सत्यमेव जयते

भारत सरकार
Government of India
विद्युत मंत्रालय
Ministry of Power
केन्द्रीय विद्युत प्राधिकरण
Central Electricity Authority
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Planning Wing
विद्युत शक्ति सर्वेक्षण और भार पूर्वानुमान प्रभाग
Power Survey & Load Forecasting Division

भारत के उन्नीसवे विद्युत शक्ति सर्वेक्षण की रिपोर्ट (भाग - द्वितीय)
(राष्ट्रीय राजधानी क्षेत्र)

REPORT ON NINETEENTH ELECTRIC POWER SURVEY OF INDIA (VOLUME-II)
(NATIONAL CAPITAL REGION)

विद्युत अधिनियम -2003 की धारा 73 (ए) के तहत केन्द्रीय विद्युत प्राधिकरण के दायित्व के पालन हेतु प्रकाशित

Brought out in fulfilment of CEA's obligation under Section 73(a) of the Electricity Act-2003

नई दिल्ली
New Delhi

दिसम्बर - 2019
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ABBREBIATIONS

AGR	:	Annual Growth Rate
AVVNL	:	Ajmer Vidyut Vitran Nigam Limited
BRPL	:	BSES Rajdhani Power Limited
BYPL	:	BSES Yamuna Power Limited
CAGR	:	Compounded Annual Growth Rate
CEA	:	Central Electricity Authority
DHBVN	:	Dakshin Haryana Bijli Vitaran Nigam
DISCOM	:	Distribution Company
DSM	:	Demand Side Management
DTL	:	Delhi Transo Limited
DVVNL	:	Dakshinanchal Vidyut Vitran Nigam Limited
EER	:	Electrical Energy Requirement
GDP	:	Gross Domestic Product
HPGCL	:	Haryana Power Generation Corporation Limited
HSEB	:	Haryana State Electricity Board
HT	:	High Tension
HVPNL	:	Haryana Vidyut Prasharan Nigam Limited
IPGCL	:	Indraprastha Power Generation Company Limited
JDVVNL	:	Jodhpur Vidyut Vitran Nigam Limited
JVVNL	:	Jaipur Vidyut Vitran Nigam Limited
KESC	:	Kanpur Electric Supply Company
LT	:	Low Tension
MES	:	Military Engineering Services
MVVNL	:	Madhyanchal Vidyut Vitran Nigam Limited
NCR	:	National Capital Region
NCRPB	:	National Capital Region Planning Board

NCT	:	National Capital Territory
NDMC	:	New Delhi Municipal Corporation
NDPL	:	North Delhi Power Limited
NOIDA	:	New Okhla Industrial Development Authority
PEUM	:	Partial End Use Methodology
PPCL	:	Pragati Power Corporation Limited
PuVVNL	:	Purvanchal Vidyut Vitran Nigam Limited
PVVNL	:	Paschimanchal Vidyut Vitran Nigam Limited
PWW	:	Public Water Works
RRVPNL	:	Rajasthan Rajya Vidyut Prasharan Nigam Limited
RVUNL	:	Rajasthan Vidyut Utpadan Nigam Limited
SERC	:	State Electricity Regulatory Commission
SEZ	:	Special Economic Zone
T&D	:	Transmission & Distribution
TPDDL	:	Tata Power Delhi Distribution Limited
TRANSCO	:	Transmission Company
UHBVN	:	Uttar Haryana Bijli Vitaran Nigam
UPPCL	:	Uttar Pradesh Power Corporation Limited
UPRJVUNL	:	Uttar Pradesh Rajya Jal Vidyut Utpadan Nigam Limited
UPRVUNL	:	Uttar Pradesh Rajya Vidyut Utpadan Nigam Limited
UPSEB	:	Uttar Pradesh Electricity Board

EXECUTIVE SUMMARY

National Capital Region (NCR) in India is a unique example for inter-state regional development planning for a region that covers the entire National Capital Territory of Delhi, fourteen districts of State of Haryana, eight districts of State of Uttar Pradesh and two districts of State of Rajasthan. It covers an area of about 55,083 sq. kms at present. As per Census 2011, the total population of NCR was 460 lakhs that is projected to reach 791 lakhs by 2021 after including the areas added in NCR since 2011 also viz. Bhiwani, Charkhi Dadri, Mahendragarh, Jind and Karnal districts in Haryana, Bharatpur district in Rajasthan and Hapur, Shamli & Muzaffarnagar districts in Uttar Pradesh.

National Capital Region was constituted under the National Capital Region Planning Board (NCRPB) Act, 1985 to promote balanced and harmonized development of the Region. The power sector is one of the most important sectors for development of any region and electricity demand projection is a pre-requisite for its proper planning. With this objective, CEA has prepared this electric power survey of NCR.

Methodology of Power Forecast:

In this report, the Partial End Use Methodology (PEUM) has been used to forecast electricity demand. It is a "bottom up" approach focused on end uses. As working out electricity demand by considering electricity consumption of individual end users would be exhaustive, a partial approach has been taken and electricity demand forecast has been made for various categories of electricity consumers viz. Domestic, Commercial, Public Lighting, Public Water Works, Irrigation, Industrial, Railway Traction & Bulk (Non-Industrial HT) Supply.

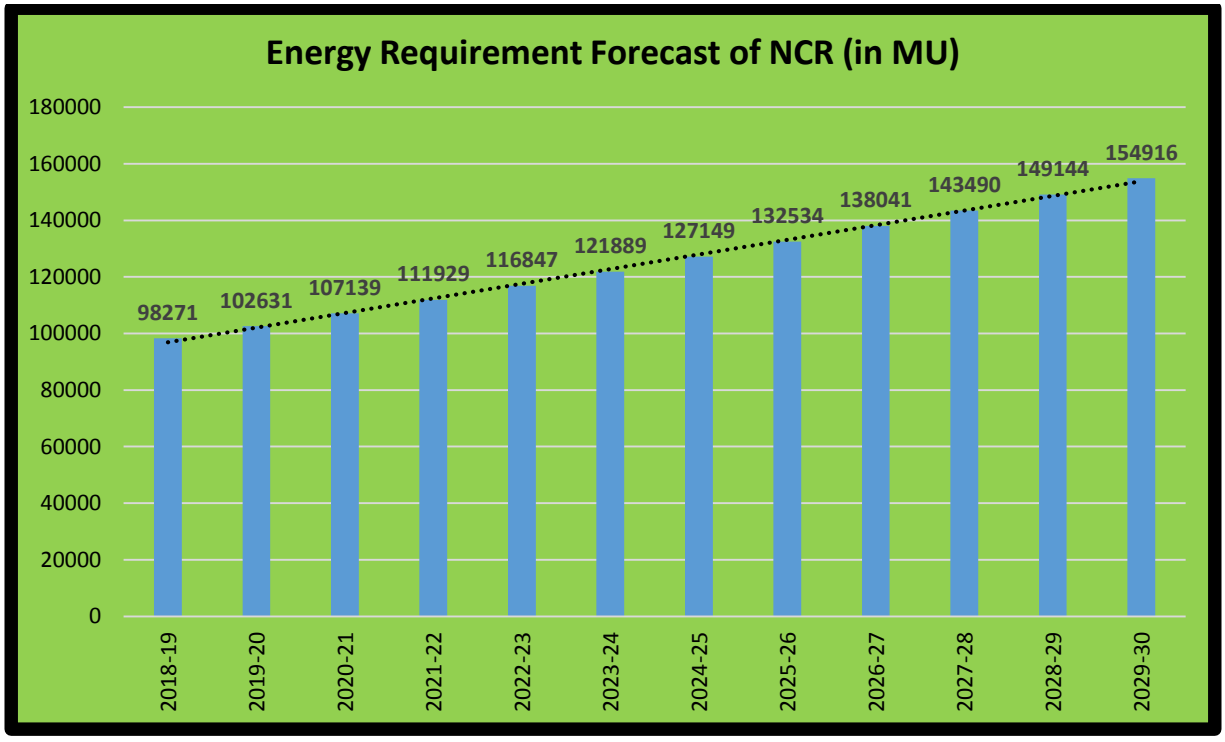
The input data for this study comprises of the category wise data of all districts of NCR from the year 2003-04 to 2018-19. Based on these input data, the year-wise electricity projection has been carried out for each district for the year 2019-20 to 2029-30 with the year 2018-19 being taken as the base

year. Thereafter, the results have been added to prepare forecast of each sub-region falling within a particular state and then it is finally summed up for projecting energy demand of the whole NCR. The peak demands have been derived from the energy requirement estimation on the basis of load factor trends witnessed in the past.

The Power Forecast – Energy Requirement:

The total electricity consumption of NCR in year 2018-19 was 83849 MU and with 14.68 % T&D losses, the requirement was 98271 MU. The Haryana sub region and Delhi NCT have the most of NCR electrical energy requirement in 2018-19 followed by Uttar Pradesh & Rajasthan sub region.

The total energy requirement of NCR is estimated as 102631 MU in Year 2019-20 that is expected to reach 127149 MU in year 2024-25 with CAGR of 4.38%. The energy requirement is estimated as 154916 MU by the year 2029-30 with CAGR of 4.03% for the period 2024-25 to 2029-30.



(Figure 1: Energy Requirement Forecast of NCR)

The Sub Region wise energy requirement forecast is summarized below:

Sl. No.	Constituents	Energy Requirement (in MU)		
		2019-20	2024-25	2029-30
1.	NCT-Delhi	34542	40573	47099
2.	Haryana Sub-region	34389	43111	53109
3.	Rajasthan Sub-region	7739	9435	11474
4.	Uttar Pradesh Sub-region	25961	34030	43234
	Total (NCR)	**102,631**	**127,149**	**154,916**

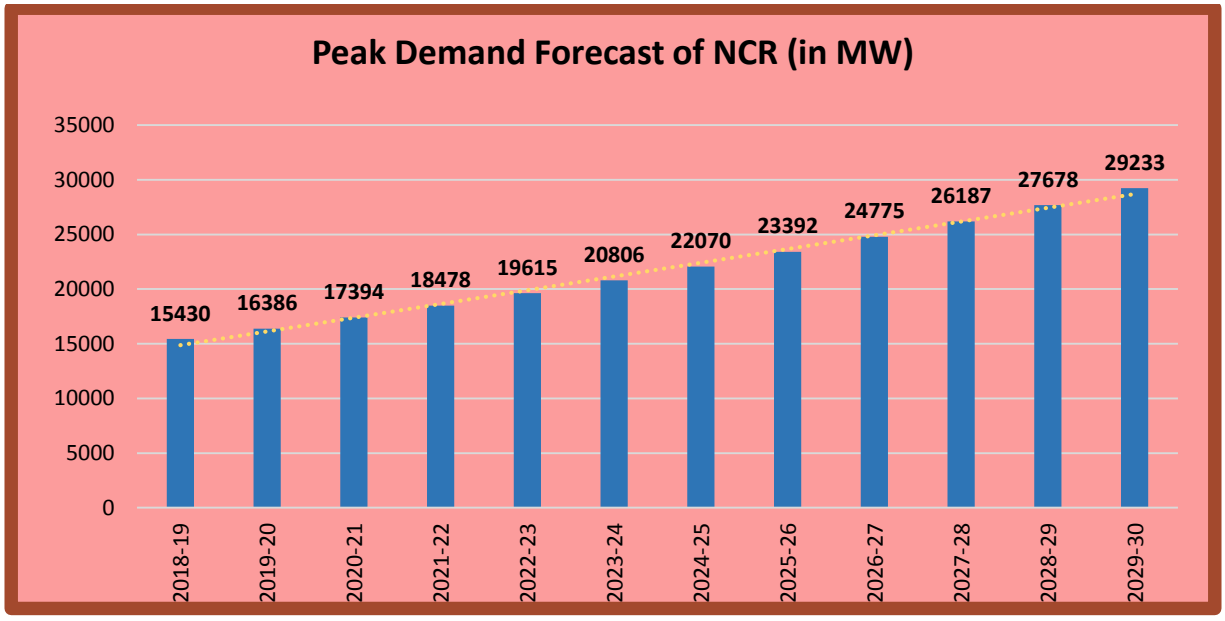
(Table 1: Energy Requirement Forecast of NCR)

Sl. No.	Constituents	Energy Requirement CAGR (in %)		
		2019-20 to 2024-25	2024-25 to 2029-30	2019-20 to 2029-30
1.	NCT-Delhi	3.27	3.03	3.15
2.	Haryana Sub-region	4.62	4.26	4.44
3.	Rajasthan Sub-region	4.04	3.99	4.02
4.	Uttar Pradesh Sub-region	5.56	4.90	5.23
	Total (NCR)	**4.38**	**4.03**	**4.20**

(Table 2: Energy Requirement CAGR Forecast of NCR)

The Power Forecast – Peak Demand:

The Peak Demand for the NCR was 15430 MW in year 2018-19 and it is expected to see 6.14% CAGR upto 2024-25 and will reach 22070 MW in comparison to 16386 MW in year 2019-20. The Peak Demand is expected to reach 29233 MW in year 2029-30 with a CAGR of 5.78% after 2024-25.



(Figure 2: Peak Demand Forecast of NCR)

The Sub Region wise peak demand forecast is summarized below:

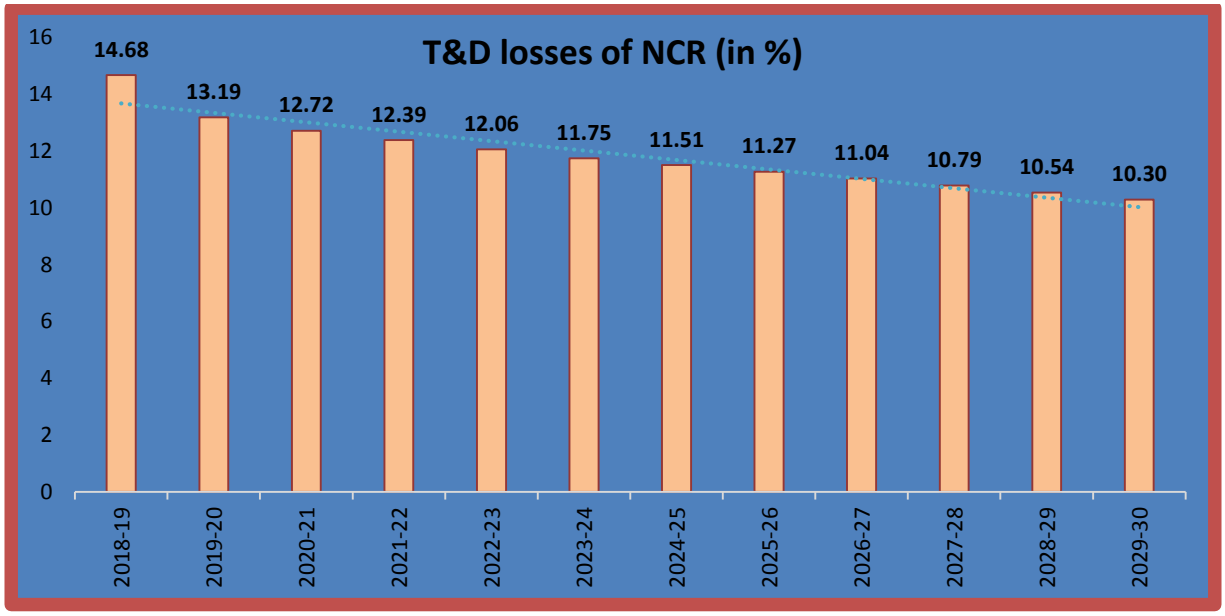
Sl. No.	Constituents	Peak Demand (in MW)		
		2019-20	2024-25	2029-30
1.	NCT-Delhi	7400	9433	11884
2.	Haryana Sub-region	6538	7899	9379
3.	Rajasthan Sub-region	1260	1581	1978
4.	Uttar Pradesh Sub-region	4085	5554	7319
	Total (NCR)	**16386**	**22070**	**29233**

(Table 3: Peak Demand Forecast of NCR)

Sl. No.	Constituents	Peak Demand CAGR (in %)		
		2019-20 to 2024-25	2024-25 to 2029-30	2019-20 to 2029-30
1.	NCT-Delhi	4.97	4.73	4.85
2.	Haryana Sub-region	3.86	3.49	3.67
3.	Rajasthan Sub-region	4.64	4.59	4.61
4.	Uttar Pradesh Sub-region	6.34	5.67	6.01
	Total (NCR)	**6.14**	**5.78**	**5.96**

(Table 4: Peak Demand CAGR Forecast of NCR)

The T&D losses of NCR were hovering around 30-40% at the turn of this century that is estimated to come down to 14.68 % in year 2018-19. The target level is to bring it down to about 11.51 % and 10.30 % by the end of 2024-25 & 2029-30 respectively.



(Figure 3: T&D Loss Forecast of NCR)

In comparison to 18th EPS wherein the energy requirement of NCR was forecast to witness CAGR of 8.31% during 2011-12 to 2016-17 & thereafter 6.82% for the next five years, this report forecast lower CAGR for the energy requirement (4.20%) for the next ten years. Similarly, the CAGRs for peak demand were estimated as 7.66% during 2011-12 to 2016-17 & 6.79% for the next five years in the 18th EPS whereas this report forecast 5.96 % CAGR for the peak demand for the next ten years. This estimation is based on the recent trends witnessed in energy requirement that clearly suggest a distinct and appreciable downfall in CAGR in recent times. It has been observed that CAGR of energy requirement for the entire NCR was 8.56% for the period 2009-10 to 2013-14 that came down to 4.87% during 2013-14 to 2017-18. The possible explanations of this slower growth could be attributed to slower growth witnessed in Delhi-NCT, changing rural-urban profile of NCR & reduction in T&D losses. The energy requirement of Delhi-NCT, that contributes a major part of electrical energy requirement of the whole NCR (about 33%), grew with a CAGR of 3.74% only during 2013-14 to 2017-18.

The electrical energy requirement of other areas of NCR (excluding Delhi) grew with 5.46% CAGR for the same period that was comparable to the growth recorded for the Northern Region and also for the All India. The reason for Delhi-NCT witnessing lesser growth could be attributed to existence of already a higher demand that is reflecting even higher increase in the quantum of energy requirement also into lower growth rate. Another reason for slower growth witnessed in the NCR region during 2013-14 to 2017-18 was its changed demography because of inclusion of additional areas. The districts added during this period i.e. Bhiwani, Charkhi Dadri, Mahendragarh, Jind and Karnal districts in Haryana, Bharatpur in Rajasthan and Hapur, Shamli & Muzaffarnagar in Uttar Pradesh – all are having more rural population that has now changed the predominantly urban fabric of the NCR demography. Also, the NCR region has witnessed reduction in T&D losses during the past years (from about 21% in 2009-10 to 14.68% only in year 2018-19) and therefore, the energy saved on account of reduced T&D losses is reflecting in reduced energy requirement.

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CHAPTER 1

PROFILE OF NCR

The National Capital Region (NCR) in India was constituted under the National Capital Region Planning Board (NCRPB) Act, 1985 to promote balanced and harmonized development of the Region, and to contain haphazard and unplanned urban growth by channelizing the flow and direction of economic growth (on which the urban phenomenon feeds) along more balanced and spatially-oriented paths.

Constituent Area:

National Capital Region is a unique example for inter-state regional development planning for a region that covers the entire National Capital Territory of Delhi, fourteen districts of State of Haryana, eight districts of State of Uttar Pradesh and two districts of State of Rajasthan.

It covers an area of about 55,083 sq kms and is one of the largest National Capital Region of the World that constitutes about 1.68% of the country's land area. The region lies between 26^{O}42' and 29^{O}59' North latitude and 75^{O}28' and 78^{O}29' East longitude.

The NCR constitutes of four Sub-Regions as detailed below:

- The Delhi-NCT Sub Region consists all of its eleven districts viz. New Delhi, North Delhi, North West Delhi, West Delhi, South West Delhi, South Delhi, South East Delhi, Central Delhi, North East Delhi, Shahdara & East Delhi that constitute about 3% area (1,483 sq. kms.) of NCR.

- The Haryana Sub-Region comprises of fourteen districts - Faridabad, Gurugram, Nuh (earlier known as Mewat), Rohtak, Sonepat, Rewari, Jhajjar, Panipat, Palwal, Bhiwani, Charkhi Dadri, Mahendragarh, Jind and Karnal that together constitute about 46% area (25,327 sq. kms.) of the NCR and 52% of the area of the state;

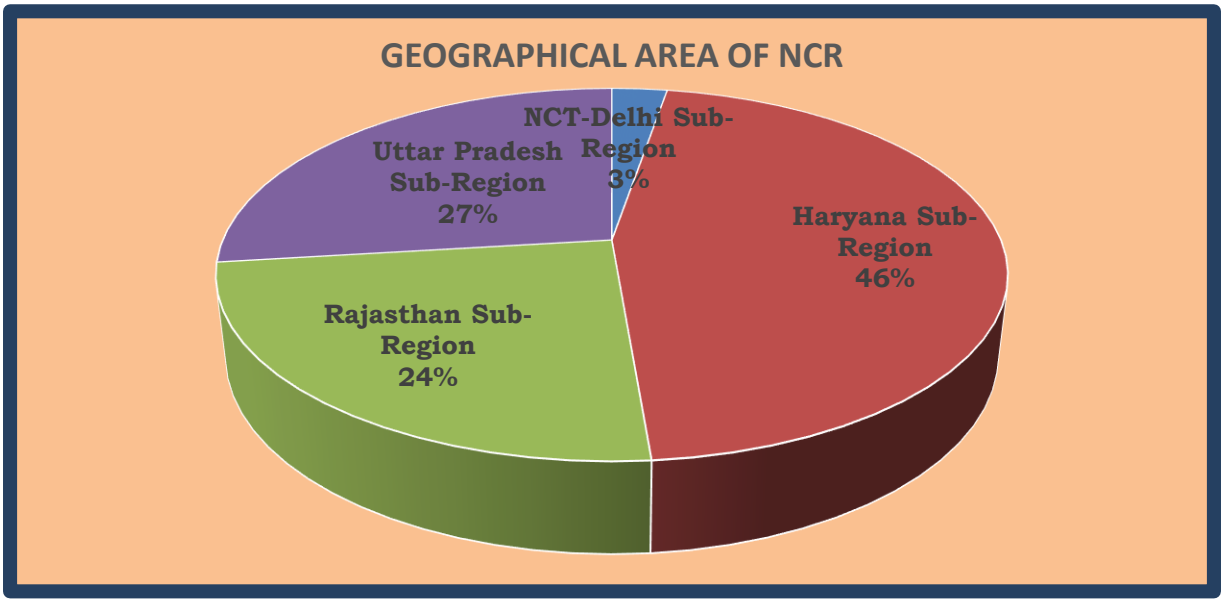
- The Rajasthan Sub-Region comprises of Alwar & Bharatpur districts that constitute about 24% area (13,447 sq. kms.) of the NCR and 4% area of the state.

- The Uttar Pradesh Sub-Region comprises of eight districts, i.e. Meerut, Ghaziabad, Gautam Buddha Nagar, Bulandshahr, Baghpat, Hapur, Shamli & Muzaffarnagar that together constitute about 27% area (14,826 sq. kms.) of NCR and 6% area of the state;

Three cities of NCR viz. Karnal, Faridabad & New Delhi are included in Smart Cities Mission of the Government of India.

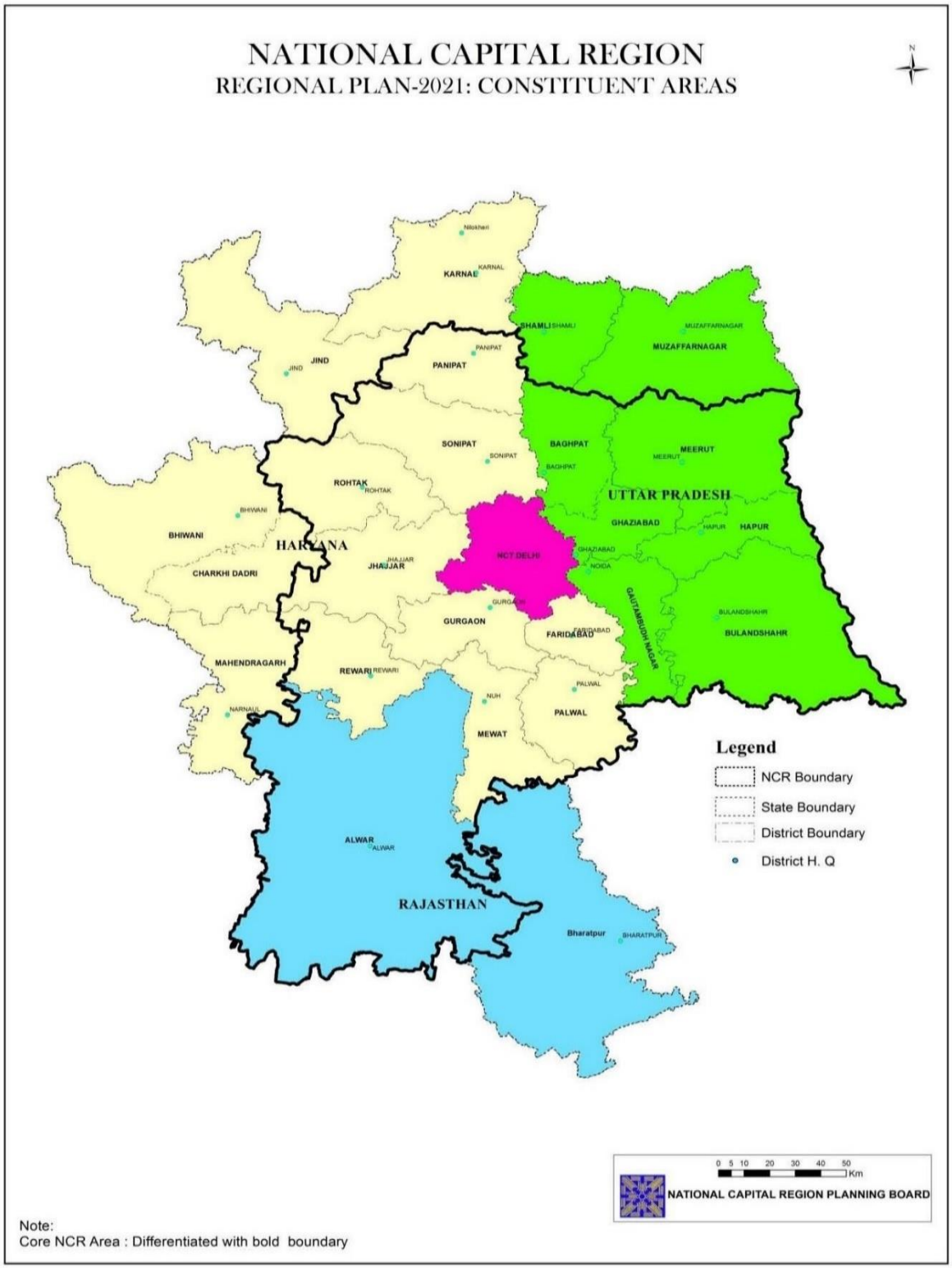
Sl. No.	Constituents	Area (in sq. kms)	% Area of NCR	% Area of State
1.	NCT-Delhi	1,483	3	100
2.	Haryana Sub-region	25,327	46	52
3.	Rajasthan Sub-region	13,447	24	4
4.	Uttar Pradesh Sub-region	14,826	27	6
	Total (NCR)	**55,083**	**100**	**-**

(Table 5: Geographical Area of NCR)



(Figure 4: Geographical Area of NCR)

National Capital Region (including additional areas): Constituent Areas



(Figure 5: Map of NCR)[1]

[1] Regional Plan 2021 for additional areas of NCR, NCRPB, Page 5

NCR is characterized by the presence of highly ecologically sensitive areas like extension of Aravalli ridge, forests, wildlife and bird sanctuaries, rivers Ganga, Yamuna and Hindon and fertile cultivated land.

Historical Facts:

When first conceptualized in 1985, NCR covered an area of 34,144 sq. km only consisting of whole of NCT of Delhi, six districts of Haryana viz. Gurugram, Faridabad, Sonipat, Rohtak (then including Jhajjar tehsil) and Panipat & Rewari tehsils those were then in Karnal and Mahendragarh districts respectively; three districts of Uttar Pradesh viz. Bulandshahr, Meerut (then including Baghpat tehsil), and Ghaziabad (then including Hapur tehsil) and some part of the Alwar district of Rajasthan. Thereafter, several additions had been made down the line as detailed below:

- Baghpat district in Uttar Pradesh was separated from Meerut in 1997.
- Gautam Buddha Nagar district was created out of the existing NCR districts of Ghaziabad and Bulandshahr in 1997.
- Jhajjar district was carved out of Rohtak district in 1997.
- Remaining part of Alwar district was added on 23.08.2004.
- Mewat (Renamed as “Nuh” in 2016) district was created out of the existing NCR districts of Gurugram and Faridabad in 2005.
- Palwal district was carved out of Faridabad district in 2008.
- Hapur district was carved out from Ghaziabad district on 28 September 2011.

- NCR was expanded to include three more districts, Bhiwani, and Mahendragarh in the state of Haryana and Bharatpur district in the state of Rajasthan vide GoI Gazette Notification dated 01.10.2013 [2].

- Three more districts - Jind and Karnal districts in the state of Haryana and Muzaffarnagar district in Uttar Pradesh were included in NCR vide GoI Gazette Notification dated 24.11.2015.

- Charkhi Dadri district was carved out of Bhiwani district in Haryana in 2016.

- Shamli district in Uttar Pradesh, that was separated from Muzaffarnagar district in 2011, was included in NCR vide GoI Notification dated 16.04.2018.

About 20,939 sq km addition area has been inducted in NCR till now since its inception.

Population:

As per Census 2011, the total population of NCR was 460 lakhs only as per existing areas then. This population stood out as 581.5 lakhs after adding the 2011 populations of the areas included in the NCR thereafter. The number of metropolitan cities (more than ten lakhs population) within the region has increased from one (Delhi) in 1991 to three (Delhi, Meerut, and Faridabad) in 2001 and subsequently, four after addition of Ghaziabad city also in 2011.

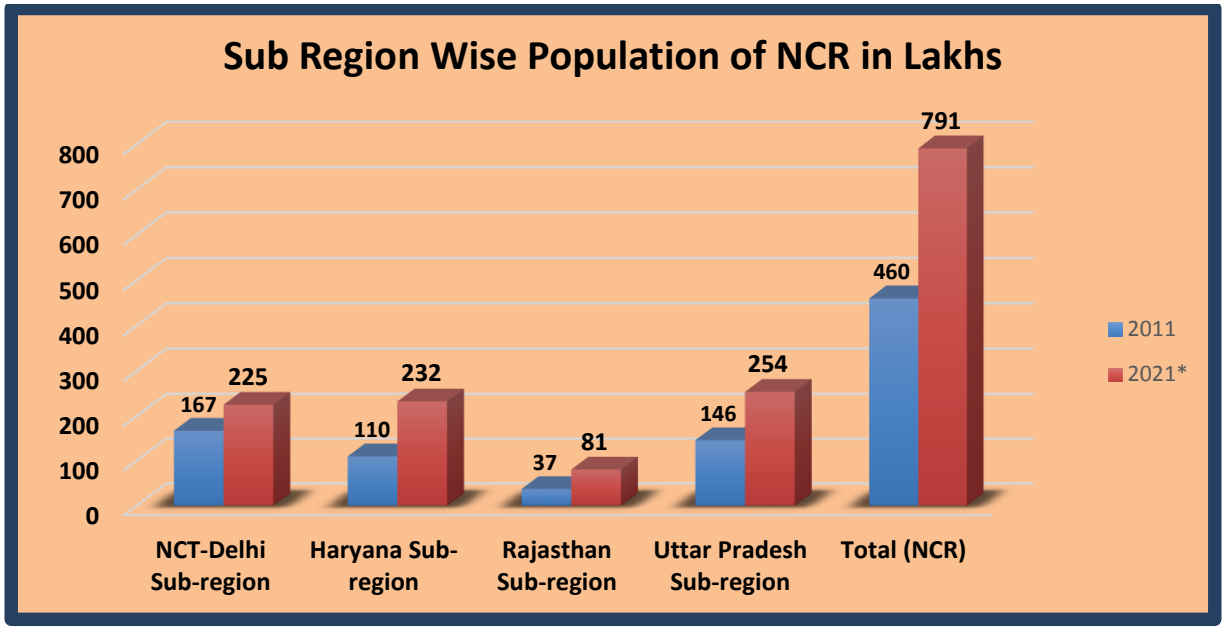
The population of NCR is projected as 791 lakhs by 2021. It is expected that the population of NCT-Delhi, Haryana, Rajasthan & Uttar Pradesh Sub-regions would reach 225 lakhs, 232 lakhs, 81 lakhs & 254 lakhs respectively by 2021.

[2] Annual Report 2017 -18, National Capital Regional Planning Board

Constituent	For NCR Area Notified in 2011		For Additional NCR Area Notified after 2011		Total NCR Area (As on 31.08.2019)	
	2011	2021*	2011	2021*	2011	2021*
Delhi-NCT Sub-region	167	225	-	-	167	225
Haryana Sub-region	110	164	54	68	164	232
Rajasthan Sub-region	37	49	25	32	62	81
Uttar Pradesh Sub-region	146	204	41	50	187	254
Total (NCR)	**460**	**641**	**121**	**150**	**581**	**791**

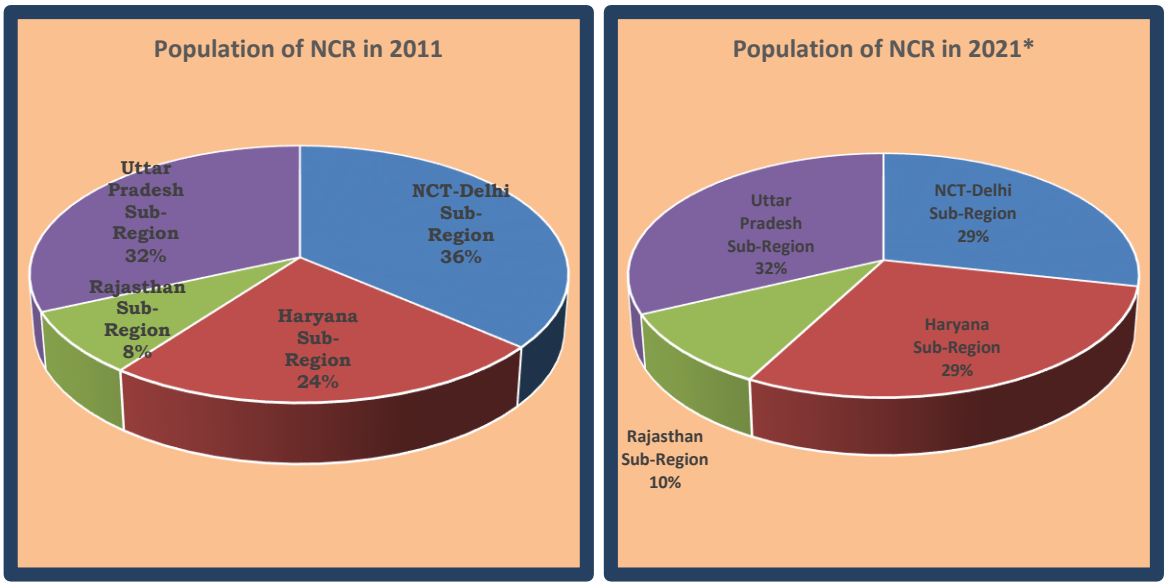
(Table 6: Population in Lakhs)

* Forecast



(Figure 6: Sub Region Wise Population in Lakhs)

Population wise, NCT Delhi region was the biggest sub region in 2011 with 36.44% share in the total population. Uttar Pradesh sub-region was the next with 31.64% share. Haryana sub-region contributed 23.95% of the total population whereas Rajasthan sub-region share was less (7.98%). Now, because of induction of several districts in between, the share of population of sub regions have been changed. The expected population profile in 2021 suggests Uttar Pradesh Sub Region as the most dominant part.



(Figure 7: Population Profile in 2011 & 2021)

Climate:[3]

The NCR area falls under the semi-arid climatic region. Extreme dryness with hot summer and cold winter are the characteristics of the climate. The year can broadly be divided into four seasons. The cold season starts in late November and extends to about the beginning of March. This is followed by the hot season, which lasts till the end of June when the monsoon arrives over the district. The monsoon continues to the last week of September. The two post monsoon months October and November constitute a transition period from the monsoon to winter condition.

The average annual rainfall in the area varies greatly from as low as 300 mm in the western parts to about 850 mm in the central and north-eastern parts. The normal annual rainfall for Delhi sub region is more than 600 mm and that for the Rajasthan sub-region is more than 500 mm. Haryana sub-region is observed with normal annual rainfall to the tune of 650 mm while in Uttar Pradesh sub region it is to the tune of 700 mm. The rainfall is mostly received during the monsoon months viz. July, August and September.

[3] Functional Plan for Ground Water Recharge in NCR, Report, NCRPB, 2009

The cold season starts towards the latter half of November when both day and night temperature drops rapidly with the advance of the season. January is the coldest month. In the NCR area, the extreme climatic conditions are observed during the winter months and the cold waves are common. Sometimes the temperature goes down to the freezing point also.

From about the middle of March, temperature begins to rise fairly rapidly. May and June are the hottest months. In May and June maximum temperature sometimes reaches 46°C to 47°C.

Economy:[4]

The NCR economy is a crucial part of the Indian economy. Delhi has now become the main centre for various service providers. Haryana sub-region is a mix of industries and service sector. On the other hand, the economy of sub-regions of Uttar Pradesh and Rajasthan are Industrial and agricultural based. There is a perceptible change in the structure of sub-regions with a considerable shift towards manufacturing activities.

There are stark differences in the growth patterns of all constituents of the NCR. Among various sub-regions of the NCR, Delhi reports the highest GDP followed by Haryana, Uttar Pradesh and Rajasthan respectively. Among NCR districts (excluding Delhi), Gurugram has the highest GDP followed by Faridabad, while Nuh has the lowest GDP. Districts such as Gautam Buddha Nagar and Gurugram have grown faster than the other districts such as Rohtak, Jhajjar, and Alwar. The Per Capita Income of the NCR has uniformly been higher than India's Per Capita Income during the period 2004-05 to 2009-10.

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[4] Economic Profile of NCR Report, NCRPB 2015

CHAPTER 2

18th EPS OF NCR – FORECAST VS ACTUAL

After the publication of 18th EPS Report of NCR in 2013[5], NCR has been expanded geographically and Bhiwani, Charkhi Dadri, Mahendragarh, Jind & Karnal districts in Haryana, Bharatpur district in Rajasthan and Hapur, Shamli & Muzaffarnagar districts in Uttar Pradesh are now included in it. As the forecasts of these districts were excluded from the NCR forecast done during the 18th EPS, the comparisons of actual scenario versus forecast were also done after excluding these districts. The comparisons of energy requirement forecast of NCR in the 18th EPS and actual scenario in the past indicates deviations in the higher range. The forecasts done were finally came out consistently more than the actual requirement and the gap between them had also followed an increasing trajectory. The story in this region was similar to the all India scenario as the expected economic growth had not been achieved during that period and consequently, also with the power requirement.

Sl. No.	Year	Energy Requirement (in MU)		% Deviation
		Actual	Forecast	
1	2011-12	59466	63867	-7.40
2	2012-13	62395	69199	-10.90
3	2013-14	67497	74897	-10.96
4	2014-15	71264	80975	-13.63
5	2015-16	73777	87600	-18.74
6	2016-17	77851	94817	-21.79
7	2017-18	81346	101379	-24.63
8	2018-19	86009	108405	-26.04

(Table 7: Energy Requirement Forecast of NCR in 18th EPS vs Actual)

[5] Based on data upto 2010-11 only

The comparisons of Peak demand of NCR forecast in the 18th EPS and actual scenario in the past also indicates higher deviations.

Sl. No.	Year	Peak Demand (in MW)		% Deviation
		Actual	Forecast	
1	2011-12	10002	11273	-12.71
2	2012-13	10485	12134	-15.73
3	2013-14	11317	13051	-15.33
4	2014-15	11906	14013	-17.70
5	2015-16	12333	15060	-22.11
6	2016-17	12990	16197	-24.69
7	2017-18	13551	17312	-27.76
8	2018-19	14332	18505	-29.12

(Table 8: Peak Demand Forecast of NCR in 18th EPS vs Actual)

The larger deviations may be explained on account of higher growth in energy consumption witnessed in the NCR region during the time of 18th EPS (i.e. 2010-11). The CAGR of energy consumption of the whole NCR for the last five years at that time was about 11% with Delhi-NCT, Haryana Sub Region, Rajasthan Sub Region and UP Sub Region growing at 8%, 12%, 20% & 12% CAGR respectively. Based on the trends prevailing at that time, 18th EPS forecast suggested that the energy requirement of NCR would witness CAGR of 8.31% during 2011-12 to 2016-17 & thereafter 6.82% for the next five years. The CAGRs for peak demand were estimated as 7.66% & 6.79% respectively. In comparison, the energy requirement growth witnessed during 2011-12 to 2016-17 was 6.78% only.

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CHAPTER 3

POWER FORECAST - METHODOLOGY

Power is an important aspect of the physical infrastructure that requires planning in advance, development and management for improved quality of life, productivity and economic activities. The electricity demand forecast is an important input for planning of the power sector to meet the future power requirement of various sectors of electricity consumption. The primary objective of the electrical energy forecast is to assess the electricity demand so that the utilities are able to plan and arrange the power infrastructure to meet demand in full and provide electricity to all. The electricity demand forecast also works as a tool for planning the Demand Side Management (DSM) strategy on long term basis for optimizing the peak demand and also plan long term tariff policy.

Methodology of Power Forecast:

Partial End Use Methodology (PEUM) that is traditionally being used by CEA for carrying out Electric Power Survey has been adopted for this study also for forecasting electricity demand of NCR. It is a bottom up approach based on energy need of end users.

As working out electricity demand by considering electricity consumption of individual end users across would be exhaustive, a partial approach has been taken and electricity demand forecast has been made for various categories of electricity consumers viz. Domestic, Commercial, Public Lighting, Public Water Works (LT, HT < 1 MW, HT >1 MW), Irrigation, Industrial (LT, HT < 1 MW, HT >1 MW), Railway Traction & Bulk Supply (Non- Industrial Consumers & Licences).

The input data for this study comprises of the category wise data of all districts of NCR from the year 2003-04 to 2018-19. The category wise historical data required for assessment of future demand has been provided by all DISCOMs operating in NCR. These furnished data were scrutinized by

comparing it with the data available with CEA and reconciled further with all the concerned utilities.

The time series method has been used to derive growth indicators for each category of consumer for each district with giving higher weight to recent trends so as to incorporate benefits of energy conservation initiatives and impact of technological changes. However, in cases where no definite trend emerged, weighted average (chronological or maximum AGR-maximum weightage) has been used for forecasting electricity demand.

The input data for the period 2003-04 to 2018-19 was scrutinized for the study and the year-wise EER was worked out up to 2029-30 by taking 2018-19 as the base year. The Annual Growth Rate (AGR) and Compounded Annual Growth (CAGR) for No. of consumers, Connected Load and Energy Consumption for the past years of various categories of Load has been analysed thoroughly and then forecast of electricity requirement for various categories of Load for each district of NCR has been made using the aforesaid method. The forecasts of electricity demand were discussed with DISCOMS & TRANSCOs operating in NCR to elicit their views/suggestions on the likely growth rate for various categories of electricity consumption & policies/programmes which would have bearing on the future electricity demand.

The year-wise electricity projection made for each district for the year 2019-20 to 2029-30 have been added to prepare forecast of each sub-region falling within separate states and then it is finally summed up for projecting energy demand of the whole NCR.

Peak Demand Estimation:

It was observed that peak demand figures for the past years submitted by the Discoms were on a very higher side for the most of the districts of NCR that was not sacrosanct with peak demand witnessed in the past for the respective states. Based on such peak demand data submitted by the Discoms, the load factors were coming out in the range of 20-40% only in most of the district

that is much lower to the average 65-75% load factor witnessed in the past for the region.

Therefore, the peak data submitted were found unrealistic. The main reasons for such unreliable data are non-monitoring of real time peak demand data at the district level and non-segregation of dedicated distribution feeders as per contours of each district. In comparison, as the energy data are based on commercially consumed electrical energy, it was considered as reliable data.

In view of this inconsistency observed in peak demand data, the peak demand for each district was calculated on the basis of load factor trends witnessed in the respective states of the NCR region. The load factor for a state is based on its energy requirement data and peak demand and both are very reliable data if considered within a state boundary. The load factor of a particular sub region of NCR was assumed as same to the load factor witnessed in the state it belongs to. Similarly, the load factor for the whole NCR was assumed as load factor prevailing in the whole Northern Region (NR).

Sl. No.	**Years**	**Load Factor (in%)**					
		Delhi	Haryana	Rajasthan	UP	Region	All India
1.	2014-15	56.08	57.92	70.06	76.43	74.66	83.36
2.	2015-16	57.77	59.42	69.99	73.23	73.07	83.88
3.	2016-17	56.15	60.26	74.37	74.90	74.53	82.59
4.	2017-18	55.64	60.76	69.70	74.77	71.43	85.55
5.	2018-19	52.53	59.65	68.47	66.09	69.83	82.43
6.	**Average**	**55.63**	**59.60**	**70.52**	**73.08**	**72.70**	**83.56**

(Table 9: Load Factor of NCR & All India during 2014-15 to 2018-19)

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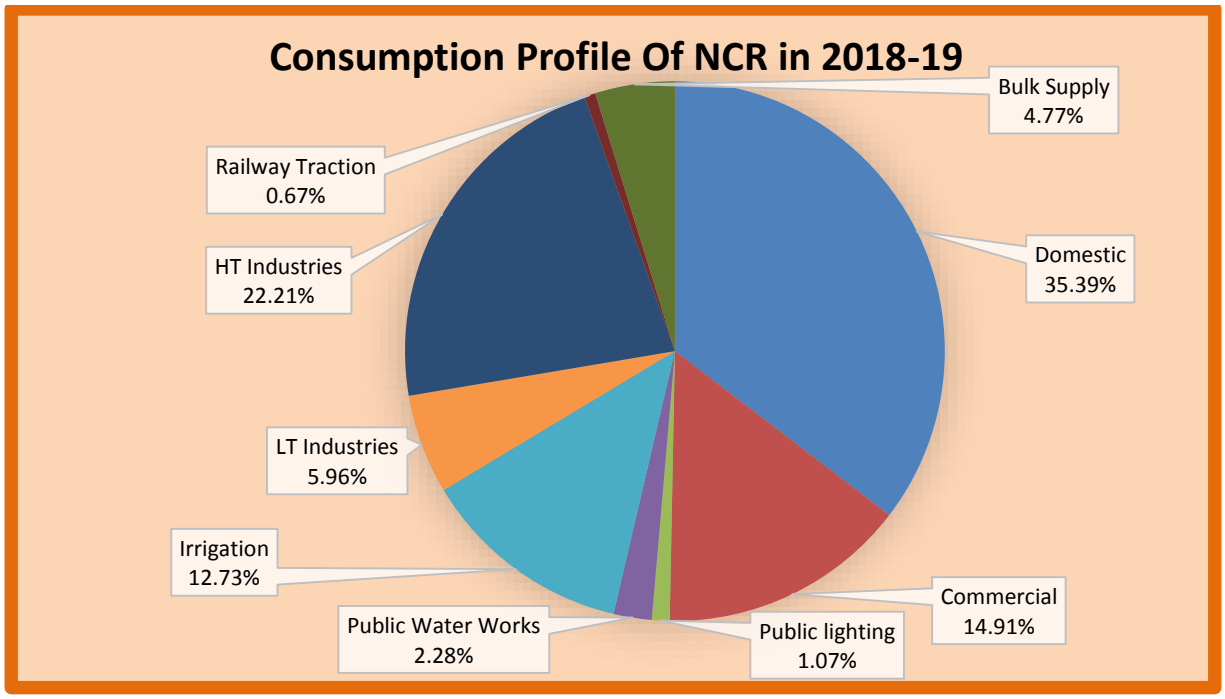
CHAPTER 4

POWER FORECAST OF NCR

Existing Power Scenario:

The total electricity consumption of NCR in year 2018-19 was 83849 MU and with 14.68% T&D losses, the requirement was 98271 MU. During the last four years (2013-14 to 2017-18), the NCR has observed annual growth rate of 4.87% in terms of electrical energy requirement. The Peak Demand for the region was 15430 MW in year 2018-19.

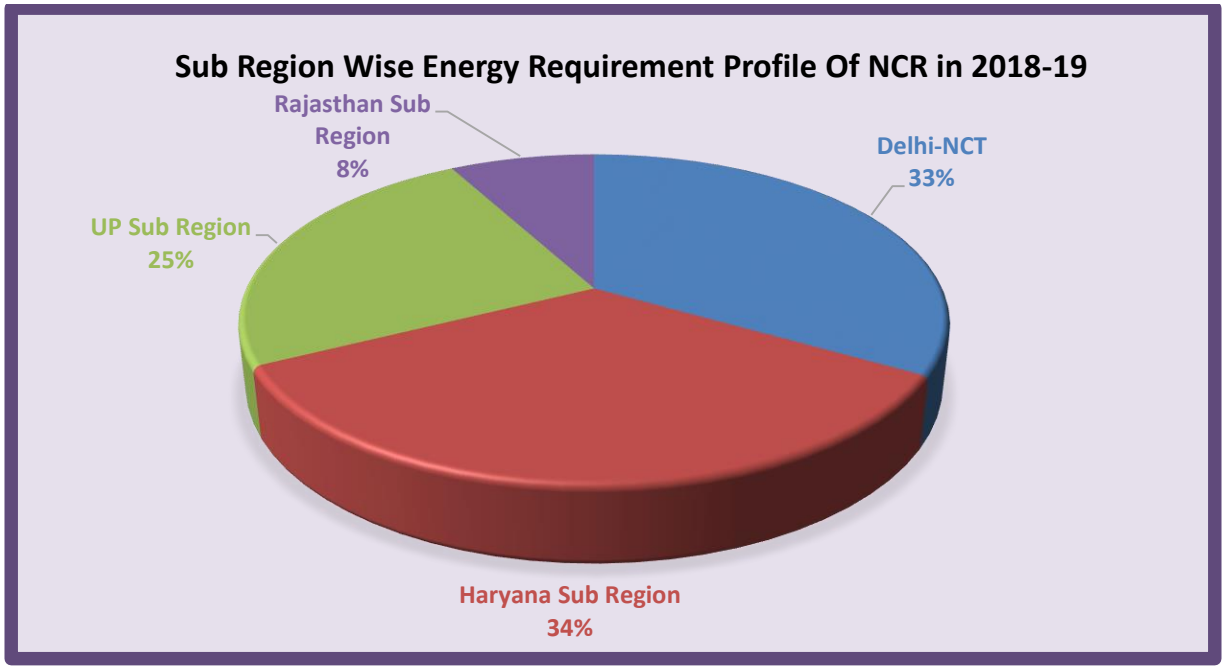
The Domestic sector was the biggest consumer of electricity (35%). Thereafter, HT Industry sector and Commercial sector were consuming about 22% & 15% respectively of the total electricity consumption of NCR.



(Figure 8: Energy Consumption Profile of NCR in 2018-19)

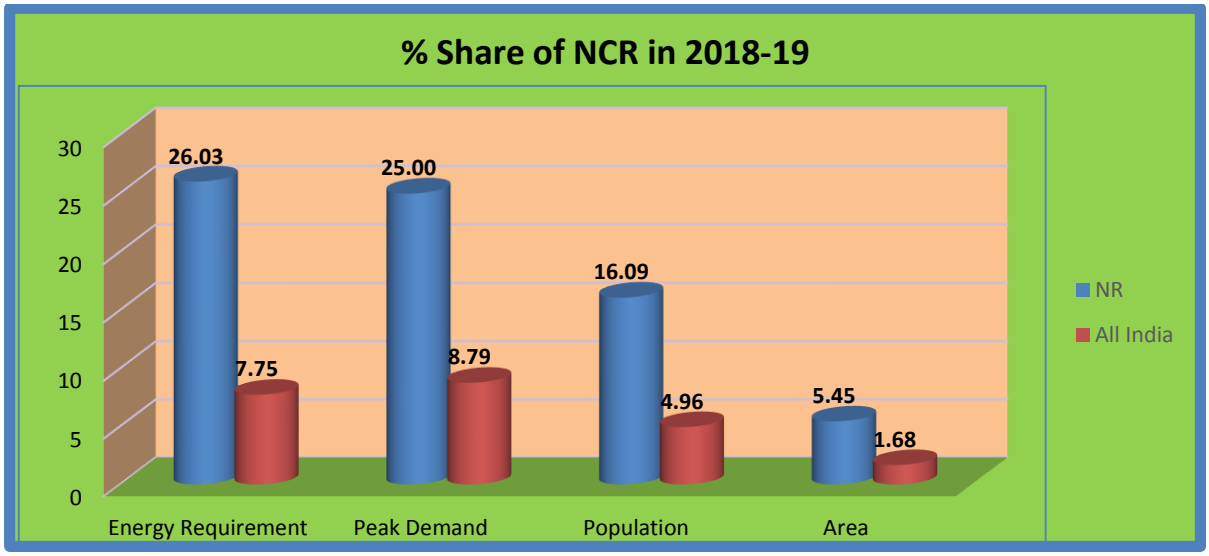
The Haryana sub region and Delhi-NCT had the most of NCR electrical energy requirement in 2018-19 followed by Uttar Pradesh & Rajasthan sub region. Haryana sub region and Delhi-NCT had almost equal energy requirement in 2018-19 constituting about 34% & 33% of the total NCR energy requirement

respectively. The population of both the sub regions are also very similar (it is expected that population of Delhi-NCT and Haryana Sub Region will reach 225 & 232.47 lakhs respectively by 2021) whereas their area shares in NCR differ substantially (2.69 % & 46 % respectively).



(Figure 9: Sub Region Wise Energy Requirement Profile of NCR in 2018-19)

The comparison of energy data of NCR with the entire Northern Region for the year 2018-19 indicates that although contributing only 5.45% area wise and 16.09% population wise, the energy requirement of NCR was more than one fourth (26.03 %) of total Northern Region Energy Requirement.



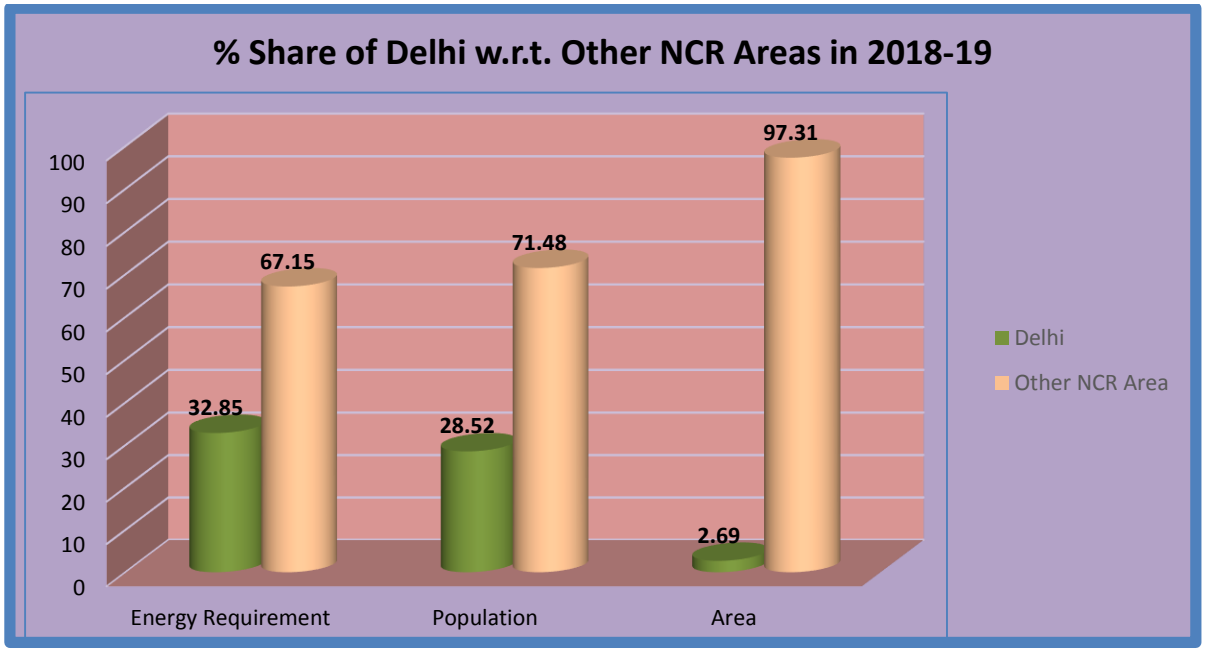
(Figure 10: Comparison of NCR with NR & All India)

Similarly, on comparison of energy data of NCR with the All India figures for the year 2018-19, it is observed that energy requirement of NCR was 7.75% of the total energy requirement of the country whereas its contribution in area and population were 1.68 % and 4.96 % only. It shows comparatively huge concentration of energy demand in the NCR region.

Sl. No.	Particulars	Delhi NCT	NCR	NR	All India	NCR as % of NR	NCR as % of All India
1.	Energy Requirement (in MU)	32282	98271	377595	1267526	26.03	7.75
2.	Peak Demand (in MW)	7016	15430	61726	175528	25.00	8.79
3.	Population	192,07,448	673,58,564	4186,65,806	13571,98,722	16.09	4.96
4.	Area (in sq km)	1,483	55,083	10,10,616	32,87,240	5.45	1.68

(Table 10: Comparison of NCR with NR & All India in 2018-19)

The Comparison of Delhi NCT with Other NCR Areas in 2018-19 suggests that Delhi-NCT contributed about 2.69% of the total NCR area but its energy requirement was about 32.85%. In terms of population although, the differences were not much that indicates similar per capita consumption in Delhi NCT and other areas of NCR.



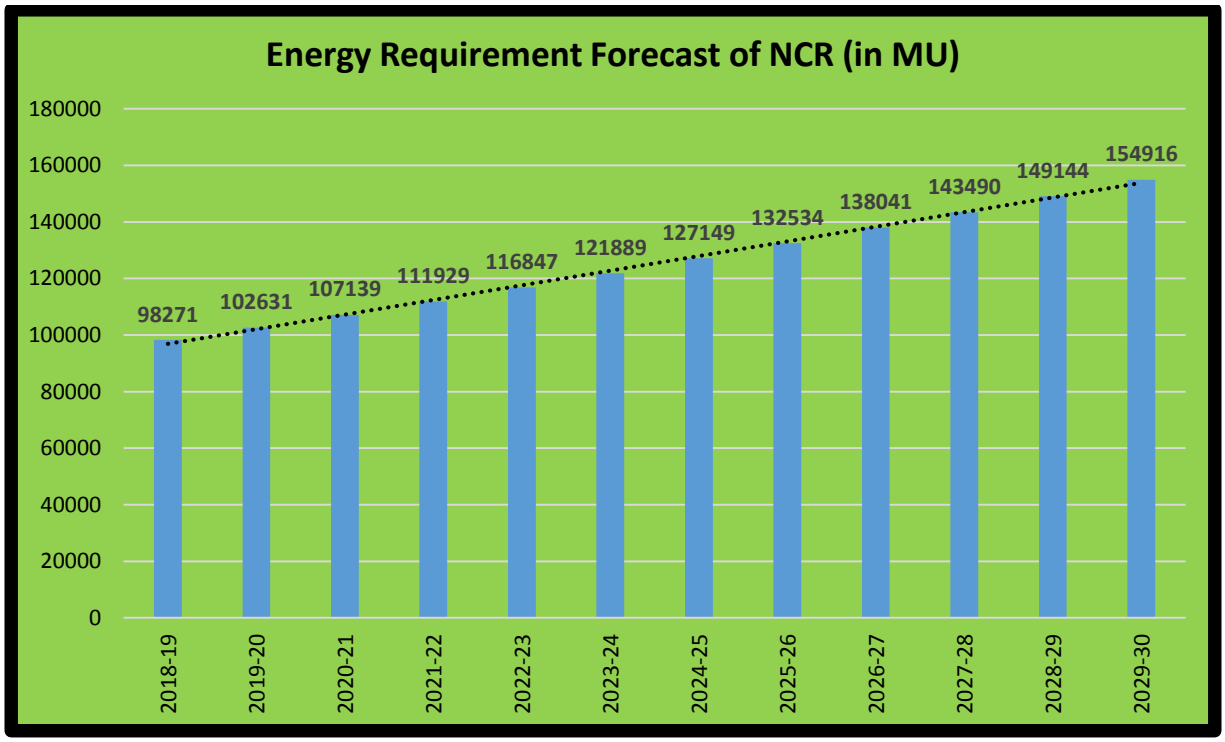
(Figure 11: Comparison of Delhi-NCT with other areas of NCR)

Sl. No.	Particulars	Delhi NCT	Other NCR Area	Total NCR	Share of Delhi	Share of Other NCR Area
1.	Energy Requirement (in MU)	32,282	65,989	98,271	32.85	67.15
2.	Population	192,07,448	481,51,115	673,58,564	28.52	71.48
3.	Area (in sq. km)	1,483	53,600	55,083	2.69	97.31

(Table 11: Comparison of Delhi-NCT with other areas of NCR in 2018-19)

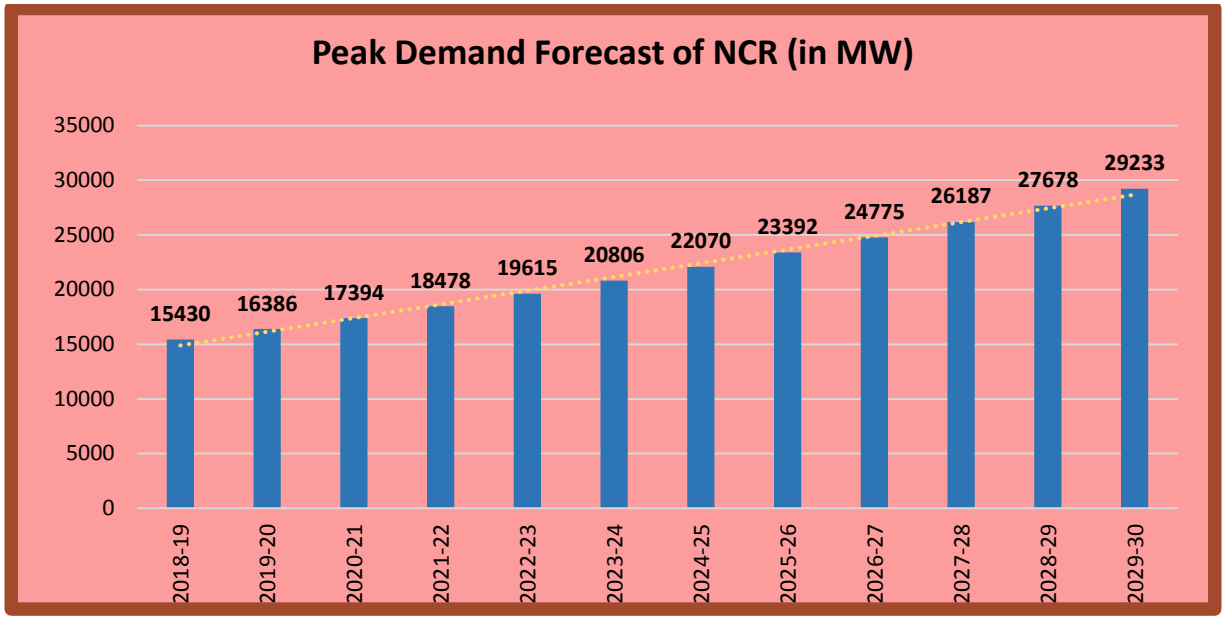
Power Forecast of NCR:

Based on total electricity consumption and T&D Losses, the total energy requirement of NCR is estimated as 102631 MU in the year 2019-20. It is expected that the energy requirement of NCR will reach to 127149 MU with 4.38% CAGR for the period 2019-20 to 2024-25. With CAGR of 4.03% for the period 2024-25 to 2029-30, its energy requirement is estimated as 154916 MU by the year 2029-30. The CAGR of energy requirement for the next ten years (2019-20 to 2029-30) is expected as 4.20%.



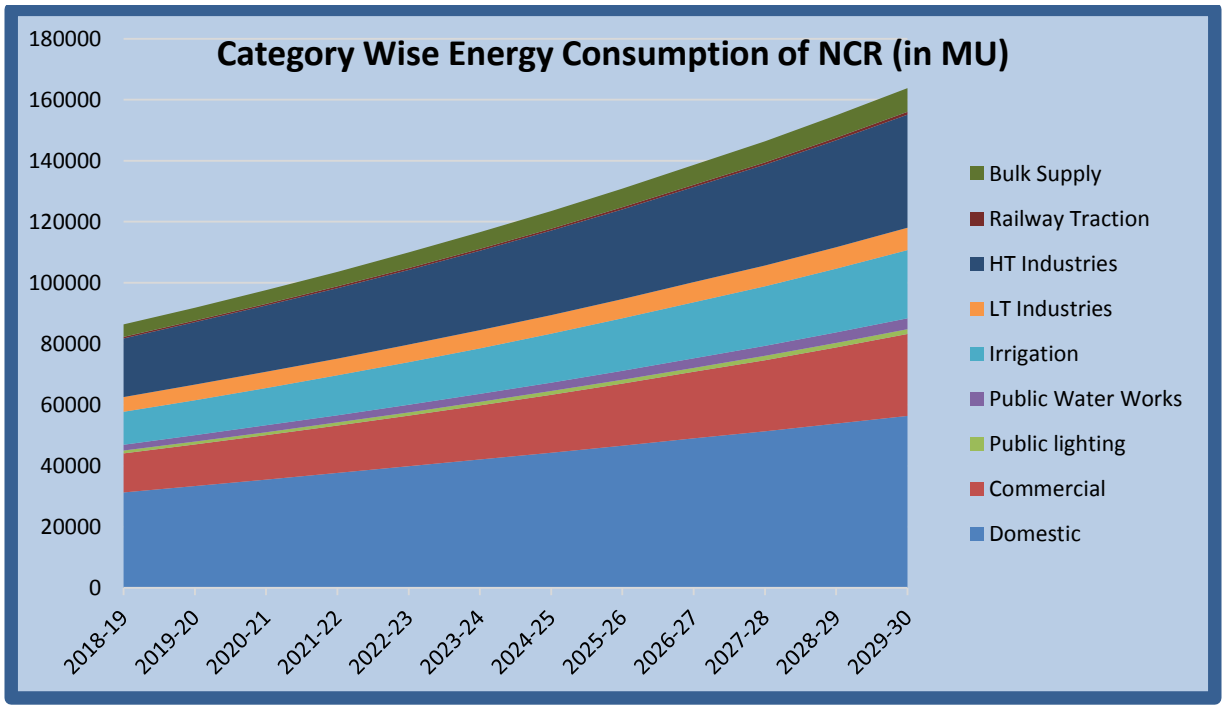
(Figure 12: Energy Requirement Forecast of NCR)

Peak Demand of the NCR is expected to see 6.14% CAGR upto 2024-25 and will reach 22070 MW in comparison to 16386 MW in year 2019-20. The Peak Demand is expected to reach 29233 MW in year 2029-30 with a CAGR of 5.78% after 2024-25. The CAGR of peak energy demand for the next ten years (2019-20 to 2029-30) is expected as 5.96 %.



(Figure 13: Peak Demand Forecast of NCR)

The category wise energy consumption forecast of NCR are as follows:



(Figure 14: Category Wise Energy Consumption Forecast of NCR)

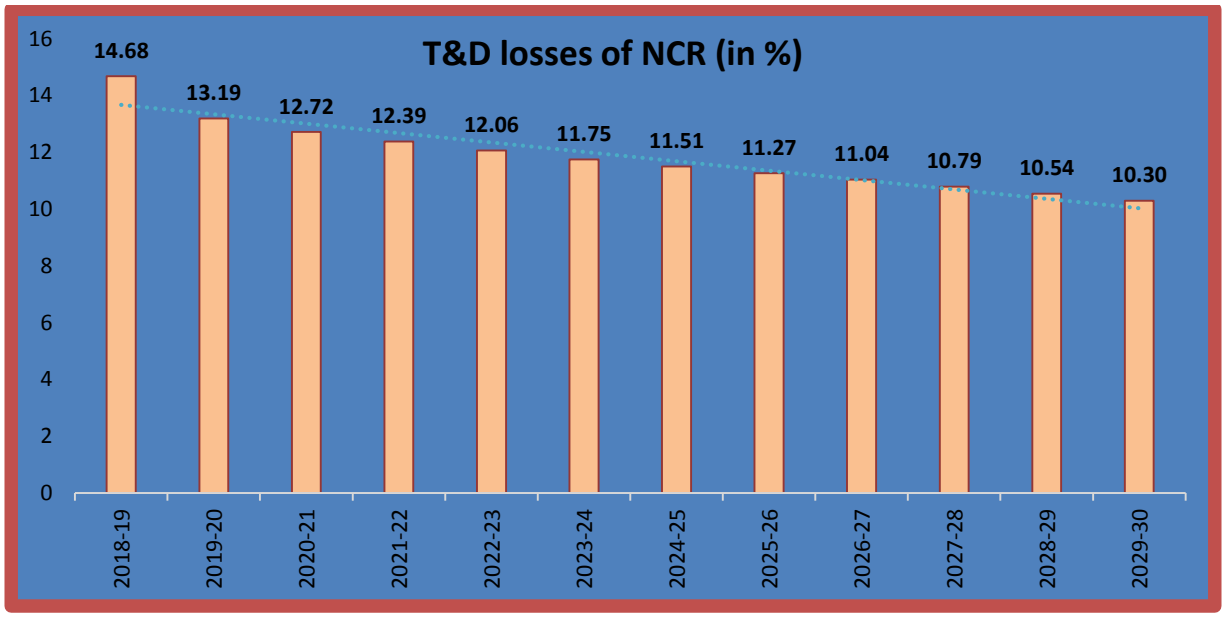
The CAGR expected in the next ten years (2019-20 to 2029-30) along with its break up in five years (2019-20 to 2024-25 & 2024-25 to 2029-30) is tabulated below:

Sl No.	Category	Energy Consumption CAGR in %		
		2019-20 to 2024-25	2024-25 to 2029-30	2019-20 to 2029-30
1.	Domestic	5.25	4.44	4.85
2.	Commercial	4.97	4.68	4.83
3.	Industrial	4.22	4.00	4.11
4.	Irrigation	4.10	3.89	4.00
5.	Others	5.14	4.63	4.88
6.	**Total**	**4.78**	**4.31**	**4.55**

(Table 12: Expected CAGR of NCR - Category Wise Consumption)

Transmission & Distribution Losses:

T&D losses of NCR was hovering around 30-40% at the turn of this century that is estimated to come down to 14.68% in year 2018-19. The target level is to bring it down to about 11.51% and 10.30% by the end of 2024-25 & 2029-30 respectively.



(Figure 15: T&D Loss Forecast of NCR)

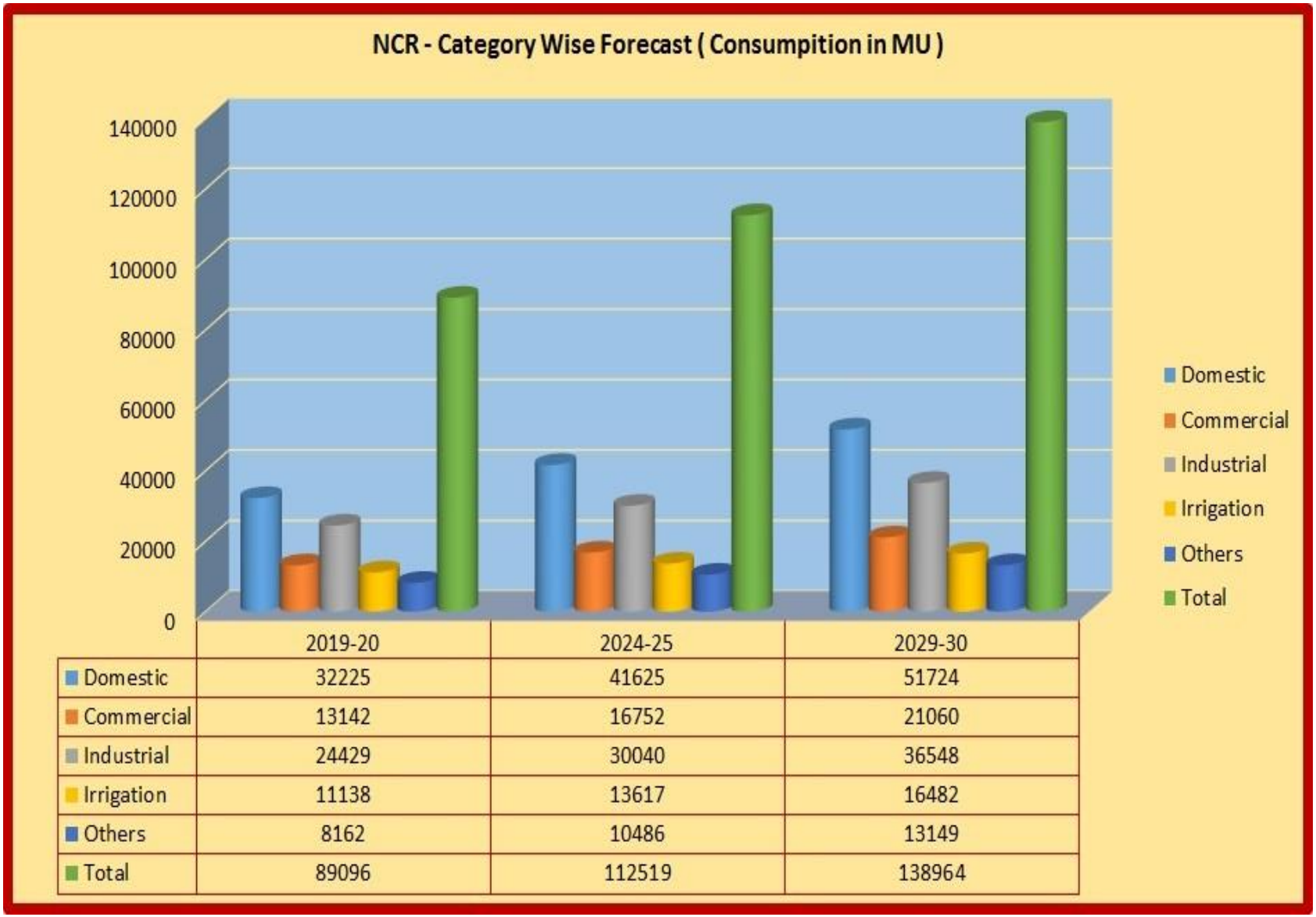
National Capital Region

Electrical Energy Consumption, Energy Requirement and Peak Electricity Demand

(Category Wise and Year Wise Summary)

Year	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30
Domestic	**32225**	34033	35878	37760	39675	41625	43605	45615	47591	49639	51724
Commercial	**13142**	13801	14491	15213	15966	16752	17568	18415	19271	20155	21060
Public lighting	**935**	980	1027	1074	1123	1173	1223	1276	1328	1383	1440
Public Water Works	**2073**	2181	2295	2414	2538	2669	2805	2948	3095	3250	3412
Irrigation	**11138**	11605	12085	12579	13090	13617	14160	14721	15273	15869	16482
LT Industries	**5079**	5265	5452	5643	5835	6030	6226	6424	6624	6830	7040
HT Industries	**19350**	20217	21116	22048	23012	24010	25042	26108	27201	28337	29508
Railway Traction	**504**	520	538	556	575	595	618	642	666	691	717
Bulk Supply	**4650**	4912	5184	5465	5753	6049	6351	6657	6965	7273	7580
Total (Energy Consumption)	**89096**	**93515**	**98066**	**102751**	**107568**	**112519**	**117599**	**122805**	**128013**	**133426**	**138964**
T&D losses -MU	**13535**	13624	13863	14096	14321	14630	14935	15236	15476	15718	15952
T&D losses -in %	**13.19**	12.72	12.39	12.06	11.75	11.51	11.27	11.04	10.79	10.54	10.30
Energy Requirement - MU	**102631**	**107139**	**111929**	**116847**	**121889**	**127149**	**132534**	**138041**	**143490**	**149144**	**154916**
Annual Load Factor - %	**71.50**	70.31	69.15	68.00	66.88	65.77	64.68	63.61	62.55	61.51	60.49
Peak Load - MW	**16386**	**17394**	**18478**	**19615**	**20806**	**22070**	**23392**	**24775**	**26187**	**27678**	**29233**

(Table 13: NCR Forecast)



	2019-20	2024-25	2029-30
Domestic	32225	41625	51724
Commercial	13142	16752	21060
Industrial	24429	30040	36548
Irrigation	11138	13617	16482
Others	8162	10486	13149
Total	89096	112519	138964

(Figure 16: NCR Forecast – Category Wise)

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CHAPTER 5

DELHI – NATIONAL CAPITAL TERRITORY

New Delhi became a state in 1992 under the National Capital Territory Act. The NCT of Delhi is spread over an area of 1,483 sq km that accounts for about 2.69 % of the total area of NCR. With population of 167 lakhs, NCT-Delhi sub-region contributed about 36% of total NCR population as per Census 2011. In 2021, this ratio is expected to reach about 29% with total population of 225 lakhs.

Being the capital of India, Delhi has undergone rapid urbanization. According to the United Nations (2007), Delhi is the world's sixth-largest urban agglomerate. Services sector and manufacturing are the predominant income and workforce contributors in Delhi.

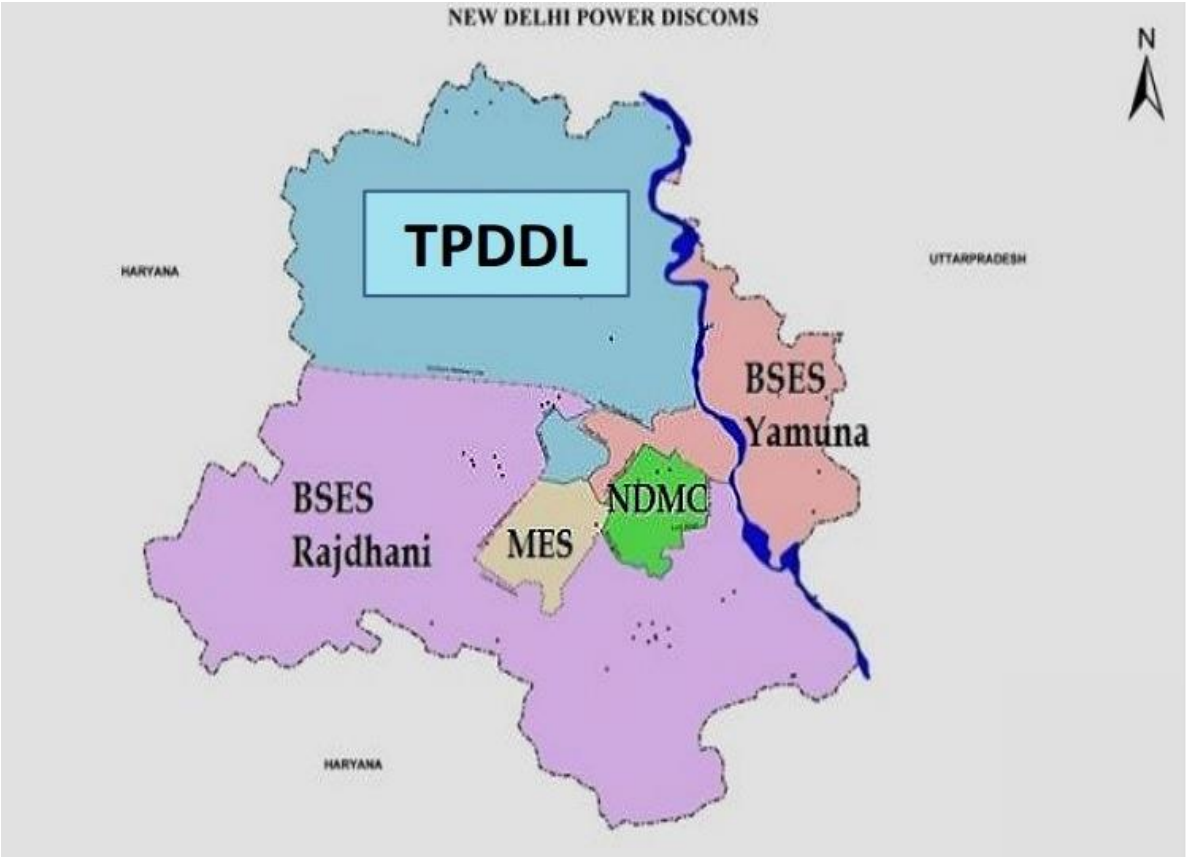
There are eleven districts in Delhi – New Delhi, North Delhi, North West Delhi, West Delhi, South West Delhi, South Delhi, South East Delhi, Central Delhi, North East Delhi, Shahdara & East Delhi.

Power Utilities of Delhi-NCT:

Following the privatisation of Delhi's power sector and unbundling of the Delhi Vidyut Board in July 2002, two generation companies Indraprastha Power Generation Company Limited (IPGCL) and Pragati Power Corporation Limited (PPCL) came into existence. Delhi Transco Limited (DTL) is now responsible for transmission of power. The business of power distribution was transferred to BSES Yamuna Power Limited (BYPL), BSES Rajdhani Power Limited (BRPL) and Tata Power Delhi Distribution Limited (TPDDL). TPDDL was earlier named as North Delhi Power Limited (NDPL).

BRPL distributes power in South and West zones and BYPL distributes in North-East, South-East and Central zones. TPDDL is responsible for distribution in North and North Western parts of Delhi. Besides that, Military Engineering Services (MES) & New Delhi Municipal Corporation (NDMC) are also working as deemed distribution licensee. NDMC distributes power in

territories under its jurisdiction, which mainly include the area comprising the territory that has been described as Lutyen's Delhi. MES is responsible for the distribution of power in Delhi's cantonment areas.



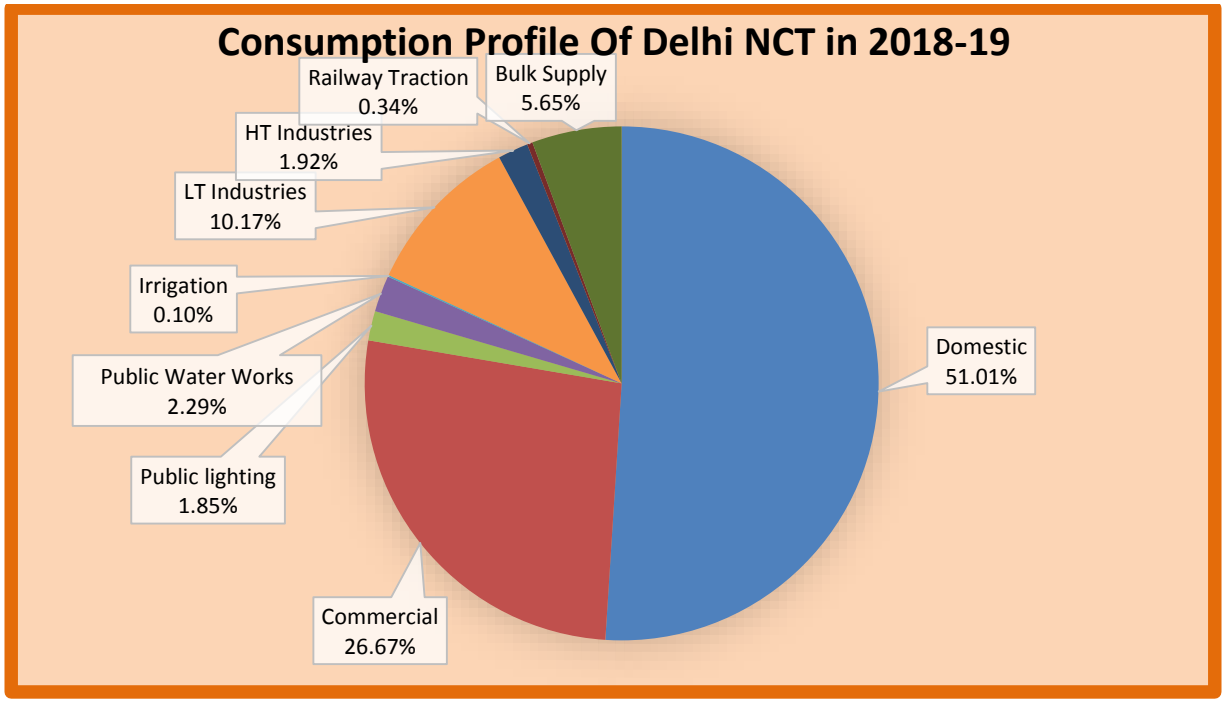
(Figure 17: Delhi – Power Distribution)[6]

Existing Power Scenario:

The total electricity consumption of Delhi-NCT in year 2018-19 was 28121 MU and with 12.89% T&D losses, the requirement was 32282 MU that was 32.85% of the total energy requirement of the NCR. During the last four years (2013-14 to 2017-18), Delhi–NCT has observed annual growth rate of 3.74% in terms of electrical energy requirement. The Peak Demand was 7016 MW in year 2018-19.

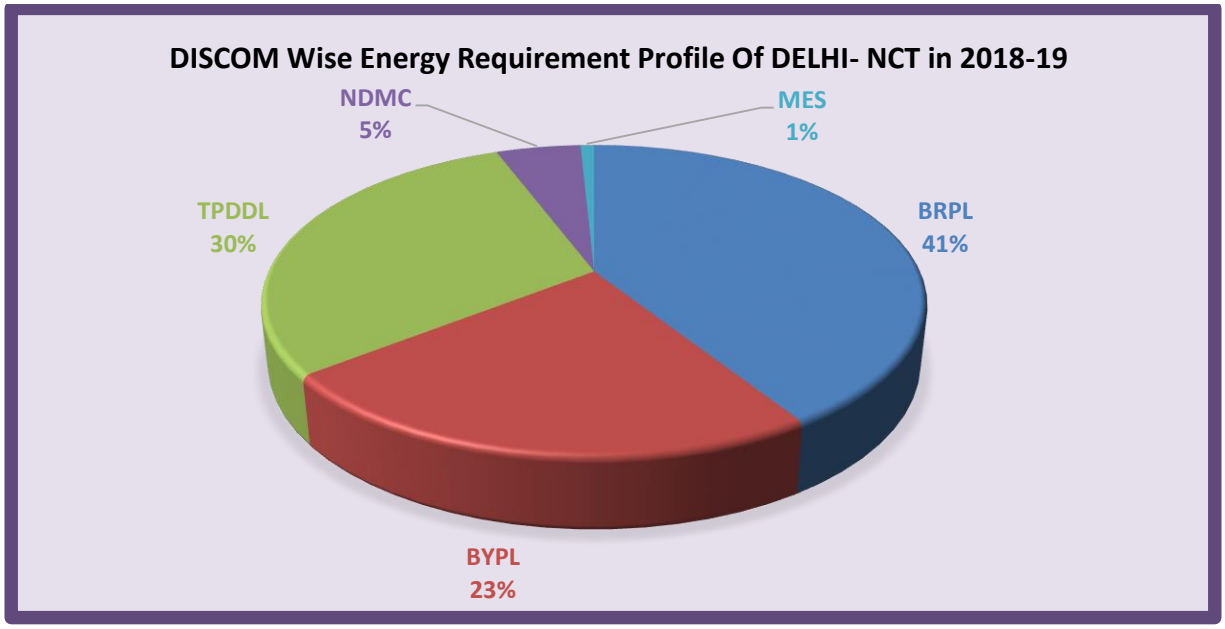
[6] Source:
https://www.tatapower ddl.com/UploadedDocuments/TPDDL%20_Excellence%20Journey_June%202015_18062015.pdf
NDPL is now "Tata Power Delhi Distribution Limited (TPDDL)

The Domestic sector is the biggest consumer of electricity in Delhi-NCT and its consumption was more than half of the total energy consumption of Delhi-NCT (51%) in year 2018-19. Thereafter, commercial sector came that consumed about 27% of the power.



(Figure 18: Energy Consumption Profile of Delhi NCT in 2018-19)

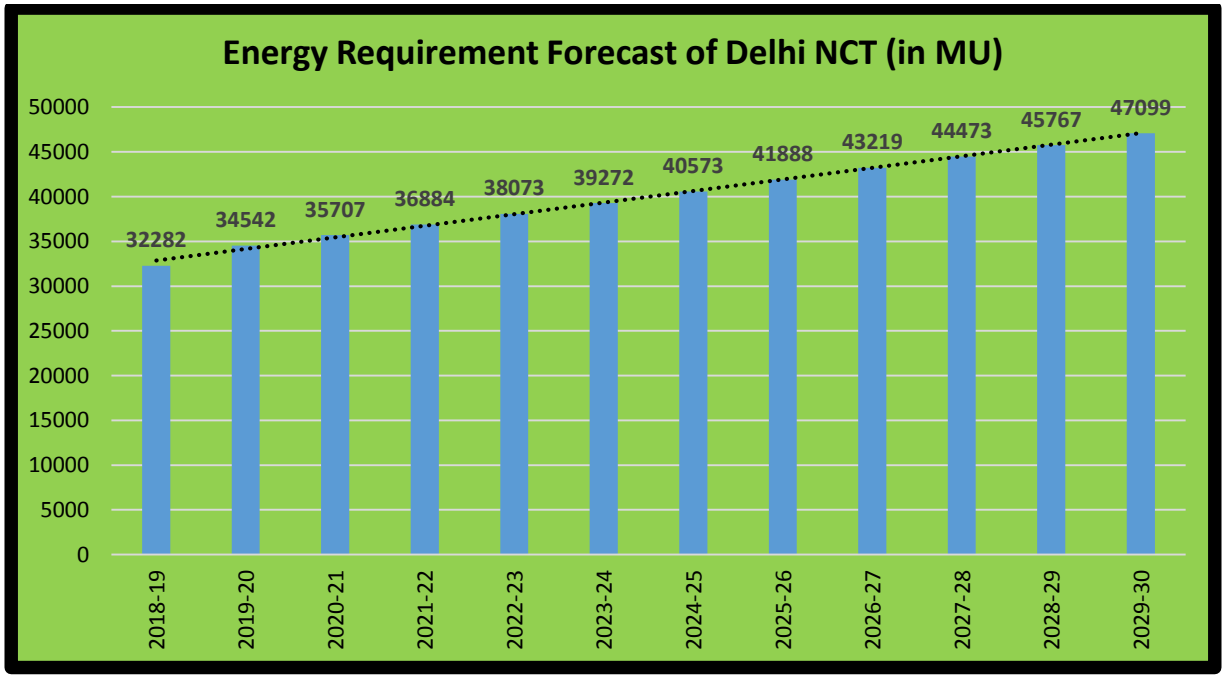
If we compare Discom wise pattern of energy requirement, then BRPL is the largest consumer of electricity (41%) followed by TPDDL (30%) & BYPL (23%).



(Figure 19: Discom Wise Energy Requirement Profile of Delhi NCT in 2018-19)

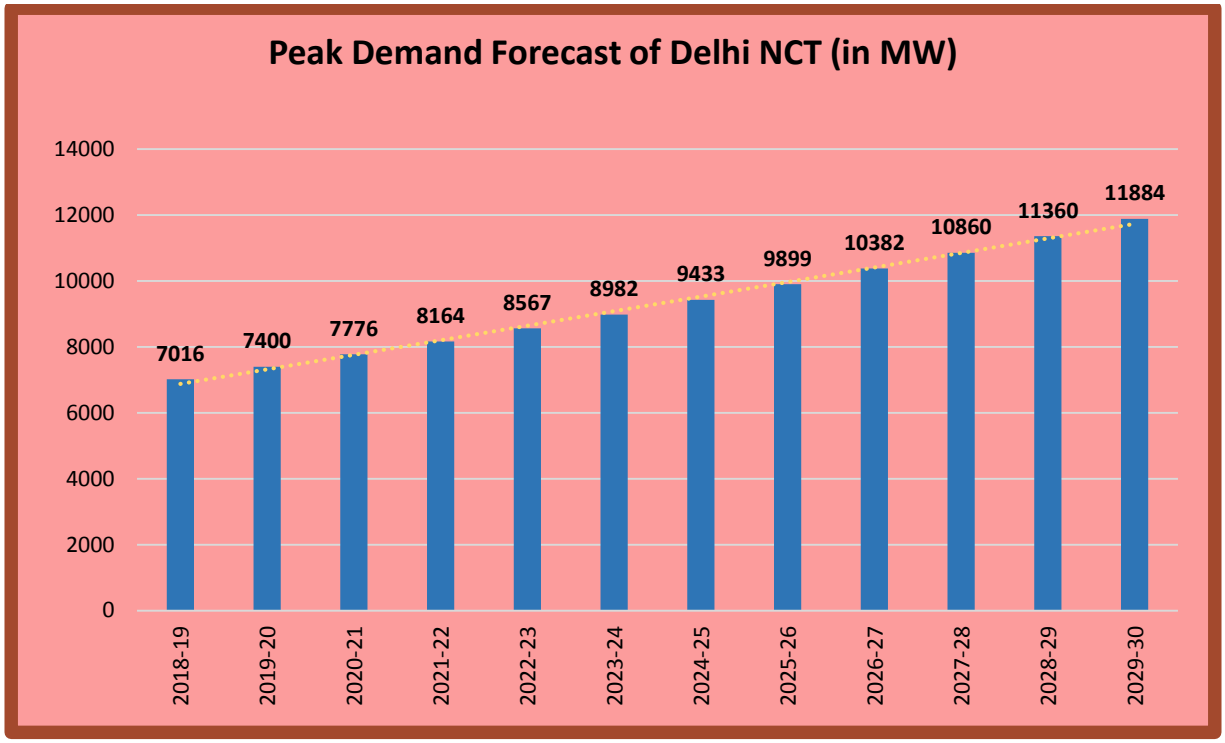
Power Forecast:

Based on total electricity consumption and T&D Losses, the total energy requirement of Delhi-NCT is estimated as 34542 MU in year 2019-20. It is expected that the energy requirement of this sub-region will reach to 40573 MU with 3.27% CAGR for the period 2019-20 to 2024-25. With CAGR of 3.03% for the period 2024-25 to 2029-30, its energy requirement is estimated as 47099 MU by the year 2029-30. The CAGR of energy requirement for the next ten years (2019-20 to 2029-30) is expected as 3.15% that is lower than the energy requirement growth rate estimated for the whole NCR (4.20%). It is because of existence of already a higher energy requirement in Delhi-NCT region that reflects even a higher increase in quantum of energy into a lower energy growth in percentage term.



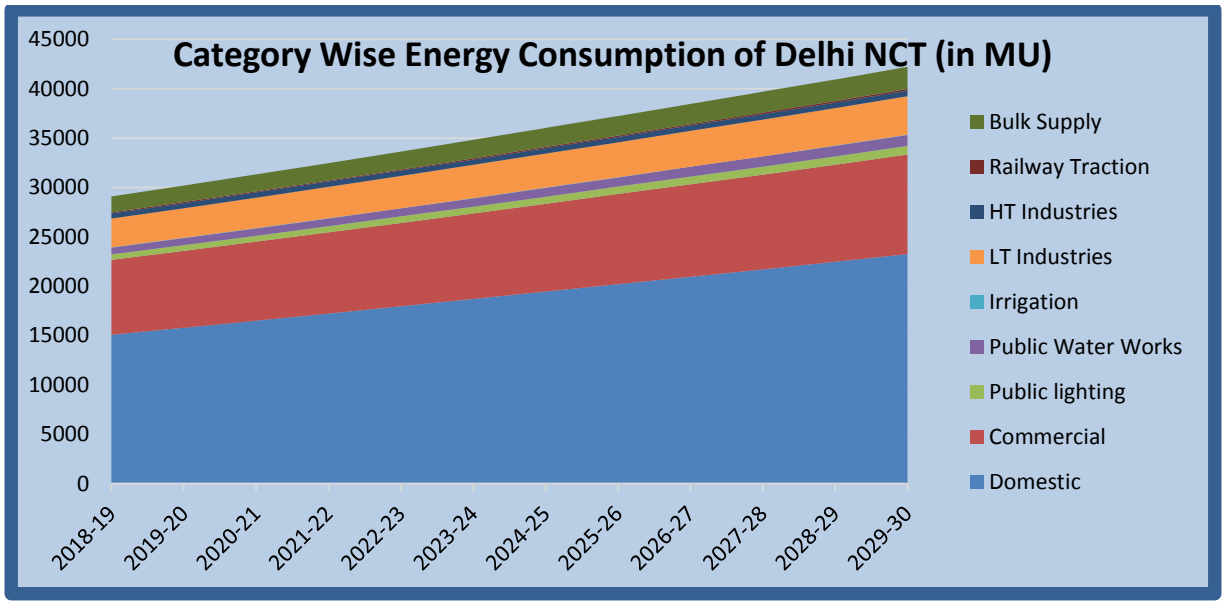
(Figure 20: Energy Requirement Forecast of Delhi-NCT)

Peak Demand of this sub-region is expected to see 4.97% CAGR upto 2024-25 and will reach 9433 MW in comparison to 7400 MW in year 2019-20. It is expected to reach 11884 MW in year 2029-30 with a CAGR of 4.73% after 2024-25. The CAGR of peak energy demand for the next ten years (2019-20 to 2029-30) is expected as 4.85% that is again less compared to the whole NCR region (5.96 %).



(Figure 21: Peak Demand Forecast of Delhi-NCT)

The category wise energy consumption forecast of Delhi-NCT are as follows:



(Figure 22: Category Wise Energy Consumption Forecast of Delhi-NCT)

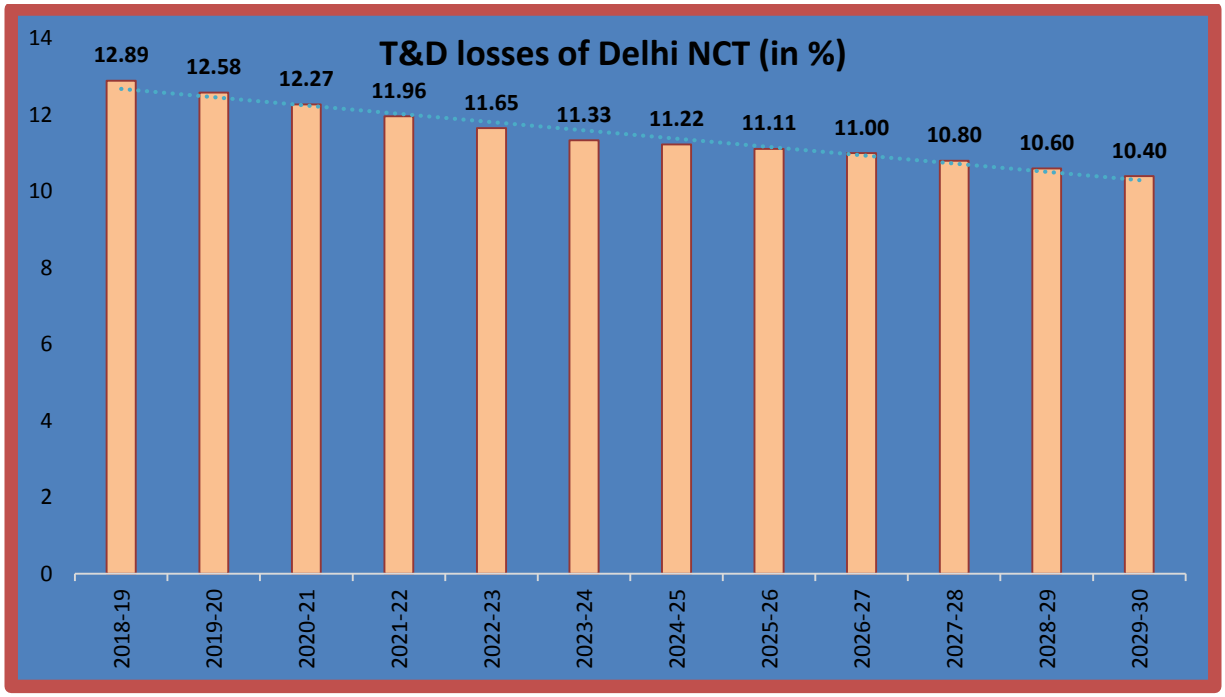
The CAGR expected in the next ten years (2019-20 to 2029-30) along with its break up in five years (2019-20 to 2024-25 & 2024-25 to 2029-30) is tabulated below:

Sl No.	Category	Energy Consumption CAGR in %		
		2019-20 to 2024-25	2024-25 to 2029-30	2019-20 to 2029-30
1.	Domestic	4.27	3.62	3.94
2.	Commercial	2.67	2.56	2.61
3.	Industrial	2.48	2.28	2.38
4.	Irrigation	-2.22	-2.16	-2.19
5.	Others	3.65	3.67	3.66
6.	Total	3.59	3.22	3.40

(Table 14: Expected CAGR of Delhi-NCT - Category Wise Consumption)

Transmission & Distribution Losses:

T&D losses of Delhi-NCT was about 35% in 2004-05 that is estimated to come down to 12.89% in year 2018-19. The target level is to bring it down to about 11.22% and 10.40% by the end of 2024-25 & 2029-30 respectively.



(Figure 23: T&D Loss Forecast of Delhi-NCT)

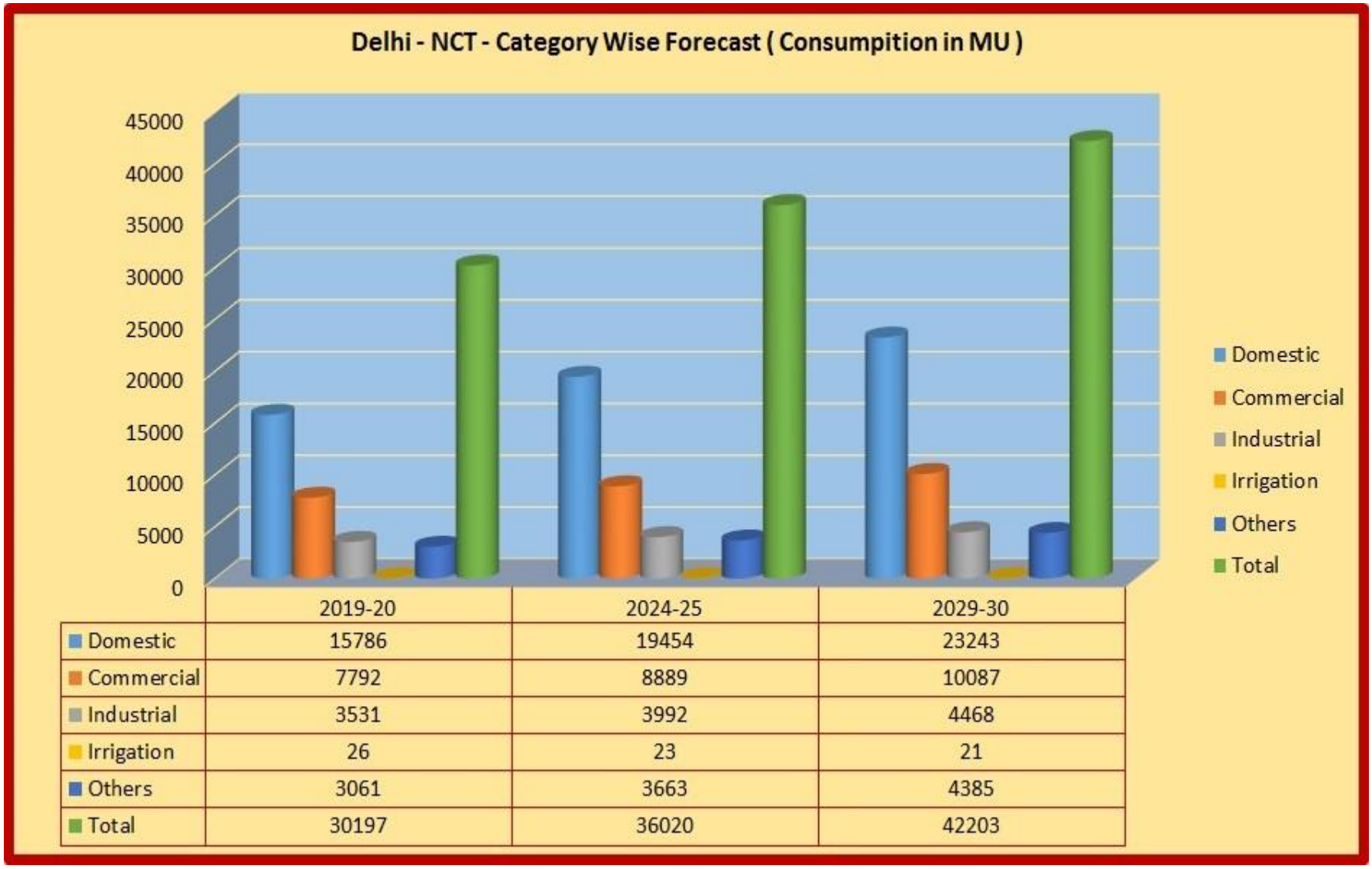
Delhi - NCT

Electrical Energy Consumption, Energy Requirement and Peak Electricity Demand

(Category Wise and Year Wise Summary)

Year	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30
Domestic	**15786**	16502	17228	17963	18705	19454	20206	20964	21697	22457	23243
Commercial	**7792**	8002	8216	8435	8660	8889	9125	9366	9601	9841	10087
Public lighting	**577**	605	633	662	691	720	751	781	813	845	879
Public Water Works	**707**	741	776	813	851	891	933	976	1020	1066	1114
Irrigation	**26**	25	25	24	24	23	23	22	22	21	21
LT Industries	**3001**	3089	3176	3264	3351	3439	3526	3614	3704	3797	3891
HT Industries	**530**	535	539	544	549	553	558	562	567	572	576
Railway Traction	**104**	108	112	117	121	126	132	139	146	153	161
Bulk Supply	**1673**	1719	1767	1818	1870	1925	1982	2042	2103	2166	2231
Total (Energy Consumption)	**30197**	**31326**	**32473**	**33639**	**34821**	**36020**	**37235**	**38467**	**39672**	**40917**	**42203**
T&D losses -MU	**4345**	4381	4411	4434	4450	4553	4653	4752	4801	4849	4896
T&D losses -in %	**12.58**	12.27	11.96	11.65	11.33	11.22	11.11	11.00	10.80	10.60	10.40
Energy Requirement - MU	**34542**	**35707**	**36884**	**38073**	**39272**	**40573**	**41888**	**43219**	**44473**	**45767**	**47099**
Annual Load Factor - %	**53.29**	52.42	51.57	50.73	49.91	49.10	48.30	47.52	46.75	45.99	45.24
Peak Load - MW	**7400**	**7776**	**8164**	**8567**	**8982**	**9433**	**9899**	**10382**	**10860**	**11360**	**11884**

(Table 15: Delhi-NCT Forecast)



	2019-20	2024-25	2029-30
Domestic	15786	19454	23243
Commercial	7792	8889	10087
Industrial	3531	3992	4468
Irrigation	26	23	21
Others	3061	3663	4385
Total	30197	36020	42203

(Figure 24: Delhi-NCT Forecast – Category Wise)

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CHAPTER 6

HARYANA SUB REGION OF NCR

The Haryana Sub-Region comprises of fourteen districts - Faridabad, Gurugram, Nuh, Rohtak, Sonepat, Rewari, Jhajjar, Panipat, Palwal, Bhiwani, Charkhi Dadri, Mahendragarh, Jind and Karnal that together constitute about 46% (25,327 sq. kms.) of the Region.

Since 2011, Haryana sub-region of NCR has undergone through the following area wise changes:

- Two districts viz. Bhiwani and Mahendragarh in the state of Haryana were included in NCR vide GoI Gazette Notification dated 01.10.2013.

- Two more districts of Haryana - Jind and Karnal districts were included in NCR vide GoI Gazette Notification dated 24.11.2015.

- Charkhi Dadri district was carved out of Bhiwani district in Haryana in 2016.

As per Census 2011 (consisted of nine districts only at that time viz. Faridabad, Gurugram, Nuh, Rohtak, Sonepat, Rewari, Jhajjar, Panipat and Palwal) Haryana sub-region contributed about 24% of total NCR population with population of 110 lakhs. In 2021, this ratio is expected to reach about 29% with total population of 232 lakhs that also includes population of the areas inducted in NCR after 2011.

Haryana sub-region is a mix of industries and service sector. Faridabad and Gurugram are the most industrialized districts in the state followed by Panipat. Gurugram is evolving as the main centre for high-value added services. Sonepat district is not only a major destination for construction and industrial activities but it is fast emerging as a knowledge centre because of coming up of several universities and training centres. Jhajjar district, a trade and commerce centre traditionally, that could not grow fast due to its poor

infrastructure base, has become very vibrant recently due to increased investments in the areas like power and the upcoming Reliance SEZ (though the progress of SEZ is very slow). Rohtak is primarily an agrarian economy with a number of educational institutions, both technical and nontechnical. Rewari is also majorly an agrarian centre but industrial activities are increasing very fast with two important industrial growth centre situated in Dharuhera Industrial Complex and Bawal Growth Centre. Panipat district houses a number of industries in textiles including handloom and powerloom and it is the biggest centre of Shoddy Yarn in the World. Nuh (Mewat), a predominantly rural district, is one of the most backward regions of the state and lags behind the rest of Haryana.[7]

Power Utilities of Haryana:

In pursuant to The Haryana Electricity Reforms Act 1997, the erstwhile Haryana State Electricity Board (HSEB) has been restructured into separate companies for generation, transmission and distribution of power.

- Haryana Power Generation Corporation Limited (HPGCL) is responsible for generation of power for Haryana state.

- Haryana Vidyut Prasharan Nigam Limited (HVPNL) is responsible for transmission of power in the state.

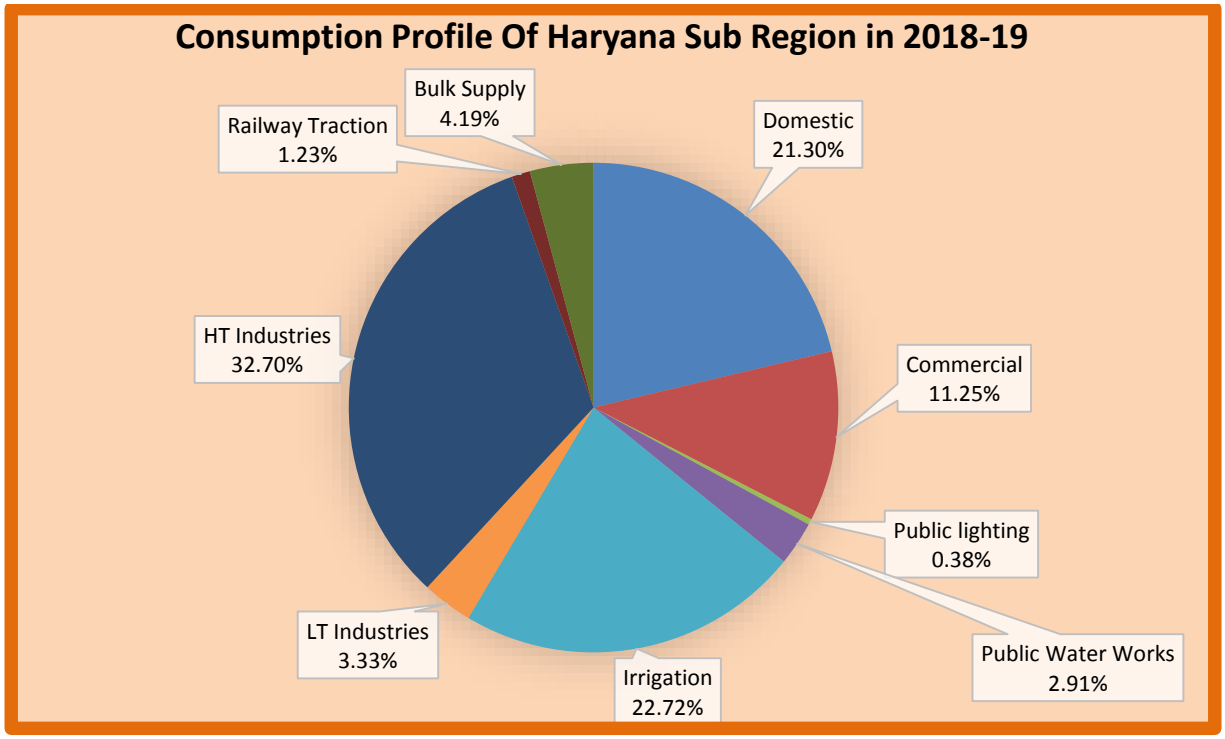
- The distribution function has been split into two geographical areas under two separate companies namely Uttar Haryana Bijli Vitaran Nigam (UHBVN) and Dakshin Haryana Bijli Vitaran Nigam (DHBVN). The UHBVN comprises of 10 districts including 5 districts of NCR (Jhajjar, Karnal, Panipat, Rohtak & Sonepat) and DHBVN comprises of 12 districts including 9 districts NCR viz. Bhiwani, Charkhi Dadri, Faridabad, Gurugram, Jind, Mahendragarh, Nuh, Palwal & Rewari.

[7] Economic Profile of NCR Report , NCRPB 2015

Existing Power Scenario:

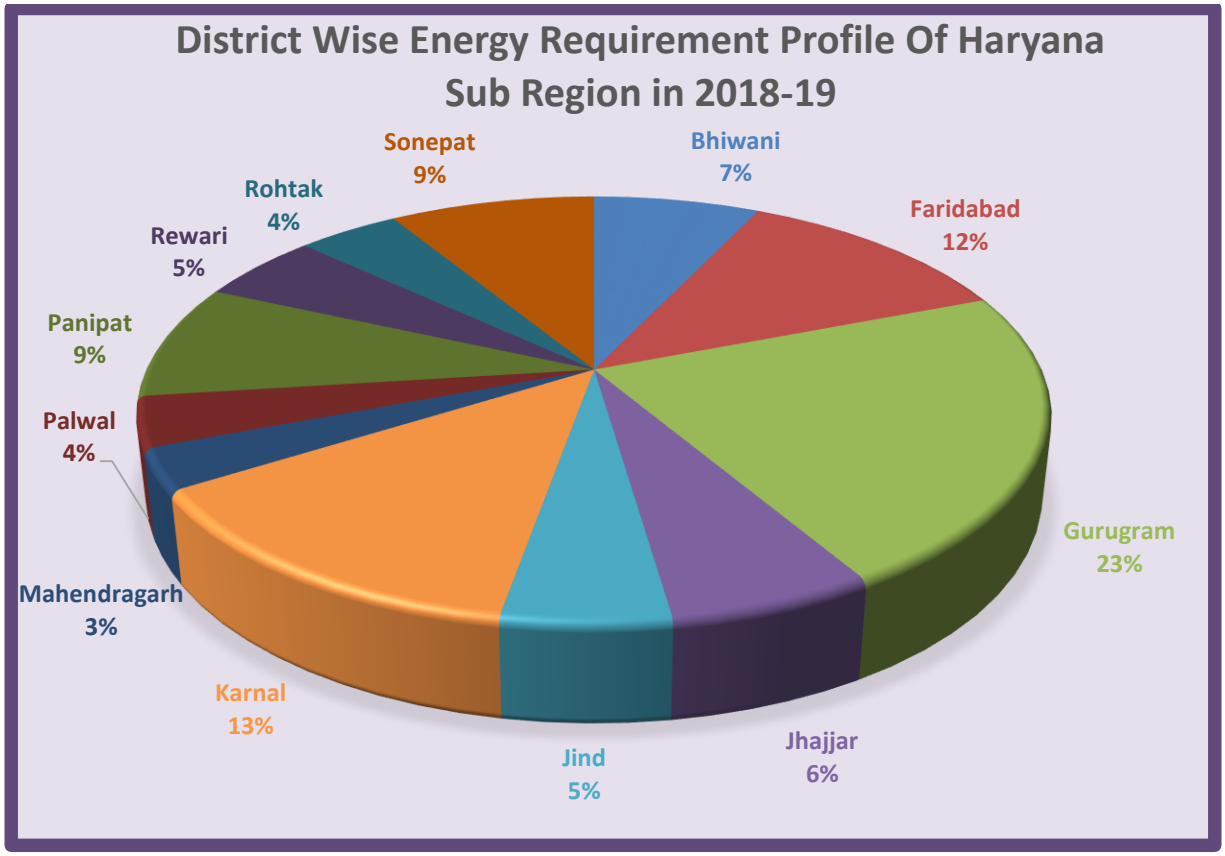
The total electricity consumption of Haryana Sub Region of NCR in year 2018-19 was 27640 MU and with 18.24% T&D losses, the requirement was 33760 MU that was 62.91% of the energy requirement of the entire Haryana state and 34.35% of the total NCR. During the last four years (2013-14 to 2017-18), this Sub Region has observed annual growth rate of 4.58% in terms of electrical energy requirement. The Peak Demand for this sub region was 6466 MW in year 2018-19.

The category wise energy consumption profile of this sub region is not aligned with such profiles of other sub regions and NCR as a whole except for Rajasthan Sub region. In this sub region, the HT Industry sector is the biggest consumer of electricity (33% in 2018-19) that indicates presence of various large scale industries in these areas. Thereafter, irrigation sector and domestic sector are consuming about 21-22% of electricity each. In comparison, more than 50% share in energy consumption comes from domestic sector in Delhi-NCT. In other sub regions and NCR as a whole also except for Rajasthan Sub region, domestic sector is the most dominant part.



(Figure 25: Energy Consumption Profile of Haryana Sub-Region in 2018-19)

If we compare district wise pattern of energy requirement, then Gurugram (including Nuh District) is the largest consumer of electricity (23%) followed by Karnal (13%) & Faridabad (12%). Karnal & Faridabad have almost equal consumption but as higher T&D losses were prevailing in Karnal (32%) in comparisons to Faridabad (17%), its requirement was higher.

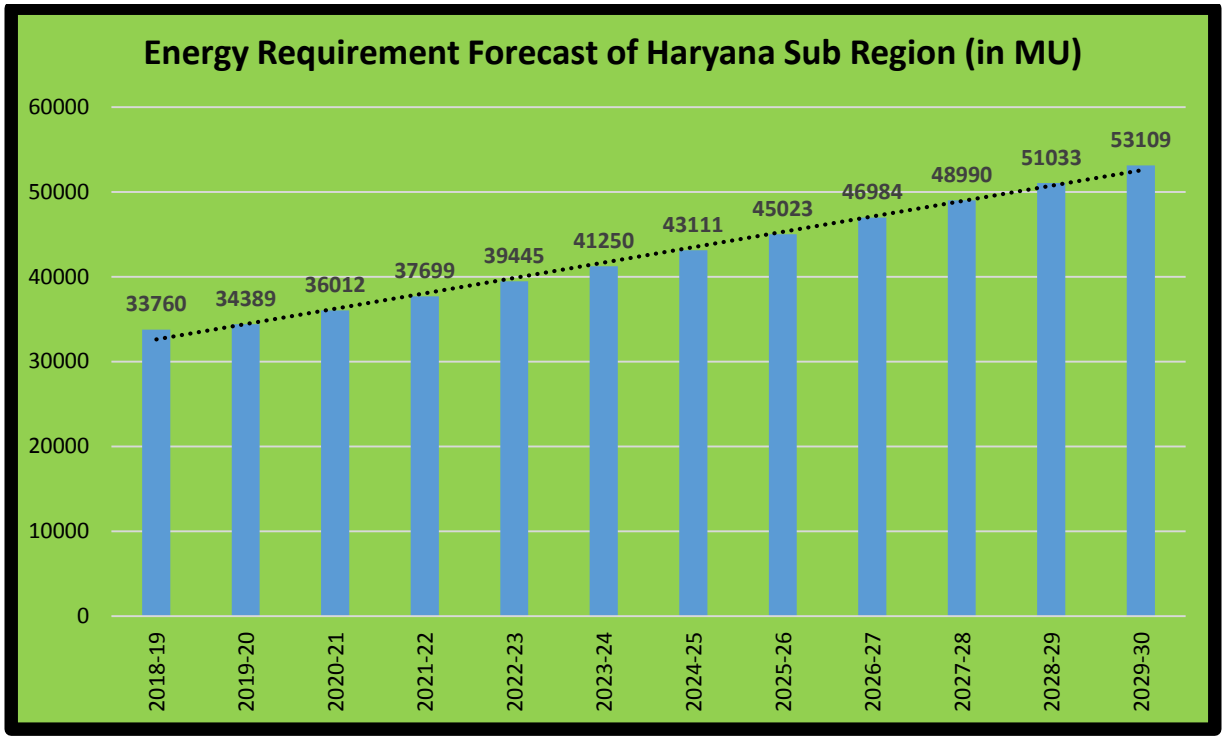


(Figure 26: District Wise Energy Requirement Profile of Haryana Sub-Region in 2018-19)

*Nuh district is included in Gurugram district & Charkhi Dadri district is included in Bhiwani district.

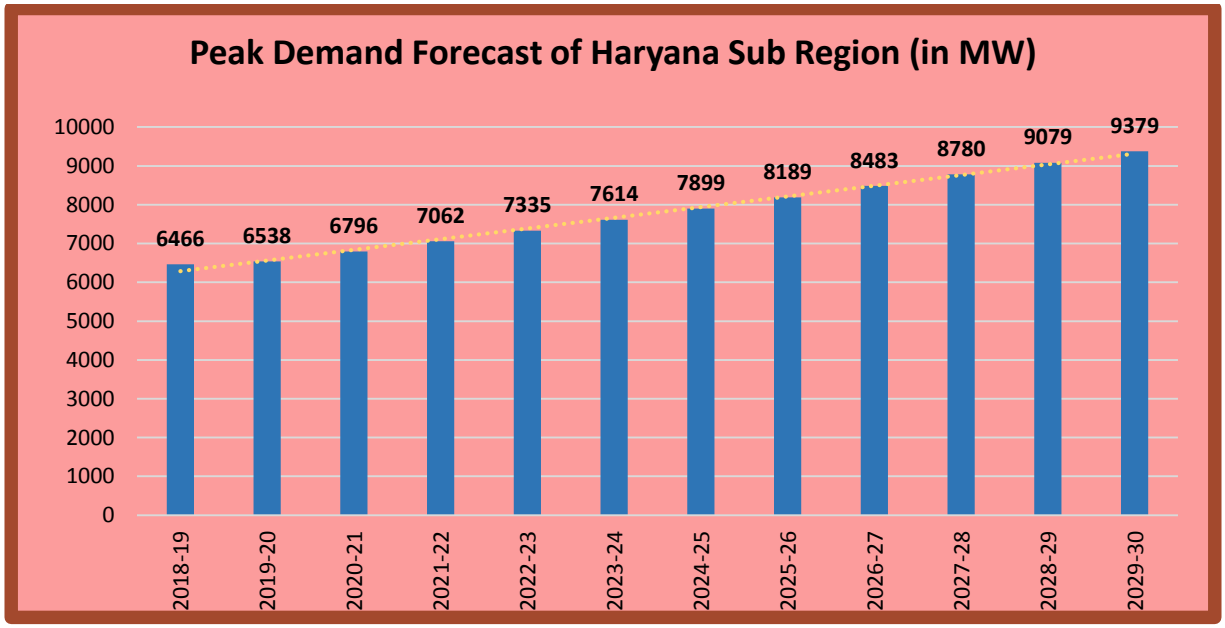
Power Forecast:

Based on total electricity consumption and T&D Losses, the total energy requirement of Haryana Sub Region of NCR is estimated as 34389 MU in year 2019-20. It is expected that the energy requirement of this sub-region will reach to 43111 MU with 4.62% CAGR for the period 2019-20 to 2024-25. With CAGR of 4.26% for the period 2024-25 to 2029-30, its energy requirement is estimated as 53109 MU by the year 2029-30. The CAGR of energy requirement for the next ten years (2019-20 to 2029-30) is expected as 4.44 %.



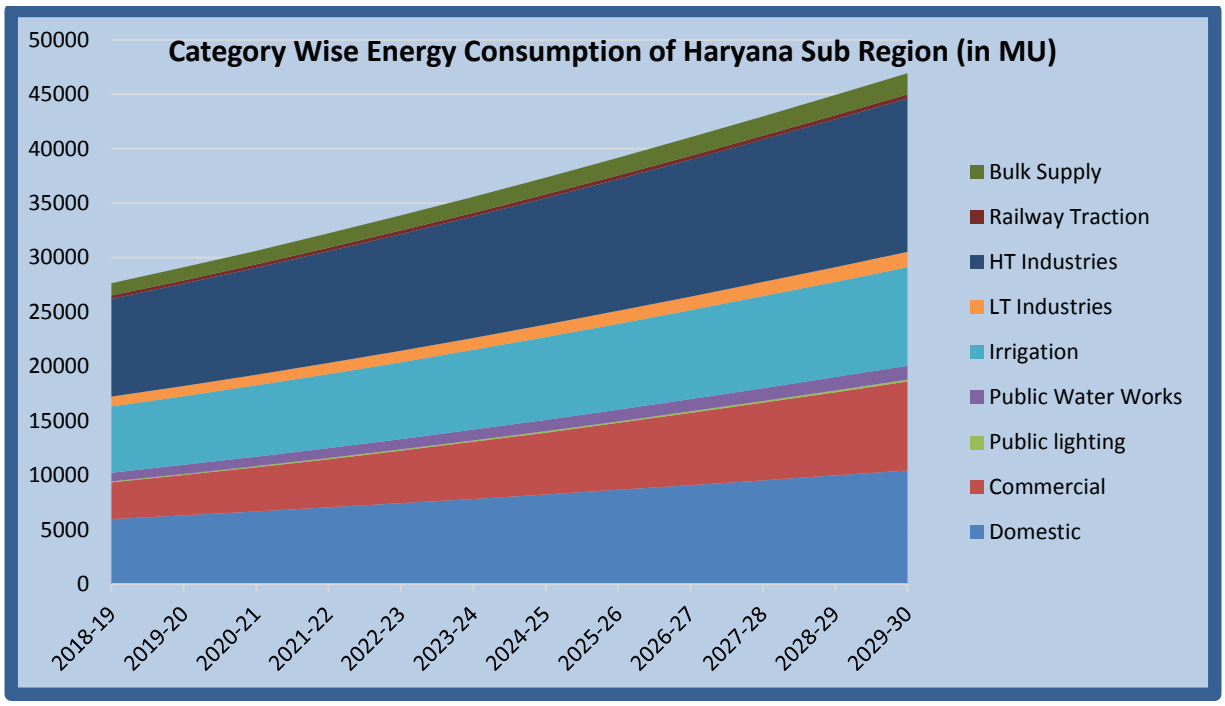
(Figure 27: Energy Requirement Forecast of Haryana Sub-Region)

Peak Demand of this sub-region is expected to see 3.86% CAGR upto 2024-25 and will reach 7899 MW in comparison to 6538 MW in year 2019-20. The Peak Demand is expected to reach 9379 MW in year 2029-30 with a CAGR of 3.49% after 2024-25. The CAGR of peak energy demand for the next ten years (2019-20 to 2029-30) is expected as 3.67%.



(Figure 28: Peak Demand Forecast of Haryana Sub-Region)

The category wise energy consumption forecast of Haryana sub region of NCR are as follows:



(Figure 29: Category Wise Energy Consumption Forecast of Haryana Sub-Region)

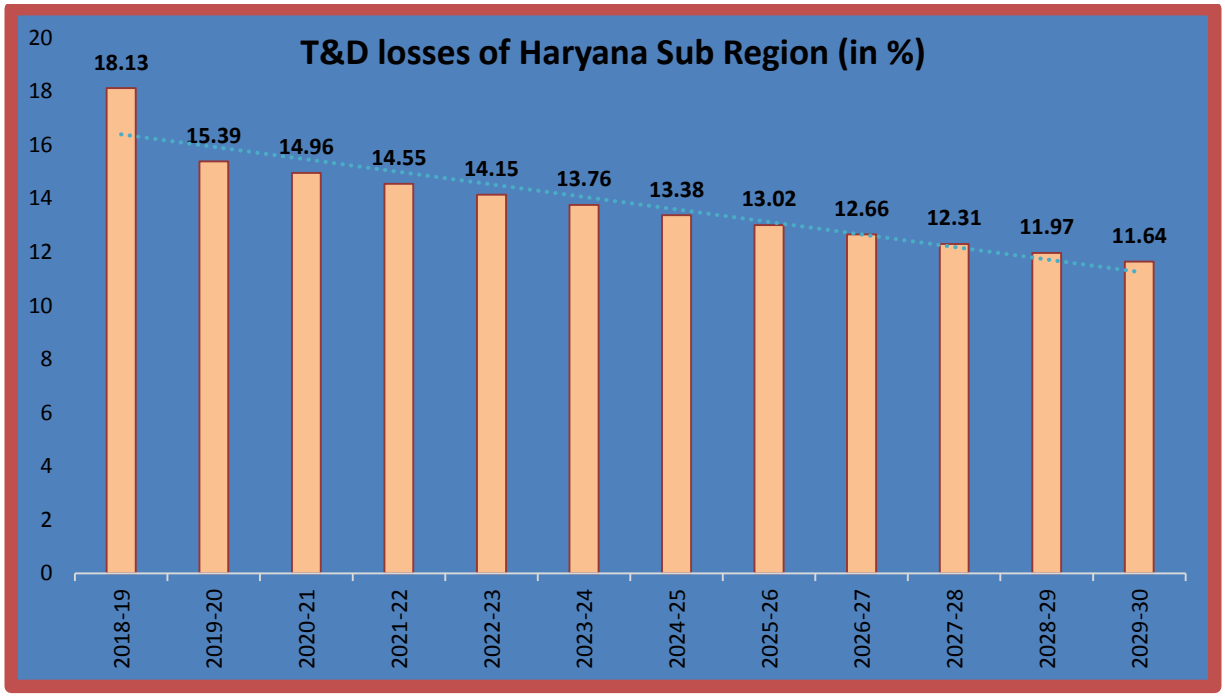
The CAGR expected in the next ten years (2019-20 to 2029-30) along with its break up in five years (2019-20 to 2024-25 & 2024-25 to 2029-30) is tabulated below:

Sl No.	Category	Energy Consumption CAGR in %		
		2019-20 to 2024-25	2024-25 to 2029-30	2019-20 to 2029-30
1.	Domestic	5.44	4.86	5.15
2.	Commercial	9.00	7.50	8.25
3.	Industrial	4.33	3.93	4.13
4.	Irrigation	3.78	3.61	3.70
5.	Others	4.55	4.30	4.43
6.	Total	5.11	4.68	4.89

(Table 16: Expected CAGR of Haryana Sub Region - Category Wise Consumption)

Transmission & Distribution Losses:

T&D losses of Haryana Sub Region was about 33% in 2004-05 that is estimated to come down to 18.13% in year 2018-19. The target level is to bring it down to about 13.38% and 11.64% by the end of 2024-25 & 2029-30 respectively.



(Figure 30: T&D Loss Forecast of Haryana Sub-Region)

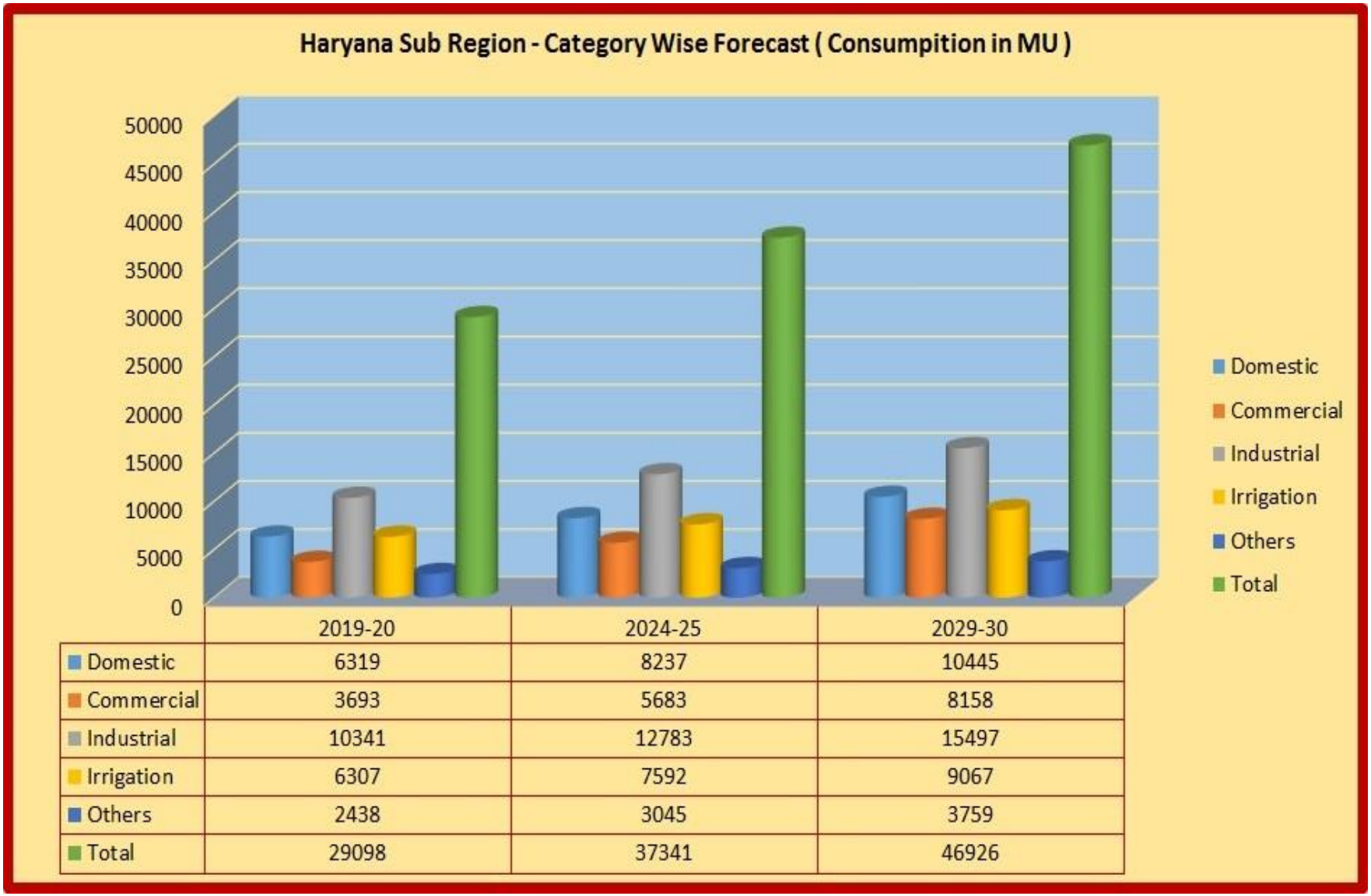
Haryana Sub Region

Electrical Energy Consumption, Energy Requirement and Peak Electricity Demand

(Category Wise and Year Wise Summary)

Year	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30
Domestic	**6319**	6677	7048	7432	7828	8237	8658	9090	9532	9984	10445
Commercial	**3693**	4044	4419	4818	5239	5683	6147	6629	7127	7638	8158
Public lighting	**108**	114	120	125	132	138	144	151	158	164	171
Public Water Works	**831**	870	910	951	994	1038	1083	1130	1178	1228	1279
Irrigation	**6307**	6548	6797	7054	7319	7592	7872	8159	8455	8757	9067
LT Industries	**943**	984	1025	1068	1112	1157	1203	1250	1299	1348	1399
HT Industries	**9398**	9821	10256	10702	11159	11626	12103	12590	13085	13588	14099
Railway Traction	**314**	319	325	331	337	343	349	355	361	367	373
Bulk Supply	**1184**	1248	1314	1382	1453	1527	1604	1683	1765	1849	1936
Total (Energy Consumption)	**29098**	**30624**	**32213**	**33863**	**35573**	**37341**	**39163**	**41037**	**42959**	**44923**	**46926**
T&D losses -MU	**5291**	5388	5486	5582	5677	5770	5860	5947	6031	6110	6183
T&D losses -in %	**15.39**	14.96	14.55	14.15	13.76	13.38	13.02	12.66	12.31	11.97	11.64
Energy Requirement - MU	**34389**	**36012**	**37699**	**39445**	**41250**	**43111**	**45023**	**46984**	**48990**	**51033**	**53109**
Annual Load Factor - %	**60.04**	60.49	60.94	61.39	61.84	62.30	62.76	63.23	63.70	64.17	64.64
Peak Load - MW	**6538**	**6796**	**7062**	**7335**	**7614**	**7899**	**8189**	**8483**	**8780**	**9079**	**9379**

(Table 17: Haryana Sub Region Forecast)



	2019-20	2024-25	2029-30
Domestic	6319	8237	10445
Commercial	3693	5683	8158
Industrial	10341	12783	15497
Irrigation	6307	7592	9067
Others	2438	3045	3759
Total	29098	37341	46926

(Figure 31: Haryana Sub Region Forecast – Category Wise)

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CHAPTER 7

RAJASTHAN SUB REGION OF NCR

The Rajasthan Sub-Region comprises of Alwar & Bharatpur districts that constitute about 24% (13,447 sq. kms.) area of the Region. As per census of 2011, Rajasthan sub-region that consisted of Alwar district only then contributed about 8% of the total NCR population. In 2021, the share is estimated as 10% approximately with total population of 80.50 lakhs that also includes population of the Bharatpur district that was inducted in NCR vide GoI Gazette Notification dated 01.10.2013.

The economy of Alwar district is dependent on Industrial and agricultural sector. However, it is expected that Alwar will observe structural change in its economic activities in the next two decades with more development in the manufacturing sector. Bharatpur, other district of Rajasthan coming under NCR, is dependent on agriculture to a large extent. The industries located in Bharatpur are also primarily dependent on agricultural products such as mustard seed oil industries.[8]

Power Utilities of Rajasthan:

The Government of Rajasthan established Rajasthan Electricity Regulatory Commission on 10th December 1999. The stakeholders of development of power infrastructure in Rajasthan State are:

- Rajasthan Vidyut Utpadan Nigam Limited (RVUNL)
- Rajasthan Rajya Vidyut Prasharan Nigam Limited (RRVPNL)
- Jaipur Vidyut Vitran Nigam Limited (JVVNL)
- Ajmer Vidyut Vitran Nigam Limited (Ajmer VVNL)
- Jodhpur Vidyut Vitran Nigam Limited (JDVVNL)

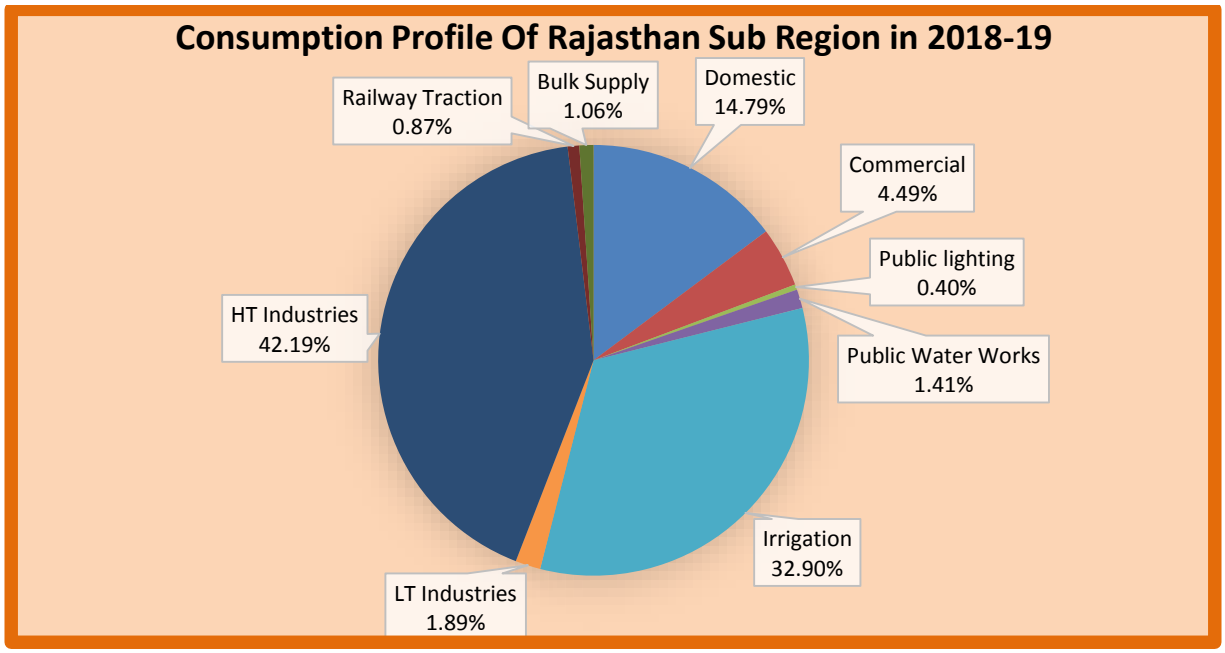
Jaipur Vidyut Vitran Nigam Limited has the responsibility of power distribution in Alwar & Bharatpur districts.

[8] Economic Profile of NCR Report , NCRPB 2015

Existing Power Scenario:

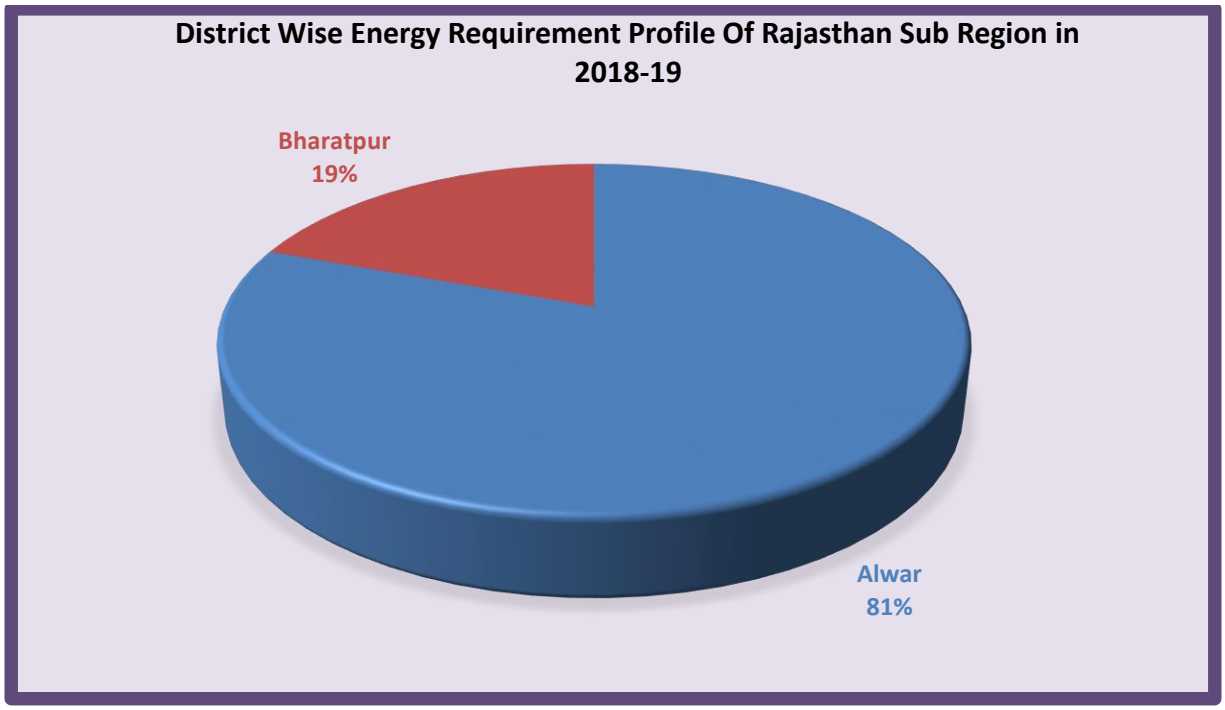
The total electricity consumption of Rajasthan Sub Region of NCR in year 2018-19 was 6075 MU and with 21.05% T&D losses, the requirement was 7704 MU that was 9.68% of the energy requirement of the entire Rajasthan state and 7.84% of the total NCR. During the last four years (2013-14 to 2017-18), the Rajasthan Sub Region has observed annual growth rate of 4.19% in terms of electrical energy requirement. The Peak Demand for this sub region was 1262 MW in year 2018-19.

The category wise consumption profile of this sub region is in complete contrast of other sub regions of NCR. Whereas energy is mostly consumed in the domestic sector in other parts of NCR region, the HT industry and irrigation sector consume most of the electricity in this part of NCR that suggests that economy of this sub region is dependent on industry as well as on agriculture. The HT Industry sector is the biggest consumer of electricity (42%) that clearly indicates presence of various large scale industries in these areas mainly in Alwar district. Irrigation sector is the next one consuming about 33% of electricity. The consumption in domestic sector is very low (9% only) that is in sharp contrast to Delhi-NCT wherein this sector has more than 50% share in energy requirement.



(Figure 32: Energy Consumption Profile of Rajasthan Sub-Region in 2018-19)

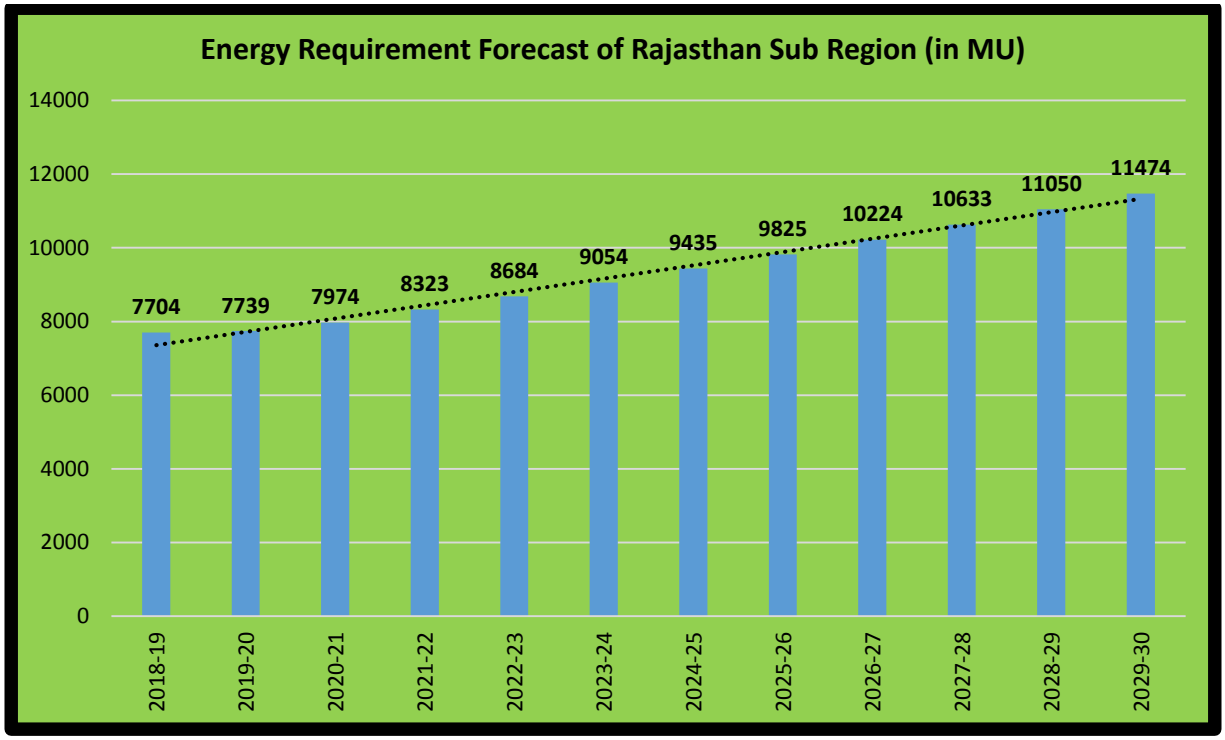
Among the districts of this sub region, the energy requirement of Alwar district alone is more than 4/5th of the total requirement of this sub region whereas the difference in population is not that much in proportion (as per Census 2011, the population of Alwar and Bharatpur were 36.74 & 25.48 lakhs respectively). The higher energy requirement in Alwar district is attributed to presence of a large number of industries there.



(Figure 33: District Wise Energy Requirement Profile of Rajasthan Sub-Region in 2018-19)

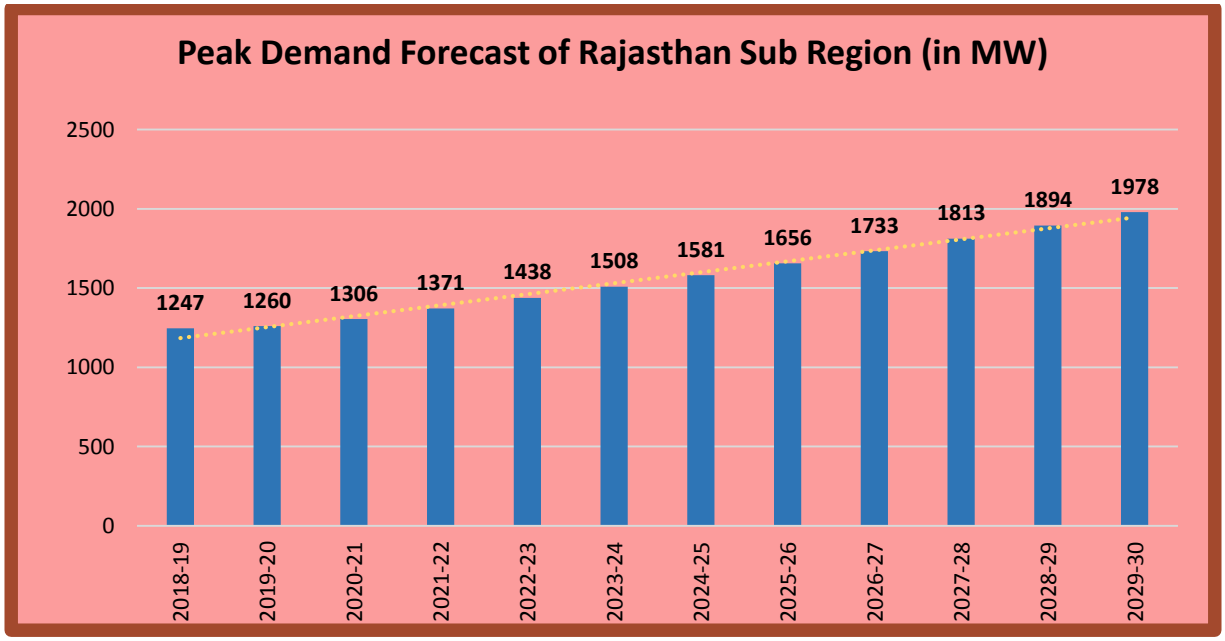
Power Forecast:

Based on total electricity consumption and T&D Losses, the total energy requirement of Rajasthan Sub Region of NCR is estimated as 7739 MU in Year 2019-20. It is expected that the energy requirement of this sub-region will reach to 9435 MU with 4.04% CAGR for the period 2019-20 to 2024-25. With CAGR of 3.99% for the period 2024-25 to 2029-30, its energy requirement is estimated as 11474 MU by the year 2029-30. The CAGR of energy requirement for the next ten years (2019-20 to 2029-30) is expected as 4.02%.



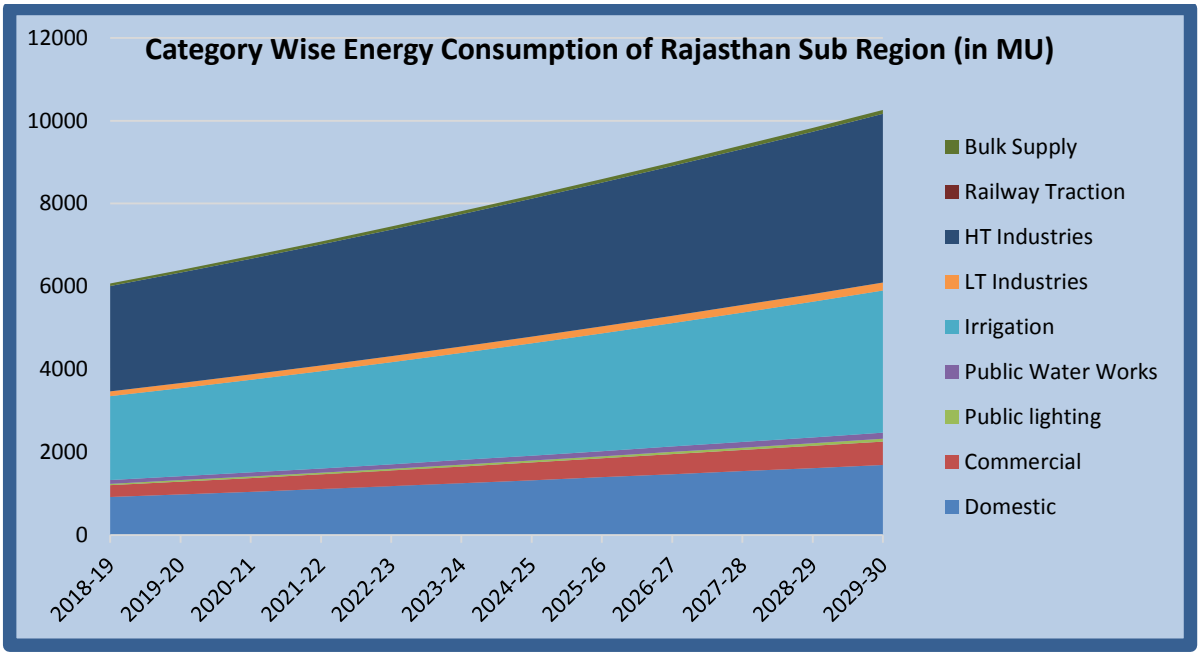
(Figure 34: Energy Requirement Forecast of Rajasthan Sub-Region)

Peak Demand of this sub-region is expected to see 4.64% CAGR upto 2024-25 and will reach 1581 MW in comparison to 1260 MW in year 2019-20. The Peak Demand is expected to reach 1978 MW in year 2029-30 with a CAGR of 4.59% after 2024-25. The CAGR of peak energy demand for the next ten years (2019-20 to 2029-30) is expected as 4.61%.



(Figure 35: Peak Demand Forecast of Rajasthan Sub-Region)

The category wise energy consumption forecast of Rajasthan sub region of NCR are as follows:



(Figure 36: Category Wise Energy Consumption Forecast of Rajasthan Sub-Region)

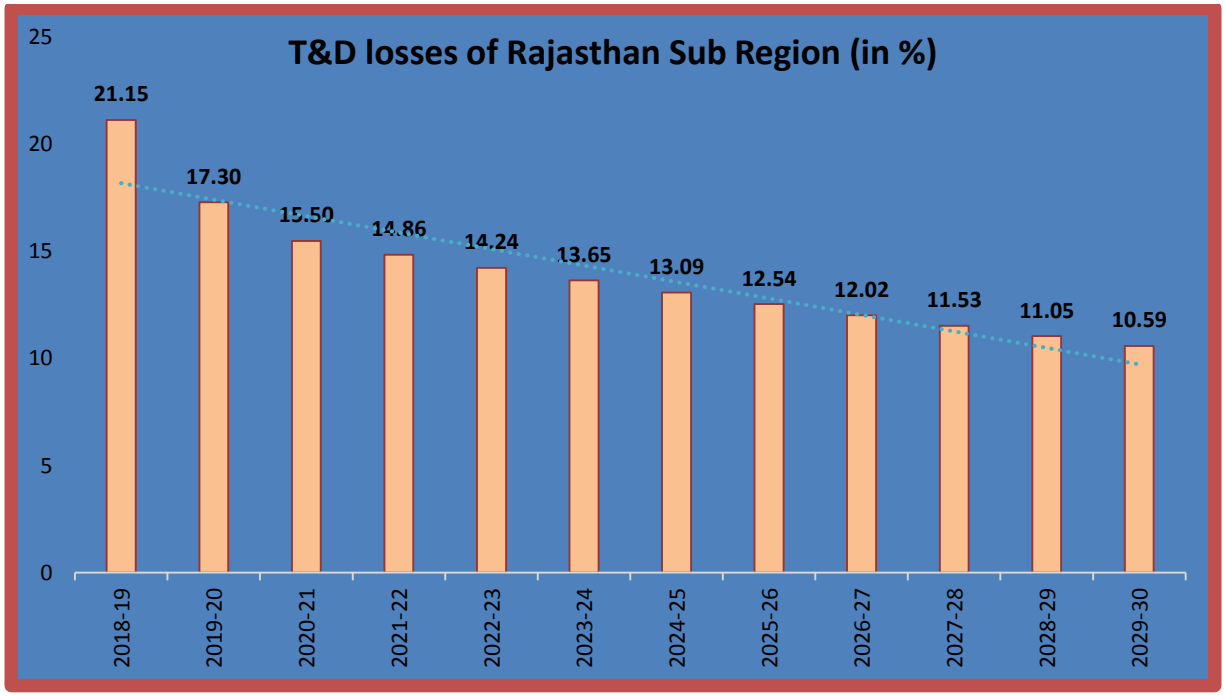
The CAGR expected in the next ten years (2019-20 to 2029-30) along with its break up in five years (2019-20 to 2024-25 & 2024-25 to 2029-30) is tabulated below:

Sl No.	Category	Energy Consumption CAGR in %		
		2019-20 to 2024-25	2024-25 to 2029-30	2019-20 to 2029-30
1.	Domestic	6.20	5.03	5.62
2.	Commercial	6.55	5.79	6.17
3.	Industrial	4.60	4.07	4.34
4.	Irrigation	4.94	4.84	4.89
5.	Others	5.19	4.30	4.74
6.	Total	5.08	4.58	4.83

(Table 18: Expected CAGR of Rajasthan Sub Region - Category Wise Consumption)

Transmission & Distribution Losses:

T&D losses of Rajasthan Sub Region was about 26% in 2004-05 that is estimated to come down to 21.15% in year 2018-19. The target level is to bring it down to about 13.09% and 10.59% by the end of 2024-25 & 2029-30 respectively.



(Figure 37: T&D Loss Forecast of Rajasthan Sub-Region)

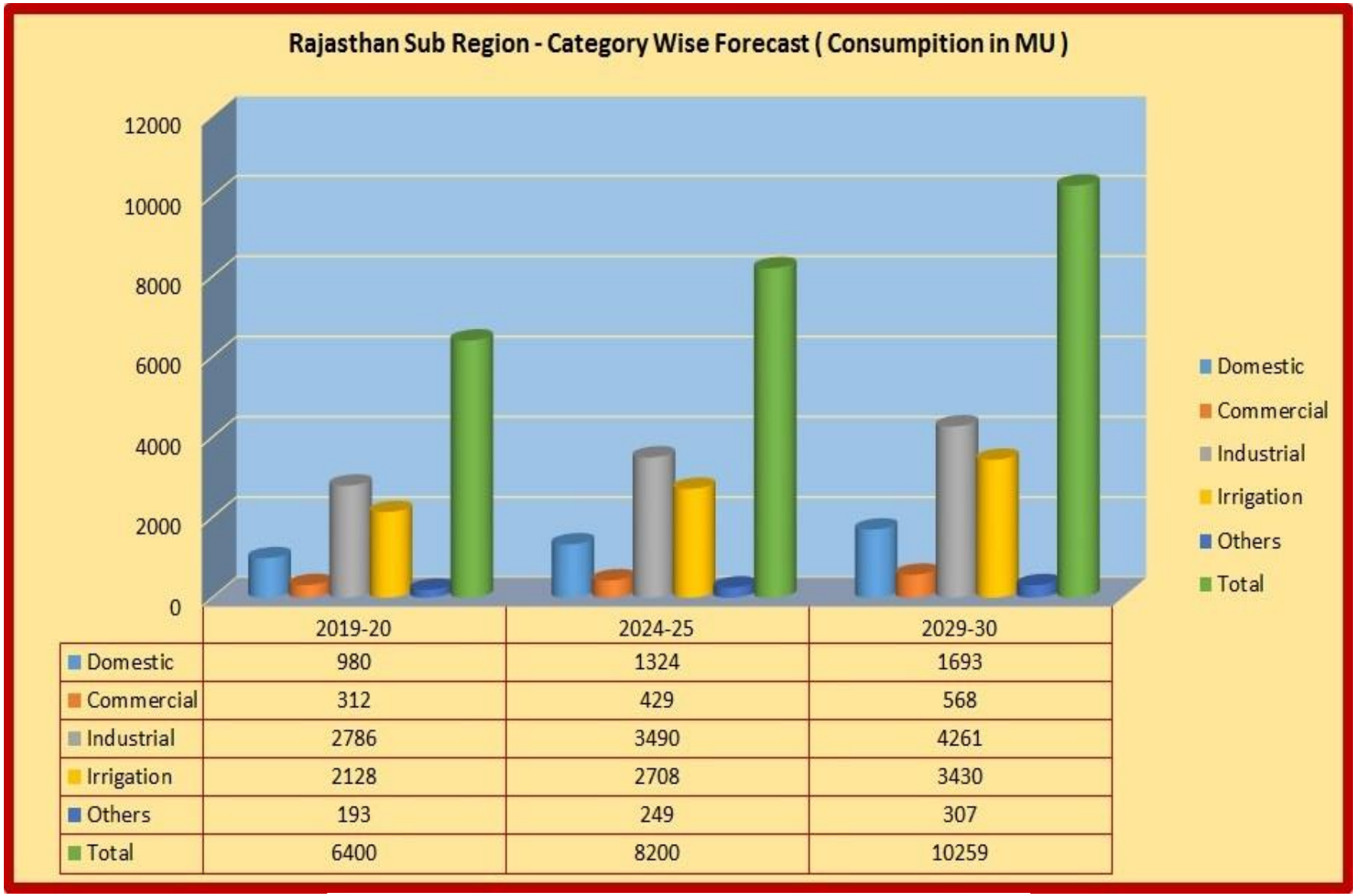
Rajasthan Sub Region

Electrical Energy Consumption, Energy Requirement and Peak Electricity Demand

(Category Wise and Year Wise Summary)

Year	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30
Domestic	**980**	1045	1113	1182	1252	1324	1397	1471	1545	1619	1693
Commercial	**312**	334	356	379	403	429	455	482	510	539	568
Public lighting	**34**	37	40	43	46	49	52	56	59	63	67
Public Water Works	**93**	98	103	108	114	119	124	130	135	141	146
Irrigation	**2128**	2234	2345	2461	2582	2708	2840	2978	3123	3273	3430
LT Industries	**124**	130	137	144	151	158	165	172	180	187	194
HT Industries	**2663**	2790	2921	3055	3192	3332	3474	3619	3766	3916	4067
Railway Traction	**0**	0	0	0	0	0	0	0	0	0	0
Bulk Supply	**66**	69	72	75	78	81	84	87	89	92	95
Total (Energy Consumption)	**6400**	**6738**	**7087**	**7447**	**7818**	**8200**	**8592**	**8995**	**9407**	**9829**	**10259**
T&D losses -MU	**1339**	1236	1237	1237	1236	1235	1232	1229	1225	1221	1215
T&D losses -in %	**17.30**	15.50	14.86	14.24	13.65	13.09	12.54	12.02	11.53	11.05	10.59
Energy Requirement - MU	**7739**	**7974**	**8323**	**8684**	**9054**	**9435**	**9825**	**10224**	**10633**	**11050**	**11474**
Annual Load Factor - %	**70.11**	69.71	69.31	68.92	68.52	68.13	67.74	67.35	66.97	66.58	66.20
Peak Load - MW	**1260**	**1306**	**1371**	**1438**	**1508**	**1581**	**1656**	**1733**	**1813**	**1894**	**1978**

(Table 19: Rajasthan Sub Region Forecast)



	2019-20	2024-25	2029-30
Domestic	980	1324	1693
Commercial	312	429	568
Industrial	2786	3490	4261
Irrigation	2128	2708	3430
Others	193	249	307
Total	6400	8200	10259

(Figure 38: Rajasthan Sub Region Forecast – Category Wise)

CHAPTER 8

UTTAR PRADESH SUB REGION OF NCR

The Uttar Pradesh Sub-Region comprises of eight districts viz. Meerut, Ghaziabad, Gautam Buddha Nagar, Bulandshahr, Baghpat, Hapur, Shamli & Muzaffarnagar that together constitutes about 27% (14,826 sq. kms.) of the Region. This sub-region contributed about 32% of the total NCR population as per census of 2011(consisted of five districts only at that time viz. Meerut, Ghaziabad, Gautam Buddha Nagar, Bulandshahr & Baghpat) and this ratio is expected to remain same in 2021 also with total population of 253.74 lakhs that also includes population of the areas inducted in NCR after 2011 i.e. the areas of Shamli & Muzaffarnagar (Hapur district was earlier a part of Ghaziabad district).

Since 2011, Uttar Pradesh sub-region of NCR has undergone through the following area wise changes:

- Hapur district was carved out from Ghaziabad district on 28 September 2011.

- Muzaffarnagar district was included in NCR vide GoI Gazette Notification dated 24.11.2015.

- Shamli district in Uttar Pradesh, that was separated from Muzaffarnagar district in 2011, was included in NCR vide GoI Notification dated 16.04.2018.

Economically, the two locations namely NOIDA and Greater NOIDA under Gautam Buddha Nagar have emerged as important centre of production for electronics, textiles, engineering, computer software, etc. Due to the support to large number of educational institutions, Greater NOIDA is also known as an Educational Park. The district has all features to become an international

city especially with formula-one track, Yamuna expressway and upcoming international airport. On the other hand, Ghaziabad is an old industrial town and one of the most industrialized cities in Uttar Pradesh. The most dominant sector that is driving the local economy of Ghaziabad district is financial services, insurance, real estate and business services. Philkhawa, a small town in Ghaziabad district, is a centre for making traditional textile items. Hapur district, that was a part of Ghaziabad district recently, is known for its facilities for wheat processing. Bulandshahr district is known for its three important activities i.e. its agriculture, milk production and ceramics. Meerut is an industrial city famous for its scissors, handloom cloths, gold jewellery, sports goods (especially cricket goods). It is an important centre of education with number of educational institutions and universities. Baghpat has a strong agrarian base and is a major centre of gur making in the region. Baraut city of Baghpat district is popularly known for manufacturing of wheels and excels for agriculture vehicles like Buggies and Trollies. Similarly, the Shamli district is also famous for sugar/gur. The economy of the Muzaffarnagar district is mainly based on agriculture; sugarcane, paper and steel industries.[9]

Power Utilities of Uttar Pradesh:

Uttar Pradesh Electricity Board (UPSEB) which was responsible for generation, transmission and distribution of electricity in Uttar Pradesh, was divided into following three companies by the State Government on 14.01.2000 after UP Electricity Reforms Act, 1999 came into effect:

- Uttar Pradesh Power Corporation Limited (UPPCL) to look after procurement and distribution of electricity.
- Uttar Pradesh Power Transmission Corporation Limited (UPPTCL) to look after transmission of electricity.
- Uttar Pradesh Rajya Vidyut Utpadan Nigam Limited (UPRVUNL) to look after power generation from all thermal power projects of the state.

[9] Economic Profile of NCR Report , NCRPB 2015

- Uttar Pradesh Rajya Jal Vidyut Utpadan Nigam Limited (UPRJVUNL) is responsible for hydro power generation in state.

UPPCL has been further divided into following five distribution companies on 12.08.2003:

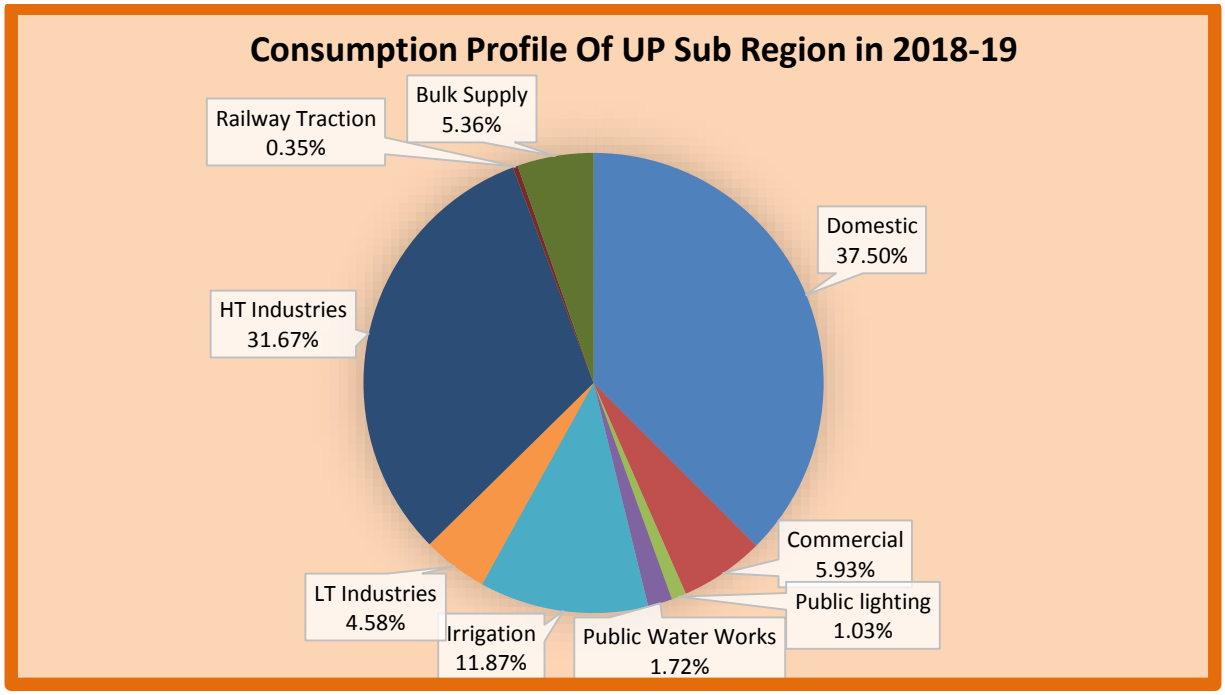
- Madhyanchal Vidyut Vitran Nigam Limited (MVVNL), Lucknow
- Paschimanchal Vidyut Vitran Nigam Limited (PVVNL), Meerut
- Purvanchal Vidyut Vitran Nigam Limited (PuVVNL), Varanasi
- Dakshinanchal Vidyut Vitran Nigam Limited (DVVNL), Agra
- Kanpur Electric Supply Company(KESCO), Kanpur

In addition to the above five DISCOMs, Noida Power Company Limited (NPCL), a joint venture company of RPG group and Greater NOIDA Industrial Development Authority (GNIDA) is distributing power in its licensed area of Greater Noida.

Paschimanchal Vidyut Vitran Nigam Limited (PVVNL) is responsible for distribution of power in 11 districts of Western Uttar Pradesh which includes all eight districts falling under NCR except the Greater NOIDA area.

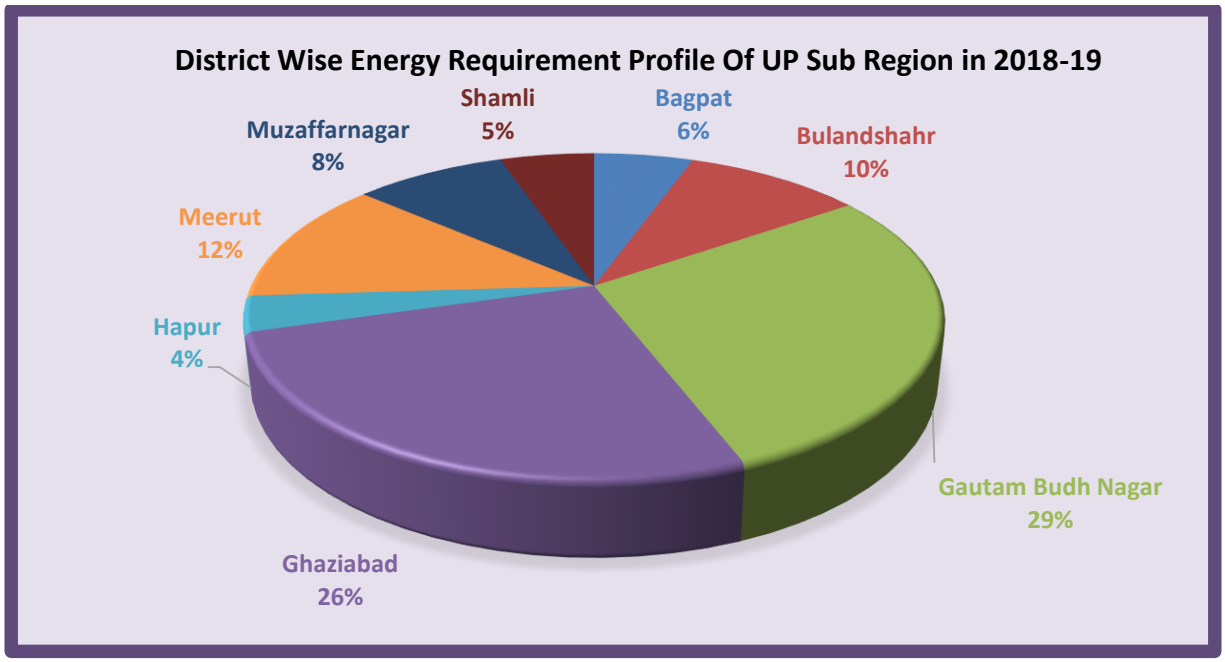
Existing Power Scenario:

The total electricity consumption of Uttar Pradesh Sub Region of NCR in year 2018-19 was 22013 MU and with 10.24 % T&D losses, the requirement was 24524 MU that was 21.11% of the energy requirement of the entire Uttar Pradesh state and 24.96% of the total NCR. During the last four years (2013-14 to 2017-18), the UP Sub Region has observed annual growth rate of 7.26% in terms of electrical energy requirement. The Peak Demand for this sub region was 3831 MW in year 2018-19. Almost two third of total electricity of this sub region was consumed in the domestic and the industrial category with domestic sector was the dominant one (37.5%). This profile is similar to overall NCR scenario but in contrast to Delhi NCT wherein domestic and commercial sector consumes major portion of electricity.



(Figure 39: Energy Consumption Profile of UP Sub-Region in 2018-19)

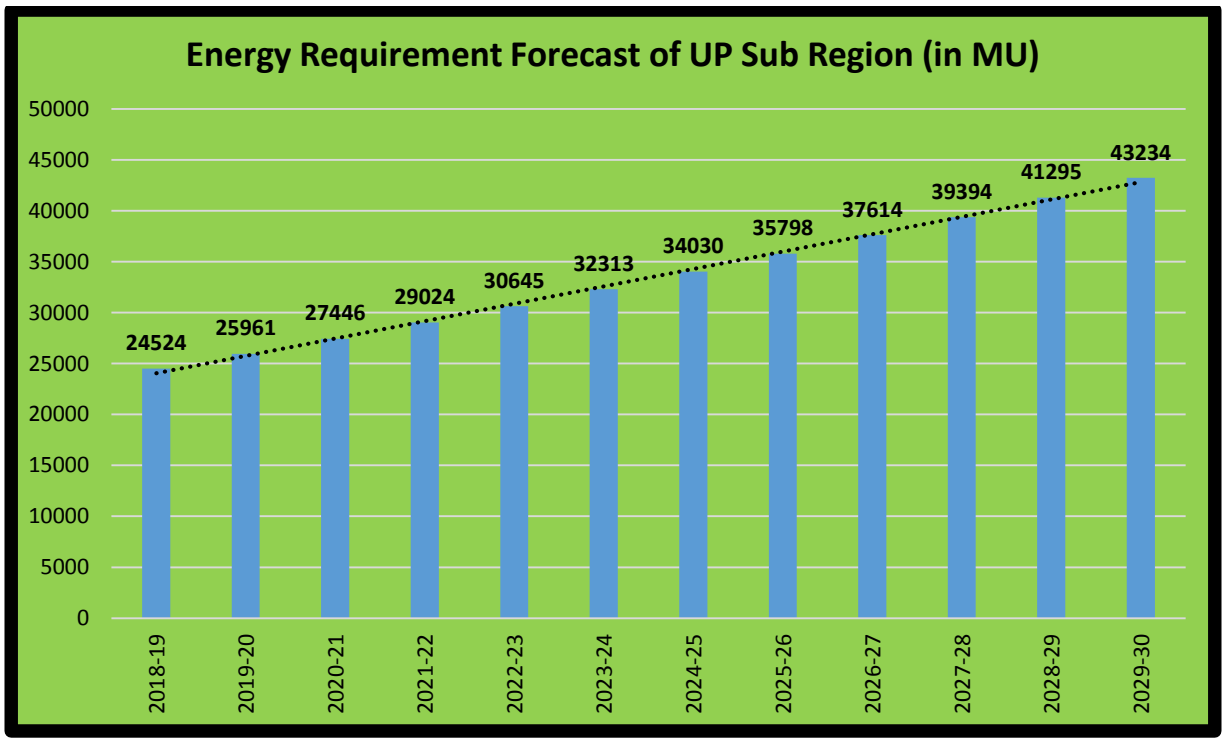
Among the districts of this sub region, the energy requirement of Ghaziabad and Gautam Buddha Nagar are very similar and together these two districts had more than half of the total energy requirement of this sub region. The energy requirement shares of Meerut and Bulandshahr were in the range of 10-12 % whereas shares of Shamli, Bhagpat and Hapur districts were in the range of 4-6 % only.



(Figure 40: District Wise Energy Requirement Profile of UP Sub-Region in 2018-19)

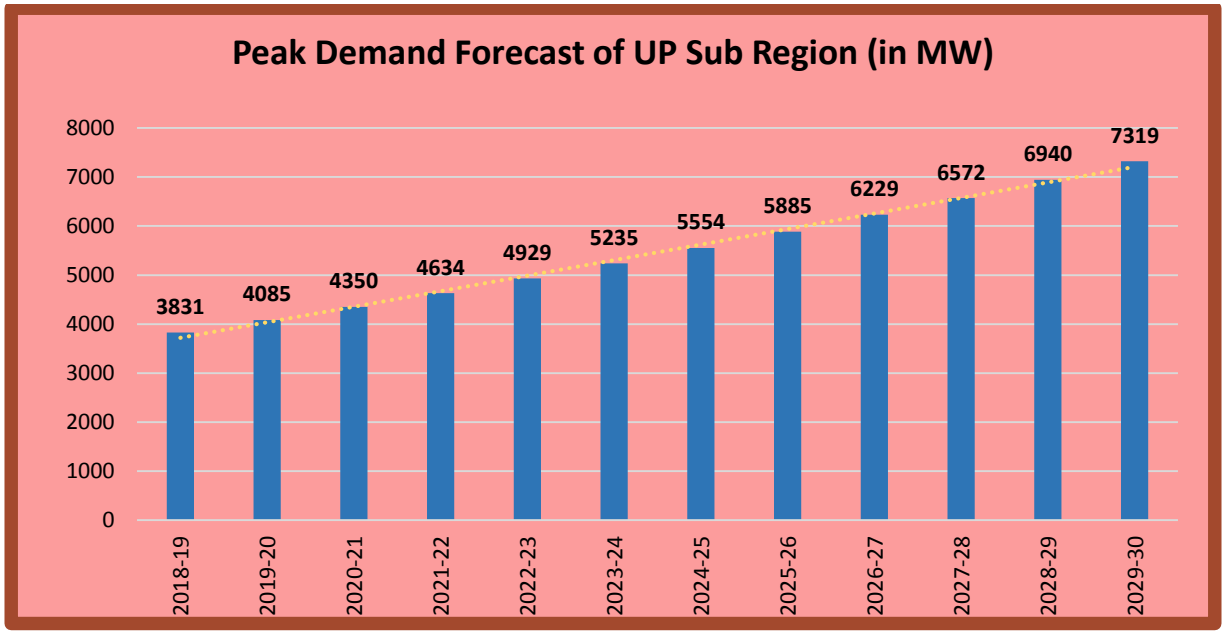
Power Forecast:

Based on total electricity consumption and T&D Losses, the total energy requirement of Uttar Pradesh Sub Region of NCR is estimated as 25961 MU in Year 2019-20. It is expected that the energy requirement of this sub-region will reach to 34030 MU with 5.56% CAGR for the period 2019-20 to 2024-25. With CAGR of 4.90% for the period 2024-25 to 2029-30, its energy requirement is estimated as 43234 MU by the year 2029-30. The CAGR of energy requirement for the next ten years (2019-20 to 2029-30) is expected as 5.23%.



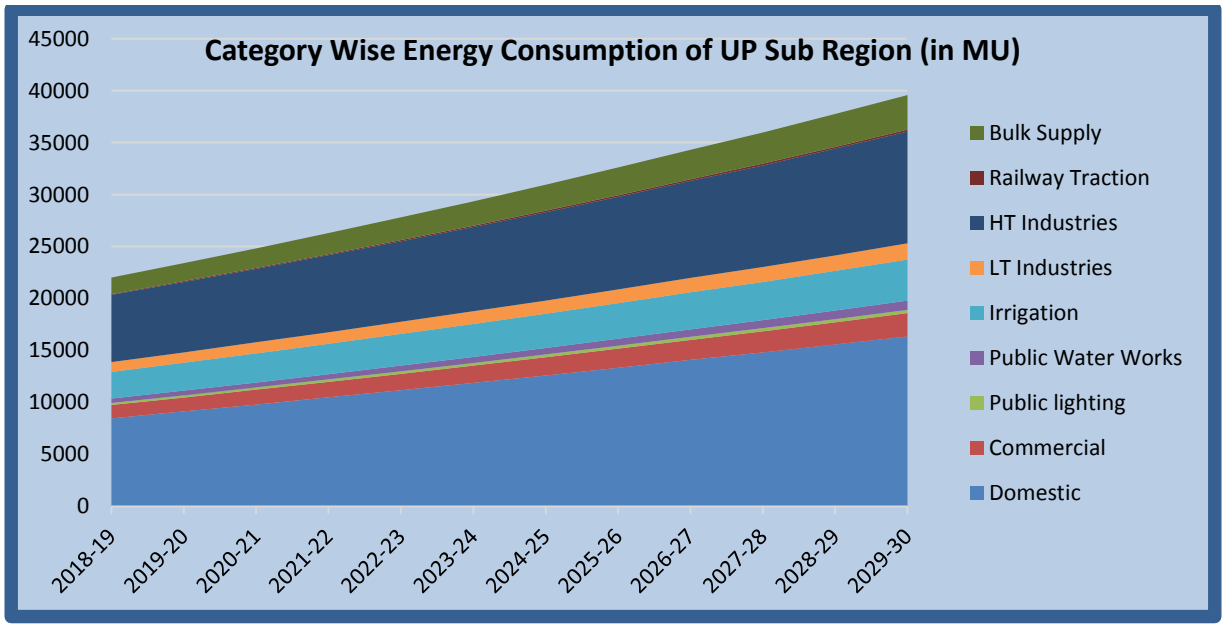
(Figure 41: Energy Requirement Forecast of UP Sub-Region)

Peak Demand of this sub-region is expected to see 6.34% CAGR upto 2024-25 and will reach 5554 MW in comparison to 4085 MW in year 2019-20. The Peak Demand is expected to reach 7319 MW in year 2029-30 with a CAGR of 5.67% after 2024-25. The CAGR of peak energy demand for the next ten years (2019-20 to 2029-30) is expected as 6.01%.



(Figure 42: Peak Demand Forecast of UP Sub-Region)

The category wise energy consumption forecast of UP sub region of NCR are as follows:



(Figure 43: Category Wise Energy Consumption Forecast of UP Sub-Region)

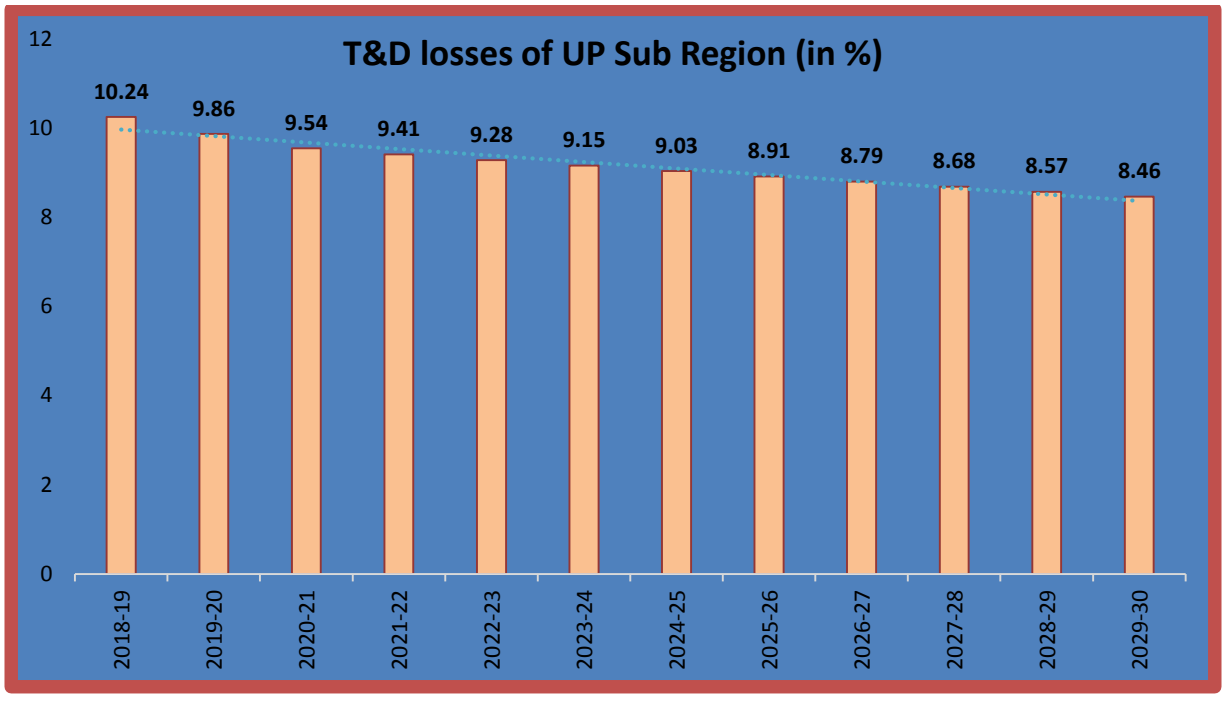
The CAGR expected in the next ten years (2019-20 to 2029-30) along with its break up in five years (2019-20 to 2024-25 & 2024-25 to 2029-30) is tabulated below:

Sl No.	Category	Energy Consumption CAGR in %		
		2019-20 to 2024-25	2024-25 to 2029-30	2019-20 to 2029-30
1.	Domestic	6.65	5.32	5.98
2.	Commercial	5.43	5.12	5.27
3.	Industrial	4.70	4.74	4.72
4.	Irrigation	4.23	3.78	4.00
5.	Others	7.40	5.89	6.64
6.	Total	5.76	5.03	5.40

(Table 20: Expected CAGR of UP Sub Region - Category Wise Consumption)

Transmission & Distribution Losses:

T&D losses of Uttar Pradesh Sub Region was about 33% in 2004-05 that is estimated to come down to 10.24% in year 2018-19. The target level is to bring it down to about 9.03% and 8.46% by the end of 2024-25 & 2029-30 respectively.



(Figure 44: T&D Loss Forecast of UP Sub-Region)

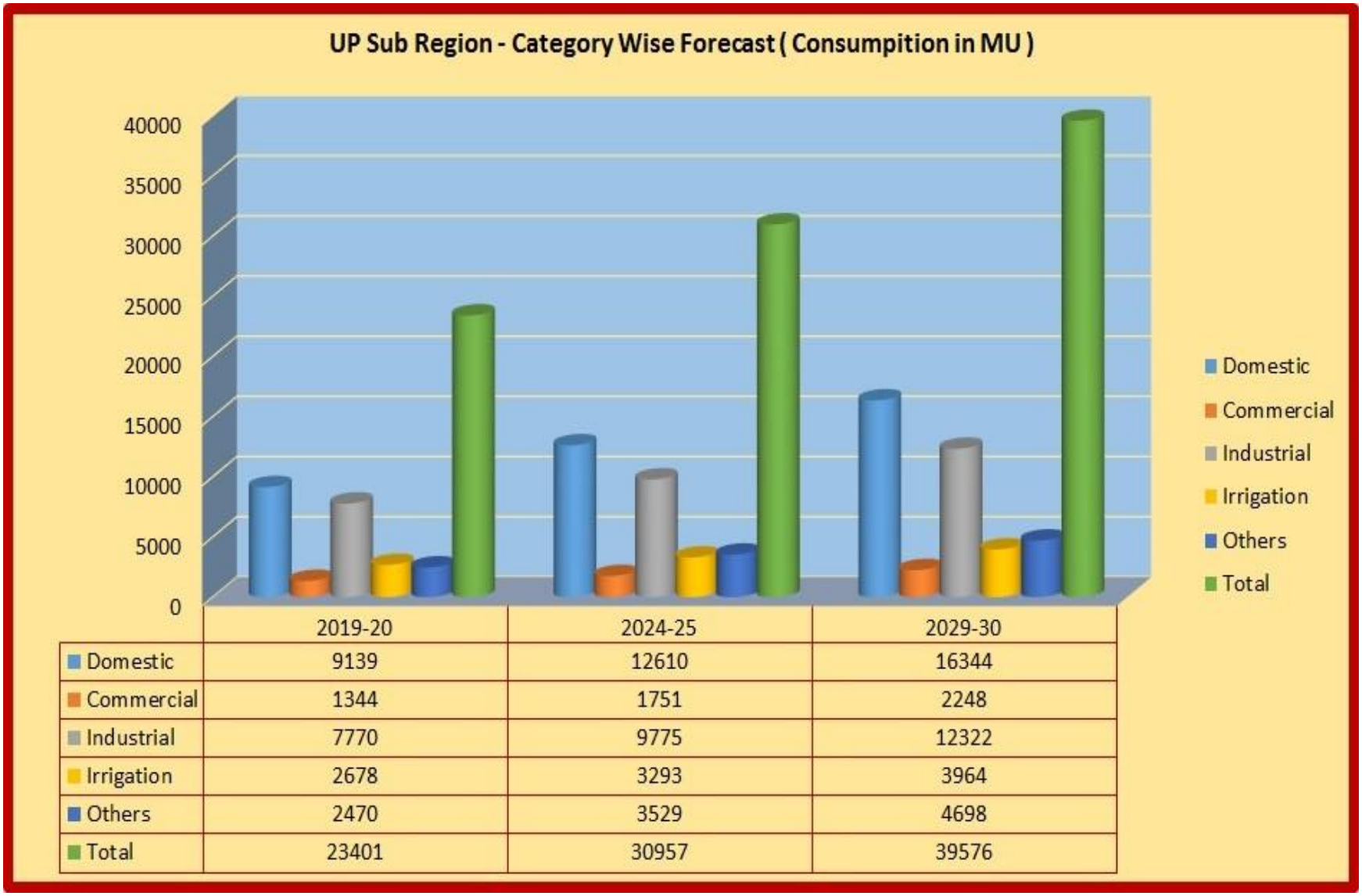
Uttar Pradesh Sub Region

Electrical Energy Consumption, Energy Requirement and Peak Electricity Demand

(Category Wise and Year Wise Summary)

Year	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30
Domestic	**9139**	9809	10490	11183	11890	**12610**	13344	14091	14817	15579	**16344**
Commercial	**1344**	1421	1500	1581	1664	**1751**	1842	1937	2033	2138	**2248**
Public lighting	**215**	225	234	244	255	**265**	276	288	299	311	**323**
Public Water Works	**441**	473	506	542	580	**621**	665	712	761	815	**873**
Irrigation	**2678**	2798	2918	3040	3165	**3293**	3425	3561	3674	3817	**3964**
LT Industries	**1010**	1061	1114	1167	1221	**1276**	1331	1388	1442	1499	**1555**
HT Industries	**6759**	7071	7400	7747	8112	**8499**	8906	9336	9783	10262	**10767**
Railway Traction	**86**	93	100	108	117	**126**	137	148	159	170	**183**
Bulk Supply	**1727**	1876	2030	2189	2351	**2516**	2681	2845	3008	3166	**3319**
Total (Energy Consumption)	**23401**	**24827**	**26293**	**27801**	**29356**	**30957**	**32608**	**34306**	**35975**	**37757**	**39576**
T&D losses -MU	**2560**	2619	2731	2843	2957	**3073**	3190	3307	3419	3538	**3657**
T&D losses -in %	**9.86**	9.54	9.41	9.28	9.15	9.03	8.91	8.79	8.68	8.57	8.46
Energy Requirement - MU	**25961**	**27446**	**29024**	**30645**	**32313**	**34030**	**35798**	**37614**	**39394**	**41295**	**43234**
Annual Load Factor - %	**72.55**	72.02	71.50	70.98	70.46	**69.95**	69.44	68.93	68.43	67.93	**67.43**
Peak Load - MW	**4085**	**4350**	**4634**	**4929**	**5235**	**5554**	**5885**	**6229**	**6572**	**6940**	**7319**

(Table 21: Uttar Pradesh Sub Region Forecast)



	2019-20	2024-25	2029-30
Domestic	9139	12610	16344
Commercial	1344	1751	2248
Industrial	7770	9775	12322
Irrigation	2678	3293	3964
Others	2470	3529	4698
Total	23401	30957	39576

(Figure 45: Uttar Pradesh Sub Region Forecast – Category Wise)

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CHAPTER 9

ANALYSIS OF THE RESULTS

1. The slower growth trajectory:

During the time of 18th EPS (i.e. 2010-11), NCR was witnessing higher growth in energy consumption. The CAGR for the last five years during that time was about 11% for the whole NCR with Delhi-NCT, Haryana Sub Region, Rajasthan Sub Region and UP Sub Region recording 8%, 12%, 20% & 12% CAGR respectively. Based on the trends prevailing at that time, 18th EPS forecast indicated that energy requirement of NCR would witness CAGR of 8.31% during 2011-12 to 2016-17 & thereafter 6.82% for the next five years. The CAGRs for peak demand were estimated as 7.66% & 6.79% respectively. In comparison, the energy requirement growth witnessed during 2011-12 to 2016-17 was 6.78% only. The fall in CAGR were more in recent years. The CAGR of energy requirement for 2009-10 to 2013-14, 2013-14 to 2017-18 & 2009-10 to 2017-18 for all the sub regions are tabulated below that clearly suggest an appreciable downfall in CAGR in the recent times. Another distinct trait quite observable is the convergence of CAGR of all the sub regions.

Sl. No.	Constituents	Energy Requirement CAGR in %		
		2009-10 to 2013-14	2013-14 to 2017-18	2009-10 to 2017-18
1.	NCT-Delhi	3.87	3.74	3.81
2.	Haryana Sub-region	11.14	4.58	7.81
3.	Rajasthan Sub-region	7.10	4.19	5.64
4.	Uttar Pradesh Sub-region	9.90	7.26	10.73
	Total (NCR)	8.56	4.87	6.70

(Table 22: Actual Energy Requirement CAGR of NCR – 2009 to 2017)

Based on the recent trends witnessed in the energy requirement, this report forecast slower CAGR for the next ten years for the energy requirement for the whole NCR as well as for all the sub regions of NCR individually also.

Sl. No.	Constituents	Energy Requirement CAGR (in %)		
		2019-20 to 2024-25	2024-25 to 2029-30	2019-20 to 2029-30
1.	NCT-Delhi	3.27	3.03	3.15
2.	Haryana Sub-region	4.62	4.26	4.44
3.	Rajasthan Sub-region	4.04	3.99	4.02
4.	Uttar Pradesh Sub-region	5.56	4.90	5.23
	Total (NCR)	**4.38**	**4.03**	**4.20**

(Table 23: Energy Requirement CAGR Forecast of NCR – 2019 to 2029)

The CAGR of peak demand for 2019-20 to 2024-25, 2024-25 to 2029-30 & 2019-20 to 2029-30 for all the sub regions are tabulated below that is suggesting very similar trends as of energy requirement.

Sl. No.	Constituents	Peak Demand CAGR (in %)		
		2019-20 to 2024-25	2024-25 to 2029-30	2019-20 to 2029-30
1.	NCT-Delhi	4.97	4.73	4.85
2.	Haryana Sub-region	3.86	3.49	3.67
3.	Rajasthan Sub-region	4.64	4.59	4.61
4.	Uttar Pradesh Sub-region	6.34	5.67	6.01
	Total (NCR)	**6.14**	**5.78**	**5.96**

(Table 24: Peak Demand CAGR Forecast of NCR – 2019 to 2029)

The slower trend of energy growth in the recent past is also visible in almost all parts of the country. The energy Requirement CAGR of NCR vis-à-vis NR & All India for the period of 2009-10 to 2017-18 is shown below:

Sl. No.	Constituents	Energy Requirement CAGR in %		
		2009-10 to 2013-14	2013-14 to 2017-18	2009-10 to 2017-18
1.	NCR	8.56	4.87	6.70
2.	NR	6.67	5.89	6.28
3.	All India	6.48	5.85	6.16

(Table 25: Energy Requirement CAGR of NCR vis-à-vis NR & All India in Past)

The decreased energy demand could be explained on account of following reasons:

1. Slower Growth of Delhi-NCT.
2. Changing Rural-Urban Profile of NCR.
3. Reduction in T&D losses.

1.1. Slower Growth of Delhi-NCT:

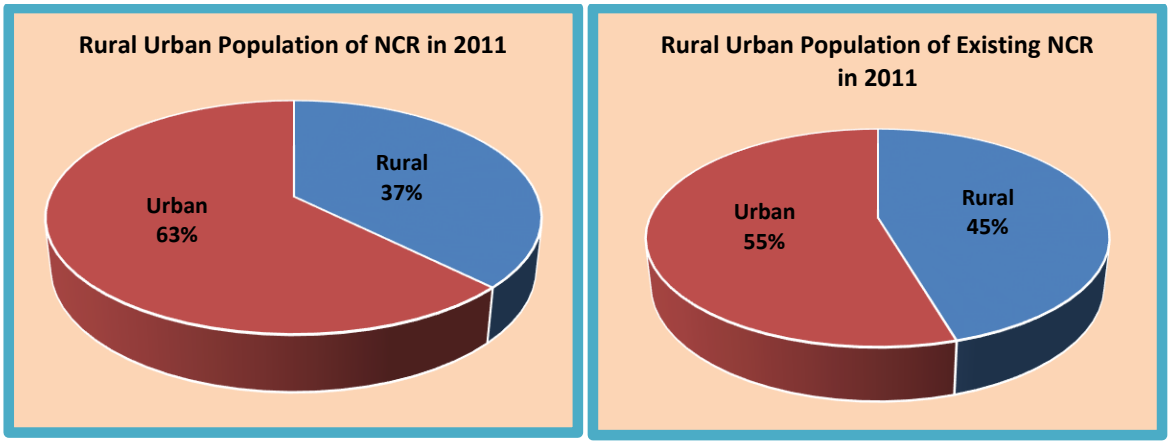
The growth of NCR in comparison to Northern Region and also with respect to all India was comparatively low during 2013-14 to 2017-18 as evident from the Table 25 above. The possible explanation could be lesser growth witnessed in the Delhi-NCT (3.74%) that contributes a major part of electrical energy requirement of the whole NCR (about 33%). The electrical energy requirement of other areas of NCR (excluding Delhi) witnessed 5.46% CAGR for the same period that was comparable to the growth recorded for Northern Region and All India. The reason for Delhi-NCT witnessing lesser growth could be attributed to its already high demand that is reflecting even a higher increase in the quantum of energy requirement also into lower growth rate.

Sl. No.	Constituents	Energy Requirement CAGR in %		
		2009-10 to 2013-14	2013-14 to 2017-18	2009-10 to 2017-18
1.	Delhi - NCT	3.87	3.74	3.81
2.	NCR (excluding Delhi – NCT)	11.59	5.46	8.48

(Table 26: Energy Requirement CAGR of Delhi-NCT vis-à-vis Other NCR Area)

1.2. Changing Rural-Urban Profile of NCR:

Another reason for slower growth witnessed in the NCR region during 2013-14 to 2017-18 was its changed demography because of inclusion of additional areas. The districts added during this period i.e. Bhiwani, Charkhi Dadri, Mahendragarh, Jind and Karnal districts in Haryana, Bharatpur in Rajasthan and Hapur, Shamli & Muzaffarnagar in Uttar Pradesh – all are having more rural population that has now changed the predominantly urban fabric of the NCR demography.



(Figure 46: Changing Rural-Urban Profile of NCR)

Sl. No.	Area	Population (As Per Census 2011)			%	
		Rural	Urban	Total	Rural	Urban
1.	NCR in 2011	172,34,321	288,34,982	460,69,303	37.41	62.59
2.	Additional Area	91,87,002	29,00,981	120,87,983	76.00	24.00
3.	Existing NCR	264,21,323	317,35,963	581,57,286	45.43	54.57
4.	All India	833748852	377106125	12108,54,977	68.86	31.14

(Table 27: Changing Rural-Urban Profile of NCR)

1.3. Reduction in T&D losses:

The NCR region has witnessed reduction in T&D losses during the past years. The losses were 21% in 2009-10 that is estimated to reduced to 14.68% only in year 2018-19. The energy saved on account of reduced T&D losses is reflecting in reduced energy requirement.

2. NCR Growth vis-à-vis NR & All India Growth (Forecast):

The energy requirement of NCR is projected to increase with CAGR of 4.38% & 4.03% for the period 2019-20 to 2024-25 & 2024-25 to 2029-30 respectively (Table 23) in view of the growth trends witnessed in the region in the recent past. This projected CAGR of NCR is comparatively on the lower side with respect to CAGR of Northern Region and All India as forecast in the first volume of 19th EPS Report (Table 28).

Sl. No.	Constituents	Energy Requirement CAGR in %		
		2016-17 to 2021-22	2021-22 to 2026-27	2026-27 to 2031-32
1.	NR	5.60	5.65	4.24
2.	All India	6.18	5.51	4.33

(Table 28: Forecast of Energy Requirement CAGR of NR & All India)

However, in case of peak demand, the CAGR of NCR are expected as 6.14% & 5.78% for the period of 2019-20 to 2024-25 and 2024-25 to 2029-30 respectively (Table 24), that is comparable to the CAGR expected for Northern Region and All India (Table 29).

Sl. No.	Constituents	Peak Demand CAGR in %		
		2016-17 to 2021-22	2021-22 to 2026-27	2026-27 to 2031-32
1.	NR	5.82	5.67	4.11
2.	All India	6.88	5.77	4.40

(Table 29: Forecast of Peak Demand CAGR of NR & All India)

3. Category Wise CAGR of Each Sub Region:

The comparison of CAGR of each Sub Regions projected for the year 2019-20 to 2029-30 indicates the highest growth in UP Sub Region followed by Haryana. All the sub regions are expected to witness higher growth compared to Delhi- NCT. The commercial sector of Haryana Sub Region is expected to witness very high CAGR compared to other sub regions. The irrigation sector in Delhi NCT is expected to see negative growth.

Sl. No.	Category	Energy Consumption CAGR (in %) for 2019-20 to 2024-25				
		Delhi NCT	Haryana Sub Region	Rajasthan Sub Region	UP Sub Region	NCR (Total)
1.	Domestic	4.27	5.44	6.20	6.65	5.25
2.	Commercial	2.67	9.00	6.55	5.43	4.97
3.	Industrial	2.48	4.33	4.60	4.70	4.22
4.	Irrigation	-2.22	3.78	4.94	4.23	4.10
5.	Others	3.65	4.55	5.19	7.40	5.14
6.	Total	3.59	5.11	5.08	5.76	4.78

(Table 30: Energy Consumption CAGR Forecast of NCR – 2019 to 2024)

Sl. No.	Category	Energy Consumption CAGR (in %) for 2024-25 to 2029-30				
		Delhi NCT	Haryana Sub Region	Rajasthan Sub Region	UP Sub Region	NCR (Total)
1.	Domestic	3.62	4.86	5.03	5.32	4.44
2.	Commercial	2.56	7.50	5.79	5.12	4.68
3.	Industrial	2.28	3.93	4.07	4.74	4.00
4.	Irrigation	-2.16	3.61	4.84	3.78	3.89
5.	Others	3.67	4.30	4.30	5.89	4.63
6.	Total	3.22	4.68	4.58	5.03	4.31

(Table 31: Energy Consumption CAGR Forecast of NCR – 2025 to 2029)

Sl. No.	Category	Energy Consumption CAGR (in %) for 2019-20 to 2029-30				
		Delhi NCT	Haryana Sub Region	Rajasthan Sub Region	UP Sub Region	NCR (Total)
1.	Domestic	3.94	5.15	5.62	5.98	4.85
2.	Commercial	2.61	8.25	6.17	5.27	4.83
3.	Industrial	2.38	4.13	4.34	4.72	4.11
4.	Irrigation	-2.19	3.70	4.89	4.00	4.00
5.	Others	3.66	4.43	4.74	6.64	4.88
6.	Total	3.40	4.89	4.83	5.40	4.55

(Table 32: Energy Consumption CAGR Forecast of NCR – 2019 to 2029)

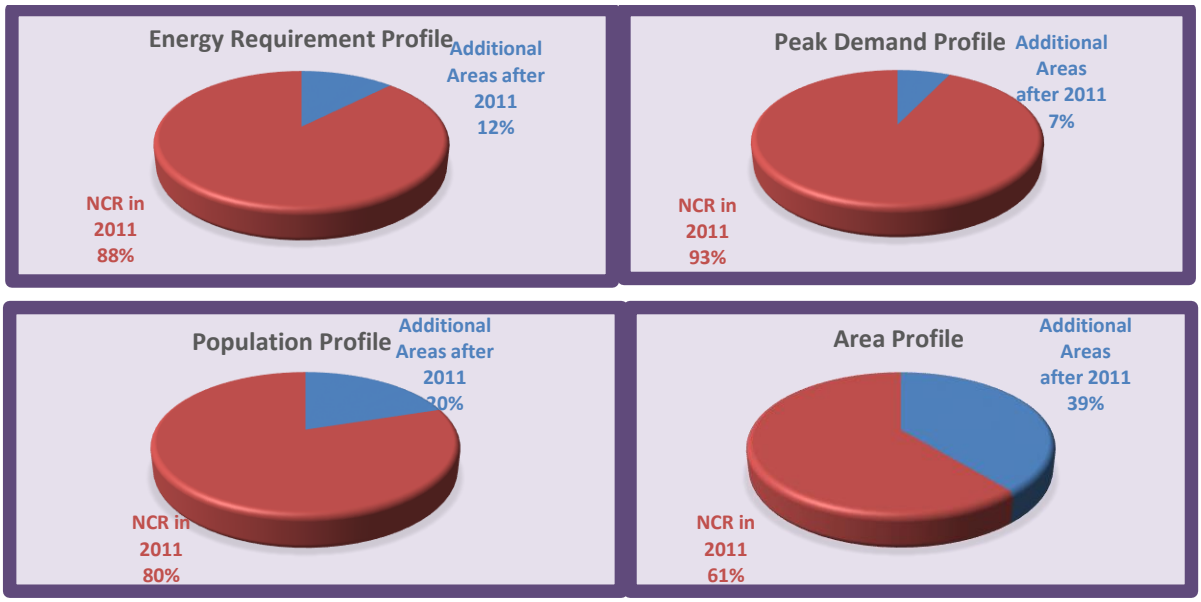
4. Growth of NCR as existed in 2011-12:

As the geographical area of NCR has undergone through several changes in recent times, a comparative study of the power demand and population of the areas of NCR existed in 2011-12 & existing in 2018-19 has been done that is tabulated below. It indicates that due to increase of 64.04% additional area in NCR, there were 46.52% increase in population, 54.27 % increase in peak demand and 65.26% increase in energy requirement. The same increase would have been only 17.17%, 43.29% and 44.64% respectively if the additional areas had not been included in the NCR in between.

Sl. No.	Particulars	2011-12	2018-19		% change during 2011-12 to 2018-19 w.r.t. NCR as in 2011-12	
		For NCR As in 2011-12	For NCR As in 2018-19	For NCR As in 2011-12	For NCR As in 2018-19	For NCR As in 2011-12
1.	Energy Requirement (in MU)	59466	98271	86009	65.26	44.64
2.	Peak Demand (in MW)	10002	15430	14332	54.27	43.29
3.	Population (in Lakhs)	460	674	539	46.52	17.17
4.	Area (in sq km)	33,578	55,083	33,578	64.04	0.00

(Table 33: Growth of NCR as existed in 2010-11)

In the CAGR term, the energy requirement and peak demand appeared to be grown as 7.44% and 6.39% respectively for the period 2011-12 to 2018-19. However, energy requirement had actually grown with 5.41% and peak demand with 5.27% CAGR only if we exclude the additional areas. In terms of quantum of power, the additional areas had contributed in increasing the energy requirement and peak demand of NCR by 12262 MU and 1098 MW respectively.



(Figure 47: NCR Profile in 2018-19 for the areas as in 2011 and additional areas included thereafter)

5. Impact on energy requirement for the areas included in NCR in 2013:

Three districts viz. Bhiwani and Mahendragarh districts in the state of Haryana and Bharatpur district in the state of Rajasthan were included in the NCR in year 2013. The combined CAGR of energy requirement for all these three districts for the past four years before their inclusion in NCR (2008-09 to 2012-13) was 5.90% only that increased thereafter to 8.22% for the next four years (2012-13 to 2016-17). It clearly indicates the positive impact of inclusion of these areas in NCR.

Sl. No.	Year	Energy Requirement CAGR (Bhiwani + Mahendragarh + Bharatpur)
1.	2008-09 to 2012-13	5.90%
2.	2012-13 to 2016-17	8.22%

(Table 34: Energy Requirement CAGR of the areas included in NCR in 2013)

6. NCR Comparison with States similar in Population & Area:

NCR is comparable to Gujarat & Karnataka State in terms of population and Himachal Pradesh & Uttarakhand with respect to area. The comparative statement of all these four states and NCR in terms of Energy Requirement & Peak Demand for the year 2018-19 is tabulated below. The population of these states are shown as per Census 2011. For NCR, the population as per Census 2011 has been shown for all the existing area presently falling under NCR.

Sl. No.	State/Region	Population (As per Census 2011)	Area in 2018-19 (sq kms)	Energy Requirement in 2018-19 (MU)	Peak Demand in 2018-19 (MW)
1.	Gujarat	60,439,692	196,244	11,6356	16,963
2.	Karnataka	61,095,297	342,239	71,695	12,877
3.	Himachal Pradesh	6,864,602	55,673	9,618	1,700
4.	Uttarakhand	10,086,292	53,483	13,753	2,216
5.	NCR	58,157,286	55,083	98,271	15,430

(Table 35: NCR Comparison with States similar in Population & Area)

The above table suggests that energy profile of NCR is resembling the Gujarat state. The population of NCR is about 96% population of Gujarat whereas

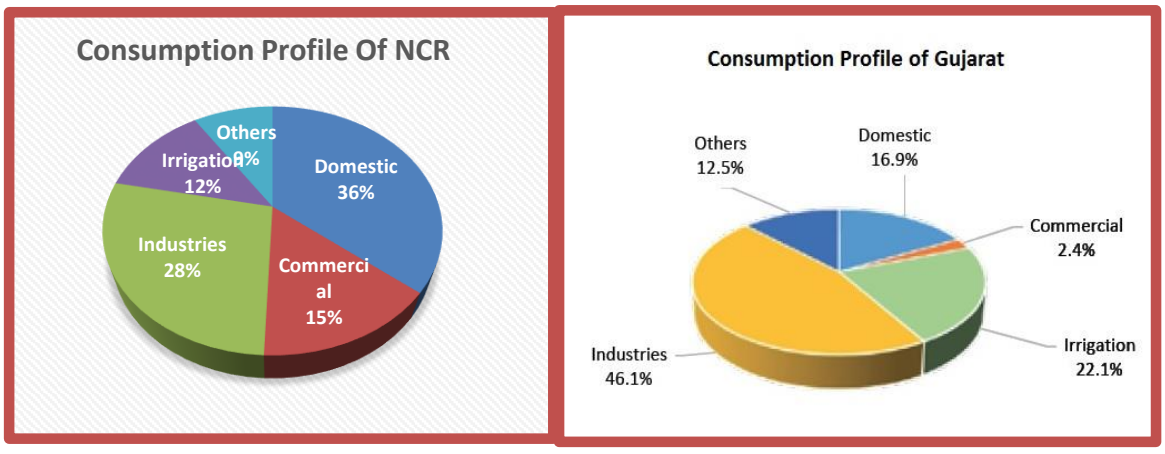
Energy Requirement and Peak Demand of NCR are about 84% & 91% respectively.

The comparative statement of future growth rates of Energy Requirement and Peak Demand for Gujarat vis-à-vis NCR is indicated below that suggests that although energy requirement of Gujarat is predicted to grow faster, NCR is expected to witness more growth in peak demand.

Sl. No.	State / region	CAGR in % (2019-20 to 2024-25)	
		Energy Requirement	Peak Demand
1.	Gujarat (As per 19th EPS Vol –I)	5.93	4.94
2.	NCR	4.38	6.14

(Table 36: CAGR Forecast of NCR vis-à-vis Gujarat)

The reason for higher energy requirement growth rate estimation for Gujarat and higher peak demand growth rate estimation for NCR is the differences witnessed in their energy consumption profiles. The consumption in domestic category is more in NCR region. On the other hand, the industrial sector is consuming more energy in Gujarat thereby making a flatter demand curve comparatively (The Load Factor prevailing in the Gujarat is in the range of 75-80%).



(Figure 48: Consumption Profile of NCR vs Gujarat)

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APPENDIX-I

ASSUMPTIONS:

i. The NCR region will remain in its present shape with no alteration of its geographical area.

ii. The projection of electricity demand has been made for the demand incident on the utility system only and it does not include the portion of electricity demand of industries and other consumers that would be met from captive power plants.

iii. T&D losses have been calculated on the trends and the target fixed by Government of India i.e. less than 15% by 2020.

iv. In case of Delhi, since the actuals till now is not in much deviations with the forecast of 19th EPS (volume I), the same figures have been taken in this report also. However, as the peak demands recorded were not exactly in consonance with the predictions made, it has been modified in accordance with the recent trends witnessed.

v. The electrical energy growth trends have been estimated on the basis of the data till 2017-18 only for estimating more reliable trends as for some districts only provisional data for FY 2018-19 were available.

vi. The impact of solar rooftop and electric vehicle has not been considered exclusively. It is assumed that the impact would be negligible as both have still not come up in a big way. Also, additional demand on the grid due to electric vehicles are expected to be off shouldered by rooftop solar to some extent.

vii. The geographical area indicated in this study are taken from the Census-2011 report.

viii. In view of inconsistency observed in peak demand data submitted by the power utilities, the peak demand for each district was calculated on the basis of load factor trends witnessed in the respective states of the NCR region. The load factor for a state is based on its energy requirement data and peak demand and both are very reliable data if considered with respect to the state boundary. The load factor of a particular sub region of NCR was assumed as same to the load factor witnessed in the state it belongs to. Similarly, the load factor for the whole NCR was assumed as load factor prevailing in the whole Northern Region.

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APPENDIX-II

POPULATION CALCULATION:

i. The population of each district for the year 2001 & 2011 has been taken as per Census 2001 & 2011 respectively.

ii. CAGR of each district has been calculated based on its population in 2001 & 2011.

iii. Based on the CAGR calculated, the population of each district has been extrapolated for the year 2018.

iv. The population of a sub region of NCR has been calculated after summing up estimated population of each district under that particular sub region.

v. The population of the areas added subsequently in NCR after 2011 i.e. Bhiwani, Charkhi Dadri, Mahendragarh, Jind and Karnal district in Haryana, Bharatpur in Rajasthan and Hapur, Shamli & Muzaffarnagar in Uttar Pradesh has also been considered in Sub Region and the total NCR population for the year 2001 & 2011.

Sl. No.	Region	Population - As Per Census		CAGR	Projected Population
		2001	2011	2001-2011	2018
1	Delhi – NCT	138,50,507	167,87,941	1.94	192,07,448
2	Haryana Sub Region	133,88,603	164,27,524	2.07	191,37,894
3	Rajasthan Sub Region	50,93,734	62,22,641	2.02	71,58,812
4	Uttar Pradesh Sub Region	151,10,452	187,19,180	2.16	218,54,409
5	NCR (Total)	474,43,296	581,57,286	2.06	673,58,564

(Table 37: Sub Region Wise Population of NCR)

Sl. No.	Region	Population - As Per Census		CAGR	Projected Population
		2001	2011	2001-2011	2018
	Delhi Sub Region				
1	Delhi	138,50,507	167,87,941	1.94	192,07,448
	Rajasthan Sub Region				
2	Alwar	29,92,592	36,74,179	2.07	42,41,693
3	Bharatpur	21,01,142	25,48,462	1.95	29,17,119
	Haryana Sub Region				
4	Bhiwani (Including Charkhi Dadri)	14,25,022	16,34,445	1.38	17,99,096
5	Faridabad	13,65,465	18,09,733	2.86	22,04,186
6	Gurugram	8,70,539	15,14,432	5.69	22,31,377
7	Karnal	12,74,183	15,05,324	1.68	16,91,643
8	Jhajjar	8,80,072	9,58,405	0.86	10,17,351
9	Jind	11,89,827	13,34,152	1.15	14,45,474
10	Mahendragarh	8,12,521	9,22,088	1.27	10,07,462
11	Nuh	7,89,750	10,89,263	3.27	13,64,215
12	Palwal	8,29,121	10,42,708	2.32	12,24,177
13	Panipat	9,67,449	12,05,437	2.22	14,06,067
14	Rohtak	9,40,128	10,61,204	1.22	11,55,120
15	Rewari	7,65,351	9,00,332	1.64	10,08,747
16	Sonepat	12,79,175	14,50,001	1.26	15,82,979
	UP Sub Region				
17	Bhagpat	11,63,991	13,03,048	1.13	14,10,159
18	Bulandshahr	29,13,122	34,99,171	1.85	39,78,228
19	Gautam Buddha Nagar	12,02,030	16,48,115	3.21	20,55,597
20	Ghaziabad (Including Hapur)	32,90,586	46,81,645	3.59	59,92,198
21	Meerut	29,97,361	34,43,689	1.40	37,95,101
22	Muzaffarnagar (including Shamli)	35,43,362	41,43,512	1.58	46,23,126

(Table 38: District Wise Population of NCR)

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