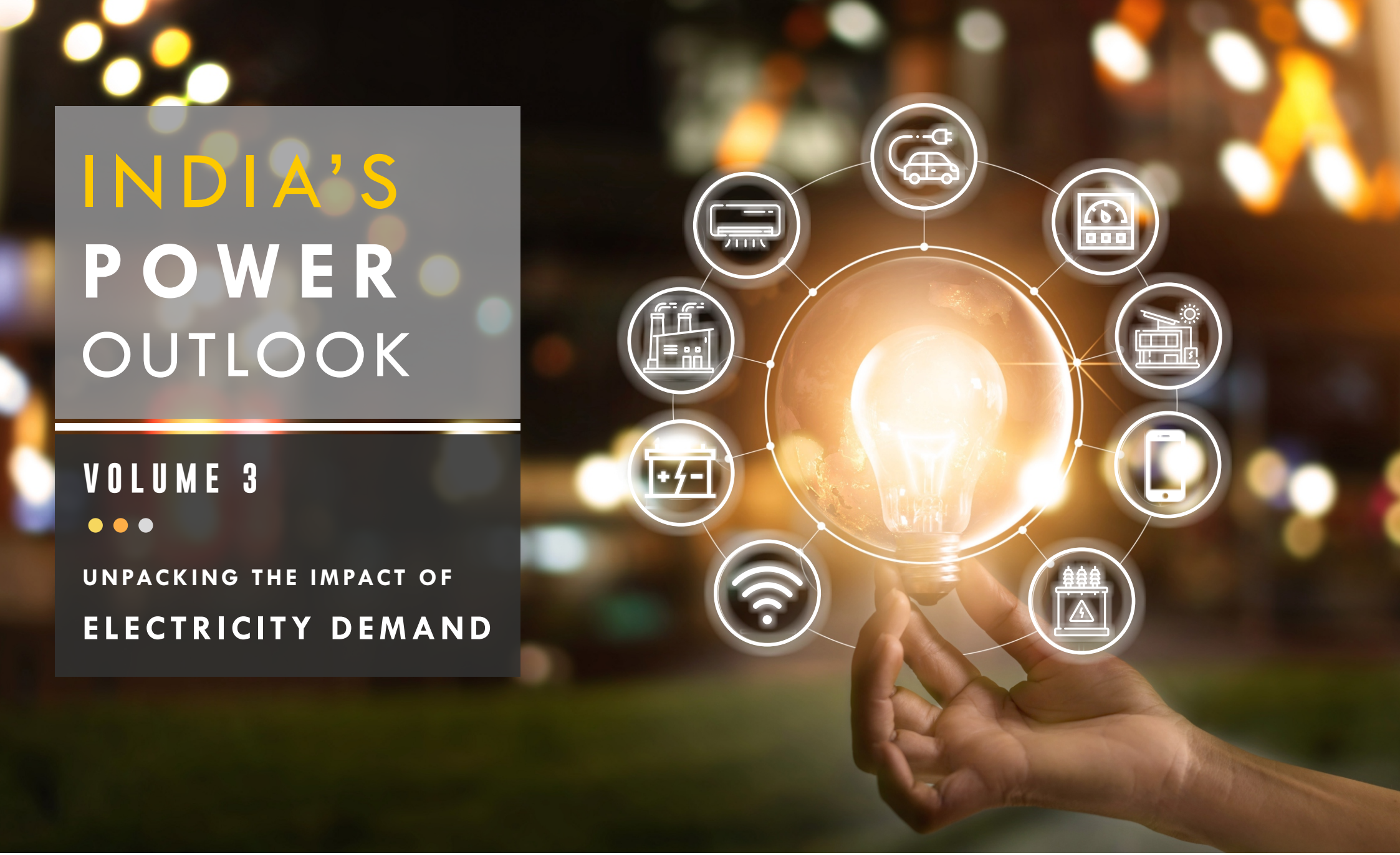
INDIA'S POWER OUTLOOK

VOLUME 3

UNPACKING THE IMPACT OF ELECTRICITY DEMAND



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The Power Outlook Series developed by Vasudha Foundation with support from Shakti Sustainable Energy Foundation provides an overview of the current status of India's power sector with a focus on significant and emerging developments. The outlook series aims to develop a more informed understanding of the power sector and act as a tracking tool for stakeholders. 'Unpacking the impact of electricity demand' is third in the series of India Power Outlook Reports.

The Volume 1 and 2 focused on assessing the implications and trends on the supply side of the system. The Volume 3 exclusively looks at unpacking the impacts of electricity demand across the power sector value chain. It dovetails the generation related challenges like forced outages, capacity delays, supply chain hurdles etc to various attributes of consumption such as low demand, newer disruptions and the state of electricity distribution in India. The Volume further provides a brief assessment of the trickle-down effect of the Covid-19 pandemic across the power sector.

All the data pertains to 30th November 2020, unless otherwise mentioned.

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CONTENTS

INTRODUCTION

India has made visible strides in advancing a clean energy transition by adding large renewable energy, robust grid integration and network enhancement. Often, what has been missed, is an integrated approach to look at the demand side of the system and how it has evolved over time.

The massive electricity demand slump due to the Covid-19 outbreak has made this discussion even more pertinent than ever before. Although the demand for electricity declined by 20-25% during the lockdown, its value proposition has risen. Reliable electricity supply was not only critical for sustained medical services but for working remotely during the lockdown period, amongst others. The power sector, particularly the distribution utilities were left juggling with the load and revenue drop coupled with rapid changes in the load mix and load shape[i].

The crisis has provided for opportunities to re-shape the sector for future resilience and learn from our past mistakes. There is a need to move away from the traditional approaches of supply side planning to more flexible and consumer based integrated planning. Many recent policies and programme announcements like Electricity (Rights of Consumers) Rules, 2020, Real-time Electricity Market, Privatization of selected Discoms etc are all the steps in the right direction towards rewiring the electricity sector and bringing consumer to the centerstage.

In the last three years, 26 million households have been connected to the grid under the Saubhagya programme. Consequently, India's energy access debate has shifted from providing electricity connections to supplying reliable electricity supply. Moreover, programmes such as Atma-Nirbhar, support to domestic/local manufacturing, Digital India and other similar initiatives aimed at creating jobs in rural India, could further boost rural demand. The improved electricity supply and rising rural incomes could lead to unprecedented increase in electricity consumption. Another notable transition shaping the sector is the electrification of the transport sector, which is both an opportunity and a challenge. Along with higher revenues, the Discoms need to conduct accurate demand assessments and load management for successful electric vehicle and grid operations. More so, with rising urbanisation, improved standards of living and increasing appliance penetrations; the consumer will be the only constant in the future power sector dynamics. The huge demand boost and treating electricity as a service presents a lucrative opportunity to more than sixty Distribution companies to anchor their respective transformation needed for energy transition.

With this background, the third power outlook series is aimed to understand the implications of transforming power demand and its impact on the value chain. It further attempts to unpack four different Discoms to understand their unique financial and operational journey.

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[i] Demand from industry and commercial segment dropped while the demand from residential segment increased. Further the load shape witnessed higher peaks during the morning and evening hours, which pointed to higher demands from the households

India Power Sector - A Snapshot

GENERATION

374 GW (As on Nov'20)
Total installed capacity

1,389 BUs (FY'20) | **902 BUs** (Apr'20-Nov'20)
Overall generation

90.04 GW (As on Nov'20)
Installed RE capacity (excluding large hydro)

136 GW (As on Nov'20)
Total Installed RE capacity

56% (FY'20) | **50.8%** (Apr'20-Nov'20)
Average thermal PLFs (excluding gas-based plants)

GW-Gigawatts, BU-Billion units

TRANSMISSION

4,33,510 ckm (As on Nov'20)
Number of transmission lines

9,93,923 MVA (As on Nov'20)
Substation transformation capacity

ckm -Circuit kilometers, MVA-Mega Volt-Ampere

DISTRIBUTION

1,291BUs (FY'20) | **834 BUs** (Apr'20-Nov'20)
Total energy requirement

1,284 BUs (FY'20) | **831 BUs** (Apr'20-Nov'20)
Total energy available

184 GW (FY'20) | **177 GW** (Apr'20-Nov'20)
Total peak demand

183 GW (FY'20) | **176 GW** (Apr'20-Nov'20)
Total peak met

24.6%*
Average AT&C loss

0.85 Rs/unit*
ACS - ARR gap

**As per UDAY Dashboard, on September, 2020*

CONSUMPTION

~21.44 Crores
Number of households electrified

1,208 kWh (As on Mar'20)
Per capita electricity consumption

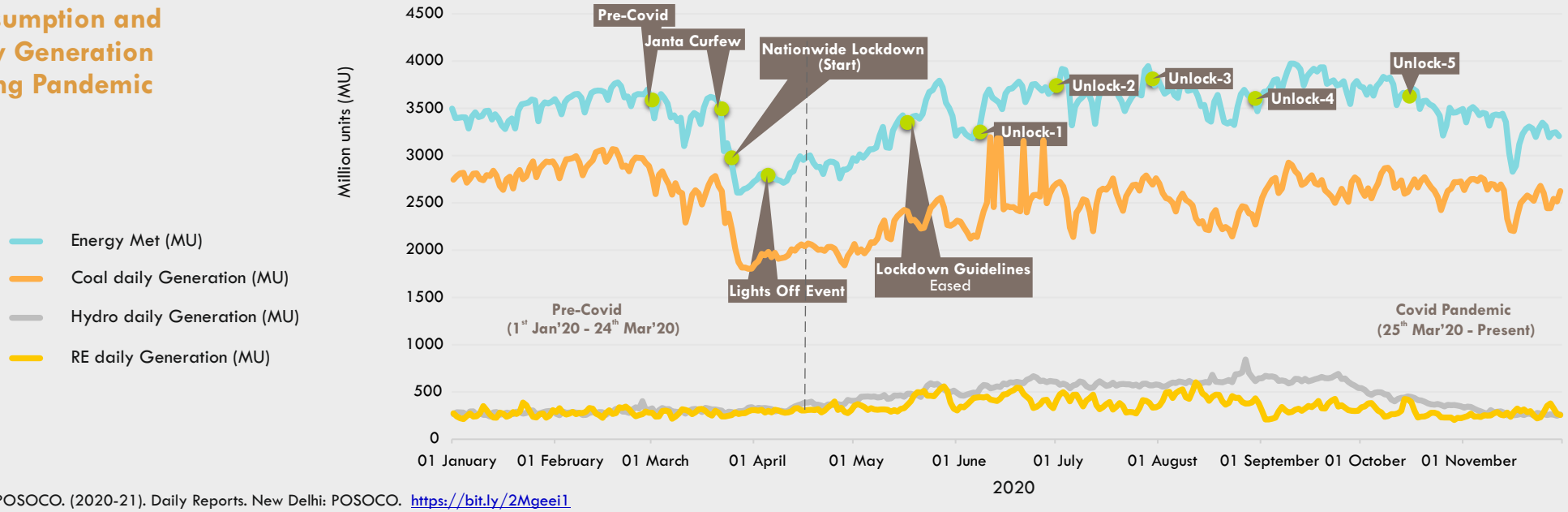
42% (As on Mar'20)
Percentage electricity share by Industry
(Highest demand sector)

Source-CEA, Saubhagya Dashboard, MNRE and UDAY dashboard. Information collated by Vasudha Foundation for India's Power Sector Outlook Series

1 COVID-19 IMPACT

In 2020, in a world affected by Covid-19, India's power sector was no exception. The pandemic worsened the compromised situation of the sector, throwing some of the most unprecedented challenges. From commercial activities like billing, metering and collection due to physical distancing measures to power supply management due to sudden dropping of demand to the disruptions in global supply chain owing to restriction on Chinese imports, all were harshly impacted. However, the power sector, being part of the essential service, had maintained a steady and reliable power supply to the hospitals and rising residential demand (despite a liquidity crunch).

Change in Electricity Consumption and Daily Generation During Pandemic



Source: POSOCO. (2020-21). Daily Reports. New Delhi: POSOCO. https://bit.ly/2Mgeei1

Impact of Covid-19 on Power Sector Value Chain - A Snapshot

	2020	Actual Energy Consumption MU	Change in Energy Consumption (wrt 2019) Percentage	Amount Billed to Discoms Rs. (Billion)	Amount paid by Discoms Rs. (Billion)	Monthly Thermal PLFs Percentage	Change in Emissions (wrt 2019) Percentage
PRE-COVID	JAN	105,158	+3.95%	18.3	12.2	57.61%	1%
	FEB	103,815	+11.73%	17.2	9.5	60.35%	-9%
LOCK-DOWN PERIOD	MAR	98,952	-8.68%	18.2	18.9	52.55%	-14%
	APR	84,550	-23.21%	19.6	5.1	42.40%	-32%
	MAY	102,089	-14.94%	17.6	6.5	47.92%	-23%
UN-LOCK PERIOD	JUN	105,086	-10.94%	15.3	7.6	49.52%	-19%
	JULY	112,147	-3.72%	15.9	16.8	52.92%	-3%
	AUG	109,657	-1.67%	16	12	49.01%	-3%
	SEP	112,436	4.58%	14.7	11.08	49.58%	9%
	OCT	109,174	11.58%	15.69	11.81	55.51%	13%
	NOV	96,883	3.12%	13.17	13.17	53.03%	4%

DEMAND DECLINE → LOW REVENUES & RISING OVERDUES → SHRINKING PLFs → LESSER EMISSIONS

*The change in emissions is only with respect to the emissions from the power sector i.e the coal based power plants.

Source: MoP. (2020, November). Praapti. Retrieved from Praapti Portal: https://bit.ly/3aS6VYd & CEA. (2020). Multiple reports. Retrieved from https://bit.ly/3hNEsnF

ELECTRICITY DEMAND

Demand drop by 20-25%.

- Highest demand reduction ~25% recorded in Apr'20 wrt 2019 levels.

Changing load composition with a rising domestic demand

- Between March 25th to August 31st (the lockdown period) the domestic load increased from 24% to 36% whereas the industrial load decreased from 42% to 32%.
- Sample households in states like UP and Maharashtra reported higher (26%) daily electricity consumption in the lockdown period as compared to the pre-lockdown period.
- Industrial Index (RBI) was lowest in Apr'20 (54.0).

Demand recovery started in early September

- Power consumption was affected for six months from Mar'20 to Aug'20. The demand showed recovery from Sep'20.
- Studies[1] estimated slower recovery in the eastern and north-eastern regions, primarily due to their low-income levels.

DISTRIBUTION

Low billing and collection[2]

- Discoms collection rate dropped around 70-80%, resulting in a cash crunch.
- Seven to eight states imposed force-majeure conditions to free themselves from the payment of fixed charges to generators[3].

Significant revenue loss[4]

Due to lockdown, it is estimated that Indian Discoms will incur

- A revenue loss of $4 billion.
- A liquidity crunch of $7.2 billion.

Need for revival

- Three months moratoriums to Discoms to make payments.
- 90,000 crores package for Discoms. Further extended to 1.27 lakh crore. A special long-term transition loan to help Discoms pay off their dues to generators and have immediate debt repayment.
- The two-tranche loan was necessitated to be guaranteed by the states and assure the payment of interest and other charges. The second tranche would be released only after certain reform conditions on loss reduction and performance improvement are met.

GENERATION AND RESOURCE AVAILABILITY

Plummeting demand led to generation curtailment and power surplus

- Record low PLF of 42.4% for thermal power plants.
- Power prices collapsed in the markets with the average market clearing price (MCP) hitting its lowest ever at Rs.1.95/kWh on 25th Mar'20.

RE continued to rise and shine

- Thermal power declined at 15% in Q2 (April to June) wrt to the pre-covid Q1 (January to March).
- However, RE, with its must-run status, saw a corresponding 15% increase in its generation in Q2 over Q1.
- India hydro power kept its promise showing the earliest reviving trend in June at 19%.

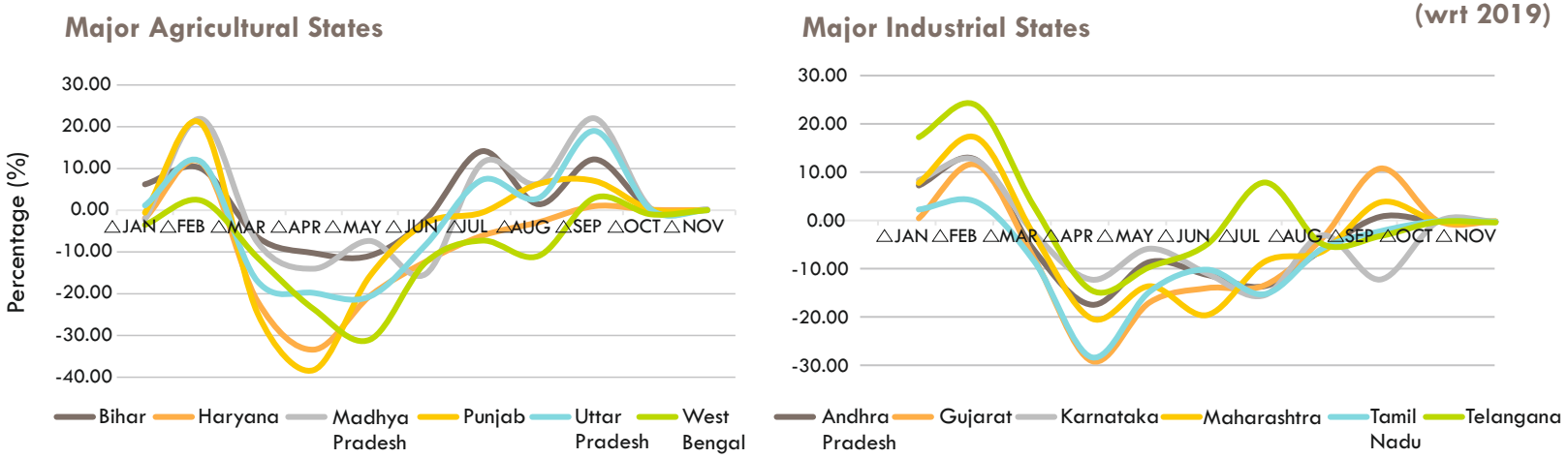
Other externalities

- Rise in solar PV module cost by 10-20% due to decline in imports from China.

1.1 Energy Supply Variations at State Level – Monthly Trends

- Most states saw a visible decline in their demand requirements during the lockdown months (March to June) ranging from -2% to as high as -38% (in the case of Punjab).
- States with large industrial shares like Gujarat, Tamil Nadu and Maharashtra reported electricity demand drop for more months than the less industrialized states like Bihar, Uttar Pradesh which experienced marginal gain in demand due to reverse migration.

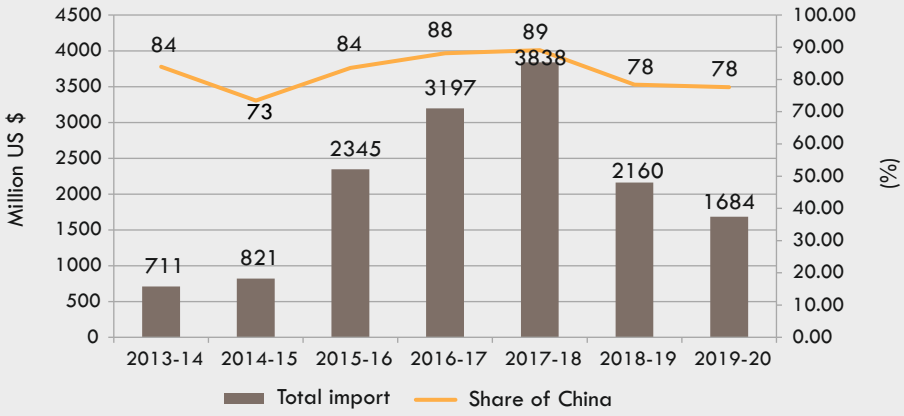
Change in Energy Supplied (wrt 2019)



Source: CEA. (2020). Energy Supply Position Report. New Delhi: CEA. https://bit.ly/3rFclpV

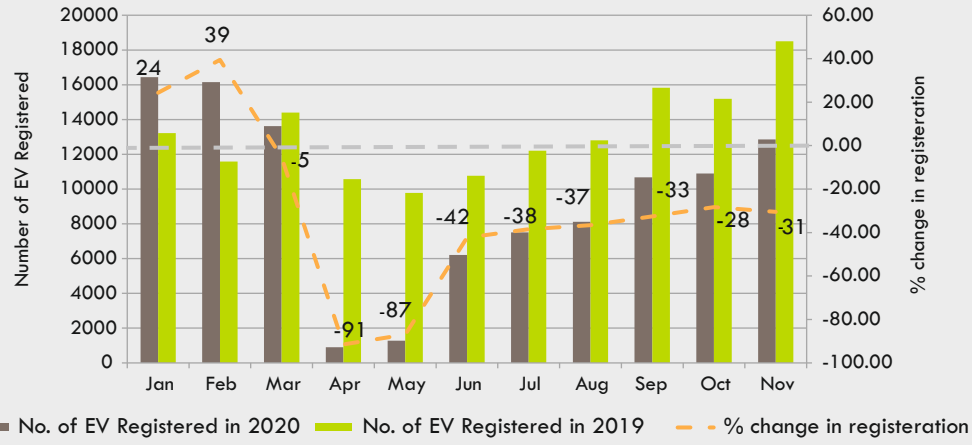
1.2 Disruption in Supply Chain

Trends of Import of Solar Equipments (2013-14 to 2019-20)



Source: Ministry of Commerce and Industry, Import and Export Data Bank https://bit.ly/3hN8xUp
MNRE. (2020-21). Third Report: Demand for Grants. New Delhi: Loksabha Secretariat. Retrieved from https://bit.ly/3ojSGzh

Number of EV registered and Change in % of Registration



Source: Ministry of Road Transport and Highways. (2020). Vahan Dashboard . Retrieved from https://bit.ly/2JMPI7g

- Import of solar equipment declined by around 90% during FY21 compared to previous year due to supply chain disruptions from China and other countries resulting from the lockdown restrictions. This is also due to the import duties imposed by GoI on Chinese modules to decrease import dependence and boost domestic production.
- Due to supply chain disruptions and low demand, EV registration declined during FY21 with substantial fall during lockdown period (Apr-May'20), but is steadily picking up post relaxations after lockdown. Nonetheless, registrations have been lower as compared to last year.
- However, BNEF projected that countries like India, could see better than average EV sales in the medium term with procurements backed by governments and early adopters[5].

GENERATION 2

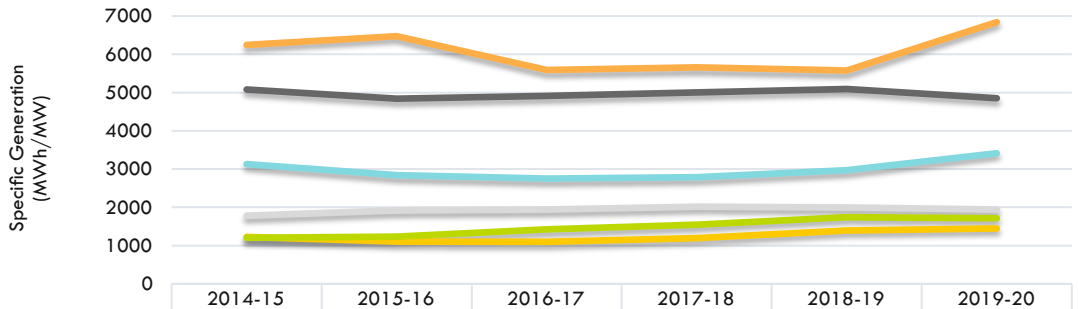
India's electricity generation is mostly dominated by fossil fuels with coal at 55% share of the total installed capacity of 374 GW and an astounding 72% share in total generation[ii] of 1,385 TWh in 2019-20. However, in the recent years, the Government of India is making concerted efforts to decarbonise the power sector. India's NDC commitments and the 175 GW renewable energy target by 2022 has given a significant push to cleaner energy and led to snowballing of many players contributing towards the growth of RE based generation. Together, this has led to an installed RE capacity of 87 GW by Mar'20, adding an average of 10.25 GW since 2015-16.

As of Nov'20, India's installed RE capacity stood at 90 GW, with a share of 24% of the total installed capacity mix rising from 15% in 2015-16. As per the NEP 2018, it is planned to construct a total of 50 GW coal capacity by 2026-27 and retire a similar 48 GW of older inefficient coal power plants. Also, with an RE target of 450 GW by 2030, the total generation from renewables is expected to contribute ~45% of the total electricity demand of 2,325 TWh by 2029-30[6] . Hence, the sector is at the cusp of its most vital transition.

[ii] Due to its high plant load factor compared to that of Renewable energy, Coal power plant generates more electricity with the same installed capacity compared to RE plants

2.1 Specific Generation[iii] Trend by Source

Specific Generation by Sources



	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20
Coal/Lignite	5077	4840	4913	5004	5093	4855
Gas	1781	1923	1938	2017	1998	1943
Hydro	3132	2837	2751	2785	2971	3413
Nuclear	6246	6473	5592	5656	5577	6841
Solar	1229	1101	1098	1195	1393	1447
Wind	1203	1233	1425	1547	1741	1715

Source: CEA. (2020). Monthly Reports. https://bit.ly/3b051F7

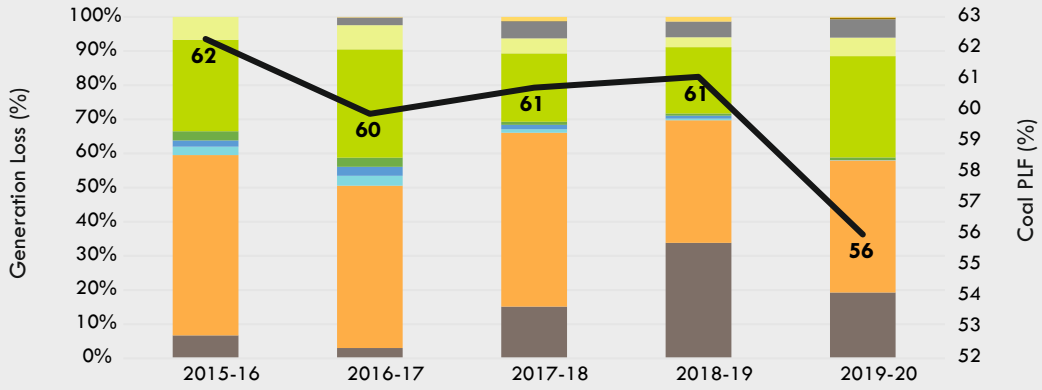
- Specific generation of coal declined from 5,077 MWh/MW in FY15 to 4,855 MWh/MW in FY20 owing to low PLF, forced shutdown and impact on efficiency due to frequent ramp up and ramp down.
- Over the same period, specific generation of hydro increased by 8%. Interestingly, the generation output for hydro is highest in 2019-20, with only 300 MW of capacity addition during that year.
- Specific generation of Solar and Wind has steadily increased in recent years due to technology advancement and efficiency improvement.
- Specific generation of renewables is expected to increase further due to more capacity addition in the system along with storage, hybrid and round the clock (RTC) arrangement for reliable and flexible operation of the grid.
- Solar PV tariff dipped to record lows of Rs1.99 Rs/kWh in 2020 from about Rs 15/kWh in the past decade in India.

- Low PLF of coal power plants affects the efficiency and requires more maintenance due to frequent ramp up and down. Therefore, National Electricity Plan (CEA, 2018)[7] had recommended to retrofit existing power plants for increased ramping up capacity and backing down capacity.
- This will further result in better integration of renewables. Such retrofitting will help in grid balancing and help consumers avail benefits of lower tariffs.

[iii] Specific generation signifies the generation output MWh per MW of installed power plant.
This depends on factors like PLF, efficiency, CUF and source type. Low MWh/MW means low generation output.

2.2 Generation Losses due to Forced Outages

Year on Year Generation Loss in Coal Power Plants due to Forced Outage (%)



*Outage data has been compiled from CEA Daily Generation Sheets

Source: National Power Portal (2020). Daily Outage Reports. https://bit.ly/3bwrD05
CEA. (2020)Review of Thermal Power Stations Report. https://bit.ly/3oBFrKm

A forced outage refers to the emergency shutdown of a power plant which could be due to a combination of reasons such as coal shortage, technical power plants related faults, grid related issues, uneconomical operation, low scheduling and demand, no Power Purchase Agreement (PPA), raw water unavailability etc. Frequent forced outages has resulted in huge generation losses and thereby increasing the cost of generation.

- The generation loss was in the range of 300 to 370 BU in FY16 which has increased further to 497 BU in FY20.
- While the generation outages rose; the PLFs of coal power plants declined from 62% in 2015-16 to 56% in 2019-20.
- Share of generation loss due to forced outages to total generation has been in the range of 40% to 50% since 2015-16.

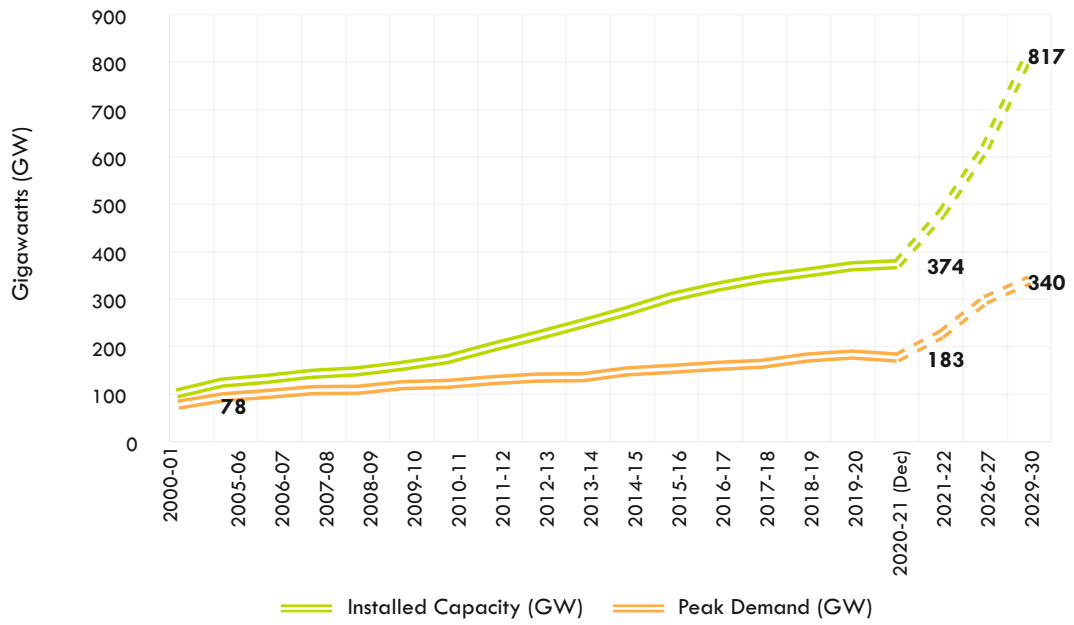
- 40% of the Forced outages in the coal fired power plant generation was largely due to plant technical issues.
- Further, outages due to low demand, low scheduling and No PPAs constituted almost 40% of forced outages in coal fired power plants in 2019-20.
- Other notable reasons for forced outages include coal shortage, amongst others.
- Generation loss due to forced outages in FY20 resulted in a firm capacity loss of around 70 to 80 GW[iv], which roughly constitutes 34% of the total current installed coal capacity of 205 GW.
- In order to address the issue of inefficiencies of power plants, the Ministry of Power is looking at retrofitting inefficient coal power plants. This move could help in improving the performance of some coal plants, and an optimum utilisation of generation assets.

India lost approximately 497 BU of coal power generation in FY20; which is substantial considering the total power generated in FY20.

[iv] When calculated using 2005 level PLFs of 70 to 80%.

2.3 Capacity Adequacy vs Peak Demand

Increasing Gap between Installed Capacity and Peak Demand



Source: CEA. (2018-19). Annual Report. New Delhi. https://bit.ly/2Lcwkkn & CEA. (2020). Peak Power Supply Position Report. New Delhi. https://bit.ly/2XAnfF7

The tables have turned now. The sector is moving away from a power deficit situation to a power sufficient scenario. It generates adequate amount of electricity not just for meeting the domestic and agriculture (8 hours a day) energy consumption needs but also for exports. However, as a country we are still far behind from achieving a 24*7 reliable power for all.

The power demand in Dec'20 reached 183 GW (All time high) in comparison to 182 GW level reached in May'19.

- Installed capacity has grown at a CAGR of 6.7 % from FY01 to FY20 however the peak demand has grown at a CAGR of 4.4%.
- The gap between installed capacity and peak demand increased from 23% (24 GW) in FY01 to 50% (186 GW) in FY20.

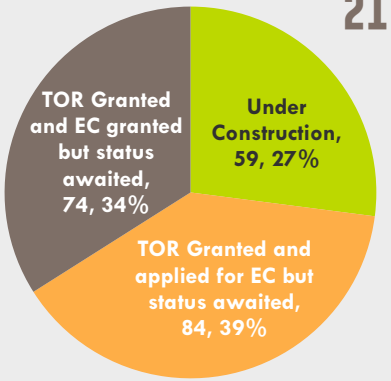
Slower demand growth and aggressive focus on capacity addition are primarily the reasons for the widening gap. The gap could further expand due to prolonged periods of low electricity demand and decelerating economic conditions owing to the Covid-19 pandemic. However, a significant percentage of this installed capacity is also planned to accommodate for the grid level losses and rising infirm capacity in recent years (due to increasing RE capacity addition). As discussed in the previous sub-section, outages also contribute to declining firm power in the system especially coal.

Going ahead, there is a need to improve the overall efficiency of the system to include demand side options like load shifting, energy storage etc to better manage the peak load. This will help in offsetting the need for additional power plants and further relieve the banks (that are already stressed with the mounting distribution losses) from additional financing. Moreover, the expansion of the power infrastructure needs to balance itself with the goals of providing reliable power to all households.

[v]2.4 Capacity Addition of Power Plants (by source) - A Status Update

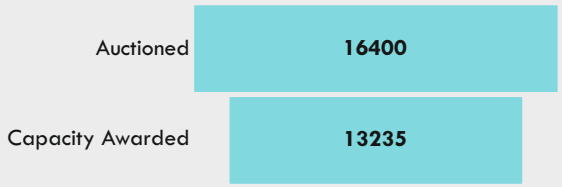
Coal Pipeline Capacity-in GW (as on Sep'20)

217 GW



- A huge pipeline coal capacity of 217 GW is under various stages of approvals, progress and completion. This is despite planned capacity addition of 50 GW (approx.) by 2027.
- Coal capacity of 36 GW was shelved due to issues like land acquisition, coal linkage deferred, local agitation, no clearance from EC, technical/infrastructure, project not completed and other reasons.

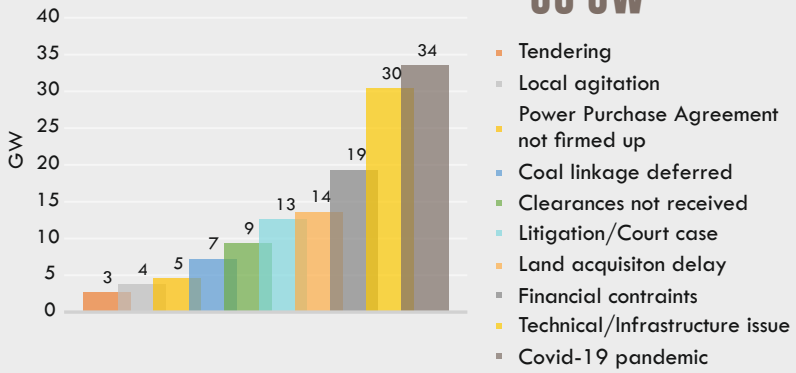
Wind Capacity at Various Stages-in MW (as on Dec'20)



- The Wind pipeline capacity stands at 16.4 GW further translating to 13.2 GW of awarded capacity.

Delayed Under-construction Coal Capacity-in GW (as on Sep'20)

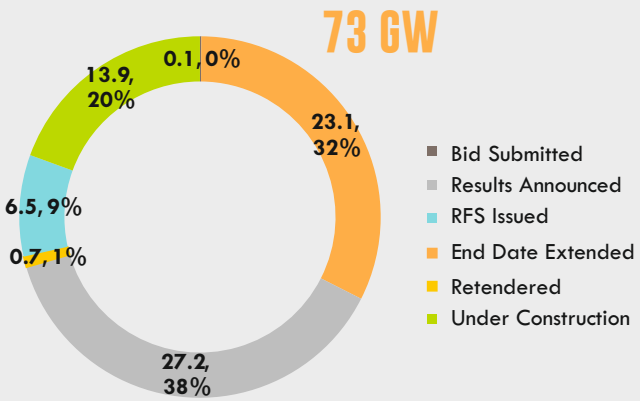
59 GW



- A large share of under-construction coal power plants (almost 34GW) have cited Covid-19 pandemic as a chief reason for the delay in construction.

Solar Pipeline Capacity - in GW (as on Nov'20)

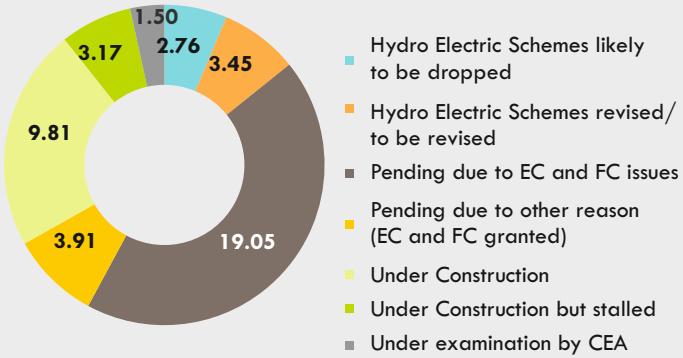
73 GW



- An impressive solar pipeline capacity of 73 GW is planned. This includes ~14GW of under construction capacity and the rest are in various stages of bidding and tendering.

Hydro Pipeline Capacity-in GW (as on Nov'20)

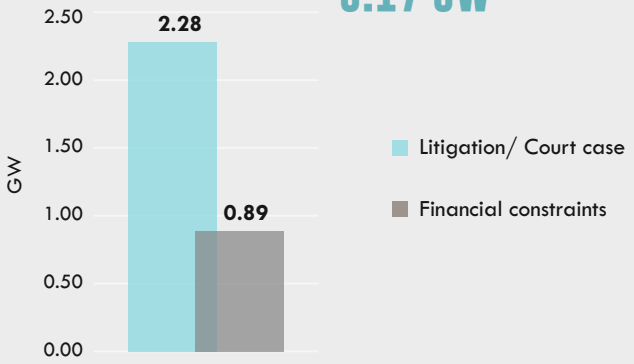
44.23 GW



- The total pipeline hydro capacity is 44.23 GW. Almost 13 GW of capacity is under construction, out of which 3.17 GW is stalled due to financial and litigation issues.

Delayed Under-construction Hydro capacity-in GW (as on Nov'20)

3.17 GW



- A large number of hydro capacities is pending for approvals due to issues like revisions of hydroelectric schemes by CEA and environment & forest clearances.

Source : Vasudha Analysis (2020, November 08)

[v]EC - Environmental Clearance

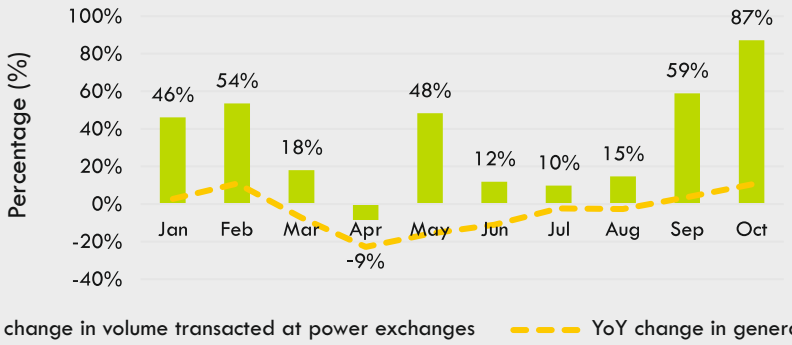
2.5 Electricity Market: A Game Changer for India

The need for a robust power market has always been at the forefront of a real power sector reform. The value of flexible and competitive power procurement was further realised with the sudden demand fall due to the pandemic outbreak. The Discoms were in a double-whammy where the incomes fell due to sudden demand fall from their cherry consumers (industrial and commercial consumers), while they continued to incur fixed charges on power purchase from the generators.

With the announcement of the real time (RTM) and green term ahead market (GTAM), India's power sector is set for a paradigm shift in its generational planning, power procurement and clean energy transition.

- The RTM[vi] is set to become the biggest game changer for the Discoms to manage real time load and generation variability.
- The GTAM[vii] will give a boost to RE rich states to develop capacity beyond their Renewable Purchase Obligations (RPO).

Monthly Change in the Electricity Volumes Transacted at the Market Exchanges wrt 2019



Source: Central Electricity Regulatory Commission(2020).Report on short term power market. Delhi: CERC https://bit.ly/35x5dba, CEA (2020), Power supply position report, https://bit.ly/38FvGoW , CEA (2020), Executive summary. https://bit.ly/3sjMpGb

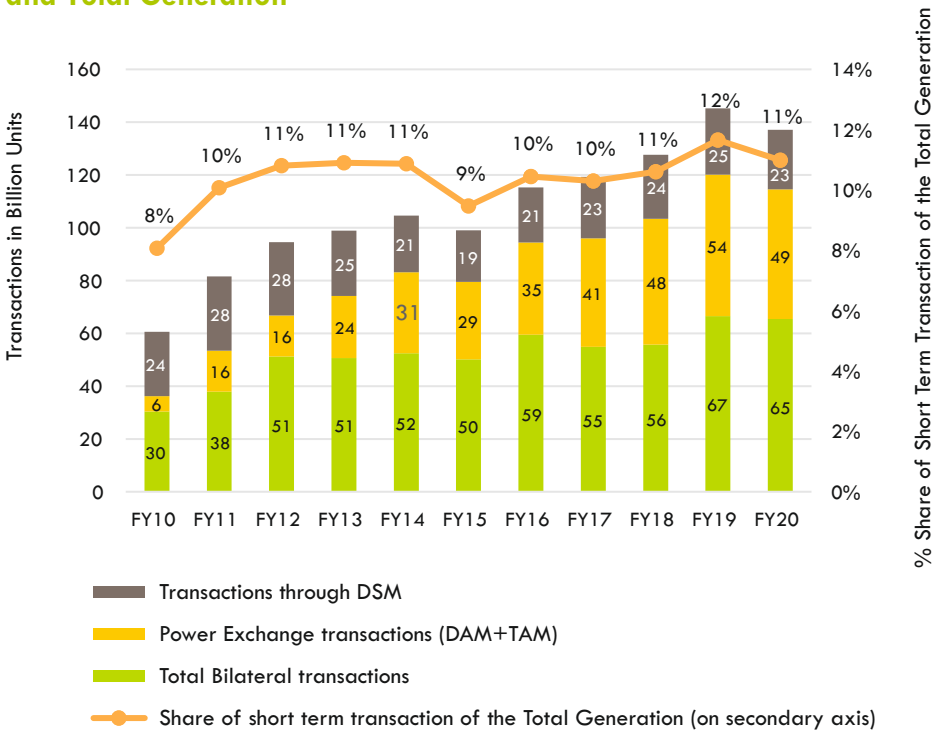
During the lockdown period, the overall electricity generation and consumption declined with respect to 2019 levels. However, the electricity volumes transacted at the markets has been surging since Jan'20. This trend indeed reinforces markets as the most preferred platform for the distribution utilities and the open access consumers for meeting their power requirements in the most flexible and competitive manner.

[vi] Real Time Market (RTM) features a new auction session every half an hour with power to be delivered after 4-time blocks or an hour after gate closure of the auction. The price and quantum of electricity trading is determined through a double-sided closed auction bidding process.

[vii] Green Term Ahead Market (GTAM) trades in renewable energy. This features contracts such as Green-Intraday, Green-Day-ahead Contingency (DAC), Green-Daily and Green-Weekly. The matching mechanism is continuous/spot trading for Green-Intraday, Green-DAC and Green-Daily contracts whereas double sided open auction process to be implemented for Green-Weekly.

A. Increase in Share of Short-term Transactions[viii] and Improved Congestion Management

Volume of Short-term Transactions of Electricity and Total Generation



Source: Central Electricity Regulatory Commission. (2020). Report on short term power market. Delhi: CERC. https://bit.ly/3pAxK7b

- The share of short term power in the overall generation increased from 8% in FY10 to 11% in FY20.
- Volume of electricity transacted through power exchange increased at a CAGR of 21% since its inception in FY09.
- Volume of electricity that could not be cleared due to congestion as % to unconstrained cleared volume has decreased from 12% in FY10 to 0.4% in FY20.

[viii] Short term transaction refers to contract of less than 1 year for electricity transacted through DSM, bilateral and power exchange.

B. Introduction of New Markets: Real Time Market (RTM) and Green Term Ahead Market (GTAM)

1. Real Time Market- A game changer for power market

Real Time Market has become a preferential choice for the buyers since its inception in Jun'20.

- It's an arrangement for delivery of power within an hour.
- There is an increase in trend of lower price in RTM which is attractive for buyers (PowerLine, 2020)[8]

The (RTM) registered a total trade of 4574 MU since its inception in Jun'20

- The market saw a steep rise in volume traded on Month-on-month basis from 515 MUs in Jun'20 to 894 MUs in Nov'20 at a CAGR of 11.6%
- Average (RTC) from Jun'20 to Nov'20 was 2.48 Rs/KWh with Peak price of 2.90 Rs/KWh and non-peak price of 2.35 Rs/KWh in this period

Top 3 State purchasers at RTM (Nov'20)

- NLC (Neyveli Lignite Corporation Limited), Telangana, Odisha

Top 3 State sellers at RTM (Nov' 20)

- Jammu & Kashmir, Andhra Pradesh, Rajasthan

2. Green Term Ahead Market- A revolutionary step advancing RE uptake

The Green Market can be used by the generators to sell excess power and further can be used by obligated entities such as Discoms, industries, open access consumers to fulfil their RPO compliance in a flexible manner.

- GTAM offers trade in intraday and day ahead contracts in both solar and non-solar.
- Registered a volume of 459 MU since its inception in Sep'20.
- The market saw participation from 23 participants during the month Nov'20.
- The key participants included the distribution utilities such as Telangana, Karnataka West Bengal, Haryana, Dadra & Nagar Haveli, Daman & Diu, Delhi, Bihar, Maharashtra among others.

C. Comparative Trends of Different Markets at India Energy Exchange

Particulars	TAM*	DAM**	RTM	GTAM
Launch Date	Sep'09	Jun'08	Jun'20	Sep'20
Volume traded (MU) Till Nov'20	19,583	3,71,417	4,574	459
Volume Traded (MU) (Jun'20 to Nov'20)	926	28,290	4,574	459
Price Range (Rs/kWh) (Jun'20 to Nov'20)	-	0.7 to 6	0.1 to 6.8	-
Weighted Average Price- Rs/kWh	2.62 (as of Nov'20)	2.56 (as of Nov'20)	2.48 (as of Nov'20)	3.52 (as of Nov'20)

*Term Ahead Market, **Day Ahead Market

Source: India Energy Exchange. (2020, November 20). Market Data. https://bit.ly/3n6fXTH

- Over the past five months, RTM has occupied a 16% share of DAM indicating high popularity amongst the market players
- The high variability in prices in RTM and DAM indicates a good sign of market maturity
- Interestingly, power surplus states like Maharashtra, Gujarat, Telangana continue to use market platforms like DAM, RTM to purchase cheaper power than the costly PPAs.
- Southern states having RE surplus are using the GTAM during the day time.
- GTAM could outshine Renewable Energy Certificate (RECs) mechanism.

The surge in the short-term power market could be attributed to more transparent mechanism of price discovery, improved congestion management, increasing number of stressed thermal power assets, availability of cheaper and flexible power and tightening of grid frequencies. While the share is still minuscule in the overall power generation, the trend is set to be steeper with increasing hesitation to sign long term power purchase agreements and need for flexible power to manage the variable grid. This is evident from the recent increase in volume of electricity transacted at the exchange and the introduction of a new real time market at the India Energy Exchange.

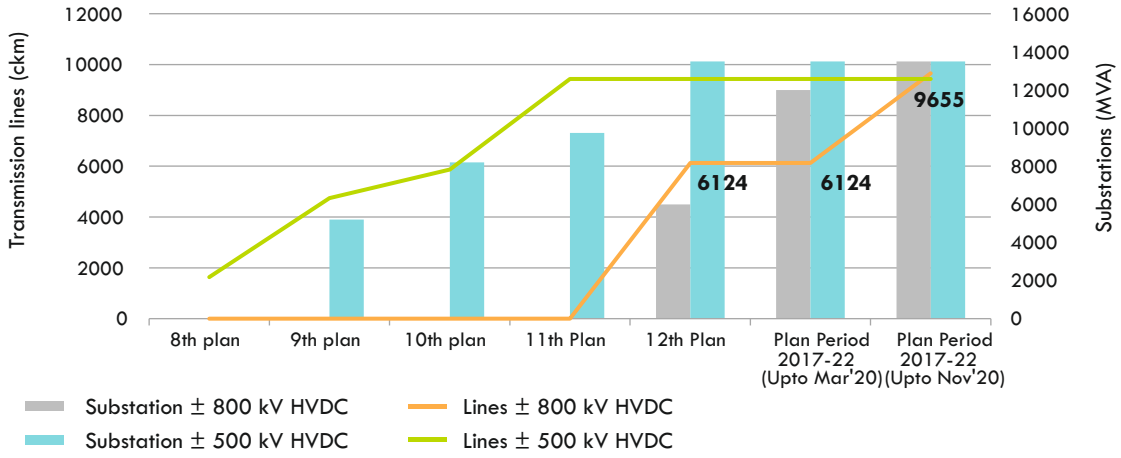
3 TRANSMISSION

With large focus towards renewable capacity addition in the next decade, electricity transmission will become crucial to evacuate power from RE generating station to the load centres. Hence it is important to strengthen this element for efficient distribution of power to consumers. According to a recent study (ICRA Research, 2020)[9], the domestic transmission segment expects an investment of Rs. 1.8 lakh crore over the five-year period from FY21 to FY25 primarily for evacuating power from RE stations.

A total of 4.33 lakhs ckm and 9.9 lakh MVA have been established in the plan period 2017-22 (As on Nov'20).

3.1. Increasing Maturity of the Transmission System

Growth of Transmission Lines and Substations (± 800 kV and ± 500 kV HVDC) As on Nov'20

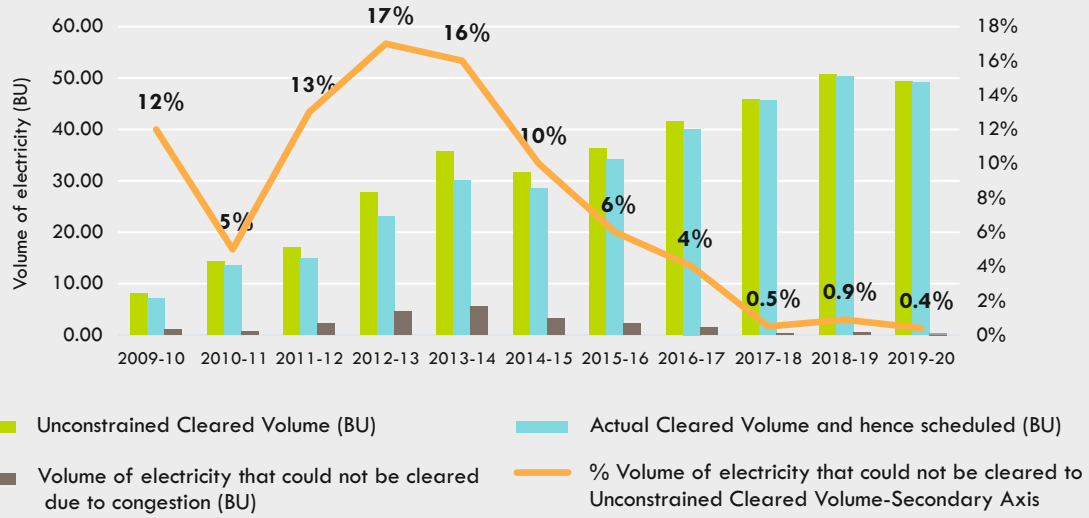


Source: CEA, Monthly Reports on progress of Transmission Lines and Substations. https://bit.ly/3c5Dqmu, https://bit.ly/39RZa2i

- The emerging HVDC transmission technology is at the forefront of the emerging smart grid revolution and large scale RE penetration. Moreover, the SAUBHAGYA led rural electrification and a large focus on reliable power supply presents a huge market opportunity for HVDC transmission.
- HVDC is an efficient mode of transmitting power compared to HVAC. This is due to its advantages like transmission of bulk power for longer distances especially from remote locations and at lower loss levels.
- Over the years, there has been an increase in lines at ± 800 kV HVDC (CEA, 2020)[10] (CEA, 2020)[11]. Further, the market for the HVDC transmission segment is expected to grow at a 6.2% CAGR between 2020-2025[12].

3.2 Decreasing Congestion for the Power Transacted at Power Exchanges

Effect of Congestion on the Volume of Electricity Transacted through Power Exchanges (2009-10 to 2019-20)



Source: Central Electricity Regulatory Commission. (2020). Report on short term power market. Delhi: CERC.https://bit.ly/3pAxK7b

- Congestion for the volume of electricity transacted through power exchanges has seen a declining trend since the integration of NEW Grid and SR Grid in Dec'13.
- Post grid integration of the NEW grid and SR grid, volume of electricity that could not be cleared, decreased drastically from 17% in FY13 to just 0.4% in FY20.
- In the last 3 years i.e. FY18 to FY20, the volume of electricity that could not be cleared as % to unconstrained cleared volume was less than one per cent which shows that the congestion was insignificant.
- As a result of fall in congestion, congestion charges on the power exchanges fell from 453 INR Cr in FY13 to 55 INR Cr in FY20.

4 DISTRIBUTION

The Discoms are the sole intersection point between the supply-side and the demand- side of the system. However, they continue to remain the weakest link with their rising accumulated losses of 4.88 lacs crores in 2018-19(PFC, 2018-19)[13] and outstanding dues at Rs. 1.3 lakh crores (as of Nov'20)(MoP, 2020)[14].

Time and again, the continuous financial woes of the distribution sector has been associated to all the problems of the power sector. However, it's worth highlighting that the functioning of each Discom is an interplay of numerous variables like consumer mix, political interests, investment certainty, technology cost, consumer behaviour change etc. For a more nuanced understanding of the variations and impact of these factors; we unravelled the journey for a set of four Discoms and captured it's notable trends from 2014-15 to 2019-20.

Electricity Distribution Sector Statistics - A Sneak Peek[15]

Accumulated Losses FY10 to FY19 **4.6 X**	Tariff Subsidy FY10 to FY19 **3 X**	Agri Subsidy/year **~ ₹ 50,000 Crores**	State with Highest RE Installed Capacity **15.3 GW** Karnataka Nov'20	Rooftop Installed Capacity **5953 MW** Jun'20	State with Highest Rooftop Capacity **866 MW** Maharashtra Nov'20
State with Highest Subsidy (Booked) **KARNATAKA**	Highest AT&C Losses **55.5%** Arunachal Power Department	Lowest AT&C Losses **6%** Dakshin Gujarat Vij Co. Ltd.	Space Cooling Demand from ACs to increase **~5 X** by FY38	Smart Metering Status **1%**	Cooling Energy Gap **335 TWH/YEAR**
Per capita rise in Electricity Consumption **2 X** FY10 to FY20	Cost of Supply<Revenue Highest **MESCOM** Lowest **HPSEBL**	Cost of Supply>Revenue Highest **ARUNACHAL PD** Lowest **CSPDCL & NESCO**	Cost of Supply>Revenue (Gross Input Basis) **40 DISCOMS**	Cost of Supply<Revenue (Gross Input Basis) **15 DISCOMS**	Highest Agri Load **HESCOM 60.2%**
Total Financial Relief Amount **~53 BILLION USD** FY01 to FY20	State with Highest EV Penetration **KARNATAKA** (FAME-II) 26th Nov'20	State with Lowest EV Penetration **MEGHALAYA** (FAME-II) 26th Nov'20	Highest Industrial Load **DGVCL 77.4%**	Average Cost of Supply **6.09 ₹/KWH**	Average Revenue (Subsidy Booked) **5.67 ₹/KWH**

Source: Vasudha's Analysis

A Quick Glance at the Four Discoms FY 2018-19

	UGVCL	MSEDCL	SBPDCL	HESCOM
	Uttar Gujarat Vij Company Limited, Gujarat	Maharashtra State Electricity Distribution Co. Ltd., Maharashtra	South Bihar Power Distribution Co. Ltd., Bihar	Hubli Electricity Supply Company Limited, Karnataka
Discom Characteristic	**Successful**	**Progressive**	**Reforming**	**State-Motivated**
Total Electricity Sales (MUs)	22,399	1,09,531	10,586	11,760
Total Revenues (₹ Crores)	12,356	85,596	7,953	7,860
Consumer Profile (% share)	Industry - 43%, Agriculture - 43% Domestic - 10% Others - 4%	Industry - 37% Agriculture - 31% Domestic - 19% Others - 13%	Industry - 22% Agriculture - 5% Domestic - 57% Others - 16%	Industry - 13% Agriculture - 60% Domestic - 15% Others - 12%
Highest Consumer Tariff (₹/kWh)	6.86 (Industry) 7.21 (Not in any category)	13.93 (Commercial)	8.5 (Public Water Works)	8.05 (Commercial)
Average Power Purchase Cost (₹/kWh)	4.15	4.12	4.70	4.68
Average Cost of Supply (₹/kWh)	5.30	7.25	7.35	6.80
Average Revenue Rate (₹/kWh)	5.44	7.07	7.38	6.50
RE Share in purchase (%)	9.9%*	9.94%	2%	28%
Average Power Purchase Cost of RE (₹/kWh)	NA	5.71	5.85	4.81
Share of subsidy received in the total revenue (%)	4%	14%	33%	39%
AT&C Losses (%)	6%	16.90%	32.60%	14.60%
Profit/Losses (₹ Crores)	10.58	437	-2287	690
Overdues (By end of Nov'20) (₹ Crores)	1.13	7,668	537	3,899
Share of Discom consumption in state (%)	28%	Above 90%	57%	20%

*Since UGVCL purchase 90% of the power sourced by GUVNL, this is the % share of the RE power purchased by GUVNL.

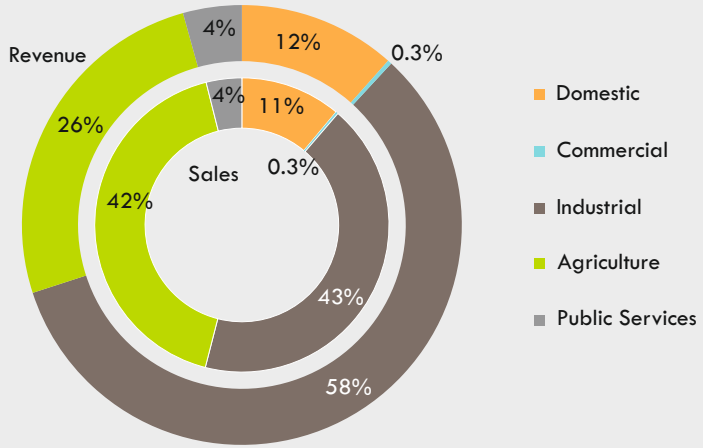
Source: PFC. (2018-19). Report on Performance of State Power Utilities. PFC. Retrieved December 31, 2020, from https://bit.ly/3pDfOJq & MoP. (2020, October). Praapti. Retrieved from Praapti Portal: https://bit.ly/3aS6VYd

Uttar Gujarat Vij Company Limited (UGVCL) - Gujarat

- Gujarat ranked 3rd among the highest renewable energy installed capacity with 11,826 MW as on Nov'20.
- The state has the second highest wind installed capacity (i.e., 8042 MW) in India as on Nov'20 and third highest RE installed capacity in India (as on Nov'20).
- State's peak demand: 18,437 MW for FY 2019-20.

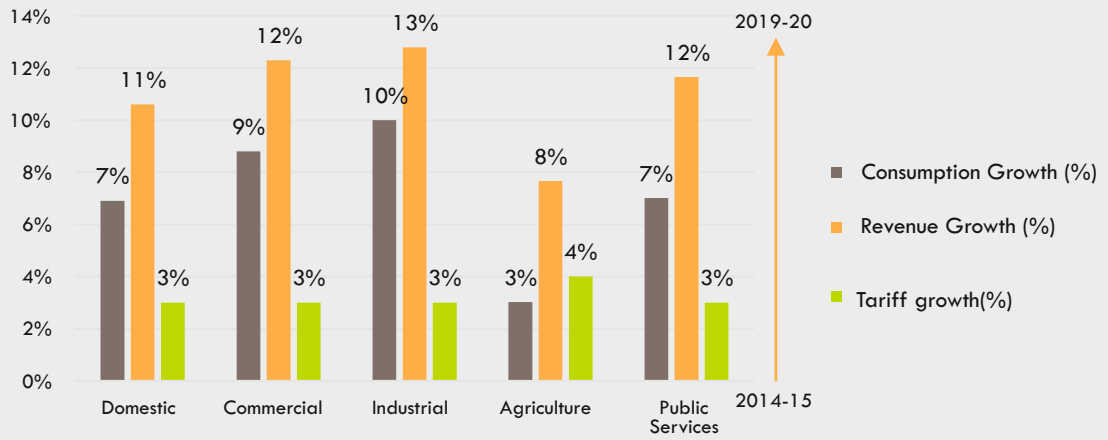
Operational Status[16,17]

Consumer Category-wise Break up of Sales (MU) & Revenue (Rs. crores) 2019-20



- The Discom presents a favourable consumer mix with a large share of ~43% dominated equally by the Industry and Agriculture consumers. The Discom typically has low shares of domestic consumers at just 11% of the sales mix.
- The revenue share of 58% by the Industry and 26% by the agriculture category provides a clear example of cross-subsidy practice that is unique to Discoms in India.

UGVCL Consumption, Revenue and Tariff (CAGR) Growth Trends FY15 to FY20

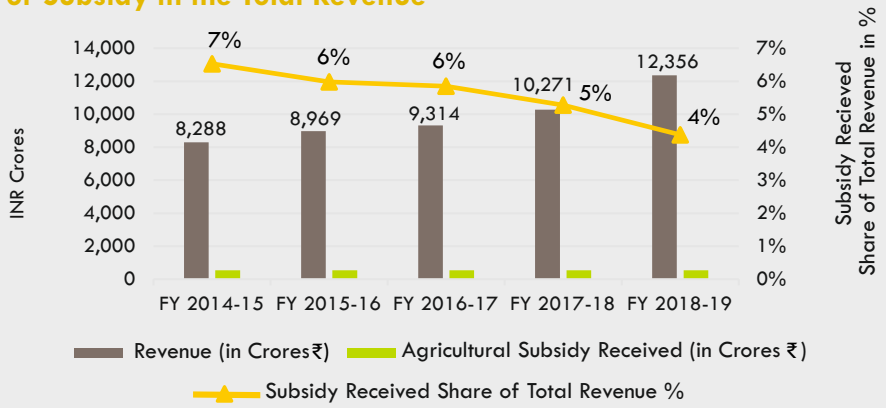


Source: (GERC, FY16, FY17, FY18, FY19, FY20 & FY21) and (UGVCL, FY15, FY16, FY17, FY18 & FY19)

- Over the past five years, the Discom has seen an increase in Industrial energy sales at 10% whereas the farm consumption only increased by 3%. This is primarily due to the reduction in open access consumers, resulting in an increase in HT industry sales. The high demand charges from HT consumers for open access and a higher additional surcharge imposed on Open Access consumers make open access unviable in the state.
- Notably, while the average tariff rise has been at 3%, there is an impressive 11% rise in average revenue from all the consumers.
- This positive development is due to the rise in billing efficiency from 86% in 2014-15 to an impressive 98% in 2019-20 and continuous 100% collection efficiency for the same period.

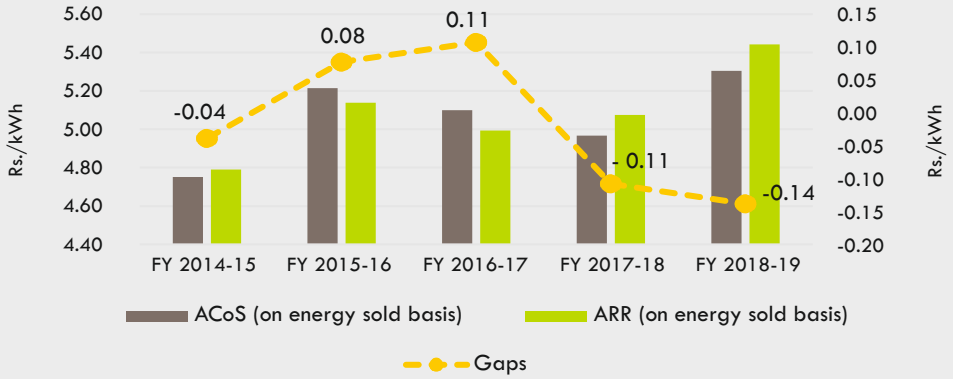
Financial Health[18]

Share of Subsidy in the Total Revenue



- The subsidy (received) share in the total revenue of the DISCOM has steadily declined since FY15 (7%) to 4% in FY19 indicating a good financial health of the utility. Interestingly, UGVCL receives all its subsidy as Agriculture subsidy implying no tariff subsidy for its domestic consumers.

ACS-ARR GAP

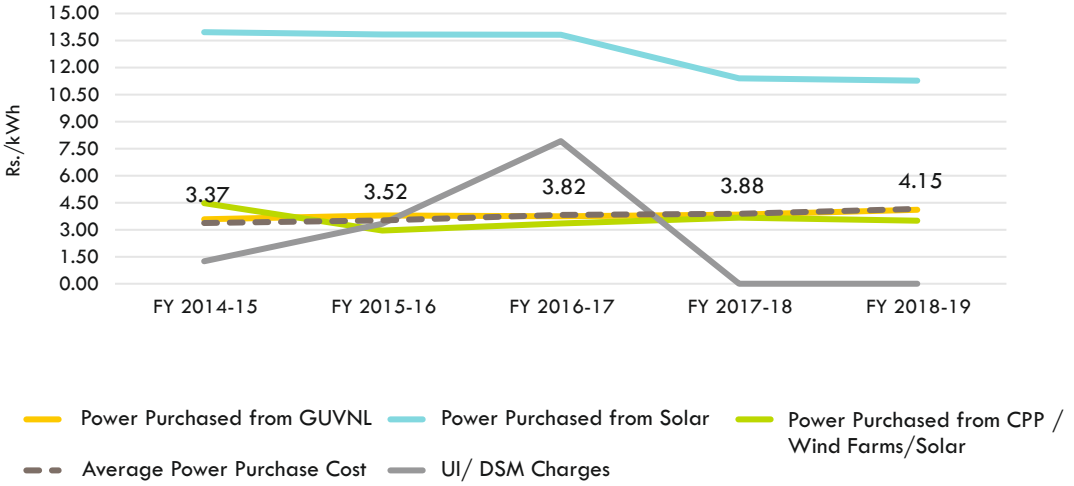


- The gap between the cost of supply and revenue has significantly reduced in recent years from 0.11 Rs/kWh in FY17 to -0.14 Rs/kWh in FY19, thus indicating profit on per unit of electricity sold by the Discom.

Optimising Power Purchase Costs[19,20]

- UGVCL purchases 99% of the power sourced by Gujarat Vitran Nigam Limited (GUVNL) - the holding company of all the Discoms.
- The Discom efficiently balanced its real time demand deviations and hence did not incur any Unscheduled Interchange (UI) /Deviation Settlement Mechanism (DSM) charges consecutively for two years in FY18 and FY19.
- Unit cost have increased for power purchased from GUVNL from 3.58 Rs/kWh in 2014-15 to 4.11 Rs/kWh in FY19. Overall average power purchase cost has increased from 3.37 Rs/kWh in FY15 to 4.15 Rs/kWh in FY19.

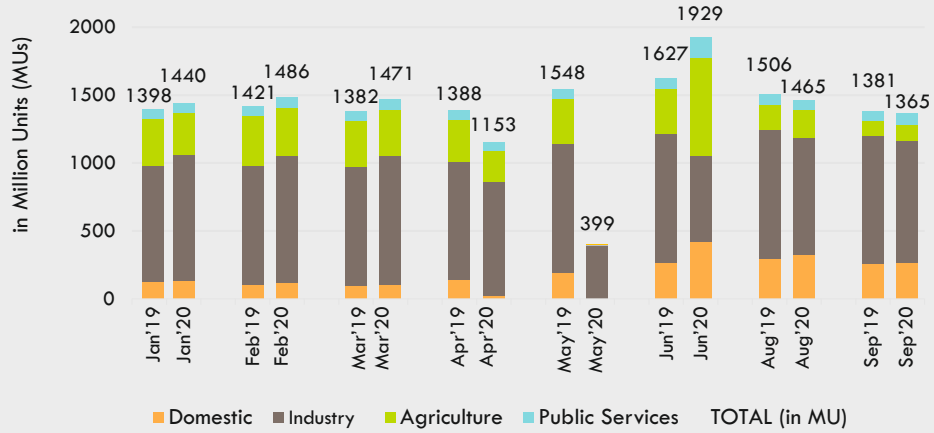
Unit Cost of Power Procurement (Rs./kWh)



Source: (GERC, FY16, FY17, FY18, FY19, FY20 & FY21) and (UGVCL, FY15, FY16, FY17, FY18 & FY19)

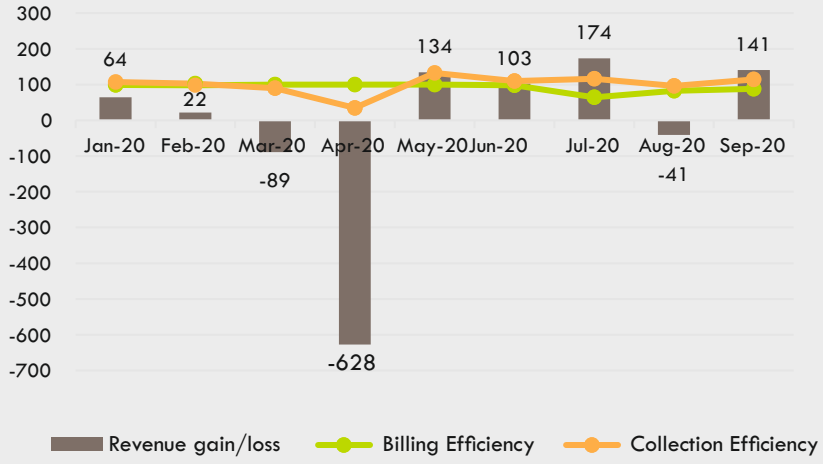
Impact of Covid-19 Pandemic on Discom's Performance

Month-on-Month Change in Category Level Consumption wrt 2019 levels



Source : Vasudha's Analysis

UGVCL- Billing, Collection Efficiency and it's Resultant Impact



Source : Vasudha's Analysis

- The Discom suffered the maximum demand decline ~75% in May'20 compared to May'19. Only some of the HT industry continued to be operational due to its essential status during the pandemic.
- Notably, the Discom reported a huge decline in its domestic and agriculture demand during the April and May months, indicating the migration of various contract workers to their hometowns.
- The pandemic majorly impacted the functioning of the Discoms especially with regard to collection of the revenue. The collection efficiency slumped to 35% in Apr'20 from a whopping 100% plus efficiency in the pre-covid months. However, the billing efficiency continued to be ~99% indicating a smarter Discom with remote management.
- The Discom suffered a revenue lag of 717 crores during March and Apr'20 after which the collection efficiency improved to higher than the pre-covid levels.

- ***Lowest AT&C of 6% (FY 19) achieved ever by any Discom.***
- ***Consistent track record of profitability despite a dominant share of agriculture consumers.***
- ***Automated meter reading (AMR) metering for majority HT consumers and 96% metered consumers - resulting in higher billing and collection efficiencies.***
- ***Continuous measures to strengthen distribution network by rural feeder segregation, installation of 4-star transformers, bifurcation of over-loaded feeders etc.***
- ***Improved estimation of demand and accurate scheduling resulting in no DSM charges.***

- ***Non-viable open access policies discouraging competition in the state.***
- ***Excessive dependence on the holding company for power procurement.***

Maharashtra State Electricity Distribution Company (MSEDCL), Maharashtra

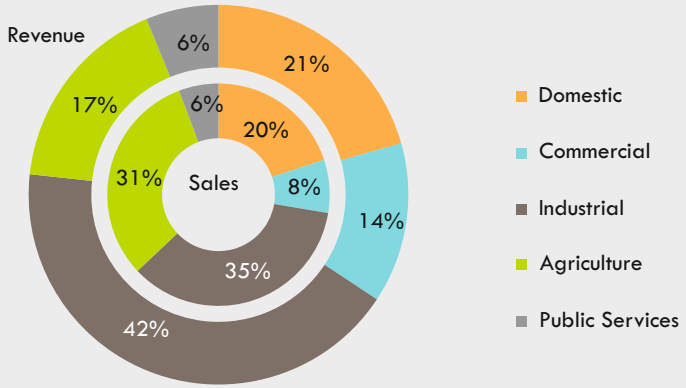
- Maharashtra is of crucial importance both in terms of economic gain and electricity share.
- As per the 2017-18 annual survey of industries, Maharashtra had the highest share of 18% in the Gross value added in India.
- The state has the highest share in the installed capacity with 44GW at an individual state level.
- Quite remarkably, MSEDCL- the state owned Discom is the single largest utility in the country managing the highest consumer demand of over 1 lakh MUs. The utility has been a frontrunner of many distribution sector reforms and has transformed itself into a progressive and revenue surplus utility.

Operational Improvement[21]

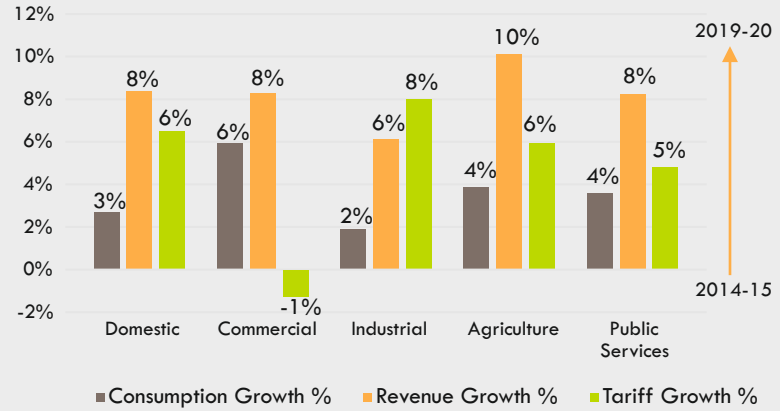
Looking at the category of consumers, the industrial consumers makes up for 1% of the consumer mix, contributing to 35% of the sales, and 42% of the revenue. Residential category amounted to 74% of the consumer mix, bringing in 20% of the sales, and 21% of the revenue. Agriculture consumers comprised 17% of the consumer mix, contributing 31% of the sales, and 17% of the revenue.

- Typically, the average tariffs for the commercial HT are the highest at ~15 Rs/unit. This is despite a 1% y-o-y reduction in the commercial category tariff (graph below). The LT agriculture enjoys the lowest tariffs at 3.7 Rs/unit.
- The cross-subsidizing categories include the Industry, commercial and HT bulk supply housing complex.
- The agriculture consumers depict the maximum revenue growth of 10% indicating improved billing and collection.

Consumer Category-wise Break up of Sales (MU) & Revenue (Rs. crores) 2019-20



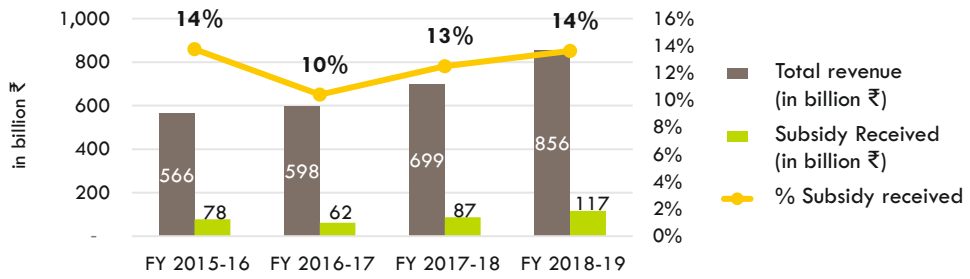
MSEDCL Consumption, Revenue and Tariff (CAGR) Growth Trends FY15 to FY20



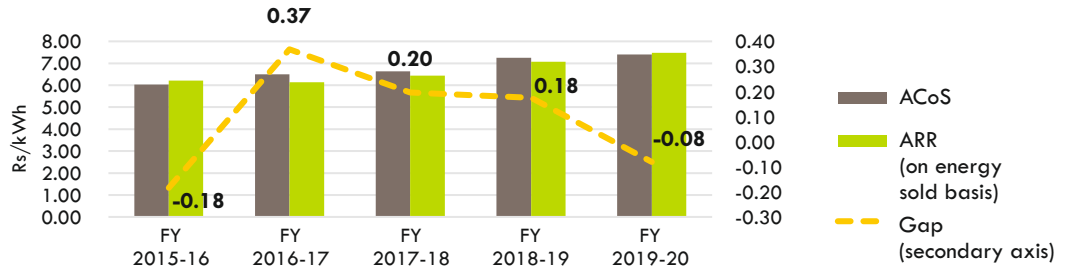
Source: (MERC, FY16, FY17, FY18, FY19 & FY20)

Financial Health[22]

Share of Subsidy in the Total Revenue



ACS-ARR GAP



Source: (MERC, FY16, FY17, FY18, FY19 & FY20)

- The subsidy from the state Government has been steady around 13-14% with a revenue rise of ~50% between FY16 to FY19.
- Per the MSEDCL tariff order, the ACS-ARR gap have declined year on year, thus improving the financial viability for selling power.
- However, for FY21, the utility has projected a higher cost of supply (ACoS = 7.61 Rs/kWh) despite reductions in the projections for power purchase cost (APPC= 4.24 Rs/kWh) from FY20. This could be attributed to increased operational expenses for the Discom due to the pandemic.

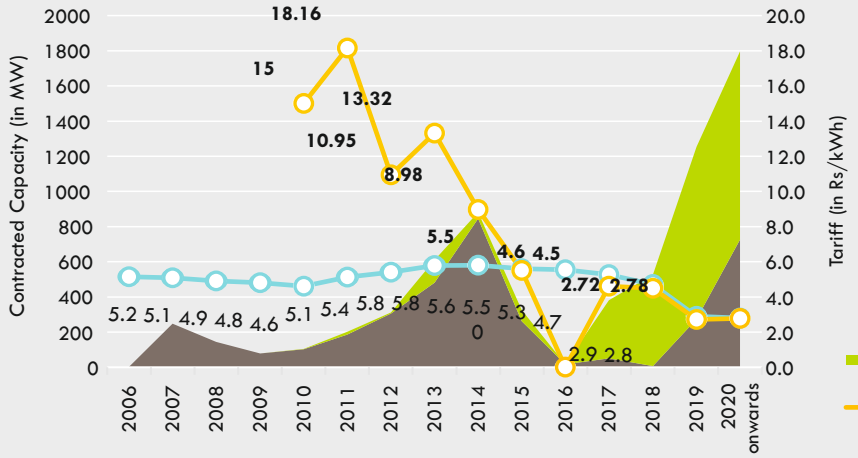
Optimising Power Purchase Costs

Average Power Purchase Price Trajectories MSEDCL (Rs/kwh)

	2015-16	2016-17	2017-18	2018-19	2019-20
State Generators	4.14	3.52	3.56	3.97	4.23
Central ISGS	2.76	2.98	2.77	3.17	3.74
Independent Power Producers	3.21	3.49	3.72	4.19	3.93
Non Conv. Energy	2.73	5.33	5.65	5.71	4.94
Average Power Purchase Cost	3.79	3.71	3.86	4.12	4.35

Source: (MERC, FY16, FY17, FY18, FY19 & FY20)

Wind and Solar Tariff Trajectory for MSEDCL



Expensive wind power purchase led to higher power purchase for non-conventional energy. However, the Discom procured cheaper RE at an average 2.8 Rs/kWh in 2019 and 2020.

- ***Ensuring sound financial structure by improving its debt/equity ratio by 60% and creditors turnover ratio by ~35% since FY15 (mostly due to UDAY since FY17).***
- ***Upgradation of systems and processes such as solarization of agriculture feeders and Feeder input-based group metering.***
- ***Trading of surplus power to realize additional revenue.***
- ***100% feeder segregation and rural electrification.***
- ***Employee up skilling programs.***

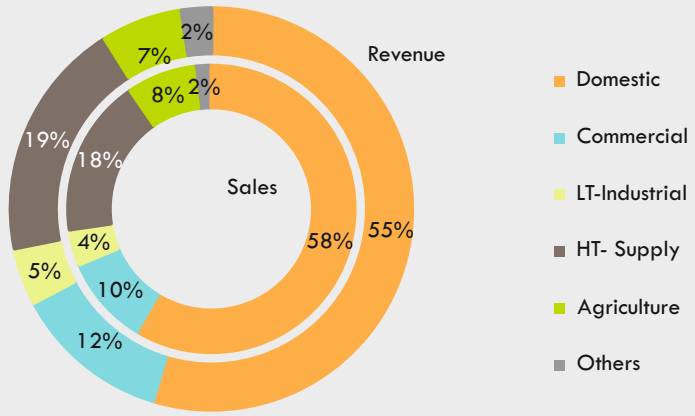
- ***Slower improvement in its operational efficiency with 17-18% AT&C losses and 85% billing efficiency since FY15.***

South Bihar Power Distribution Company Limited (SBPDCL), Bihar

- Bihar's GDP growth rate has increased from 3.6% from FY15 to 6.4% in FY18.
- As per the power for all document released in 2015, 100% electrification of urban and 140 lakhs households was targeted by 2018-19. The success of this target has led to a dramatic rise in domestic consumers and electricity consumption for this segment.
- Bihar is the first state in India to install 25,000 smart meters in a prepaid mode.

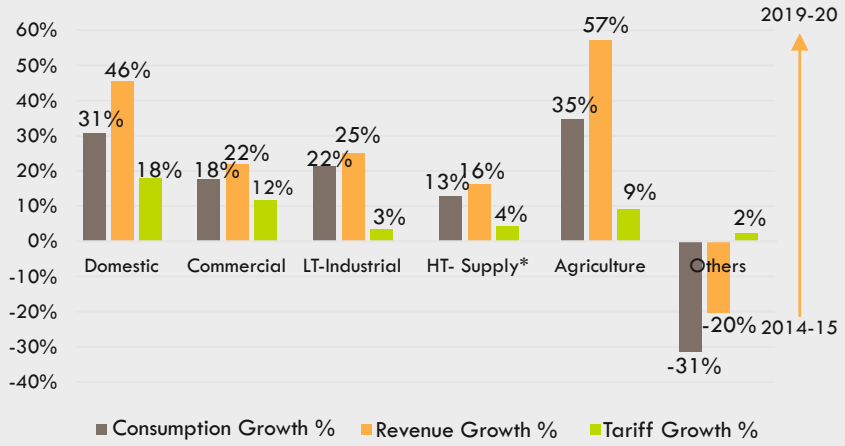
Operational Improvement[23]

Consumer Category-wise Break up of Sales (MU) & Revenue (Rs. crores) 2019-20



- Domestic consumers contribute the highest share in the sales mix and a significant growth of 31% over the years. This is visible with the rise in number of consumers from 31 lakhs in FY15 to 87 lakhs in FY20.
- Agriculture sales saw the maximum growth of 35% from FY15 with its share doubling from 4% in FY15 to 8% in FY20 in the electricity sales mix. Hence, indicating improved power supply for irrigation.
- Average tariff is highest for others category comprising Street lights, Public water works and railways having average tariff of 7.28 Rs/unit (FY20). Interestingly, tariff for HT-Supply is on the lower side at 6.09 Rs/unit in FY20
- Fall in electricity sales in the 'others' category can be attributed to increased energy efficiency of the street lighting and public water works system.

SBPDCL Consumption, Revenue and Tariff (CAGR) Growth Trends FY15 to FY20



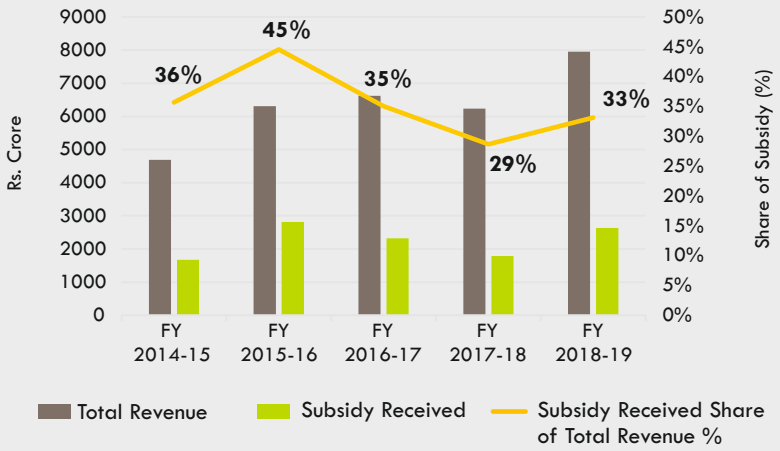
*HT supply is High tension supply for consumers billed on KVAH basis e.g., industrial furnaces etc

Source: (Bihar Electricity Regulatory Commission, FY17, FY18, FY19, FY20 & FY21) & (SBPDCL, FY16, FY17, FY18, FY19)

- It is observed that the share of revenue from LT consumers has increased over the years from 71% in FY15 to 81% in FY20. This can be attributed to rise in the domestic set of consumers, non-domestic and LT industrial consumers and their corresponding revenues. The rise is also due to improvement in billing efficiency from 56% in FY16 to 74% in FY20 and the subsequent reduction in AT&C losses from 46% in FY16 to 35% in FY20.

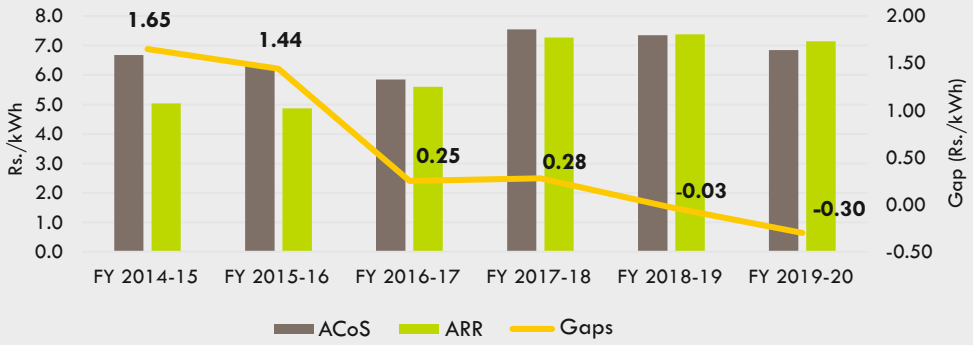
Financial Health[24]

Share of Subsidy in the Total Revenue



- The Discom has thrived on a relatively high subsidy share of 36% in FY15 to 33% in FY19.

ACS-ARR GAP



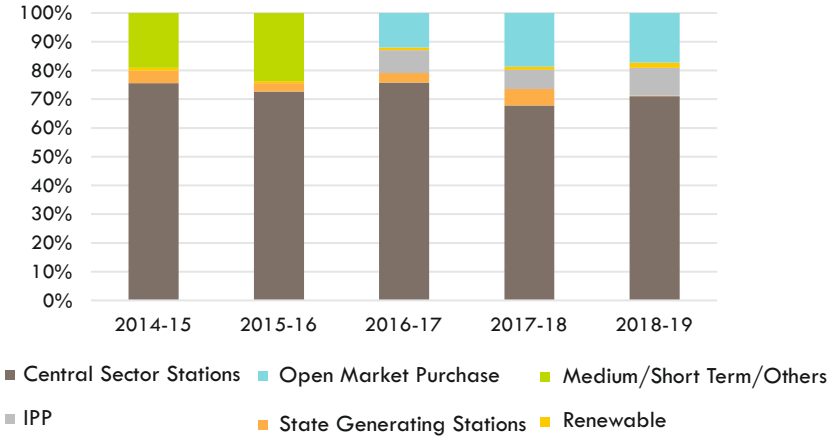
Source: (Bihar Electricity Regulatory Commission, FY17, FY18, FY19, FY20 & FY21)

- ACoS-ARR gap has reduced dramatically from 1.65 Rs/unit in FY15 to -0.03 Rs/unit in FY19[ix]. Improved billing and collection efficiency and metering upgradation has played an important role in reducing this gap for the Discom.

[ix] But ACoS is projected to rise in FY21 due to decrease in billing efficiency up to 61% (As of Aug'20) due to the pandemic, which will further impact the AC0S-ARR gap in FY21.

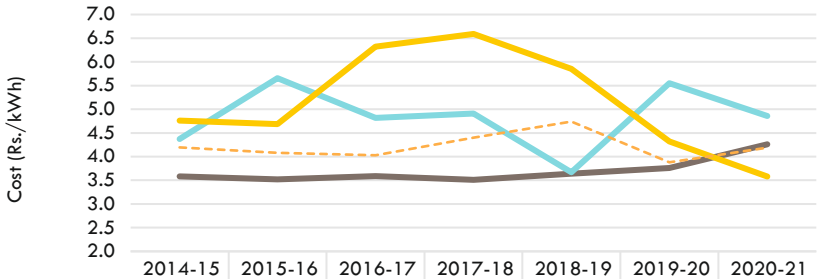
Optimising Power Purchase Costs[25]

Source-wise Share of Power Procurement-SBPDCL



- Decline in power procurement cost for Renewables from 4.8 Rs/unit in FY15 to 4.3 Rs/unit in FY19-20.

Source-wise Unit Cost of Power Procurement



	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20 (APR)	2020-21 (Approved)
Central Sector Stations	3.6	3.5	3.6	3.5	3.6	3.8	4.3
State Generating Stations	4.4	5.7	4.8	4.9	3.7	5.6	4.9
Renewable	4.8	4.7	6.3	6.6	5.9	4.3	3.6
Net Power Purchase	4.2	4.1	4.0	4.4	4.7	3.9	4.2

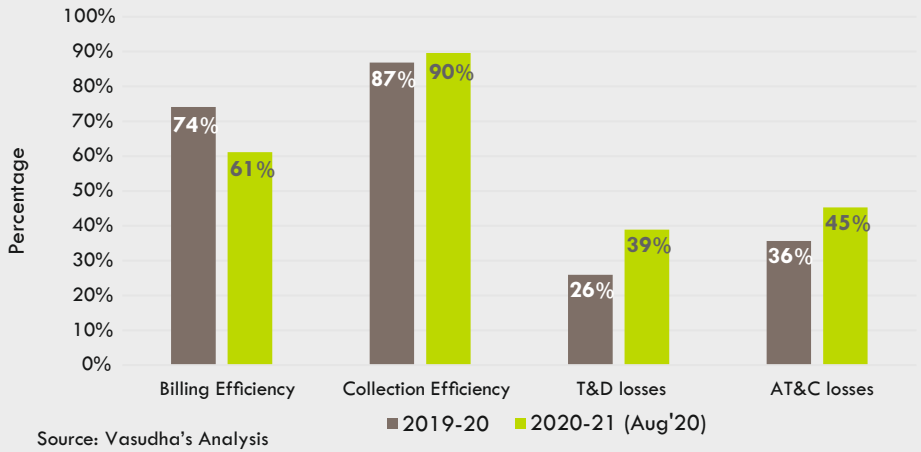
Source: (Bihar Electricity Regulatory Commission, FY17, FY18, FY19, FY20 & FY21)

- Due to high shares of the power from central sector stations, a small rise in its unit cost will increase the cost of supply for the Discom substantially

Impact of Covid-19 Pandemic on Discom's Performance

- Decline in the billing efficiency resulted in significant rise in AT&C losses and increase in T&D losses.
- However, the Discom maintained a high collection efficiency owing to the pre-paid revenue collected through EESL-led smart metering programme.

Covid-19 Impact on SBPDCL



Source: Vasudha's Analysis

- ***Massive electrification and tariff reforms leading to a rise in revenue from 56% in FY15 to 92% in FY19 improvement in ACoS-ARR gaps and financial efficiency of the Discom.***
- ***Large Improvement in AT&C losses from 46% in FY15 to 36% in FY20 due to continuous improvement in billing and collection efforts.***
- ***Metering of 3.5 lakhs unmetered connections by Mar'20.***
- ***Amidst lockdown, Discom was earning Rs 5 lakh per day prepaid revenue through EESL-led smart metering programme.***

- ***Continuous trend of higher subsidy shares of the total revenue (33% in FY19).***
- ***Rise in AT&C losses during FY21 (As of Aug'20) 45% as a result of low billing efficiency 61% in the same period.***
- ***A lower share of Industrial sales together with subsidized tariffs compromises on the Discom's ability to adequately meet its cost of supply.***
- ***Limited focus on optimal planning of power purchase leading to higher costs for the Discom.***
- ***High dependence on conventional fuels with only 2% RE share in purchase of power.***

Discom 4

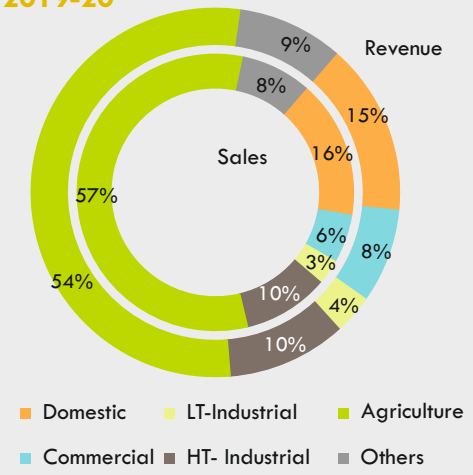
Hubli Electric Supply Company Limited (HESCOM), Karnataka

- Karnataka's GDP growth has increased from 6.24% from FY15 to 10.75% in FY18.
- It is the highest renewable electricity generator in the country with 18% of the total renewable energy installed capacity. Also, it has 51% share of RE to the total installed capacity within the state.
- Karnataka is the best state for setting up a roof top solar project according to the State Rooftop Solar Attractiveness Index –SARAL released by the Ministry of New and Renewable Energy.

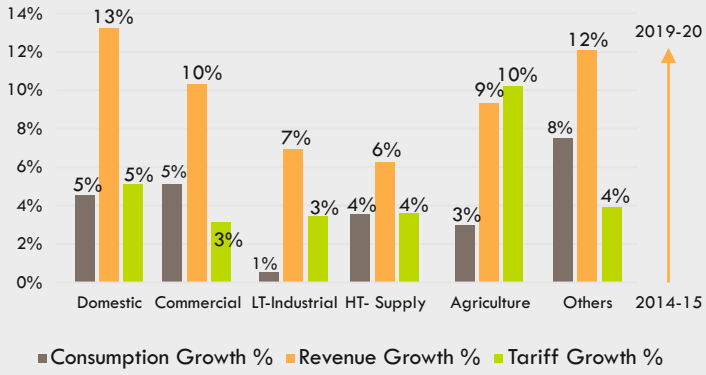
Operational Improvement[26]

- HESCOM has relatively higher level of agricultural consumption, which is almost 60% of the total electricity consumption.
- The cost of free power to agricultural sector & Bhagya Jyoti/Kuteera Jyoti (BJ/KJ) connections has been provided by the State Government through subsidy. HESCOM has received total subsidy of Rs. 4204 crores from the state Government during the FY20 which includes Rs. 4,068 crores towards subsidy for free power supply to IP sets, Rs.136.51 crores towards BJ/KJ subsidy.
- It is observed that the revenue growth is higher than the consumption in the last 5 years. The revenue collection has increased due to improvement in technical parameters i.e. improved billing and collection efficiencies, reduced AT&C and distribution losses.
- Tariff growth was highest for agriculture sector at 10%.

Consumer Category-wise Break up of Sales (MU) & Revenue (Rs. crores) 2019-20



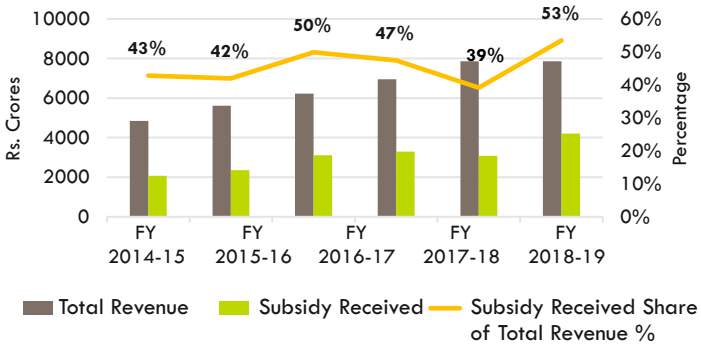
HESCOM Consumption, Revenue and Tariff (CAGR) Growth Trends FY15 to FY20



Source: (HESCOM, FY16, FY17, FY18 and FY19)

Financial Health[27]

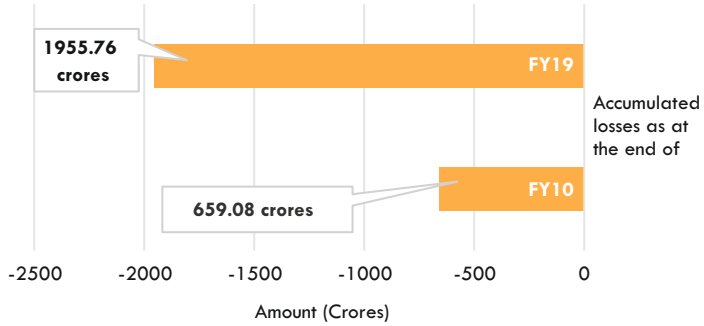
Share of Subsidy in the Total Revenue



Source: HESCOM, FY16, FY17, FY18 and FY19

- The share of subsidy in the total revenue increased by 10% since FY15. During the same period, the Discoms subsidy requirement ascended by 60%, indicating high subsidy dependence for revenue.

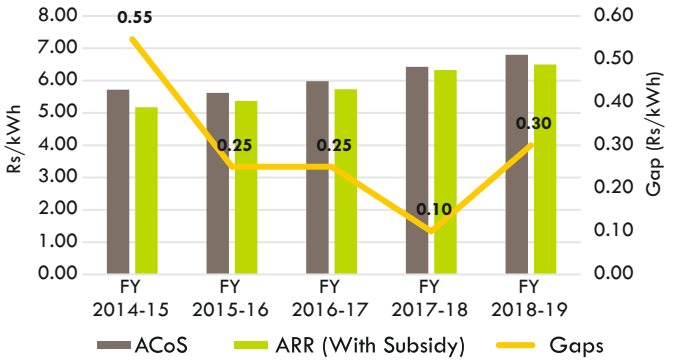
Accumulated Losses in FY10 and FY19



Source: (HESCOM, 2019)

- The total accumulated losses of HESCOM nearly tripled over a period of 10 years. As on Mar'19, as per the financials, the company' accumulated losses stood at Rs. 1955.7 Crores against a shared capital of Rs. 1554.23 crores leading to a negative net worth.

ACS-ARR GAP



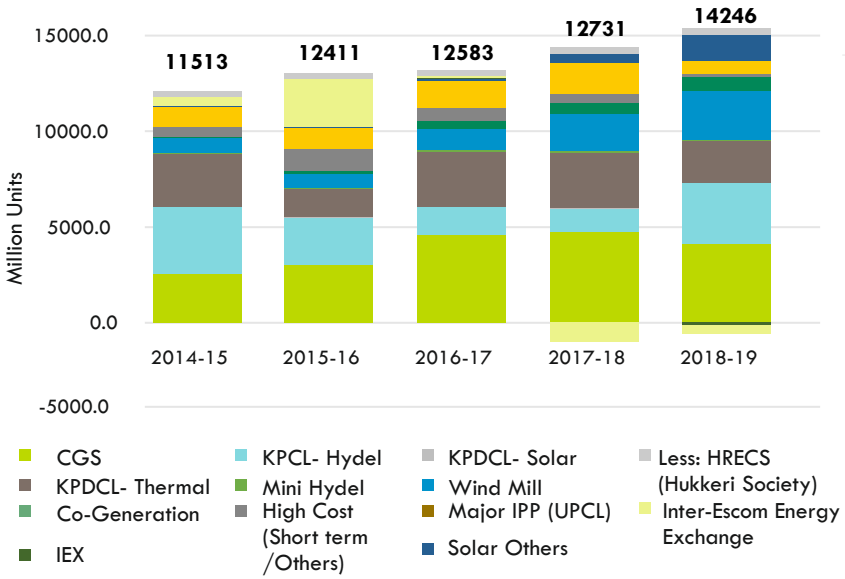
Source: (HESCOM, FY16, FY17, FY18 and FY19)

- ACS-ARR gap reduced from 0.55 Rs/unit in FY15 to 0.30 Rs/unit in FY19. Factors like increased ARR, improved billing efficiency, collection efficiency and metering upgradation has played an important role in reducing this gap and also the improvement in financial functioning.

Optimise Power Purchase

- Majority of the power procurement by HESCOM is from central power generating utilities but the recent trends show increased power purchase quantum from wind mill and co-generation.
- Increasing trend in power purchased, changing source-wise mix of power supply and the reconciliation of energy and its cost among ESCOMs, have resulted in increase in average power purchase cost of HESCOM.
- The average power purchase cost increased from 3.29 Rs./kWh in FY15 to 4.68 Rs./kWh in FY19.

Source-wise Power Purchase by HESCOM (MUs)



Source: (HESCOM, FY16, FY17, FY18 and FY19)

Source-wise Unit Cost of Power Procurement

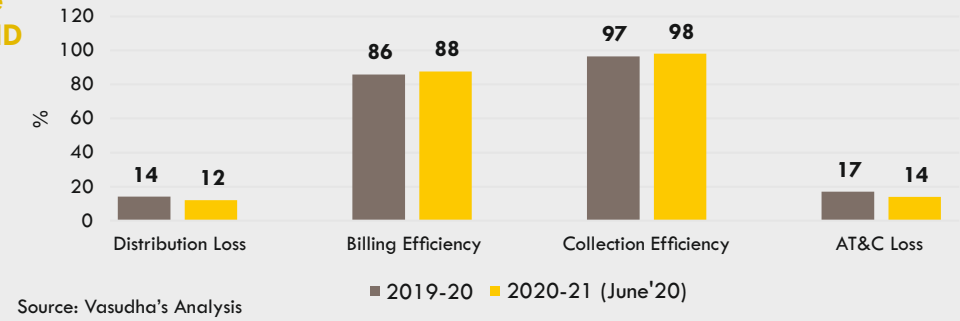
	2014-15	2015-16	2016-17	2017-18	2018-19
Central Generating Station	3.5	3.7	3.6	4.0	4.5
State Generating Utilities	3.5	3.5	3.9	4.0	4.2
Solar	2.3	4.3	5.1	5.9	5.3
Wind	3.5	3.6	3.8	4.1	4.1
Other RE	3.2	3.7	3.5	4.4	3.8
IPPs	4.7	4.7	5.8	5.2	6.2
Co-Generation	3.7	4.1	3.8	5.3	4.2
Open Markets	3.8	3.2	3.9	3.7	4.2

Source: (HESCOM, FY16, FY17, FY18 and FY19)

Impact of Covid-19 Pandemic on Discom's Performance

- Billing efficiency improved from 86% in FY20 to 88% in FY21 and collection efficiencies improved from 97% in FY20 to 98% in FY21.
- Distribution losses reduced from 14% in FY20 to 12% in FY20 while AT&C losses reduced from 17% in FY20 to 14% in FY21.

Performance during COVID



Source: Vasudha's Analysis

- ***Decline in ACoS-ARR gap from 0.55 Rs/unit in FY15 to 0.30 Rs/unit in FY 20.***
- ***Large improvement in billing and collection efficiencies and further reduction in distribution & AT&C losses especially for the agriculture sector.***
- ***High RE procurement share out of the total power purchased (Increased from 7% in FY15 to 27% in FY19).***
- ***Improvement in Debtor's turnover ratio from 138 days in FY15 to 80 days in FY20.***

- ***Very high subsidy shares of the total revenue (Increased from 43% in FY15 to 53% in FY20.***
- ***High Consumption share from agriculture sector (57%) increases dependency on subsidy for revenue.***
- ***Accumulated losses increased by 3X since 2009-10.***

Key Insights

Consumer mix has a large amount of bearing on the Discom financial health and its viability.

Subsidies and Cross-Subsidies are unique to India's power sector to bridge the gap between Discom costs and its revenues. However, it is an unsustainable way to keep the sector afloat.

AT&C loss reduction is a continuous effort that is intertwined with large scale metering, improvement in billing and collection efforts and identification of leakages.

There is a need for better innovation and learning amongst Discoms to address conventional challenges and exchange implementation experience on schemes like solarization of agriculture feeders, installation of smart pre-paid meters, bifurcation of overloaded feeders etc.

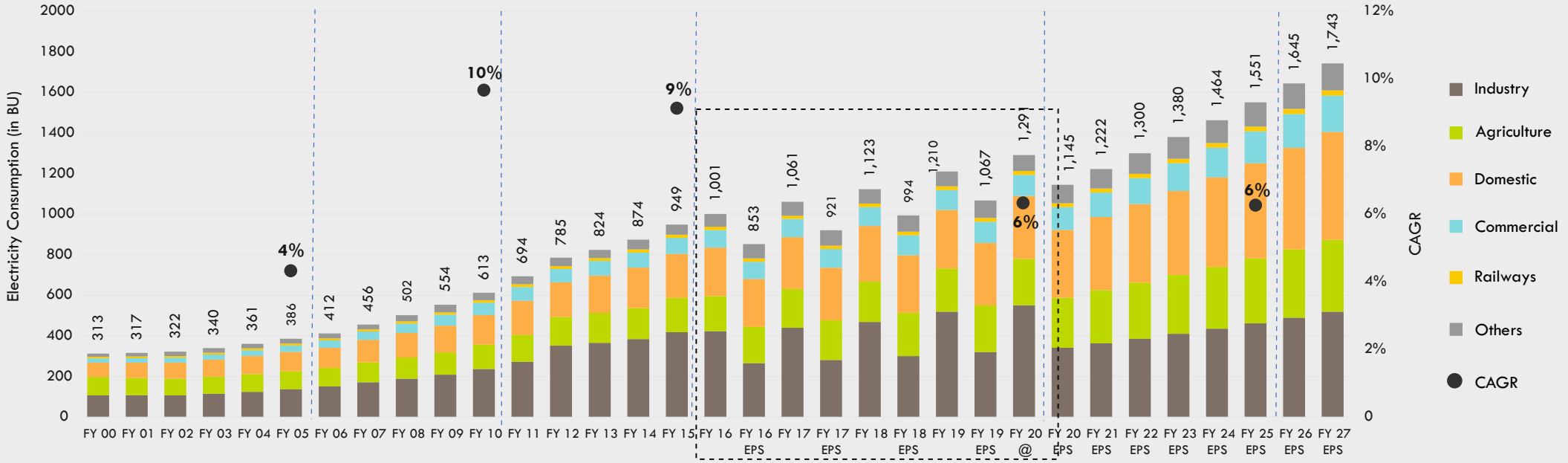
Large scale electrification and service quality accompanied with a rational tariff reform will lead to a more reliable and efficient distribution sector.

5 CONSUMPTION

The recent World Energy Outlook 2020 estimates a rapid electricity demand recovery to pre-2019 levels in 2021. The recovery is faster for the developing and emerging economies fuelled by its growth drive as compared to the developed economies whose demand recovers only by 2023 and follow a rather slower curve thereafter. As per IEA 2018, India ranked 3rd in electricity consumption behind China and US accounting for almost 5.3% of the global electricity consumption (IEA, 2018) [28].

India provides for the highest relative electricity demand growth in the world rising by almost 65% by 2030 from its 2019 levels[29].

Trends in Category-wise Actual Consumption vs 19th EPS Projected Electricity Consumption (in BU)



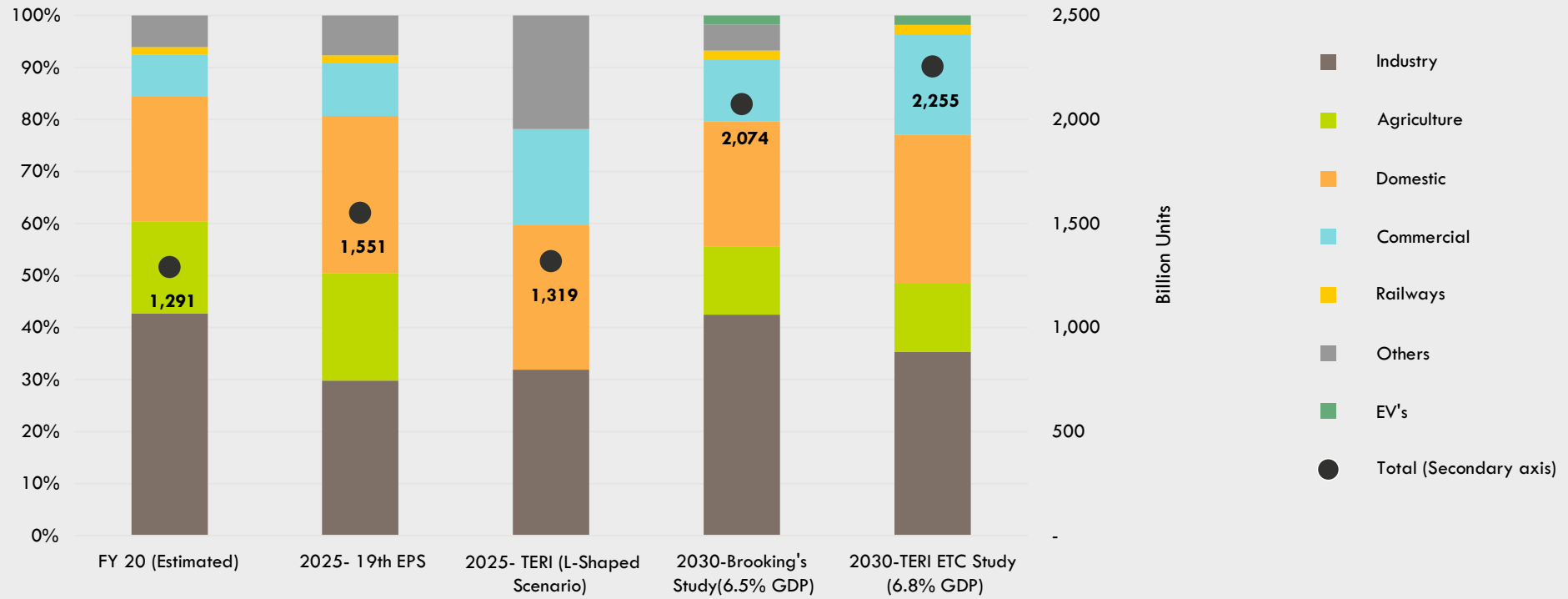
Source : CEA. (2017). 19th Electric Power Survey of India. New Delhi. https://bit.ly/3of1ia8 , MOSPI. (2020). Energy Statistics. New Delhi. https://bit.ly/3o1W6GB & CEA. (2020). Growth of Electricity Sector in India from 1947-2020. https://bit.ly/38gyjxa (@Estimated)

- Over the last twenty years, the five-year growth in actual electricity consumption has increased from 4% CAGR between FY00 and FY05 to 6% CAGR between FY15 to FY20.
- The 19th EPS projections for the actual periods FY16 to FY20 are on average 14% lesser than the actual consumption with large variations in the industrial category consumption. A reliable forecast enable utilities to design cost-effective power procurement portfolios.
- The major increase in the demand share has been from the Industrial sector with an increase in share from 34% in FY00 to 43% in FY20. While the domestic and commercial sector have largely occupied the same share at 24% and 7-8% respectively, agriculture sector share has declined from 27% to 18% during the same period.

The new decade (by FY27) is expected to see a phenomenal change in the consumption mix, with the domestic demand rising to 31% and industrial share declining to 30% from the FY20 levels. Interestingly, the domestic share could be much higher than the projected values due to work from home and other social distancing norms in the future years.

A historical assessment of the country' consumption scenario from FY00 to FY20 suggests an average demand growth at a 8% CAGR. However, the demand suppression is expected to last longer with the demand growing from 2019-20 at a CAGR of only 0.5% for 2025 and 6% for 2030 as per recent projections by TERI(L-shaped scenario) and Brookings.

Short-term Demand Projection Comparison Across Recent Studies



Source: CEA. (2017). 19th Electric Power Survey of India. New Delhi. https://bit.ly/3of1ia8 , Thomas Spencer. (2020). Bending The Curve. New Delhi. https://bit.ly/2L69Lhl , Thomas Spencer, A. A. (2019). Analysing and Projecting Indian Electricity Demand to 2030. New Delhi. https://bit.ly/3rKlFxk & Ali, S. (2018). The Future of Indian Electricity Demand. New Delhi. https://brook.gs/2X1glbu

Nonetheless, the power sector is set for paradigm shifts with the electricity demand almost tripling in the next two decades.

The Saubhagya led electrification drive, improving incomes and lifestyles, increasing appliance ownership and air-conditioners, declining clean energy costs, advent of innovative and smart technologies all together are leading to a more consumer centric and dynamic power system.

It is resulting in creation of an 'informed and digitally engaged' customer that can make choices and has preferences and responds to various price, sustainability and market signals.

Here, we unpack the enablers leading to a new demand side transition for the India power sector.

5.1. Increasing Space Cooling Needs of Buildings

As per the ICAP, the cooling related electricity demand for buildings is expected to rise from 135 BUs in FY18 to 585 BUs in FY38 - a four fold increase. The figure further translates to an increase in household AC penetration from 4% to 40% during the same period.

IEA has further estimated that by 2050, 45% of India' peak electricity demand is expected to come from space cooling alone (IEA, 2018). With a large number of buildings and appliance stock yet to be realised, the cooling sector provides a lucrative opportunity to lock in long-term energy savings, more significantly in the residential sector.

The cooling demand will largely be driven by the high penetration of room air conditioners in the residential sector due to rapid urbanisation led construction, worsening weather conditions and rising rural demand.

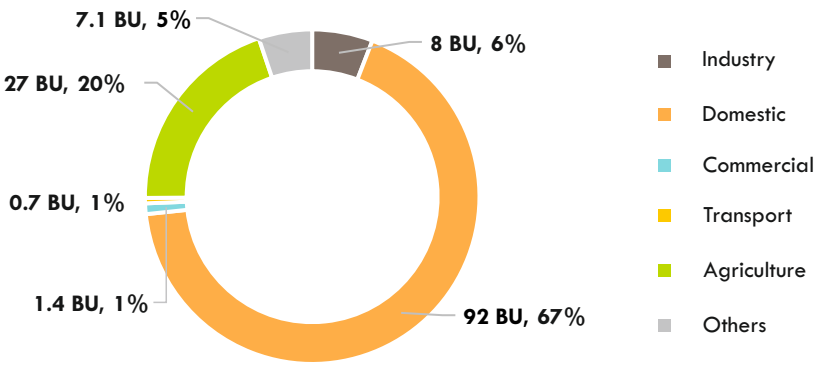
Space Cooling Electricity Demand Analysis

- However, the projections under the above studies can be considered as modest estimates, since they do not consider the SDG goal of 'thermal comfort for all'.
- A recent study (S. Maithel, 2020)[30] estimated that the cooling electricity demand for providing 'thermal comfort for all', only in the urban residential buildings is estimated at 326 TWh/year in 2020, which itself is three times the current electricity consumption for space cooling in India (108 TWh as per ICAP in 2017-18).

Source: MoEFCC. (2018). India Cooling Action Plan. New Delhi.https://bit.ly/2LcsCHq , IEA. (2018). The Future of Cooling. https://bit.ly/2MnTW6r & NITI Aayog. (2015). India Energy Security Scenarios (IESS) 2047. New Delhi.https://bit.ly/3htVnM5

5.2. Deepening Energy Efficiency of Demand Sectors

136 BU Electricity Savings Across Various End-use Sectors by 2018-19



Source: BEE. (2018-19). Impact of Energy Efficiency Measures. New Delhi. https://bit.ly/3ht19h0[x]

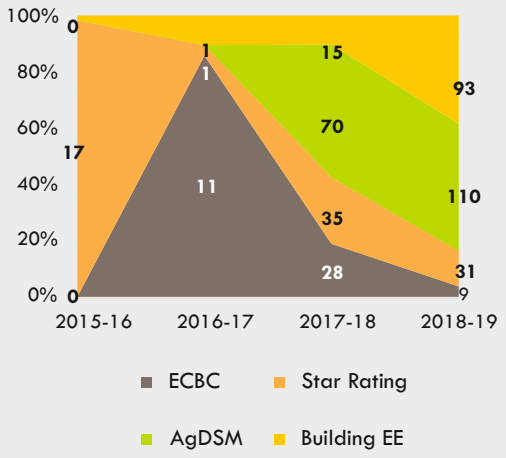
Over the past few years, the country has been implementating many energy efficiency measures throughout its energy demand sectors.

Reportedly, our per capita electricity consumption has gone up from 613 kWh in 2004-05 to 1,208 kWh[31] in 2019-20 but the energy intensity of the economy has declined by 20%[32] during the same period.

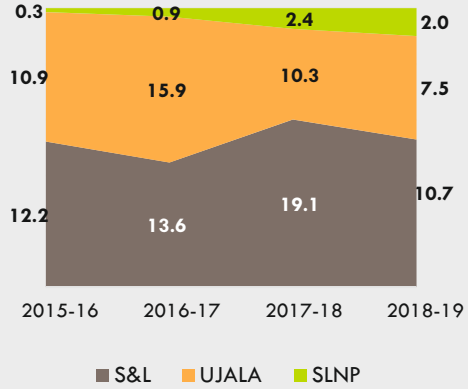
[x] Industry sector includes the savings from Pat (Excluding – DISCOM, Buildings, Railways) and MSMEs
Domestic sector includes the savings from S&L (except pump sets and DTs) and savings from UJALA programme
Commercial buildings include buildings under PAT
Transport including railways
Others (including Municipal DSM and DISCOM efficiency)
Agriculture (including Star Rated Pumps)

- The Standards & Labelling (S&L), Unnat Jyoti by Affordable LEDs for All (UJALA) and Street Lighting National Program (SLNP) have resulted in maximum energy efficiency savings in the country' pie for energy savings.
- The UJALA (LED) program has led to a market transformation of the entire lighting industry. Over a span of 6 years, it has resulted in a cost-saving of Rs 19,000 crore annually that translated to energy savings of around 47BU in 2020 (EESL, 2020)[33]. For the same period, the SLNP has saved around Rs 24,000 crore (ET EnergyWorld, 2020)[34] / 7.6 BU (EESL, 2020)[35] annually through the installation of 11 million smart LED street lights.
- Accordingly, there is a need to move away from piece meal program savings to cover sector level inefficiencie. For instance, under the S&L program, a large focus has been towards efficient adoption of ACs for building energy efficiency. But efficient envelope technology has been often missed out. While an efficient AC helps in lowering the energy consumption; efficient building envelope technologies reduces the overall demand for cooling and also increases the number of comfortable hours of a building.
- However, the savings estimated under the S&L has been queried by the Comptroller and Auditor General (CAG) (Financial Express, 2020)[36], that recently tabled the audit report of the BEE' flagship program in the parliament. The program was called out for poor testing capabilities and label verification resulting in the penetration of relatively inefficient appliances under the government approved star labels.

Energy Savings from Various Schemes/Programmes by GOI (MU)

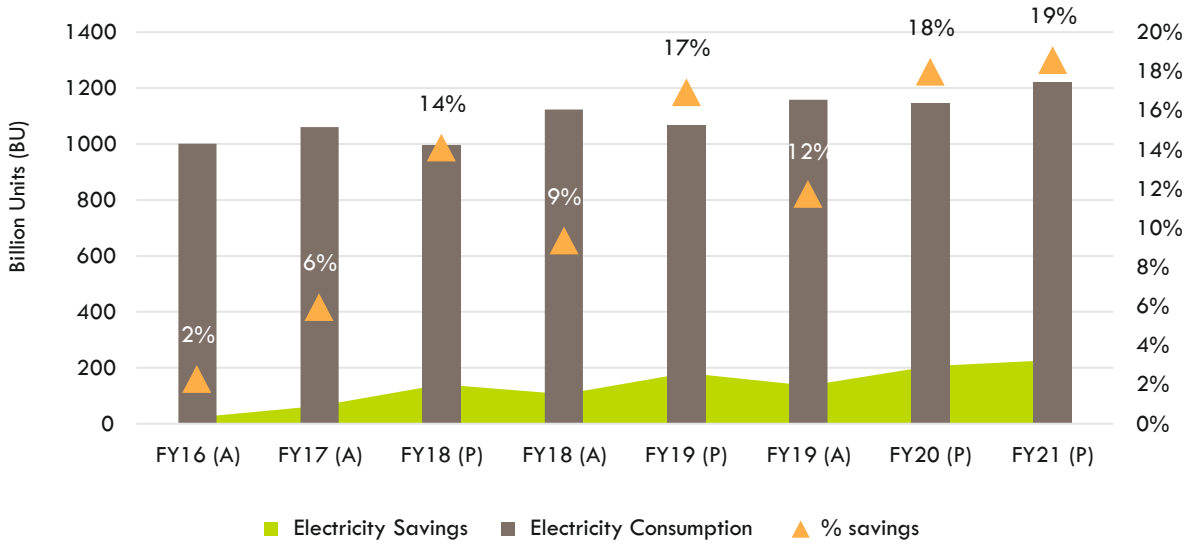


Energy Savings from S&L, UJALA and SLNP Programs (BU)



Source: BEE. (2018-19). Impact of Energy Efficiency Measures. New Delhi. https://bit.ly/3ht19h0

% Electricity savings of the Total Electricity Consumption (BU)



Source: BEE. (2018-19). Impact of Energy Efficiency Measures. New Delhi. https://bit.ly/3ht19h0 & CEA. (2018). National Electricity Plan. New Delhi. https://bit.ly/3aSO4fC ; A(Actual), P(Projected)

- As per the BEE report, the actual electricity savings in 2018-19 was 12% of the total electricity consumption in India.

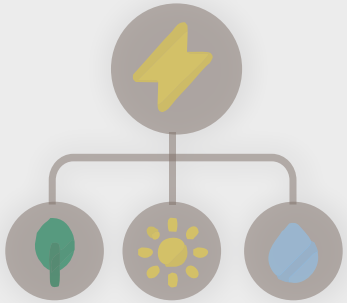
The actual savings have been lesser than estimated, but there is a rise in the percentage of electricity savings of the total consumption increasing from 2% in 2015-16 to 12% in 2018-19.

- According to the National Electricity Plan, the various EE policies and programs are expected to result in annual energy savings of 228 BU which will be almost 19% of the projected consumption in FY20-21.

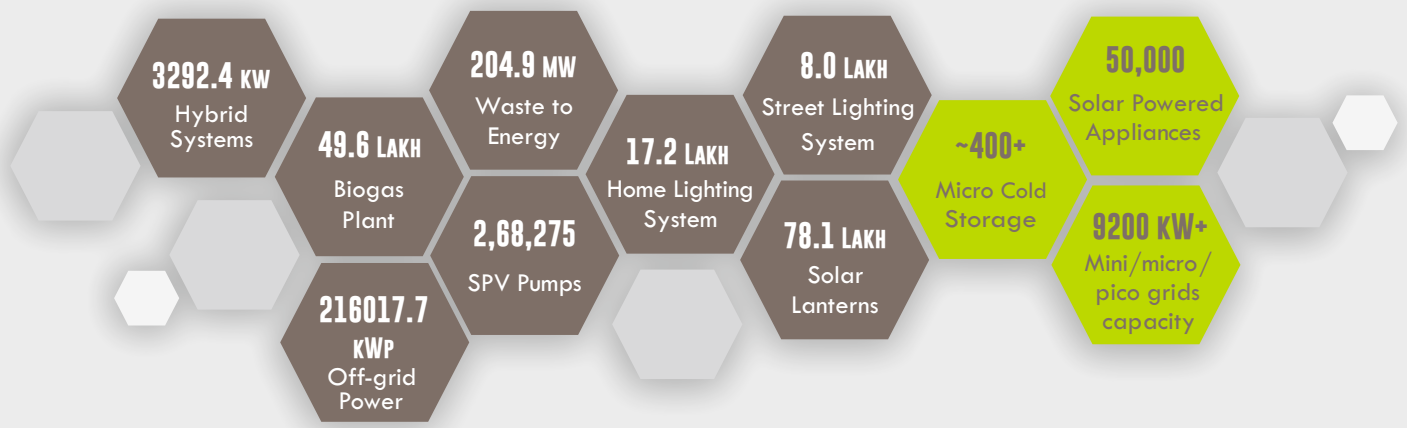
5.3. Emerging Shift to Decentralised Renewable Energy Solutions

The rapid electrification efforts coupled with rising energy aspirations and grid parity of solar is carving a new chapter for decentralised renewable energy in India.

- The sector narrative has now moved beyond from the lack of electricity connections to more complex aspects of energy accesss - energy supply conditions and the state of energy poverty in India.
- The recently released MNRE' draft policy framework for developing and promoting DRE based livelihood applications in rural areas is a testimony to this transition.
- A variety of business models and pilots have been successful in providing DRE based livelihood applications in agriculture, health and education, poultry, tailoring, irrigation services etc in the rural areas.



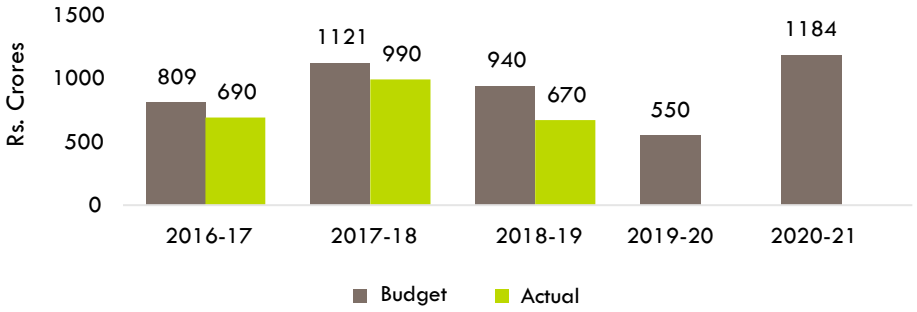
Status of Deployment of Decentralised/Off-Grid Renewable Energy Systems/Devices



Source: MNRE. (2020). Physical Progress (as on Nov'20) . https://bit.ly/3aT9Cc0
& cKinetics & Shakti Sustainable Energy Foundation. (2020). Stepping Up: Lighting to Livelihoods. New Delhi. https://bit.ly/3px7yu8

Over the past few years, some of the conventional DRE solutions like solar lanterns, Solar home-lighting Systems, irrigation pumpsets have received good support from the government. Also, the KUSUM scheme has given a huge push to off-grid solar pumps.

MNRE Budget Allocation for Decentralized Renewable Rnergy in India



Source: MNRE. (FY17, FY18, FY19, FY20 & FY21). Union Budget. New Delhi. https://bit.ly/3aX8QLe

- The total budgetary alllocation by MNRE for DRE in India has increased by 115 per cent from 2019-20 to 2020-21, of which 60% is allocated for solar pumps under the KUSUM scheme.
- Rapidly declining RE prices, improving storage economics and need for electricity reliability establishes that we are not too far from a decentralised energy grid.
- More remarkably, the Covid-19 pandemic has provided for enough evidence about the benefits of DRE systems for sustaining the livelihoods in the rural areas. These include the solar power-minigrids in Jharkhand, community solar pumping model in Uttar Pradesh, portable solar-power refrigerator in Manipal, amongst many others that are constantly providing for the essential services that are critical for their livelihood.

With the strong impetus on local solutions (by the honorable PM), decentralisation of resources will lead the way in building community resilience and addressing local problems. In the light of burgeoning discoms losses and rising unemployment owing to the pandemic, there is an urgent need to combine the centralised power providers and DRE solutions to ensure a relaible and affordable power supply to the socio-economically weaker sections of the country.

5.4. Rapid Electrification of the Transport Sub-sector

In India, the sale of electric vehicles (EVs)increased by 20% in 2019-20. According to the Society of Manufacturers of Electric vehicles, 1,56,000 EVs were sold in 2019-20. This rising uptake in the country has been mostly on account of two-wheelers in recent years. Increasingly , there is also rise of three wheelers in the country which is retaining the the maximum share of 72% of EVs in FY21.

As per a Brookings report, , electricity demand from EVs is expected to be in the range of 37 to 97 TWh in the lower bound (33% EV sales) and upper bound (100% EV sales) scenarios of the electricity demand by 2030 considering only intra city (Urban) passenger travel (Mohd. Sahil Ali, 2018)[37]. Buses and private 4 wheelers accounts for half of this demand. In the recent released Global EV Outlook Report 2020, electricity demand from EV in India is expected to reach 45 TWh by 2030 (Stated Policies Scenario) and 83 TWh (Sustainable development scenario) by 2020(IEA, 2020)[38].

Even with 100% EV sales by 2030, electricity demand is less than 100 TWh which constitutes only 4% of the CEA's projected total electricity demand of 2,325 TWh in 2029-30. This can be easily managed by the current grid without any issues related to flexibility and reliability.

Some Recent Electricity Tariffs for EVs (2020-21)

State	Regulatory Commissions	Energy Charge	Fixed Charge
Andhra Pradesh[39]	APERC	6.70 Rs./kWh	Nil
Chhattisgarh[40]	CSERC	5 Rs./kWh	Nil
Delhi[41]	DERC	4.00 Rs./kVAh (at HT) & 4.50 Rs./kWh (at LT)	Nil
Gujarat[42]	GERC	4.10 Rs./kWh	Rs. 25 per per installation per month
Maharashtra[43]	MERC	4.05 Rs./kWh	70 Rs. /kVA/Month
Punjab[44]	PSERC	6.00 Rs./kVAh	Nil

POLICY & REGULATORY

FAME II scheme-

- **10,000 crore support to electrification of public and shared transportation**
- **New policies by various states for rapid EV adoption eg. Delhi EV policy**
- **Policies on charging infrastructure where EV charging is defined as a service not as a sale**

UPSTREAM INCENTIVES

- **GST on EV reduced from 12% to 5%**
- **Custom duty exemptions on parts exclusively used for EVs.**

DOWNSTREAM DRIVERS

- **Waiving off road taxes, registration fees, purchase and scrapping incentives**
- **Income tax rebate of upto 1.5 lakhs on interest payable on EV related loans**
- **Subsidised tariffs category for EV charging**
- **Office memorandum by MoRTH seperating battery and chassis for boosting Electric 2 & 3 wheelers sales**

TARGET

- **30% of EV sales by 2030 Demand Impact**
- **4% of the electricity demand in 2030**

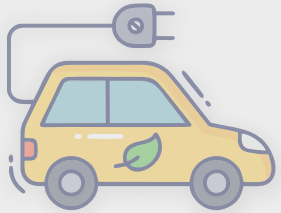
Source: PIB. (2019, December 02). Promotion to Manufacturing of Electric Vehicles.https://bit.ly/381F45V & Transport Department. (2020). Delhi Electric Vehicles Policy. Delhi. https://bit.ly/3n8TpC8

Discoms as Facilitators

As per India Electric Mobility Finance (IEMF) study, Distribution utilities are playing the role of a facilitator. Gradually, India has also begin adopting some of these measures to upscale EVs

1. Online processes for empanelment of customer, vendors and partners
2. Programs like Kerb-side charging launched with utilities and city council
3. Subsidies provided to set up initial charging capabilities
4. Discoms carry out upgradation of distribution network to support large load of EVs
5. Tariff schemes to attract customers and reduce peak time charging

The penetration of EVs will happen since there is a clear business case. What needs to be seen how the Discom manages to increase it's demand and use it to better manage its load profiles.

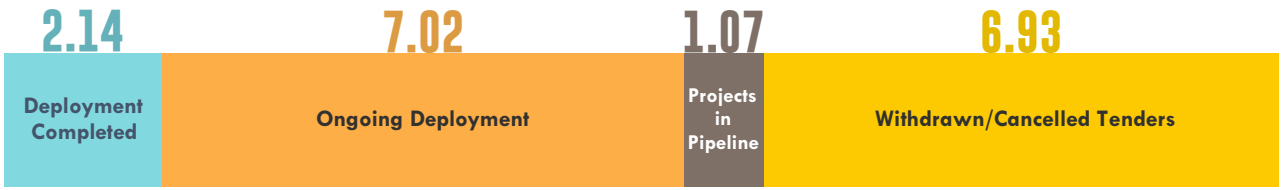


5.5. Faster Infusion of New Age Technology and Digitalisation

The advent of new-state of the art technologies based on artificial intelligence is scripting a new story for the electricity distribution sector in India. The combination of electrical grid with information and communication technhologies is providing vast opportunities for the utilities to manage utility operations, predict consumer behaviour and optimise power supply. Moreover, the Covid-19 pandemic has provided for enough evidence for the utlities to automate their operations and make online provisons for bill payments, meter reading, e-bills and complaints etc. Digitalisation is a key enabler to integrate emerging technologies such as DRE, EV, storage etc.

To embark on this smart grid journey, the Government of India aims to replace 250 million[45] conventional meters with smart meters across India.

Smart Meter Deployment in India (in million no's) As on 24th Dec'20



Source: National Smart Grid Mission. (2020, December 24). Smart Meters Installed in India. Retrieved from https://bit.ly/2XhnSTL

With only 1% of the smart meters installed out of the total connections, there is a need to identify the bottlenecks and bring economies of scale for increased roll-out of smart meters in the country.

Many state governments have tenders on smart meter installations in association with EESL as well other implementation agencies like Genus, ITI , L&T etc. Uttar Pradesh is leading the deployment journey with the installation of 1.12 million smart meters out of the 2.14 million smart meters installed in India.

Advanced Discoms in cities like Delhi, Mumbai, Bengaluru, Ahmedabad are using a variety of these technologies for remote monitoring and real-time energy management. Some recent examples are as follows[46] -

TATA POWER

Smart Grid lab to showcase different communication and information technologies implemented by the utility.

BSES

Drone technologies to detect power theft and network management and inspect rooftop solar technologies.

BESCOM

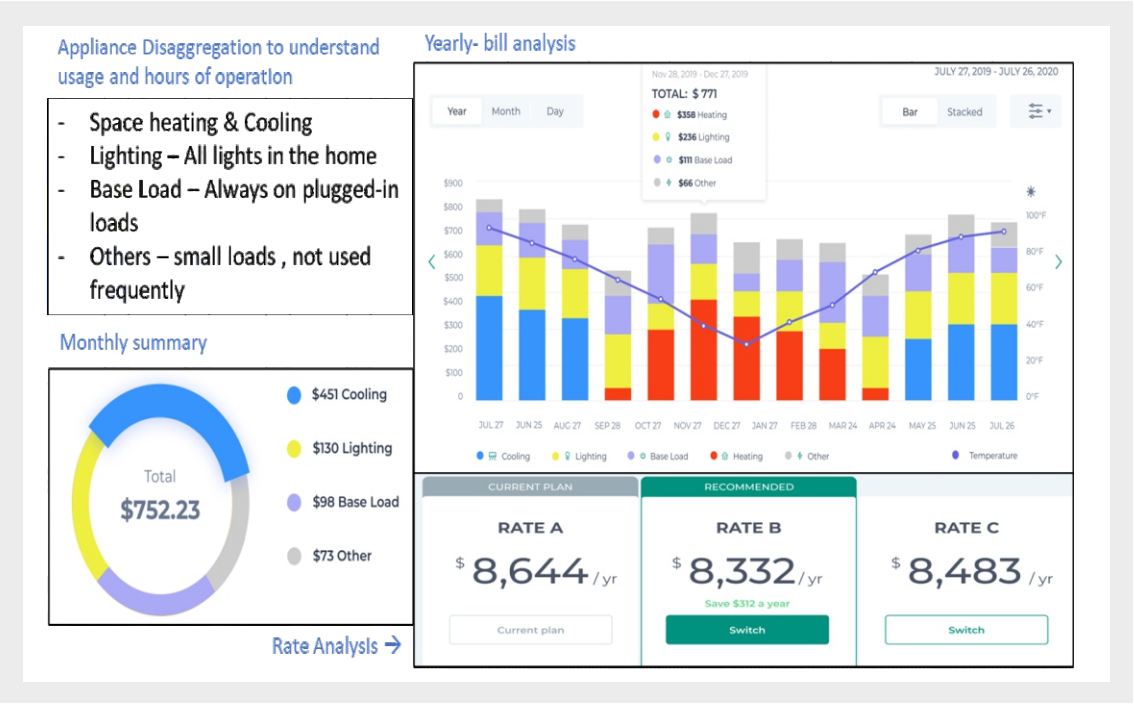
Leading the setting up of EV charging stations in Bengaluru

MSEDCL

Pioneering a number of digital initiatives to improve consumer experience

Far more interestingly, there is a wide variety of energy management service providers who offers useful bill and usage insights for the consumers to enable them make smarter and cleaner choices in terms of appliances usage as well distributed applications like Rooftop solar. These service providers and their advanced technologies are making the consumer aware of its energy consumption and enabling them to identify smart and energy efficient ways to optimise it. An illustration of the bidgely portal (in California) is presented here[xi] -

There is an increasing transparency towards data visibility and accessbility in the form of various dashboards/portals to assess demand side scenarios and access information. These include Government dashboards like Saubhagya, India Energy Dashboards by Niti Aayog, IESS 2047, EESL dashboards etc. There are various non-government initiatives supporting comprehensive dashboards/surveys to assess varied consumer behaviour and types.

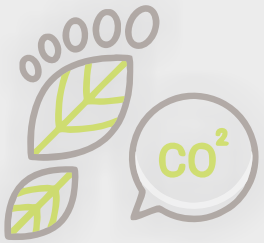


Source: Snapshots from Bidgely . (2020). US Dashboard .https://bit.ly/3n0FbD5

[xi] Appliance Disaggregation- a process that takes the energy usage data from the meter and uses software algorithms to identify the individual appliances that are using the energy.

5.6. Evolution of Conscious Consumption

Expanding environmental and sustainability business drive



Globally many large corporates like Google, Adobe, Procter & Gamble, Walmart, and McDonald's, for example - have announced energy efficiency targets for 2020 to gain a competitive advantage, boost bottom lines, and, more recently, for environmental sustainability. Taking cue from international counterparts, many Indian bigwigs like flipkart, Dalmia Cement, Wipro have announced long term sustainability plans like carbon negative and net-zero plans.

Infosys[47] announced achieving carbon neutrality in 2020, 30 years ahead of the timeline set by the Paris Agreement.

Overall, there is greater drive to go carbon neutral/zero-energy and hence creating a demand pull for clean energy and energy efficiency. This is going to impact the traditional working of the Discoms, who will now have to woo their cherry and high-paying customers with not just increased relaibility but also ensure cleaner power portfolio.

CONCLUSION

The Covid-19 pandemic has been an eye opener in more ways than one and has impacted economies globally. This crises played out against the ever-present threat of climate change.

From India's power sector perspective, the change in demand patterns for electricity across various consumer segments during the pandemic peak has impacted the entire sector.

The demand for electricity fell by 23% in Apr'20 as compared to the demand in the same period in 2019. The fall in demand continued till Aug'20 and started to reach the demand levels of the corresponding period of 2019 only in Sep'20. The consumer segments that contributed largely to the fall in demand was the industrial and commercial electricity consumption, largely due to the lock-down put in place by the Government from Mid-March to Jun'20.

The rapid fall in electricity demand resulted in the idling of significant capacity, particularly the coal fired plants. The PLF for the FY20-21, up to 30th Nov'20, stood at 50.80% as compared to a PLF of 55.99% in 2019-20 and 62.07% in the preceding 2018-19. The PLF for Apr'20 for coal fired power generation was an all-time low of 42.40%.

This in turn impacted the financial health of most electricity distribution utilities, which are already in poor financial health. The cross-section of multiple constraints in billing, metering and collection from consumers resulted in accumulation of large outstanding payments by the Discoms to the generating companies. Even in terms of new projects, the pandemic resulted in delays in project commissioning and a number of tenders, particularly in the renewable energy space had to be postponed due to lack of sufficient interest by project developers.

But having said this, the learning from the pandemic experience could help in strengthening the power sector and to insulate the sector from similar shocks in the future.

Assessment of demand for electricity by identifying key growth centres for electricity demand could be an approach that Discoms could embark upon. Realistic demand assessments, would also help in streamlining setting up of new power plants in India and avoid the possible risk of 'stranded assets' in the sector. In other words, a paradigm shift from the traditional and hitherto followed approach of supply side planning taking precedence over demand side could now change to integrated resource planning.

Everything about how we generate, transmit and consume power is about to radically change and our preparations to tide along will test the grit of India's power sector.

One area, where the power sector in India has done well is in the scaling up of renewable energy. The pace of decarbonizing the power sector can be faster, and one of the drivers of this would be to strengthen the Discoms in India.

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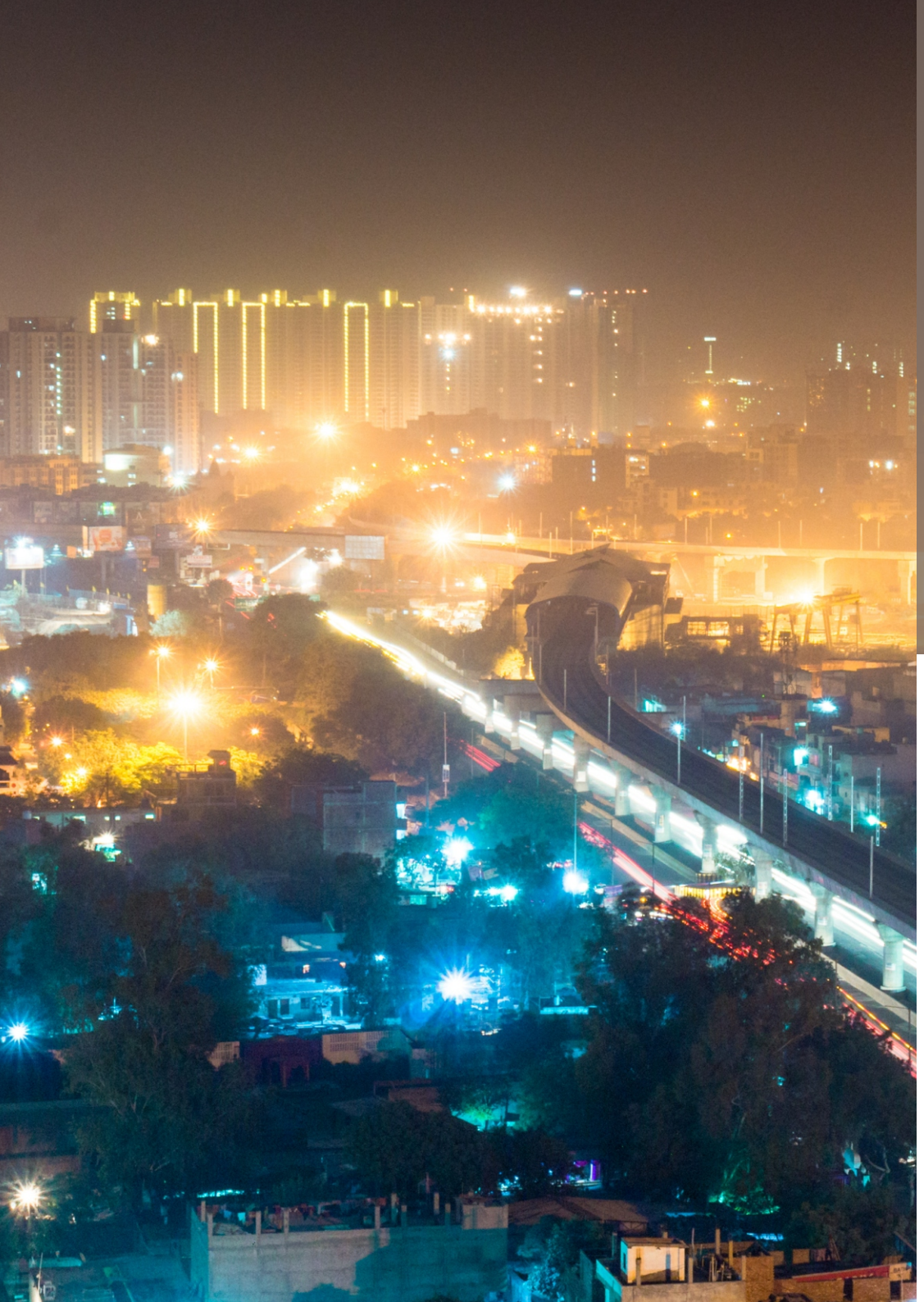
The core mission is to promote environment -friendly, socially just and sustainable models of energy by focusing on renewable energy and energy efficient technologies and lifestyle solutions. The organization focuses to bring about reduction in greenhouse gas emissions in the environment and ensure energy efficiency, energy security, energy independence, and sustainable development and simultaneously, promoting the concept of “Low Carbon Solutions” and “Green Economies”.



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