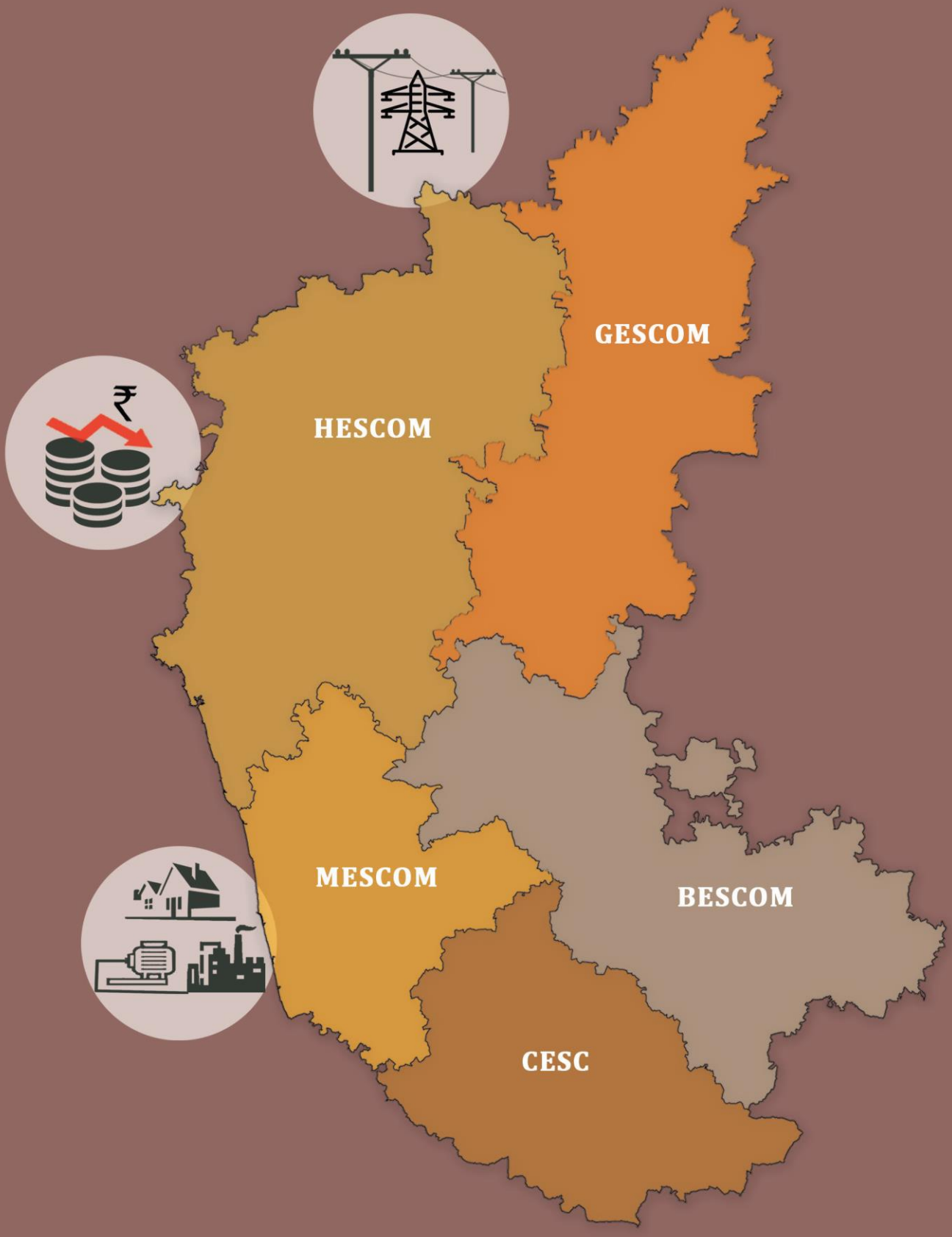
KARNATAKA DISTRIBUTION SECTOR LANDSCAPE



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SHAKTI SUSTAINABLE ENERGY FOUNDATION

Karnataka Distribution Sector Landscape

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Center for Study of Science, Technology and Policy (CSTEP)

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Abbreviations and Acronyms

ACS	Average Cost of Supply
AT&C	Aggregate Technical and Commercial
ARR	Average Revenue Realisation
BESCOM	Bangalore Electricity Supply Company Limited
CESC	Chamundeshwari Electricity Supply Corporation Limited
CEA	Central Electricity Authority
CGS	Central Generating Station
ESCOM	Electricity Supply Company
EESL	Energy Efficiency Services Limited
GESCOM	Gulbarga Electricity Supply Company Limited
GW	Gigawatt
HESCOM	Hubli Electricity Supply Company Limited
IPPs	Independent Power Producers
KEB	Karnataka Electricity Board
KPCL	Karnataka Power Corporation Limited
KERC	Karnataka Electricity Regulatory Commission
KPTCL	Karnataka Power Transmission Corporation Limited
KREDL	Karnataka Renewable Energy Development Limited
LED	Light-Emitting Diode
MESCOM	Mangalore Electricity Supply Company Limited
MNRE	Ministry of New and Renewable Energy
MoP	Ministry of Power
MU	Million Units
MW	Megawatt
RE	Renewable Energy
RTPV	Rooftop Photovoltaic
UDAY	Ujwal DISCOM Assurance Yojana
UJALA	Unnat Jyoti by Affordable LEDs and Appliances for All

Executive Summary

The launch of Ujwal DISCOM Assurance Yojana (UDAY) in November 2015 gave new hope to the ailing distribution companies (DISCOMs) in India. Karnataka signed up for UDAY with a view to improve its operational efficiency. The DISCOMs under the scheme have to reduce Aggregate technical and commercial (AT&C) losses to 14.2% , and bring down the gap between average cost of supply (ACS) and average revenue realisation (ARR) to zero by 2019. As the deadline for the UDAY scheme is approaching, it is vital to review the progress made in the distribution sector in Karnataka over the last five years.

Center for Study of Science, Technology and Policy (CSTEP) undertook this study and identified key issues in the growth of the distribution sector in the state over the past five years from FY2013 to FY2017.

It is observed that while the state has achieved its target of reducing AT&C losses to the desired level (as reported by Karnataka ESCOMs), the ACS-ARR gap has shown a steep increase in the last two years. In the absence of an accurate assessment of consumption by agricultural consumers because of unmetered supply, it is necessary to conduct feeder-wise energy audit to accurately determine the AT&C losses. Our analysis also revealed that increase in power purchase cost by 90 paise/unit from FY2015 to FY2017 resulted in the widening of ACS-ARR gap. Therefore, a better power procurement strategy is necessary in future so as to bridge the gap between ACS and ARR.

Further, reduced share of industrial and commercial categories in total electricity consumption demonstrates the need for more competitive tariffs from ESCOMs as compared to open access supplies from merchant power plants and renewable energy sources.

Key recommendations from this study include the following:

- Review the power procurement strategies to smoothen unforeseen spikes in costs
- Third party evaluation of reporting of AT&C losses by ESCOMs
- Need for ESCOMs to take steps for accurately measuring and regulating the free supply of electricity for the irrigation pumps in order to reduce their dependence on subsidy payments from the state government
- Strict monitoring to study the impact of the feeder segregation initiative (Niranthara Jyoti Yojana) to analyse abnormal deviations in the consumption data
- Mandatory universal adoption of micro-irrigation technologies for achieving optimum benefits for both agriculture and the power sector
- Need for accurate assessment of the quality of supply indicators to identify areas where strengthening of distribution network is critical

The policy recommendations to mitigate those challenges would aid in ensuring a sustainable and commercially viable distribution sector in the long run in Karnataka. The study invokes the need for carrying out similar studies to review the progress of the distribution sector in other states. Such studies would help in identifying the challenges being faced by the distribution sector, in particular.

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History of Reforms

Among Indian states, Karnataka has been a pioneer in power generation and transmission. In 1902, the then state of Mysore, became the first state in Asia to commission a hydro-electric station at Sivasamudram, along with the then longest high voltage transmission line (35 kV, 140 Km) between Sivasamudram and Kolar gold fields.

Karnataka was also the first state to have separate entities for generation and distribution of electricity long before the power sector reforms were initiated. Karnataka Electricity Board (KEB) owned the transmission and distribution of electricity while Karnataka Power Corporation Limited (KPCL), formed in 1970 owned the generation units. With the announcement of Karnataka electricity reforms in 1999, KEB was restructured to form Karnataka Power Transmission Corporation Limited (KPTCL) to look after transmission and distribution. Also, in the same year, Karnataka's regulatory body, Karnataka Electricity Regulatory Commission (KERC) was established, to oversee the regulatory aspects related to power sector in the state. In order to promote renewable energy (RE) and initiate necessary action for energy conservation in the state, Karnataka Renewable Energy Development Limited (KREDL) was established in 1996.

In 2002, KPTCL was unbundled to form four separate electricity supply companies (ESCOMs) namely Bangalore Electricity Supply Company Limited (BESCOM), Mangalore Electricity Supply Company Limited (MESCOM), Hubli Electricity Supply Company Limited (HESCOM), and Gulbarga Electricity Supply Company Limited (GESCOM). Later, in 2005, Chamundeshwari Electricity Supply Corporation Limited (CESC) was made, as a separate entity out of MESCOM.

Current Trends in Supply and Demand

Installed Capacity

Karnataka has an installed generation capacity of 25 gigawatt (GW), as on March 31, 2018 (KPTCL, 2018). Of the 25 GW (Table 1), state-owned hydro and thermal plants account for 36% of the capacity, followed by renewables with 35%. About 15% of the installed capacity consists of the state's share of central generating stations (CGS). The remaining 15% of the capacity consists of independent power producers (IPPs), and captive and co-generation capacity.

Table 1: Installed capacity in Karnataka (as on March 31, 2018)

Source of Generation	Capacity (GW)
KPCL Hydro	3.8
KPCL Thermal	5.0
CGS—State's Share	3.8
IPPs	1.2
Renewables	8.6[1]
Captive and Cogeneration	2.5
Total	25

Source: KPTCL daily generation sheet as on March 31, 2018

Almost all of the installed capacity in Table 1 feeds into the distribution system in the state. Additionally, there is a coal based plant of 1,460 Megawatt (MW) located in Bellary district, owned

[1]As per KREDL data, the renewable installed capacity is 12.3 GW as of March 2018. However, this may be only installed capacity and not commissioned.

by M/S Jindal Steel Works (JSW), which is meant partly for captive consumption with some capacity used as a merchant plant[2]. Also, various other privately owned captive generators feeding to their own demand are located in different parts of the state.

Peak and Energy deficit

Despite its head-start in power generation, Karnataka has been a power deficit state since the seventies due to continued growth in demand. The state was able to supply 42,041 Million Units (MUs) against the energy demand of 45,550 MUs in 2010 (CEA, 2010). There was also a peak deficit of 13% in that year compared to 7,942 MW required (CEA, 2010). However, of late energy deficit has shown significant reduction. During FY17, the state saw a demand of 66,900 MUs and a peak of 10,261 MW (CEA, 2017). As against this, it was able to supply 65,216 MUs (energy deficit of 3%) (KERC, 2017) and met a peak demand of 10,242 MW (CEA, 2017). This narrowing of the gap was mainly because of the increase in total generation from various sources over the years, as presented inTable 2.

Table 2: Source-wise Generation (in MU)

Source	FY13	FY14	FY15	FY16	FY17
KPCL Hydro	9,863	12,637	12,775	7,239	6,165
KPCL Thermal	12,414	14,470	15,411	16,184	16,505
CGS	11,459	12,207	13,831	16,304	22,795
IPPs	6,015	6,372	6,019	7,629	7,248
Renewables	5,528	5,927	5,908	5,057	6,550
Medium, Short term & Others	11,779	6,168	5,993	8,862	5,953
Total	**57,058**	**57,781**	**59,937**	**61,275**	**65,216**

Source: ESCOMs' tariff order 2014, 2015, 2016, 2017 and 2018

Karnataka's Distribution Sector

Karnataka's distribution sector comprises five electricity supply companies namely BESCOM, MESCOM, HESCOM, GESCOM and CESC Mysore. Figure 1 depicts districts in the area of operations of all the five ESCOMs. The operational area of each ESCOM is organised into zones headed by chief engineers (Elec.). Each zone is further divided into operation and maintenance (O&M) circles headed by superintendent engineers (Elec.). Each circle is then divided into O&M divisions, each headed by an executive engineer. The O&M divisions are further divided into O&M sub-divisions, each headed by an assistant executive engineer. Each sub-divisional office consists of around 2-3 O&M section offices to ensure reliable distribution of power in its jurisdictional area, each headed by an assistant engineer or a junior engineer.

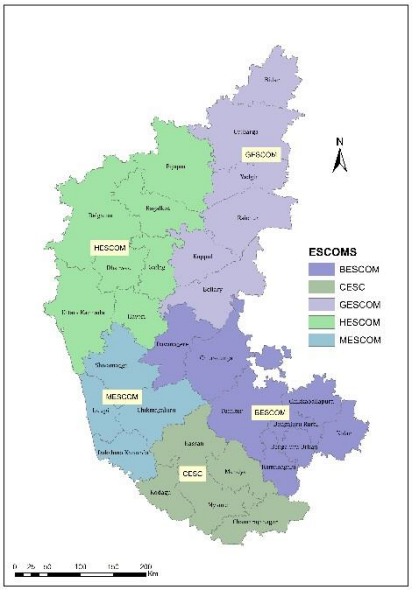

Figure 1: ESCOM area-wise operations

[2]A merchant plant is one which has only short term agreements and sells its power to power exchange

Category-wise Electricity Consumption

The electricity supply in the state caters to different categories of consumers as mentioned below:

(i) Low-tension (LT) consumers including domestic, commercial, agriculture, industries, other miscellaneous categories, with 75% of the total consumption, and;
(ii) High tension (HT) consumers including residential apartments, industries, commercial, irrigation, and water supply, consuming 25% of the total supply.

Domestic and agricultural sectors account for 62% of the total electricity consumption in the state (Figure 2). The agricultural sector has the largest share of consumption of around 40% (21,563 MU) in FY17, mainly for operating around 25 lakh irrigation pump sets in the state. This is followed by 22% (11,741 MU) consumption by 172 lakh domestic consumers and 17% (9,310 MU) by around 4 lakh industrial consumers. The remaining 21% of consumption is shared amongst 20 lakh commercial consumers with 12% (6,315 MU) of electricity consumption and 10 lakh others[3] category of consumers with electricity consumption of 9% (4,831 MU) (KERC, 2018b).

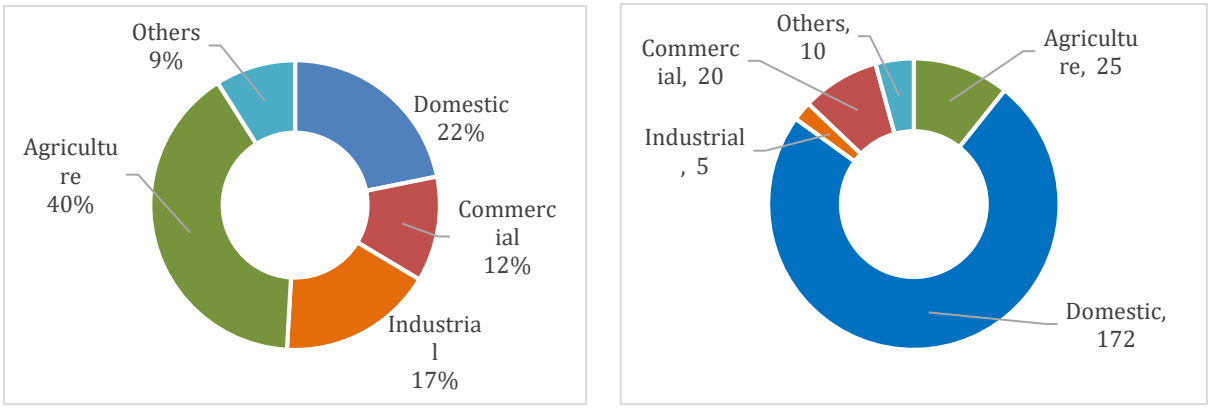

Figure 2: Category-wise consumption (%) and consumers (lakhs) in FY17

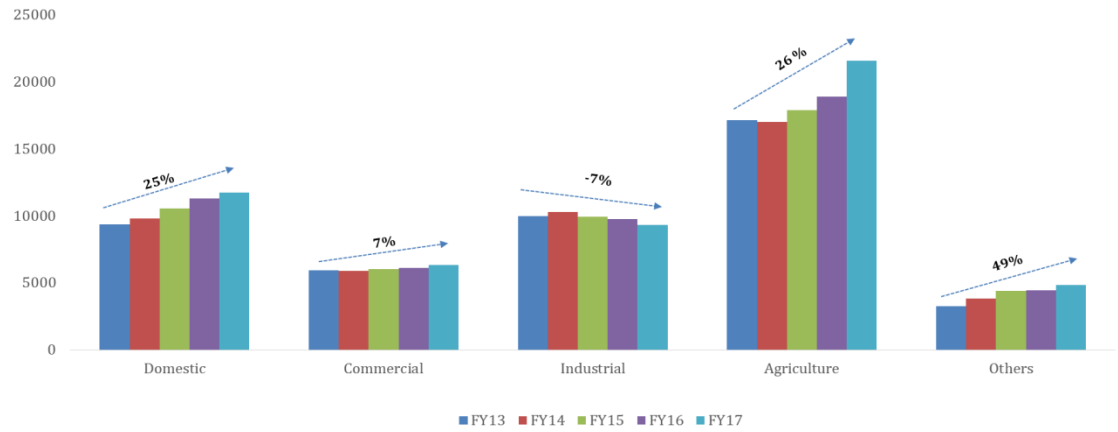

Figure 3: Karnataka's category-wise electricity consumption from FY13 to FY17

In the period from FY13 to FY17, the total electricity consumption in the state grew by 18% from 45,617 MUs to 53,756 MUs. CESC and MESCOM have seen the highest growth with 26% each from

[3] Others category include private professional educational institutions, hospitals, and nursing homes (LT-2b), water supply installations (LT-6a), public lighting (LT-6b), temporary supply (LT-7 and HT-5), water supply and sewerage (HT-1), hospitals and educational institutions (HT-2c)

FY13 to FY17, followed by HESCOM with 22% growth. BESCOM showed a growth of 15%, while GESCOM witnessed a growth of only 11% (Table 3).

Table 3: ESCOM-wise overall consumption (MU) from FY13 to FY17

ESCOM	FY13	FY14	FY15	FY16	FY17	%Growth (FY13-FY17)
BESCOM	22,796	23,065	24,083	24,539	26,239	15%
CESC	4,975	5,112	5,240	5,176	6,260	26%
GESCOM	5,724	5,977	6,132	6,507	6,358	11%
HESCOM	8,389	8,664	9,208	10,092	10,209	22%
MESCOM	3,733	3,993	4,103	4,227	4,689	26%
Total	45,617	46,811	48,766	50,541	53,756	18%

Source: CSTEP, ESCOMs' tariff order 2014, 2015, 2016, 2017 and 2018

The consumption by domestic and agricultural sector grew by 25% and 26% respectively in the period from FY13 to FY17 (Figure 3). The consumption by other category of consumers has increased significantly by 49% during this period. In contrast, the industrial sector's consumption has declined by 7%[4] from 9,965 MUs in FY13 to 9,310 MUs in FY17.

Analysis of Category-wise Sales Growth

This section provides a comparison of year-on–year (Y-O-Y) growth in consumption for different categories of consumers in Karnataka. CESC, HESCOM, and GESCOM together account for around 60% of the state's total agricultural consumption which also accounts for 50% of their total sales in FY17. Similarly, both BESCOM and HESCOM account for 76% of the consumption from industrial and commercial consumers (combined).

Agriculture Sector

During the period from FY13 to FY17, the total consumption recorded against agricultural sector has gone up by 26% from 17,132 MU to 21,561 MU (Table 8). A closer look at the consumption pattern in agricultural sector reveals that the growth (Figure 4) in sales was either stagnant or negative during the first three years (FY14, FY15, and FY16). However, it experienced a sudden spike in the growth in the last year of the period (FY17). This is evident from the consumption pattern of CESC and MESCOM during the period from FY13 to FY17. In CESC, the growth in sales ranged from -8% to 0.2% during FY14 to FY16, and it suddenly shot up to 49% in FY17. Similarly, in MESCOM, the growth rate ranged from -3% to 9% during first three years of period (FY14 to FY16), while it saw a huge increase to 36% in FY17. Although seasonal conditions could alter the agricultural consumption by some proportion, the highly erratic consumption pattern of ESCOMs during this period, could not be explained by unusual seasonal conditions or abnormal increase in number of irrigation pump sets.

According to Karnataka's economic survey report FY16-17, the state witnessed a drought situation consecutively for the sixth year in FY16 (Department of Planning, Programme Monitoring and Statistics, 2017). This should have indicated a comparatively higher growth in agricultural consumption in FY16 over FY15. However, CESC experienced negative growth of 8%

[4] This excludes consumption by open access consumers

in FY16. Similarly, in FY15, while all other ESCOMs sales to agricultural sector showed some growth, both CESC and MESCOM showed decline in their agricultural consumption. It is, therefore, difficult to conclude that seasonal variations (low rainfall) impacted the agricultural consumption pattern in Karnataka. This disparity in the consumption pattern for all the ESCOMs needs further explanation or investigation. Further, in the absence of metered irrigation pump (IP) sets, the agricultural consumption is calculated on the basis of assessed consumption. Although feeder segregation has been undertaken for all the ESCOMs except MESCOM, it appears that there is no strict monitoring of the same . Thus, this abnormal deviations in the consumption need to be verified by diligently monitoring the impact of the feeder segregation initiative on the agricultural consumption.

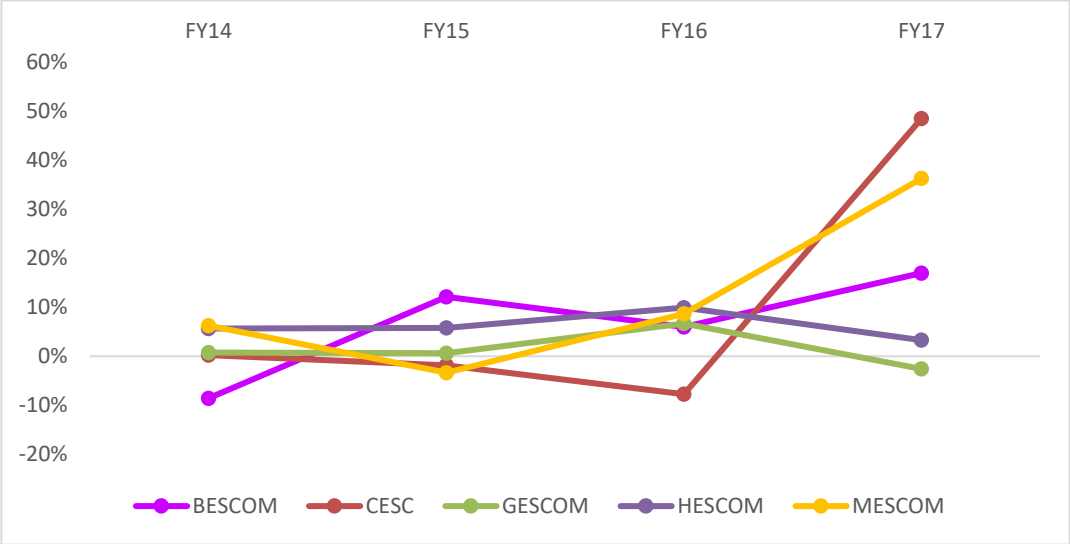

Figure 4: Agricultural Sales Y-o-Y growth (%)

Industrial and Commercial Sector

The industrial sector has shown a decline in overall growth, during the period from FY13 to FY17, for all the ESCOMs (Table 9). The ESCOMs have seen this decline in different years. According to Figure 5, BESCOM saw a decline in FY15 and FY17, CESC and HESCOM in FY14 and FY17, MESCOM in FY16 and FY17, and GESCOM, consecutively in three years (FY15, FY16, and FY17). Factors such as industries becoming more energy efficient or industries purchasing power through open access mechanism, could have contributed to this decline in sales to industries. As per the analysis in KERC's tariff orders (KERC, 2018c), open access procurement by industries and commercial consumers, appears to be one of the major reasons for reduced industrial sales in FY17. The open access procurement, for all the five ESCOMs increased from 502 MUs in FY15 to 2,856 MUs in FY17. As per the short term market reports by Central Electricity Regulatory Commission (CERC), the number of open access consumers in Karnataka (including both industrial and commercial categories) increased by 57% from 192 (CERC, 2016) in FY16 to 301 (CERC, 2017) in FY17. Consequently, impact of open access explains the low industrial sales for all ESCOMs. The commercial establishments (Table 10), most of them being fairly small in nature, do not seem to have opted for open access to a large extent.

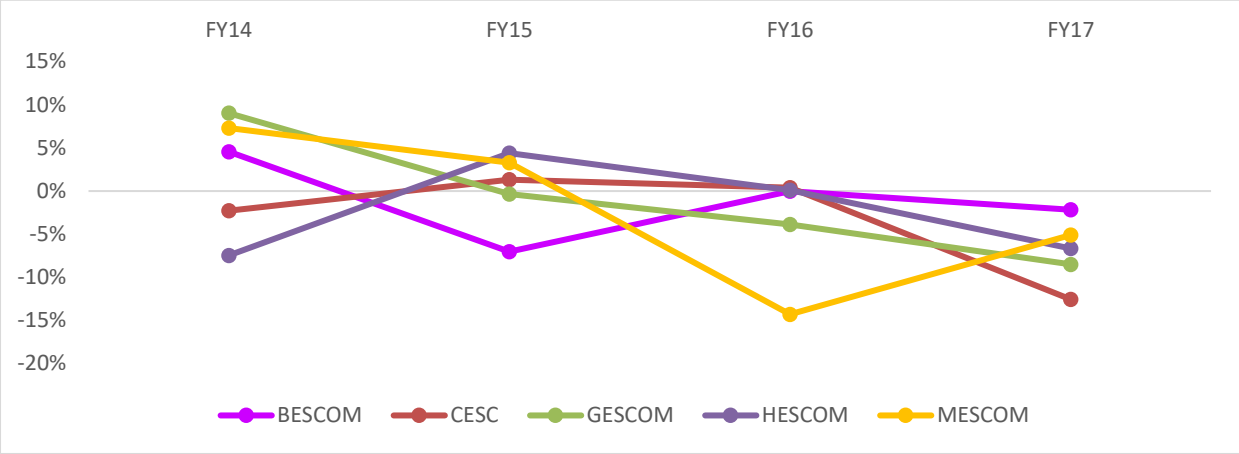

Figure 5: Industrial Sales Y-o-Y growth (%)

Domestic Sector

While the state has achieved 100% progress in urban household electrification, rural households are 95% electrified (MoP, 2018). Additionally, implementation of light emitting diode (LED) programme in Karnataka seems to have impacted the domestic consumption pattern. The programme is estimated to have saved 2,627 MU of energy per year, and avoided a peak demand of 526 MW through distribution of around two crore LEDs in Karnataka (as of June 2018) ('National Ujala Dashboard', 2018). Overall, steady growth is seen in the domestic sector over the years, for all the five ESCOMs, though the rate of growth has decelerated in FY17 (Table 11). This could be attributed partly to the household electrification status in Karnataka.

An important point to note about the household category consumers is that almost all the household supply is metered and there is good payment discipline among the consumers except the weaker sections households covered by the Bhagya Jyothi scheme who are given free power supply with a single light point per household. These households account for about five percent of the consumption recorded against the domestic category of consumers. The free supply to bhagya jyothi consumers also gets reimbursed by subsidy from the state government at rates determined by KERC. The total number of consumers in the domestic category being in excess of about 1.5 crores in the state, monthly billing of consumption poses an administrative challenge often compromising the billing efficiency of ESCOMs. This is particularly noticeable in the rural areas where part time workers called grama vidyut pratinidhis are in charge of billing and collection.

Miscellaneous (Others) Sector

The "Others" category of consumers accounts for around 8-9% of the total electricity consumption in the state. However, the sector has shown an overall growth of 49% from 3,238 MUs in FY13 to 4,831 MUs in FY17. All the ESCOMs have registered growth in this sector ranging from 42% to 80% (Table 12) during the period from FY13 to FY17. This increase in sales could be related to activities such as increased supply to water supply installations and temporary connections by ESCOMs.

In view of the above discussions, it is observed that even though, there is total growth in sales over the years from FY13 to FY17, different sectors have shown growth differently in ESCOMs. There is no rigid pattern in the manner in which consumption has grown in ESCOMs over the period from FY13 to FY17. However, the above analysis of trends in the growth of demand for power by different categories of consumers, also points to the fact that while the overall demand

for power is increasing, the share of industrial and commercial categories is reducing as compared to the agricultural and domestic categories.

Against the overall growth in demand of 17% from FY13 to FY17, the demand from industries has shown a decline of 7% while that of commercial categories of consumers has seen a subdued 7% growth. On the other hand, the consumption of agriculture and domestic category consumers has grown by about 27%. The increasing levels of per capita income in the state may continue to result in greater power consumption by households in the coming years with more and more households using electrical appliances of various kinds, particularly in the rural areas where the average hours of supply per day for households have also increased due to separation of agricultural feeders from domestic supply. This may also contribute to some growth in consumption by rural and small scale industries and commercial establishments in rural areas. Any robust growth in the sales to industrial and commercial category consumers in the future will depend upon whether the tariff for these consumers will be made competitive as compared to open access supplies from merchant power plants and renewable energy sources.

Key Highlights:

- *High disparity in the agricultural consumption for different ESCOMs to be strictly monitored as the rainfall variation does not seem to have impacted the consumption pattern*
- *Open access being the primary reason for reduced industrial sales, ESCOMs need to make the tariffs for their high paying consumers more competitive as compared to open access supplies*
- *With increasing power consumption by households, ESCOMs need to ensure that revenue is collected for all the corresponding bills that are generated, on a regular basis*

Operational Efficiency Parameters

Along with the volume of supply, we must also keep in mind the efficiency of the distribution system. The gap between the Average Cost of Supply (ACS) and the Average Revenue Realisation (ARR) is an important indicator to evaluate the operational efficiency of ESCOMs. This is discussed in detail in the subsequent sections.

ACS-ARR Gap

Karnataka is among the states which have signed up for Ujwal DISCOM Assurance Yojana (UDAY) only in respect of improving operational efficiency of its ESCOMs, excluding the part relating to the takeover of loans of ESCOMs by the state government. As per the memorandum of understanding (MoU) signed in this regard, ESCOMs in Karnataka have to reduce their ACS-ARR gap to zero by FY19 (MoP, 2016). However, the overall ACS-ARR gap for ESCOMs in the state has seen a steep increase in FY 2016 and 2017.

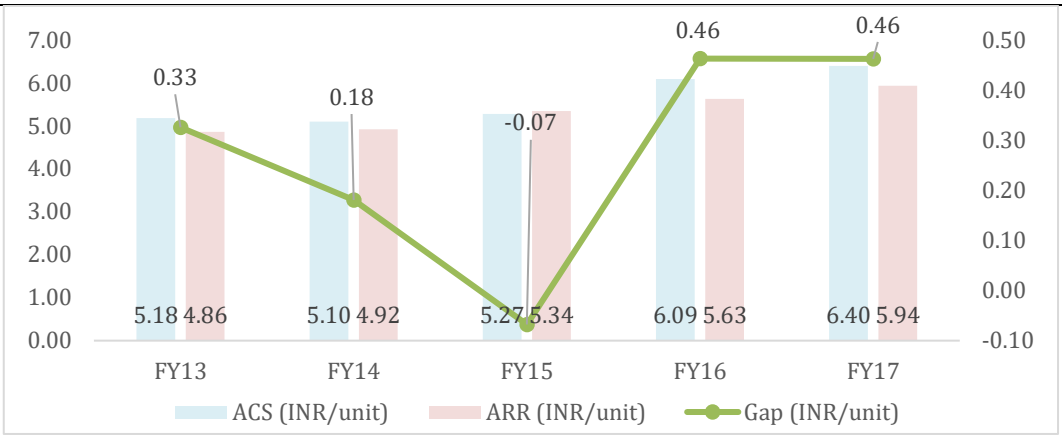

Figure 6: Karnataka's ACS-ARR gap from FY13 to FY17

Figure 6 provides the ACS-ARR gap in Karnataka over the last five years from FY13 to FY17 (KERC, 2018a). The overall ACS-ARR gap for all ESCOMs declined from 33 paise/unit in FY13 to 18 paise/unit in FY 2014 and actually became a surplus of ARR over ACS of 7 paise/unit in FY15. During these three years, the overall ACS increased only by nine paise/unit as against for which the ARR increased by 48 paise/unit. Thereafter, the overall ACS increased by 113 paise/unit (about 21%) in two years from INR 5.27/unit to INR 6.40/unit. In spite of substantial tariff revisions made in FY 2016 and FY 2017, an overall gap of about 46 paise/unit remained in both the years. The factors causing this abnormal increase in average costs leading to the large ACS-ARR gap in FY 2016 and 2017 are analysed below.

Figure 7 and Figure 8 illustrate that, while the ARR has a consistent growth pattern for each ESCOM, wide inter-ESCOM differences in ACS are evident over the years. For instance, around INR 1.06/unit difference is seen between FY17 ACS for BESCOM and MESCOM. Similarly, in FY14, whereas HESCOM has an ACS of INR 5.59/unit, ACS in GESCOM is at INR 4.60/unit (a difference of around INR 1/unit). These wide differences in ACS are visible over the years between all the ESCOMs. In contrast, the revenue realisation pattern is uniform and consistent. The large differences in ACS between ESCOMs is to be understood in terms of the policy followed in power allocation to ESCOMs, from different sources.

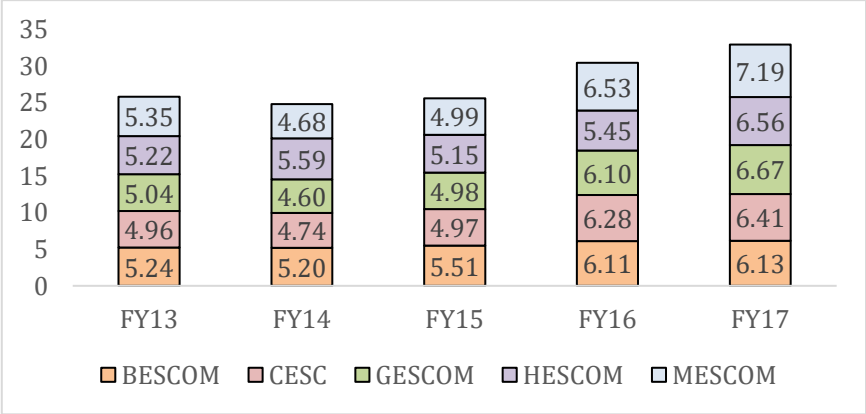

Figure 7: ESCOM-wise ACS (INR/unit) from FY13 to FY17

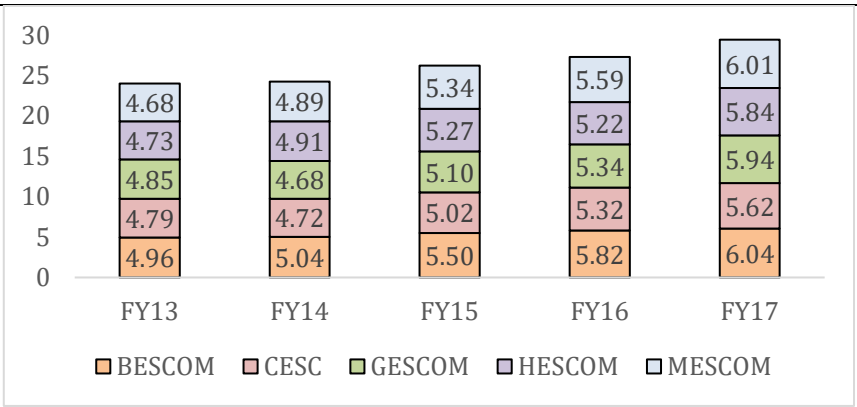

Figure 8: ESCOM-wise ARR (INR/unit) from FY13 to FY17

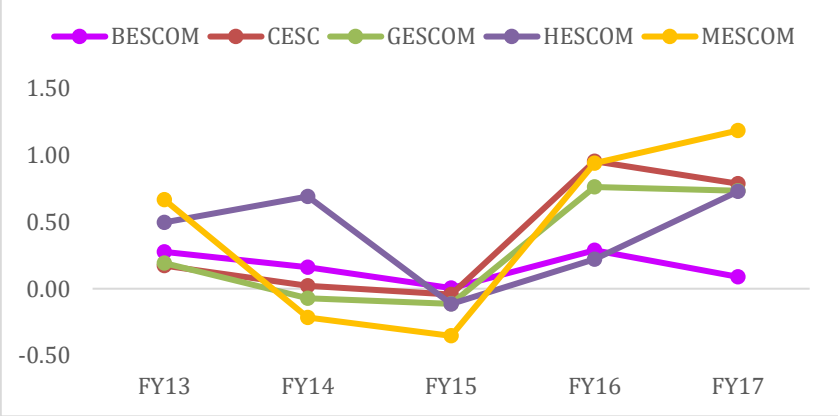

Figure 9: ESCOM-wise ACS-ARR gap (INR/unit) from FY13 to FY17

The power purchase cost (PPC) is one of the major parameters in ESCOM's cost of supply. The PPC accounts for 80-85%[5] of the total cost of supply in Karnataka. Any increase/decrease in PPC strongly impacts the average cost of supply of an ESCOM. The cost of power procurement by ESCOMs in Karnataka varies widely depending upon the source of generation, with the power procured from the hydro-electric units of the KPCL being priced at less than INR 1 per unit and the short term procurement on bilateral basis often exceeding INR five per unit. Thermal power from the KPCL's generating units and the central generating units, as well as renewable power from different sources is being procured at an overall cost ranging between INR 3.55/unit and INR 4.11/unit during the last five years. The power procured from various sources as discussed above, is allocated to different ESCOMs in different proportions every year so that each ESCOM's revenue from retail tariff is likely to cover the overall costs of the utility. The average revenue realisation in each ESCOM differs from that of others on account of the differences in their consumer mix. The sources of power are allocated to adjust procurement costs accordingly. This explains the differences in the ACS and the ARR of ESCOMs in any given year in the state. It would therefore be useful to consider the overall ACS and ARR for the distribution utilities in Karnataka. In the above context, the factors contributing to cost of supply and revenue realisation are analysed in the sections below to bring out the reasons for the ACS-ARR gaps of ESCOMs (Figure 9) in Karnataka.

Cost of Supply

The parameters affecting the cost of supply are discussed in detail below:

[5] BESCOM- 85%, CESC-81%, GESCOM-82%, HESCOM-85%, MESCOM-75%

Power Purchase Cost (PPC): It is seen that the PPC (combined for all ESCOMs) remained constant from FY13 to FY15 at INR 3.6/unit (Table 4). The combined PPC then increased by 21% from INR 3.6/unit in FY15 to INR 4.4/unit in FY17, causing an abnormal increase in ACS during this period. The main reason for this steep increase in the cost of power procured in FY 2016 and 2017 was the steep decline in the generation of hydel power from the KPCL's generating units from an average of about 12,000 MU per year to 7,239 MU in FY 2016 and 6,165 MU in FY 2017. As per the ESCOMs' tariff order 2018, there was a shortfall of supply of around 5,059 MUs from state-owned hydro (4,141 MU at 92 paise/unit) and thermal generation (918 MU at INR 4.08/unit) during FY17. In order to make good the deficit from allocated power sources, ESCOMs procured power on short term basis at a cost of INR 1,784 crores (average INR 4.31/unit). The ESCOMs purchased power from short/medium term sources at a cost of INR 4.28/unit (INR 1,310 crores), un-requisitioned surplus power from CGS at INR 3.56/unit (INR 127 crores), and imposing Section-11 on generators located in the state (for April and May 2016) at INR 4.80/unit (INR 346 Crores). If the state-owned hydro and thermal sources could have supplied the allocated power, ESCOMs would have incurred INR 381 crores at 92 paise/unit for the same quantum of energy as against INR 1,784 crores at INR 4.31/unit. This had an impact of 90 paise/unit of the total power procured (65,332 MU) in 2017.

Table 4: ESCOM-wise power purchase cost from FY13 to FY17

	BESCOM		CESC		GESCOM		HESCOM		MESCOM		Total	
	INR/ unit	MU	INR/ unit	MU	INR/ unit	MU	INR/ unit	MU	INR/ unit	MU	INR/ unit	MU
FY13	3.9	27,834	3.2	6,118	3.2	7,356	3.4	10,980	3.4	4,474	3.6	56,762
FY14	3.8	27,928	3.0	6,449	3.1	7,606	3.6	11,213	3.5	4,747	3.6	57,943
FY15	4.0	29,423	3.4	6,299	3.1	7,871	3.3	11,514	3.4	4,839	3.6	59,946
FY16	4.3	29,162	4.2	6,445	4.0	8,244	3.8	12,411	4.4	5,028	4.2	61,290
FY17	4.4	31,488	4.3	7,545	4.3	8,047	4.5	12,583	4.5	5,669	4.4	65,332

Distribution Costs: Better operational efficiencies could help ESCOMs to optimise some of their distribution costs, further aiding them in maintaining their cost of supply at optimal levels. The distribution cost includes operation and maintenance expenses, interest and finance cost, and return on equity. Each parameter of distribution cost is discussed below:

Operation and Maintenance Expenses: Operation and maintenance cost can be further broken into employee cost, administrative and general (A&G) expenses, and repairs and maintenance (R&M) cost. Employee cost accounts for around 75-80% of the entire O&M cost. The remaining 20-25% is contributed by R&M, and A&G expenses. The O&M cost in all the five ESCOMs (combined) increased by 17% from INR 2,256 in FY13 to INR 2,648 in FY15 and by 23% from INR 2,648 in FY15 to INR 3,268 in FY17 (Table 13). This increased the average cost of supply by 7 paise/unit in FY16 and 12 paise/unit in FY17.

Interest Charges: The ESCOMs tariff orders indicated an increase of 33% in interest charges (loan and working capital) from INR 984 crores in FY15 to INR 1,306 crores in FY17 (Table 14). This is because of a 47% increase in the total outstanding loans to 8,088 crores in FY17 from INR 5,518 crores in FY15. The loans have been obtained mainly for metering of distribution transformers (DTs), completion of works under Niranthara Jyothi Yojana (NJY), and implementation of high voltage distribution system (HVDS). The increase in the loan sanctioned should commensurate with the improvement in the distribution network infrastructure in the state. However, how the sanctioned amount is being utilised needs further verification. Also, the ESCOMs in Karnataka did

not get the benefit of financial restructuring under UDAY to transfer 75% of the ESCOMs' loans to state government as it signed up only for improvement in operational efficiency under UDAY.

In view of the above discussion, it is evident that as compared to FY2015, the average cost of supply in FY17 increased mainly due to increase in power purchase cost (90 paise/unit), O&M costs (12 paise/unit), and overall finance cost (6 paise/unit).

Revenue Realisation

Tariff Levels and Frequency of Revisions: Adequacy of tariff hike and timely tariff revision with respect to the cost of power is necessary to bridge the revenue gap for an ESCOM. Taking this into consideration, KERC has been consistently revising tariff over the years. (FY14-23 paise/unit, FY15-32 paise/unit, FY16-13 paise/unit, FY17-53 paise/unit, and FY18- 48 paise/unit) (KERC, 2013).

AT&C Losses: AT&C losses represent the sum of technical losses and commercial losses in the distribution network. Karnataka's ESCOMs claim to have brought down their AT&C losses over the last five years. A reduction in AT&C losses potentially increases the revenue realisation, and also reduces the average cost of supply. According to reports, the combined AT&C losses of ESCOMs have reduced to 15% in FY17 (MoP, 2015) from 21% in FY13 (PFC, 2013). As per UDAY, ESCOMs in Karnataka have a target of reducing its AT&C losses (combined) to 14.2% (MoP, 2015) by FY19. Table 5 provides AT&C losses for all the ESCOMs in Karnataka. AT&C losses can be calculated correctly only if there is accurate information on energy input and energy consumed. Since most of the agricultural consumers are unmetered, the accurate assessment of consumption is difficult. In the absence of reliable consumption data relating to agricultural consumers, the approach of reporting AT&C losses (or T&D losses) by ESCOMs is questionable. This is evident from the reported AT&C losses by CESC and HESCOM in two consecutive years (FY15 and FY16). Apparently, AT&C losses in CESC increased from 13.9% in FY15 to 17.3% in FY16. Similarly, in HESCOM, the AT&C losses increased to 20.9% in FY16 from 16.7% in FY15. Variation in assessment of agricultural consumption could have been one of the factors for this deviation in reported losses. Hence, it is extremely important to critically analyse the reported losses by ESCOMs.

Table 5: ESCOM-wise AT&C losses (%) from FY13 to FY17

	FY13 (%)	FY14 (%)	FY15 (%)	FY16 (%)	FY17 (%)
BESCOM	14.2	13.9	13.5	13.5	13.2
CESC	15.1	14.7	13.9	17.3	13.1
GESCOM	19	17.8	18.9	18.7	17.3
HESCOM	19.9	18.1	16.7	20.9	16
MESCOM	11.9	11.9	11.6	11.5	11.4
Karnataka	16	15.3	14.9	16.4	14.2

Consumer Sales: The reduced consumer sales over the years may be an indication of lower billing efficiency and thus; lower revenue realisation. As discussed earlier, although sales to industrial consumers reduced from FY13 to FY17, overall sales increased during the same period. The total sales (all the five ESCOMs) have grown by 18% from 45,617 MUs in FY13 to 53,756 MUs in FY17.

Government Subsidy for Power Supply to Agricultural and Rural Consumers: In order to provide free power supply or supply at a nominal rate for agricultural consumers and weaker section households, the state government provides subsidy so as to compensate ESCOMs on their cost of supply. Hence, appropriate and timely payment of subsidies is an important factor in reducing the revenue gap. GoK has been providing subsidies to ESCOMs for power supply to agricultural and other consumers, since 2000. As per KERC (Manner of payment of subsidy by

state government) Regulations, 2008, (KERC, 2008), state government shall pay the subsidy to a licensee every quarter, in advance. An increase of 83% is witnessed in the subsidy provided by GoK from INR 4,993 crores in FY13 to INR 9,152 crores in FY17.

Reduction of Consumption by High Paying Consumers (Industrial and Commercial): As discussed in earlier section, industrial and commercial consumers appear to be opting out of ESCOMs network through open access mechanism and procuring power from alternative sources for lower tariff and reliable supply. Table 9 indicates a 9% decline in industrial consumers from FY14 to FY17. If these industrial consumers had continued to procure power from ESCOMs, it would have resulted in an increase of 11 paise/unit in the ARR in FY17. Therefore, it is necessary for ESCOMs to explore innovative strategies to retain their high paying consumers.

Although AT&C losses and movement of high paying consumers impacted ESCOMs revenue, the average revenue realisation in Karnataka has shown a growth of 22% from FY13 to FY17. Thus, the widening ACS-ARR gap in the state is result of increased cost of supply and not due to inadequate revenue realisation.

Key Highlights:

- *ACS-ARR gap increased by 21% during FY15 to FY17. Of this, 71% is contributed by increase in power purchase cost*
- *The power allocation to different ESCOMs is done in such a manner so that each ESCOM's revenue covers its overall costs. Despite this, MESCOM experienced a gap of INR 1.18/unit in FY17, which is much higher than the overall ACS-ARR gap of INR 0.46/unit*
- *Inaccurate estimation of agricultural consumption adversely affects AT&C losses, which is evident from the deviation in the reported AT&C losses of ESCOMs ranging between 11% to 16%*

Issues and Policy Recommendations

ACS-ARR Gap (Need for Better Power Procurement Strategy)

As shown in this study, the main reason for the widening ACS-ARR gap of Karnataka ESCOMs in recent years is the steep increase in the average power procurement cost from INR 3.6/unit to INR 4.4/unit in the years 2015 to 2017. During these years the state was deprived of low cost hydro power from the state owned units to the extent of about 4000 MU to 6000 MU per year as compared to the average availability of hydro power of about 12,000 MUs per year. This was partly due to natural causes like low rainfall in the catchments. Also, a fire accident in a major generating station added to the above distress situation. Substituting high cost power procured on short term basis for the low cost hydro power dramatically pushed up the ACS during those years. However, it is important to note that the cost of power procured on short term basis was significantly higher at about INR 4.2/unit than the average cost of short term bilateral sale of power as published by the CERC (Table 6 and Table 7). Karnataka's ESCOMs had to procure power at higher than the prevailing prices apparently due to non-availability of the transmission corridor for import of power to the state from the Western and the Northern zones. It is also not clear if the state could not obtain additional allocation of power from Central power generating stations to tide over the shortages caused by unforeseen circumstances during those years. The above analysis underlines the need for the state to review its power procurement strategies to smoothen unforeseen spikes in power procurement costs by further diversifying its sources of power. Steps are also necessary to enlarge the corridor capacity for transmission of power from Western and Northern zones into the state by expediting the construction of inter-state transmission lines delayed due to right of way problems within Karnataka. Further, the state must consider using the low-cost hydro power for building up pumped storage capacity which will also help in utilising RE sources of power more effectively. Considering that Karnataka is one of the few states with potential for tapping wind and solar energy on a large scale, and in view of the lower cost of these sources compared to cost of generating thermal power in the state, it is imperative that the state's power procurement portfolio in future will have to consist of a much greater proportion of renewable energy in the coming years.

Table 6: Volume and price of electricity transacted in short-term market (FY13 to FY17)

Year	Price (INR/Unit)	Volume (MU)
FY13	3.7	23,540
FY14	2.9	30,670
FY15	3.5	29,400
FY16	2.7	35,010
FY17	2.5	41,120

Table 7: ESCOM-wise short-term power purchase (FY13 to FY17)

	BESCOM		CESC		GESCOM		HESCOM		MESCOM		Total	
	INR/ unit	MU	INR/ unit	MU	INR/ unit	MU	INR/ unit	MU	INR/ unit	MU	INR/ unit	MU
FY13	4.3	7,638	4.5	758	5.9	229	5.9	1,620	4.4	639	4.6	10,827
FY14	4.9	4,013	5.4	277	5.4	763	4.8	1,194	5.3	209	4.9	6,455
FY15	5.1	3,673	5.2	911	5.0	662	5.0	554	5.1	444	5.1	6,244
FY16	4.8	3,600	5.2	481	5.1	560	5.2	615	5.3	520	5.0	5,776
FY17	4.2	3,008	4.0	632	4.2	574	4.2	813	4.2	431	4.2	5,458

AT&C Losses

The ESCOMs in Karnataka have reported AT&C losses ranging between 11% and 17% in the year 2017. These are lower when compared to the country's average of AT&C losses reported by ESCOMs, and are in sync with the objectives of containing AT&C losses under UDAY. However, in the absence of metered supplies for the agricultural consumers, and in view of the large proportion of total power supplied to the sector, it is necessary to have the AT&C losses accurately determined by a system of feeder-wise energy audit. The KERC have for many years been urging the ESCOMs in the state to conduct such audit by tallying the feeder wise supply and the consumer billing every month. KERC has further issued detailed instructions to the ESCOMs to correlate input energy as metered at the DT level with the consumption recorded at the consumers' level to pinpoint the points of leakage. The procedure suggested by KERC is likely to yield reliable data on AT&C losses on each feeder, as almost all consumer supplies on even rural feeders are metered except the agriculture feeders which are anyway segregated. Systematic feeder wise energy audit is therefore highly recommended for ESCOMs in Karnataka not only to determine the level of AT&C losses on a reliable basis, but also to take effective measures to reduce these losses in areas where they are beyond acceptable levels. Another compelling reason for determining the AT&C losses accurately is the steep increase in the power procurement costs seen in recent years which has resulted in a widening gap between the ACS and ARR of ESCOMs in the state.

Billing and Collection Efficiency

As noted in this study, the state ESCOMs have had their retail tariff revised by KERC regularly for several years now. The KERC tariff orders seem to provide adequate tariff to cover all the costs as assessed by the regulator. The ESCOMs have in most years failed to recover the revenue as projected for a number of reasons, including more than projected supply to low tariff/ free supply consumers and poor billing and collection efficiency in many areas. In the face of increasing cost of service, and the increasing retail tariff, it is imperative for the ESCOMs to ensure that there is no scope for non-billing of supply or non-recovery of billed tariff from consumers. The general culture of electricity consumers in Karnataka is highly responsive to billing and recovery efforts. However, ESCOMs need to streamline their billing and recovery machinery by making the sub-division and section level staff more accountable. Rigorous energy audit coupled with linking of billing and collection to input of energy at DT and feeder levels should be introduced to ensure greater billing and collection efficiency at the field level.

Consumption by Agricultural sector

One of the major reforms implemented in the state relates to the feeder separation programme, called Niranthara Jyothi Yojana (NJY), which has achieved segregation of feeders providing supply to agricultural consumers, from the supply to domestic and other categories of consumers in rural areas. Except in the four districts in the jurisdiction of MESCOM, the work of separating agricultural feeders is nearly completed in all the districts. This has presumably helped in load management to a great extent as agricultural supply is restricted to less than eight hours in most areas and is also given on rotation basis during non-peak hours. Feeder separation has also made it possible to provide near 24-hour supply to most rural areas which has benefitted the household and other non-agricultural categories of consumers. However, these benefits are yet to be assessed on the basis of reliable data as no state-wide evaluation of the feeder separation programme has been carried out so far.

An evaluation of the NJY programme in the state will be of great importance as this will help to more reliably quantify the consumption of electricity by the agricultural sector. This will in turn enable a more accurate assessment of the AT&C losses in the state as there is a strong likelihood

that agricultural consumption in the state is overstated by the current practice of ESCOMs 'assessing' such consumption as a residual after deducting metered sales and estimated AT&C losses from the total supplies. In the year 2014, KERC directed a change in the above methodology keeping in view the substantial progress made in the state in separating the agricultural feeders from the rest of the feeders in the rural areas. The commission sought to monitor the consumption of power by IP sets at the (segregated) feeder level to determine the specific consumption and the aggregate consumption by IP sets in each ESCOM area. This approach has been insisted upon by KERC in every tariff order issued since 2015 except in respect of MESCOM which was directed to adopt the method of reading the consumption at the individual IP set level as most IP sets have meters in its area. The new method of determining specific and aggregate consumption of IP sets is obviously easy to follow as feeder separation programme is almost fully implemented in four out of five ESCOMs.

In view of the state government subsidising the cost of free supply to farmers, there appears to be a perverse incentive for ESCOMs overestimating consumption in the agricultural sector. The KERC tariff orders for the year 2017-18 in respect of some ESCOMs have expressly raised this issue by substantially discounting the estimates of agricultural sector consumption submitted to them. Given the fact that GoK pays over INR 9,000 crores of subsidy per year for free supply of power to farmers and that the share of power supplied to agricultural sector is estimated at nearly 40% of the total supply in the state (the highest proportion among all states), it is of utmost importance that the operation of the segregated agricultural feeders is evaluated through third party studies at the earliest.

Energy Efficiency in Irrigation

Adoption of energy efficiency measures in the irrigation sector is another measure that is guided by the large share of the agricultural sector in electricity consumption. ESCOMs in the state have already gained some experience in implementing projects for replacing inefficient energy pumps of farmers using the services of Energy Saving Companies (ESCOs). These projects have demonstrated savings of 20 to 35% in electricity consumption by irrigation pump sets (Table 15). The benefit energy saved is shared by the ESCOMs with ESCOs which implement the project in a given project area without any capital investment by the farmers or the ESCOMs. Scaling up such programmes to cover all areas with significant agricultural consumption is strongly recommended in the coming years.

Another important measure recommended for the irrigation sector is the adoption of drip/ sprinkler irrigation which helps in achieving the twin objectives of conserving water resources as well as achieving energy efficiency. According to official statistics, 35 lakh hectares of irrigated area in Karnataka (29% of total irrigated area) (Karnataka State Department of agriculture, 2015) is ground water based which accounts for about 25 lakh irrigation pump sets using electricity. The state and central government programmes also subsidise the capital cost of adopting drip irrigation by farmers under various programmes. Universal adoption of these micro irrigation technologies needs to be made compulsory for achieving optimum benefits for both agriculture and the power sector. This could be achieved by educating farmers on modern methods of rejuvenating groundwater and nuances of using energy efficient IP sets.

Energy Efficiency Services Limited (EESL) is also implementing a pilot project in Andhra Pradesh for replacement of existing inefficient IP sets with smart control panel enabled energy efficient IP sets. These IP sets will help farmers to monitor power consumption, and switch on and off the IP sets through mobile phones. An energy saving potential of 25% is estimated under this project covering over 40,000 farmers.

Quality of Supply

Karnataka's per capita electricity consumption at 1,211 kWh (in 2015) is above the national average of 1,010 kWh and is lower only compared to Gujarat (1,558 kWh) among the large states in the country. The state has also maintained an average growth of about 5% per annum in supply of electricity during the last ten years. According to the CEA estimate, the projected demand for the state was 67,744 MU for 2017-18 against which the supply achieved by the state's distribution utilities is 67,575 MU with an estimated shortfall of only 0.2%. The power generation capacity in the state has grown from 7,160 MW in 2007-08 to 13,701 MW in 2017-18 excluding RE sources and including the state's share of generation capacity of CGS (KPTCL, 2018). The installed capacity of RE sources has also grown from 1,784 MW to 8,508 MW in the last ten years (KPTCL, 2018). Thus, at the present level of the state's economic activity, the state may be considered as having no major power shortages seriously constraining the operations of any particular sector. Also, according to the CEA data, the state has achieved 100% rural electrification and the coverage of households is also over 95% in the state (MoP, 2018).

Thus, while the overall supply situation appears to indicate adequacy of power supply in the state, frequent interruptions of supply are common, particularly in the rural areas. While KERC has introduced a system of reviewing the quality of supply in each division of ESCOMs, this appears to need further fine tuning in order to arrive at an accurate assessment of the quality of supply. Overall the available data on System Average Interruption Duration Index (SAIDI) and System Average Interruption Frequency Index (SAIFI) appears to indicate the need for strengthening the distribution network in several parts of the state to improve quality of supply.

Way Forward

ESCOMs in Karnataka are estimated to experience a major change in the demand pattern due to the addition of new and emerging technologies such as rooftop photovoltaic, and electric vehicles. Therefore, it is of utmost important for ESCOMs to better manage their demand and improve operational efficiency so as to be commercially viable. This would eventually help them in investing in innovative technologies and making them sustainable in the long run. Nevertheless, future sustainability of ESCOMs would depend upon the corrective measures that are undertaken in the present scenario.

Controlling power procurement costs is undoubtedly an urgent priority. The power procurement in future years will have a greater proportion of renewables. Reducing AT&C losses through energy audit and adoption of smart distribution technologies, as well as improving their billing and collection efficiencies are issues to be addressed in the short term context. Equally important, ESCOMs must take steps to more accurately measure and regulate the free supply of electricity for the irrigation pumps in order to reduce their dependence on subsidy payments from the state government.

Since state government has been generally supportive of adopting these measures, it would, hence, go a long way in enabling ESCOMs to support the growth of the state's economy in a more robust manner.

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Annexure

Table 8: Agriculture category Sales (MU) from FY13 to FY17

	FY13	FY14	FY15	FY16	FY17
BESCOM	5,748	5,256	5,893	6,247	7,308
CESC	2,395	2,400	2,355	2,173	3,228
GESCOM	3,052	3,074	3,094	3,301	3,215
HESCOM	4,850	5,125	5,422	5,961	6,156
MESCOM	1,087	1,155	1,117	1,213	1,654
Total	17,132	17,010	17,882	18,895	21,561

Table 9: Industrial category Sales (MU) from FY13 to FY17

	FY13	FY14	FY15	FY16	FY17
BESCOM	5,205	5,443	5,889	6,253	6,605
CESC	817	873	944	1,006	1,049
GESCOM	923	978	1,041	1,151	1,163
HESCOM	1,300	1,329	1,423	1,552	1,571
MESCOM	1,126	1,185	1,250	1,337	1,352
Total	9,372	9,808	10,546	11,298	11,740

Table 10: Commercial category Sales (MU) from FY13 to FY17

	FY13	FY14	FY15	FY16	FY17
BESCOM	4,382	4,393	4,386	4,369	4,499
CESC	319	338	354	367	392
GESCOM	270	287	311	345	349
HESCOM	443	446	486	534	546
MESCOM	497	433	459	510	528
Total	5,910	5,897	5,996	6,125	6,314

Table 11: Domestic category Sales (MU) from FY13 to FY17

	FY13	FY14	FY15	FY16	FY17
BESCOM	5,909	6,179	5,745	5,744	5,619
CESC	892	872	883	887	775
GESCOM	1,119	1,220	1,216	1,169	1,070
HESCOM	1,285	1,190	1,242	1,243	1,160
MESCOM	760	815	842	722	685
Total	9,965	10,275	9,928	9,765	9,310

Table 12: Other category Sales (MU) from FY13 to FY17

	FY13	FY14	FY15	FY16	FY17
BESCOM	1,552	1,795	2,170	1,926	2,208
CESC	553	631	704	744	817
GESCOM	360	416	469	541	561
HESCOM	510	575	636	803	775
MESCOM	263	404	436	445	470
Total	3,238	3,821	4,415	4,459	4,831

Table 13: ESCOM-wise O&M cost (INR crores) from FY13 to FY17

	FY13	FY14	FY15	FY16	FY17
BESCOM	871	957	1,054	1,210	1,298
CESC	334	347	367	414	445
GESCOM	341	349	370	411	458
HESCOM	449	543	554	599	689
MESCOM	260	287	303	338	378
Total	2,256	2,482	2,648	2,973	3,268

Table 14: ESCOM-wise interest on borrowings & working capital (INR crores) from FY13 to FY17

	FY13	FY14	FY15	FY16	FY17
BESCOM	286	374	482	561	655
CESC	58	68	97	134	157
GESCOM	81	94	108	128	140
HESCOM	173	171	210	232	255
MESCOM	70	73	87	89	99
Total	668	780	984	1,144	1,306

Table 15: Details of pilot projects for replacement of IP sets

Project name	ESCOM	Total IP sets	No of IP sets replaced	Energy Savings (%)
Doddaballapur Project-Water and Energy Nexus Activity(WENEXA) (funded by USAID)	BESCOM	6,77,637	277	23%
Malavalli project (funded by EESL)	CESC	3,45,730	1,337	37%
Hubli project (funded by EESL)	MESCOM	2,92,276	590	37%

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