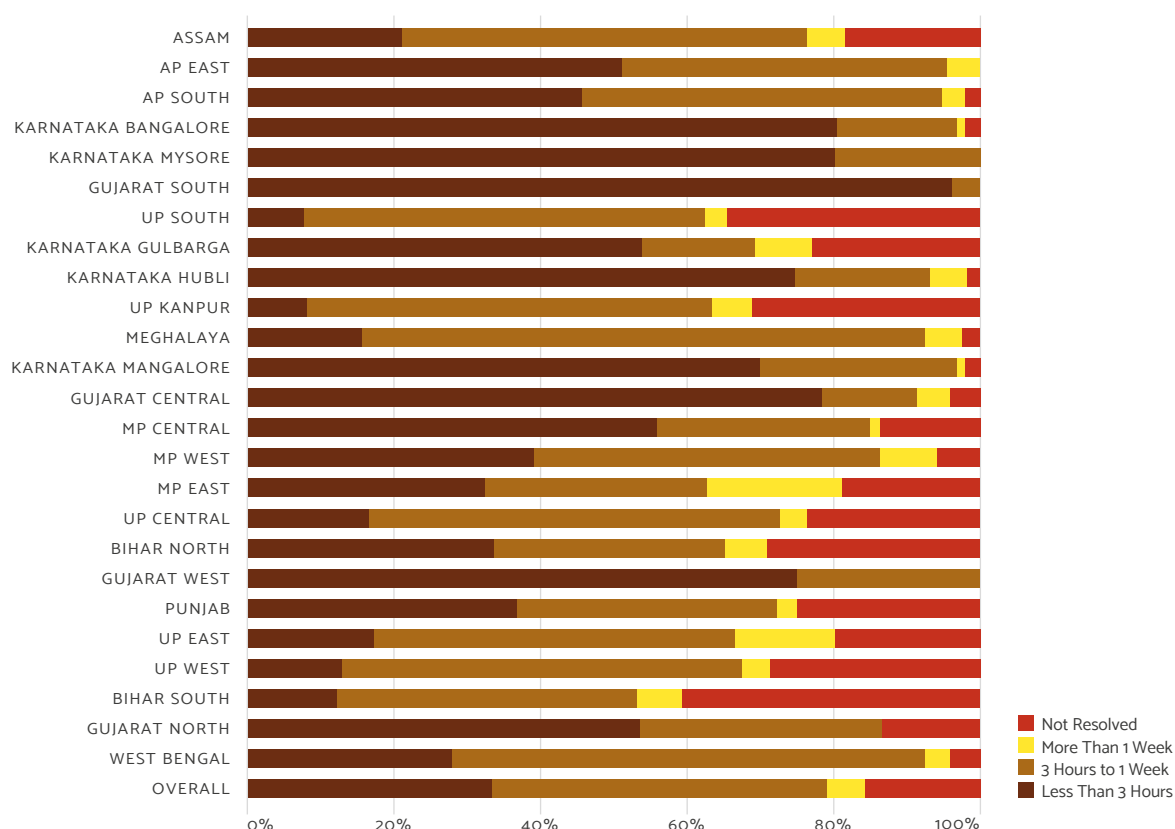
- ▶ In the household category, the Karnataka Mysore distribution utility stands out among all distribution utilities for responding to and resolving all maintenance-related complaints by household customers. Nearly three quarters of household customers (71%)

“ Electricity office waise toh current ka complaint karne par kabhi phone nahi uthata ya kisi ko nahi bhejta but agar chori ka koi complaint aa jaye toh hathi ghoda jeep sab leke pahunch jaata hai.”

(The electricity office does not answer phone calls or send anyone out on a complaint regarding poor supply. But if there is a complaint regarding electricity theft, then they arrive quickly armed with all tools and equipment.)

– Commercial customer, Village Sirama Patna, Paschim Medinipur, West Bengal, India

Figure 2-36: Time taken to resolve a complaint in the past one year, by distribution utility



reported that their complaints over the past 1 year were resolved in less than 3 hours.

- ▶ In the agricultural category, Gujarat West and Gujarat South top the list, for resolving 100% (Gujarat West) and 80% (Gujarat South) agricultural customers' complaints for the past 1 year within 3 hours.
- ▶ In the commercial category, the three distribution utilities from Karnataka – Karnataka Hubli (100%), Karnataka Gulbarga (100%), and Karnataka Bangalore (88%) – perform more efficiently than any other distribution utility.
- ▶ In the institutional category, Karnataka Mysore, Gujarat Central, and MP Central all have 100% of institutional customers responding that the complaint resolution time was “within 3 hours.”
- ▶ A majority of institutional customers from UP Kanpur (57%), Bihar North (55%), and Gujarat North (55%) reported that they are still waiting for their complaints, filed in the past 1 year, to be resolved.

Given the patterns of non-resolved complaints, it is imperative that electricity distribution utilities enhance their institutional capacity. Sustainability of electricity access cannot be ensured in the absence of appropriate systems for redressing consumer complaints.

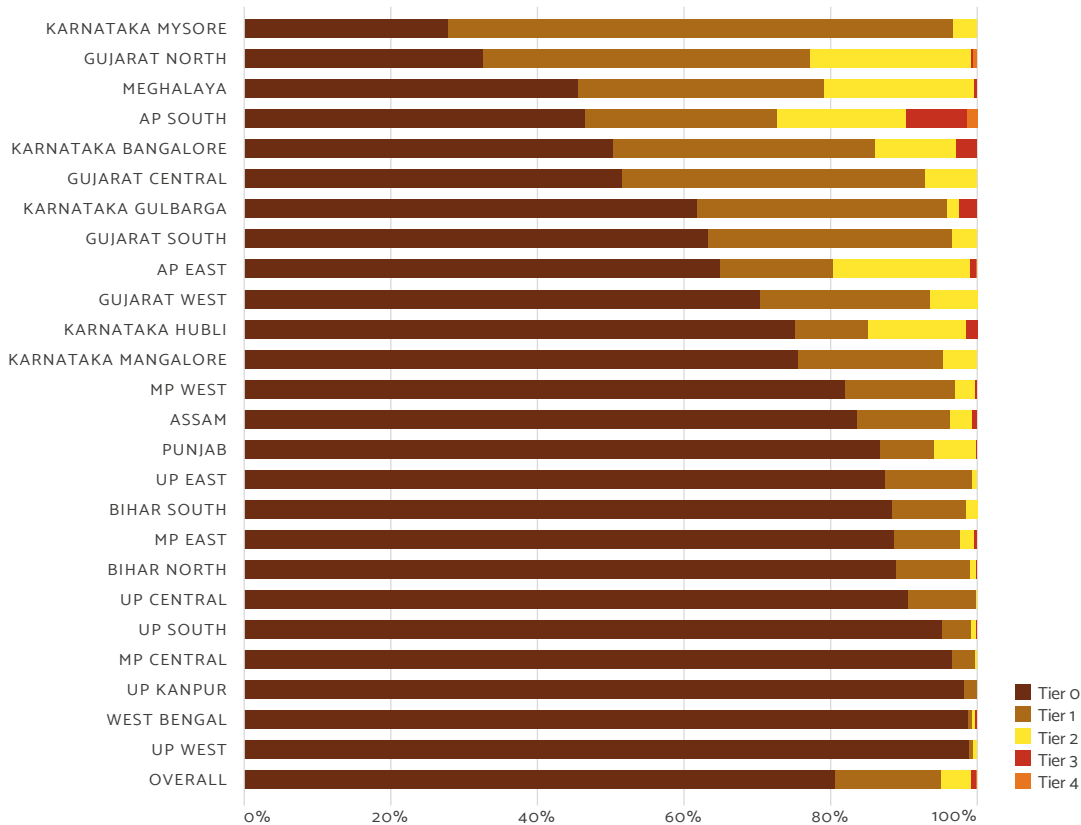
Throughout this section, each of the various dimensions of sustainability of electricity access were described separately. However, sustainability is built on the interaction of the multiple underlying factors. The next section provides a more comprehensive look at sustainability by aggregating the various access indicators and parameters through an overall access index based on the MTF-I. This enables comparison among utilities and identifies utilities which have been able to perform well overall.

State of Electricity Access: Performance Summary

This section uses the MTF-I to present a summary of the 25 utilities' performance on various dimensions of electricity access. Three types of performance indicators were developed: (a) a unique tier allocation for each customer, (b) an overall access index score for each customer category, and (c) an overall access index score for each distribution utility.

At the end of the section, summary notes on electricity access are provided for each state, and Table 2-10 lists the key challenges

Figure 2-37: Tier distribution of all customers combined, by distribution utility



customers in all categories face in obtaining sustainable access to electricity. This information provides the necessary information to incorporate into strategy and policymaking in terms of providing more sustainable electricity access to each tier of customers and providing worse-performing utilities with key learnings from the top-performing utilities to emulate.

Performance Indicators

Unique Tier Allocation for Each Customer

This report uses the MTF-I, which has a total of five tiers. Thus a “tier” is an ordinal variable varying from zero to four. A customer assigned Tier 0 has the least degree of electricity access, while a customer assigned Tier 4 has the highest degree of electricity access.

In each tier, all dimensions of access are assigned equal weights. Customers are thus assigned an overall tier based on the lowest tier assigned across all dimensions. These tier assignments provide information on the relative tier-specific distribution of customers across states and utilities, and thus support a comprehensive composite understanding of electricity access.

The definition and formulation of MTF-I used in the context of this report, along with detailed notes on the process of allocating customers to tiers and calculating access index scores for utilities, are provided in Appendix.

Overall Access Index Score for Each Customer Category

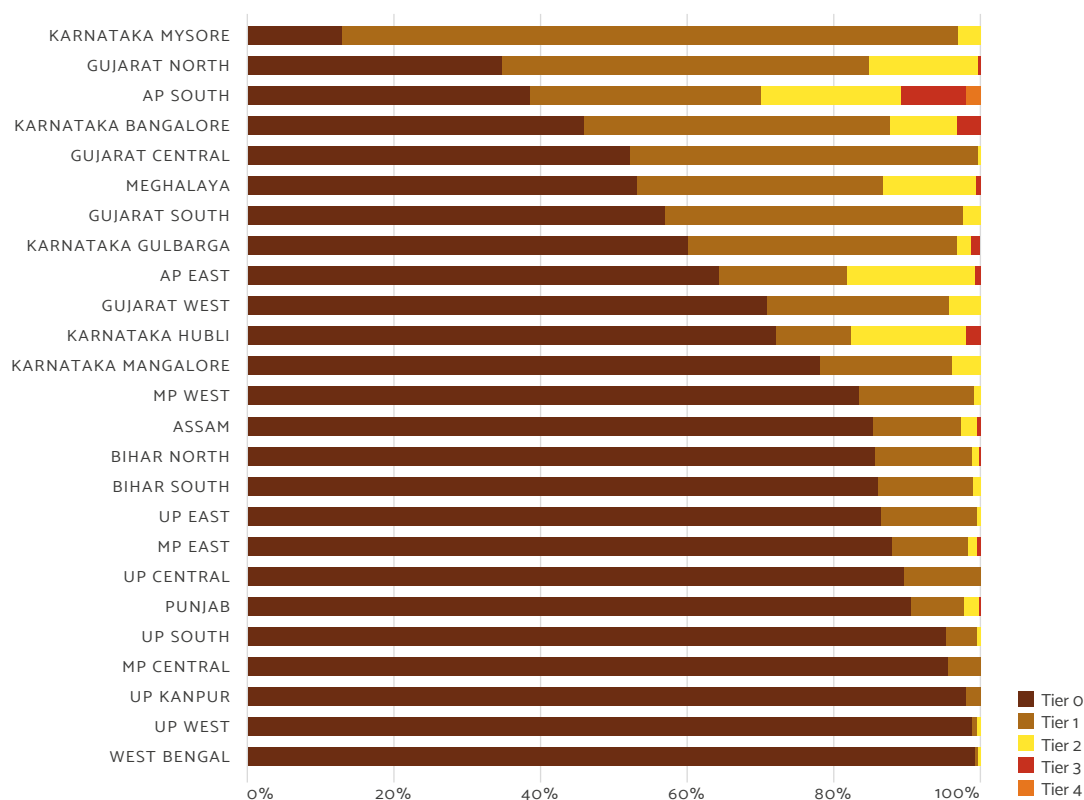
After the tier assignments for each customer were completed, an overall access index score was calculated for each customer category. This score is based on the proportion of the customers in each tier within that category.

Overall Access Index Score for Each Distribution Utility

After the tier assignments for each customer were completed, an overall access index score was calculated for each utility. This score considers two components: (a) the proportion of the utility’s customers in each tier, and (b) the overall level of access provided, by weighting the utility’s customers based on their tier position.

The values of the overall access index scores should be interpreted in relative terms, to compare one utility with another. For example: an access index score between 0

Figure 2-38: Tier distribution of household customers, by distribution utility



and 25 indicates that the majority of the utility’s customers are still at lower tiers of access, while a score of 75 to 100 indicates that most customers are at higher tiers of access.

The next sections of this chapter discuss access index findings by customer category and then by electricity distribution utility. Findings are discussed based on customers’ unique tier allocations, which reflect a comprehensive composite understanding of sustainable access to electricity.

lower percentage of Tier 0 customers than the survey average.²⁵

Among all utilities, Karnataka Mysore had the lowest percentage of household and institutional customers in Tier 0, which indicates comparatively better performance in terms of composite and sustainable access to electricity.

Customer distributions by customer category, utility, and tier level are presented in Figure 2-38, Figure 2-39, Figure 2-40, and Figure 2-41.

Summary of Unique Tier Allocation by Customer Category and Distribution Utility

As shown in Figure 2-37, the percentage of customers at Tier 0 is large across all utilities, probably due to the inclusion of customer service parameters into the MTF-I. Around 81% of customers overall are still waiting to move from Tier 0 into the upper tiers of electricity access. Only five utilities – Karnataka Bangalore, AP South, Meghalaya, Gujarat North, and Karnataka Mysore – had 50% or more of their customers above Tier 0. In other words, only four states – Andhra Pradesh, Karnataka, Gujarat, and Meghalaya – had a



25 Figures used for comparison as the survey average are taken from the aggregate or average of the 10 states surveyed during this study.

Figure 2-39: Tier distribution of agricultural customers, by distribution utility

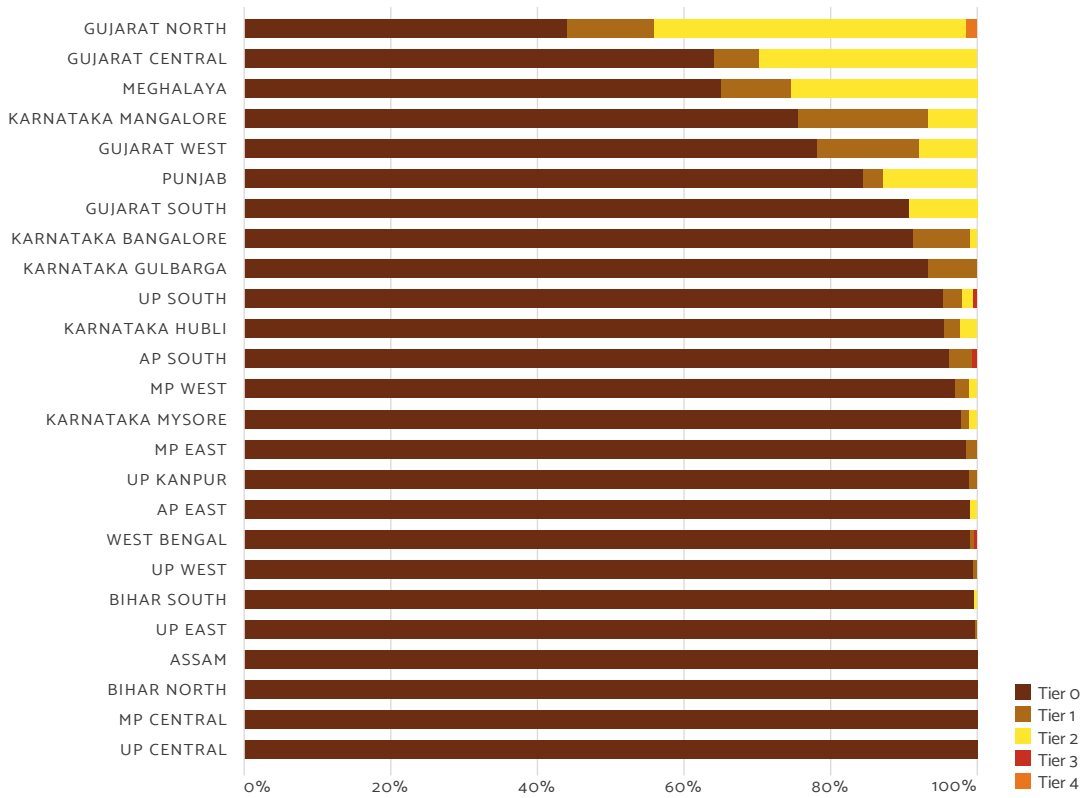


Figure 2-40: Tier distribution of commercial customers, by distribution utility

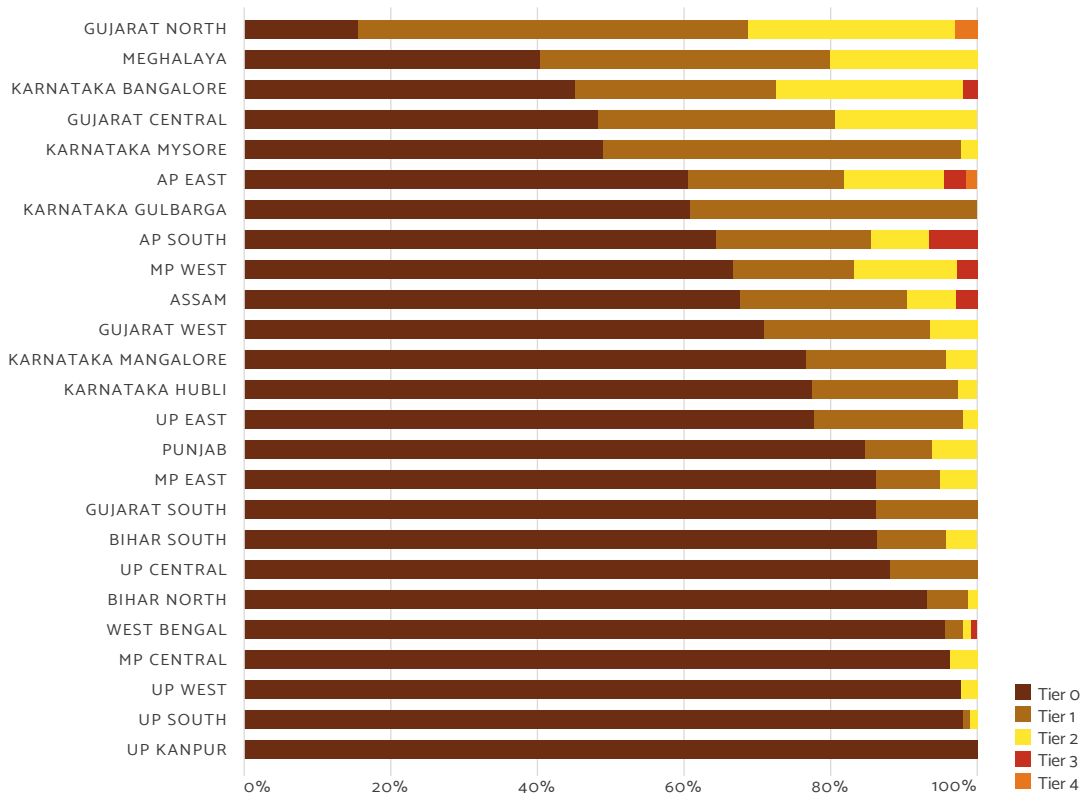
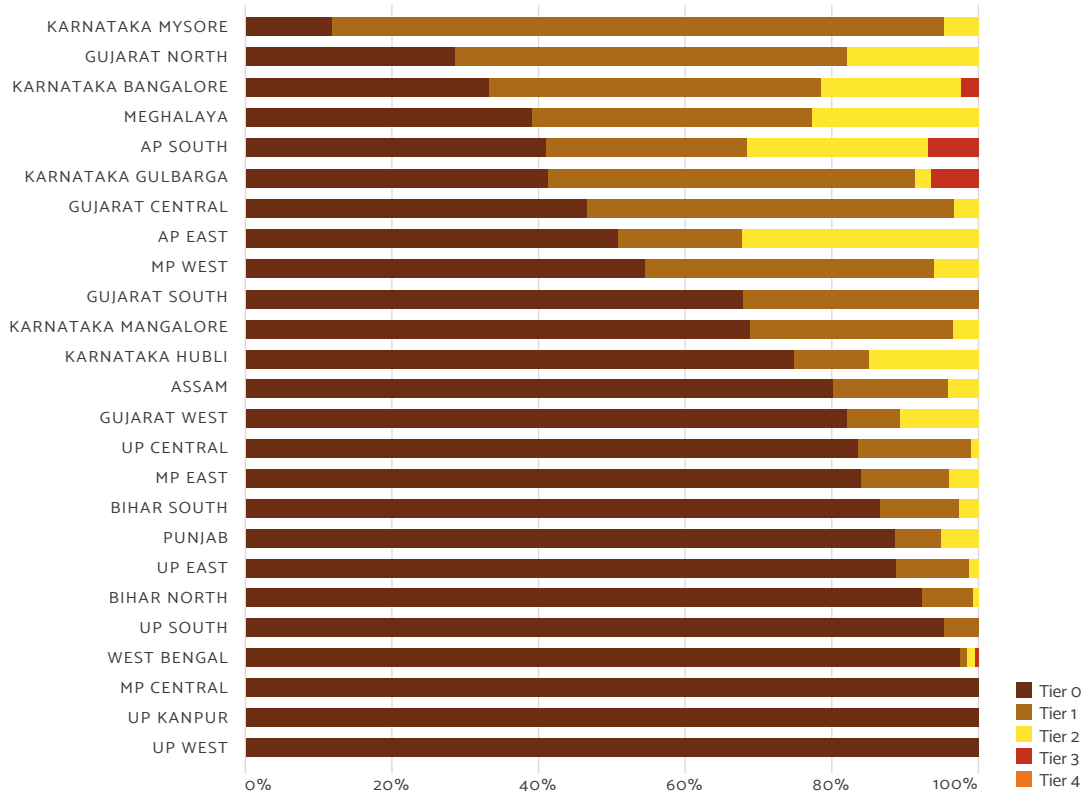


Figure 2-41: Tier distribution of institutional customers, by distribution utility



Summary of Access Index Scores by Customer Category

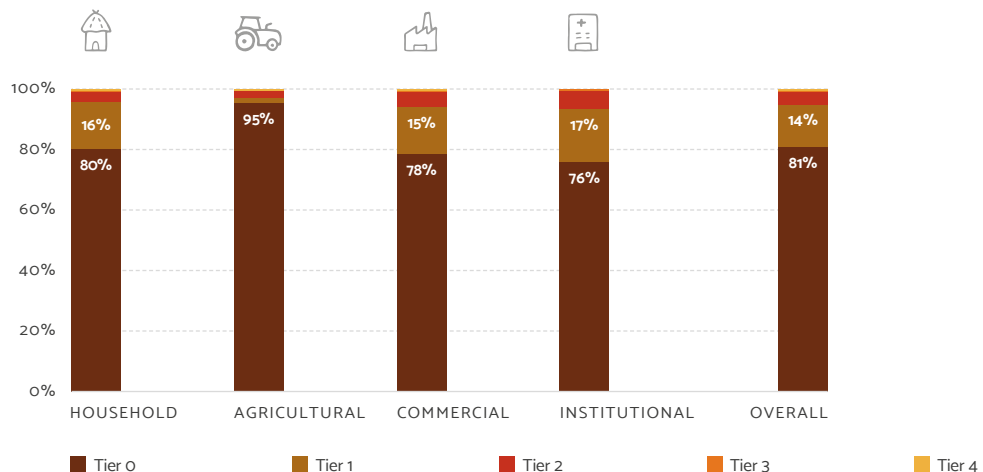
Figure 2-42 shows the percentages of total surveyed customers in each category in the different tiers of access. Cross-category findings reveal that customers' overall access index scores range from 65 to 67 on a scale of 0 to 100.

The agricultural category holds the largest percentage of Tier 0 customers, with a very large difference between the percentage

of agricultural customers at Tier 0 and the percentage of all electricity customers in Tier 0.

In each customer category, the three major issues preventing sustainable access to electricity are low capacity, low availability (duration), and low reliability. An access deficit²⁶ of more than 30% was observed in all customer categories, with no significant difference observed between categories in terms of the overall access index score (Table 2-6).

Figure 2-42: Tier distribution of customers, by customer category



26 For this subsection, access deficit is calculated as 100% minus the overall access index score (on its scale of 0 to 100).

Table 2-7: Access index scores of distribution utilities, by customer category and overall

Power distribution utility	Access index scores				
	Household	Agricultural	Commercial	Institutional	Overall
AP East	76	59	73	75	71
AP South	82	66	77	77	76
Assam	67	50	67	63	62
Bihar North	62	55	59	56	58
Bihar South	58	51	58	55	56
Gujarat Central	78	66	81	82	77
Gujarat North	81	72	82	81	79
Gujarat South	74	57	76	76	71
Gujarat West	82	63	77	75	74
Karnataka Bangalore	73	68	75	77	73
Karnataka Gulbarga	67	55	70	72	66
Karnataka Hubli	70	62	69	67	67
Karnataka Mangalore	70	63	65	67	66
Karnataka Mysore	73	58	68	75	69
Meghalaya	65	54	66	70	64
MP Central	66	50	69	61	62
MP East	68	58	65	69	65
MP West	70	57	75	77	70
Punjab	68	60	68	66	66
UP Central	60	54	57	59	58
UP East	61	54	57	53	56
UP Kanpur	59	54	60	57	58
UP South	59	53	52	51	54
UP West	64	52	59	54	57
West Bengal	67	57	63	67	64
Average	67	66	65	66	

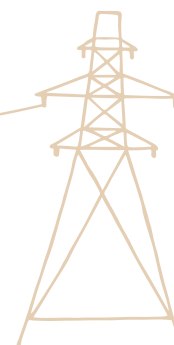


Table 2-8: Distribution of utilities with respect to median value of overall access index score

Utilities with overall access index scores below median	Utilities with overall access index scores at median	Utilities with overall access index scores above median
UP South	Punjab	Karnataka Hubli
Bihar South	Karnataka Gulbarga	Karnataka Mysore
UP East	Karnataka Mangalore	MP West
UP West		AP East
UP Central		Gujarat South
UP Kanpur		Karnataka Bangalore
Bihar North		Gujarat West
MP Central		AP South
Assam		Gujarat Central
West Bengal		Gujarat North
Meghalaya		
MP East		

Summary of Access Index Scores by Distribution Utility

Access indices by utility were calculated at two levels: (a) an access index score for each distribution utility in each customer category, and (b) an overall access index score for each utility.

Table 2-7 provides utilities' access index scores at both levels: the last column of the table presents each utility's overall access index score, which was calculated by averaging the scores of all four customer categories. A detailed description of how access index scores are derived is provided in Appendix 2.4.

Overall access index scores vary from 54 to 79 across the surveyed distribution utilities. Table 2-8 presents the distribution of utilities based on the median overall access index score.

Figure 2-43 displays the proportion of utilities above, below, and at median access index score both overall and by customer category. The distribution is the same for household and commercial categories, while the institutional category has the highest proportion of utilities with access index scores above the median.

Key Challenges to Sustainable Access

The findings from the access indices and percentages of customers at different tiers provide details on which key challenges to sustainable access to electricity are still to be addressed in each state. Table 2-9 summarizes the challenges state by state and compares the issues faced by customers in each category in that state.

Figure 2-43: Percentage of utilities by access index scores, by customer category

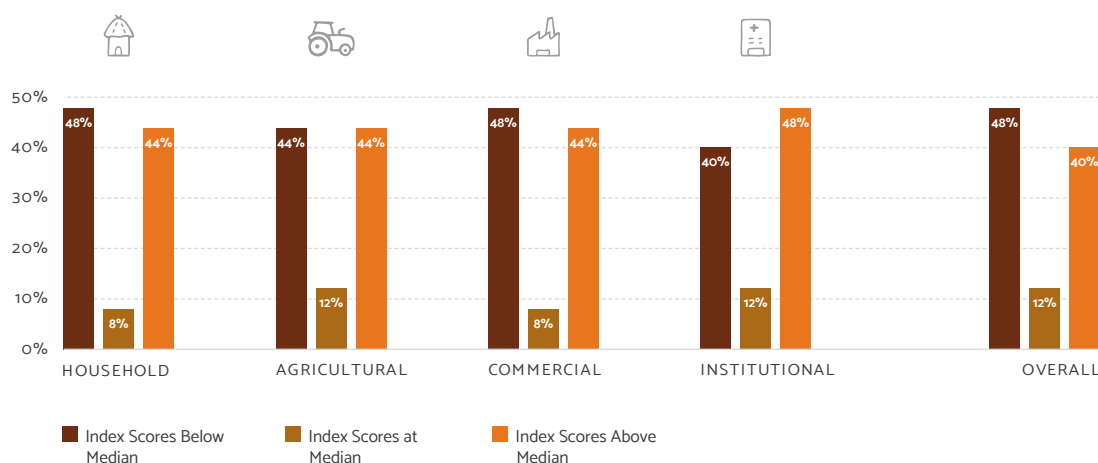


Table 2-9: Key challenges to achieving sustainable access to electricity, by state and customer category

State	Household	Agricultural	Commercial	Institutional
Andhra Pradesh	Unscheduled power cuts (East), capacity	Unscheduled power cuts, capacity, complaint resolution time (East)	Capacity (East), unscheduled power cuts	Unscheduled power cuts, capacity
Assam	Unscheduled power cuts, capacity, duration, complaint resolution time	Very high frequency of unscheduled power cuts, very low capacity, complaint resolution time	Unscheduled power cuts	Unscheduled power cuts, capacity, duration
Bihar	Unscheduled power cuts, capacity, duration	Complaint resolution time (South), low capacity, unscheduled power cuts	High frequency of unscheduled power cuts, duration, capacity, complaint resolution time	Complaint resolution time (North), unscheduled power cuts, capacity, duration
Gujarat	Billing frequency, capacity, unscheduled power cuts	Unscheduled power cuts, capacity (South, West)	Very low capacity (South)	Unscheduled power cuts (South, West), capacity (South, Central), billing frequency (South, West), complaint resolution time (North)
Karnataka	Unscheduled power cuts (Mangalore), capacity, duration	Unscheduled power cuts (Mysore), unmetered connections (Gulbarga)	Unscheduled power cuts (except Mysore), duration (except Bangalore and Hubli), capacity (Gulbarga)	Complaint resolution time (Gulbarga), unscheduled power cuts, capacity, duration
Madhya Pradesh	High frequency of unscheduled power cuts, capacity, complaint resolution time	Unmetered connection and billing frequency (Central), capacity, unscheduled power cuts, complaint resolution time	High frequency of unscheduled power cuts, duration, complaint resolution time	Very low capacity, unscheduled power cuts
Meghalaya	Low capacity, duration	Very low capacity, complaint resolution time, billing frequency	Low capacity, duration	Low capacity, duration, maintenance staff
Punjab	Unscheduled power cuts, complaint resolution time	Unscheduled power cuts, billing frequency	Unscheduled power cuts, billing frequency	Unscheduled power cuts, duration
Uttar Pradesh	High frequency of unscheduled power cuts, duration, capacity, complaint resolution time	Unscheduled power cuts, complaint resolution time, Unmetered connection, capacity	High frequency of unscheduled power cuts, duration, capacity, complaint resolution time	Complaint resolution time (Kanpur, South), billing frequency (Kanpur), unscheduled power cuts, duration, very low capacity
West Bengal	High frequency of unscheduled power cut, capacity, billing frequency	Unscheduled power cuts, capacity, complaint resolution time, billing frequency	Unscheduled power cuts, billing frequency, capacity	Very low capacity, unscheduled power cuts, billing frequency



State-by-State Summary of State of Electricity Access

Andhra Pradesh: The two distribution utilities in Andhra Pradesh – AP East and AP South – have higher access index scores than the average of the surveyed utilities²⁷ in all four customer categories. The significant difference between the two was observed in the household and agricultural categories. AP South is among the top five performers across all 25 surveyed distribution utilities.

Assam: The utility at Assam has an overall access deficit of 23%. For this utility, all customer categories other than agricultural have access index scores close to the survey average. Among agricultural customers, the access deficit is 16% higher than the survey average.

Bihar: Both utilities in this state, Bihar North and Bihar South, are in the bottom five performers in all four customer categories on supplying sustainable electricity access. North Bihar has an access index score for agricultural customers that is close to the survey average and significantly higher than the score at Bihar South. In the other three customer categories, both utilities have scores significantly lower than the survey average.

Gujarat: Gujarat North is a top performer in terms of the access index, with scores significantly higher than the survey average in all four customer categories. Gujarat Central and Gujarat West also have a place in the top five performers in terms of access.

Karnataka: Out of the five utilities in Karnataka, Karnataka Bangalore has been most successful at providing more sustainable access to electricity. With the exception of Karnataka Gulbarga, the other four utilities in the state have access index scores equal to or more than the survey average in all four customer categories.

Meghalaya: Meghalaya records more access deficits for agricultural customers than for customers in the other three categories. In all four categories, low capacity and low duration of power availability seem to be the two key challenges.

Madhya Pradesh: Out of the three utilities in Madhya Pradesh, MP West stands out on access, with access index scores significantly higher than those at MP East and MP Central. However, all three utilities have lower access index scores than the survey average for agricultural customers, and there is very high variation among customer categories in terms

of composite access. This is also evident in the overall access index scores, which vary from 56 to 77 across the state.

Punjab: The utility at Punjab performs poorly on access indicators for institutional customers compared to the other customer categories. In all four categories, Punjab has less access deficit than the survey average. However, the problem of unscheduled power cuts pervades through all four customer categories, and billing frequency turns out to be a major bottleneck in providing sustainable composite access to agricultural and commercial customers.

Uttar Pradesh: All five utilities from Uttar Pradesh are among the poorest performers on access indicators. Customers from the household and commercial categories face high frequencies of unscheduled power cuts. Complaint resolution time is another challenge to overcome for all utilities in all four categories. All five utilities have access index scores lower than the survey average for all four customer categories. UP West and UP Kanpur scored significantly higher on the access index for agricultural customers compared to the other three distribution utilities. However, the state overall has close to 40% access deficits in all four categories.

West Bengal: The distribution utility in West Bengal has significantly lower access index scores than the survey average in all four categories. It reports more than 30% access deficits in terms of composite access, in all four customer categories.

This section provides a new understanding and evaluation of distribution utilities' performance on providing sustainable access to electricity. The next task is to understand customers' levels of satisfaction at these levels of performance. Chapter 3 thus discusses survey findings regarding customers' level of satisfaction with their access to electricity. This knowledge will enable managers and policymakers to design recommendations for policies, operating practices, and other remedies for satisfying customer expectations.



27 Figures used for comparison as the survey average are taken from the aggregate or average of the 10 states surveyed during this study.

Landscape of Electricity Access Across States

Customer Satisfaction

URBAN

63%



66%

HOUSEHOLD



69%

COMMERCIAL

RURAL

75%



67%

AGRICULTURAL



71%

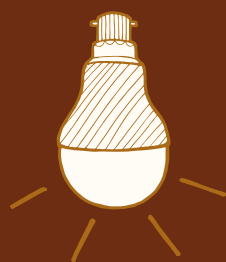
INSTITUTIONAL

State-wise

% Satisfied

AP	80
Assam	39
Bihar	66
Gujarat	91
Karnataka	80
Meghalaya	17
MP	73
Punjab	81
UP	60
West Bengal	54

Other customers either stated they were dissatisfied or they were neither satisfied nor dissatisfied



State of Access

Availability¹

URBAN

19.5



18.1

HOUSEHOLD



16.7

COMMERCIAL

RURAL

16.9



14.7

AGRICULTURAL



17.9

INSTITUTIONAL

Quality³

URBAN

48%



36%

HOUSEHOLD



41%

COMMERCIAL

RURAL

33%



38%

AGRICULTURAL



46%

INSTITUTIONAL

State of Connectivity

Availability Rate

URBAN

98%



97%

HOUSEHOLD



98%

COMMERCIAL

RURAL

90%



75%

AGRICULTURAL



97%

INSTITUTIONAL

Sources of Electricity



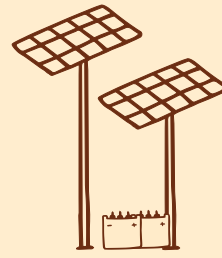
Grid

96%
HOUSEHOLD

91%
COMMERCIAL

52%
AGRICULTURAL

78%
INSTITUTIONAL



Non-Grid

4%
HOUSEHOLD

9%
COMMERCIAL

48%
AGRICULTURAL

22%
INSTITUTIONAL

Reliability²

URBAN

65%

RURAL

72%

71%
HOUSEHOLD

70%
COMMERCIAL

64%
AGRICULTURAL

62%
INSTITUTIONAL

Capacity⁴

URBAN

88%

RURAL

87%

92%
HOUSEHOLD

76%
COMMERCIAL

67%
AGRICULTURAL

78%
INSTITUTIONAL

State-wise Supply Hours Reliability Quality

State	Supply Hours	Reliability	Quality
AP	21.5	40%	70%
Assam	15.4	94%	35%
Bihar	16.5	89%	11%
Gujarat	21.8	17%	78%
Karnataka	18.1	72%	48%
Meghalaya	17.5	71%	24%
MP	18.8	65%	43%
Punjab	16.1	51%	48%
UP	14.6	71%	37%
West Bengal	21.0	91%	23%

1 Availability is measured in hours

2 Percentage of surveyed customers who reported 1 or more powercut/day during past 1 week

3 Percentage of surveyed customers who reported no voltage fluctuations in a day during past week

4 Low capacity connections denote the following for each customer category: Household and Commercial - 0-2 kW connected load, Agricultural - 0-5 hp, and Institutional - 0-5 kW

Hook-up Rate

URBAN

91%

RURAL

85%

99%
HOUSEHOLD

93%
COMMERCIAL

70%
AGRICULTURAL

91%
INSTITUTIONAL

Access Rate

URBAN

96%

RURAL

84%

96%
HOUSEHOLD

91%
COMMERCIAL

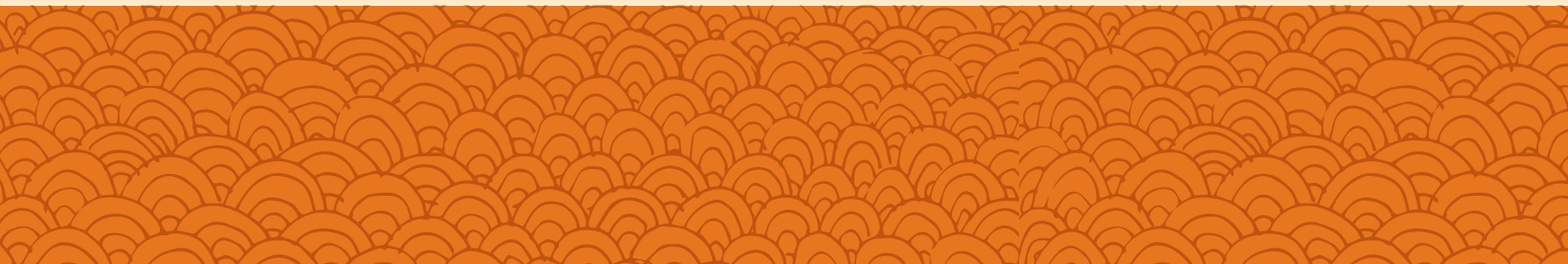
52%
AGRICULTURAL

78%
INSTITUTIONAL

State-wise Access Rate Rate %

State	Rate %
AP	79
Assam	77
Bihar	77
Gujarat	89
Karnataka	100
Meghalaya	83
MP	92
Punjab	99
UP	89
West Bengal	83

3



State of Customer Satisfaction

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State of Customer Satisfaction



In the electricity distribution business, the concept of customer centricity has been evolving. Over time, there has been an increasing realization that customers prefer their electricity purchase decisions to happen seamlessly, without much ado. Given this context, electricity distribution utilities (also known as distribution companies or DISCOMs) need to redefine what meaningful customer experience looks like and to understand the impact it is likely to have for their business.

One measure of the quality of customer experience delivered by a utility is customer satisfaction. Understanding the voice of the customer on different aspects of access will

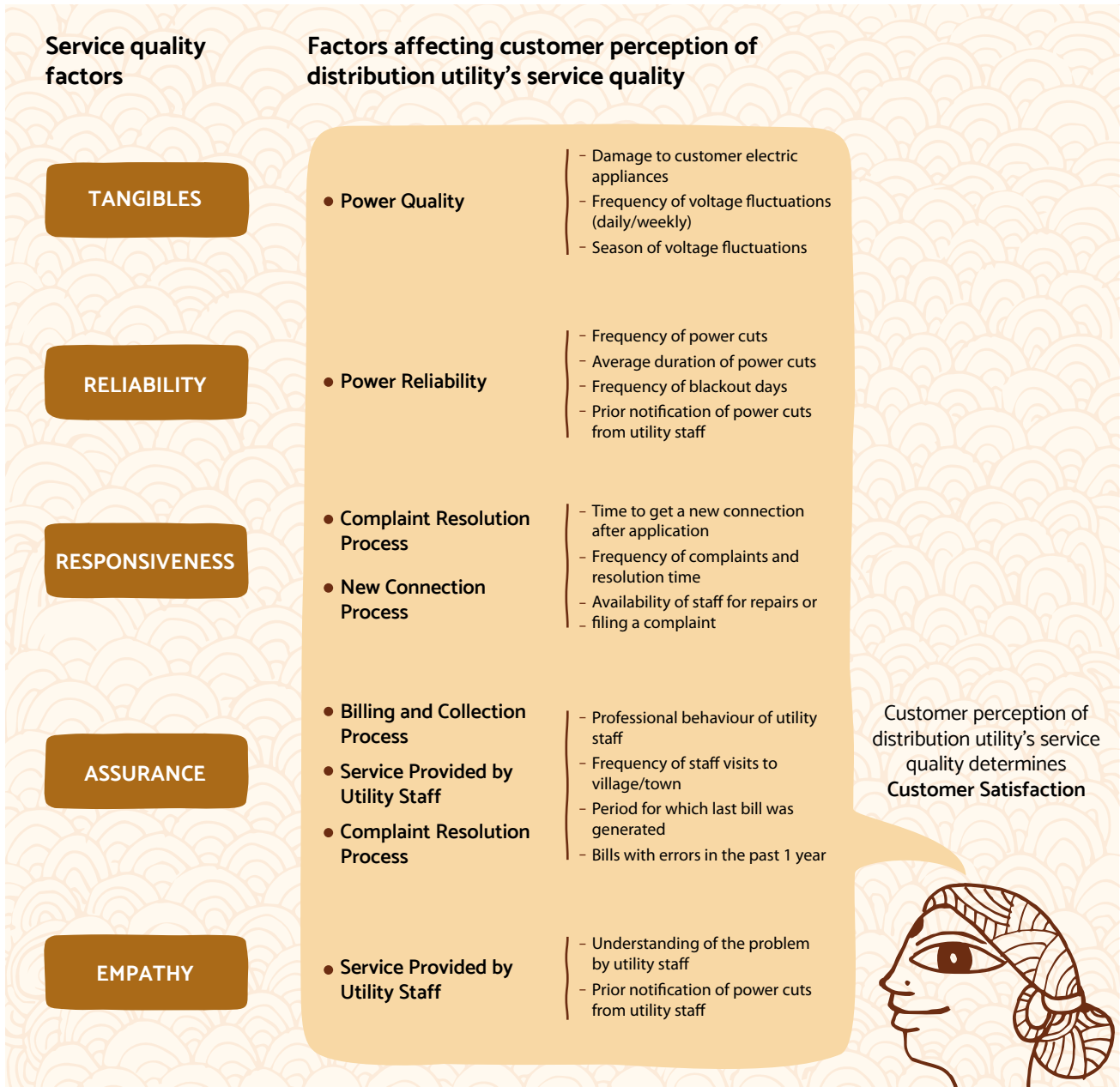
help to define clear priorities and targets. This understanding is vital to enabling utilities to use their resources optimally and potentially to enhance revenues and margins.

Customer Satisfaction

This section discusses the survey findings related to customer satisfaction²⁸ with the various distribution utilities. It also attempts to identify key drivers of customer satisfaction and to benchmark utility performance with respect to customer satisfaction. The framework shown in Figure 3-1 outlines the five service quality factors which drive

²⁸ A total of 87% of survey respondents (21,910 of the 25,000 surveyed) had access to a grid connection. However, the number of respondents who responded to each survey question related to customer satisfaction varied. The exact number of respondents will be provided where each relevant area of customer satisfaction is discussed.

Figure 3-1: Customer satisfaction and service quality framework for distribution utilities



customer satisfaction in a service industry and translate them into variables relevant to electricity distribution.

This study translates the drivers of customer satisfaction shown in Figure 3-1 – tangibles, reliability, responsiveness, assurance, and empathy – to the electricity distribution sector, while including multiple customer- and service-related metrics. As part of the customer survey, customer satisfaction was measured for the six dimensions of electricity service listed below:

- ▶ New connection process
- ▶ Power reliability
- ▶ Power quality
- ▶ Billing and collection process

- ▶ Complaint resolution process
- ▶ Service provided by utility staff

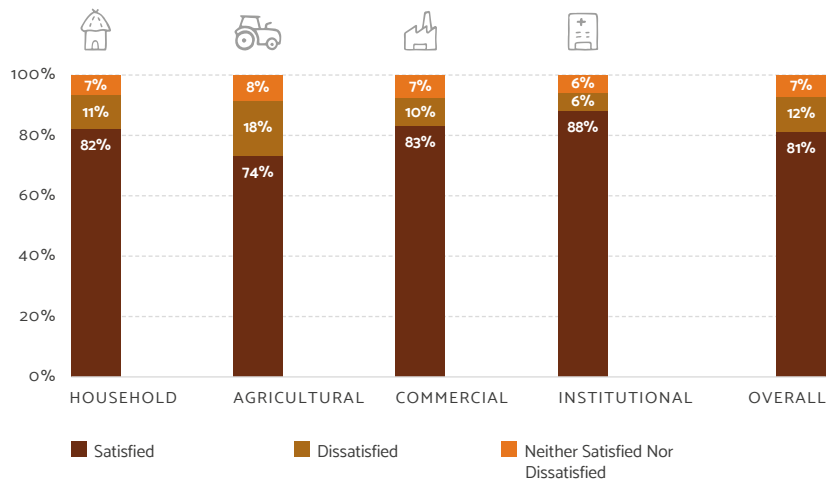
In addition, the study created a measure for overall service provided by the utility, created by aggregating the scores of all six individual dimensions. The following subsections present the findings for each dimension separately and then overall.

New Connection Process²⁹

For non-users of electricity to take a grid connection for the first time, a smooth and quick connection process is critical. It is important for this process to be seamless, especially for people in rural areas, where

29 This section's analysis is based on a sample size of 7,925 customers who responded to the question about new connections.

Figure 3-2: Customer satisfaction with the new connection process, by customer category



awareness about the new connection process may be limited. The survey found that a significant proportion of non-users of grid electricity cited complicated connection processes and paperwork as the reason for not accessing a connection to the grid. The survey results for customer satisfaction with regard to new connection processes are shown in Figure 3-2.

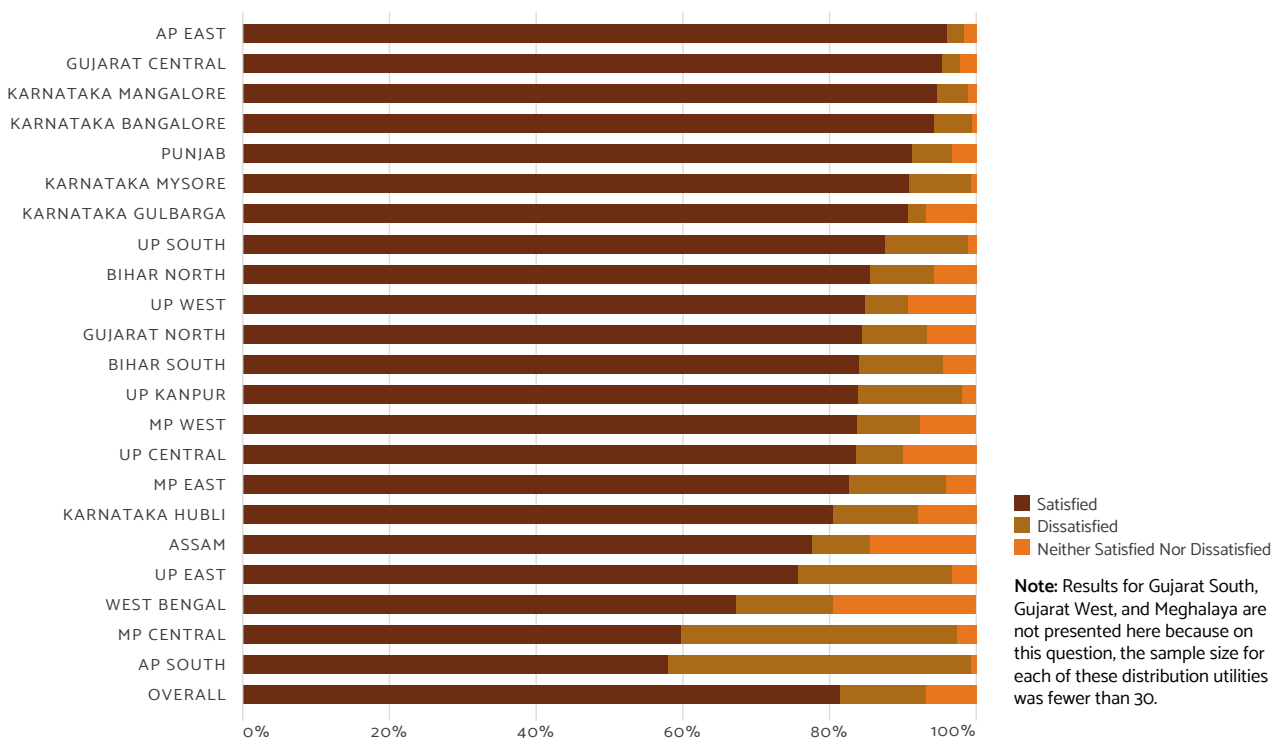
Results of interest (Figure 3-2):

- ▶ Overall, 81% of grid users were satisfied with the new connection process, with a slightly higher proportion of customers satisfied in urban areas (85%) than in rural areas (80%).
- ▶ Satisfaction and time taken to get a new connection was strongly related in both

rural and urban areas. However, there was little variation in satisfaction levels between rural and urban areas, perhaps because both time and satisfaction are very individual experiences.

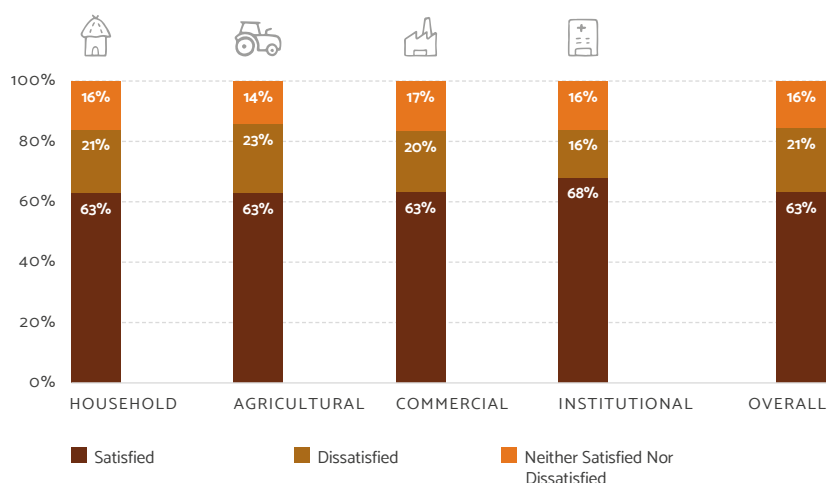
- ▶ Overall, the average time it took to get a new connection was much less among satisfied household customers (average 25 days) than dissatisfied customers (average 61 days). This trend was observed across customer categories.
- ▶ Across customer categories, satisfaction with the new connection process was highest among institutional customers (88%) and lowest among agricultural customers (73%). Time taken to get a new connection was highest for agricultural customers (average 74

Figure 3-3: Customer satisfaction with the new connection process, by distribution utility



Note: Results for Gujarat South, Gujarat West, and Meghalaya are not presented here because on this question, the sample size for each of these distribution utilities was fewer than 30.

Figure 3-4: Customer satisfaction with power reliability, by customer category



days) and lowest for institutional customers (average 27 days) and commercial customers (average 27 days). Satisfied agricultural customers stated that it took an average of 67 days to get a new connection, while among the dissatisfied agricultural customers, it took an average of 129 days.

- ▶ Satisfaction varied with socio-economic class among household customers and with land size among agricultural customers. Of the dissatisfied household customers, 75% are in the disadvantaged socio-economic class, while 65% of the dissatisfied agricultural customers have marginal or small land size.
- ▶ Satisfaction with the new connection process did not vary much between households with new connections³⁰ (83%) and older connections³¹ (82%). This indicates that there have been no recent improvements with regard to utilities' new connection processes.

Levels of customer satisfaction with the new connection process at each distribution utility are shown in Figure 3-3.

Results of interest (Figure 3-3):

- ▶ Customer satisfaction with the new connection process is highest for AP East at 96%, followed by Gujarat Central at 95%.
- ▶ Across all utilities, dissatisfaction among customers with regard to the new connection process is greatest in AP South at 41%, followed by MP Central at 38%.
- ▶ The disparities in customer satisfaction levels within the same state, Andhra Pradesh being a case in point, potentially point to two things: (1) Policies designed at the state level need to be adequately customized to meet intra-state contexts, because uniform policies

applied uniformly across all contexts may not succeed. (2) Lessons learned are not being adequately transferred across utilities to address similar problems.

Power Reliability³²

To harness the true potential of electricity for driving rapid economic growth and social development, reliability is critical. Many customers view reliability as a basic and core expectation that needs to be maintained. Where electric power is not reliable, customers will depend on alternate sources of energy.

Power reliability in this study is assessed in terms of number of power cuts and whether prior notification of upcoming power cuts is provided to customers. Figure 3-4 shows the percentage of surveyed customers in each customer category who were satisfied and dissatisfied. Figure 3-5 shows the percentage of satisfied and dissatisfied customers at each of the surveyed electricity distribution utilities.

Results of interest (Figure 3-4):

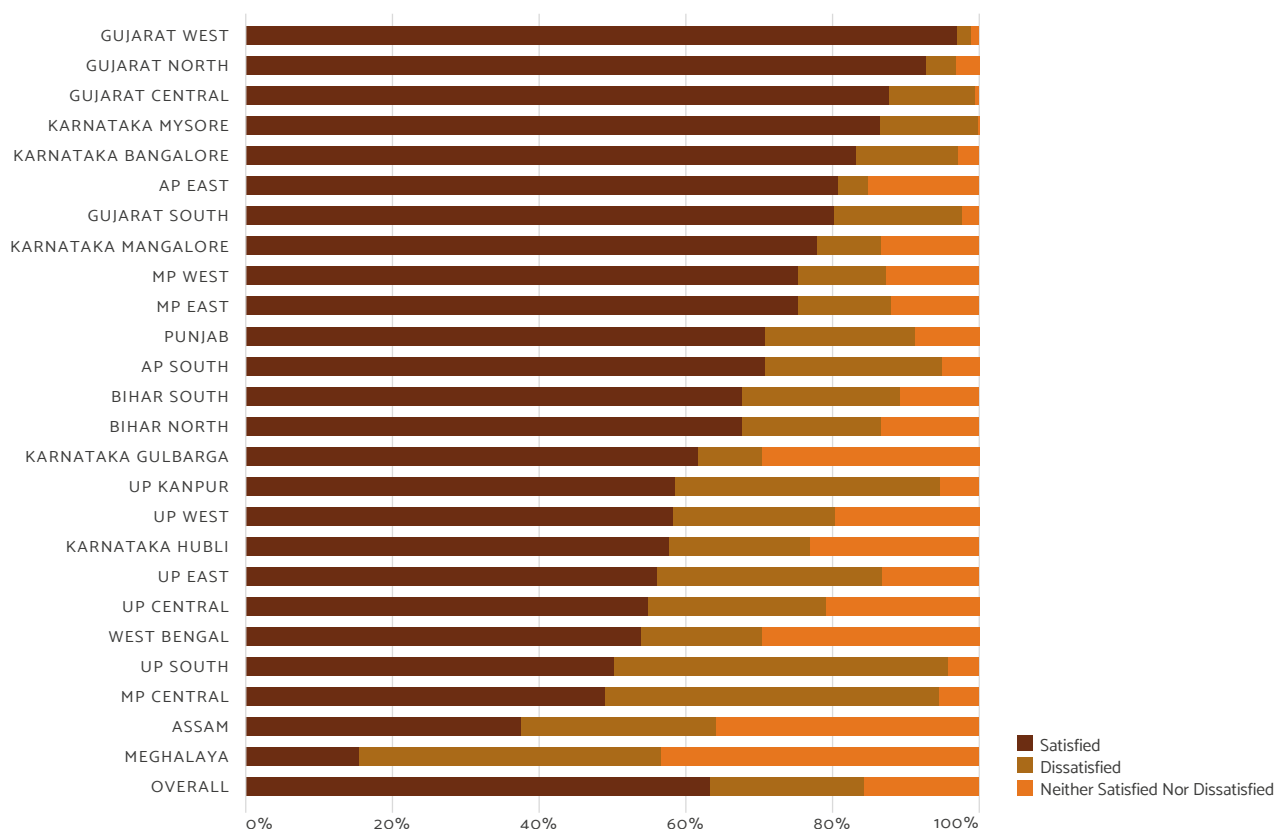
- ▶ Overall, only 63% customers reported being satisfied with the reliability of their electricity.
- ▶ As expected, urban (74%) customers are comparatively more satisfied with the reliability of power as compared to their rural (60%) counterparts, which is likely due to a higher incidence of power cuts without prior notice (67% urban vs. 76% rural). This could be due to differences in relative expectations. The recent nationwide focus on enhancing rural electricity reliability and availability led to significant improvement on the previous low baselines, and may also have led to rural customers reporting higher satisfaction levels.

³⁰ Households connected to grid electricity for less than one year.

³¹ Households first connected to grid electricity more than five years ago.

³² After removing missing observations from the total sample of 25,166 customer respondents, the analysis in this section is based on a sample size of 21,910.

Figure 3-5: Customer satisfaction with power reliability, by distribution utility



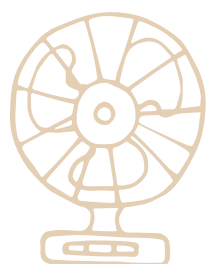
- ▶ 59% of satisfied customers reported an average power cut of no more than 1 hour in a day, while 36% reported no power cuts. Among dissatisfied customers, only 31% reported an average power cut of no more than 1 hour per day, and only 15% reported no power cuts.
- ▶ By customer category, institutional customers had the highest proportion satisfied with reliability of their electricity (68%), followed by commercial customers (64%).
 - » Among institutional customers, there was large variation in dissatisfaction levels between rural (20%) and urban (9%) areas, with respect to reliability of power supply.
 - » 45% of the satisfied institutional customers reported no power cuts, while only 20% of the dissatisfied institutional customers reported no power cuts.
- ▶ 63% of households were satisfied and 21% explicitly dissatisfied with the reliability of their electricity. Socio-economic class was relevant, as 78% of the dissatisfied households are from the disadvantaged socio-economic class. There was a higher percentage of satisfied household customers in urban areas (74%) than rural areas (59%).
 - » Among satisfied household customers, 12% reported that they always got prior

notice about power cuts, while only 7% of dissatisfied customers said they received prior notice.

- ▶ In the agricultural category, a higher proportion of agricultural customers with large land sizes³³ (32%) were dissatisfied with the reliability of their electricity, while smaller proportions of customers with small³⁴ and marginal³⁵ land sizes (23% each) reported being dissatisfied with reliability.
 - » Among satisfied agricultural customers, 46% reported no power cuts, while only 21% of dissatisfied agricultural customers reported no cuts.
 - » A majority (51%) of the satisfied agricultural customers reported power cuts of no more than 1 hour per day, while only 28% of dissatisfied agricultural customers said that power cuts were no more than 1 hour a day; the other dissatisfied customers reported longer durations.

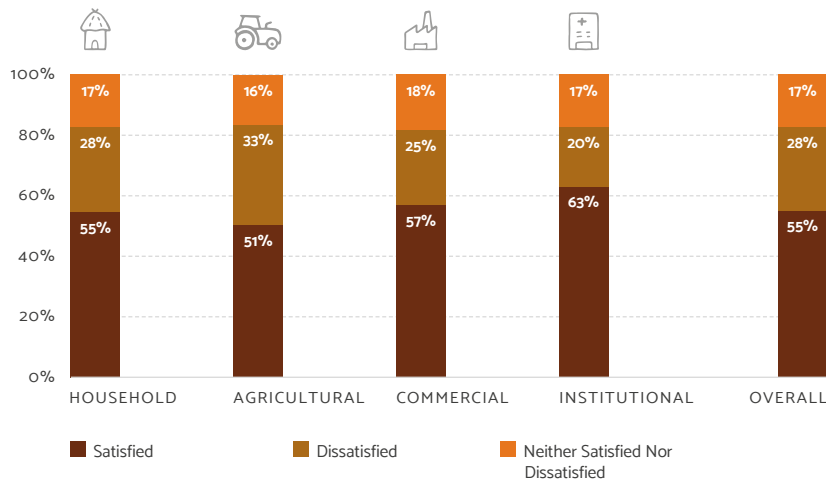
Results of interest (Figure 3-5):

- ▶ Only two utilities – Gujarat West and Gujarat North – had more than 90% of customers reporting satisfaction with the reliability of their electricity supply.



33 Agricultural landholding greater or equal to 10 hectares.
 34 Agricultural landholding between 1 and 2 hectares.
 35 Agricultural landholding less than 1 hectare.

Figure 3-6: Customer satisfaction with power quality, by customer category



- ▶ The greatest proportion of dissatisfied customers was found in UP South (46%), MP Central (46%), and Meghalaya (41%).

Power Quality³⁶

Power quality in this study is assessed in terms of number of voltage fluctuations. Such fluctuations can damage electrical appliances, which means either a higher additional cost for customers in terms of installing voltage stabilizers, or customer decisions not to invest in electrical appliances that can be potentially damaged. (Decisions to avoid certain appliances also reduce customers' electricity consumption, which causes utilities to lose opportunities for revenue that could be charged at the same overhead expenses.)

Satisfaction with power quality, measured as voltage stability, among different customer categories is presented in Figure 3-6.

Results of interest (Figure 3-6):

- ▶ Overall, 55% of all customers expressed satisfaction with the quality of their electricity supply. Satisfaction varied across rural and urban customers, with 66% of urban customers satisfied but only 51% of rural customers satisfied.
- ▶ The highest proportion of customers satisfied with quality was found in the institutional category (63%), and the lowest in the agricultural category (51%).
- ▶ A majority (55%) of household customers reported satisfaction with the quality of their electricity.
 - » Among the satisfied customers, 45% reported no voltage fluctuations, while only 15% of dissatisfied customers reported no fluctuations.

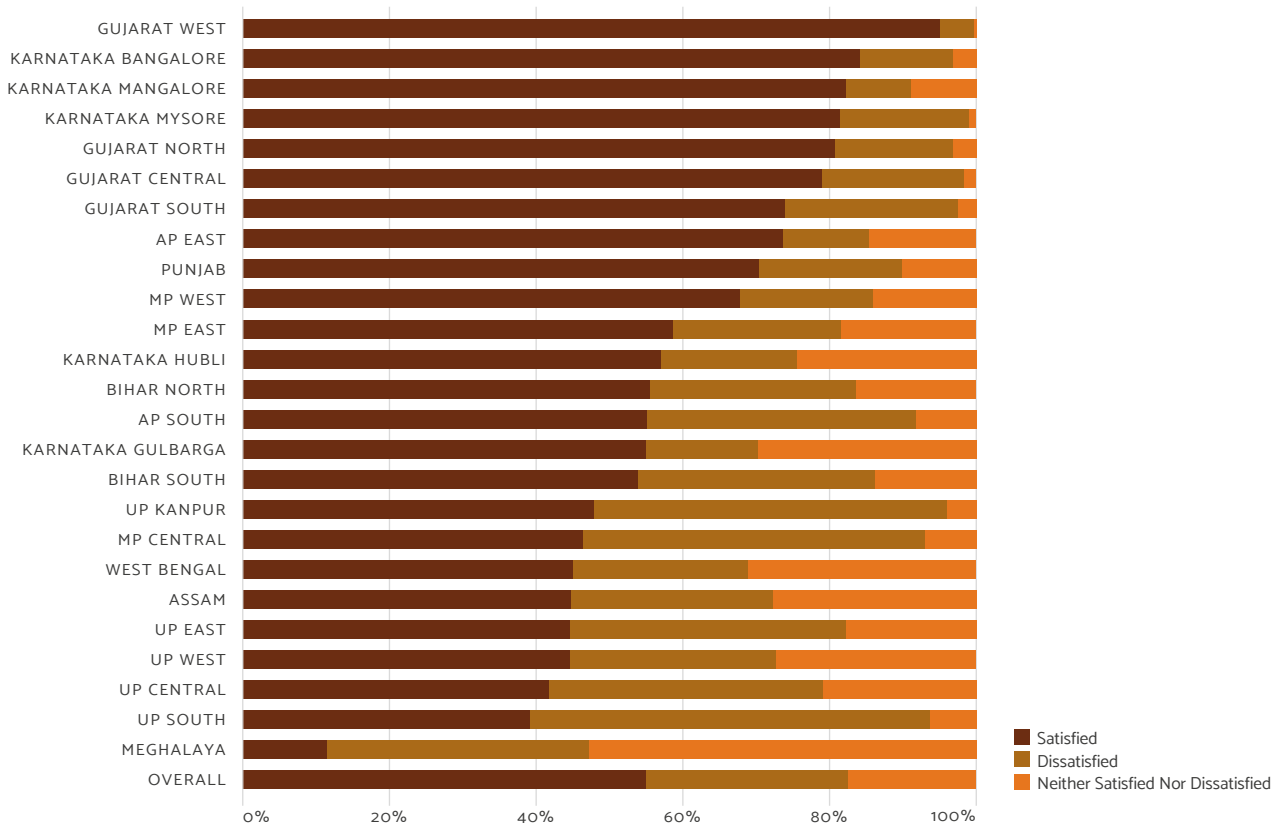
» Customers place a higher emphasis on quality of electricity during the summer: Of household customers who reported maximum voltage fluctuations in the summertime, only 47% were satisfied.

- ▶ Among agricultural customers, dissatisfaction with quality was highest among farmers with small and marginal land size (36% each), and least among farmers with large landholdings (4%). The majority (80%) of satisfied agricultural customers reported no voltage fluctuations, while only 15% of dissatisfied customers reported no fluctuations.
- ▶ Satisfaction among commercial customers varies between rural and urban areas. In urban areas, 62% of the commercial customers reported satisfaction with the quality of their power supply, but the same was true for only 54% of rural commercial customers.
 - » Among satisfied commercial customers, 57% reported no voltage fluctuations, while only 16% of dissatisfied customers reported no fluctuations.
- ▶ For institutional customers, the proportion of satisfied customers is lowest in the educational segment. Urban/rural differences are also seen, with 67% of institutional customers from urban areas reporting satisfaction with quality, while only 61% of rural institutional customers were satisfied with their electricity quality.
- ▶ Overall, there is a clear association between number of voltage fluctuations and customer satisfaction. Across all customer categories, a higher proportion of satisfied than dissatisfied customers reported no voltage fluctuations. Further, more than 75% of satisfied customers, across categories,



³⁶ After removing missing observations from the total sample of 25,166 customer respondents, the analysis in this section is based on a sample size of 21,910.

Figure 3-7: Customer satisfaction with power quality, by distribution utility



reported no appliance damage in the past 1 year, while a majority (55%) of the dissatisfied customers said they had an appliance damaged in the past year.

Results on proportion of customers satisfied with the quality of electricity supply at each of the surveyed utilities are shown in Figure 3-7.

Results of interest (Figure 3-7):

- ▶ Nearly all of the customers of Gujarat West (95%) are satisfied with the quality of their electricity. Three of the five utilities in Karnataka – Karnataka Bangalore, Karnataka Mangalore, and Karnataka Mysore – are in the top five utilities based on customer satisfaction with power quality, with satisfaction levels ranging from 82% to 84%.
- ▶ The proportion of satisfied customers is very low (12%) in Meghalaya, which could be due to the high incidence of appliance damage (61% compared to the utility average of 31%) and voltage fluctuations (75%) reported by Meghalaya customers.
- ▶ Four of the five utilities in Uttar Pradesh – all except for UP Kanpur – are in the bottom five utilities in terms of satisfaction with power quality. In all these utilities, voltage fluctuation is a major concern, reported by more than 70% of the customers.

Billing and Collection Process³⁷

A business’s billing and collection process involves how customers are billed, how often they are billed, how they receive their bill, and what payment mechanisms are available. A smooth billing process and easy payment mechanisms may encourage customers to pay on time and improve collection efficiency. Errors in billing may delay payments and also create hassles for customers in their attempts to have the bill corrected.

Billing is a customer touchpoint and hence plays a vital role in overall customer satisfaction. Performance and satisfaction on billing not only enables on-time collection of payments but also enables utilities to reach out and communicate information to customers. For example, globally, many utilities communicate electricity conservation messages and progress on sustainability efforts alongside a customer’s consumption history and invoice.

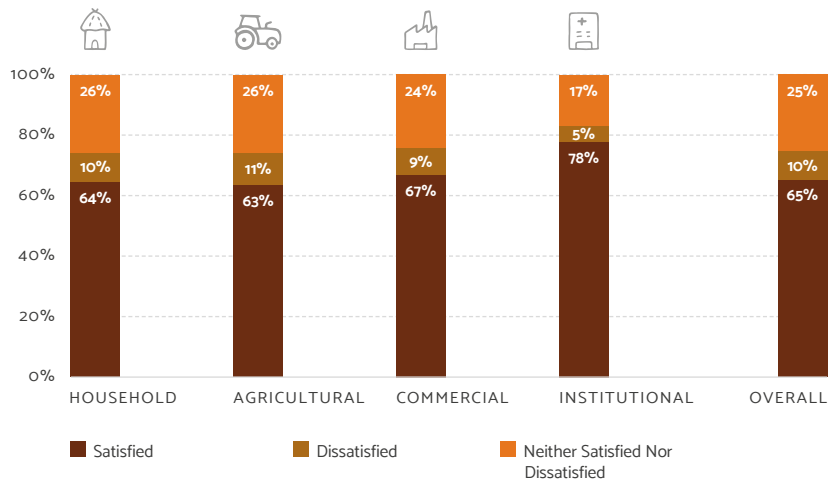
Figure 3-8 presents customer satisfaction results on the electricity billing and collection process.

Results of interest (Figure 3-8):

- ▶ Overall, 65% of customers are satisfied with their utility’s billing and collection process.

³⁷ After removing missing observations from the total sample of 25,166 customer respondents, the analysis in this section is based on a sample size of 17,017.

Figure 3-8: Customer satisfaction with billing and collection process, by customer category



- ▶ Overall, a higher proportion of urban customers (75%) are satisfied compared to customers in rural areas (61%). However, among institutional customers, there is less variation in satisfaction between urban and rural areas, with the proportion of satisfied customers at 78% in urban areas and 77% in rural areas.
- ▶ Across customer categories, the institutional category has the highest proportion of customers satisfied with the billing and collections process (78%). The commercial category has the next highest proportion of satisfied customers (67%), while the proportion of satisfied customers is

- lower in the household (64%) and agricultural (63%) categories.
- ▶ There seems to be an association between customer satisfaction, frequency of billing, and ease of understanding the electricity bill across both customer categories and rural and urban geographies. Overall, only 7% of satisfied customers did not receive their bills at a fixed frequency, while the 34% of dissatisfied customers did not have a fixed billing frequency. Over all categories, 78% of satisfied customers found their bills easy to understand, while the same was true for only 52% of dissatisfied customers.

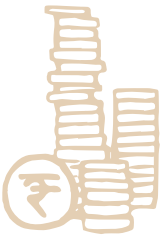
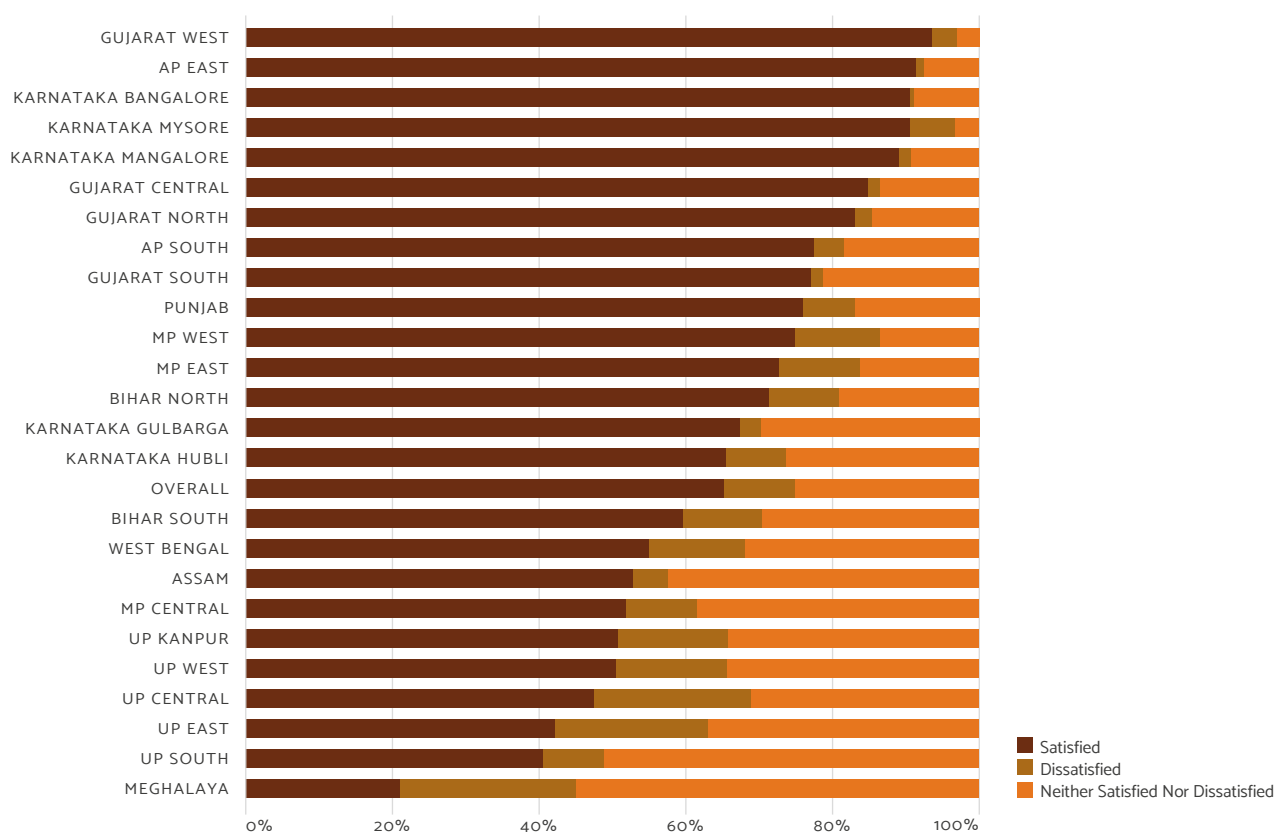


Figure 3-9: Customer satisfaction with billing and collection process, by distribution utility



Customer satisfaction with billing is ranked by utility in Figure 3-9.

Results of interest (Figure 3-9):

- ▶ Level of satisfaction with the billing and collection process is lowest among customers of Meghalaya, at 21%.
- ▶ The five utilities with the lowest levels of customer satisfaction are Meghalaya (21%) and then four of the five utilities in Uttar Pradesh (UP South, 40%; UP East, 42%; UP Central, 47%; UP West: 50%). In all of the bottom five utilities, a higher proportion of customers reported billing at no regular frequency and bills not easy to understand. Customers cited bill calculation as the primary reason for difficulty in understanding the bill. These same five utilities also had the lowest customer satisfaction regarding power quality (see Figure 3-7).
- ▶ In three of the five utilities in Karnataka – Karnataka Bangalore, Karnataka Mysore, and Karnataka Mangalore – more than 89% of customers were satisfied with the billing process, while far fewer customers were satisfied at Karnataka Gulbarga (67%) and Karnataka Hubli (65%).

Complaint Resolution Process³⁸

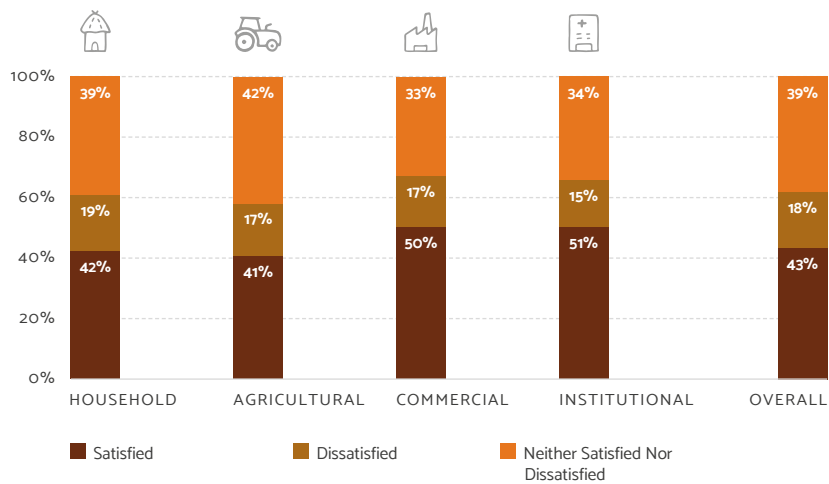
An effective mechanism for redressing complaints is critical to safeguarding customers' interests and ensuring quality services. This holds even more significance in electricity distribution given the monopoly nature of the industry. Evidence suggests that for other businesses, the way complaints are handled has significant impact on customers' decisions regarding service providers. This may not be applicable for electricity services in India currently, given the lack of competition among electricity distribution utilities. However, that lack of competition is something that could change in the near future. The Electricity Act, 2003, provides customers with a complaint redressal mechanism that offers several options, including a Consumer Grievance Redressal Forum (CGRF), an electricity ombudsman and consumer forum, or approaching the distribution utility directly. Customers usually make complaints for following issues,³⁹ among others:

- ▶ Non-supply of electricity meter

³⁸ This section's analysis is based on a sample size of 5,316 customers who responded to the questions about filing a complaint and the subsequent complaint resolution.

³⁹ Suresh Misra and S.K. Virmani, Electricity and Consumer, Consumer Education Monograph Series no. 22 (New Delhi, Centre for Consumer Studies, Indian Institute of Public Administration, 2016), <http://www.consumereducation.in/monographs/Electricity%20and%20Consumer.pdf> (2016), Electricity and customer (Frequently Occurring Problems), IIPA.

Figure 3-10: Customer satisfaction with complaint resolution process, by customer category



- ▶ Delay in sanctioning a new connection/load extension
- ▶ Delay in shifting a meter/connection lines
- ▶ Not replacing a burned meter
- ▶ Wrong meter reading
- ▶ Wrong and disproportionate billing
- ▶ Unscheduled load shedding
- ▶ Voltage fluctuations
- ▶ Delay in restoration of electricity due to line breakdown
- ▶ Delay in redressal of complaints

As part of this study, customers were asked to report on how satisfied they were with their utility's complaint resolution process. This question was asked only to those customers who had made at least one complaint regarding maintenance or technical faults in the distribution supply system in the past year. Figure 3-10 shows percentage of satisfied customers by customer category and overall.

Results of interest (Figure 3-10):

The overall finding is that customer satisfaction levels with regard to complaint resolution process are quite low.

- ▶ 43% customers are satisfied with their utility's complaint resolution process.
- ▶ The percentage of customers who are satisfied varied between rural and urban areas. In urban areas, 57% of customers are satisfied with the complaint resolution process, while only 37% of rural areas are satisfied. This could be due to a higher prevalence of better complaint redressal mechanisms in urban areas.
- ▶ Satisfaction among customers is lowest in the agricultural category (41%) and highest in the commercial and institutional

categories (50% of customers satisfied in both categories). Only 42% of household customers were satisfied with their complaint resolution process.

- ▶ Among the dissatisfied household customers, 18% reported that their complaint had not been resolved, and 51% said it took 12 hours or more to get their complaint resolved. However, among satisfied customers, 78% reported that their complaint was resolved in less than 12 hours and only 3% customers stated that their complaint had still not been resolved.
- ▶ The presence of dedicated staff to respond to complaints, which is critical for the complaint resolution process, is quite low. Overall, 38% of responding customers reported the presence of dedicated staff in their area.



Figure 3-11: Customer satisfaction with complaint resolution process, by distribution utility

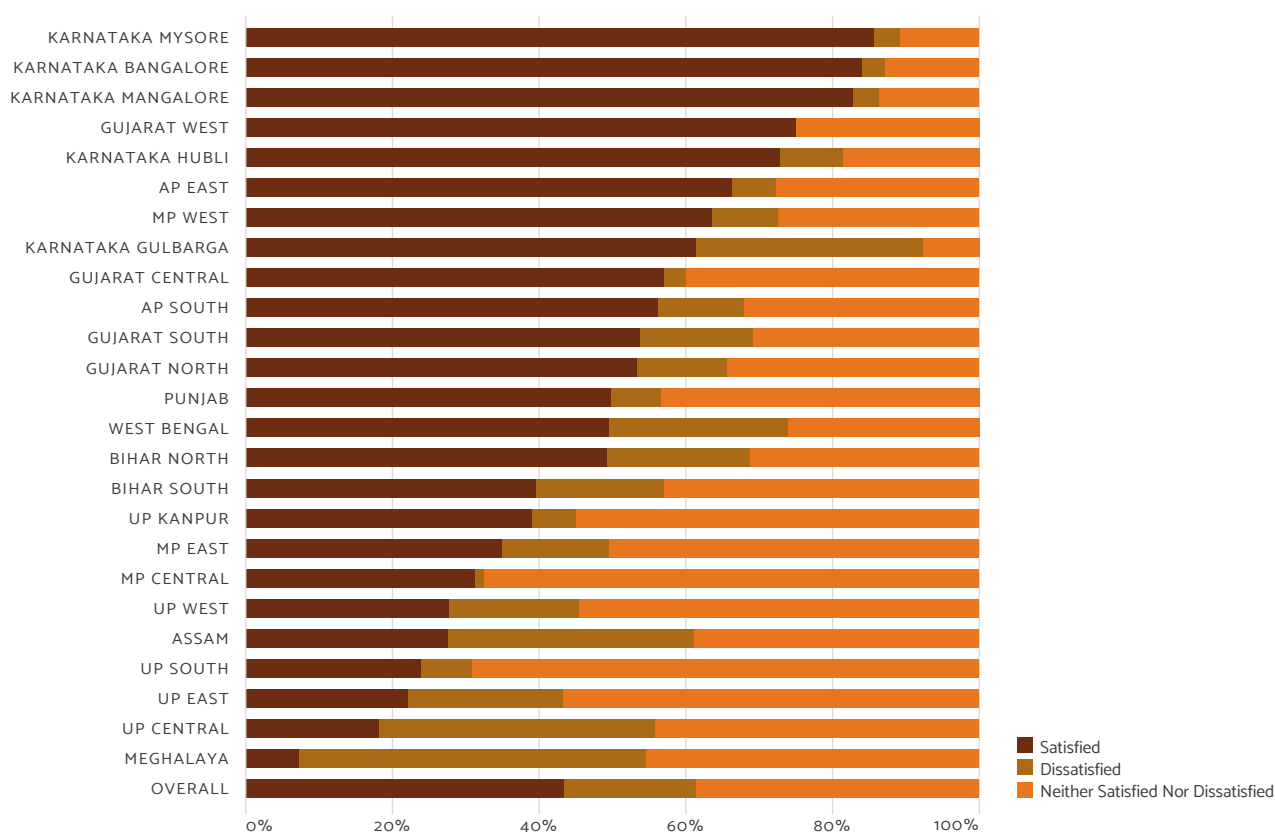


Figure 3-11 shows the percentage of customers satisfied and dissatisfied with the complaint resolution process at each of the surveyed utilities.

Results of interest (Figure 3-11):

- ▶ All the utilities from Karnataka scored higher on complaint resolution than the utilities in any other state. In Meghalaya, just 7% of the customers reported satisfaction with their utility’s complaint resolution process.
- ▶ The bottom five utilities in terms of customer satisfaction with complaint resolution are Meghalaya (7%), UP Central (18%), UP East (22%), UP South (24%), and Assam (28%). Surprisingly, quite significant proportions of customers in all five of these utilities (between 39% and 69%) reported neither satisfaction nor dissatisfaction. This may be because their complaints were minor and hence the resolution process held only minor significance.

Service Provided by Utility Staff⁴⁰

Electricity distribution utility staff, especially people at field offices, are responsible for meter reading, billing and collection processes,

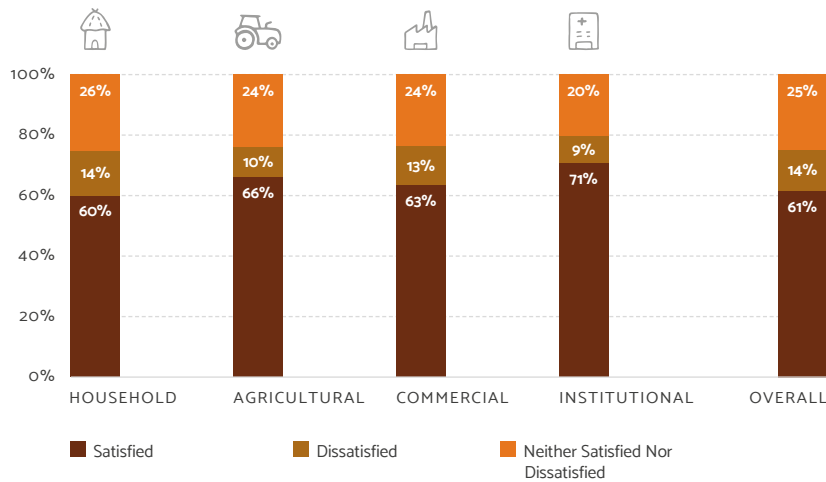
complaint management, and call centres. These staff are typically the point of contact for customers and the face of the utility’s services. Levels of customer satisfaction with the professional behaviour and service provided by utility staff are captured in Figure 3-12.

Results of interest (Figure 3-12):

- ▶ Overall, satisfaction level with service provided by utility staff stands at 62%. Satisfaction levels vary between urban (72%) and rural (58%) areas. This could be because there are more professional staff available in urban areas. Urban customers (78%) were slightly more likely than rural customers (73%) to say that staff behave professionally.
- ▶ An association was found between satisfaction with staff and reports that staff understood the problem. Across customer categories, a majority of satisfied customers reported that utility staff understood their problem. For instance, 69% of satisfied household customers reported that utility staff understood their problem, while a majority of the dissatisfied household customers (58%) stated that staff did not understand their problem. Most (81%) of the satisfied household customers stated that utility staff demonstrated professional

⁴⁰ After removing missing observations from the total sample of 25,166 customer respondents, the analysis in this section is based on a sample size of 21,237.

Figure 3-12: Customer satisfaction with service provided by distribution utility staff, by customer category



behaviour in providing services. Most (76%) of the satisfied agricultural customers but only 60% of dissatisfied agricultural customers reported that staff understood their problem, 70% of commercial customers from urban areas cited that they are satisfied with the services of staff. Overall, most (84%) of the satisfied customers reported that staff understood their problem, while only 35% of dissatisfied customers agreed.

- ▶ Among institutional customers, the proportion of customers satisfied with service provided by utility staff varied by type of institutions, with the smallest proportion of satisfied customers (68%) in educational centre and the largest proportion (78%) in public services. Among satisfied institutional customers, 83% stated that utility staff

understood their problem while only 43% of dissatisfied customers believed staff understood them.

- ▶ Surprisingly, 32% of respondents overall, including 33% of household customers and 21% of institutional customers, reported that utility staff asked for additional gratuities over and above the stipulated services fee for providing the respective services. This finding indicates that utilities need to take action to sensitize customers and staff about gratuities and related penalties. Requests for gratuities were quite prevalent in Andhra Pradesh, where 57% of the surveyed customers across both state utilities reported such occurrences. Overall, reported prevalence of gratuities ranged from 8% in Gujarat South to 57% in AP East and AP South.



“ Private companies wale apna kaam theek tarah nahi karte. Privatisation ke baad toh ab aur bhi jyada halat kharab hai. Pehle do aadmi pure gaon ka dhyan rakhte the and kisi bhi complaint ko theek kar dete the.”

(The quality of the customer service has gone down since privatization and the employees are not responsible. Earlier there were two government employees allotted to the village to check for any fault or issues in the area.)

– Customer in Village Hussainpura, Kapurthala, Punjab, India

Figure 3-13: Customer satisfaction with service provided by distribution utility staff, by distribution utility

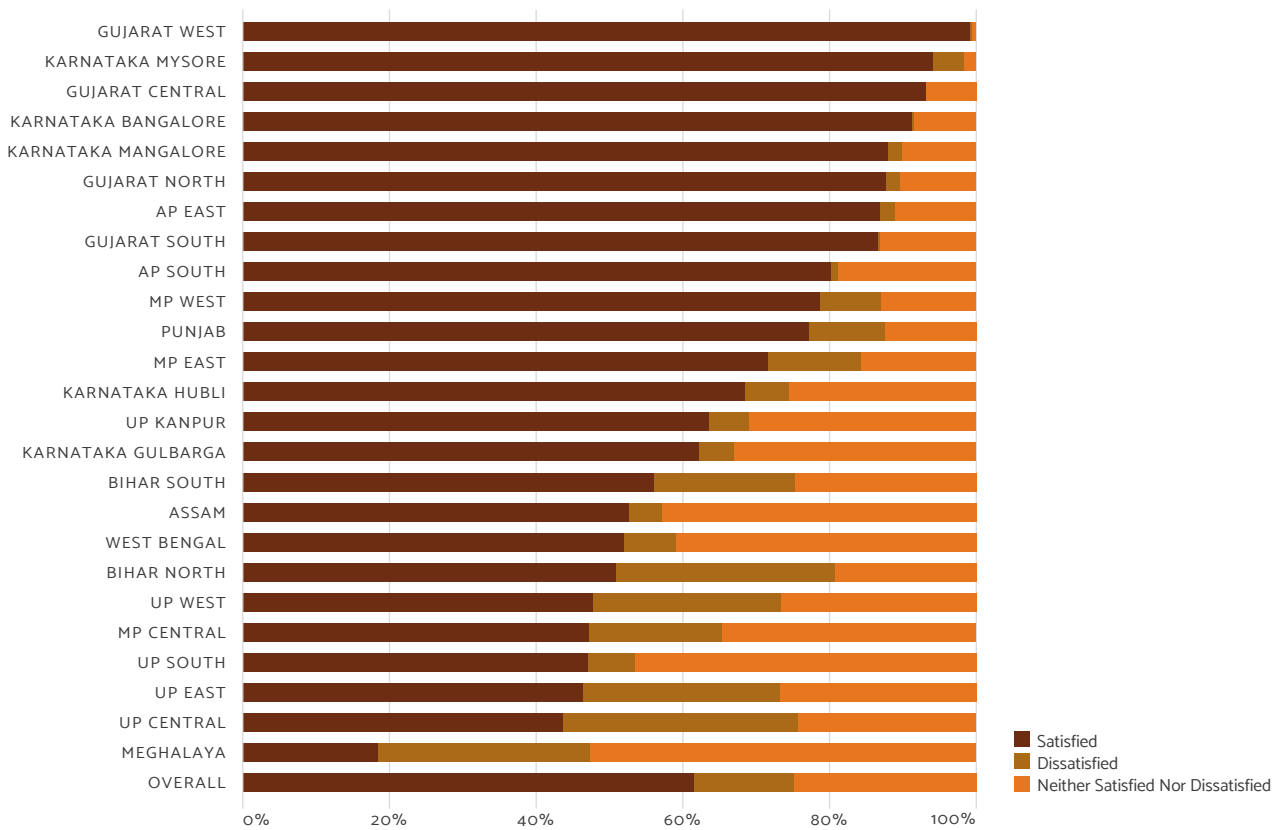


Figure 3-13 presents proportions of customers satisfied and dissatisfied with the service provided by each utility's staff.

Results of interest (Figure 3-13):

- ▶ Almost all the customers (99%) of Gujarat West were satisfied with utility staff services. The top five utilities in satisfaction with staff are, in addition to Gujarat West, Karnataka Mysore (94%), Gujarat Central (93%), Karnataka Bangalore (91%), and Karnataka Mangalore (88%).

- ▶ Meghalaya had the smallest proportion of customers satisfied with staff behaviour and services (18%). In Meghalaya, 69% of customer respondents said that utility staff did not understand their problem. Further, 49% of respondents in Meghalaya (compared with 32% overall) said that utility staff asked for gratuities for providing services. Other utilities with particularly low satisfaction with staff service are MP Central and all five utilities in Uttar Pradesh.

Figure 3-14: Customer satisfaction with overall service provided by distribution utility, by customer category

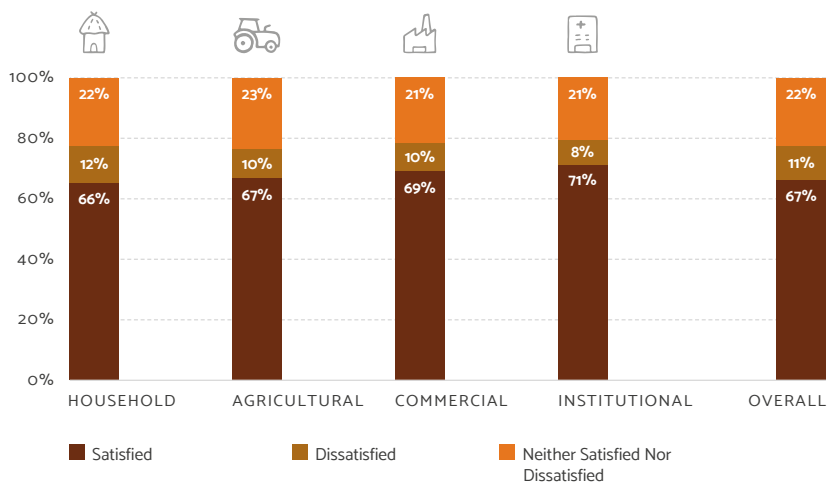
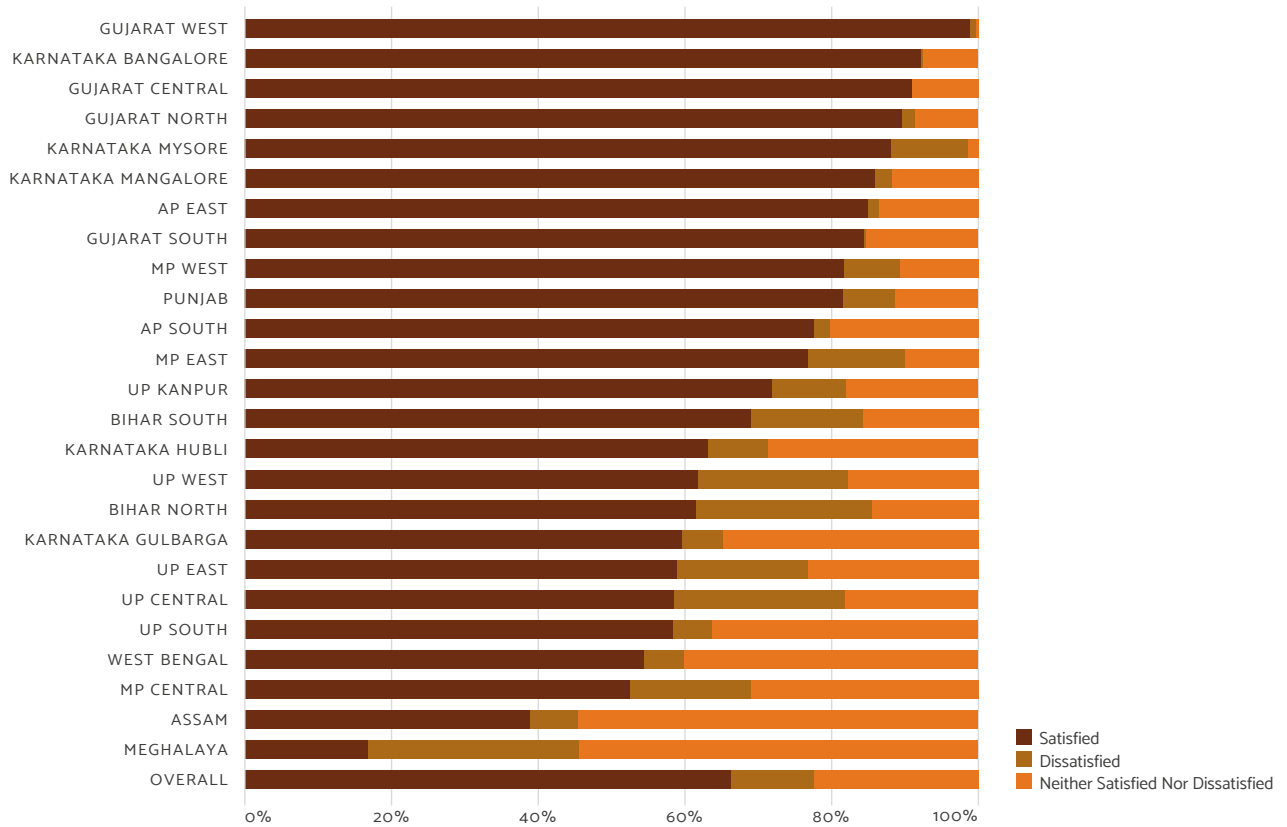


Figure 3-15: Customer satisfaction with overall service provided by distribution utility, by distribution utility



Overall Service Provided by the Utility

As part of this study, customers were also asked about their overall satisfaction with their utility’s services. Figure 3-14 shows the percentages satisfied in each customer category.

Results of interest (Figure 3-14):

- ▶ Overall, 66% customers were satisfied with their utility services. As in other service categories, satisfaction rates varied between rural and urban areas. A higher proportion of urban customers (75%) than rural customers (63%) were satisfied with their utility service overall.
- ▶ The institutional category had the highest proportion of satisfied customers (71%), and the household category had the lowest proportion of satisfied customers (66%). Among institutional customers, the lowest proportion (70%) of satisfied customers were in educational institutions.
- ▶ Among household customers, 75% of urban customers and only 62% of rural customers were satisfied with service overall. A smaller percentage of household customers in the disadvantaged socio-economic class (63%) were satisfied, compared to 71% of

satisfied customers in the advantaged socio-economic class.

- ▶ Agricultural customers with large landholdings were the least satisfied, with only (57%) saying they were satisfied with overall utility service. Approximately 65% of agricultural customers with marginal and small land sizes were satisfied with overall utility service, while 71% of agricultural customers with medium land sizes were satisfied with overall utility service.
- ▶ In the commercial category, 75% of urban customers and 66% of rural customers were satisfied with their utility service overall.

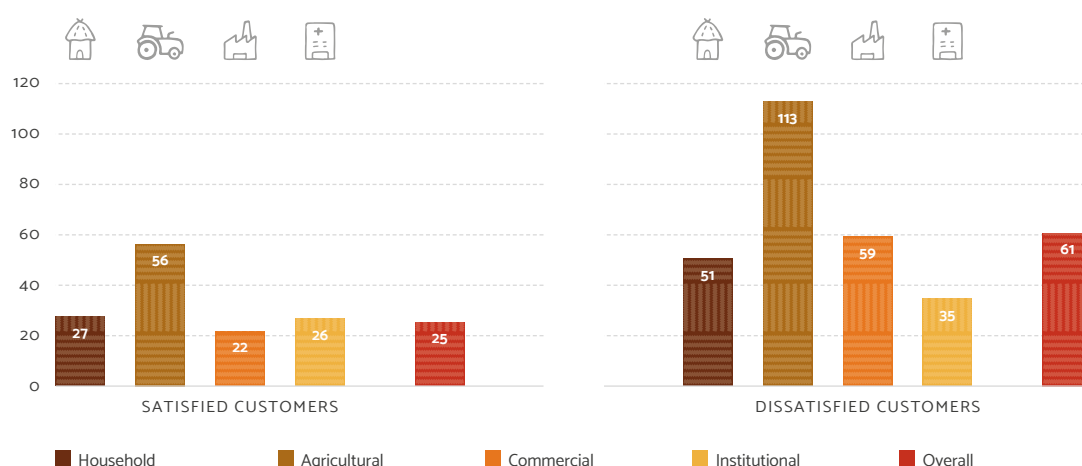
A utility by utility report of satisfaction on overall utility service is presented in Figure 3-15.

Results of interest (Figure 3-15):

- ▶ Most (99%) of the household customers of Gujarat West were satisfied with overall services, with Karnataka Bangalore having the next highest percentage of satisfied customers at 92%.
- ▶ The utility with the highest proportion of dissatisfied household customers (29%) was Meghalaya.



Figure 3-16: Average number of days to get a new connection among satisfied and dissatisfied customers, by customer category



Drivers of Customer Satisfaction

This section uses the survey data in an attempt to identify the key drivers of satisfaction for each of the six dimensions on which customer satisfaction has been reported thus far, and overall. Insights from this analysis are intended to help utilities identify and prioritize aspects of service delivery that can enhance the service experience from the customer's perspective.

To determine the drivers of satisfaction, this study used the ordered logit model. The following subsections discuss the drivers of satisfaction for each of the dimensions of electricity service separately.

New Connection Process

Satisfaction with the new connection process could be a result of the up-front cost of a new connection and the time taken to activate the connection. Both high costs and delays in accessing a new connection may adversely affect satisfaction. Time taken to get a new connection can depend on the smoothness of the activation process. Though there could be other factors as well, this section specifically examines the effect of the time taken to get a new connection and the up-front cost of the new connection on satisfaction, using the ordered logit model. To eliminate the effects of variables like location of utility, customer socio-economic class, and type of utility, control variables were introduced in the model.

The results from the model are summarized in Table A3-1 in Appendix 3.1. Figure 3-16 shows the difference in average number of days to get a new connection between satisfied and dissatisfied utility customers.

Results of the ordered logit model (Figure 3-16):

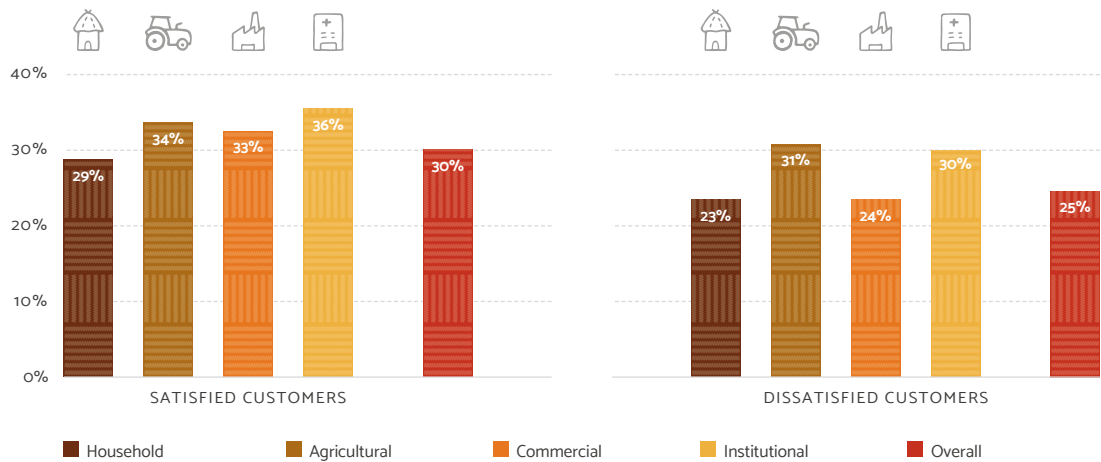
- ▶ The up-front cost of a new connection was not found to be statistically significant. This indicates that cost does not affect satisfaction for any customer category. This could be because under Saubhagya, a new connection is free for households below the poverty line and highly subsidized for households above the poverty line.
- ▶ The analysis also found that the up-front cost of a new connection was not a significant driver even for household customers in rural areas.
- ▶ However, the time taken to get a new connection was found to be both negative and statistically significant across all customer categories, which suggests that a smaller number of days between initiation and activation of a new connection increases satisfaction. This is evident in Figure 3-16. On average, in every customer category, satisfied customers had experienced a shorter time (in number of days) to get a new connection than dissatisfied customers had. Overall, a new connection took 25 days among satisfied customers but 61 days among dissatisfied customers.

Power Reliability

To analyse the key drivers of customer satisfaction with reliability of their electricity supply, the model assesses the effect of prior notification of upcoming power cuts and of seasonality of power cuts.

In this study, reliability was measured in terms of number of power cuts and prior notification of power cuts. Frequent power cuts without prior notice (unscheduled power cuts) may affect satisfaction, as shown in Figure 3-17. Prior notification about a power cut helps customers

Figure 3-17: Proportion of satisfied and dissatisfied customers who had prior notification of power cuts, by customer category



better manage the impact of the downtime. Power cuts are also expected to have seasonal attributes. In particular, power cuts during the summer, compared with other seasons, impact customers significantly more, due to the higher outdoor temperatures and increased energy demand for cooling purposes. Based on this hypothesis, the probability of satisfaction was expected to decrease where more power cuts happen in the summer than in other seasons.

Results of the ordered logit model (Figure 3-17):

- ▶ The model results found that prior notification about power cuts helps increase customer satisfaction (see Table A3-2, in Appendix 3.1). Though only a small number of customers overall received prior notification of power cuts (as reflected in the discussion of power reliability in Chapter 2), a higher proportion of satisfied customers than dissatisfied customers had received advance

notice. Overall, 30% of satisfied customers said they had prior notification of power cuts while the same was true for only 25% of dissatisfied customers.

- ▶ Customers are more dissatisfied when summer is the season they receive the least electricity. Customers from rural areas tend to be more dissatisfied with the reliability of their power supply than customers from urban areas.

Power Quality

To assess the drivers of satisfaction with power quality, voltage fluctuations and resulting damage to electrical appliances were considered explanatory variables in the model. A high number of voltage fluctuations may harm electrical appliances and thus affect customer satisfaction. All the variables used in the model are categorical in nature.



Figure 3-18: Proportion of satisfied and dissatisfied customers who experienced no voltage fluctuations, by customer category

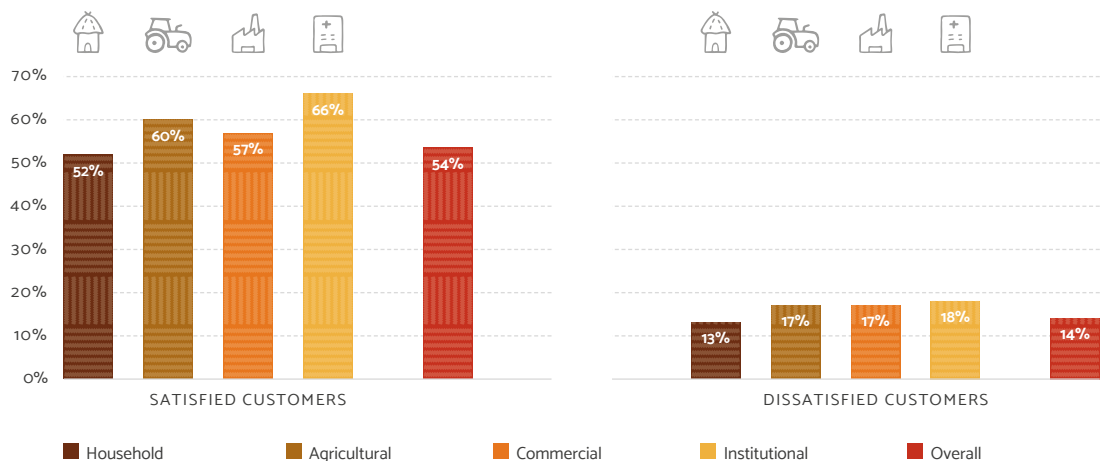


Figure 3-18 shows the percentage of satisfied and dissatisfied customers who had no voltage fluctuations. Figure 3-19 shows the percentage of customers who, whether or not they experienced voltage fluctuations, had no damage to appliances.

Results of the ordered logit model:

▶ The results of the ordered logit model for power quality (see Table A3-3 in Appendix) suggest that the number of voltage fluctuations significantly affects customer satisfaction and is the largest contributor towards dissatisfaction for all customer categories. A majority of satisfied customers (52% or more) reported no voltage fluctuations, while across categories, 18% or fewer dissatisfied customers reported no voltage fluctuations (Figure 3-18). In other words, a majority of satisfied customers faced no voltage fluctuations while a majority of dissatisfied customers faced voltage fluctuations.

- ▶ Voltage fluctuations during the summer negatively affect satisfaction more than fluctuations in other seasons.
- ▶ A majority of satisfied customers in all customer categories (65% or more) experienced no damage of appliances due to voltage fluctuations, while the same was true for a smaller proportion (62% to 70%) of the dissatisfied customers (Figure 3-19).

Billing and Collection Process

Several variables captured in the survey were considered for estimating the drivers of customer satisfaction with their utility’s billing and collection process:

- ▶ No fixed billing frequency
- ▶ Error(s) on bill
- ▶ Ease of understanding the bill
- ▶ Mode of payment available
- ▶ Distance to a bill collection centre

Figure 3-19: Proportion of satisfied and dissatisfied customers who faced no damage to appliances, by customer category

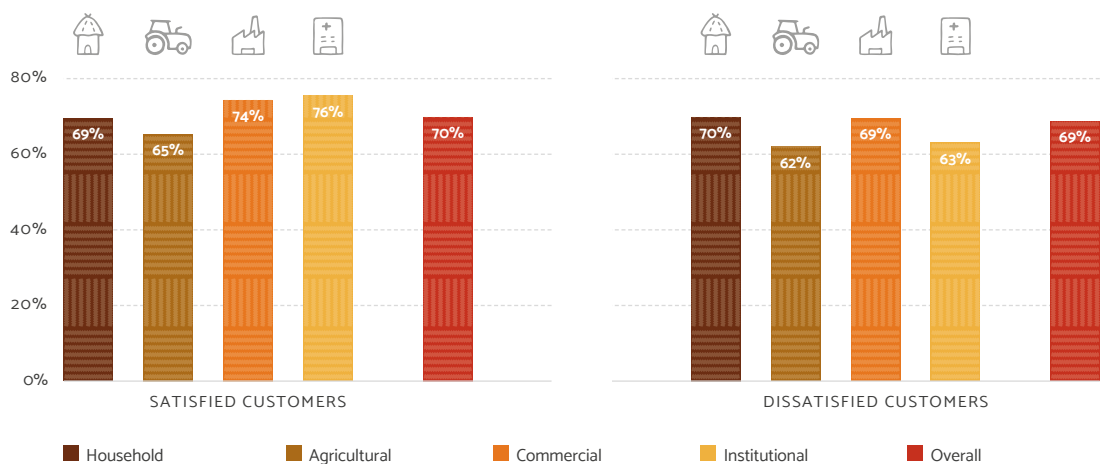


Figure 3-20: Proportion of customers satisfied and dissatisfied with the billing and collection process who said their utility bill was easy to understand, by customer category

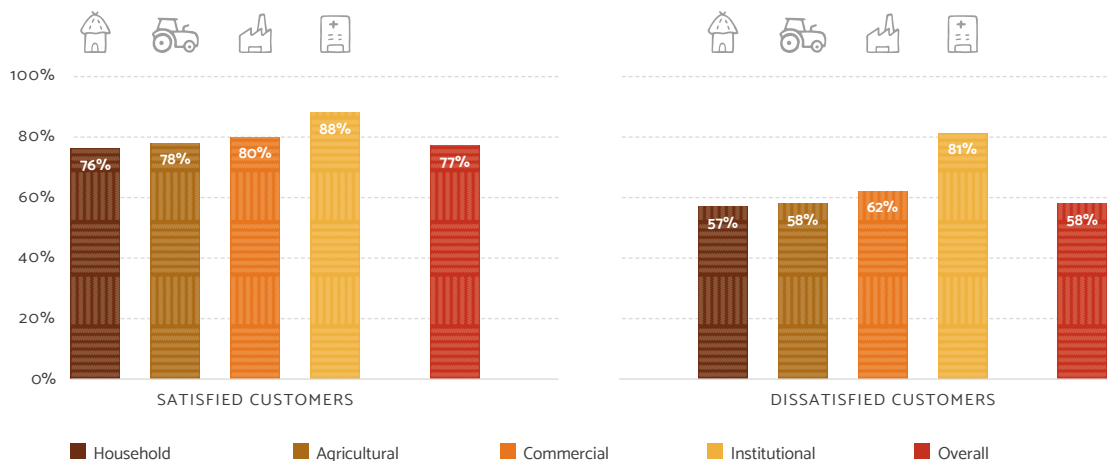


Figure 3-20 shows percentages of satisfied and dissatisfied customers who found their utility bills easy to understand.

Results of the ordered logit model (Figure 3-20):

- ▶ The ordered logit model presented in Table A3-4 (Appendix 3.1) found that infrequent billing leads to dissatisfaction. Receiving bills at regular intervals may reduce customer burden and seems to drive satisfaction.
- ▶ Customers' ability to understand their utility bill is also a statistically significant driver of satisfaction. Bills that are easy to understand, whether through use of local language, clear explanations of charges levied, or just better print quality, are a significant driver of satisfaction across all customer categories. Overall, 77% of customers satisfied with the billing and collection process said their bill was easy to understand, while the same was true for only 58% of dissatisfied customers.

- ▶ An online mode of payment was found to increase customer satisfaction. This should be looked at in conjunction with the variable of customers' distance from a collection centre: with increases in distance to a collection centre, customer satisfaction decreases. Hence, it is in the interest of the utilities to provide and increase use of modes of online bill payment.

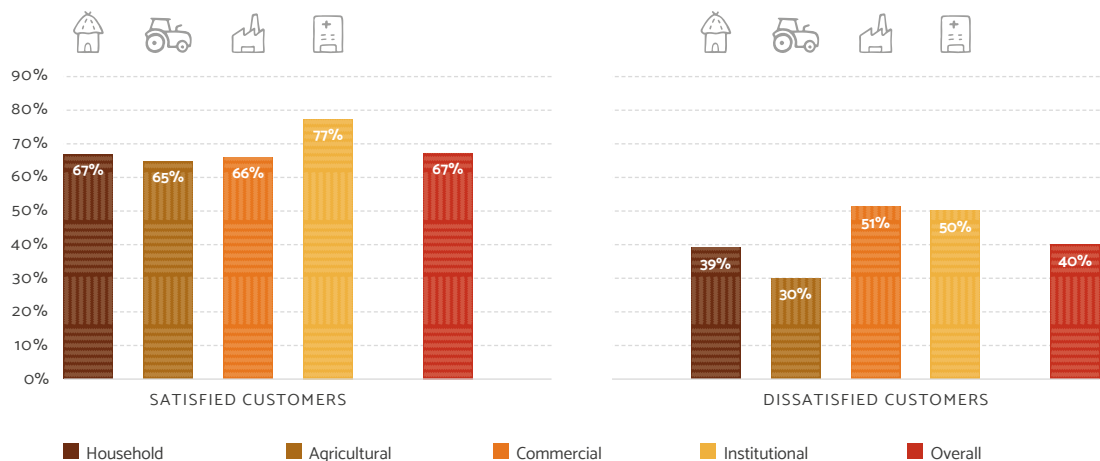
Complaint Resolution Process

To assess the drivers of customer satisfaction with utilities' complaint resolution processes, the ordered logit model was set with the following explanatory variables.

- ▶ Point-of-contact staff person at utility office or powerline technician
- ▶ Presence of dedicated staff for handling complaints
- ▶ Frequency of visits by maintenance staff
- ▶ Time taken to get a complaint resolved



Figure 3-21: Proportion of satisfied and dissatisfied customers whose complaints were resolved within 12 hours, by customer category



These variables influence the ease of making a complaint and also the speed of resolution of complaints and were expected to affect customers' satisfaction regarding their utility's complaint resolution process. Having easy access to either a staff person at the local utility office, a dedicated powerline technician, or other dedicated staff may facilitate both filing of complaints and resolving complaints. The time taken to get a complaint resolved affects customer satisfaction: the probability of satisfaction will increase if complaints are resolved in less time. Figure 3-21 and Figure 3-22 show the percentages of satisfied and dissatisfied customers who had short resolution times and dedicated maintenance staff.

Results of the ordered logit model:

- ▶ The model found that across all customer categories, higher complaint resolution time negatively impacts satisfaction (see Table A3-5 in Appendix). Complaint resolution times among satisfied customers was significantly less than among dissatisfied customers.

- ▶ Across all customer categories, more than 65% of customers who were satisfied with the complaint resolution process said their complaints were resolved within 12 hours of filing the complaint. The same was true for less than 51% of dissatisfied customers (Figure 3-21).
- ▶ The ordered logit model also found that the presence of dedicated staff is a significant driver of satisfaction for household and institutional customers, but not significant for agricultural and commercial customers. Figure 3-22 shows that a higher proportion of satisfied customers than dissatisfied customers reported presence of dedicated staff, across customer categories and overall.

Figure 3-22: Proportion of satisfied and dissatisfied customers who had dedicated maintenance staff, by customer category

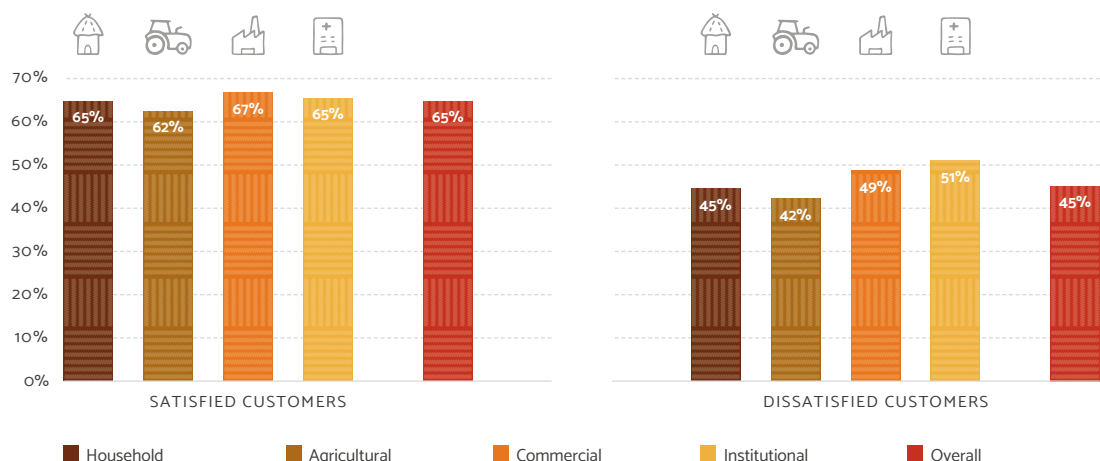
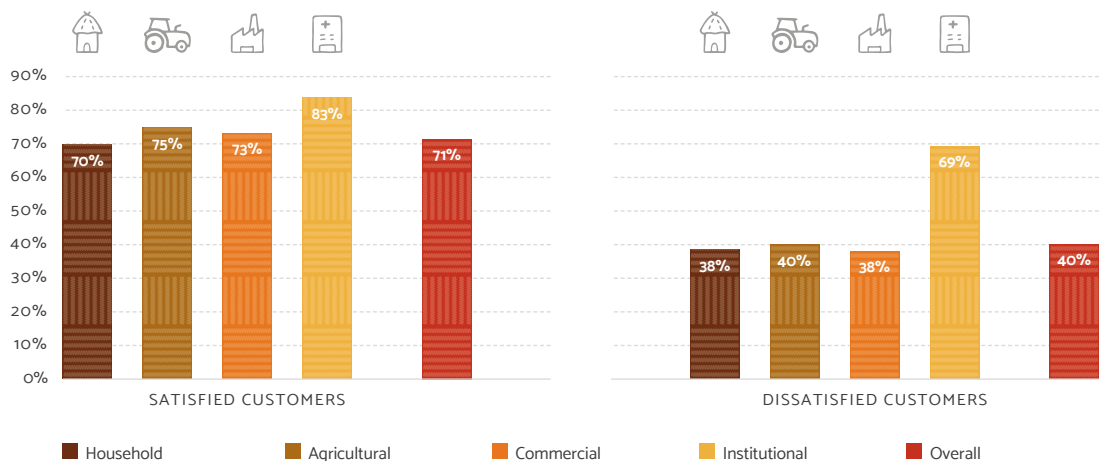


Figure 3-23: Proportion of satisfied and dissatisfied customers who said distribution utility staff behaved professionally, by customer category



Service Provided by Utility Staff

Two variables covered in the survey were considered for determining the drivers of customer satisfaction with the services provided by utility staff:

- ▶ Incidence of gratuities and tips claimed or requested by utility staff
- ▶ Professional behaviour by utility staff

The presence of professional and knowledgeable staff is assumed to lead to better service and thereby to drive satisfaction. However, if staff members ask for gratuities or tips for providing services, this may adversely affect customer satisfaction.

The effects of various other factors, such as the respondent’s educational background, social status, per capita expenditure, size of landholding (for agricultural customers), ownership of the enterprise (for commercial customers), and status as head of the institution (for institutional customers), are controlled by introducing these variables in the model.

Based on the model (shown in Table A3-6), both professional behaviour and incidence of requests for gratuities are found to be statistically significant across all customer categories. This confirms that both variables affect customer satisfaction on with the service provided by electricity distribution utility staff. As shown in Figure 3-23, a relatively higher proportion of satisfied customers than dissatisfied customers reported that their utility’s staff had behaved professionally.

Overall Service Provided by the Utility

The discussion of “overall service provided” refers to all aspects of the electricity service; hence all relevant indicators influence overall customer satisfaction. Using the ordered logit model as in other service categories (see Table A3-7 in Appendix), findings reveal that several variations in the drivers of overall satisfaction, based on type of customer:

- ▶ For household customers, power reliability, power quality, the billing and collection process, and the service provided by utility staff are significant contributors to overall customer satisfaction.
- ▶ For commercial customers, the new connection process, billing and collection process, and service provided by utility staff are significant contributors to overall satisfaction.
- ▶ For agricultural customers power reliability, the complaint resolution process, and service provided by utility staff are significant contributors to overall satisfaction.



Table 3-1: Ranking of distribution utilities on the customer satisfaction index

Distribution Utility	Score on the Customer Satisfaction Index	Rank Based on the Customer Satisfaction Index
Karnataka Bangalore	74	1
Karnataka Mangalore	65	2
Gujarat Central	64	3
Gujarat West	64	3
Gujarat North	64	3
AP East	63	6
Karnataka Mysore	61	7
Gujarat South	58	8
MP East	57	9
Punjab	56	10
AP South	54	11
MP West	54	11
Bihar North	49	13
Bihar South	48	14
UP Kanpur	47	15
Karnataka Hubli	47	15
West Bengal	42	17
MP Central	41	18
Karnataka Gulbarga	41	18
UP West	41	18
UP South	39	21
Assam	36	22
UP East	36	22
UP Central	35	24
Meghalaya	11	25

Note: A rank of 1 indicates highest customer satisfaction, and a rank of 25 indicates lowest satisfaction.

Customer Satisfaction: Performance Summary

Utility Performance on Customer Satisfaction

This section attempts to assess the performance of each distribution utility in terms of customer satisfaction. Utility performance is analysed via a customer satisfaction index that includes all six individual dimensions of electricity service discussed in this chapter and constructed using a double cut-off method. This method measures the level and intensity of customer satisfaction at the utility level. These are the six dimensions of electricity service:

- ▶ New connection process
- ▶ Power reliability
- ▶ Power quality
- ▶ Billing and collection process
- ▶ Complaint resolution process
- ▶ Service provided by utility staff

The methodology for constructing the overall customer satisfaction index is given in Appendix. Each of the six dimensions in the index gets equal weight. Index values lie between 0 and 100, with 0 indicating the worst performance and 100 indicating the best performance. The customer satisfaction index score for each utility is given in Table 3-1, in order of best to worst performance. Two of the utilities in Karnataka (Karnataka Bangalore and Karnataka Mangalore) ranked at the top in customer satisfaction, while Karnataka Mysore stands seventh. The bottom five utilities in terms of customer satisfaction are UP South, Assam, UP East, UP Central, and Meghalaya.

Table 3-2 captures the key issues in customer satisfaction in states where the issues are more prevalent. These issues were identified based on the high proportions of customers dissatisfied with these specific service parameters.



Table 3-2: Key issues affecting customer satisfaction, by state

State	Issue (Distribution Utility)
Andhra Pradesh	New connection process (AP South); power quality (AP South)
Assam	Complaint resolution process
Bihar	Power quality (Bihar South)
Gujarat	New connection process (Gujarat South)
Madhya Pradesh	New connection process (MP Central); power reliability (MP Central); power quality (MP Central)
Meghalaya	Power reliability; power quality; complaint resolution process
Uttar Pradesh	Power reliability (UP South, UP Kanpur, UP East); power quality (UP Kanpur, UP East, UP Central, UP South); complaint resolution process (UP Central)



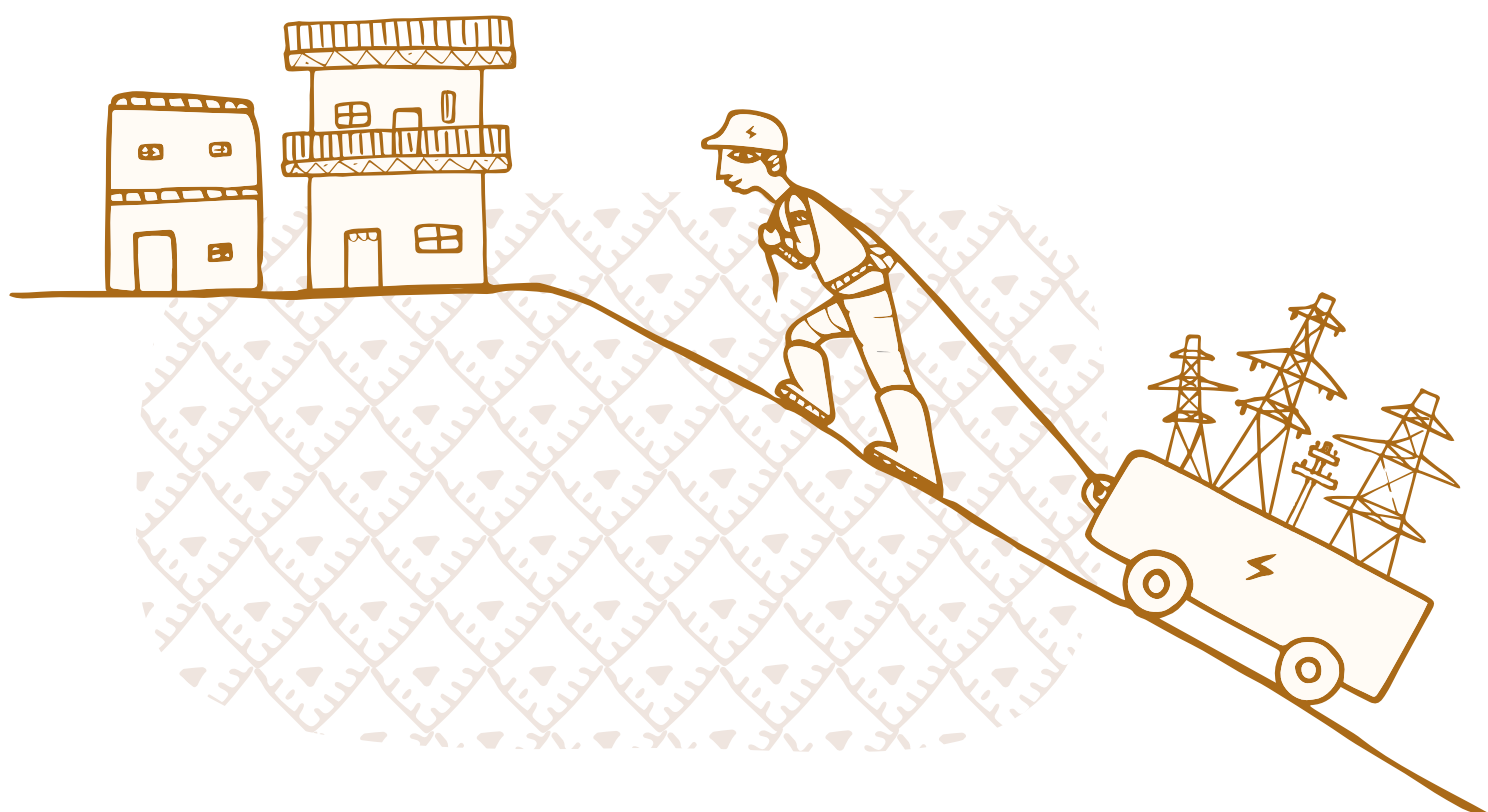
4



Capacity to Deliver Electricity Access

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Capacity to Deliver Electricity Access



Chapters 2 and 3 present and analyse customers' perspectives on the state of electricity access in India and their levels of satisfaction with electricity services. From the perspective of the electricity distribution utilities (also known as distribution companies or DISCOMs), now that they have delivered electricity connections to 100% of willing household customers across the country, it is imperative to drive sustainability of this access.

The assessment undertaken thus far underlines customers' expectations regarding service quality as well as the prevailing gaps between the desired and current quality of electricity services delivered across different distribution utilities. Critical factors for customers now pertain to adequate and satisfactory power availability, reliability, quality, affordability,

safety, and customer services. To ensure that utilities are able to meet these customer or demand-side expectations, it is paramount to understand each utility's underlying capacity to deliver on these factors.

The Government of India has implemented multiple schemes and initiatives to strengthen the capacity of electricity distribution utilities to deliver on their goals. Some of these initiatives include the Accelerated Power Development and Reforms Programme (APDRP) and Restructured Accelerated Power Development and Reforms Programme (R-APDRP), Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY), Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY), Integrated Power Development Scheme (IPDS), high voltage distribution system (HVDS) initiatives, and the recently initiated

customer-end smart metering schemes. These have been supported by corresponding programmes by respective state governments. Both national and state initiatives have focused on the multiple elements of the electricity distribution business, from expanding the electric grid, to strengthening the distribution network and systems in urban and rural areas respectively, to reducing network losses, to enabling information technology (IT) and automation by implementing ERP (enterprise resource planning) and SCADA (supervisory control and data acquisition) solutions. The schemes have delivered mixed results so far, perhaps due to policy designs that have been based primarily on assessments of the supply side, or utility needs, and have had a relatively lesser focus on customer needs on the demand side.

This chapter attempts to map the capacity of electricity distribution utilities across the fundamental pillars of infrastructural capacity and operational and institutional capacity. In addition to mapping the performance of the sampled utilities, the study also identified the available benchmarks. The larger objective of this analysis is not only to understand the utilities' current capacities but also to bring out learnings from high-performing utilities to create a road map for delivering truly sustainable access going forward.

External Factors That Affect Capacity to Deliver Access Sustainably

A distribution utility's capacity to deliver is characterized by its internal capacity in at least four areas – infrastructural, financial, operational, and institutional. However, it is crucial to understand that in addition to these controllable factors, there are also extraneous factors that impact the capacity of utilities over which a utility has little or no control. These include factors such as a state's economic status, customer profile, geography, population density, and regulatory environment – all of which are beyond the control of an electricity distribution utility but influence the performance of that utility. Some of these factors are discussed below.

State Economy

States with more developed economies that are driven by policies outside the power sector,

such as industrial policy and agricultural policy, have more access to funds. These funds can enable state investments in its infrastructure, such as roads, health, and education, as well as electricity. Furthermore, states with higher gross state domestic product (GSDP) per capita and higher GSDP contribution from various industries also have customers with a higher capacity to pay for electricity services. All of these elements directly affect the capacity of a distribution utility to deliver services.

Customer Profile

This study captures the state of electricity access and satisfaction with electricity services across four customer categories – household, agricultural, commercial, and institutional. As discussed in Chapter 2, electricity consumption patterns vary across categories, and the proportional mix of these customers will affect a utility's capacity to deliver. Some states may have more household and agricultural customers, who consume less power, or more high-value customers such as commercial customers, who consume more power. This mix of customers in a state is also related to the state's GSDP composition. For instance, states with higher GSDP contributions from commercial customers may have correspondingly higher numbers of customers with a higher ability to pay. On the other hand, agrarian states have a higher mix of household and agricultural customers with both lower electricity consumption and lower ability to pay.

Geography and Topography

Geography plays a major role in the design of electricity distribution networks. Widely spaced rural networks with lower per capita electricity consumption merit long low-tension (LT) networks, which affects the performance of the system and can result in poorer quality of electricity supply than in urban areas with more high-tension (HT) networks. In hilly terrains such as those in the northern and north-eastern parts of India, it is commercially unviable for utilities to extend their distribution networks, and customers there often rely on off-grid solutions. Historically, some of the states in the eastern part of the country have been affected by natural calamities such as floods, cyclones, and deluges. This of course affects utilities' ability to maintain an efficient and resilient network.

“ A strong customer connection is very important for a utility to have. Going an extra mile to provide improved customer experience can result in developing trust and a long-lasting mutual relationship that is reciprocated at both ends. Many years ago, during an instance of severe floods, a few of our linemen who were sent to resolve a network breakdown got washed away while crossing a bridge. I immediately called the sarpanch of the village, whom I knew from one of our earlier meetings and from previous work done in the village. He remembered me and acted promptly, sending some of the best swimmers in the village on a rescue operation, and our personnel were brought back to safety. This level of trust helps a utility’s ground operations in multiple ways.”

– Director, Operations & Projects,
APEPDCL (AP East)



Population Density

Like geography, population density also plays a major role in capacity to deliver electricity. The state of Uttar Pradesh, for instance, has the highest population density in the country, at 829 people per square kilometre. The infrastructure requirements for improving utilities’ performance standards are thus different in Uttar Pradesh than in Meghalaya, which has a population density of 52 people per square kilometre. In Uttar Pradesh, high

investments and high-return interventions such as HVDS may work, while in low-density states such as Meghalaya, other innovative solutions would have to be implemented to justify the costs of infrastructure improvements. Regions with relatively higher population density are also likely to generate higher revenues at equal overhead costs.

Regulatory and Policy Environment

Each state’s power sector is today at a different level of maturity, having taken diverging paths over time. The regulatory and policy environment in each state has to an extent mirrored this process. Although it significantly impacts utilities’ financial and operational performance, this environment remains outside the purview of the utility itself. For example, regular or irregular increases in tariffs, presence or absence of funding and investment support for infrastructure, and presence or absence of law and order support for curbing electricity theft can play major roles in a utility’s performance.

Focus of This Chapter

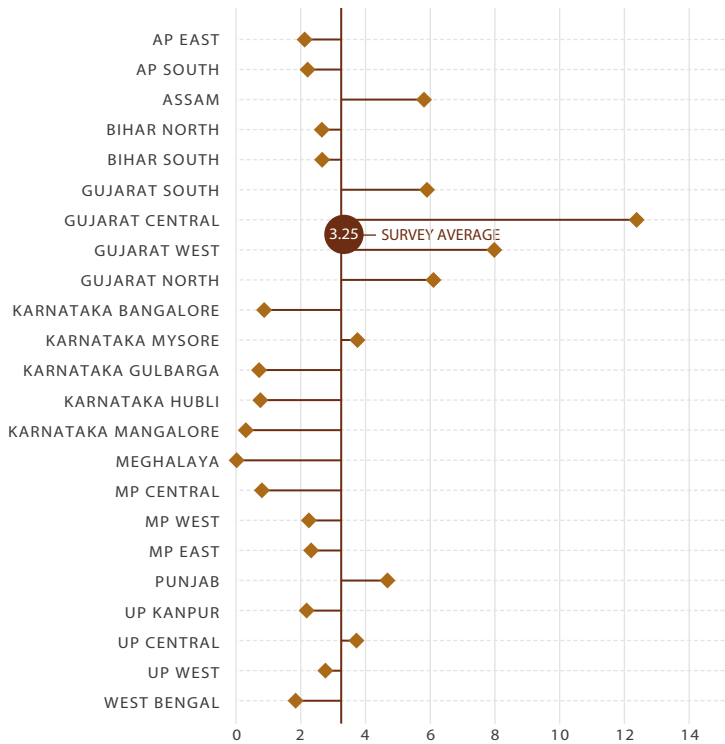
The next sections of this chapter give a broad idea of utilities’ capacities to deliver electricity access sustainably. However, it is also crucial to acknowledge the context in which each utility functions. This study focused on assessing and improving the performance of factors that are within a utility’s control. After mapping out each utility’s capacity and evaluating the relationship of capacity with customer satisfaction as well as the utility’s overall performance, the report brings out recommendations for various stakeholders to identify priorities and pave the way forward.

Table 4-1: Factors that affect a utility’s capacity to deliver

Infrastructural Capacity	Operational Capacity
Substation capacity per MW of peak demand	AT&C losses
HT:LT network ratio	Billing efficiency
Average 11 kV feeder capacity	Employees per 1,000 customers
Average DT failure rate (%)	DT and 11 kV feeder metering (%)
Per customer electricity supplied	Number of interruptions
	Complaint resolution (%)
	Reported theft cases per 1,000 customers
	Institutional capacity

Abbreviations: AT&C, aggregate technical and commercial; DT, distribution transformer; HT, high tension; kV, kilovolt; LT, low tension.

Figure 4-1: Substation capacity as ratio of total capacity to peak demand, by distribution utility



Note: UP South and UP East did not submit data on substation capacity.

Internal Factors That Affect Capacity to Deliver Access Sustainably

Factors that enable an electricity distribution utility to provide electricity access sustainably (see Table 4-1) reflect the performance of the utility. The next sections describe the relevance of each such factor or performance metric, along with the capacity of the surveyed utilities with respect to that metric. This assessment uses primary data collected from the utilities as well as discussions held with utility staff as part of the study.

Infrastructural Capacity

Infrastructural capacity refers to the capacity of a utility's electrical power distribution network to deliver and maintain the required levels of power supply. Adding and augmenting infrastructure capacity and strengthening a distribution grid is a matter for careful consideration and planning. However, such work also helps to manage

the supply side and to maintain the smooth functioning of the electrical network. Adequate infrastructural capacity ensures that demand-side or customer-driven requirements such as availability, reliability, and quality of power are met.

This study evaluated the infrastructural capacity of the surveyed power distribution utilities using five key metrics that capture the essential elements of network loading, performance, and ability to enhance the quantum of power supply flowing through the network.

Substation Capacity Per MW of Peak Demand

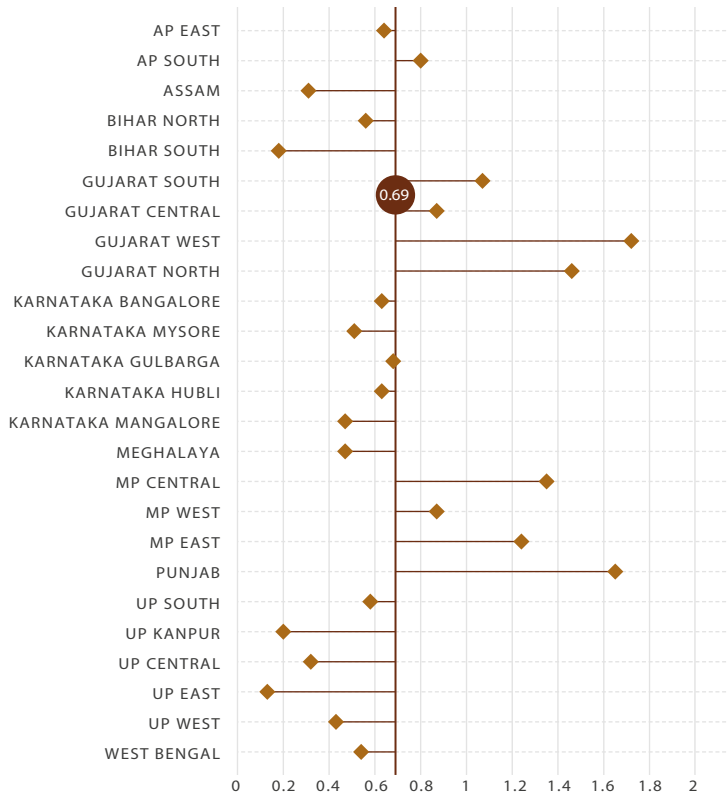
Substation capacity per MW of peak demand is measured as a ratio of the total power substation capacity of a utility in megavolt-ampere (MVA) to the peak demand generated in the system in megawatts (MW). A higher value of this ratio indicates that the distribution network has adequate capacity to further absorb and deliver increased customer demand for electricity, whether for base or for peak demand. However, a fine balance needs to be maintained in this ratio, as a very high ratio implies the presence of unutilized assets. In such a case, investment and operating costs are generally passed on to customers as increased tariffs. An efficient planning process is needed for cost-benefit analysis while making policy and investment decisions regarding substation capacity.

Some factors that influence the substation capacity ratio are the types of customers, the difference between the system's base load and peak load,⁴¹ and the expected growth in demand in the near future. States with high industrial demand may have a higher ratio, whereas states with high agricultural demand may have a comparatively lower ratio. The ratio also depends upon the quality of the underlying distribution network; utilities with recent investments in their distribution backbone typically demonstrate a higher ratio. Although there are no clearly defined benchmarks around the substation capacity ratio, it is generally thought that it should be in the range of 2 to 3. Figure 4-1 shows the substation capacity for each of the surveyed utilities.

Data collected from 23 utilities across the 10 states (UP South and UP East did not provide data on substation capacity) found an average substation capacity ratio of approximately 3.25, which seems to be in the desired range. Figure 4-1 shows that the utilities in Gujarat

⁴¹ Base load: Amount of electricity that is always required in the system. Peak load: Highest amount of electricity required among the daily fluctuations of electricity used by customers.

Figure 4-2: HT:LT ratio, by distribution utility



have some of the highest ratios across the sampled utilities, ranging from 6 to 12. The utilities of Assam and Punjab also have a higher ratio, most likely due either to recently added new network capacity which continues to be unutilized, or to a high mix of industrial customers. On the other hand, the utilities in Meghalaya and Karnataka have some of the lowest ratios. There are, however, specific exceptions that need to be taken into account. For instance, the substation capacity ratios in Gujarat and Punjab take into account capacities at the 66 kilovolt (kV) level, while most other surveyed distribution utilities use only the traditional 33 kV voltage starting point. However, the distribution utilities in Karnataka do not report capacity at the 33 kV level. These factors create skewness in the ratios presented in Figure 4-1. Nonetheless, substation capacity is a crucial ratio to monitor, as it provides a fundamental sense of the ability of the distribution utility to ramp up its power supply.

The ratio may also vary across utilities by season and be higher in off-peak seasons due to reduced needs for energy. Utilities with exceptionally higher or lower substation capacity ratios may need to focus more on network design and planning to optimize their capacity.

HT:LT Network Ratio

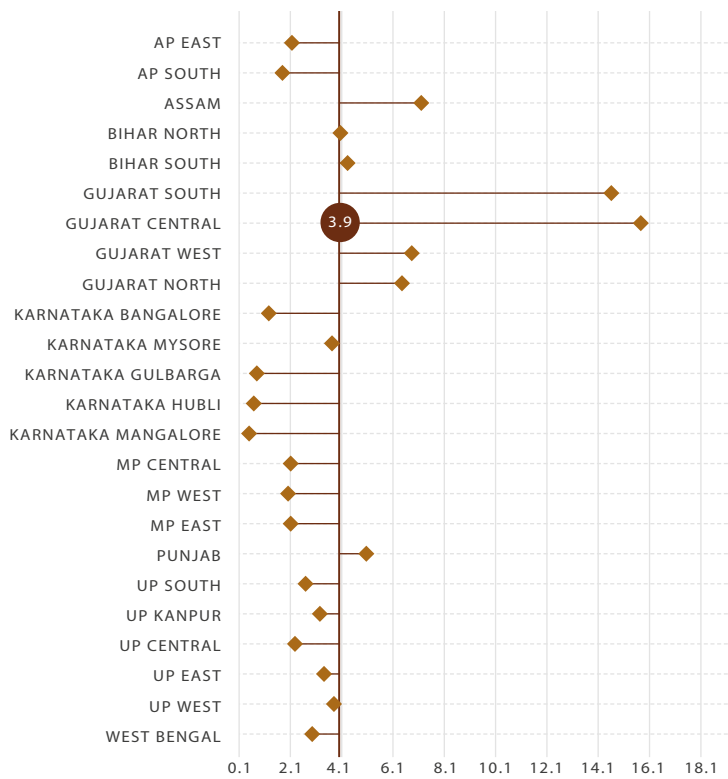
Power distribution networks that operate at higher voltages ensure that they minimize network losses by lowering technical losses. For a utility therefore, a higher value of the ratio between HT network length and LT network length may not only translate to lower technical losses but also ensure minimum drops in system voltages at the tail end, as mandated under the Standards of Performance. Supplying electricity at higher voltage levels not only reduces technical losses, but also discourages theft.

Ideally every utility may want its HT:LT ratio⁴² to be high. However, due to the design of the distribution network system, this comes at a significant cost. High HT:LT ratios are challenging in the current scenario, which includes limited resources available to state utilities, and further affect customer tariffs. Currently, therefore, any ratio in the range of 1:1 is seen as a fair practice to maintain the fine balance between associated network costs and technical loss reductions.

As shown in Figure 4-2, this study found that the average HT:LT ratio for the surveyed utilities was approximately 0.69, with Gujarat West having the highest value at 1.72. UP East has the

⁴² HT:LT ratio: The ratio of the distribution utility's overall HT network infrastructure to its overall LT network infrastructure.

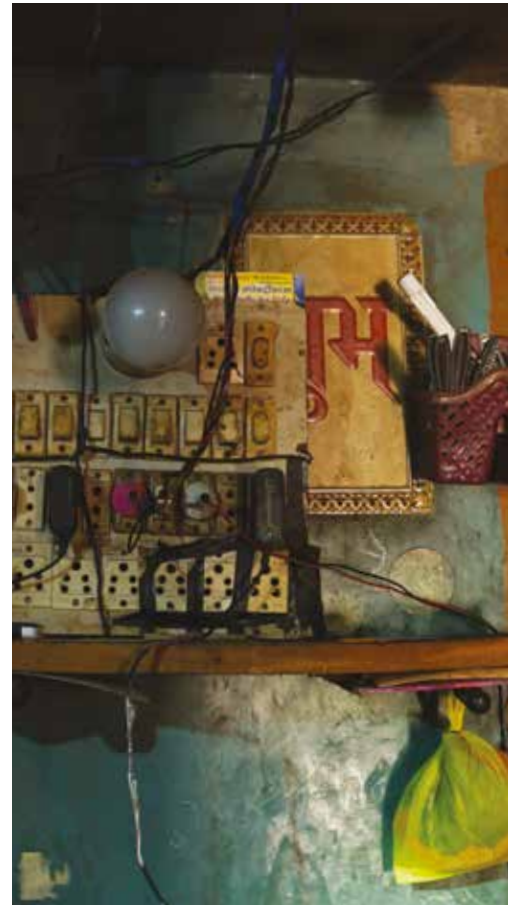
Figure 4-3: Average 11 kV feeder capacity (MVA), by distribution utility



Note: Meghalaya data not available.

lowest ratio, 0.13, which can be attributed to its widespread customer base and the consequent rapid spread of its LT network. Better HT:LT ratios for utilities may result from substantial investments under state government schemes, better network planning, or drives to segregate feeders and then convert to HVDS.

As part of this study, a sample survey was conducted to assess reasons for poor performance by utilities on various distribution aspects, such as HT:LT ratios. It was generally observed that along with HT networks, large LT network spans were added into utilities' distribution systems to expedite the release of new service connections under Saubhagya, and that this led to lower HT:LT ratios. Typically, utilities should ensure that extension of LT networks follows approved Standards of Performance, and only after considering factors such as voltage at tail end, load growth in area, upstream LT network length, and HT network capacity. However, due to current operating practices and the sheer scale of the Indian distribution market, distribution utilities only seldom comply with all of the checks and balances before commissioning a new LT service connection and embarking on associated network extension activities.

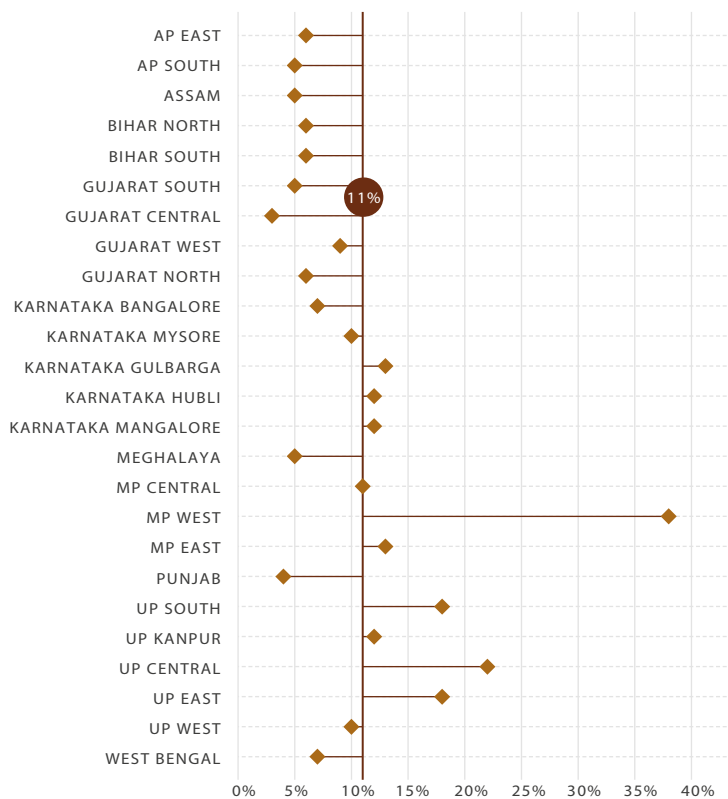


Average 11 kV Feeder Capacity

Feeder capacity is measured as the ratio of the total capacity of a utility's 11 kV feeders (in MVA) to the total number of 11 kV feeders. This measure reflects the utility's ability to cater to the demand generated by the downstream customer load. Ideally, establishment of 11 kV feeders should be done with a critical view to connected downstream customer load and the length of the feeder. A feeder with higher capacity will cater to a larger number of customers and corresponding connected load. There will thus be higher risk involved in catering to a large customer base on a typical 11 kV feeder. Breakdown across such an 11 kV feeder will make more customers vulnerable to power outage.

Figure 4-3 shows the average feeder capacity of the surveyed utilities. The utilities across Gujarat appear to maintain much higher feeder capacity than the utilities of other states, with an average in Gujarat almost fourfold the average across all surveyed utilities. For utilities with higher feeder capacities, ensuring reliability is critical, and use of ring main units or feeder loops becomes imperative to ensure continued supply in case of feeder breakdowns. Otherwise, supply of electricity from other sources becomes essential.

Figure 4-4: Average annual DT failure rate, by distribution utility



Average Distribution Transformer (DT) Failure Rate

Distribution transformer (DT) failure rate is the ratio of the number of failed or damaged DTs to the total number of DTs installed annually. This measure indicates the percentage of failure annually against the total number of installed DTs. It is a critical parameter which indicates the status of power reliability to customers as well as the performance of the DTs.

The main reason for higher DT failure rates is overloading, lightning, short circuit faults, ageing, oil leaks, loose connections, and bad workmanship. A high failure rate indicates high disruption in power supply and therefore high rates of customer dissatisfaction, as well as loss of revenue for the outage period, high repair and maintenance costs, and high inventory costs for the utility. With state utilities already struggling with low revenue, such losses of revenue and increases in repair cost may prompt them to review maintenance practices. Although the ideal DT failure rate for any utility should be zero, available benchmarks suggest that a rate in the range of 1–2% is acceptable.⁴³ DT failures can be prevented by appropriate selection of DT specifications and vendors,

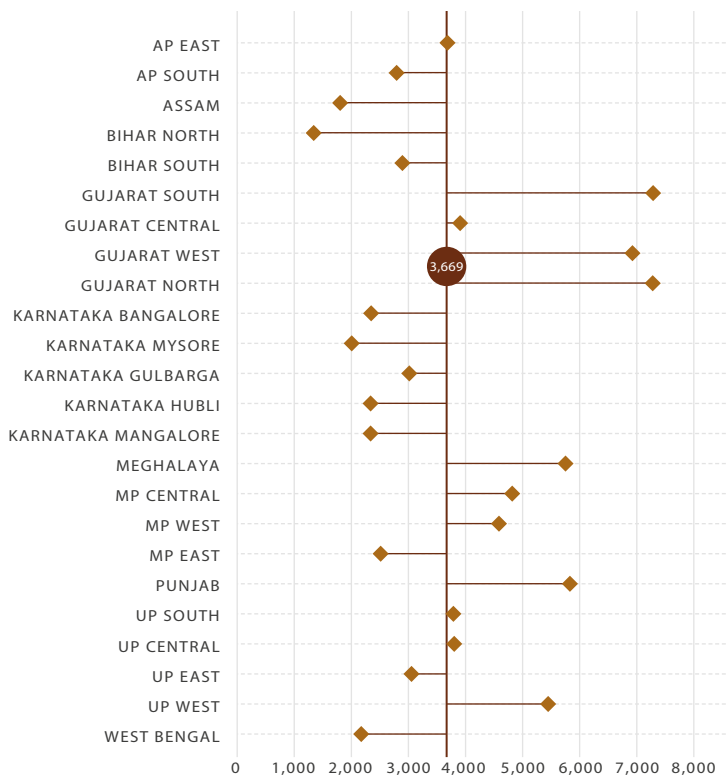
adequate planning to avoid overloading, and preventive operations and maintenance practices.

As shown in Figure 4-4, the surveyed utilities reported an average DT failure rate of 11%, with three utilities in Gujarat (Central, South, and North) having low DT failure rates mainly due to adoption of better maintenance practices. MP West has the highest DT failure rate, which at 38% is dramatically higher than the utility with the next highest rate (MP East, at 13%). This could be attributed to unbalanced load, lack of a protection system, and poor workmanship in the installed DTs.

During this study's utility survey, it became evident that some utilities have preventive maintenance practices in place for DT upkeep. Such utilities ensure complete asset coding and entry of the DT codes in an ERP system, thereby maintaining a record of failure rates for each DT. Some utilities were observed to keep limited track of even the repaired transformers being sent out from their transformer repair workshops. Substandard repair work and lack of skilled labour power for DT repairs may further increase utilities' failure rates.

⁴³ International Copper Association India, "Distribution Transformers," 2018, <https://copperindia.org/distribution-transformers/>.

Figure 4-5: Per customer electricity supplied in kWh per annum, by distribution utility



Note: UP Kanpur did not submit data on per customer electricity supplied.



Per Customer Electricity Supplied

Per customer electricity supplied is measured as the ratio of total kilowatt-hours (kWh) of electricity that a utility supplies annually to the total number of electricity customers. It indicates the average quantum of electricity consumed by a customer in a year, an important indicator of economic development and standard of living.

As shown in Figure 4-5, the average per customer sales for the surveyed utilities is approximately 3,600 kWh, with utilities across Gujarat having the highest sales, at around 7,200 kWh per year per customer. Bihar North has the lowest per customer electricity supplied, at 1,341 kWh, mainly due to the large amount of household customers in the overall customer mix. Typically, sales per customer is lower for utilities with higher household customer bases than for utilities with higher numbers of commercial customers.

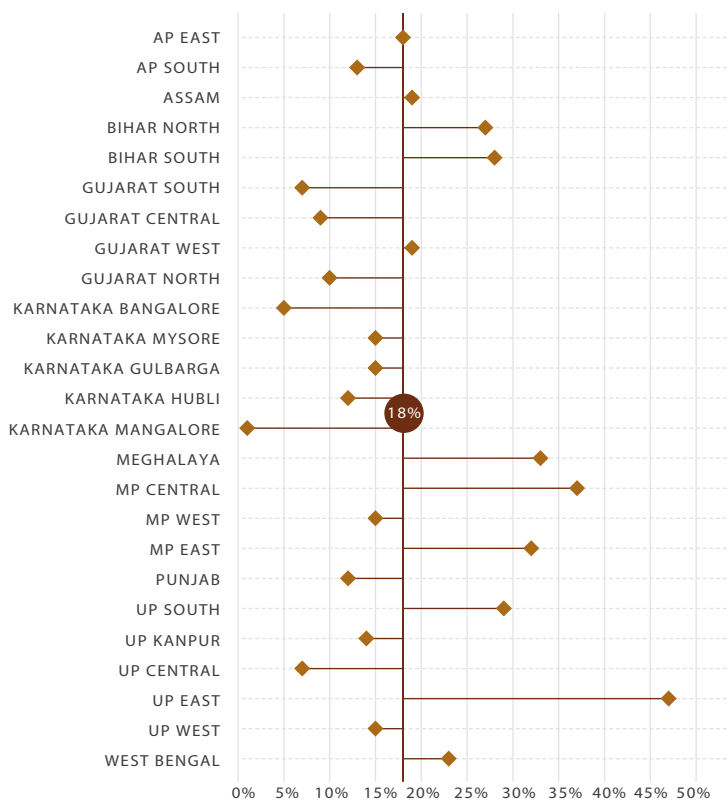
During the utility survey, variations in annual sales to similar customer categories was observed across different utilities within the same state. For example, in Uttar Pradesh, household electricity sales at UP South is approximately 11 kWh, compared to around 323 kWh for household sales at UP Kanpur.

Operational and Institutional Capacity

Operational and institutional capacity refers to a utility’s ability to deliver the required level of service and an enhanced customer experience to its customers. This means delivering a reliable and quality 24*7 supply of electricity and electricity access to all. Operational capacity also indicates the capacity of the utility to perform persistently and to cater to the growing electricity demand, with minimal downtime and very low turnaround time in case of failures in the system. To ensure adequate operational capacity, a utility should have high levels of operational efficiencies, adequate labour power for day-to-day operation and maintenance of the business, requisite systems and processes in place to carry out preventive operations and maintenance, and an adequate focus on revenue generation driven by customer-side initiatives.

This study evaluates operational capacity using seven metrics, including Aggregate Technical & Commercial (AT&C) losses, staffing and billing efficiency, number and duration of interruptions, percentage of customer complaints resolved, and overall institutional capacity. Each of these metrics is essential for uninterrupted quality power supply.

Figure 4-6: Aggregate technical and commercial losses, by distribution utility



Aggregate Technical and Commercial (AT&C) Losses

AT&C loss is the sum of technical loss, commercial loss, and shortage due to non-realization of the total billed amount.⁴⁴ It encompasses both billing and collection efficiencies and quantifies a utility's overall operational losses. High AT&C losses can be attributed to low billing and low collection efficiency.

AT&C losses indicate the overall health of the utility. A higher AT&C loss indicates the quantum of non-realized energy input into the utility's distribution system, creating a revenue gap in comparison to the cost of energy supplied to system and affecting profitability. Generally, the cost of purchasing power accounts for about 80% of the total annual costs for any typical power utility. Thus non-realization of costs for even 10% of the energy supplied may lead to significant revenue shortfall. Anything short of 100% collection efficiency leads to an increase in debtors over time, which continue to accumulate. In the entire energy value chain, the revenue is collected from the end customer by the distribution utility. Any underperformance in collecting these revenues will impact the whole value chain.

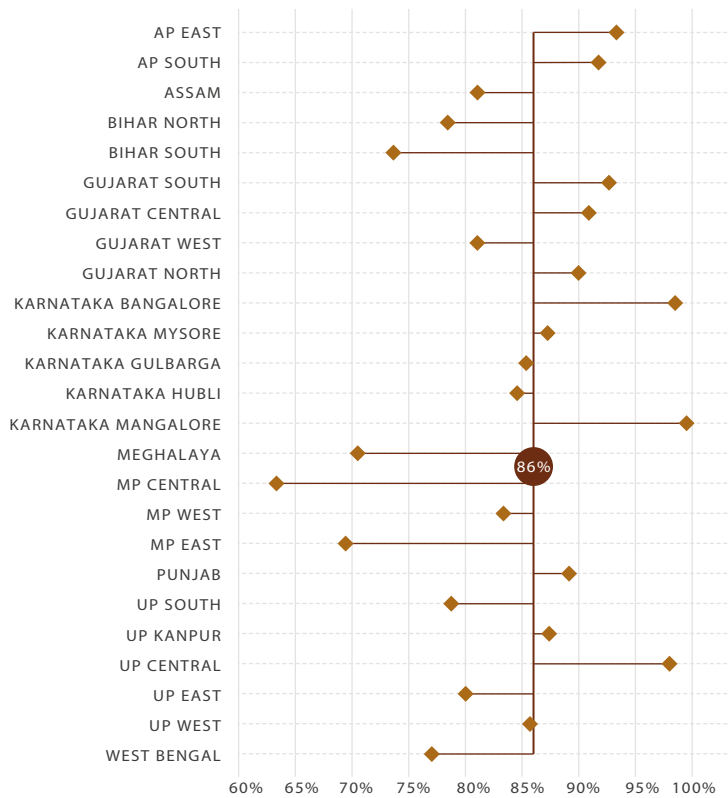


By reducing AT&C losses, utilities can not only improve revenues but also ensure the availability of additional energy, which can then be supplied to either existing or new customers. Ideally, every utility wants AT&C losses to be zero; due to design of the distribution system, however, there will always be some residual losses.

The Government of India's Ujwal DISCOM Assurance Yojana (UDAY) scheme targets a level of 15% AT&C losses, and many utilities have reduced their AT&C losses considerably in the last two years. According to the UDAY portal,⁴⁵ AT&C losses for UDAY states stands at 21.74% as of 2 December 2019. In this study's survey, the utilities in the state of Gujarat reported the lowest AT&C losses: between 5% and 10%, numbers that indicate 100% collection efficiency. As shown in Figure 4-6, the utilities in Madhya Pradesh and Uttar Pradesh tend to have higher AT&C losses, ranging from 29% to 47%. Lower billing efficiency is one of the major factors in higher AT&C losses.

⁴⁴ AT&C loss is calculated by the following formula: AT&C Losses = (1 - (Billing Efficiency x Collection Efficiency)) x 100.
⁴⁵ Government of India, UDAY Portal, <https://www.uday.gov.in>.

Figure 4-7: Billing efficiency, by distribution utility



Billing Efficiency

Billing efficiency indicates the ability of a utility to account for and bill for the power purchased efficiently. It is a key indicator of a utility’s operational performance; higher billing efficiencies reflect the ability to maximize the sales to customers of the energy purchased from power suppliers. This measure also indicates the extent of energy lost in the system in comparison to the energy supplied. A 100% billing efficiency would mean no pilferage due to theft and no technical losses. While complete elimination of theft is practicable, due to the inherent nature of electrical equipment, this is not the case with technical losses. None of the surveyed utilities have an established framework for technical loss reduction.

Figure 4-7 shows that a few of the surveyed utilities (Karnataka Mangalore, Karnataka Bangalore, and UP Central) report a billing efficiency close to 100%, while the average among all 25 surveyed utilities (hereafter, “survey average”) is only around 86%. A low billing efficiency of around 65% to 75% is reported by several utilities, including the lowest rate, around 63% found at MP Central. MP East and MP West, Bihar South, and Meghalaya also have reported lower billing efficiencies, indicating a need for improvement across customer billing and theft control practices; technical losses are generally a small fraction of total billing efficiency losses.



During the study’s field survey, the challenges faced by utilities were evident, with a majority expressing concerns following the implementation challenges of the Saubhagya scheme, whereby large numbers of customers were provided electricity immediately following energy meter installation. Inability to bill these customers as per the regulatory guidelines may lead to challenges in operational sustainability.

“ We have executed the Saubhagya programme at an exceptional speed, but the billing and metering challenges still unresolved may prove to be a challenge in the long run. Having pre-paid meters included as part of Saubhagya could have helped us. Such programs should allow for some flexibility to implement customized solutions relevant for a particular area or a state. In regards to additional load coming online due to Saubhagya and the capacity of our network, we do not think that is a problem, since many of the new customers were already hooking up to the same network to meet their needs. With formal connections and proper billing, the overall load could even come down.”

– Senior officials, PuVNNL (UP East)

Figure 4-8: Number of employees per 1,000 customers, by distribution utility

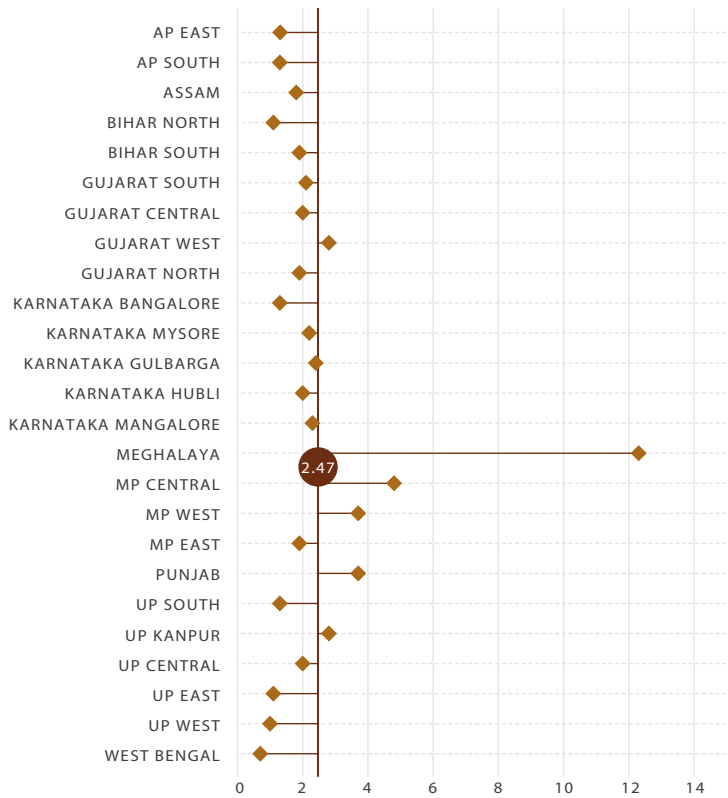
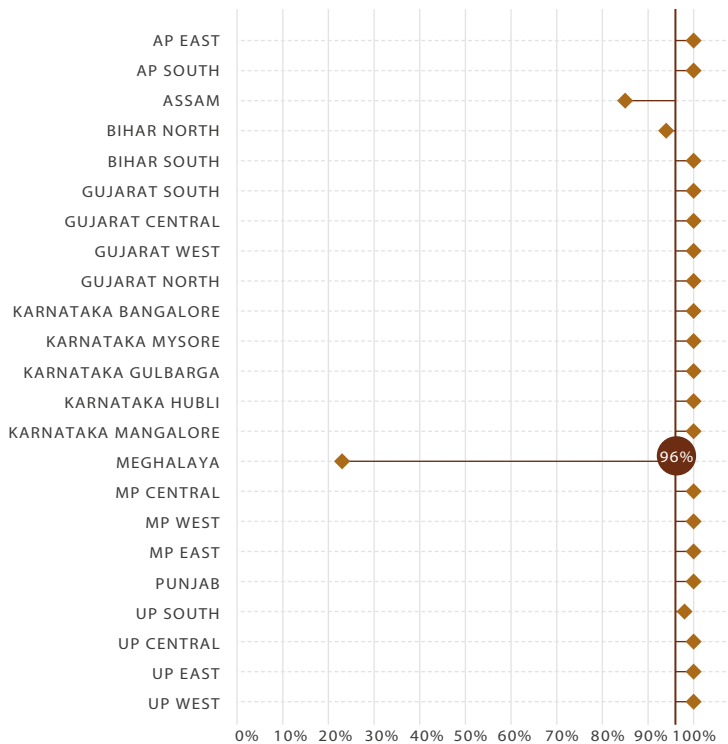


Figure 4-9: Coverage of 11 kV feeder metering, by distribution utility



Note: UP Kanpur and West Bengal did not submit data on 11 kV feeder metering.

Post Saubhagya, the new connection process has been simplified, with only two documents required to initiate an electricity connection across most of the surveyed utilities. Some focus areas for improving billing efficiency include automatic meter reading, on-the-spot billing, multiple touchpoints for collections, and billing by rural revenue franchises.

Employees Per 1,000 Customers

The ratio of total number of staff employed by a utility per 1,000 customers of the utility is an indicator of customer service. Monitoring this number helps to ascertain the labour power required for overall service of the distribution utility. The higher the value, the better the service quality. However, an optimum ratio is desired to manage the utility's staffing costs.

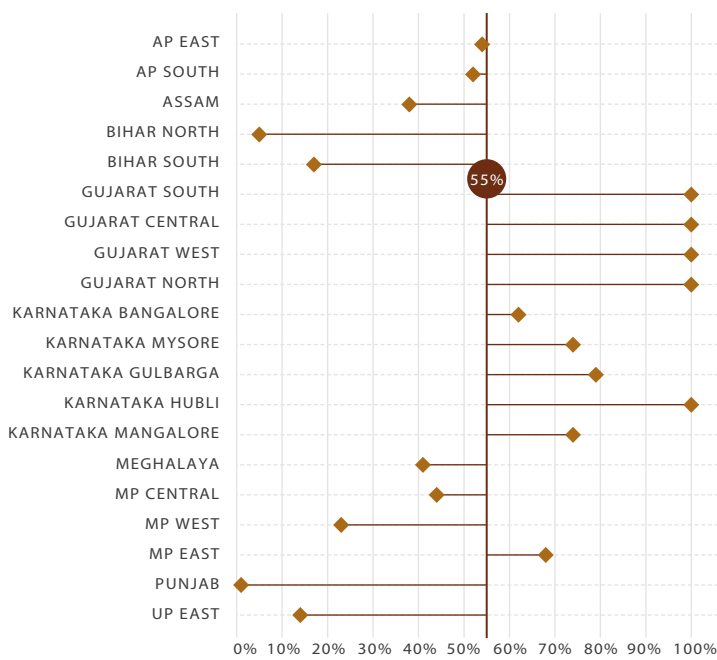
The surveyed utilities reported an average of 2.47 employees per 1,000 customers. As shown in Figure 4-8, Meghalaya operates at 12.33 employees per 1,000 customers while West Bengal, with the lowest ratio, has 0.70 employees per 1,000 customers. Benchmarking is essential to assess what size staff is adequate and required across various functions, which may be based on the size of distribution network that a utility operates. An overstaffed utility incurs additional employee costs in comparison to a utility with lower numbers of staff per customer base.

To optimize staffing, driven by service standards, network spread, and institutional framework, due diligence is needed. In this study's utility survey, even utilities with similar customer profiles and in the same state were seen to have varying labour power. Utility-specific benchmarking studies are needed to assess the optimum labour power required to meet the Standards of Performance.

Distribution Transformer (DT) and 11 kV Feeder Metering

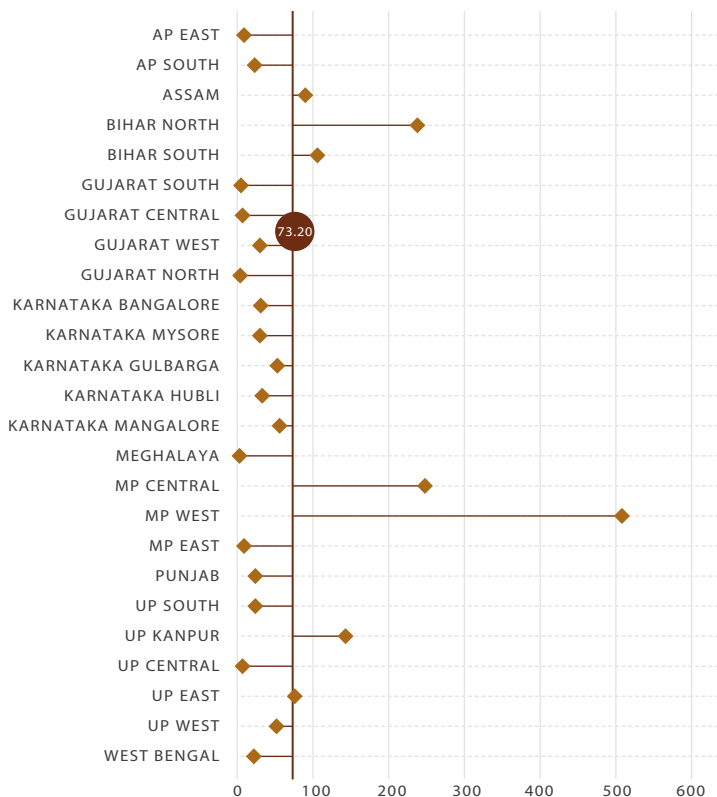
To measure energy consumption at different levels of a distribution network, DT and feeder metering is required. Metering is important for energy accounting to identify high technical and commercial loss areas at the DT and 11 kV feeder level and to strategically plan activities to reduce these losses. Metering can also help improve availability of the power supply and thus eventually result in better customer satisfaction. Most of the surveyed utilities are already achieving 100% coverage of feeder metering, as shown in Figure 4-9. Adding DT metering (see Figure 4-10) would certainly involve a considerable amount of effort but low investment.

Figure 4-10: Rural coverage of DT metering, by distribution utility



Note: UP South, UP Kanpur, UP Central and West Bengal did not submit data on DT metering. Urban DT metering is not presented here because there is low variability across utilities, with many utilities achieving 100% urban metering coverage.

Figure 4-11: Total number of interruptions per month, by distribution utility



All utilities except Assam, Bihar North, and Meghalaya have completed nearly 100% coverage of feeder metering, but coverage of DT metering is still lagging, with the surveyed utilities reporting an average of 55% coverage. The states of Uttar Pradesh, Punjab, and Bihar have made little progress on this, with less than 5% of DTs being metered. During the on-the-ground field survey, a serious lack of DT metering across rural areas was observed in most states, with only a few adopting a focused approach to address this.

Without accurate metering, it is difficult to identify high-loss DTs and feeders and to plan for loss reduction. Together with accurate customer mapping, DT and feeder metering can help utilities plan for both technical and commercial loss reductions. However, across the surveyed utilities, challenges in maintaining 100% communication of DT and remote feeder metering data on a monthly basis were observed. The purpose of metering these distribution assets is forfeited where data on periodic consumption patterns are unavailable.

Number of Interruptions

Power interruption is an important indication of the reliability of power supply to electricity customers. The number of interruptions helps to gauge two different aspects of a distribution system – system resilience and electricity deficit. The available benchmark is 15 interruptions per customer per month,⁴⁶ yet the average across the surveyed utilities is around 73 interruptions (of more than 5 minutes each) per month, as shown in Figure 4-11. (Data on power interruptions by individual customer was not available, so this analysis assumed the average number of interruptions per customer of each utility would affect all or most customers equally.)

The utilities in Madhya Pradesh reported the highest number of interruptions, with MP West reporting around 508 interruptions per month, while Meghalaya reported the lowest number, of around 3 interruptions per month. MP East, UP Central, and AP East also reported less than 10 interruptions per month of more than 5 minutes duration. Utilities also need to ensure accurate data upkeep, with system-based records for monitoring interruptions.

Higher numbers of interruptions may affect utilities' performance in various ways. Interruptions affect revenues, as the quantum of power supplied and billed is less when there are power outages. Power reliability also suffers,

⁴⁶ Forum of Regulators, *Report on Power Quality of Electricity Supply to the Consumers* (Janpath, New Delhi, 2018), <http://www.forumofregulators.gov.in/Data/Reports/Power07.pdf>, page 49-50.

Figure 4-12: Percentage of complaints resolved within stipulated timelines, by distribution utility

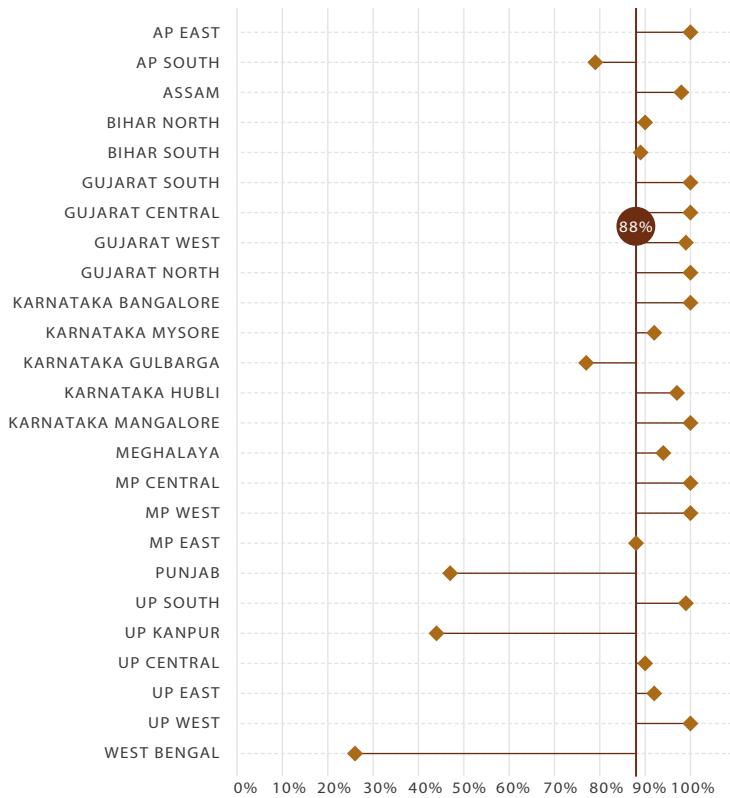
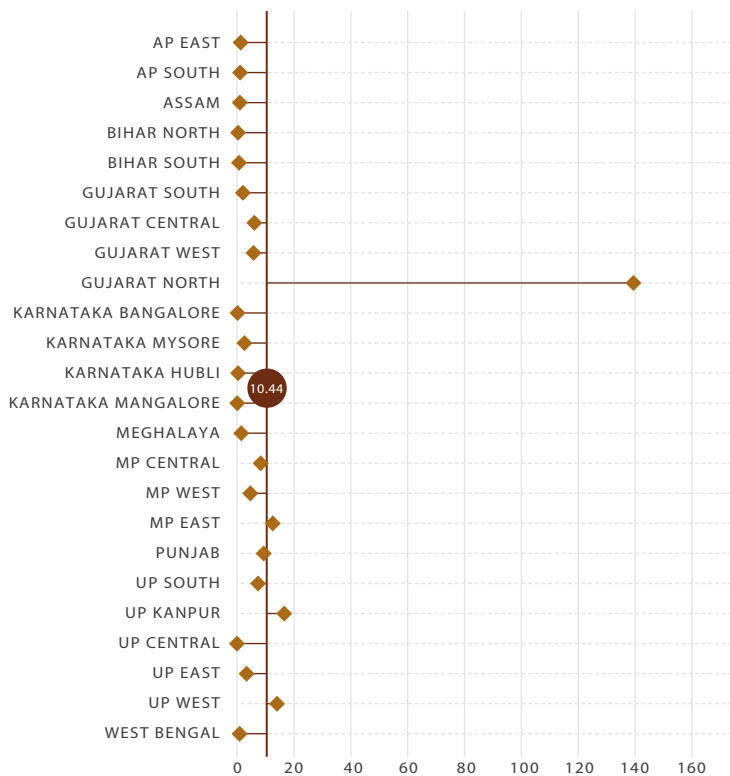


Figure 4-13: Number of theft cases detected per 1,000 customers annually, by distribution utility



Note: Karnataka Gulbarga did not submit data on theft cases.

and may further impact customer satisfaction levels, especially when interruptions impact customers' daily activities.

Complaint Resolution

Complaint resolution is another measure of utilities' operational capacity. This is measured as the percentage of customer complaints resolved by utility staff in the time stipulated by the regulatory commission of the state. It is an indicator of staff efficiency and is the direct indicator of customer satisfaction, faster complaint resolution, and better customer experience. Apart from customer satisfaction, it is also an important metric for meeting the Standards of Performance. Delayed resolution of complaints leads to customer dissatisfaction and further repeated complaints by the same customers. Such failure to achieve the Standards of Performance makes a utility vulnerable to penalties by State Electricity Regulatory Commission. At that point, the utility may be liable for compensation to the customer if it is found in default in resolving a complaint as per the standards.

To improve its complaint resolution percentage, a utility needs an ERP system or other efficient IT system that allows it to locate the affected customer, inform and deploy the relevant field team, and then track the resolution timeline. This means high investments, which is a challenge for financially crunched utilities. The stipulated time for complaint resolution depends on the type of resolution required and type of problem, from local problem to the type of problem that requires upgrades to the distribution system. According to the latest report by the Central Electricity Regulatory Commission, the maximum time for customer complaint resolution is 2 days if the fault is identified to be local and 180 days if an upgrade of the system is required.⁴⁷

The survey average for complaint resolution is 88%. As shown in Figure 4-12, nine of the surveyed utilities reported a perfect 100% in complaint resolution. The lowest percentage of complaints resolved, 26%, was by West Bengal. Punjab and UP Kanpur are also lagging, with less than 47% of customer complaints resolved in the stipulated time. This could be due to an ERP system that does not map the Standards of Performance regarding complaint resolution, or the lack of any ERP system at all. Except for in Gujarat, almost all states covered in the utility survey lacked an integrated ERP system for tracking power-related complaints.

⁴⁷ Forum of Regulators, *Report on Power Quality*, 2018, page 94.

Customer feedback is one of the critical elements of the complaint resolution framework, yet few utilities practise the same. Historically, in the absence of even a basic ERP system, it was common to see large numbers of wrong closures of complaints. This created distrust among customers and dented the image of electricity distribution utilities. It is essential to implement a comprehensive and uniform complaint resolution framework across Indian power utilities, bringing transparency and encouraging utilities to comprehend their responsibilities. Minimum mandatory sample checks at different hierarchy levels across the distribution utilities may be needed to add transparency and accountability to the system.

Reported Theft Cases Per 1,000 Customers



Post 100% household electrification, it has become a challenge for the utilities to keep check on network theft. The majority of the utilities do not have a robust framework for vigilance activities, which makes it difficult for them to minimize losses at the feeder or DT level. Utilities should devise a monthly vigilance plan to cover high-loss areas, and need adequate staffing to cover their vast customer base.

The indicator of power theft at a utility is the number of theft cases reported annually per 1,000 customers. Theft case reporting indicates the strength and reach of the utility's vigilance systems to identify the electricity theft cases in the distribution license area. The low reporting of theft cases at the surveyed utilities, as shown in Figure 4-13, can be attributed to a host of reasons, including inadequate data upkeep, a limited vigilance framework and inefficient tracking of vigilance activities, inadequate labour power to cover the large geographic area of the distribution network, and limited use of technologies and industry best practices for controlling theft.

The survey average for reported theft cases per 1,000 customers is 10.44. Among the surveyed utilities, Gujarat North reported the highest number of theft cases, of around 139.44 per 1,000 customers. Seven other utilities reported less than 1 theft case per 1,000 customers, with UP Central reporting the lowest figure of 0.02. By comparing Figure 4-6 and Figure 4-13, it becomes clear that some utilities with lower numbers of theft detections also have higher AT&C losses and should look into the possibility of implementing better established vigilance frameworks.

Utilities with lower billing efficiencies also need to focus on enhancing their vigilance and theft detection activities. Increasing the number of theft cases reported and adding cross-jurisdictional site visits by utility employees will bring in transparency.

Institutional Capacity

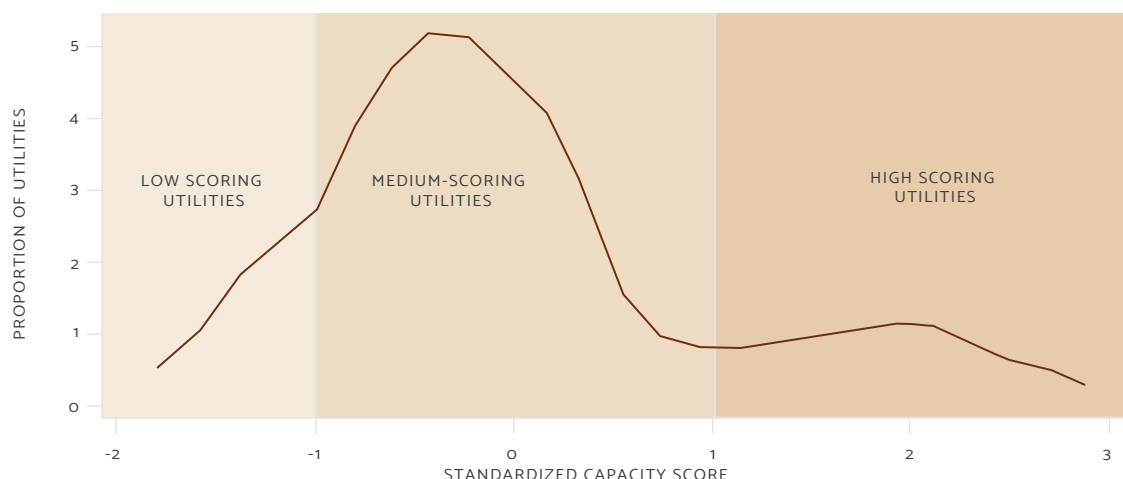
Institutional capacity broadly defines the established processes and competencies used across utilities to perform a task, as well as the resources and organizational structures in place. To achieve business objectives and targets, it is essential for a utility to maintain its institutional arrangements and bring out the best in an organization. This is also necessary to manage the business functions cost-effectively and efficiently. A frail institutional set-up may hamper a utility's ability to perform per standards and impact its overall performance. Some of the key elements of institutional capacity are a clear company vision, the availability of a knowledge portal, and the use of an IT system such as an ERP.

- ▶ **Clear company vision:** A company vision describes where the company aspires to be in the future upon achieving its goals and mission. It should be clear, progressive, and time-bound. Such a vision shows a clear road map of the company and identifies priority areas. In the case of distribution utilities, a clear and positive vision has a positive impact on overall service delivery and performance. As a utility's strategic goals and targets are derived from its vision, this vision acts as a guide for employees in decision-making and participating in achieving company objectives.

“ Poor vendor delivery and stringent project schedules have been challenging quality implementation on the ground. We face severe challenges due to our geographic landscape, and this sometimes impacts network strengthening and upgradation initiatives. And increasingly, we see that young engineers and staffers are reluctant to work hands-on in the field and prefer being in the corporate office. Utility operations require that field staff is properly enabled, encouraged, and incentivized to hit the ground on a regular basis.”

– Senior official, APDCL (Assam)

Figure 4-14: Bell curve for capacity of utilities



Note: “Other reasons” include several other reasons cited by customers during focus group discussions.

All the surveyed utilities were observed to have a clear company vision, but considering the dynamic work environment, another look into company vision is likely to be essential.

- ▶ **Availability of a knowledge portal:** A knowledge portal provides a “one-stop knowledge-shop” to a knowledge seeker or user within a utility. Presence of a knowledge portal indicates the ability of the utility to develop organizational knowledge as well as individual skill sets and capacity among employees. A knowledge portal acts as a supporting structure during online education and training requirements. It promotes secured knowledge-sharing among different categories of end users.

For the majority of the surveyed utilities, their knowledge portal is unstructured, with limited documentation. On random verification, certain crucial documents like Standards of Performance were found to be missing. It is prudent to have all such documents, including basic electrical reference documents, tutorial videos, and more, available in line with domestic and international best practices.

- ▶ **Availability of an IT system such as an ERP:** Availability of an IT system such as an ERP system allows a business to integrate and automate its processes with the least human intervention. It brings complete visibility into all the important processes, across various departments of an organization. Distribution utilities leverage technology to enhance operational efficiency and improve customer engagement and services. Such technological systems also ensure an automatic and coherent workflow from one department or function to another, ensuring smooth transitions, and enable quick and effective decision-making by drawing insight from the available data and bringing transparency

into the system. Such IT systems also enable a single, clearer reporting mechanism for the organization, accessible from any place at any point of time.

The majority of the surveyed utilities have not established an integrated ERP system. An exception is a few of the Gujarat utilities, which have established ERP systems.

Utility Ranking Based on Capacity to Deliver Access Sustainably

This chapter has thus far discussed the performance of the different utilities on specific elements of capacity. It is also imperative to compare the overall performance of each utility vis-à-vis one another. The objective of this exercise is to assess each utility’s strength and to enable the utilities to draw up corrective action plans for improving their performance and their ability to sustain that performance level.

Ranking the different utilities on a uniform scale can help to visualize their overall performance. This can also help the underperforming utilities to learn and adopt best practices used by better performers in their specific area of concern.

Methodology for Assessing and Ranking Capacity

In order to understand the drivers and initiatives behind utility performance, study staff engaged in primary interactions with senior and middle management across all utilities. In addition, field visits were carried out across each state to understand the on-the-

Table 4-2: Distribution utilities' scores on each category of capacity metrics and rank in order of capacity to deliver access

Utility	Infrastructural Capacity	Operational & Institutional Capacity	Total Score	Rank	Band
Gujarat South	35	53	88	1	High
Gujarat Central	34	49	83	2	High
Gujarat West	33	44	76	3	High
Gujarat North	34	39	73	4	High
Punjab	34	30	64	5	Medium
AP East	20	36	56	6	Medium
Karnataka Bangalore	15	39	54	7	Medium
MP West	21	33	54	8	Medium
UP Central	16	37	53	9	Medium
Karnataka Mysore	18	34	52	10	Medium
AP South	20	31	51	11	Medium
Karnataka Mangalore	9	43	51	12	Medium
MP Central	20	30	50	13	Medium
Karnataka Hubli	11	39	50	14	Medium
Karnataka Gulbarga	13	36	49	15	Medium
Meghalaya	17	29	46	16	Medium
Bihar South	20	26	45	17	Medium
UP West	22	24	45	18	Medium
Assam	22	22	44	19	Medium
MP East	17	26	44	20	Medium
Bihar North	20	18	37	21	Medium
UP South	13	19	32	22	Low
West Bengal	16	17	32	23	Low
UP East	10	21	31	24	Low
UP Kanpur	11	16	27	25	Low

Note: Utilities are listed in rank order from 1 (best performance) to 25 (worst performance). Scores could range from zero (worst performance) to 100 (best performance).

ground situation of the distribution network. The field visits assessed randomly identified feeders and substations across urban and rural areas served by each state's distribution utilities. The focus of the utility survey was to bring out best practices across utilities.

In the rest of this section, the utilities surveyed for this report are ranked from 1 (best performance) to 25 (worst performance) on each of the 12 metrics described in this chapter under infrastructural capacity and operational and institutional capacity. Each of the metrics is then weighted equally and each utility's score across each metric calculated by multiplying the rank score and the weight. The scores for

each aspect were then aggregated to obtain a consolidated overall score for each utility on its overall capacity to deliver access sustainably.

Key Findings on Utility Capacity

Table 4-2 provides each of the surveyed utilities' scores on infrastructural capacity and operational and institutional capacity, along with the overall aggregated score and utilities' relative ranks on these elements of capacity.

- The Gujarat utilities lead in capacity to deliver, with all four receiving the top four ranks among the surveyed utilities and

Table 4-3: Best practices and key challenges among the surveyed distribution utilities

Category	Best Practices	Key Challenges
High scoring (Rank 1–8)	<ul style="list-style-type: none"> • High levels of feeder segregation • Routine preventive maintenance practices • Accurate tracking of losses feeder by feeder • High-level monitoring and tracking of performance via digital dashboards • Strengthened customer grievance redressal mechanisms • Refined NSC release processes • Frequent Lokdarbars at the village level for customer grievance redressal • State-specific schemes for operational improvement, HVDS implementation • Strategic network planning, maintaining adequate HT:LT ratios • Large-scale network undergrounding activities, increasing reliability and safety • Strong customer and system metering practices 	<p>Short term:</p> <ul style="list-style-type: none"> • Limited awareness among agricultural customers on timely bill payments • Delayed payments by state government departments <p>Long term:</p> <ul style="list-style-type: none"> • Limited strategies for realization from long-pending debtors • Limited preparedness among utilities for healthy upkeep of undergrounded networks • Limited technological interventions for further bringing down existing levels of AT&C losses
Medium scoring (Rank 9–16)	<ul style="list-style-type: none"> • E-Seva portals for customer assistance and faster release of NSCs • Smart metering across select areas • Regularization of irrigation pump customers • Customer interaction weeks across rural areas • Organizing HT/EHT customer meets (on a yearly basis) • Routine network load balancing activities • Annual felicitations to best-performing sections/subdivisions/divisions • Technical audit and quality control checks on materials/works • Focused collection drives for arrear collection from customers • Undergrounding across select areas • Check metering across high-value customers 	<p>Short term:</p> <ul style="list-style-type: none"> • Limited awareness among customers (specifically agricultural customers) on the need for meter-based billing • Errors across customer billing largely due to human intervention • Limited supervision/monitoring of billing and collection activities • Limited preparedness among utilities for adhering to regulator-defined Standards of Performance <p>Long term:</p> <ul style="list-style-type: none"> • Terrain/topology-specific network planning and development • Limited strategies for realization from long-pending debtors • Increasing reliance on automation and IT-based initiatives, with limited in-house IT competency among employees and dependency on outsourced models • Effective maintenance of services to remote customers, especially across rural areas • Limited focus on imparting quality service-oriented training to employees • Developing a robust performance management system to simultaneously drive employee motivation and utility performance
Low scoring (Rank 17–25)	<ul style="list-style-type: none"> • Use of single-phase transformers in places with dispersed population to avoid load imbalance • Dedicated grievance portals for industrial customers • Launch of Jhatpat connection scheme for quick release of new connections • Regular customer awareness camps for bill dispute resolution • Engagement of agencies for arrear collection from customers • Involving public representatives and local civic authorities to mobilize new-connection and other service-related issues 	<p>Short term:</p> <ul style="list-style-type: none"> • Network load balancing across rural areas, with scattered customers and irregular loading patterns • Limited staff adherence to the Standards of Performance, leading to inferior services • Limited preparedness among utilities for adhering to regulator-defined Standards of Performance • Limited system checks in place to identify customers with arrears trying to avail NSCs • Delayed payments by state government departments • Feeble vigilance/enforcement mechanisms in place for scattered rural customer bases <p>Long term:</p> <ul style="list-style-type: none"> • Low capacity of network to deliver quality and reliable power, with the majority of past investments put towards network expansion • Non-existence of preventive maintenance frameworks • Regulatory disallowances limiting adequate resources for strengthening investment or operational activities • Terrain/topology-specific network planning and development • Limited IT interventions across operations, leading to lower transparency • Developing a robust performance management system to simultaneously drive employee motivation and utility performance • Limited focus on imparting quality service-oriented training to employees

Abbreviations: AT&C, aggregate technical and commercial; HT/EHT, high tension/extra high tension; HT:LT, high tension to low tension; HVDS, high voltage distribution system; IT, information technology; NSC, new service connection.



delivering all-round performance on all three categories of capacity. Gujarat South, securing rank 1 in all categories, demonstrated consistency in performance.

- ▶ Utilities across Uttar Pradesh performed far below the other utilities, with three of its five utilities ranking above 20 and UP East ranking 25.
- ▶ Several utilities demonstrated inconsistent performance, performing well in one capacity but poorly in another.

Best Practices and Challenges for Distribution Utilities

Understanding where utilities rank against each other in terms of their capacity to deliver access is the first step. With this knowledge, the intent is to identify key challenges being faced by utilities and bring out some of the best practices already implemented. These best practices may have either strengthened a utility's internal capacity or directly impacted customer satisfaction. Table 4-3 summarizes the learnings that enabled the surveyed utilities to solve specific challenges.

In addition to best practices, Table 4-3 also captures some key challenges that are being faced by the surveyed utilities. In order to contextualize these learnings and develop an appropriate set of recommendations, the utilities are divided into three categories based

on their capacity scores – high scoring, medium scoring, and low scoring.

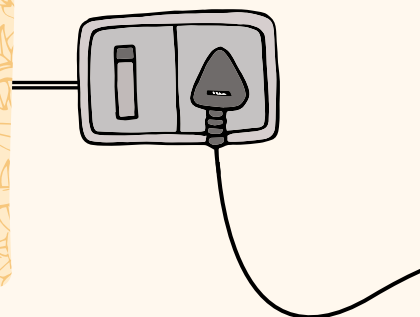
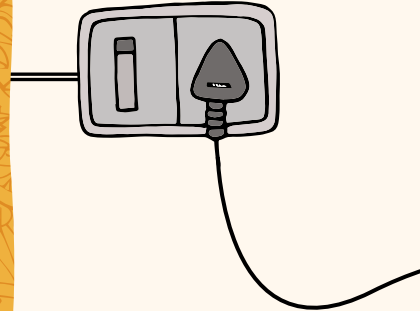
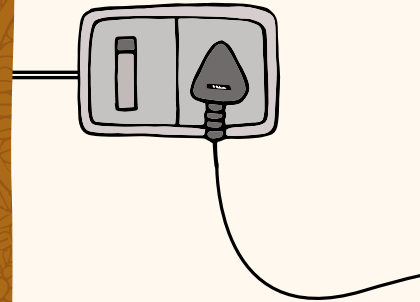
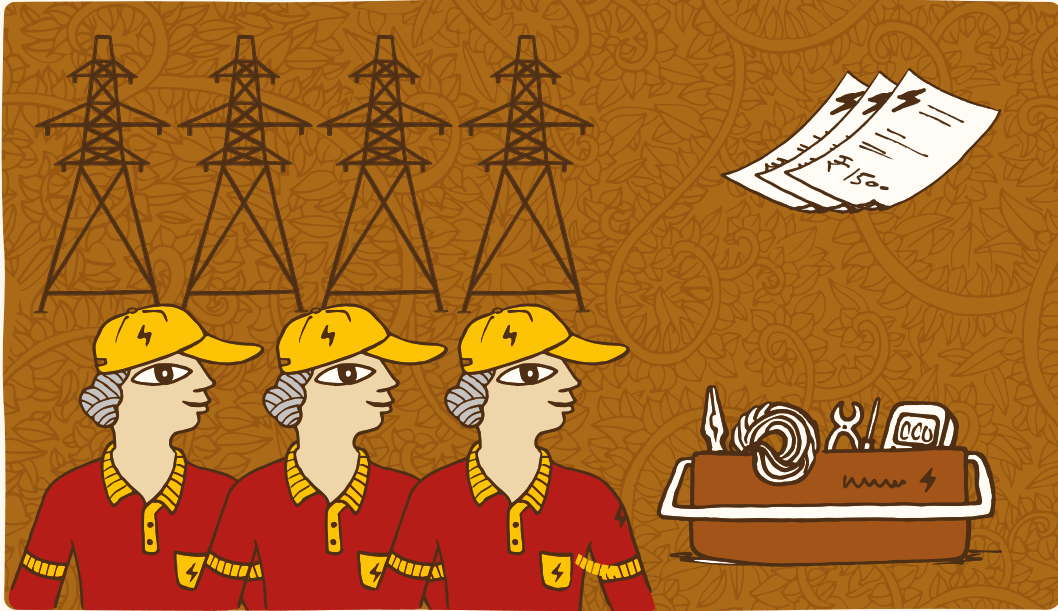
Findings from the Observational Field Survey

To assess and obtain a better understanding of the various utilities' field operations, sample surveys were conducted on the ground, randomly selecting feeders across rural and urban areas. The selected feeders were observed to identify performance on a number of parameters, including hours of supply, network condition, metering efficiencies, and level of theft.

Poor network condition was observed across the majority of states in this study, with damaged cables/conductors, unsafe DT installations, and oil leakage across DTs. Theft was observed across rural and urban feeders in most of the states, indicating a need for strengthened vigilance and theft control activities. Feeder segregation was not completed across all the utilities, with a large number of feeders still serving a mix of agricultural and non-agricultural customers. There was limited DT metering, even across urban feeders, with only a few utilities across Gujarat, Uttar Pradesh, and West Bengal providing DT metering across both rural and urban areas. Detailed findings from the observational field survey, by state and distribution utility, are provided in Appendix.



Drivers of Access



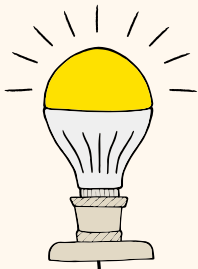
Access Score

High Performer (>70)

Medium Performer (70-60)

Low Performer (<60)

High



INFRASTRUCTURAL CAPACITY

5.91
(MVA/MW)

1.10
HT/LT RATIO

6.0%
DT FAILURE RATE (%)

OPERATIONAL & INSTITUTIONAL CAPACITY

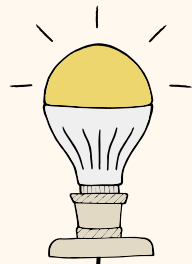
11.2%
AT&C LOSSES

90.4%
BILLING EFFICIENCY

95.4%
COMPLAINTS RESOLVED WITHIN SOP TIMELINES

1.87
NO. OF EMPLOYEES PER 1,000 CUSTOMERS

Medium



INFRASTRUCTURAL CAPACITY

2.40
(MVA/MW)

0.77
HT/LT RATIO

10.8%
DT FAILURE RATE (%)

OPERATIONAL & INSTITUTIONAL CAPACITY

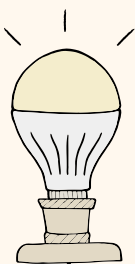
19.8%
AT&C LOSSES

82.4%
BILLING EFFICIENCY

85.8%
COMPLAINTS RESOLVED WITHIN SOP TIMELINES

3.17
NO. OF EMPLOYEES PER 1,000 CUSTOMERS

Low



INFRASTRUCTURAL CAPACITY

2.79
(MVA/MW)

0.34
HT/LT RATIO

13%
DT FAILURE RATE (%)

OPERATIONAL & INSTITUTIONAL CAPACITY

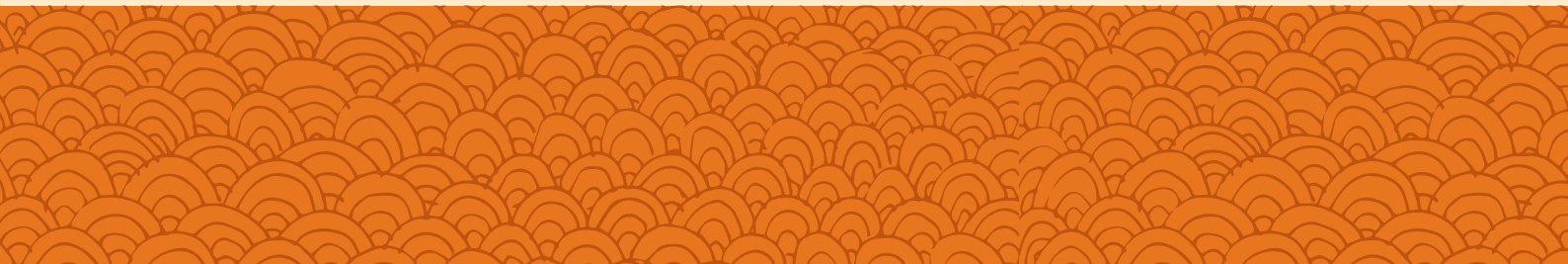
23.9%
AT&C LOSSES

83.1%
BILLING EFFICIENCY

86.4%
COMPLAINTS RESOLVED WITHIN SOP TIMELINES

1.60
NO. OF EMPLOYEES PER 1,000 CUSTOMERS

5



Drivers of Sustainability for Utilities

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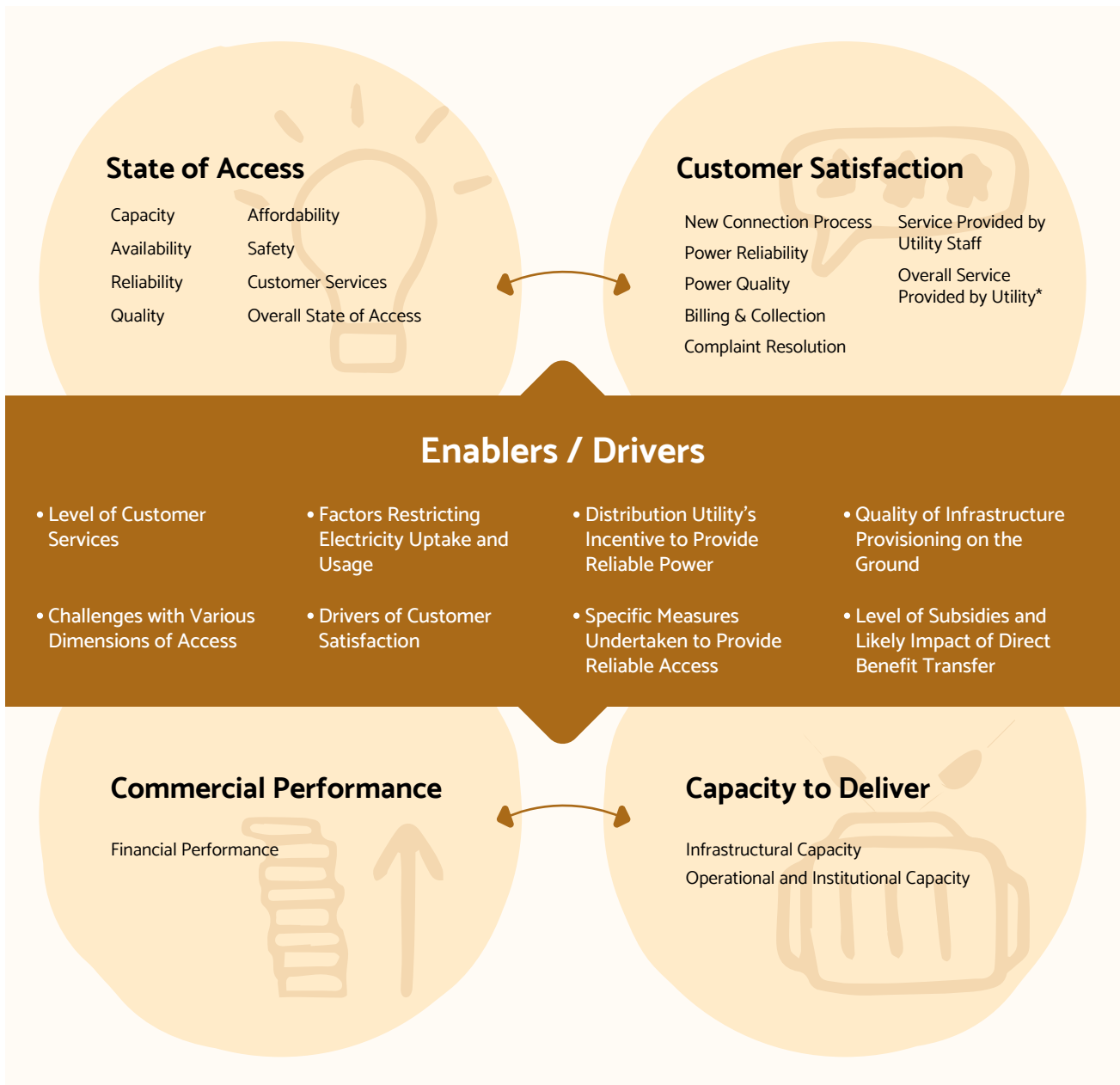
Drivers of Sustainability for Utilities



The preceding chapters have discussed electricity's demand side (customers) and supply side (electricity distribution utilities, also known as distribution companies or DISCOMs). Chapter 2 addresses the state of electricity access and the sustainability of electricity access in India. Chapter 3 discusses customers' satisfaction with regard to different aspects of electricity service. These chapters also compare the performance of distribution utilities with regard to electricity access and customer satisfaction. Chapter 4 focuses on the utilities' capacity to deliver electricity access, based upon the fundamental pillars of infrastructural, financial, operational, and institutional capacity.

This chapter explores the relationships between different elements mentioned in

the previous chapters, including customer satisfaction achieved, level of access delivered, and utilities' capacities to deliver sustainable electricity access. This exploration can help identify the key drivers for each of these elements and provide evidence as well as insights for accelerating access. It is also important to understand how these aspects may influence utilities' financial performance. This understanding can help to identify priorities for utilities to address in order to enhance their own profitability and sustainability.



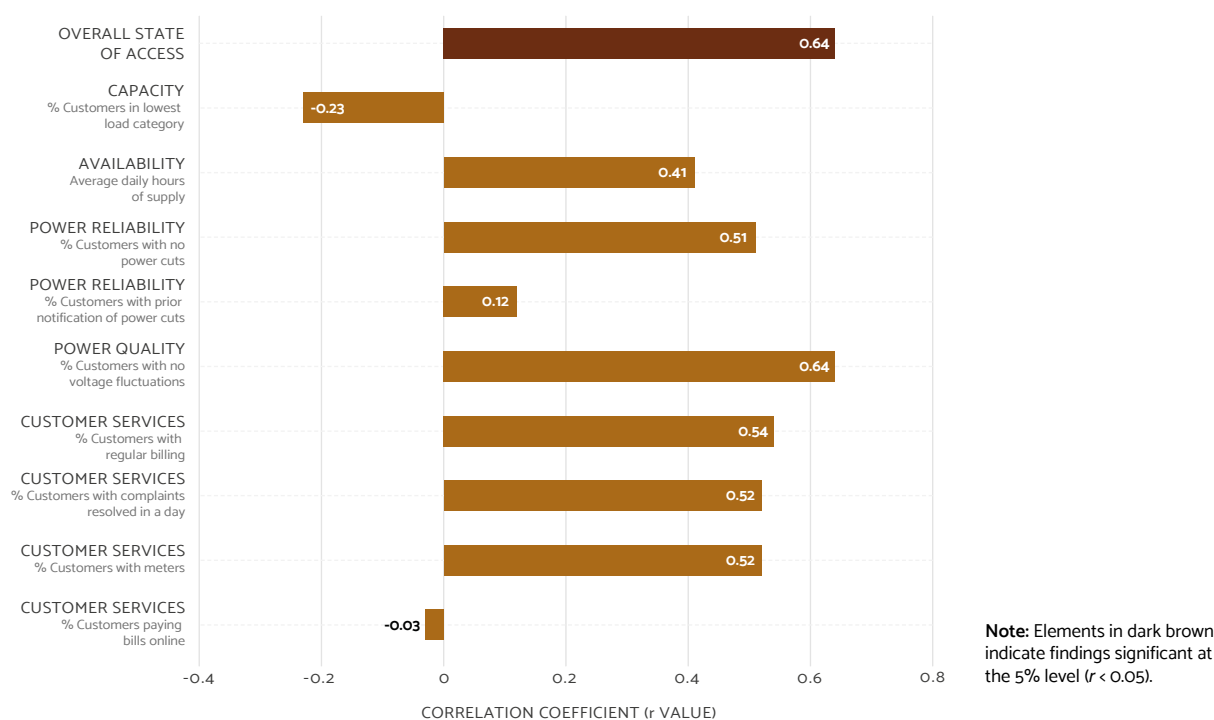
*The dimensions of overall state of access and overall service provided by utility each include aggregated performance on all preceding dimensions in that category

Conceptual Framework

For any industry, the customer is the most crucial part of the value chain. Customers are the source of revenue. This is even more true for a service industry: customer experience and satisfaction become even more critical in the face of possible variability of services, whereas in a manufacturing or product-based industry, the quality of the offering delivered can be largely controlled and standardized. For a service provider, customer satisfaction acts as a feedback tool that helps the provider to maximize revenues or minimize losses by calibrating its service delivery to encourage customer loyalty and retention.

Due to the inherently monopolistic nature of the power distribution utility business in India, the service component part has often been neglected. After all, the user/customer has not had much choice traditionally. However, this may not always be true. Potential policy reforms such as segregation of carriage and content, enablement of open access, and creation of a National Open Access Registry may drive change in this regard. Further, even in the present scenario, there are serious concerns about the financial performance and profitability of the electricity distribution business in India. Urgent solutions are required to ensure a functioning energy sector. In addition, the national clean energy goals are dependent on the ability of the power distribution business to revive itself, and any slippages are likely to derail progress on the climate change agenda.

Figure 5-1: Correlation trend between overall customer satisfaction and selected indicators of access



Another crucial aspect which has been overlooked is utilities' capacity to deliver on the lofty goal of 100% grid-based electricity access. Since the last round of major reforms, including the introduction of the Electricity Act, 2003 and the unbundling of the state electricity boards, utility performance has typically been measured by financial or operational efficiency. Few attempts have been made to uncover a deeper understanding of the underlying drivers of capacity and performance for distribution utilities.

In order to understand these drivers, the remainder of this chapter explores the relationship between some of the different elements at play. At an overall level, this includes the following questions:

- ▶ Is there a relationship between the level of electricity access delivered by a utility and the satisfaction level of its customers?
- ▶ Is there a relationship between a utility's capacity to deliver sustainable energy access and the overall level of electricity access achieved?
- ▶ Is there a relationship between a utility's financial performance, customer satisfaction level, and capacity to deliver sustainable energy access?

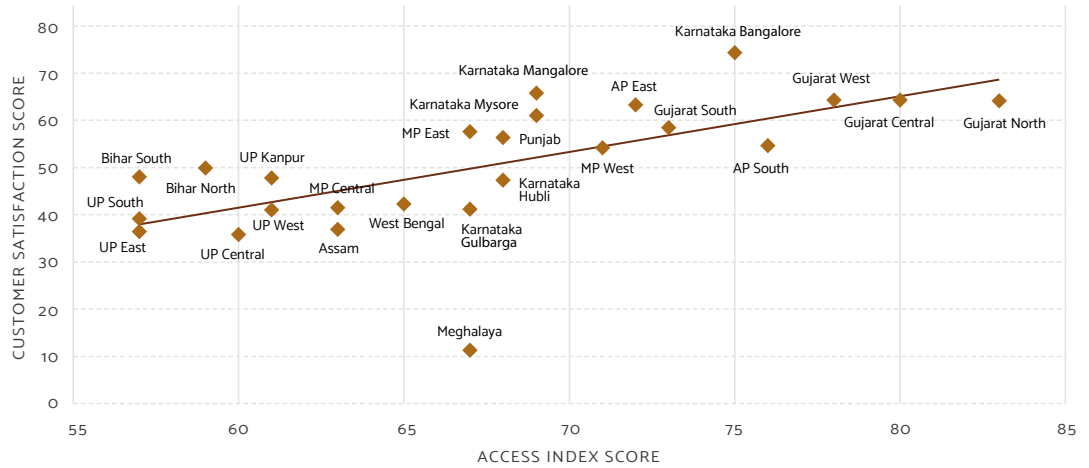
Understanding the Relationship Between Access and Customer Satisfaction

Identifying factors that impact customers' satisfaction with their electricity services can help utilities prioritize aspects of service and ensure optimum utilization of limited public resources. This section connects the dots between the type and depth of electricity access achieved and the levels of customer satisfaction. The analysis is based on the dimensions of meaningful access in the Multi-tier Framework–India (MTF-I), as introduced in Chapters 1 and 2, and the customer satisfaction index presented in Chapter 3. The specific elements used as baseline to examine the relationship between satisfaction and access for a particular distribution utility are summarized below:

- ▶ Overall state of access
- ▶ Capacity – percentage of customers in lowest load category
- ▶ Availability – average daily hours of supply
- ▶ Reliability – percentage of customers with no power cuts
- ▶ Reliability – percentage of customers with prior notification of power cuts
- ▶ Quality – percentage of customers with no voltage fluctuations



Figure 5-2: Relationship between customer satisfaction and access index scores



- ▶ Customer services – percentage of customers with regular billing
- ▶ Customer services – percentage of customers with complaints resolved in a day
- ▶ Customer services – percentage of customers with meters
- ▶ Customer services – percentage of customers paying bills online

Figure 5-1 presents the correlations between customer satisfaction and selected indicators of electricity access, some of which are considered key factors in customer satisfaction.

Figure 5-1 shows that a utility’s overall access index score is strongly correlated with its overall customer satisfaction score at a statistically significant level. This is also visible in Figure 5-2’s scatter plot, which distributes each of the surveyed utilities based on their access index and customer satisfaction scores. By using the access index score, each utility’s position on level of access accounts for all of the drivers of sustainability of electricity access. (Details on calculation of the access index score can be found in Appendix.)

As shown in Figure 5-2, states with better performance on access have also achieved higher customer satisfaction. A strong correlation between these elements of performance is seen among utilities at both right and left ends of the trend line. Utilities in Gujarat and Andhra Pradesh (at right), for example, show both higher levels of access and satisfaction, while utilities in Uttar Pradesh (at left) shows lower levels of access and satisfaction.

Chapter 2 reported that 13% of the surveyed customers do not have any access to grid-based electricity, and many users, especially commercial customers, depend on non-grid sources to meet their electricity requirements. Providing access to grid electricity would increase customer satisfaction.

Among customers who already have grid access, the quality of the electricity supply is critical and strongly influences satisfaction. A majority of the customers (71%) who were satisfied with the quality of their power reported no voltage fluctuations (see Figure 5-3).

Figure 5-3: Relationship between customer satisfaction and power quality (% of customers with no voltage fluctuations)

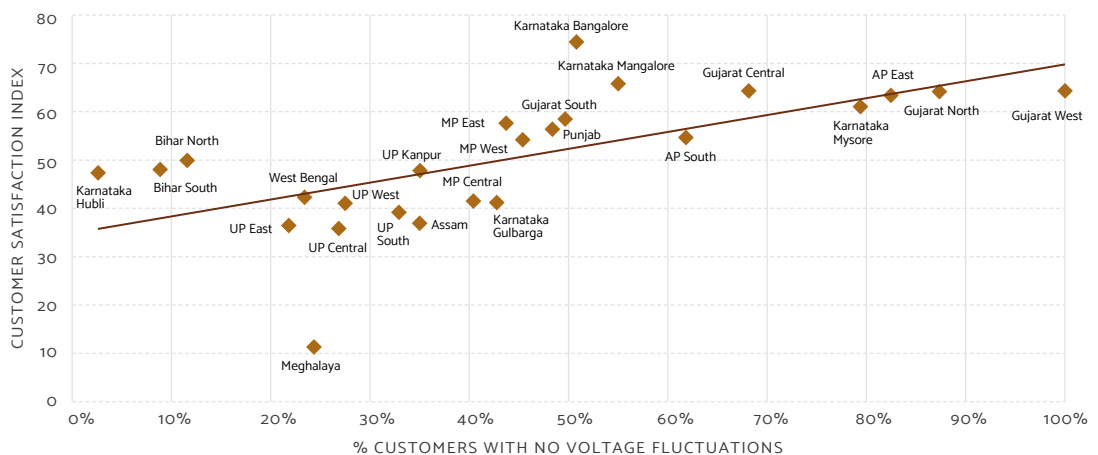
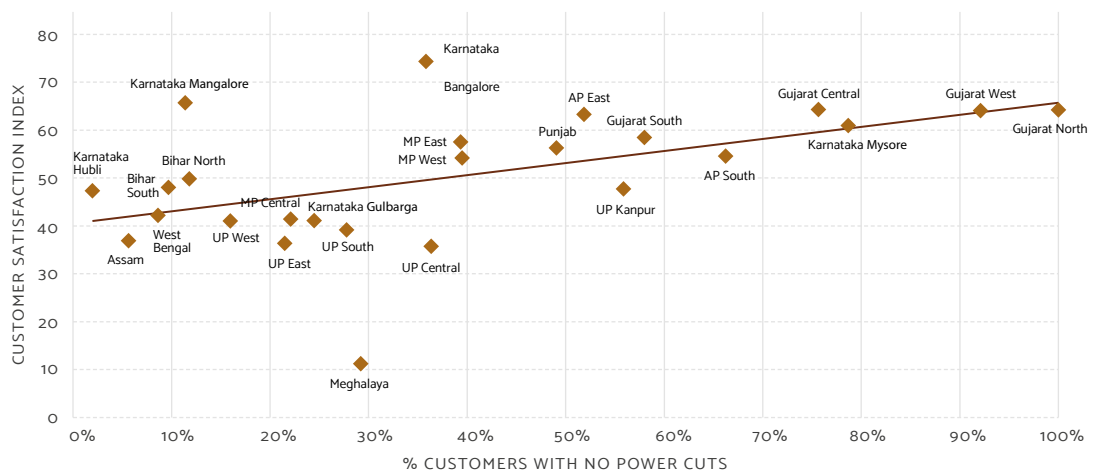


Figure 5-4: Relationship between customer satisfaction and power reliability (% of customers with no power cuts)



To examine the relationship between customer satisfaction and power reliability, two variables – number of power cuts and prior notification of power cuts – were considered. Absence of power cuts is strongly correlated with customer satisfaction (see Figure 5-4), and customers seem to value fewer power cuts even more than they value prior notification of upcoming power cuts. Reducing the number of power cuts can therefore drive customer satisfaction.

Surprisingly, the correlation between customer satisfaction and average number of hours of electricity supplied per day is weak. This is probably due to customers' increased expectations and perceptions of a 24*7 power supply as a basic need to be met by utilities.

Besides quality and reliability, several aspects of customer services also influence customer satisfaction. Regular billing (i.e., billing at a fixed frequency) is strongly correlated with satisfaction. Most of the customers (61%) who were satisfied with their overall electricity services reported receiving bills at regular intervals. Regular billing by a distribution utility helps customers pay on time in smaller increments and not feel the burden of one large lump-sum payment. Complaint resolution time is also strongly correlated with customer satisfaction ($r = 0.52$): 62% of customers satisfied with their overall electricity services reported that their complaints got resolved within a day. This indicates that timely resolution of complaints drives satisfaction.

The fact that higher-order needs like power quality, reliability, and customer services (e.g., regular billing and complaint resolution time) are critical drivers of customer satisfaction is an interesting finding. It highlights a sort of reversal in trend wherein having a basic electricity connection and availability of supply

during evening or night hours is no longer enough to drive positive customer opinion. Instead, the drivers seem to have shifted to the service aspects of electricity distribution. Utilities will need to emphasize these aspects of electricity services to drive customer satisfaction. Increased customer satisfaction would lead to timely payment and increased demand, which ultimately can help the utilities improve performance.

Other variables that could help customers better manage outages, like mode of payment and prior notification of power cuts, do not seem to influence customer satisfaction. Sanctioned load also doesn't appear to influence customer satisfaction.

Understanding the Relationship Between Access and Capacity to Deliver

As seen in the previous section, customer satisfaction is driven by indicators related to overall sustainability of electricity access. Sustainability of access also implicates utility capacity and may broadly depend on the infrastructural, operational, and institutional capacity existing within a distribution utility.

This section attempts to evaluate the relationship between a utility's capacity and the level of electricity access achieved among its customers. For the purpose of analysis, a capacity score was calculated for each distribution utility using two dimensions: infrastructural capacity and combined operational and institutional capacity. These dimensions are further made up of various relevant metrics (discussed in Chapter 4). Each

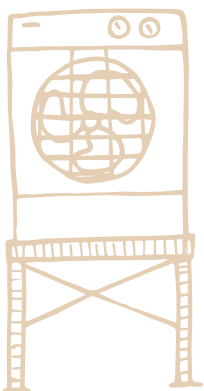
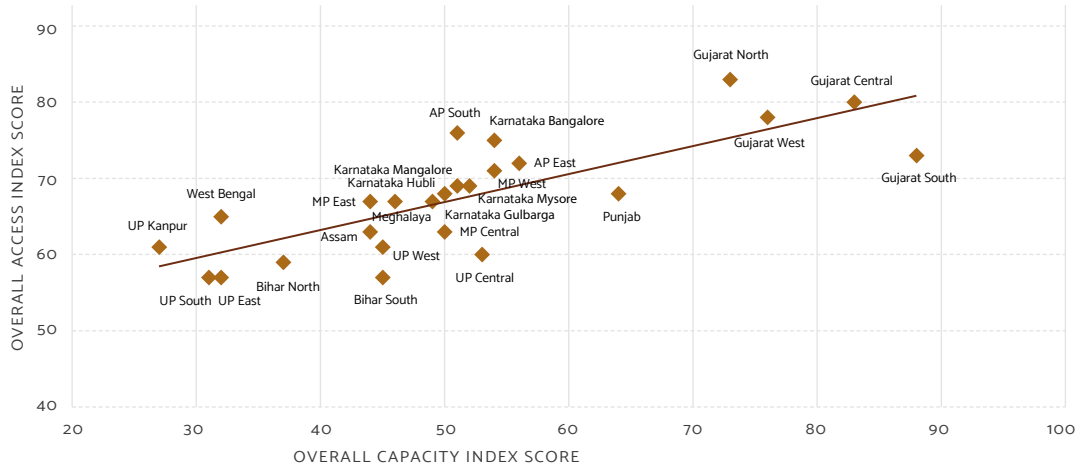


Figure 5-5: Relationship between access index and capacity index scores



dimension and each indicator is assigned equal weight to construct the composite capacity scores. The surveyed utilities' overall access index scores are then regressed against their capacity scores to understand the existence of any relationship between the two. (The methodology for calculating capacity scores is discussed in Chapter 4 and Appendix.)

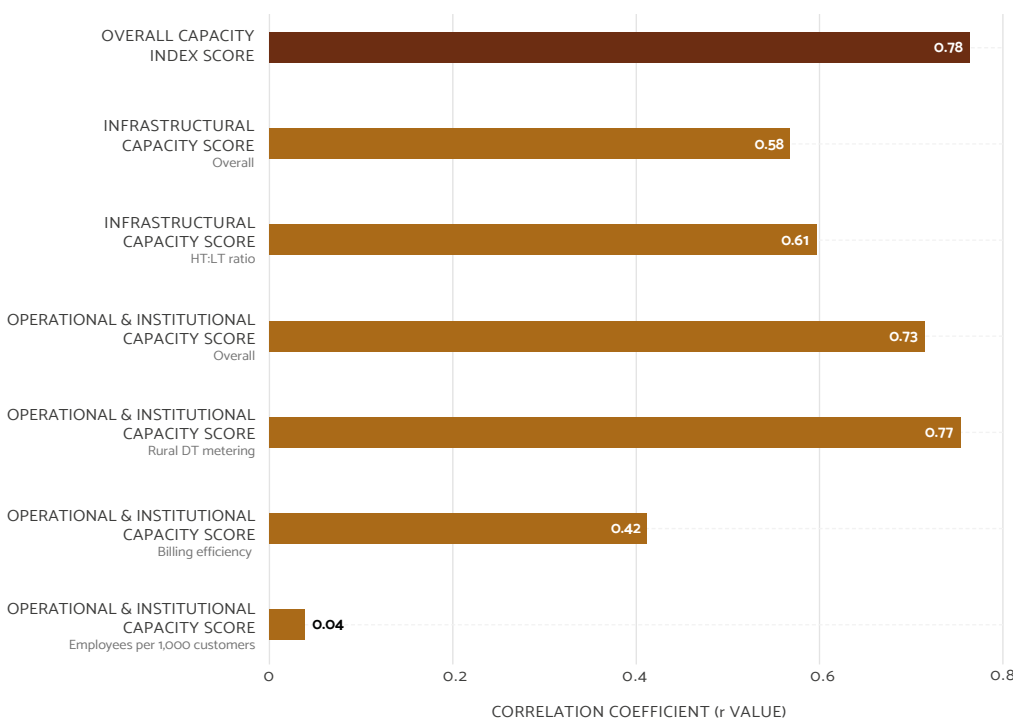
As shown in Figure 5-5, a utility's overall capacity index score is strongly correlated with its access index score, indicating a strong positive relationship between capacity to deliver and the level of access achieved. This relationship is statistically significant as indicated by a *t*-test ($t = 7.33$). In order to improve access, utilities need to enhance their capacity to deliver.

Figure 5-6 presents the correlations between level of access achieved by a utility and the dimensions of that utility's capacity to deliver.

Results of interest (Figure 5-6):

- ▶ Though both infrastructural and operational capacities are critical, operational capacity appears to be more important for delivering access. This is indicated by relative strength of the correlation coefficients (the correlation between infrastructural capacity and access = 0.58, whereas the correlation between operational capacity and access = 0.73).
- ▶ The strong correlation between operational capacity and access indicates that strengthening operational capacity can improve a utility's performance on access.

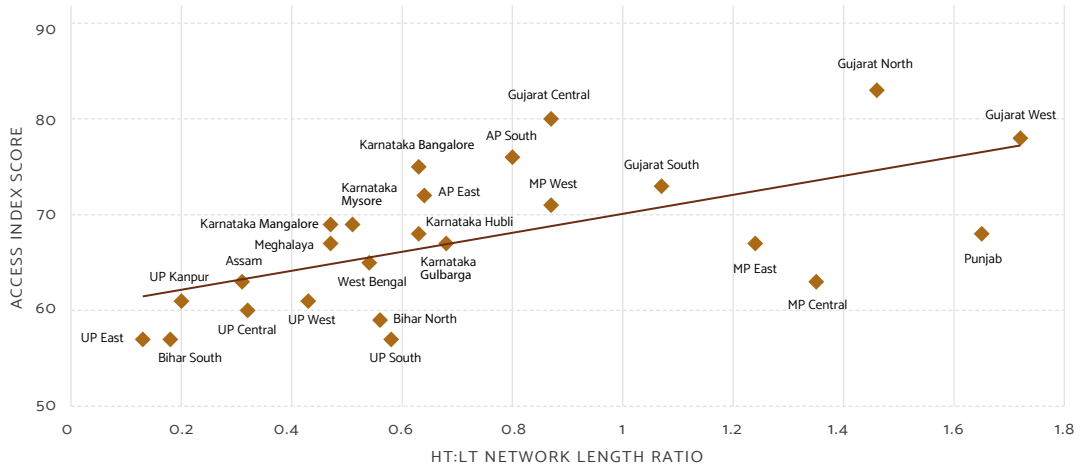
Figure 5-6: Correlation coefficient between overall access and selected indicators of capacity to deliver



Note: Elements in dark brown indicate findings significant at the 5% level ($r < 0.05$).

Abbreviations: DT, distribution transformer; HT, high tension; LT, low tension.

Figure 5-7: Relationship between access and infrastructural capacity (HT:LT ratio)



Abbreviations: HT, high tension; LT, low tension.

- ▶ Within operational capacity, the relative strengths of different indicators varied. Rural distribution transformer (DT) metering was found to be strongly correlated with access. However, the correlation between number of employees (permanent employees per 1,000 customers) and access is weak. This shows that employment levels or lack of employees is not acting as a barrier to access, perhaps because many of a distribution utility’s services can be improved or delivered by leveraging technology. Gujarat North, the best performing utility in terms of access, ranks 14 in number of permanent employees per 1,000 customers.
- ▶ The correlation between infrastructural capacity and access ($r = 0.58$), while weaker than that between operational capacity and access, is still strong. Within the infrastructural capacity, the high-tension network to low-tension network (HT:LT) ratio is critical for delivering access. The strong association between HT:LT ratio and overall access index scores is shown in Figure 5-7. The relationship between access and operational and institutional capacity is shown in Figure 5.8.

Understanding the Relationships Between Utility Performance, Customer Satisfaction, and Capacity to Deliver

Profitability is critical for long-term financial viability and sustainability of electricity distribution utilities, as well as their ability to meet customer expectations. Profitability allows a utility to upgrade its infrastructure and its operational and institutional capacity to improve access to electricity. This section discusses the relationship between profitability and a utility’s capacity to deliver. It also discusses the relationship between type of customers and profitability.

It is critical first to appreciate the various contours of profitability in the Indian power distribution business. The power distribution

Figure 5-8: Relationship between access and operational and institutional capacity

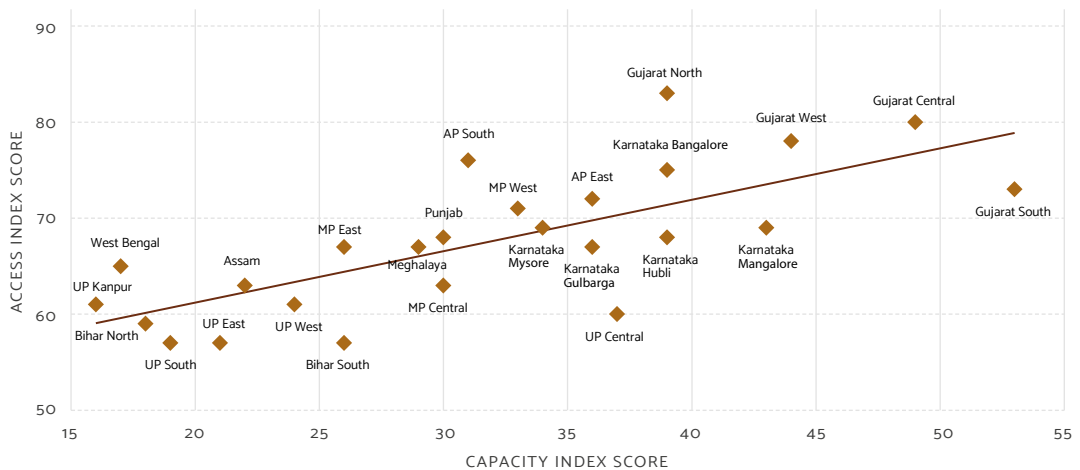


Table 5-1: Reported profit/loss percentage and ACS-ARR gap by utility

Distribution Utility	Profit/Loss as % of Revenue ^a	ACS-ARR Gap (INR/kWh) ^b
AP East	-6%	0.71
AP South	-4%	0.25
Assam	0%	0.29
Bihar North	0%	0.17
Bihar South	-57%	0.6
Gujarat Central	2%	-0.08
Gujarat North	1%	-0.03
Gujarat South	1%	-0.11
Gujarat West	1%	-0.01
Karnataka Bangalore	0%	-0.02
Karnataka Gulbarga	0%	0.09
Karnataka Hubli	-1%	-0.03
Karnataka Mangalore	1%	-0.04
Karnataka Mysore	0%	-0.02
Meghalaya	-51%	1.32
MP Central	41%	0.99
MP East	-31%	1.09
MP West	-11%	0.6
Punjab	-1%	-0.05
UP Central	-4%	0.13
UP East	13%	2.26
UP Kanpur	0%	-1.12
UP South	5%	1.67
UP West	0%	-0.42
West Bengal	0%	0.03

a Negative numbers indicate loss, and positive numbers indicate profit.

b Positive numbers indicate loss, and negative numbers indicate profit.



business is completely regulated to avoid the burden of high tariffs to customers, which essentially means that profitability of utilities is also regulated. In a true sense, most utilities will not have very high profit margins. At the same time, various state governments have specific policies on providing subsidies to customers and to utilities in order to cover cost or revenue gaps. This also affects profitability of the utility. Therefore, profitability itself may not necessarily give a correct picture of a utility's financial performance. For this reason, a surrogate value for profitability was also considered. This metric, the difference between the average cost of supply (ACS) and the average

revenue realized (ARR) per unit of electricity sold by a utility, is formally known as the ACS-ARR gap, although it can indicate either a gap (loss) or surplus in revenue. It is a standard metric used by the Government of India and other authorities for measuring utility performance. For the purpose of this study, data on a utility's ACS-ARR gap was provided by the utility itself or collected as available on public forums in the absence of data shared by the respective utility.

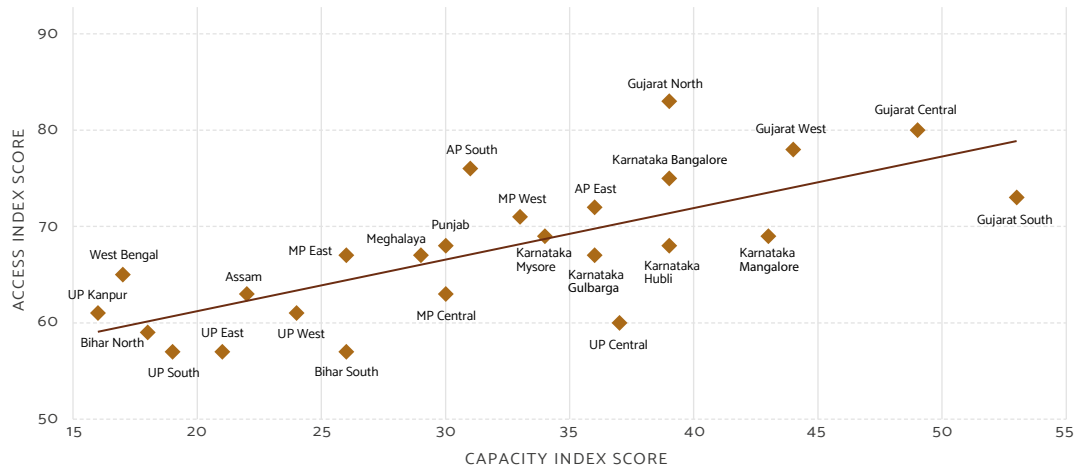
Overall, in Fiscal Year 2018–2019, out of the total 25 utilities surveyed, 8 utilities made a profit, 8 utilities broke even (zero profit), and the remaining 9 utilities incurred losses. When using ACS-ARR gap data, however, 14 utilities had a per unit gap between average costs and revenue, whereas only 11 had a surplus. Table 5-1 captures the profit/loss as a percentage of the utility's total annual revenues and ACS-ARR gap for Fiscal Year 2018–2019, as reported by all 25 utilities.

Utility Performance and Customer Satisfaction

Customer satisfaction and company performance are closely linked across several industry sectors. Although there are a number of factors that affect the performance of a company, customer satisfaction is considered to be key. This phenomenon is most predominant across service sector businesses such as retail. From the company's perspective, it is paramount to identify the key factors impacting (directly or indirectly) customer satisfaction, because customer satisfaction in turn influences the company's performance. Across industries, customer satisfaction level can generally be attributed to factors such as product delivery time, quality, price, service response time, replacement policies, and so forth. Companies work to ensure the suitability of their product or services to achieve higher customer satisfaction and enhanced company performance.

The same applies in the distribution utility business, wherein historically the primary focus has been on the more tangible aspects of ensuring physical connectivity and adequate supply hours, while other key service components have taken a back seat. Various other industries have developed service models based on the relationship between customer satisfaction and business performance, and a similar model can be developed for power distribution utilities to identify areas for improvement.

Figure 5-9: Relationship between financial performance (ACS-ARR gap) and customer satisfaction



Abbreviations: ACS, average cost of supply; ARR, average revenue received; INR, Indian rupee; kWh, kilowatt-hour.

Figure 5-9 lays out the relationship between a utility’s customer satisfaction score and profitability, as measured by its ACS-ARR gap. The scatter plot shows a moderately negative correlation ($r = -0.41$) for this relationship. This indicates that a high customer satisfaction score can be correlated to a lower ACS-ARR gap (meaning better financial performance, as a negative ACS-ARR gap indicates a surplus, not a deficit).

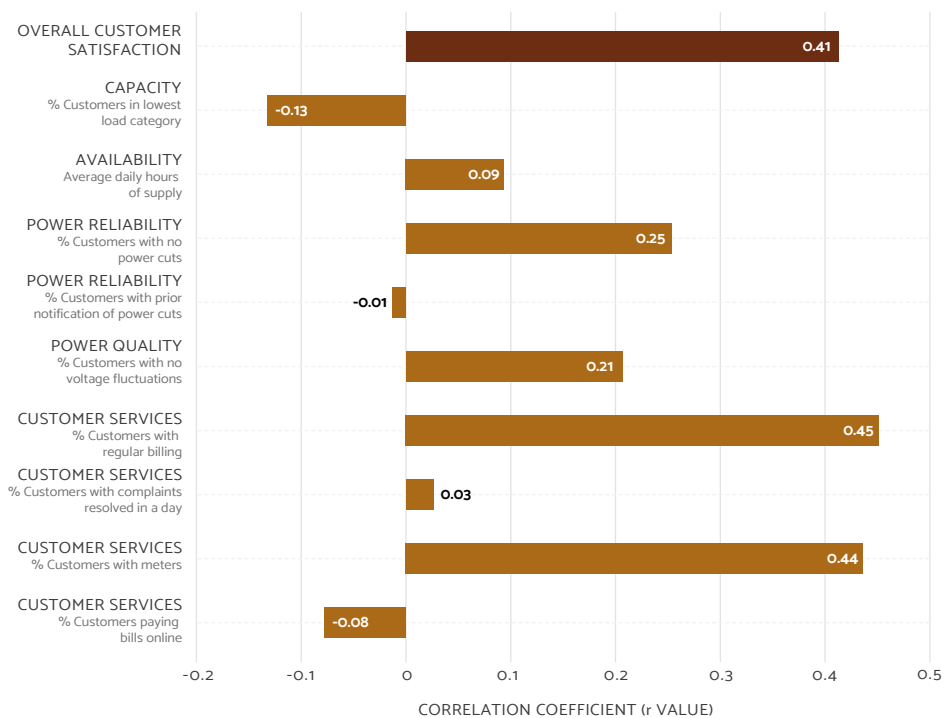
This relationship should be seen in the context of the above discussion of power distribution being a regulated market, in which financial performance is also influenced by several external factors. Looking at the relationship between a utility’s financial performance and

the drivers of customer satisfaction (which are based on the drivers of state of access, as explained in Chapter 3), we get the results shown in Figure 5-10.

Results of interest (Figure 5-10):

- ▶ Supply factors such as increasing available hours of electricity supply do not seem to have a significant correlation with utility performance.
- ▶ Timely and regular billing correlates with positive financial performance, leading to a per-unit ACS-ARR surplus.
- ▶ Metering coverage also correlates with positive financial performance.

Figure 5-10: Correlation trend between financial performance and selected drivers of customer satisfaction



Note: Elements in dark brown indicate findings significant at the 5% level ($r < 0.05$).

Utility Performance and Capacity to Deliver

It has now been seen that a utility's capacity to deliver is strongly correlated with the state of electricity access in its area of operation, which in turn is strongly correlated to customer satisfaction. Customer satisfaction, on the other hand, has only a moderate relationship with a utility's financial performance, owing to the regulated nature of the business. It remains important to explore the relationship between a utility's capacity and its financial performance, or in other words, to understand if utilities with better financial performance tend to have greater capacity to deliver access sustainably. This relationship is captured in Figure 5-11.

Results of interest (Figure 5-11):

- ▶ There appears to be only a weak correlation between overall capacity (infrastructural and operational capacities) and financial performance among the utilities ($r = -0.30$). This is possibly again due to the regulated nature of the industry.
- ▶ Utilities that are performing better financially, such as those in Gujarat and Karnataka, tend to have higher scores for capacity to deliver. Therefore a relationship, although weak, does seem to exist.

Other Factors Impacting Utility Performance

This section examines several other relationships that affect a utility's performance. In particular, the study examined relationships between a utility's customer profile or customer mix and its financial performance. The different utilities prefer not to be compared

with each other due to the variation in their customer base, especially the presence of a large percentage of agricultural or rural customers, which has been thought to influence overall customer capacity or willingness to pay and hence the financial performance of the utility. However, the data collected as part of this study and presented in Figures 5-12 through 5-17 provide a different picture:

- ▶ There is no correlation between percentage of agricultural customers and profitability.
- ▶ There is almost no correlation between profitability and percentage of rural customers.
- ▶ There is no correlation between profitability and percentage of customers in the disadvantaged socio-economic class.
- ▶ A higher percentage of commercial customers seems to have a positive correlation with a utility's financial performance, primarily owing to the typically higher cross-subsidized tariffs levied on these customers.
- ▶ However, there is a caveat here. Chapter 2 showed that access rates for commercial customers are much lower than those for household customers. This means that utilities which have ensured better access to the grid for commercial customers have in fact been able to reap the benefits of relatively higher tariffs as well as higher per capita consumption. Connecting commercial customers to the grid, therefore, can be a crucial tool for improving per-customer and per-unit sold revenues and increasing utility margins.

Figure 5-16 shows the relationship between financial performance and aggregate technical and commercial (AT&C) losses, in which greater profitability is significantly ($r = 0.78$)

Figure 5-11: Relationship between financial performance (ACS-ARR gap) and capacity to deliver



Note: Elements in dark brown indicate findings significant at the 5% level ($p < 0.05$).

Abbreviations: ACS, average cost of supply; ARR, average revenue received; INR, Indian rupee; kWh, kilowatt-hour.

Figure 5-12: Relationship between financial performance (ACS-ARR gap) and % of agricultural customers [$r = -0.03$]

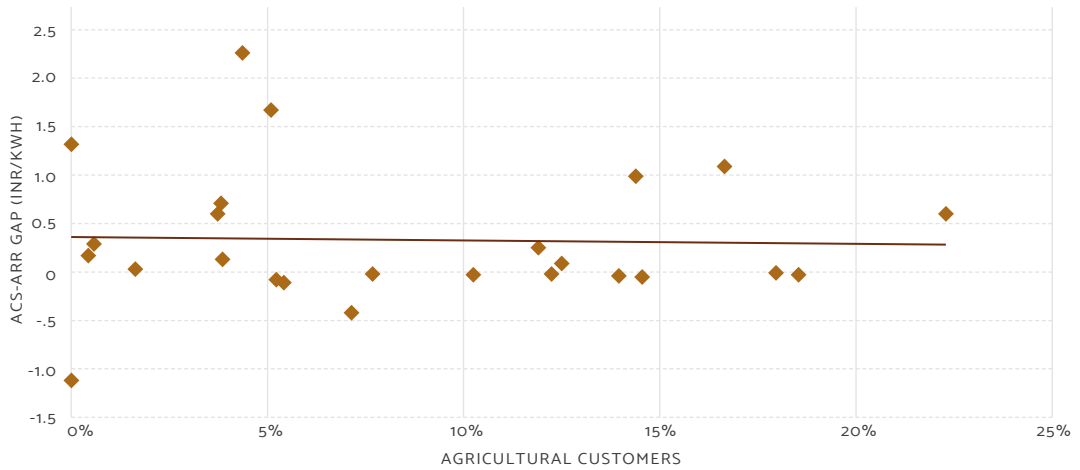


Figure 5-13: Relationship between financial performance (ACS-ARR gap) and % of commercial customers [$r = -0.69$]

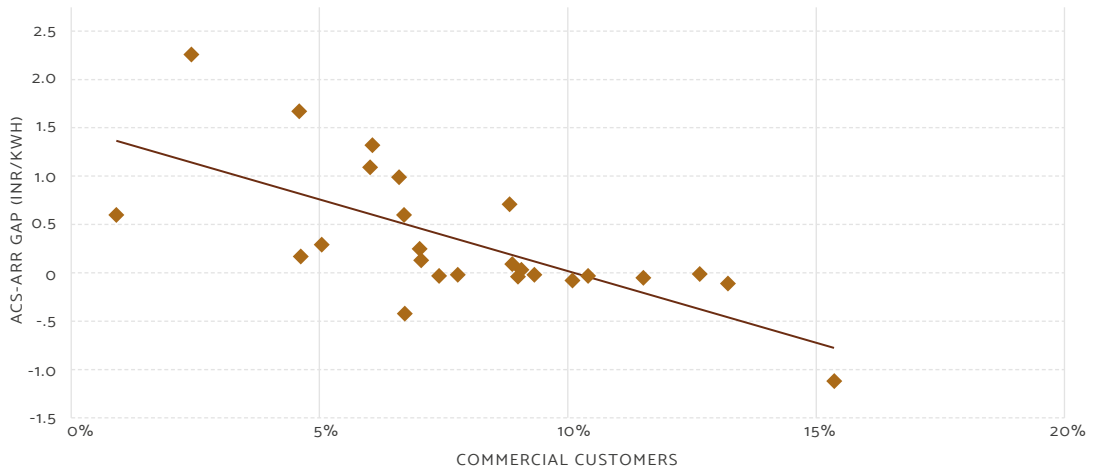
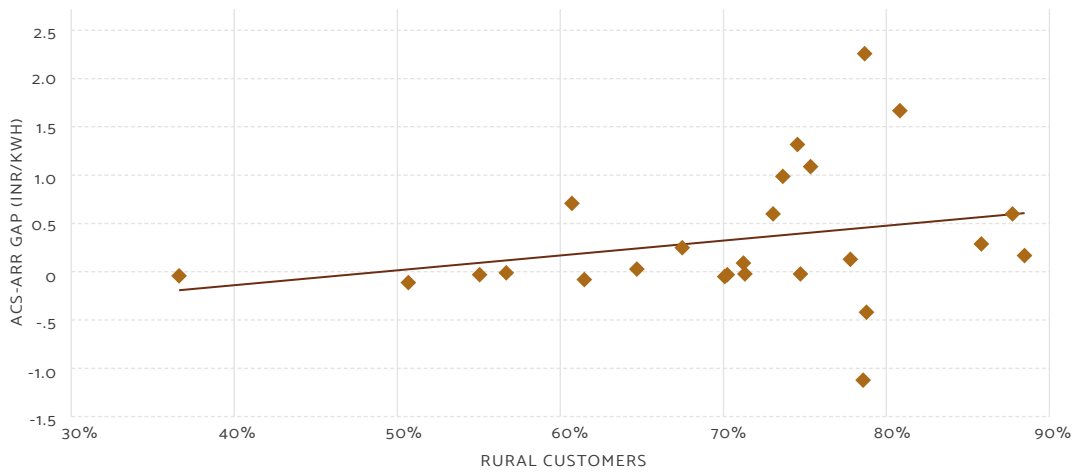


Figure 5-14: Relationship between financial performance (ACS-ARR gap) and % of rural customers [$r = 0.26$]

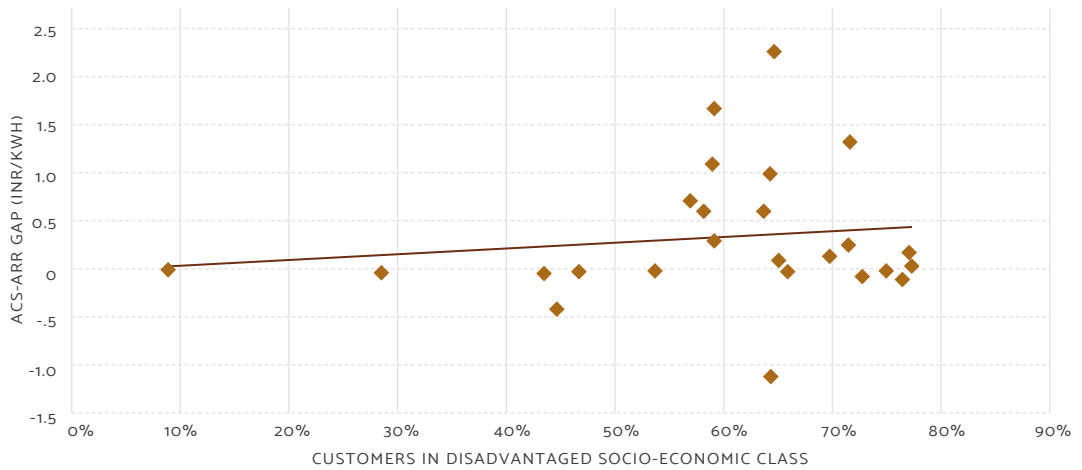


correlated with lower losses. High AT&C losses affect profitability. For distribution utilities, AT&C losses increase due to high technical losses (from old LT networks or long LT networks) or to high commercial losses

(from pilferage, inefficient metering, and non-realization of billed amounts from customers).

It is commonly believed that electricity theft or pilferage leads to high AT&C losses and weak financial performance for utilities. However, the

Figure 5-15: Relationship between financial performance (ACS-ARR gap) and % of customers in the disadvantaged socio-economic class [$r = 0.14$]



Note: Socio-economic classes used for this study are defined in Chapter 1.

Figure 5-16: Relationship between financial performance (ACS-ARR gap) and AT&C losses [$r = 0.78$]

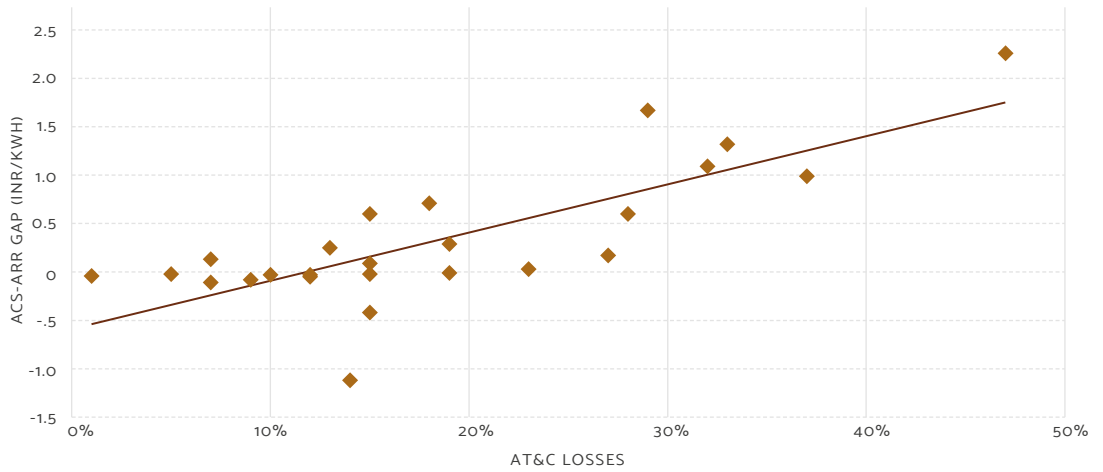
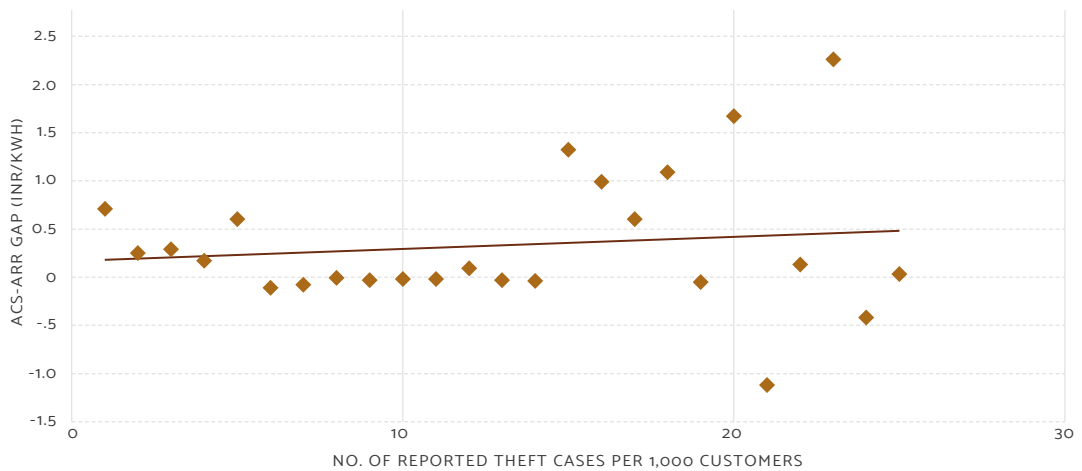


Figure 5-17: Relationship between financial performance (ACS-ARR gap) and number of theft cases reported [$r = 0.14$]



survey data presented in Figure 5-17 shows only a very weak correlation between the number of theft cases (per 1,000 customers) reported by a utility and that utility's financial performance. It seems that the challenge and related remedy

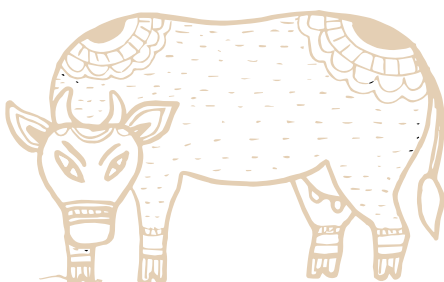
for AT&C losses lies somewhere else, and that curbing theft alone may not be fruitful in improving utility performance. On the other hand, it should be noted that the data collected for this study presents the number of cases in

which a utility took action on a theft case. The weakness of the correlation, therefore, could indicate that utilities are not taking enough measures to curb theft and perhaps not even logging and reporting all theft cases accurately.

Summary

As seen in this chapter, the overall state of electricity access is strongly correlated with the level of customer satisfaction. Utilities that perform better on access have also done better on keeping customers satisfied. The quality of power also plays an important part in customer satisfaction, as satisfied customers in this study reported fewer voltage fluctuations. The number of power cuts has a stronger correlation with customer satisfaction than prior notification of power cuts, but both are significant. In essence, the electricity customer now expects better service and better power quality, not just basic availability of an electricity connection.

Based on the findings of this chapter and previous ones, Chapter 6 will discuss various recommendations that can improve utility performance and operations.





6



Summary and Recommendations

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Summary and Recommendations

In the preceding chapters, this report established a baseline for the state of electricity access in India, benchmarked electricity distribution utilities on customer satisfaction and capacity to deliver sustainable access, and created a framework to understand the drivers of sustainable electricity access.

This final chapter stitches together the study findings across various themes and makes recommendations that stakeholders can adopt to deliver on goals for electricity access across the country.

Summary of Key Findings

Table 6-1 summarizes the key findings from the study. These findings – derived from quantitative customer surveys, focus group discussions, data from electricity distribution utilities, stakeholder interviews, on-the-ground observations, and cross-tabulation and correlation of data across themes – suggest that there are still significant gaps between electricity supply and electricity demand.

Recommendations

Based on the key study findings, and with the vision of meeting customer or demand-side expectations, the following eight recommendations are proposed to further improve the performance of electricity distribution utilities. These recommendations are structured by the following categories: policy and regulatory recommendations, operational and process improvement recommendations, infrastructure recommendations, capacity-building recommendations, and governance recommendations.

Policy and Regulatory Recommendations

Revamp New Electricity Connection Process to Enable Quick, Transparent and Easy Turnaround, with Focus on Non-Household Customer

Since the implementation of the Saubhagya scheme, a majority of electricity distribution utilities have achieved complete electrification of all willing household customers: the survey found that 96% of household customers now have a grid-based electricity connection. To accomplish this level of success at the scheme's ambitious timelines, Saubhagya not only allowed the release of new household connections at either no cost or at a discount, but also ensured that new connections were released in a timely manner after a simplified application process.

This focus on new electricity connections now needs to turn to other customer categories, as the survey found that only 52% of agricultural customers and 78% of institutional customers have access to grid-based electricity connections. The remaining respondents either use non-grid sources of power or don't use any power at all. In fact, about 2.5% of respondents stated that they do not have access to any source of lighting or electricity, and many of these are in the institutional category (18.4% of institutional customers reported no access to any source of electricity or lighting). Providing grid access to all non-household customers will not only allow customers to reduce their energy costs and thereby improve productivity, but will also allow utilities to capitalize on new revenue opportunities, as tariffs are typically higher for non-household than for household customers. Data analysis for this study also found a strong correlation ($r = 0.70$) between a higher percentage of commercial customers

Table 6-1: Key study findings

Theme	Key Findings
State of Access	Sources of lighting and electricity <ul style="list-style-type: none"> • 87% of customers are connected to the grid (AG: 52% IN: 78%) • 32% of non-grid users depend on diesel generators for electricity • 18% of IN have no source of electricity at all • Non-grid HH depend on solar panels (28%) and kerosene (23%) • Non-grid AG depend on distributed generation (48%)
	Availability rate <ul style="list-style-type: none"> • 92% (AG: 75%)
	Hook-up rate <ul style="list-style-type: none"> • 86% (AG: 70% IN: 81%)
	Access rate <ul style="list-style-type: none"> • 87% (AG: 52% IN: 78%) • Post Saubhagya, there is almost no difference in access rates for HH with disadvantaged or advantaged SEC • 13 of the 25 surveyed utilities have access rates < 90% • AG: Access rates vary with size of land (marginal: 45% large: 68%) • IN: Access rates are lower for panchayats and local administration organizations (73%) and educational organizations (75%)
	Reasons for not having electricity access / no grid connection <ul style="list-style-type: none"> • 13% of customers report no electricity connection from the grid; more than half are AG • Of those with no grid connection, 47% report the nearest electric pole being far away, and 20% report poor quality of service • CO: 48% say affordability and high prices is the major reason • IN: 22% have been refused a connection and another 21% have applied for and are awaiting a connection
	Capacity (sanctioned and effective connected loads) <ul style="list-style-type: none"> • High percentages of customers report very low capacity connections [HH (0–1 kW): 92% AG (0–3 hp): 67% CO (0–1 kW): 76% IN (0–5 kW): 78%], which may either limit electricity demand and consumption or impact utility performance • HH: Significant differences are reported between sanctioned and connected loads
	Availability <ul style="list-style-type: none"> • 17 hours average daily supply hours (HH: 18 AG: 15 CO: 17 IN: 18) • Gujarat, West Bengal, and Andhra Pradesh have the highest average supply hours, with Gujarat the only state providing 24-hour supply to all non-AG customers • The daily hours of supply reported for agricultural customers (15 hours) is higher than expected and needs to be looked into
	Reliability <ul style="list-style-type: none"> • 70% of customers report > 1 power cut/month; 14% report > 15 power cuts/month • 73% of customers are never informed of upcoming power cuts
	Quality <ul style="list-style-type: none"> • 63% of customers report > 1 voltage fluctuation/week; 10% report > 15 voltage fluctuations/week • Most customers of Gujarat West (100%), Gujarat North (86%), and AP East (84%) report no voltage fluctuations
	Affordability <ul style="list-style-type: none"> • Electricity is estimated to be affordable for the majority (83%) of HH, per the defined affordability framework
	Safety <ul style="list-style-type: none"> • 16% of customers report electrical accidents in the past year (AG: 19% IN: 17%) • Focus group discussions reported absence of any safety infrastructure
	Customer services: Metering <ul style="list-style-type: none"> • 85% of customers have a metered connection (AG: 61% IN: 83%)
	Customer services: Billing frequency <ul style="list-style-type: none"> • 5% of customers overall report irregular billing • West Bengal is the only state with quarterly billing (for all customers except IN) • 29% of customers report that bills are not easy to understand
	Customer services: Mode of payment <ul style="list-style-type: none"> • Traditional payment options are still predominant, with 64% of payments made at a utility office • Only 9% of customers pay bills online
Customer services: Complaint management <ul style="list-style-type: none"> • 41% of customers report no availability of dedicated maintenance staff • 33% of customers report complaints resolved within 3 hours; 16% report complaints are never resolved 	

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and a utility's financial performance, which indicates that this is an avenue for utilities with low connectivity among commercial customers to improve their performance.

The study found that for 18% of non-grid users, the complicated application process was the reason for not having an electricity connection. Further, only 81% of connected customers were

satisfied with their connection process, with worse performance reported by non-household customers. A primary reason for this is likely the long lead time for the release of new connections: approximately one month overall, according to the findings, with agricultural customers waiting two to four months.

Another issue is the wide range of fees that are

Table 6-1: Key study findings

Theme	Key Findings
Customer Satisfaction	New connection process <ul style="list-style-type: none"> • 81% of customers are satisfied with the new connection process (AG: 74% IN: 88%); 12% are dissatisfied • Average connection time for satisfied customers is 25 days; for unsatisfied customers, 61 days • Average connection times vary by customer category (HH: 25 days AG: 74 days IN: 27 days CO: 27 days) • HH: 85% of dissatisfied customers are from disadvantaged SEC • AG: 65% of dissatisfied customers have small or marginal size landholdings • The highest satisfaction with the new connection process is in AP East (96%) and Gujarat Central (95%)
	Power reliability <ul style="list-style-type: none"> • 63% of customers are satisfied with power reliability (Rural: 60% Urban: 74%); 21% are dissatisfied • HH: 78% of dissatisfied customers are from disadvantaged SEC • > 90% of Gujarat West and Gujarat North customers are satisfied with reliability
	Power quality <ul style="list-style-type: none"> • 55% of customers are satisfied with power quality (Rural: 66% Urban: 51%); 14% are dissatisfied • AG: Dissatisfaction is highest for marginal landholders (36%) and least for large landholders (4%)
	Billing and collection process <ul style="list-style-type: none"> • 65% of customers are satisfied with billing (Rural: 61% Urban: 75% IN: 78%); 25% are dissatisfied • 78% of satisfied customers say their bill is easy to understand (Dissatisfied: 52%)
	Complaint resolution process <ul style="list-style-type: none"> • 43% of customers are satisfied with complaint resolution (Rural: 37% Urban: 57% AG: 41%) • 78% of satisfied customers reported resolution in < 12 hours • Low proportion of dedicated maintenance staff affects satisfaction
	Service provided by utility staff <ul style="list-style-type: none"> • 62% of customers are satisfied with staff (Rural: 58% Urban: 72%) • 84% of satisfied customers say staff understood their problem (Dissatisfied: 35%) • 32% of customers say staff ask for tips • Gujarat West (99%) and Karnataka Mysore (94%) have the highest percentages of customers satisfied with service provided by staff
	Overall service provided by the utility <ul style="list-style-type: none"> • 66% of customers are satisfied with overall utility service (Rural: 63% Urban: 75%); 11% are dissatisfied • HH: 66% are satisfied (disadvantaged SEC: 63% advantaged SEC: 71%) • IN: The least satisfied customers are in education (70%)
Utility's Capacity to Deliver	Infrastructural capacity <ul style="list-style-type: none"> • Substation capacity: average 3.25 MVA/MW peak load (Gujarat utilities: 5.9–12.4) • HT:LT ratio: average 0.69 (Gujarat West: 1.72 9 utilities above average) • Feeder capacity: average 3.9 MVA (Gujarat utilities: 6.4–15.7 8 utilities above average) • Annual DT failure rate: average 11% (Gujarat utilities: 3%–9% 9 utilities above average) • Electricity supplied: average 3,669 kWh per annum (Gujarat: 7,200 9 utilities above average)
	Operational and institutional capacity <ul style="list-style-type: none"> • AT&C losses: average 18% (Karnataka Bangalore: 5% 13 utilities below average) • Billing efficiency: Average 86% • Employees/1,000 customers: average 2.47 (MP Central: 4.8 6 utilities above average) • 11 kV feeder metering: average 96% • Rural DT metering: average 55% (10 utilities above average) • No. of interruptions per month: average 73 (6 utilities above average) • Complaints resolved within Standards of Performance timelines: average 88% (9 utilities at 100%) • Theft cases reported/1,000 customers: average 10.4 • ERP has not been implemented in the majority of the utilities • No utility has implemented an effective performance management system for employees • During discussions with utilities, it emerged that there is no defined process for them to regularly report on Standards of Performance parameters to their State Electricity Regulatory Commission

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charged across states and customer categories to apply for a new electricity connection. For example, 44% of household customers said they paid INR 0–500, while 40% of agricultural customers paid upward of INR 5,000 for a new connection. With the issues related to expanding the electricity distribution backbone across the country now largely resolved, the fee charged to release a new electricity connection

should be based on last-mile connectivity alone, and should therefore be largely standardized.

Based on these findings, the recommendation is to revamp the new electricity connection process as follows:

- ▶ **Design utility policies that prioritize the release of new connections for non household customers:** This would include establishing a ready fund for release of

Table 6-1: Key study findings

Theme	Key Findings
Drivers of Sustainability	<p>Relationship between level of access and customer satisfaction</p> <ul style="list-style-type: none"> • Reasonably strong correlation between customer satisfaction and level of access on the ground ($r = 0.64$) • Potential access drivers show positive correlations with customer satisfaction: <ul style="list-style-type: none"> » Availability: No. of supply hours ($r = 0.54$) » Reliability: No power cuts ($r = 0.51$) » Quality: No voltage fluctuations ($r = 0.64$) » Customer services: Metering coverage ($r = 0.52$) » Customer services: Regular billing ($r = 0.54$) » Customer services: Complaints resolved within a day ($r = 0.52$) • Capacity (% customers in lowest load category, $r = -0.23$), reliability (prior notification of power cuts, $r = 0.12$), and mode of payment (online payment, $r = -0.03$) do not seem to have any major relationship with customer satisfaction • The drivers for customer satisfaction seem to be shifting towards service components such as reliability, quality, and customer services and away from purely product components such as availability of access and supply
	<p>Relationship between level of access and a utility's capacity to deliver</p> <ul style="list-style-type: none"> • Strong correlation between level of access and capacity to deliver ($r = 0.78$) • Potential capacity drivers show positive correlation with level of access: <ul style="list-style-type: none"> » Overall infrastructure capacity ($r = 0.58$) <ul style="list-style-type: none"> * HT:LT ratio ($r = 0.61$) » Overall operational and institutional capacity ($r = 0.73$) <ul style="list-style-type: none"> * Rural DT metering ($r = 0.77$) * Billing efficiency ($r = 0.42$) • No. of employees per 1,000 customers is not significantly correlated with state of access ($r = 0.04$), which implies that similar output can be achieved through outsourcing or IT-enabled automation of functions, irrespective of number of employees • Rather than focusing purely on infrastructure capacity, developing utilities' operational and institutional capacity may have greater impact on the state of access
	<p>Relationship between utility financial performance and customer satisfaction</p> <ul style="list-style-type: none"> • Moderate correlation between utility financial performance and customer satisfaction ($r = 0.41$) • Potential financial performance drivers show positive correlation with customer satisfaction: <ul style="list-style-type: none"> » Reliability: No power cuts ($r = 0.25$) » Quality: No voltage fluctuations ($r = 0.21$) » Customer services: Metering coverage ($r = 0.44$) » Customer services: Regular billing ($r = 0.45$) • Increasing supply hours does not seem to have a significant correlation with utility performance, whereas regular billing and increasing metering coverage correlate with positive financial performance
	<p>Other relationships explored</p> <ul style="list-style-type: none"> • No correlation is found between a customer mix with high AG, rural, or disadvantaged-SEC HH customers and utility financial performance, busting a common myth • A higher mix of CO customers seems to be positively correlated with utility financial performance ($r = 0.69$), owing to the typically higher cross-subsidized CO tariffs, but with a caveat: access rates are much lower for CO than HH. • High AT&C losses affect utility profitability ($r = 0.78$) • Very weak correlation between no. of reported theft cases/1,000 customers and utility financial performance, possibly due to failures of reporting, which would indicate a need for on-the-ground action to deter electricity theft

Note: Definitions of the socio-economic classes (SEC) used for this study are found in Chapter 1.

Abbreviations: AG, agricultural customers; AT&C, aggregate technical and commercial; CO, commercial customers; DT, distribution transformer; ERP, enterprise resource planning; HH, household customers; hp, horsepower; HT, high tension; IN, institutional customers; kW, kilowatt; LT, low tension; SEC, socio-economic class.

fast-track connections by providing last-mile connectivity, standardizing service connection costs, reviewing all pending or previously rejected applications, and reviewing commercial and institutional customers that currently use a single household-level connection for electricity.

- ▶ **Simplify and standardize the new connection application process and minimize the documentation requirements:** The existing

policy for release of new connections should be revised to comply with regulatory Standards of Performance and include timelines and lists of required documents for each category of customers (similar to what banks use for opening new accounts).

Through effective implementation of online systems and minimization of required documents, AP East, Gujarat Central, Punjab, and the five utilities of Karnataka each achieved more than 90% customer satisfaction for their new connection processes.

AP East achieved a landmark timeline of 24 hours for the release of new connections through their Seva centres.

- ▶ **Institute an online/app-based process for quick release of new connections:** Although several utilities already have an online application process, the recommendation is to move 100% of the applications for new electricity connections online or to mobile apps for ease of use by customers. The online system should use a unique identifying number for each application so that customers can track their status, with an appropriate escalation process or matrix for any delays or issues.

Prepare for DBT Implementation by Initiating Public Outreach Campaigns to Increase Customer Awareness and Ensuring KYC Completion by Utilities

Direct Benefit Transfers (DBT) involve the transfer of subsidies or other benefits directly into a customer's bank account instead of through government offices. The Government of India has launched a nationwide scheme to roll out DBT for purchase of liquefied petroleum gas (LPG) cylinders under the Pradhan Mantri Ujjwala Yojana (Ujjwala) scheme, for improving targeting of subsidies and preventing subsidy leakage. There is a similar plan to roll out DBT for electricity costs, and many utilities support this plan. DBT to customers would reduce utilities' working capital requirement, which currently must be large enough to cover the costs resulting from delays in release of state government subsidies. This study found that recent utility initiatives already ensure that customers' information is linked with their bank accounts, Aadhaar cards, and mobile phone numbers, which can enable a quick transition to using DBT for electricity.

However, unlike in the LPG sector, there is low customer awareness of electricity subsidies, and this may affect the roll-out of DBT. Study findings show that of the 80% of household and agricultural customers who are aware of DBT for their LPG subsidy, 84% are participating, yet only 32% of those are aware that electricity is

currently subsidized as well. As a result, many customers who use DBT for LPG think that there would be no government contribution for electricity or additional benefit to enrolling in DBT for electricity.

In addition, several customers cited unfavourable experiences with the existing LPG subsidy scheme and DBT experience; they were therefore averse to opting into DBT for electricity. Given this concern over customer satisfaction, the following factors would help policymakers achieve satisfactory roll-out of DBT for electricity across selected states:

- ▶ **Implement a public awareness campaign:** A holistic awareness campaign should be rolled out to make customers aware of DBT and the available subsidies for electricity. This campaign should include explanations of the concept and process of DBT, focusing on the features that are different for electricity than for LPG. Information on the effects of DBT on electricity bills and on the requirements and processes for initiating DBT should also be included. Customer dashboards or mobile apps for subsidies paid on the basis of bill cycles will also be essential to enabling DBT for electricity.
- ▶ **Establish a streamlined, on-time, and proactive subsidy transfer/payment process for customers to pay for their electricity:** The process of paying for electricity also needs to be modified to be easier for customers. To enable a proactive payment process, the DBT system overall must include links between bank accounts, Aadhaar cards, and electricity billing systems and must correctly map customer electricity accounts in order for utilities to receive and process payments before the payment due date. The system should ensure that subsidies are paid into customers' bank accounts immediately after the electricity bill is generated, and that customers are notified by SMS and/or email of the applicable bill cycle. Customer feedback has also indicated that depositing a DBT

Punjab implemented a DBT pilot for agricultural customers in three villages. Instead of compensating the electricity distribution utility for supplying free power to customers, the state deposits subsidies directly into the accounts of the farmers, who are then billed by the utility based on actual consumption.



subsidy in bank accounts in advance of the first month of service, in an amount based on previous average customer billing in the region, would help drive new connections.

- ▶ **Enhance the reach of banking channels, especially for rural customers:** Customers have reported issues in accessing banking channels, which affects their ability to take advantage of DBT for electricity. Initiatives that could help include increasing the reach of rural banking so that rural customers can access banking services closer to home, and using the Unified Payments Interface (UPI) to facilitate payment from an account that is linked to a DBT subsidy so that any local shopkeeper can help customers pay their electricity bills.

Enable Capacity Building of Regulatory Commissions to Resolve Utility Viability Challenges on Account of Widening Cost Coverage

Of the 25 surveyed utilities, 14 had an average cost of supply (ACS) that was higher than their average revenue realized (ARR). Among these 25 utilities, the average ACS-ARR gap was INR 0.33 per unit of electricity sold. Despite multiple interventions, including the Ujwal DISCOM Assurance Yojana (UDAY) scheme launched in 2015, the persisting ACS-ARR gap clearly merits another look at how to ensure cost-reflective meters.

At the same time, 35% of non-grid users stated that affordability and the high price of electricity was a key factor in not accessing an electricity connection from the grid. The assessment of affordability undertaken for this study revealed that even among connected customers, electricity is still above the affordability mark for 17% of households. Meanwhile, increasing power procurement costs, investments in network infrastructure, and operational inefficiencies have led to increasing tariffs over time, which is evident from utilities' reported average billing rates, even including significant differences across customer categories due to cross-subsidization.

Although simultaneous interventions are being undertaken to resolve these issues of affordability, the following key factors can help:

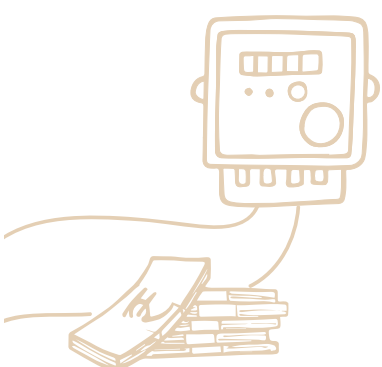
- ▶ **Set realistic efficiency benchmarks for utility performance:** In the current tariff structure, a certain portion of utilities' distribution losses are passed on to customers, with the rest of the losses borne by the utilities. The proportion of losses borne by utilities is based upon efficiency benchmarks set by policymakers or regulators at the central or

Gujarat West, AP South, and UP West have made electricity affordable for more than 97% of their household customers through significant tariff reforms and rationalization.

Tariff rationalization has also been effective in states like Bihar, whose two utilities (Bihar North and Bihar South) have made electricity affordable for many of their customers.

state level: utilities performing below these benchmarks or incurring more than the target amount of distribution losses have to bear the entire cost of the losses above the target. The targets are very stringent, however, and not realistic for utilities such as those in Uttar Pradesh and Bihar that are currently operating at high loss levels. The distribution losses these utilities bear directly affect their cost coverage gaps, leading to defaults in making payments to the power generators. In order to improve the financial performance of state-owned distribution utilities, policymakers should revise the efficiency benchmarks or loss targets every year to ensure that they are realistic and achievable in the given time frame. Appropriate enforcement mechanisms are equally important in order to make utilities achieve their targets.

- ▶ **Initiate reforms based upon "customer capacity to pay":** For 13 of the 25 surveyed utilities, electricity tariffs are affordable for less than 80% of their customers. Pre-paid meters, similar to the pre-paid cards used in the telecom sector, could help mitigate this situation to a large extent by allowing customers to control what they spend on electricity consumption. This would not only help customers take advantage of electricity services based upon their capacity to pay but also reduce utility costs involved in meter reading, billing, and collection (MBC) services. Reform is also needed in the determination of subsidies, wherein periodic assessment of tariffs and subsidy requirements should be undertaken to ensure affordability. The onus of ensuring affordability should lie on the state government, such that utilities and customers are not impacted. This policy should also call for removal of all cross-subsidies, with the difference between average cost of electricity supply and envisaged tariffs to be covered through government subsidy. Other interventions could include relaxing fixed



charges for customers in disadvantaged socio-economic classes and charging them based upon their actual consumption instead.

- ▶ **Implement tariff rationalization and simplification across utilities:** Policymakers and regulators can further simplify electricity tariffs by looking beyond the purpose of the electricity use. This work would include revising tariff categories based upon customers' actual connected loads and imposing uniform new connection charges across customer categories. Regulators can also ease the new connection process by allowing charges to be paid in multiple installments.

Operational and Process Improvement Recommendations

Strengthen Customer Engagement Through Deployment of Standard Operating Procedures

This study found that only 66% of customers were satisfied with the overall service provided by their distribution utility. Looking a little deeper at the various drivers of customer satisfaction, 65% of customers were satisfied with the billing and collection process, 62% with the service provided by utility staff, and only 43% with complaint resolution processes. This lack of satisfaction could be attributed to either non-existence of any standard customer-facing processes or limited adherence to such processes. It was also apparent from the study that many low-performing utilities emphasize either connectivity or infrastructure improvement, rather than customer services. Post Saubhagya, with almost 100% of customers connected to the grid, it is now imperative for utilities to focus on customer services and delivery processes. This will result in significant performance improvements at minimum cost. The following interventions are recommended:

- ▶ **Standardize the customer interface processes:** Standardization of internal processes is the primary activity every utility should emphasize in order to improve their performance. This includes defining, implementing, and adhering to standard operating procedures for customer services. In addition, power reliability and quality are also significant drivers of customer satisfaction. With only 63% customers satisfied with the reliability of their power supply and only 55% satisfied with power quality, utilities should shift from reactive maintenance practices to preventive

maintenance practices. This could be achieved through devising standard maintenance procedures that include a maintenance planning schedule. Every utility must clearly define its standard operating procedure and standard maintenance procedure for every customer touchpoint to improve their performance (including in power quality and reliability) and customer satisfaction. Apart from designing standard operating procedures and standard maintenance procedures, utilities also need to ensure all staff comply with these processes. To achieve this, utilities must ensure that procedures are time-bound and have responsibility defined at each level of implementation.

- ▶ **Form customer engagement departments:** With increases in customer expectations for service delivery, utilities should form a customer engagement department to increase customer touchpoints and achieve customer satisfaction. Customer engagement departments will look after customer outreach, complaint resolution, status of customer grievances, and customer feedback on utility services. The department can also extend support to registering theft cases reported by customers and increasing customer awareness regarding different customer welfare schemes launched by the government or utility. Customer engagement departments should be available both physically, based out of key utility offices, and through online and social media platforms.
- ▶ **Adhere to the Standards of Performance determined by the State Electricity Regulatory Commission:** Apart from the above recommendations, utilities should also closely monitor their adherence to the minimum Standards of Performance set by their regulatory commission, and any deviation should be escalated to the appropriate authority. Utilities may also implement enterprise resource planning (ERP) systems to streamline enforcement of and compliance with these standards. ERP will also enable utilities to monitor any deviations to ensure infrastructure availability and improve overall customer satisfaction.



Infrastructure Recommendations

Implement Data-Driven Planning for All Future Investments in Distribution Infrastructure, With a Focus on Improving Reliability and Quality of Supply

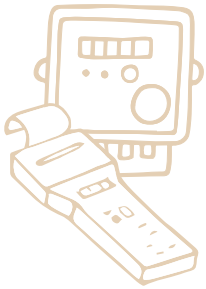
Out of 25 surveyed utilities, 16 utilities had an high-tension to low-tension (HT:LT) network ratio below the survey average of 0.69, 9 utilities had an average distribution transformer (DT) failure rate of more than 9%, and 21 utilities had less than 80% coverage of DT metering. It is clear that infrastructure planning remains a serious matter of concern for many utilities. Earlier national and state government programmes focused on infrastructure development and availability. Now, with changing customer demand and expectations, work on infrastructure development should focus on improving power quality and reliability to achieve customer satisfaction. In this study, 70% of customers had more than one power cut per month and 63% reported more than one voltage fluctuation per week. A new infrastructure investment plan should encompass the following recommendations:

- ▶ **Implement 100% customer and system metering:** New infrastructure plans should include reaching 100% coverage of customer and system metering. This will enable utilities to monitor energy consumption and losses at various voltage-level areas. System metering would include installation of boundary meters, feeder meters, and DT meters. Combined with accurate customer mapping, DT and feeder metering will not only help utilities attain energy accounting to the last mile but also help them accurately forecast demand and calculate technical and commercial losses at different voltage levels.
- ▶ **Enhance the capacity and condition of current infrastructure:** To improve the level of power reliability and quality they deliver, utilities must now focus on the capacity and condition of their infrastructure. Each utility should have a detailed infrastructure investment plan based upon the intraday load pattern, load flow analysis of individual circuits, and infrastructure capacity. Also, utilities need to conduct a cost-benefit analysis for each component of their infrastructure investment plan.
- ▶ **Segregate agricultural feeders and implement underground and LT aerial bunched cabling:** Through this study, it became evident that many of the high-performing utilities had

AP East and the utilities of Punjab and Gujarat (Central, North, South, and West) have already improved the condition of their infrastructure, segregated agricultural feeders, implemented underground and aerial bunched cabling, and implemented smart-grid technology as well as included further recommendations for smart-grid technology in their infrastructure plan. These activities are reflected in their infrastructure capacity.

significantly reduced their technical losses through agricultural feeder segregation and installation of underground cables and LT aerial bunched cables. New utility infrastructure plans must focus on these practices to curb technical losses and improve the reliability of their power supply.

- ▶ **Reduce the length of 11 kV feeders and LT lines:** To reduce technical losses in the system, utilities must also focus on optimizing the length of 11 kV feeders and reducing LT line length. This will not only improve power quality by improving the voltage profile but also result in greater reliability.
- ▶ **Implement fixed asset registers:** Utilities should ensure that a fixed asset register (a list of the distribution utility's physical assets) is available, with input from each level, to ensure asset-based indexing (including description and specifications of physical assets) and counting. This can be used to calculate current costing and future investment planning.
- ▶ **Implement smart-grid technology and smart equipment:** While many of the private utilities are shifting to automated distribution systems, state-owned distribution utilities are still struggling to manage day-to-day equipment operation. All utilities should focus on implementing SCADA (supervisory control and data acquisition) systems and other advanced technologies to improve the reliability and robustness of their distribution system.
- ▶ **Commit to periodic review and approval of infrastructure plans through the State Electricity Regulatory Commission:** In addition to the above infrastructure recommendations, utilities should have their infrastructure investment plans approved by competent statutory or regulatory authorities to ensure effectiveness. Utility investment plans should be based on a bottom-up approach and should cater to the capacity requirements of each division or subdivision of the utility.



Digitalize the Metering, Billing, and Collection (MBC) Cycle Through Implementation of Smart Metering and Demand-Side Management Measures

It is evident from this study that irregular billing and difficulty in understanding electricity bills are important drivers of customer satisfaction. Billing and collection efficiency are also important factors in utilities' financial performance, which can be directly linked with utility performance. With only 65% of customers overall satisfied with their billing and collection process, utilities should work to streamline it. Separately, utilities' infrastructure should also focus on reducing the gap between peak load and base load in order to reduce forecast errors regarding electricity demand. Decreases in peak load demand will reduce stress on the network infrastructure, which will further enhance the reliability of the network. All of this could be achieved through smart metering and demand-side management. (Demand-side management is a utility programme to influence and modify customers' electricity consumption patterns according to the utility's electricity distribution capacity.) This effort should encompass the following components:

- ▶ **Increase customer awareness and incentives to switch to smart metering:** Through implementation of smart metering, not only will the billing process be automated but billing errors will be reduced. This will also enhance and streamline energy accounting practices by linking customer metering data with system-generated data and calculating the technical losses at different voltage levels. By reducing technical losses, overall billing efficiency could be improved, which would have a direct impact on utility performance. Awareness of the above factors needs to be imparted to customers to promote a proactive transition to smart metering. Customer motivation can also be enabled through incentives such as rebates on electricity bills, which can be pooled in from the lifecycle benefits that will accrue to the utility through implementation of smart metering. Further, all manual (hand-written) as well as physical bills should be eliminated in a phased manner. Customers should be able to get their electricity bills through SMS or directly on a mobile application.

AP East and the utilities in Bihar and Uttar Pradesh are installing smart meters to improve their billing efficiency and reduce billing errors.

- ▶ **Encourage demand-side management:** Modifications in customer demand have the potential to bring the spiralling demand for energy within limits. To optimize energy consumption, utilities should encourage demand-side management, which could be achieved through smart metering. This would help customers manage their electricity expenditure during peak load hours, especially once Time of Day tariffs are implemented for household customers. Smart metering will also influence customers' capability and willingness to reduce their electricity consumption by monitoring their day-to-day consumption patterns. Further demand-side management could be achieved through energy efficiency initiatives from the central or state government or through educating customers to use energy-efficient appliances. On the other hand, utilities in rural areas need to implement measures to augment demand and boost consumption; such measures should also be based on core principles of demand-side management and energy efficiency.
- ▶ **Provide an incentive scheme for utilities for smart metering roll-out:** At this stage, only a few utilities have taken steps towards smart metering. This is due to multiple constraints, including lack of resources for a large investment programme, current technology that is not compatible with smart metering, and poor prior experience of ERP implementation. In order to drive programmes for smart metering, the central government may want to support policy mandates with financing or capital subsidy schemes as incentives. This can be tied up through adequate tranche disbursement milestones to ensure desired outcomes. Other potential interventions include providing a framework for financing such programmes, making a standard bidding document

“ Investment in strong IT infrastructure has helped us streamline our operations, connect better with customers, and reduce operational costs. Additionally, since there is only one utility for the whole state of West Bengal, it results in quick decision-making. Implementation of any decision is quick, relatively less cumbersome, and uniform across the state.”

– Senior official,
WBSEDCL (West Bengal)

available, creating a centre of excellence for a large roll-out of smart metering, and creating a centralized Advanced Metering Infrastructure solution backbone.

Capacity-Building Recommendation

Strengthen Utilities' Capacity by Redesigning Organizational Structures to Reflect Evolving Market Requirements

Before 2003, each utility was integrated, with each state having only one state distribution utility irrespective of the number of customers and geographical area of the state. After the Electricity Act of 2003, state distribution utilities across the country were divided into one or more than one state distribution utilities based upon customer base and geographical area, with the goal of improving electricity supply and customer services. However, the organizational structures within utilities that implemented business functions did not undergo any significant change, and departments remained split across business functions such as revenue, operations and maintenance, project, testing, and metering. Meanwhile, in the current market scenario, utilities' business focus has been changing from infrastructure availability to customer satisfaction. With reforms like segregation of carriage and content (e.g., further separation of the distribution value chain into distribution network operations and maintenance versus electricity supply) in the pipeline, as well as new digitization interventions and accompanying changes in customer expectations, distribution utilities will need to revisit their current organizational structure. Such a project should encompass the following tasks:

- ▶ **Determine which functions to keep in-house or outsource:** Utilities should perform regular analysis of their different services and activities to decide whether doing them in-house or outsourcing them will minimize operating costs and improve service delivery. For example, many of the surveyed utilities found that implementing ERP in-house was a failure. However, the Gujarat utilities were successful at outsourcing ERP implementation.
- ▶ **Implement performance management systems for employees:** Many utilities have archaic organizational set-ups, which need to be reviewed in consideration of the evolving electricity distribution system. When employee- and function-specific key

performance indicators are not set at the start of year, utilities' ability to track employee performance and make necessary changes to their performance goals or key performance indicators is limited. Utilities should have a standard performance management system for employee goals and performance evaluations. The employee key performance indicator should be linked with the utility's current-year target derived from the organizational vision.

- ▶ **Strengthen power procurement departments and the power trading function:** Today, 80%–85% of total costs to distribution utilities are from the cost of power purchase, which is overseen by a team of five to six employees with little attention from management. Utilities need to strengthen their power procurement departments to optimize power procurement costs. Also, with increasing gaps between base and peak loads, many utilities have surplus power while many others have power deficits. This increases the need to trade or exchange power in the market. Utilities need to strengthen both their power procurement and their power trading functions to ensure power availability at minimum cost and increase revenue.
- ▶ **Assess skills and develop need-based training and incentive plans for employees, especially field staff:** Staff behaviour and performance in providing services is still a major area of concern for many state-run distribution utilities. With the study findings clearly showing that only 62% customers overall are satisfied with the service provided by utility staff, utilities must take measures to enhance employees' skills and sensitize them about the importance of customer satisfaction. For this, utilities will need to conduct a skill assessment for each employee and develop need-based training plans across the organization. This should include training to improve field staff services behaviour with customers. Such training will help to improve timely response to customer complaints, staff service, and achievement of complaint resolution within the timelines

Organizational restructuring is a powerful tool which every utility should consider going forward. Some of the surveyed utilities have already implemented and benefited from such restructuring, including AP East, Gujarat Central, Gujarat North, and Karnataka Bangalore.



“ We invest a lot of time for both initial and regular training for our personnel. It helps us provide better services to our customers and better maintain the distribution network. The return on investment in training is high in many instances. For example, our own engineers designed a transformer that could cater to single-phase supply with absolute control.”

– Senior official,
UGVCL (Gujarat North)

stipulated in the Standards of Performance. Along with this, an employee reward and recognition mechanism should be in place to promote better performance. An incentive plan for field staff who do ground-level network maintenance and upkeep could go a long way towards tackling challenges, especially for utilities providing service across difficult terrains and topographies. Also, regular updates on the specifications

and advanced technology used in the power distribution system or processes should be shared with employees through multiple channels, including trainings, online knowledge-sharing platforms and other forums, circulars, and quarterly magazines. Such knowledge will enhance staff capability to serve customers with the changing technologies.

- ▶ **Implement an enforcement mechanism for theft identification:** To detect and prevent power theft, it will also be important to restructure utilities' vigilance departments and enhance current enforcement mechanisms, as well as implement different innovative practices prevalent across the energy industry. Such efforts could also include incentive schemes to promote customers to report theft incidents in their area.



Governance Recommendation

Enable Technology for System-Led Reporting and Decision-Making for Regulatory Filings and Reporting on Standards of Performance (SoP)

To improve delivery effectiveness and customer satisfaction, every utility must have clearly defined standard operating procedures for every process, with performance parameters based on the Standards of Performance set by regulators. Technologies for system-led reporting, such as ERP or similar information technology (IT) platforms, allow utilities to enforce their standard operating procedures and hence adhere to the Standards of Performance. Every standard operating procedure should have system-enabled reporting with clear timelines or turnaround times, along with clear accountability at different execution levels. To improve the performance of state-run distribution utilities, there should be very strict adherence and monitoring of standard operating procedures related to the quality and reliability of the power supply. This would include appointing a single point of contact for different activities related to standard operating procedures or directives, with responsibility assigned for performance of each activity.

Distribution utility managers can also deploy IT to monitor adherence to timelines and performance. This will enable them to track their utility's performance as well as implement informed decision-making. IT is also necessary to eliminate manual intervention in the information flow and to bring transparency to the system. Providing a management dashboard for utility managers and regulators will enable them to identify the root cause of low performance and implement remedial actions. For example, all the utilities in Gujarat have already implemented an ERP system to enforce adherence to standard operating procedures, monitor progress, and make informed decisions, and the results are reflected in these utilities' performance in customer satisfaction and overall.

Conclusion

Based upon the insight gained from this study of 25,000 electricity customers across 10 states and 25 state distribution utilities, we have identified the following eight recommendations. These recommendations are in general applicable to most of the surveyed utilities as well as to other utilities across the country:

- ▶ Revamp new electricity connection process to enable quick, transparent and easy turnaround, with focus on non-household customers
- ▶ Prepare for DBT implementation by initiating public outreach campaigns to increase customer awareness and ensuring KYC completion by utilities
- ▶ Enable capacity building of regulatory commissions to resolve utility viability challenges on account of widening cost coverage
- ▶ Strengthen customer engagement through deployment of standard operating procedures
- ▶ Implement data-driven planning for all future investments in distribution infrastructure, with a focus on improving reliability and quality of supply
- ▶ Digitalize the metering, billing, and collection (MBC) cycle through implementation of smart metering and demand-side management measures
- ▶ Strengthen utilities' capacity by redesigning organizational structures to reflect evolving market requirements
- ▶ Enable technology for system-led reporting and decision-making for regulatory filings and reporting on Standards of Performance (SoP)

The intent of this report is to capture in general the various aspects of the state of electricity access, customer satisfaction, and utilities' capacity to deliver as well as to capture some of the best practices that some utilities have adopted to solve some general and common problems. These practices may or may not be directly applicable to utility-specific challenges. Each utility can and will decide their own course of action and select which recommendations they want to implement, along with their priorities and timelines. For specific action plans, utilities will have to further study in detail the selected recommendations and devise their implementation plans.



APPENDIXES

All appendix data and content is available for download here: [<http://www.smartpowerindia.org/appendix-electricity-access-in-india>]

GLOSSARY

A

average cost of supply (ACS): The per unit (kilowatt-hour) cost of electricity incurred by the electricity distribution utility to supply power to the customers' premises

ACS-ARR gap: The gap between ACS (cost) and ARR (revenue); for profitable utility operation, this gap ideally should be negative

average revenue realized (ARR): The per unit (kilowatt-hour) revenue received by the distribution utility for sale of electricity

average billing rate: The proportion of total charges (in currency terms) billed to that of total number of electricity units (kWh) billed to a specific or all customer categories at a utility

B

base load: The average load connected to the network throughout the day

bill collection centre: An office or other establishment designated by the utility for its customers to pay their electricity consumption bills

billing schedule: The schedule of billing of utility customers at predefined dates

boundary meter: A meter responsible for measuring electricity consumption in a specific area of a utility's operation and at a specific interface point

C

carriage: The electricity distribution network

circuit: Any arrangement of a power source and load connected through electrical conductors that carry the power supplied to that specific load

collection efficiency: The proportion of charges collected from customers to the amount billed to customers

commercial losses: Losses to the utility primarily originating from insufficient billing and collection and theft of power

connected load: The total electrical power consumption rating of all devices connected to the power distribution system

content: The power flowing through the electricity distribution network

cost of supply: The total costs incurred by the utility to supply power to the customers' premises

cross-subsidy: A component of the electricity tariff charged to one set of customers (e.g., commercial and industrial) and used to subsidize another category of customers (e.g., households and agricultural)

customer mapping: Tagging of each customer to their respective distribution transformer and feeder to enable better planning, management, and monitoring of the electricity

distribution network and of the corresponding area's level of power consumption and theft

customer mix: The proportions of different customer categories that a utility supplies power to

D

distribution transformer: The electrical device that provides the final voltage transformation in the power distribution system

E

electric pole: A column or post used to support overhead power lines in electrical power systems, generally installed by the utilities

energy meter: An electronic device that measures the energy or electricity flowing or consumed in a particular electrical network

escalation matrix: The hierarchy through which a customer complaint can be raised and escalated further if not resolved at a lower official level

evacuation: Transmission of power from the power generating stations through transmission infrastructure for distribution to the end customer

F

fault: An abnormal electric current which impacts the normal flow of electricity in the system

feeder: The connecting infrastructure in a substation used for transmitting electricity from output terminals of power transformer to an area local to that substation through high voltage lines

feeder capacity: The capacity of a feeder to cater to the load of the substation's demand side

feeder loops: A type of distribution system in which the feeder, which originates at one power source, loops through different substations and service areas and terminates at the original substation or at another substation connected to a different bulk source

feeder segregation: The provision of dedicated electrical power lines based on the customers' tariff category

G

grid: An interconnected electrical network and associated infrastructure for delivering electricity from generators to end customers

H

HT network: The part of the network and associated equipment that carries power from a substation to a distribution transformer; HT networks carry power at high voltages (greater or equal than 11 kV)

J

Jhatpat connection scheme: The scheme launched by Uttar Pradesh Power Corporation Limited that offers a single-window system for a customer to apply for a new electricity connection

P

powerline technician or lineman: A person employed by a distribution utility for maintenance and network erection works in power system

L

load flow analysis: Numerical analysis of the power flowing in an interconnected electrical system in its steady state operation

load imbalance: The unequal distribution of load on different phases of a three-phase network, which draws unequal power from the network

load pattern: The spatial and temporal representation of load (in wattage) in the utility's area of operation

Lokdarbar: Customer interactive forums organized by distribution utilities at the local level to address and learn customer grievances and inputs

LT network: The part of the network that carries power from the distribution side of the distribution transformer to the customers' premises; LT networks carry power at low voltages (generally at voltage equal to or less than 440 Volts)

M

metering: Installation of an electrical device that measures electricity consumption by the end customers in a power distribution system

N

National Open Access Registry: A centralized electronic platform owned and operated by the National Load Dispatch Center and used for processing open access applications

network load balancing: The process of optimizing load on various components of the electricity distribution network by shifting load from highly loaded elements to comparatively less loaded ones

network loading: The total electrical load of equipment or appliances connected to the electricity network at a specific time

network planning: Planning for upgrades, maintenance, and addition of network capacity of the electricity transmission and distribution infrastructure to cater to day-to-day operations and future demand

network spread: The extent of network length (both high tension and low tension) and the number of substations and distribution transformers in a specific area of a utility's operation

new connection process: The process of obtaining an electricity connection from the electricity distribution utility

O

open access: The mechanism by which users with a requirement of 1 MW or more of power availability can buy competitive power from the market or from supply anywhere in the country

P

panchayat: The local governing body at the village level

peak demand: The maximum demand (in terms of load connected in watts) when electricity consumption is at its highest

peak load: The maximum electrical load connected to the network during any specific time

power cut, outage, interruption: Scheduled or unscheduled disruption in the supply of power

power trading: The sale and purchase of power between various power sector participating players (primarily generators, distributors, and customers) on a power exchange and under the ambit of prevailing power sector regulations

pre-paid meters: A type of electricity meter that can control the supply of electricity depending upon credit available in the customer's utility account

preventive maintenance: Regular maintenance of the electrical equipment or network to reduce the likelihood of failure and increase the reliability of the power supply

productive load: A high wattage load connected by any business entity that is crucial for the ongoing business

R

regulatory disallowances: A state regulatory commission's disallowance of expenses proposed by the distribution utility; the goal is to avoid utility inefficiencies and cost overruns creeping into the tariff charged to customers

ring main unit: Equipment used at the load connection points of a ring-type distribution network

S

sanctioned load, connection capacity: The electrical load that the distribution licensee has agreed to supply to a customer

sections, subdivisions, or divisions: Divisions of a distribution utility's operating area into various parts for better operation and management of the power distribution function

substation: A set of equipment (feeders, power transformers, switchyard etc.) used to transform high-voltage power available from transmission lines to a comparatively low-voltage power transmitted through a high-tension network to a distribution transformer

substation capacity: The designed capacity of the electrical substation to cater the electrical load of the distribution network

supply infrastructure, distribution infrastructure, network: The set of equipment used to distribute electricity from transmission substation to end customer, including transformers, electricity meters, transmission and distribution lines, and other associated switchgears

system metering: Metering of the electricity distribution network at different points (e.g., at substations, feeders, distribution transformers etc.)

system voltage: Nominal and designed voltage of the system as a whole

T

Tail end of distribution network: The section of the electricity network that runs from distribution transformer to customer premises

tariff order: The regulatory document detailing approval of all cost elements for the respective distribution utility and the final tariffs and associated charges applicable to various categories of customers for various levels of consumption

tariff rationalization: The process of simplifying the power tariff structure for customers and establishing consistency between types and categories of customers

technical losses: Losses due to energy dissipated in the conductors and equipment used for power transmission and distribution

time-of-day tariffs: Tariff structure in which different tariffs are charged for power consumed during different time periods of the day

transmission system: The infrastructure (e.g., transmission towers, high-voltage/extra-high-voltage power lines, transmission substations, power transformers, etc.) utilized for transmission of electricity from power generation stations to the distribution network

