सत्यमेव जयते

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Ministry of Power
केन्द्रीय विद्युत प्राधिकरण
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विद्युत शक्ति सर्वेक्षण और भार पूर्वानुमान प्रभाग
Power Survey & Load Forecasting Division

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

REPORT ON TWENTIETH 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

अगस्त - 2023
August – 2023

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अध्यक्ष तथा पदेन सचिव भारत सरकार
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FOREWORD

National Capital Region has emerged as one of the foremost economic centres in India. NCR was constituted under the National Capital Region Planning Board (NCRPB) Act, 1985 to promote balanced and harmonized development of the Region. National Capital Region 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. The electricity demand projection is a pre-requisite for proper planning of National Capital Region (NCR). With this objective, CEA has prepared this electric power survey of NCR.

The forecasts of electricity demand have been done in consultation 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 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. The year-wise electrical energy requirement was worked out up to 2032-33 by taking 2021-22 as the base year. Perspective electricity demand projection has also been done for the years 2036-37 & 2042-43.

I would like to thank all the officers and staff of PDM&LF division to finalize this report. I also appreciate the hard work done by the concerned discoms representatives by giving relevant information and valuable suggestions.

I am sure that the Report on 20th Electric Power Survey of India (Volume-II) (National Capital Region) would surely helpful and facilitate the demand forecasting exercise carried out for achieving the overall objective of reliable and uninterrupted power supply in NCR.

(**Ghanshyam Prasad**)

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PREFACE

The National Capital Region (NCR) of India is one of the world's largest urban agglomerations. NCR covers the entire National Capital Territory (NCT) 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. km. at present. It is one the largest load Centre in the Indian Grid.

The electricity demand projection is a pre-requisite for proper planning of National Capital Region (NCR). Based on the category-wise input data provided by DISCOMs & TRANSCOs operating in NCR from the year 2011-12 to 2021-2022, the year-wise electricity projection has been carried out for the year 2022-23 to 2032-33. The perspective demand for the year 2036-37 & 2042-43 has also been done. 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.

I am grateful to Shri Ghanshyam Prasad, Chairperson, CEA, under whose guidance, work of this report was taken up. I would especially like to acknowledge the contribution of Shri Irfan Ahmad, Chief Engineer, PDM&LF Division who has given conceptual guidance & coordinated with his team for formulating & finalizing this report.

I hope this report will certainly be helpful for future planning & development of electricity infrastructure and economy boost-up in the region.

(A. Balan)

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ACKNOWLEDGEMENT

The report covers the electricity demand projection for the entire National Capital Region (NCR) including the 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. Electricity demand projections for the entire NCR have been done using the Partial End Use Method (PEUM) which is a combination of time series analysis and end-use method. Detailed discussions were held with officers of each DISCOM/Electricity Department/Transmission company in the NCR to understand their specific issues.

Impact of various initiatives of the Government of India and State Electricity Departments in the NCR which can affect the electricity demand viz. T&D loss reduction, installation of solar rooftops, PM KUSUM Yojana, etc. were also deliberated upon and appropriately factored in demand estimation.

I am thankful to Chairperson, CEA, Shri Ghanshyam Prasad, and Member (Planning), CEA, Shri A. Balan, for their support, worthy suggestions, and guidance in the finalization of this report. Further, I wish to extend my appreciation to all the officers of the PDM&LF Division of CEA and Regional Power Survey Office (North), New Delhi for making vigorous efforts in collecting requisite data from various DISCOMs of NCR and in preparation of this report.

Furthermore, I would also like to express my sincere thanks to all stakeholders/individuals and power utilities who have provided their valuable suggestions/comments in finalizing this report.

(Irfan Ahmad)

Table of Contents

Sl. No.	Title	Page No.
1.	Abbreviations	5-6
2.	Executive Summary	7-11
3.	Chapter 1: Profile of NCR	12-19
4.	Chapter 2: An Overview of 19th EPS – Forecast vs Actual	20-22
5.	Chapter 3: Demand Forecast - Methodology	23-27
6.	Chapter 4: Demand Forecast of NCR	28-34
7.	Chapter 5: Demand Forecast of Delhi - NCT	35-41
8.	Chapter 6: Demand Forecast of Haryana Sub Region	42-49
9.	Chapter 7: Demand Forecast of Rajasthan Sub Region	50-56
10.	Chapter 8: Demand Forecast of Uttar Pradesh Sub Region	57-64
11.	Chapter 9: Perspective electricity demand projection (2037-38 and 2042-43)	65-66
12.	Appendix I: Assumptions	67
13.	Appendix II: Population Estimation	68-69

Index of Figure

	Page No.
Figure 1: Energy Requirement Forecast of NCR	9
Figure 2: Peak Demand Forecast of NCR	10
Figure 3: T&D Loss Forecast of NCR	11
Figure 1.1: Geographical Area of NCR	13
Figure 1.2: Map of NCR	14
Figure 1.3: Sub Region Wise Population in Lakhs	17
Figure 1.4: Population Profile in 2011 & 2021	18
Figure 2.1: Performance of 19th EPS Forecast (Energy Requirement)	21
Figure 2.2: Performance of 19th EPS Forecast (Peak Demand)	22
Figure 4.1: Energy Consumption Profile of NCR in 2021-22	28
Figure 4.2: Sub Region Wise Energy Requirement Profile of NCR in 2021-22	29
Figure 4.3: Comparison of NCR with NR & All India	29
Figure 4.4: Comparison of Delhi-NCT with other areas of NCR	30
Figure 4.5: Energy Requirement Forecast of NCR	31
Figure 4.6: Peak Demand Forecast of NCR	32
Figure 4.7: Category Wise Energy Consumption Forecast of NCR	32
Figure 4.8: T&D Loss Forecast of NCR	33
Figure 5.1: Delhi – Power Distribution	36
Figure 5.2: Energy Consumption Profile of Delhi NCT in 2021-22	37
Figure 5.3: Discom Wise Energy Requirement Profile of Delhi NCT in 2021-22	37
Figure 5.4: Energy Requirement Forecast of Delhi-NCT	38
Figure 5.5: Peak Demand Forecast of Delhi-NCT	39
Figure 5.6: Category Wise Energy Consumption Forecast of Delhi-NCT	39
Figure 5.7: T&D Loss Forecast of Delhi-NCT	40
Figure 6.1: Energy Consumption Profile of Haryana Sub-Region in 2021-22	44
Figure 6.2: District Wise Energy Requirement Profile of Haryana Sub-Region in 2021-22	45

Figure 6.3: Energy Requirement Forecast of Haryana Sub-Region 46

Figure 6.4: Peak Demand Forecast of Haryana Sub-Region 46

Figure 6.5: Category Wise Energy Consumption Forecast of Haryana Sub-Region 47

Figure 6.6: T&D Loss Forecast of Haryana Sub-Region 48

Figure 7.1: Energy Consumption Profile of Rajasthan Sub-Region in 2021-22 52

Figure 7.2: District Wise Energy Requirement Profile of Rajasthan Sub-Region in 2021-22 52

Figure 7.3: Energy Requirement Forecast of Rajasthan Sub-Region 53

Figure 7.4: Peak Demand Forecast of Rajasthan Sub-Region 54

Figure 7.5: Category Wise Energy Consumption Forecast of Rajasthan Sub-Region 54

Figure 7.6: T&D Loss Forecast of Rajasthan Sub-Region 55

Figure 8.1: Energy Consumption Profile of UP Sub-Region in 2021-22 60

Figure 8.2: District Wise Energy Requirement Profile of UP Sub-Region in 2021-22 60

Figure 8.3: Energy Requirement Forecast of UP Sub-Region 61

Figure 8.4: Peak Demand Forecast of UP Sub-Region 62

Figure 8.5: Category Wise Energy Consumption Forecast of UP Sub-Region 62

Index of Table

	Page No.
Table 1: Energy Requirement Forecast of NCR	9
Table 2: Energy Requirement CAGR Forecast of NCR	9
Table 3: Peak Demand Forecast of NCR	10
Table 4: Peak Demand CAGR Forecast of NCR	11
Table 1.1: Geographical Area of NCR	13
Table 1.2: Population in Lakhs	17
Table 2.1: Electrical Energy Requirement & Peak Electricity Demand as per 19th EPS Report	20
Table 2.2: Comparison of projected electrical energy requirement as per 19th EPS vs actual	21
Table 2.3: Comparison of projected peak electricity demand as per 19th EPS vs actual on all-India basis	21
Table 3.1: Estimated additional Electrical Energy requirement (in MUs) for the sub-regions of NCR by 2031-32 due to EV, Solar Roof Top & Green Hydrogen Mission.	27
Table 4.1: Comparison of NCR with NR & All India in 2021-22	30
Table 4.2: Comparison of Delhi-NCT with other areas of NCR in 2021-22	31
Table 4.3: Expected CAGR of NCR - Category Wise Consumption	33
Table 4.4: NCR Forecast	34
Table 5.1: Expected CAGR of Delhi-NCT - Category Wise Consumption	40
Table 5.2: Delhi-NCT Sub Region Forecast	41
Table 6.1: Expected CAGR of Haryana Sub Region - Category Wise Consumption	47
Table 6.2: Haryana Sub Region Forecast	49
Table 7.1: Expected CAGR of Rajasthan Sub Region - Category Wise Consumption	55
Table 7.2: Rajasthan Sub Region Forecast	56
Table 8.1: Expected CAGR of UP Sub Region - Category Wise Consumption	63
Table 8.2: Uttar Pradesh Sub Region Forecast	64
Table 9.1: Long term electricity demand projection for the years 2032-33, 2037-38 & 2042-43 for NCR region	65
Table 9.2: Summary of sub region wise electrical energy requirement & peak electricity demand for the years 2032-33, 2037-38 & 2042-43	65
Table 9.3: Electrical Energy Requirement and Peak Electricity Demand from the year 2022-23 to 2042-43 for NCR region	66
Table 9.4: CAGR of Electrical Energy Requirement and Peak Electricity Demand from the year 2022-23 to 2042-43 for NCR region	66
Table A2.1: Sub Region Wise Population of NCR	68
Table A2.2: District Wise Population of NCR	69

ABBREVIATIONS

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 which is estimated to reach 895 lakhs by 2031 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. Under this method, time series analysis has been done to derive growth indicators giving higher weightage to the recent trends so as to consider the benefits of energy conservation initiatives and technological changes. It has been observed that the behaviors of individual consumers differ drastically because of various factors. However, their behaviors are found consistent once aggregated to a certain level as such groupings cancel out the anomalies associated with any particular user. Therefore, electricity demand projection has been done for various categories of electricity consumers such as Domestic, Commercial, Irrigation, Industrial etc. As analysis was done on grouping end users under various categories and not on each end user individually, it is termed as "Partial End Use Method".

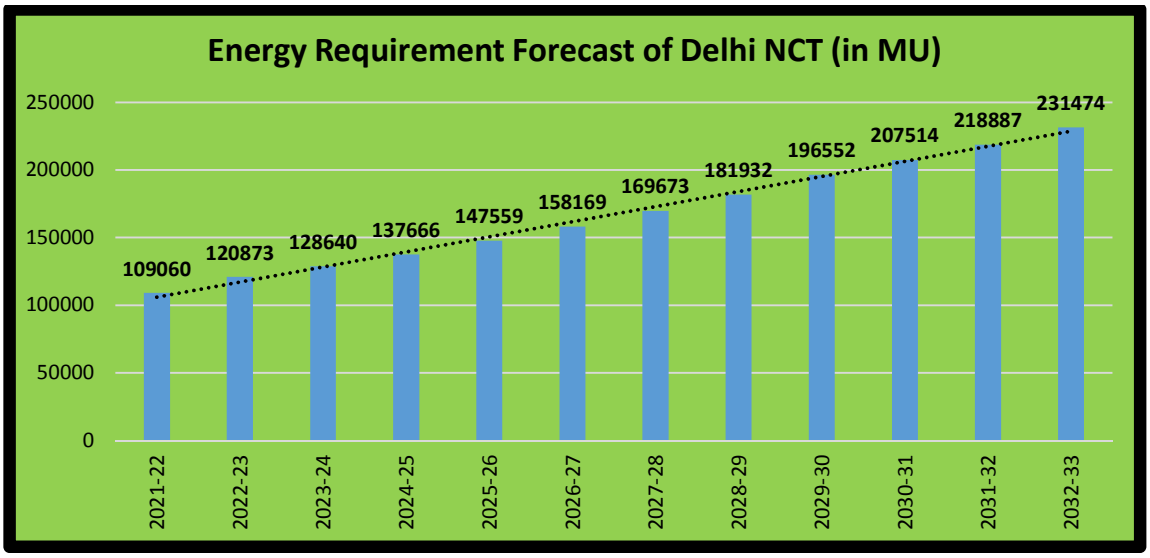
Apart from general growth trends assessed from the past data, the likely impacts of various emerging aspects and government initiatives/policies such as energy efficiency measures, penetration of electric vehicles, solar roof top, National Hydrogen Mission, PM KUSUM Yojana etc. have also been factored in while assessing the electricity demand in future.

The input data for this study comprises of the category wise data of all districts of NCR from the year 2011-12 to 2021-2022. Based on these input data, the year-wise electricity projection has been carried out for each district for the year 2022-23 to 2032-33. 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 2021-22 was 93547 MU and with 14.22% T&D losses, the requirement was 109060 MU. The electrical energy requirement of Haryana sub region was highest in the NCR in 2021-22 followed by Delhi NCT, Uttar Pradesh & Rajasthan sub region.

The total energy requirement of NCR is estimated as 120873 MU in Year 2022-23 which is expected to reach 169673 MU in year 2027-28 with CAGR of 7.02%. The energy requirement is estimated as 231474 MU by the year 2032-33 with CAGR of 6.41% for the period 2027-28 to 2032-33.



(Figure 1: Energy Requirement Forecast of NCR)

The Sub Region wise energy requirement forecast is summarized below:

Sl. No.	Constituents	Energy Requirement (in MU)		
		2022-23	2027-28	2032-33
1.	NCT-Delhi	35715	44448	55196
2.	Haryana Sub-region	41371	60109	84257
3.	Rajasthan Sub-region	11325	17875	25505
4.	Uttar Pradesh Sub-region	32130	46575	65177
	Total (NCR)	**1,20,873**	**1,69,673**	**2,31,474**

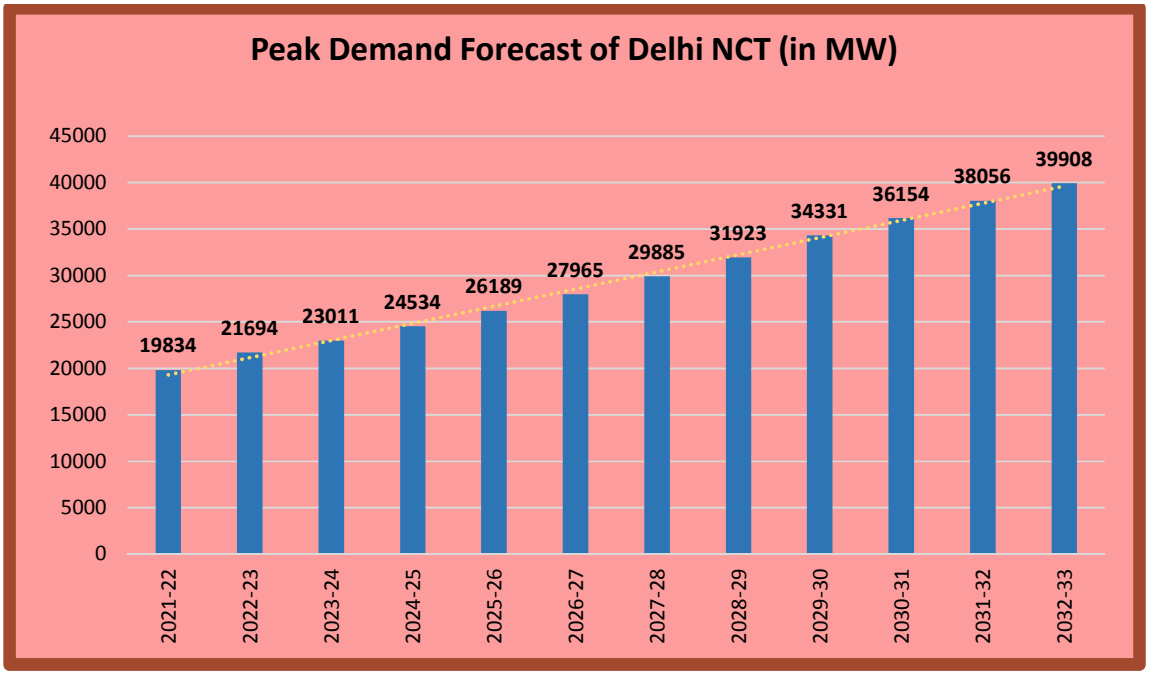
(Table 1: Energy Requirement Forecast of NCR)

Sl. No.	Constituents	Energy Requirement CAGR (in %)		
		2022-23 to 2027-28	2027-28 to 2032-33	2022-23 to 2032-33
1.	NCT-Delhi	4.47	4.43	4.45
2.	Haryana Sub-region	7.76	6.99	7.37
3.	Rajasthan Sub-region	9.56	7.37	8.46
4.	Uttar Pradesh Sub-region	7.71	6.95	7.33
	Total (NCR)	**7.02**	**6.41**	**6.71**

(Table 2: Energy Requirement CAGR Forecast of NCR)

The Power Forecast – Peak Demand:

The Peak Demand for the NCR was 19834 MW in year 2021-22 and it is expected to see 6.62% CAGR upto 2027-28 and will reach 29885 MW in comparison to 21694 MW in year 2022-23. The Peak Demand is expected to reach 39908 MW in year 2032-33 with a CAGR of 5.95% after 2027-28.



(Figure 2: Peak Demand Forecast of NCR)

The Sub Region wise peak demand forecast is summarized below:

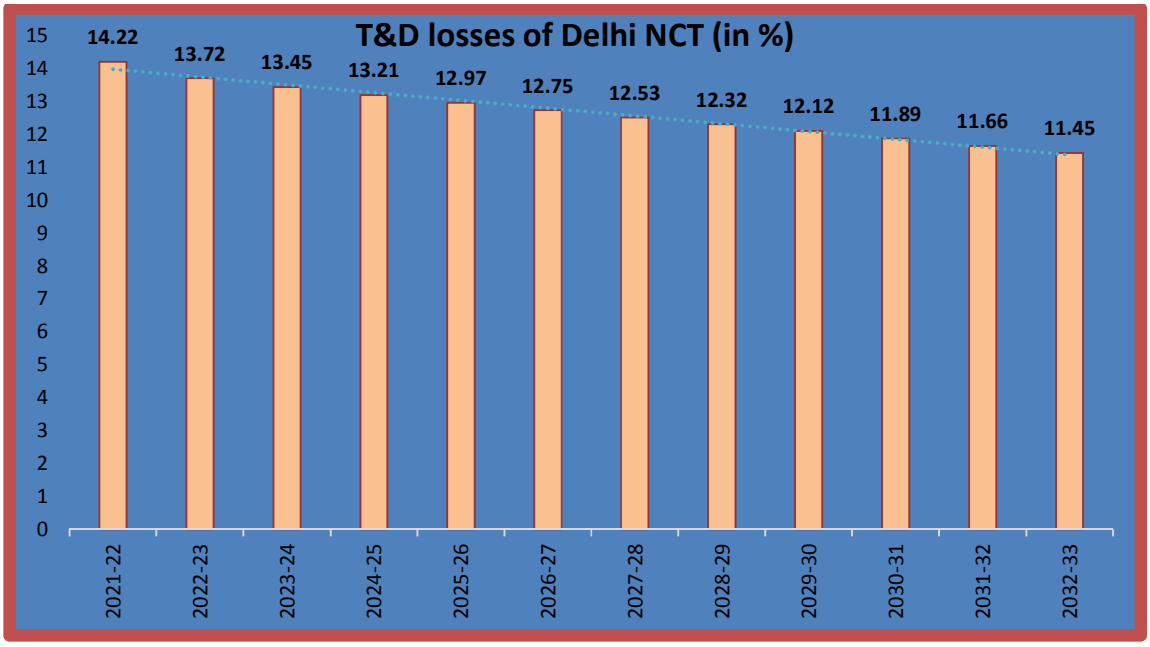
Sl. No.	Constituents	Peak Demand (in MW)		
		2022-23	2027-28	2032-33
1.	NCT-Delhi	7770	9948	12859
2.	Haryana Sub-region	8827	12425	16874
3.	Rajasthan Sub-region	1897	2822	3797
4.	Uttar Pradesh Sub-region	6021	8575	11565
	Total (NCR)	**21,694**	**29,885**	**39,908**

(Table 3: Peak Demand Forecast of NCR)

Sl. No.	Constituents	Peak Demand CAGR (in %)		
		2022-23 to 2027-28	2027-28 to 2032-33	2022-23 to 2032-33
1.	NCT-Delhi	5.07	5.27	5.17
2.	Haryana Sub-region	7.08	6.31	6.69
3.	Rajasthan Sub-region	8.28	6.11	7.19
4.	Uttar Pradesh Sub-region	7.33	6.17	6.75
	Total (NCR)	**6.62**	**5.95**	**6.28**

(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 14.22% in year 2021-22. The target level is to bring it down to about 12.53% and 11.45% by the end of 2027-28 & 2032-33 respectively.



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

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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 2.7% 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 57.3% of the area of the state.

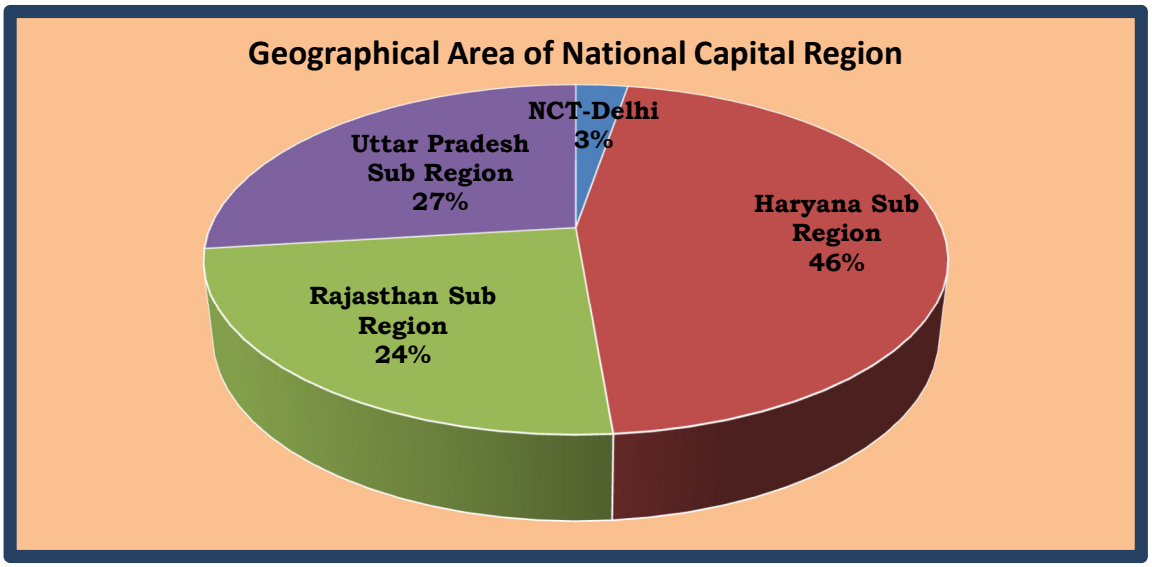
- The Rajasthan Sub-Region comprises of Alwar & Bharatpur districts that constitute about 24.4% area (13,447 sq. kms.) of the NCR and 3.9% area of the state.

- 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 26.9% area (14,826 sq. kms.) of NCR and 6.2% area of the state;

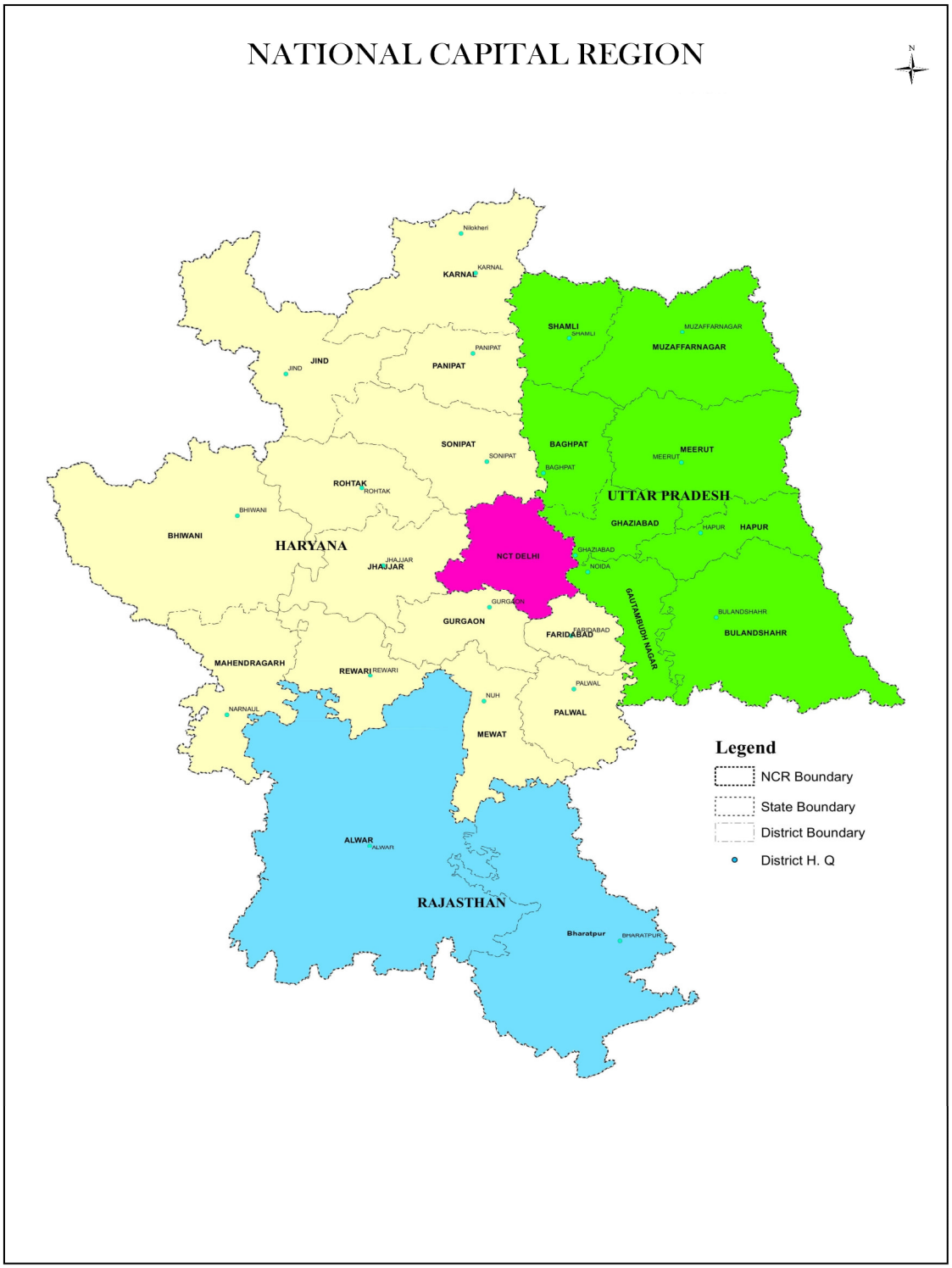
Three cities of NCR viz. Karnal, Faridabad & New Delhi are included in Smart Cities Mission of the Government of India.

Sl. No.	Constituents	Area (in sq. kms)	% Area of NCR	% Area of State
1.	NCT-Delhi	1,483	2.7	100.0
2.	Haryana Sub-region	25,327	46.0	57.3
3.	Rajasthan Sub-region	13,447	24.4	3.9
4.	Uttar Pradesh Sub-region	14,826	26.9	6.2
	Total (NCR)	**55,083**	**100.0**	**-**

(Table 1.1: Geographical Area of NCR)



(Figure 1.1: Geographical Area of NCR)



(Figure 1.2: Map of NCR)

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 [1].

- 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. As of 2021, there are a total of 24 districts in the NCR, excluding the 11 districts of Delhi.

Population:

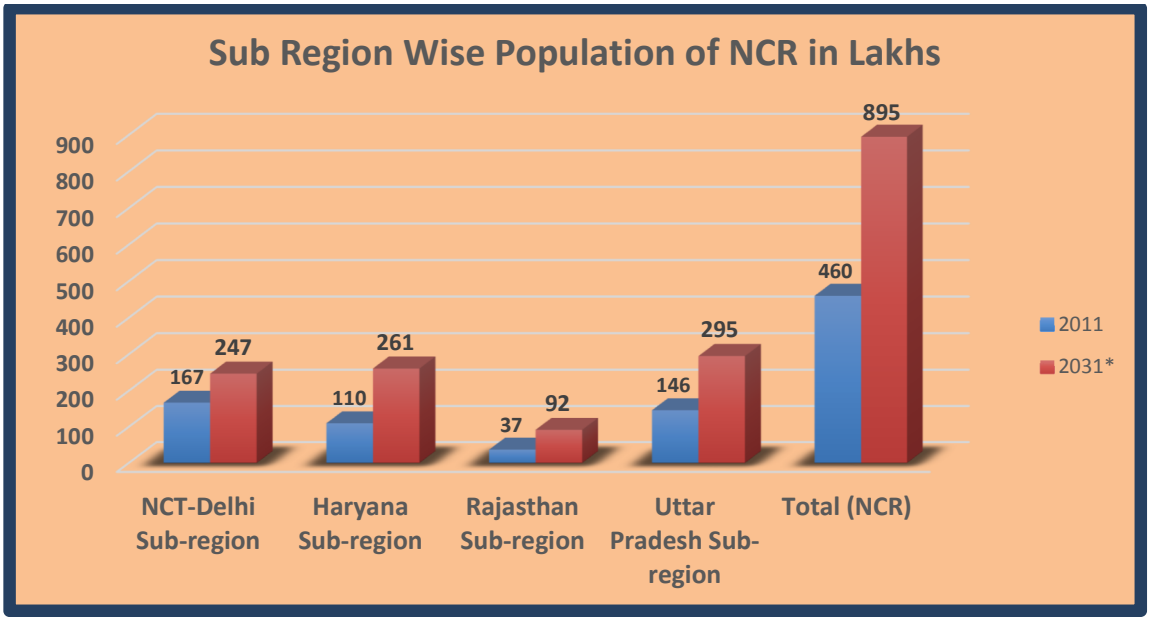
As per Census 2011, the total population of NCR was 460 lakhs only as per existing areas then. This population stood out as 581.5 lakhs after adding the 2011 populations of the areas included in the NCR thereafter. The number of metropolitan cities (more than ten lakhs population) within the region has 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 895 lakhs by 2031. It is expected that the population of NCT-Delhi, Haryana, Rajasthan and Uttar Pradesh Sub-regions would reach 247 lakhs, 261 lakhs, 92 lakhs and 295 lakhs respectively by 2031.

[1] Annual Report 2020-21, National Capital Regional Planning Board

Constituent	For NCR Area Notified in 2011		For Additional NCR Area Notified after 2011		Total NCR Area (As on 31.03.2023)	
	2011	2031*	2011	2031*	2011	2031*
Delhi-NCT Sub-region	167	247	-	-	167	247
Haryana Sub-region	110	190	54	71	164	261
Rajasthan Sub-region	37	55	25	37	62	92
Uttar Pradesh Sub-region	146	238	41	57	187	295
Total (NCR)	**460**	**730**	**121**	**165**	**581**	**895**

(Table 1.2: Population in Lakhs)

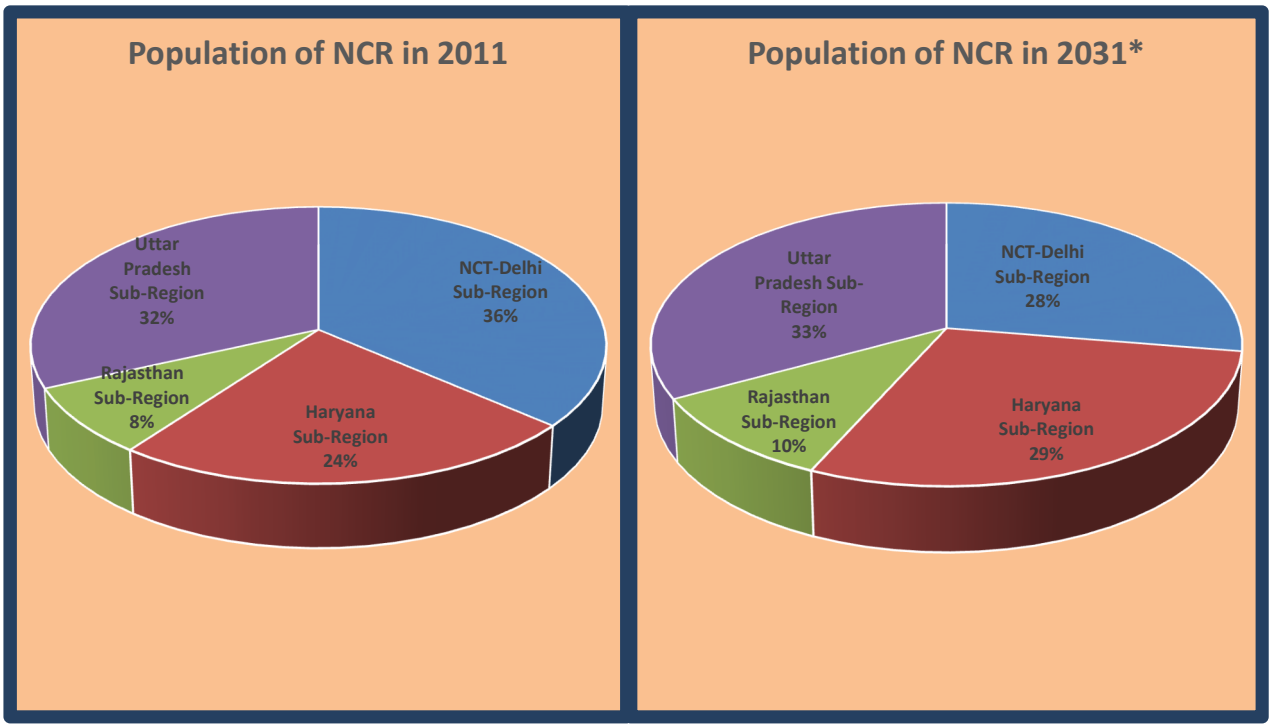


* Estimated

(Figure 1.3: 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 estimated population profile in 2031 suggests Uttar Pradesh Sub Region as the most dominant part.



(Figure 1.4: Population Profile in 2011 & 2031*)

Climate:[2]

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

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

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 primarily received during the monsoon months namely July, August and September.

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:[3]

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.

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[3] Economic Profile of NCR Report, NCRPB 2015

CHAPTER 2

Overview of 19th EPS of NCR – Forecast vs Actual

This Chapter presents a comparison between the electrical energy requirement and peak electricity demand projection of 19th EPS vis-à-vis the actual electrical energy requirement and peak electricity demand observed till the year 2022-23.

2.1 Electricity demand projection as per 19th EPS:

The projection of electrical energy requirement and peak electricity demand on all-India basis as per the 19th EPS Report is summarised in Table 2.1.

Year	Electrical Energy Requirement (in MU)	Peak Electricity Demand (in MW)
2019-20	102631	16386
2020-21	107139	17394
2021-22	111929	18478
2022-23	116847	19615
2023-24	121889	20806
2024-25	127149	22070
2025-26	132534	23392
2026-27	138041	24775
2027-28	143490	26187
2028-29	149144	27678
2029-30	154916	29233

Table 2.1: Electrical Energy Requirement & Peak Electricity Demand as per 19th EPS Report

2.2 19th EPS Forecast Vs Actual

Comparative Tables of 19th EPS projections vs actual electrical energy requirement and peak demand observed on all-India basis are given in Table 2.2 & Table 2.3 respectively.

Year	19th EPS Projections	Actual	Difference (19th EPS Forecast – Actual)	
	(in MUs)	(in MUs)	(in MUs)	(in %)
2019-20	102631	108067	-5436	-5.30
2020-21	107139	101508	5631	5.26
2021-22	111929	109060	2869	2.56

Table 2.2: Comparison of projected electrical energy requirement as per 19th EPS vs actual

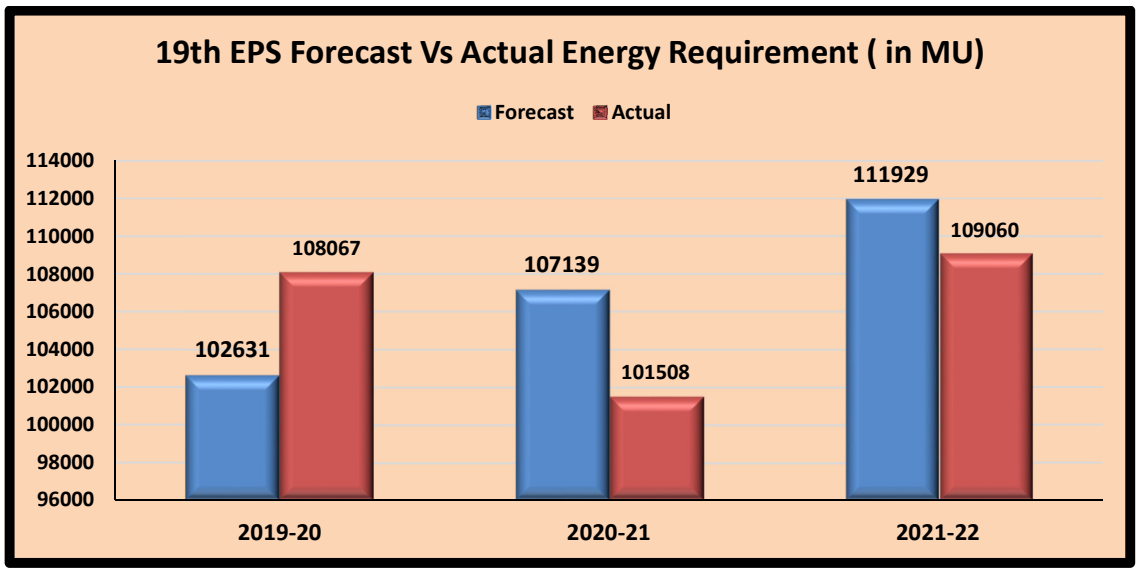

Figure 2.1: Performance of 19th EPS Forecast (Energy Requirement)

Year	19th EPS Projections	Actual	Difference (19th EPS Forecast – Actual)	
	(in MW)	(in MW)	(in MW)	(in %)
2019-20	16386	18696	-2310	-14.10
2020-21	17394	18468	-1074	-6.18
2021-22	18478	19834	-1356	-7.34

Table 2.3: Comparison of projected peak electricity demand as per 19th EPS vs actual on all-India basis

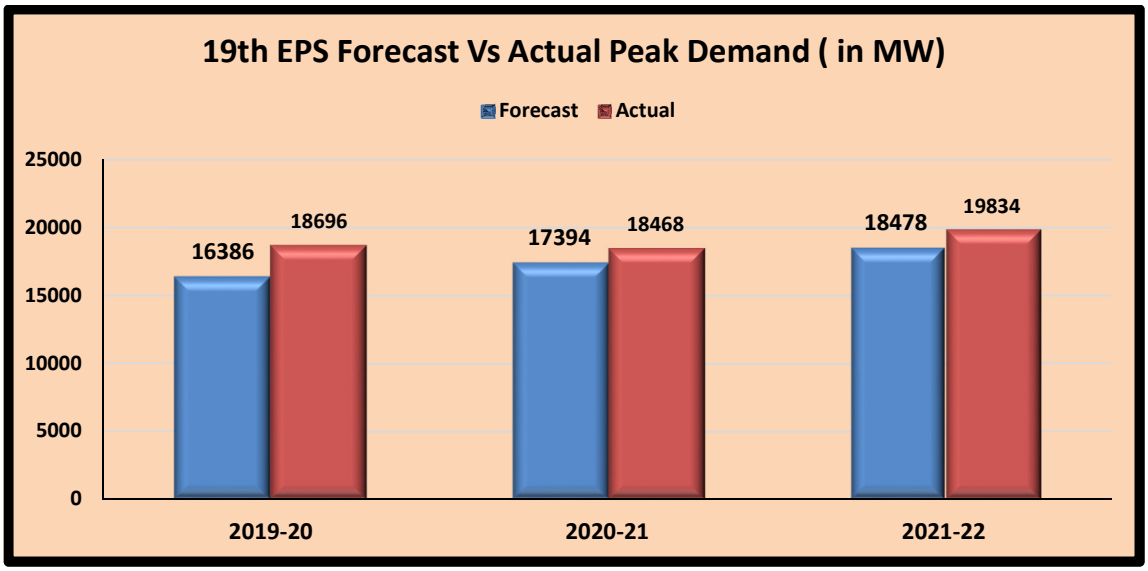

Figure 2.2: Performance of 19th EPS Forecast (Peak Demand)

It is observed that the difference between actual and estimated peak demand is higher than the difference between actual and estimated energy requirement.

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CHAPTER 3

Demand 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

3.1 Partial End-Use Method (PEUM)

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.

It has been observed that the behaviours of individual consumers differ drastically because of various factors such as their individual choices, socio-economic background, geographical locations etc. Even the behaviour of a single consumer is found to be very unpredictable that keeps on changing on day to day basis. However, their behaviours are found consistent once aggregated to a certain level as such grouping cancels out the anomalies associated with any particular user. Therefore, electricity demand projection has been made for various categories of electricity consumers viz. Domestic, Commercial, Public Lighting, Public Water Works, Irrigation, Industrial (LT & HT), Railway Traction & Bulk Supply (Non- Industrial Consumers & Licences).

As analysis was done by grouping end users under various categories and not on each end user individually, it is termed as “Partial End Use Method”.

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.

3.2 Input data:

The input data for this study comprises of the category wise data of all districts of NCR from the year 2011-12 to 2021-22. The category wise historical data required for assessment of future demand has been provided by all the 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.

3.3 Energy Requirement Forecast:

The input data for the period 2011-12 to 2021-22 was scrutinized for the study and the year-wise electrical energy requirement was worked out up to 2032-33 by taking 2021-22 as the base year. Perspective electricity demand projection has also been done for the years 2037-38 and 2042-43. Factors like reduction of transmission & distribution losses, energy efficiency improvement measures, production of green hydrogen, penetration of electric vehicles, roof-top solar, solar pumps etc. have been suitably factored in the electricity demand forecast. 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 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.

3.4 Peak Demand forecast:

The following methodologies have been adopted to forecast Peak Demand:

i. Peak electricity demand of a district has been worked out by assuming suitable load factors depending on past trends and their specific consumer mix. In case of inconsistency 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.

ii. Peak electricity demand of the sub region has been estimated by applying suitable diversity factor to the sum of peak electricity demand of all the Districts within it as per the past trends.

iii. Peak electricity demand of the NCR region has been estimated by applying suitable diversity factor, as per the past trend, to the sum of non-simultaneous peak electricity demand of the sub-region forming part of the NCR Region.

3.5 Transmission and Distribution (T&D) Losses:

The distribution losses for a district have been taken as per the trajectory of loss reduction given by the respective Discoms. The intra-state transmission losses applicable on the quantum of energy consumed have also been taken into account for calculating total transmission and distribution losses at sub region level.

3.5 Emerging aspects :

Electric Vehicle:

Based on the assumption that 30% of total vehicles sales would be BEVs by 2030 which would subsequently reach to 100% by 2042, it has been estimated that 27 BU additional energy requirement could be observed by 2031-32 on this account.

The additional energy requirement has been apportioned among various states in the ratio of number of vehicles registered in 2018-19. The EV Energy requirement of the state has been further distributed among sub regions in their respective ratio of total energy requirement for domestic and commercial categories as the additional energy requirement is expected to incident on these two categories mainly. It has also been assumed that such demand could come in Domestic and Commercial categories in the ratio of 70:30.

Solar Roof Top:

All India Estimated Installed Capacity has been assumed as 50 GW by 2031-32. This all India target has been apportioned among states as per the ratio of their target set by MNRE by 2022. The energy off set in MU from grid has been calculated as per formula (MW*24*365/1000) *0.17*0.75 assuming that 25% of the energy generated by such projects are fed to the grid. As, the impact of solar roof top is estimated to be reflected on four categories mainly viz. Domestic, Commercial, LT & HT industries. The roof top energy figures of a State have been apportioned among various sub regions as per their respective total consumptions in four categories viz. Domestic, Commercial, LT & HT industries in the ratio of their respective consumptions.

National Hydrogen Mission:

Total green hydrogen production of the country is assumed as 10 MMT by 2030. The energy demand reflected on the grid is assumed as only 1/2th of the total energy required for producing green hydrogen that is expected to meet through remote mode i.e. where electrolyzers are located at distant locations from the generating power plants. The other 1/2th of electric energy requirement for producing green hydrogen is expected to meet through co-location mode i.e. where electrolyzers are located in the vicinity of power

generation plant. The additional energy requirement for the country on account of green hydrogen production has been estimated as 250 BU by FY 2031-32.

All India energy requirement is apportioned among different states in the ratio of their HT Industrial consumption. State level energy requirement thus calculated is apportioned among its sub region in the ratio of their HT Industrial consumptions. Energy Requirement on this account is added to HT Industrial consumption only.

Constituent	Electric Vehicle	Solar roof top	Green Hydrogen
NCT Delhi Sub-region	2932	2295	841
Haryana Sub- region	676	830	4229
Rajasthan Sub-region	247	1103	3869
UP Sub-region	1487	1587	3678
Total	**5342**	**5815**	**12617**

Table 3.1: Estimated additional Electrical Energy requirement (in MUs) for the sub-regions of NCR by 2031-32 due to EV, Solar Roof Top & Green Hydrogen Mission.

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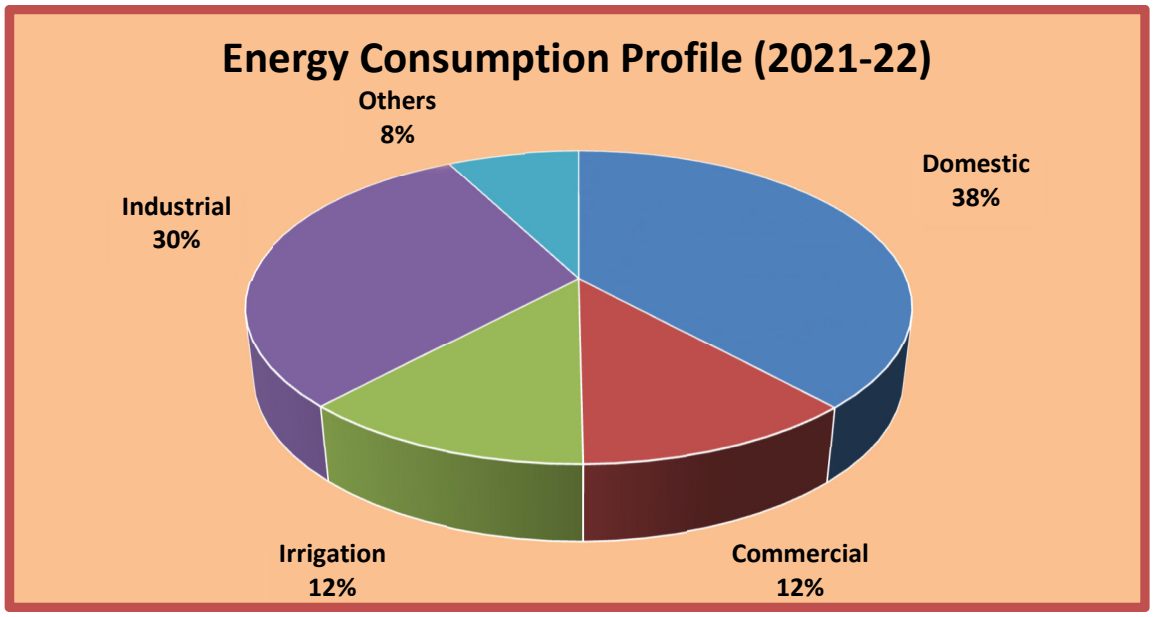
CHAPTER 4

Demand Forecast of NCR

Existing Power Scenario:

The total electricity consumption of NCR in year 2021-22 was 93547 MU and with 14.22% T&D losses, the requirement was 109060 MU. During the last decade (2010-11 to 2019-20), the NCR has observed annual growth rate of 5.16% in terms of electrical energy requirement. The Peak Demand for the region was 19834 MW in year 2021-22.

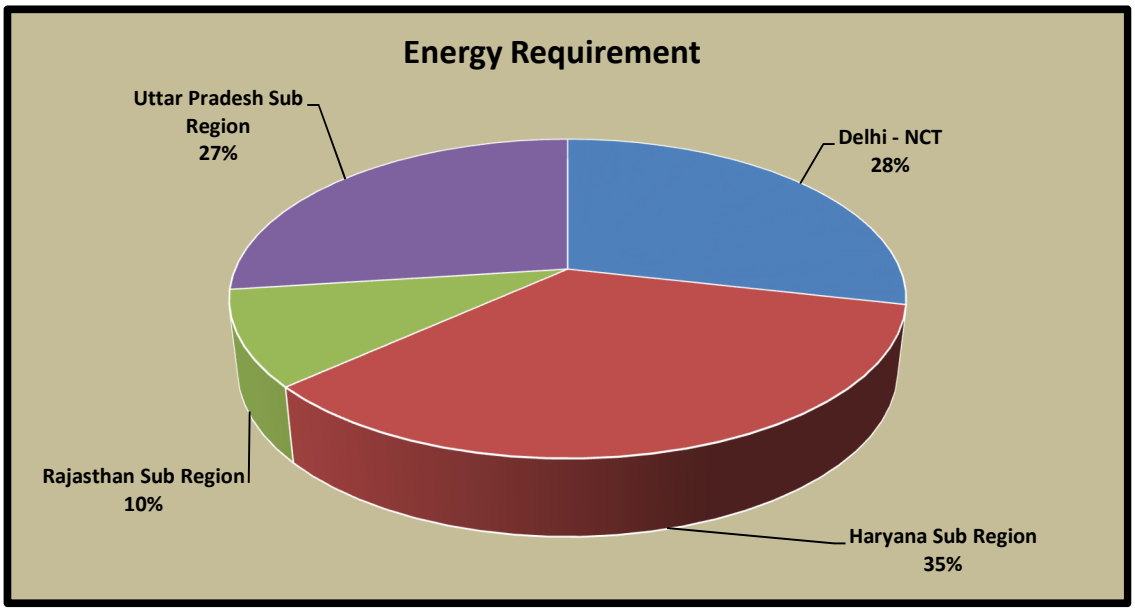
The Domestic sector was the biggest consumer of electricity (38%). Thereafter, Industry sector and Commercial sector were consuming about 30% & 12% of the total electricity consumption of NCR respectively.



(Figure 4.1: Energy Consumption Profile of NCR in 2021-22)

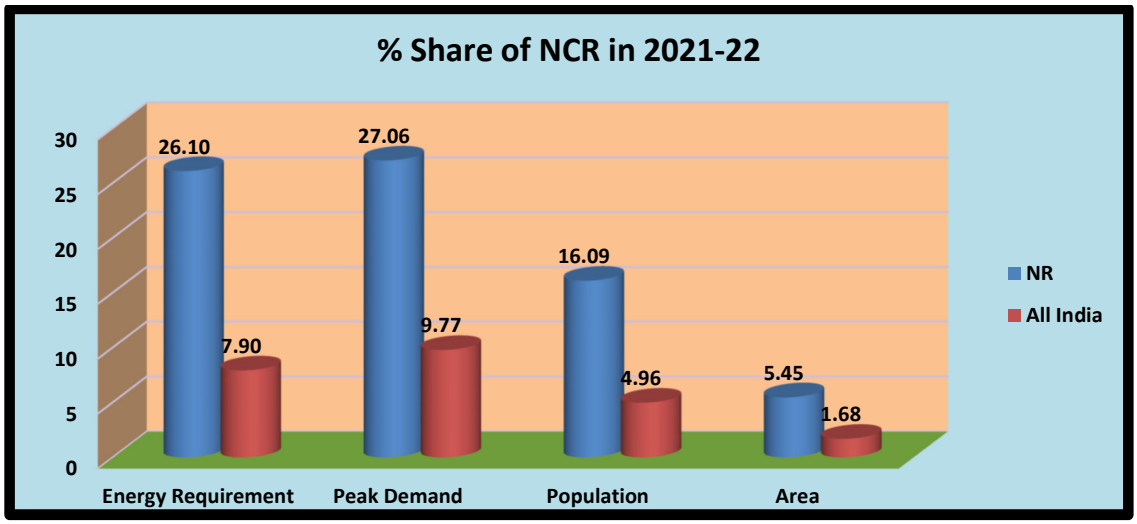
The Haryana sub region and Delhi-NCT had the most of NCR electrical energy requirement in 2021-22 followed by Uttar Pradesh & Rajasthan sub region. Uttar Pradesh sub region and Delhi-NCT had almost equal energy requirement in 2021-22 constituting about 27% & 28% of the total NCR energy requirement respectively. The population of both the sub regions are

also very similar (The estimated population of Delhi-NCT and Haryana Sub Region are 247 & 261 lakhs respectively by 2021) whereas their area shares in NCR differ substantially (2.7% & 46% respectively).



(Figure 4.2: Sub Region Wise Energy Requirement Profile of NCR in 2021-22)

The comparison of energy data of NCR with the entire Northern Region for the year 2021-22 indicates that although contributing only 5.45% in area and 16.09% in population, the energy requirement of NCR was more than one fourth (26.10%) of total Northern Region Energy Requirement.



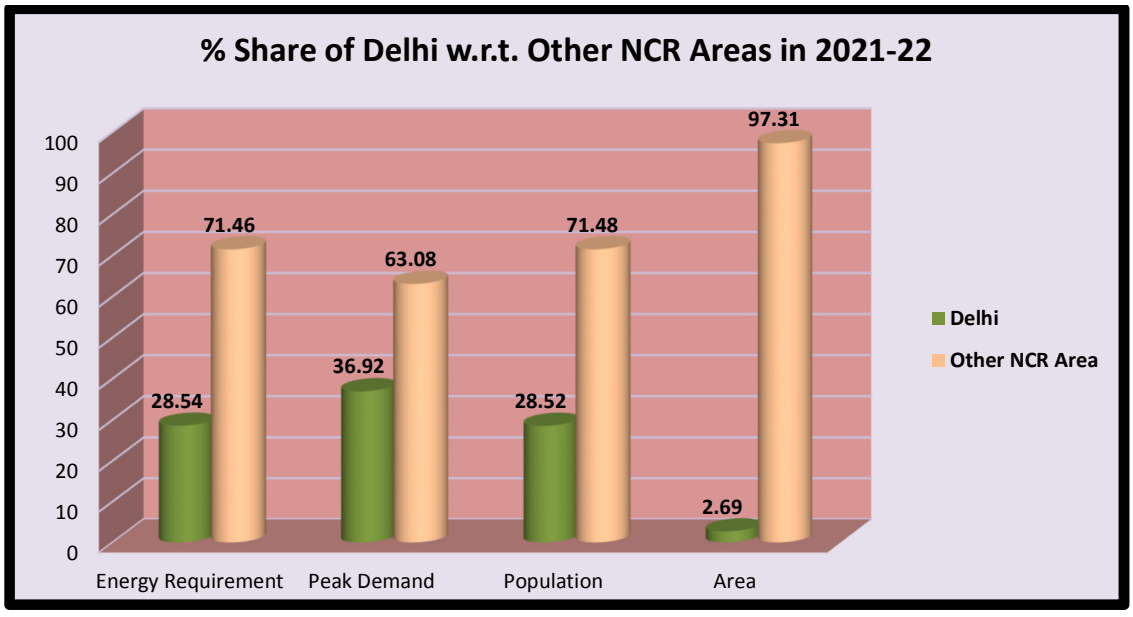
(Figure 4.3: Comparison of NCR with NR & All India)

Similarly, on comparison of energy data of NCR with the All India figures for the year 2021-22, it is observed that energy requirement of NCR was 7.90% 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)	31,128	1,09,060	4,17,934	13,79,812	26.10	7.90
2.	Peak Demand (in MW)	7,323	19,834	73,305	2,03,014	27.06	9.77
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 4.1: Comparison of NCR with NR & All India in 2021-22)

The Comparison of Delhi NCT with Other NCR Areas in 2021-22 suggests that Delhi-NCT contributed about 2.69% of the total NCR area but its energy requirement share was 28.54%. In terms of population although, the differences were not much that indicates similar per capita consumption in Delhi NCT and other areas of NCR.



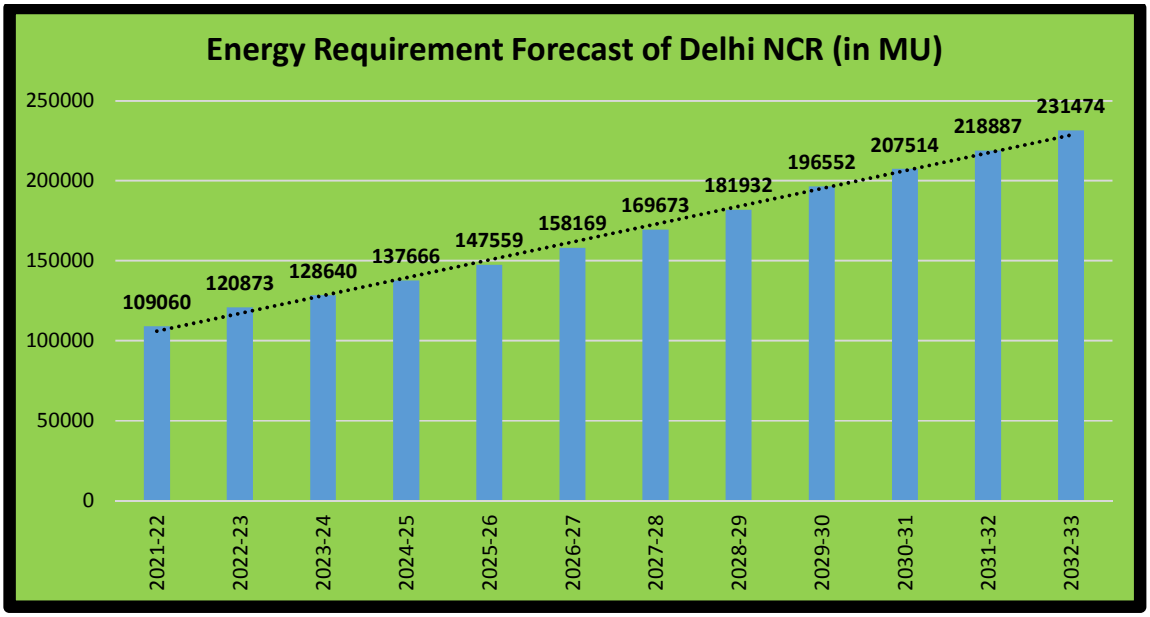
(Figure 4.4: Comparison of Delhi-NCT with other areas of NCR)

Sl. No.	Particulars	Delhi NCT	Other NCR Area	Total NCR	% Share of Delhi	% Share of Other Areas
1.	Energy Requirement (in MU)	31,128	77,932	1,09,060	28.54	71.46
2.	Peak Demand (in MW)	7,323	12,511	19,834	36.92	63.08
3.	Population	192,07,448	481,51,116	673,58,564	28.52	71.48
4.	Area (in sq km)	1,483	53,600	55,083	2.69	97.31

(Table 4.2: Comparison of Delhi-NCT with other areas of NCR in 2021-22)

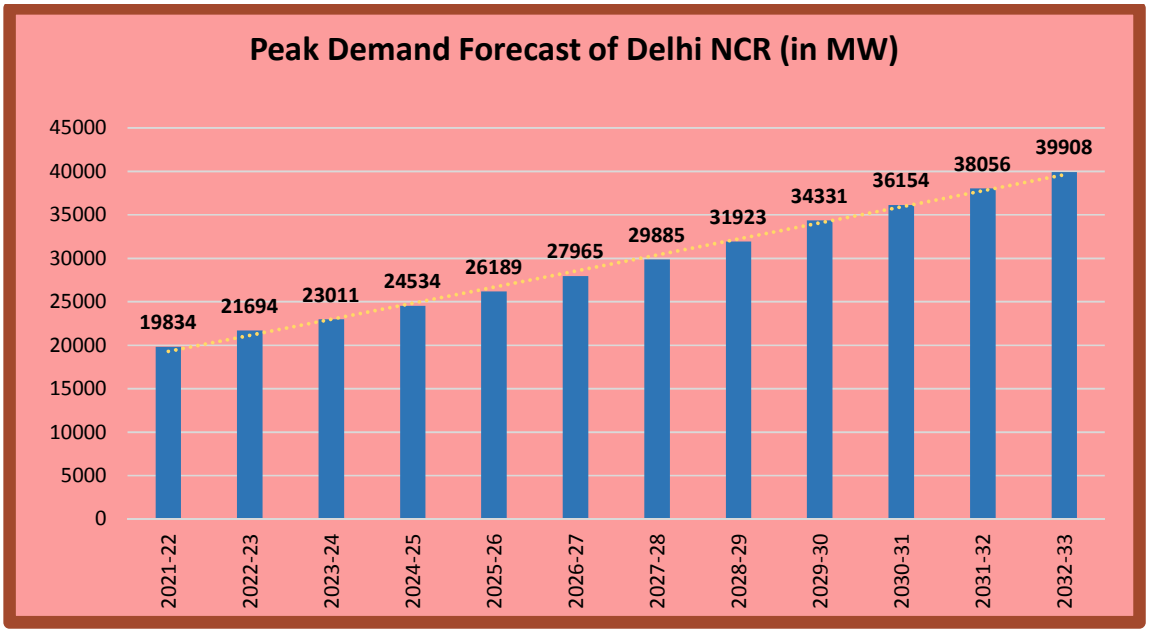
Power Forecast of NCR:

Based on total electricity consumption and T&D Losses, the total energy requirement of NCR is estimated as 120873 MU in the year 2022-23. It is expected that the energy requirement of NCR will reach to 169673 MU in the year 2027-28 with 7.02% CAGR for the period 2022-23 to 2027-28. With CAGR of 6.41% for the period 2027-28 to 2032-33, its energy requirement is estimated as 231474 MU by the year 2032-33. The CAGR of energy requirement for the next ten years (2022-23 to 2032-33) is expected as 6.71%.



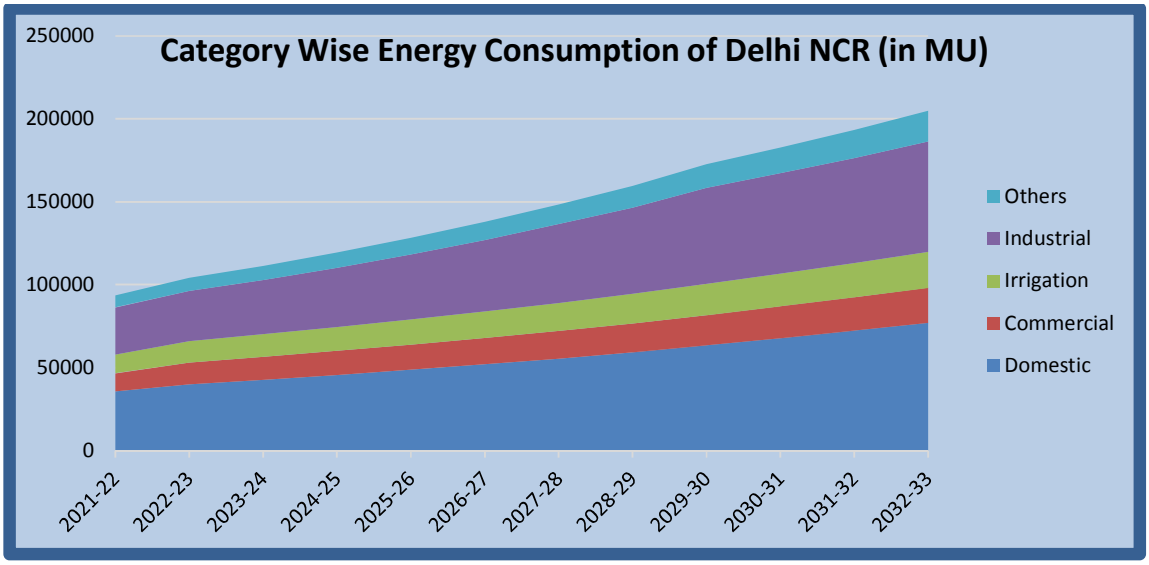
(Figure 4.5: Energy Requirement Forecast of NCR)

Peak Demand of the NCR is expected to see 6.62% CAGR upto 2027-28 and will reach 29885 MW in comparison to 21694 MW in year 2022-23. The Peak Demand is expected to reach 39908 MW in year 2032-33 with a CAGR of 5.95% after 2027-28. The CAGR of peak energy demand for the next ten years (2022-23 to 2032-33) is expected as 6.28%.



(Figure 4.6: Peak Demand Forecast of NCR)

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



(Figure 4.7: Category Wise Energy Consumption Forecast of NCR)

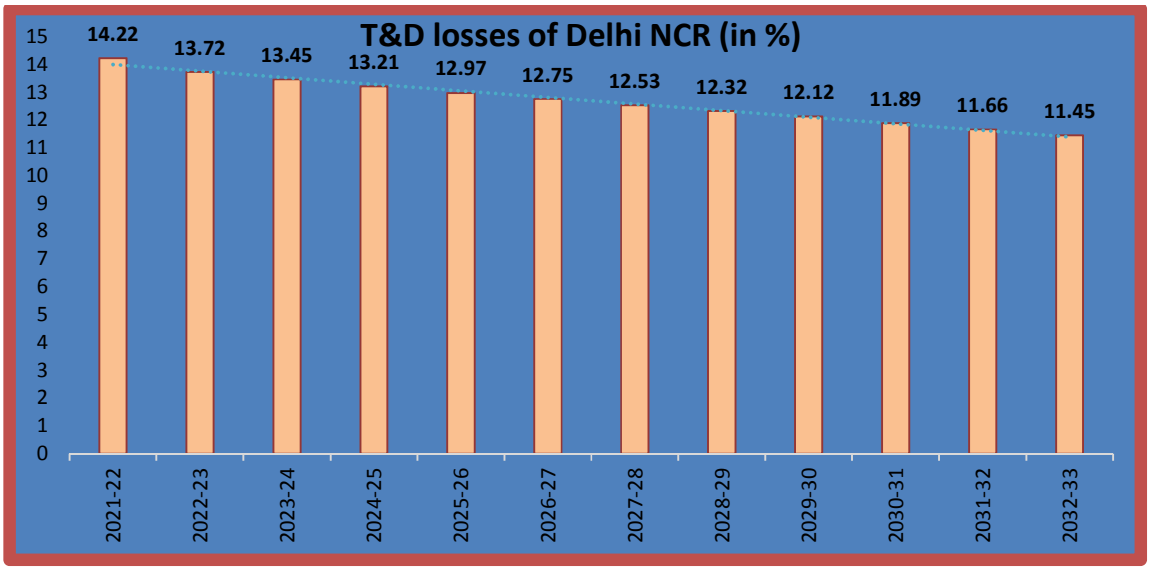
The CAGR expected in the next ten years (2022-23 to 2032-33) along with its break up in five years (2022-23 to 2027-28 & 2027-28 to 2032-33) is tabulated below:

Sl No.	Category	Energy Consumption CAGR in %		
		2022-23 to 2027-28	2027-28 to 2032-33	2022-23 to 2032-33
1.	Domestic	6.88	6.75	6.82
2.	Commercial	4.60	4.89	4.74
3.	Irrigation	5.46	5.21	5.34
4.	Industrial	9.37	7.02	8.19
5.	Others	8.53	9.18	8.85
6.	**Total**	7.31	6.67	6.99

(Table 4.3: 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 14.22% in year 2021-22. The target level is to bring it down to about 12.53% and 11.45% by the end of 2027-28 & 2032-33 respectively.



(Figure 4.8: 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	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33
Domestic	39818	42594	45540	48667	51991	55531	59311	63368	67755	72293	76996
Commercial	13299	13946	14570	15226	15918	16652	17441	18301	19257	20236	21139
Public lighting	717	740	763	787	811	836	861	888	915	943	973
Public Water Works	2131	2242	2358	2480	2607	2741	2881	3028	3181	3342	3511
Irrigation	12941	13646	14382	15152	15983	16885	17781	18716	19691	20705	21771
LT Industries	4294	4494	4701	4915	5135	5364	5598	5839	6084	6335	6635
HT Industries	26003	28058	30984	34325	37991	42040	46401	52317	54589	56902	59908
Railway Traction	770	899	1015	1182	1311	1454	1609	1816	1999	2194	2439
Bulk Supply	2582	2900	3262	3675	4144	4681	5293	5993	6794	7711	8746
Others	1730	1815	1907	2007	2114	2230	2346	2464	2582	2701	2855
Total (Energy Consumption)	**104286**	**111334**	**119481**	**128416**	**138005**	**148413**	**159524**	**172729**	**182846**	**193362**	**204973**
T&D losses -MU	16587	17305	18185	19143	20164	21260	22408	23823	24668	25525	26501
T&D losses -in %	13.72	13.45	13.21	12.97	12.75	12.53	12.32	12.12	11.89	11.66	11.45
Energy Requirement - MU	**120873**	**128640**	**137666**	**147559**	**158169**	**169673**	**181932**	**196552**	**207514**	**218887**	**231474**
Annual Load Factor - %	63.60	63.82	64.06	64.32	64.57	64.81	65.06	65.36	65.52	65.66	66.21
Peak Load - MW	**21694**	**23011**	**24534**	**26189**	**27965**	**29885**	**31923**	**34331**	**36154**	**38056**	**39908**

(Table 4.4: NCR Forecast)

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CHAPTER 5

Demand Forecast of Delhi -NCT

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 2031, this ratio is expected to reach about 28% with total population of 247 lakhs.

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

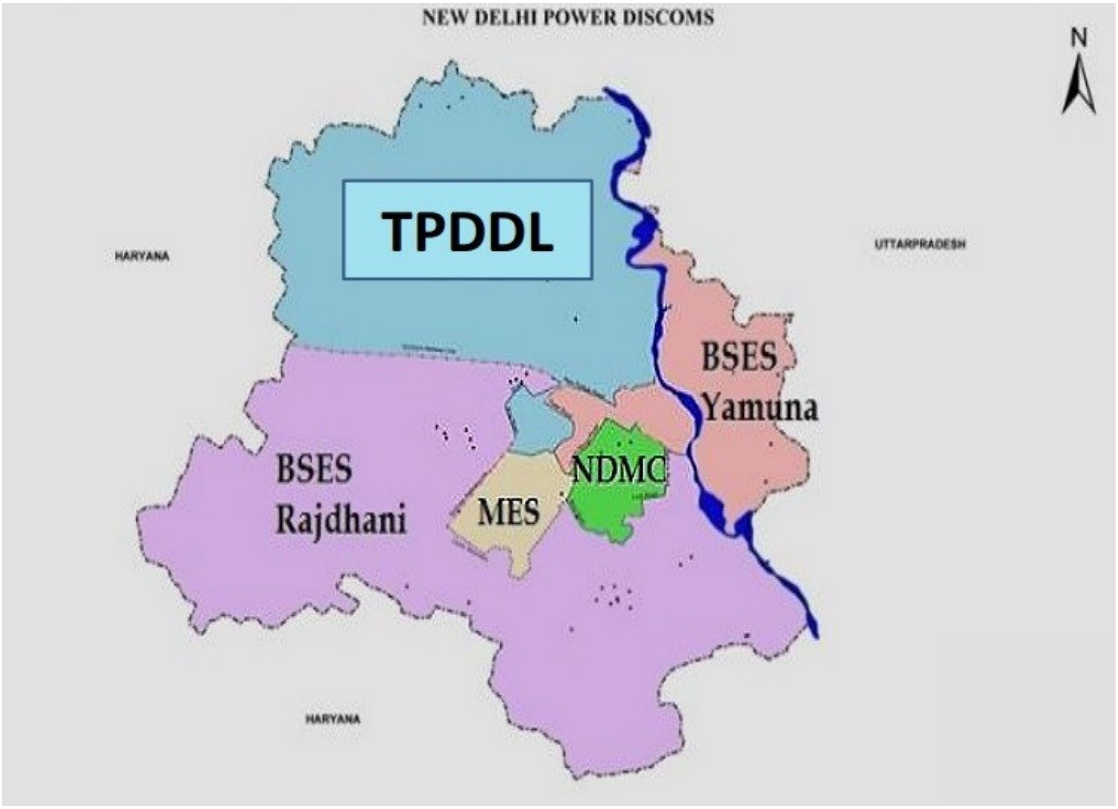
There are eleven districts in Delhi – New Delhi, North Delhi, North West Delhi, West Delhi, South West Delhi, South Delhi, South East Delhi, Central Delhi, North East Delhi, Shahdara & East Delhi.

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.



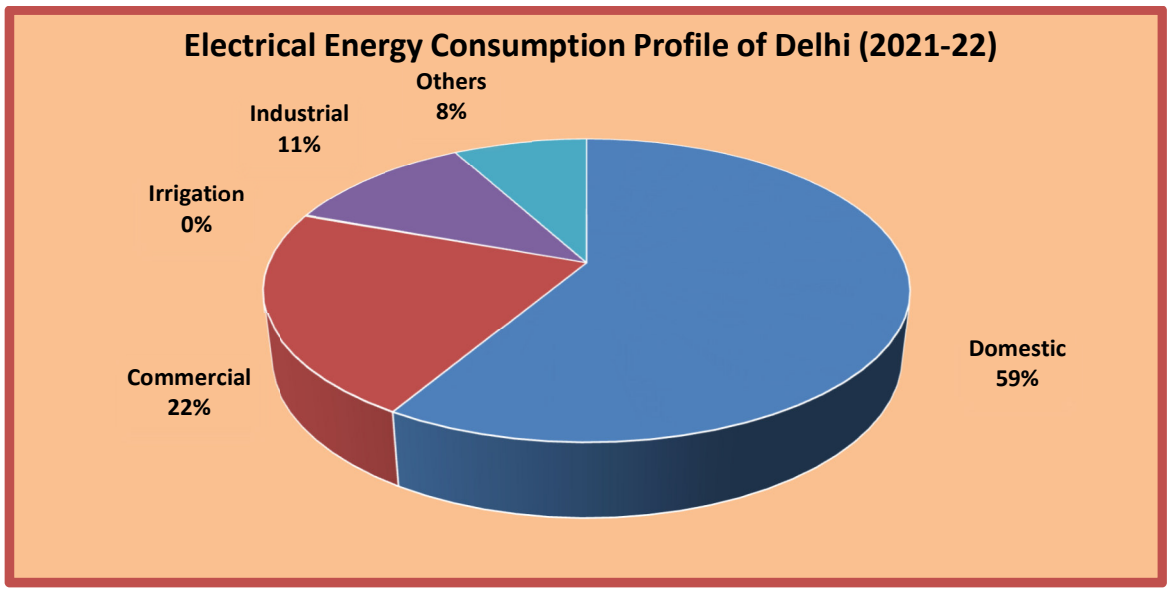
(Figure 5.1: Delhi – Power Distribution)[4]

Existing Power Scenario:

The total electricity consumption of Delhi-NCT in year 2021-22 was 28111 MU and with 9.69% T&D losses, the requirement was 31128 MU that was 28.54% of the total energy requirement of the NCR. During the last decade (2010-11 to 2019-20), Delhi–NCT has observed average annual growth rate of 2.92% in terms of electrical energy requirement. The Peak Demand was 7323 MW in year 2021-22.

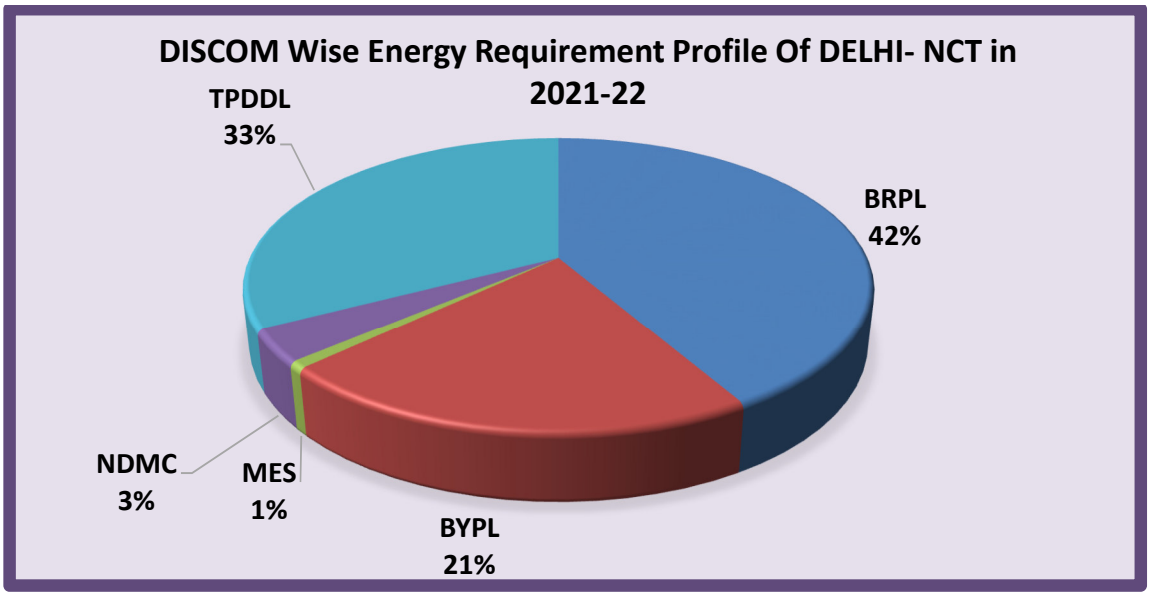
[4] Source:
https://www.tatapower ddl.com/UploadedDocuments/TPDDL%20_Excellence%20Journey_June%202015_18062015.pdf
NDPL is now "Tata Power Delhi Distribution Limited (TPDDL)

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 (59%) in year 2021-22. Thereafter, commercial sector consumed about 22% of the total power.



(Figure 5.2: Energy Consumption Profile of Delhi NCT in 2021-22)

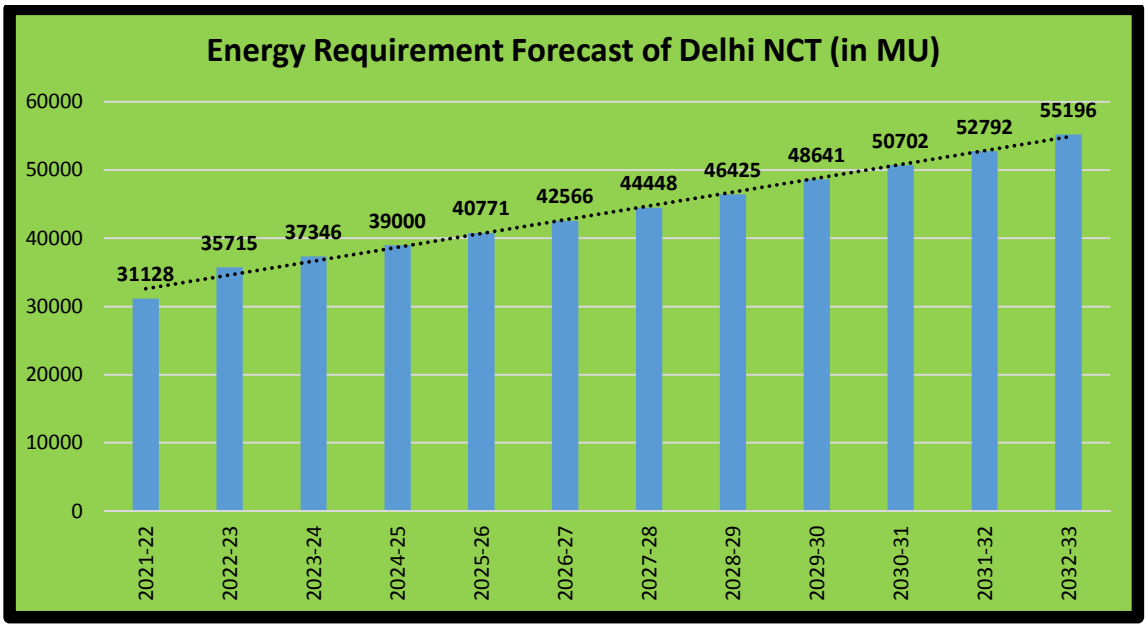
If we compare Discom wise pattern of energy requirement, then BRPL is the largest consumer of electricity (42%) followed by TPDDL (33%) & BYPL (21%).



(Figure 5.3: Discom Wise Energy Requirement Profile of Delhi NCT in 2021-22)

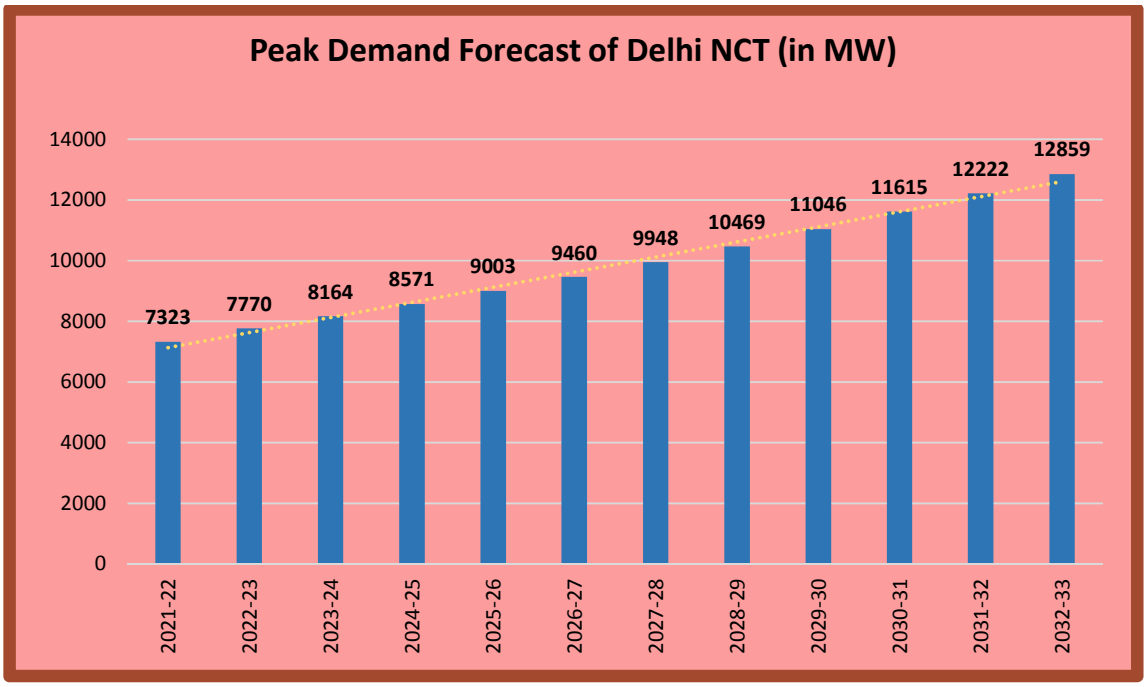
Power Forecast:

Based on total electricity consumption and T&D Losses, the total energy requirement of Delhi-NCT is estimated as 35715 MU in year 2022-23. It is expected that the energy requirement of this sub-region will reach to 44448 MU with 4.47% CAGR for the period 2022-23 to 2027-28. With CAGR of 4.43% for the period 2027-28 to 2032-33, its energy requirement is estimated as 55196 MU by the year 2032-33. The CAGR of energy requirement for the next ten years (2022-23 to 2032-33) is expected to be 4.45 % that is lower than the energy requirement growth rate estimated for the whole NCR (6.71%). 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.



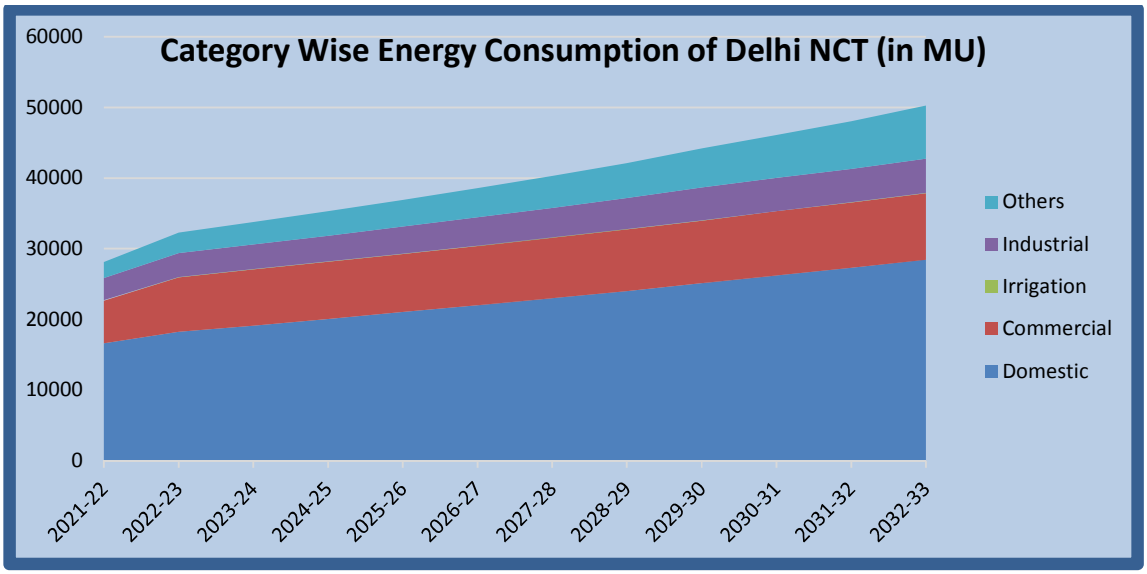
(Figure 5.4: Energy Requirement Forecast of Delhi-NCT)

Peak Demand of this sub-region is expected to see 5.07% CAGR upto 2027-28 and will reach 9948 MW in comparison to 7770 MW in year 2022-23. It is expected to reach 12859 MW in year 2032-33 with a CAGR of 5.27% after 2027-28. The CAGR of peak energy demand for the next ten years (2022-23 to 2032-33) is expected to be 5.17% that is again less compared to the whole NCR region (6.28%).



(Figure 5.5: Peak Demand Forecast of Delhi-NCT)

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



(Figure 5.6: Category Wise Energy Consumption Forecast of Delhi-NCT)

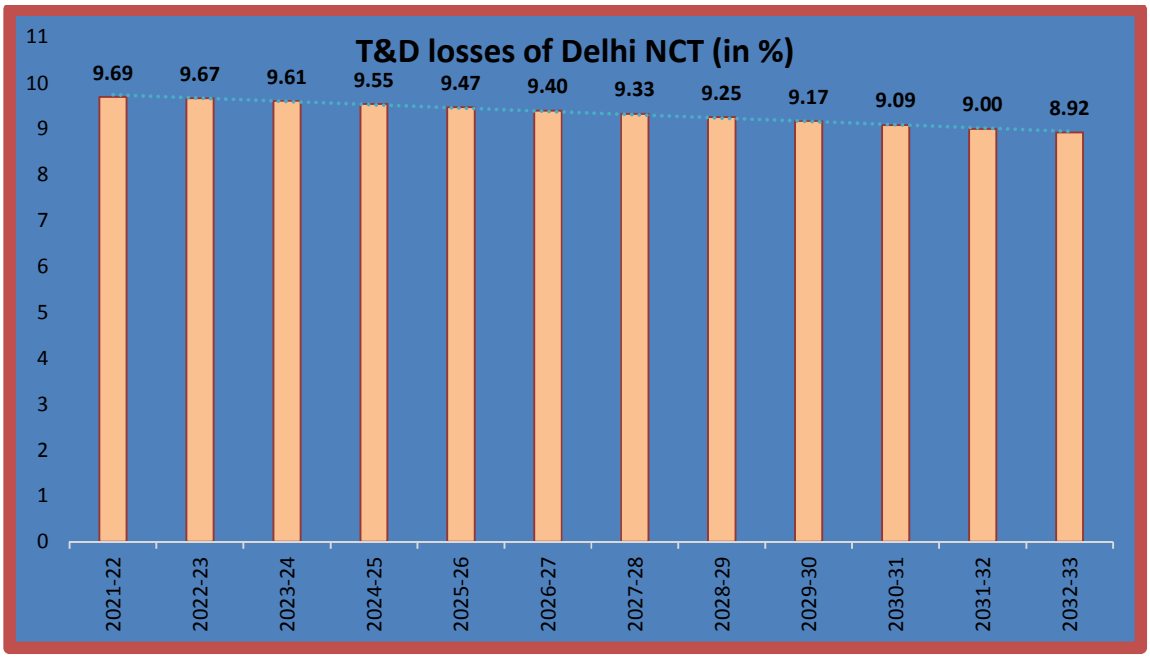
The CAGR expected in the next ten years (2022-23 to 2032-33) along with its break up in five years (2022-23 to 2027-28 & 2027-28 to 2032-33) is tabulated below:

Sl No.	Category	Energy Consumption CAGR in %		
		2022-23 to 2027-28	2027-28 to 2032-33	2022-23 to 2032-33
1.	Domestic	4.77	4.36	4.56
2.	Commercial	2.09	1.84	1.96
3.	Irrigation	2.56	1.57	2.06
4.	Industrial	4.18	3.09	3.63
5.	Others	9.46	10.71	10.08
6.	Total	4.55	4.52	4.54

(Table 5.1: 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 9.67% in year 2022-23. The target level is to bring it down to about 9.33% and 8.92% by the end of 2027-28 & 2032-33 respectively.



(Figure 5.7: 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	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33
Domestic	18218	19126	20057	21013	21991	22996	24029	25099	26218	27308	28462
Commercial	7723	7937	8098	8256	8410	8564	8719	8883	9062	9228	9382
Public lighting	368	375	380	386	392	397	402	406	410	414	418
Public Water Works	676	687	698	708	717	726	734	742	749	756	762
Irrigation	40	41	41	42	44	45	46	47	48	48	49
LT Industries	598	605	610	615	619	622	624	626	626	626	627
HT Industries	2807	2900	3043	3203	3373	3556	3746	4018	4055	4086	4238
Railway Traction	284	356	405	498	543	590	636	718	758	791	851
Bulk Supply	926	1076	1254	1465	1713	2008	2355	2766	3251	3823	4481
Others	622	655	689	725	761	799	838	877	918	960	1003
Total (Energy Consumption)	**32263**	**33758**	**35277**	**36910**	**38563**	**40302**	**42129**	**44181**	**46095**	**48040**	**50273**
T&D losses -MU	3453	3588	3723	3862	4002	4147	4296	4460	4607	4753	4924
T&D losses -in %	9.67	9.61	9.55	9.47	9.40	9.33	9.25	9.17	9.09	9.00	8.92
Energy Requirement - MU	**35715**	**37346**	**39000**	**40771**	**42566**	**44448**	**46425**	**48641**	**50702**	**52792**	**55196**
Annual Load Factor - %	52.47	52.22	51.94	51.70	51.37	51.01	50.62	50.27	49.83	49.31	49.00
Peak Load - MW	**7770**	**8164**	**8571**	**9003**	**9460**	**9948**	**10469**	**11046**	**11615**	**12222**	**12859**

(Table 5.2: Delhi-NCT Forecast – Category Wise)

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CHAPTER 6

Demand Forecast of Haryana sub region

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.

Haryana sub-region of NCR has undergone through the following area wise changes during last decade:

- 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 2031, this ratio is expected to reach about 29% with total population of 261 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.[5]

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.

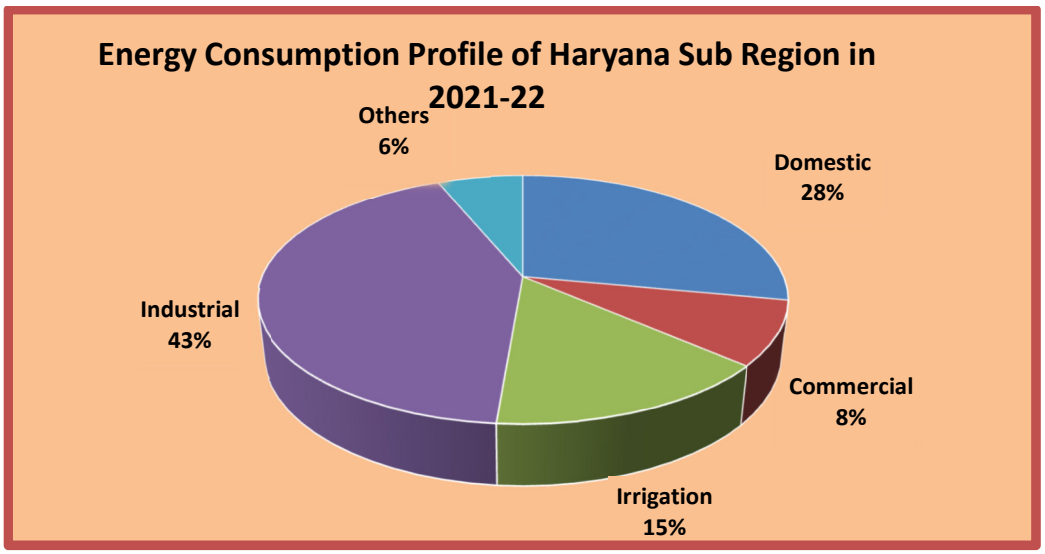
- The distribution function has been split into two geographical areas under two separate companies namely Uttar Haryana Bijli Vitaran Nigam (UHBVN) and Dakshin Haryana Bijli Vitaran Nigam (DHBVN). The UHBVN comprises of 10 districts including 5 districts of NCR (Jhajjar, Karnal, Panipat, Rohtak & Sonepat) and DHBVN comprises of 12 districts including 9 districts NCR viz. Bhiwani, Charkhi Dadri, Faridabad, Gurugram, Jind[6], Mahendragarh, Nuh, Palwal & Rewari.

[5] Economic Profile of NCR Report , NCRPB 2015
[6] Jind District was served by UHBVN till 2013-14.

Existing Power Scenario:

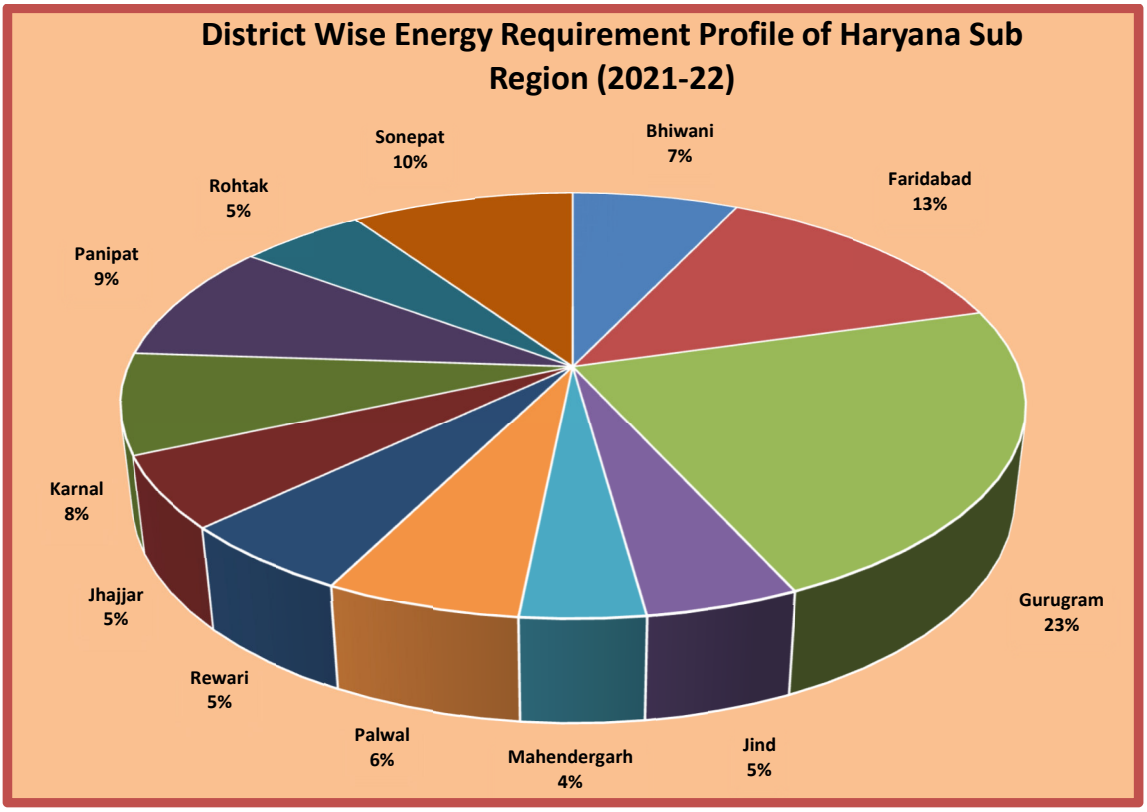
The total electricity consumption of Haryana Sub Region of NCR in year 2021-22 was 32372 MU and with 14.62% T&D losses, the requirement was 37915 MU that was 68.32% of the energy requirement of the entire Haryana state and 34.60% of the total NCR. During the last decade (2010-11 to 2019-20), this Sub Region has observed annual growth rate of 5.95% in terms of electrical energy requirement. The Peak Demand for this sub region was 7771 MW in year 2021-22.

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 Industry sector is the biggest consumer of electricity (43% in 2021-22) that indicates presence of various large scale industries in these areas. Thereafter, domestic sector is consuming about 28% of electrical energy. 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 biggest consumer of electricity.



(Figure 6.1: Energy Consumption Profile of Haryana Sub-Region in 2021-22)

If we compare district wise pattern of energy requirement, then Gurugram (including Nuh District) is the largest consumer of electricity (23%) followed by Faridabad (13%) & Sonepat (10%).

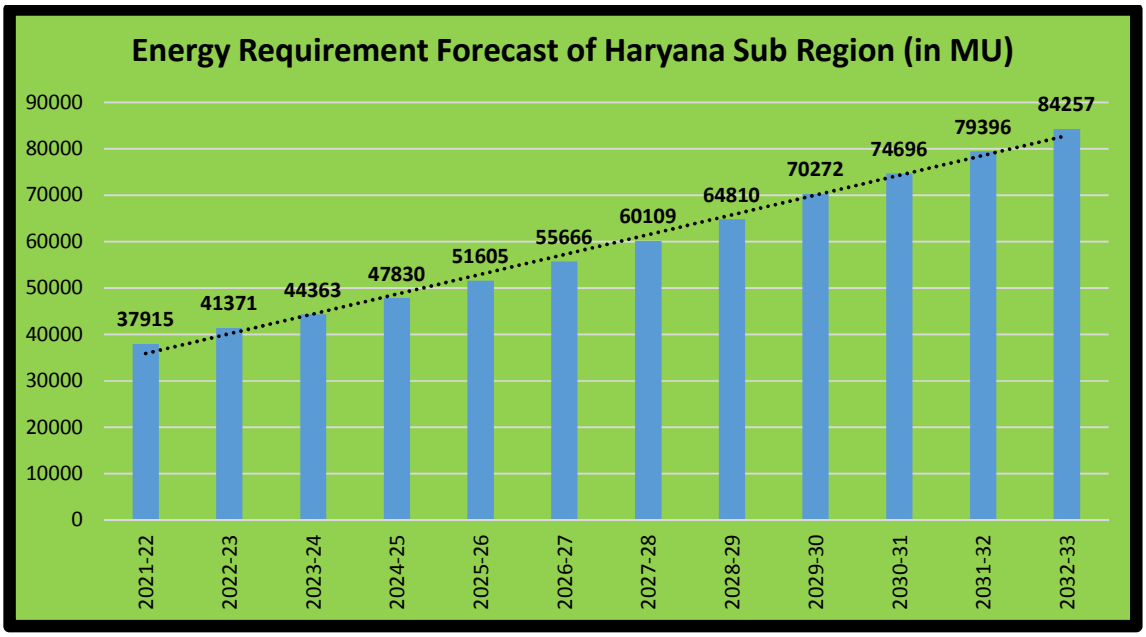


(Figure 6.2: District Wise Energy Requirement Profile of Haryana Sub-Region in 2021-22)

*The data for "Nuh" and "Charkhi Dadri" districts are included "Palwal" and "Bhiwani" districts respectively.

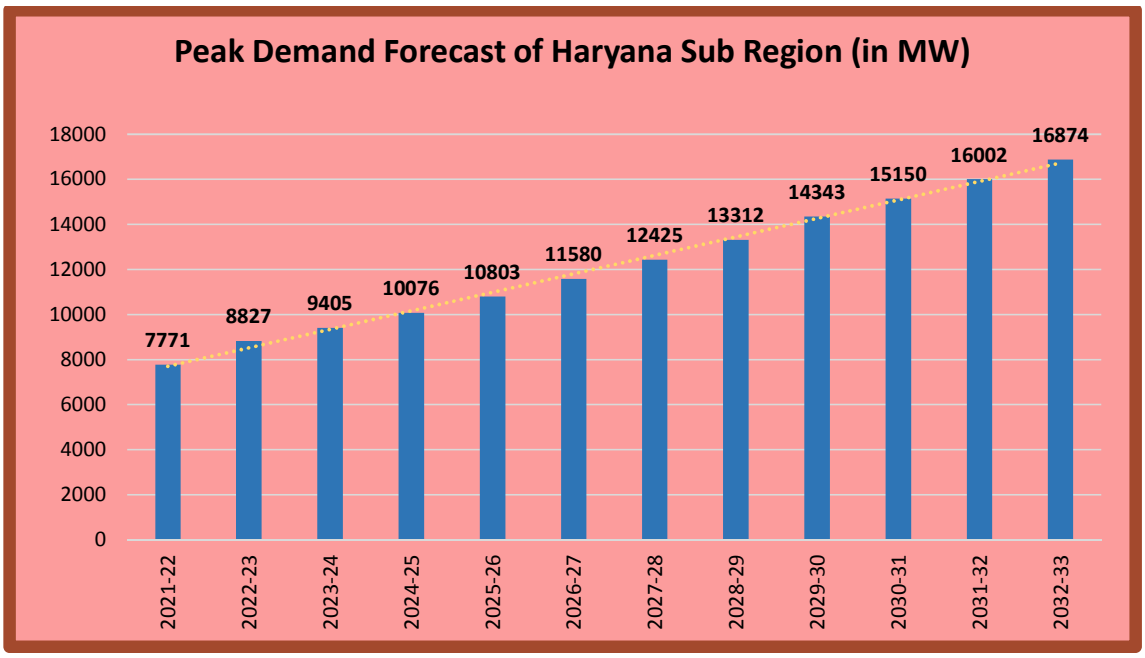
Power Forecast:

Based on total electricity consumption and T&D Losses, the total energy requirement of Haryana Sub Region of NCR is estimated as 41371 MU in year 2022-23. It is expected that the energy requirement of this sub-region will reach to 60109 MU in 2027-28 with 7.76% CAGR for the period 2022-23 to 2027-28. With CAGR of 6.99% for the period 2027-28 to 2032-33, its energy requirement is estimated as 84257 MU by the year 2032-33. The CAGR of energy requirement for the next ten years (2022-23 to 2032-33) is expected as 7.37 %.



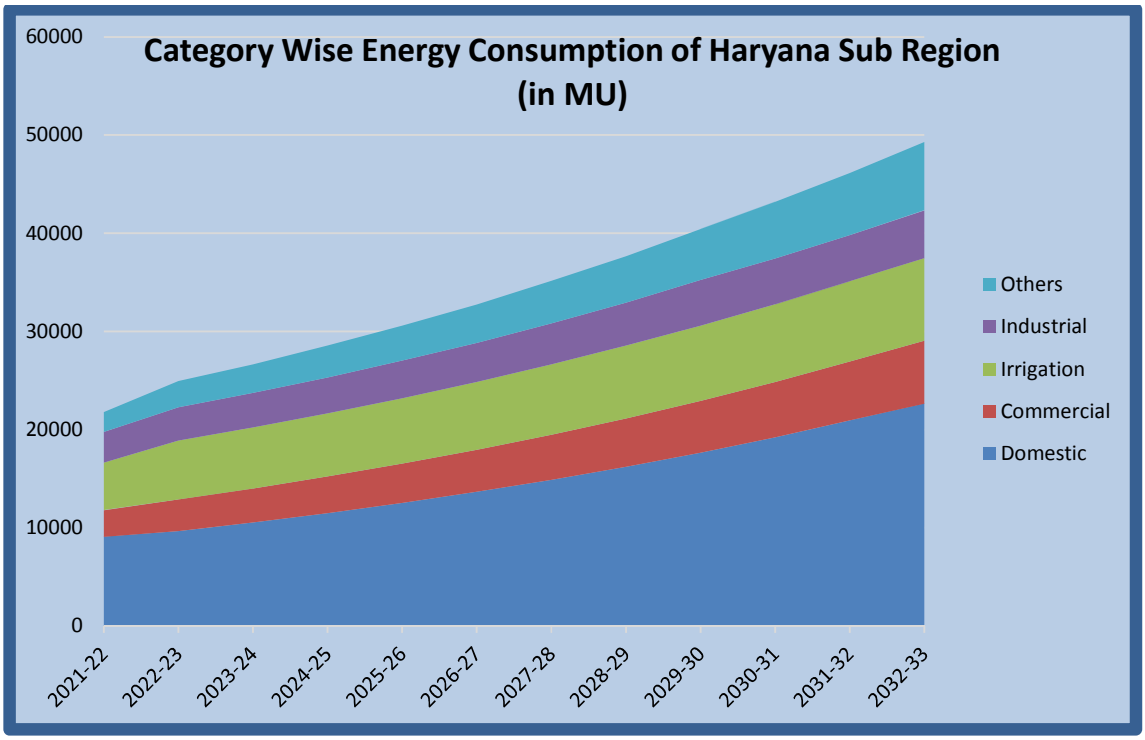
(Figure 6.3: Energy Requirement Forecast of Haryana Sub-Region)

Peak Demand of this sub-region is expected to see 7.62% CAGR upto 2027-28 and will reach 12425 MW in comparison to 8827 MW in year 2022-23. The Peak Demand is expected to reach 16874 MW in year 2032-33 with a CAGR of 6.31% after 2027-28. The CAGR of peak energy demand for the next ten years (2022-23 to 2032-33) is expected as 6.69%.



(Figure 6.4: Peak Demand Forecast of Haryana Sub-Region)

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



(Figure 6.5: Category Wise Energy Consumption Forecast of Haryana Sub-Region)

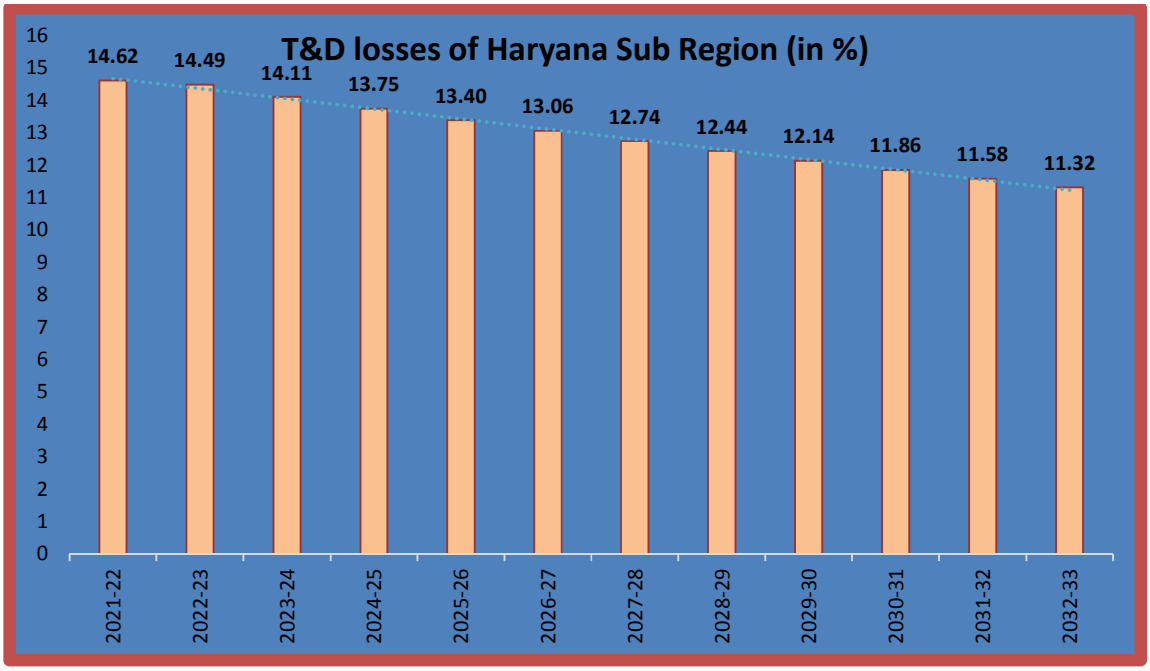
The CAGR expected in the next ten years (2022-23 to 2032-33) along with its break up in five years (2022-23 to 2027-28 & 2027-28 to 2032-33) is tabulated below:

Sl No.	Category	Energy Consumption CAGR in %		
		2022-23 to 2027-28	2027-28 to 2032-33	2022-23 to 2032-33
1.	Domestic	9.08	8.76	8.92
2.	Commercial	7.24	6.90	7.07
3.	Irrigation	3.67	3.21	3.44
4.	Industrial	9.35	7.37	8.36
5.	Others	10.09	10.11	10.10
6.	Total	8.27	7.45	7.85

(Table 6.1: 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 14.49 % in year 2022-23. The target level is to bring it down to about 12.74% and 11.32% by the end of 2027-28 & 2032-33 respectively.



(Figure 6.6: 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	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33
Domestic	9635	10521	11482	12523	13652	14875	16203	17644	19211	20904	22639
Commercial	3236	3475	3729	3999	4286	4591	4916	5262	5632	6025	6410
Public lighting	114	123	133	144	155	168	181	195	210	226	244
Public Water Works	887	950	1018	1089	1165	1246	1331	1421	1517	1617	1724
Irrigation	5998	6219	6442	6668	6897	7182	7426	7671	7916	8162	8412
LT Industries	2241	2370	2506	2649	2800	2957	3123	3297	3479	3670	3876
HT Industries	11931	12964	14302	15797	17422	19197	21101	23520	24859	26267	27743
Railway Traction	331	381	438	503	579	666	766	880	1013	1164	1339
Bulk Supply	1331	1478	1639	1817	2013	2228	2465	2726	3011	3325	3668
Others	3	3	3	4	4	4	4	4	4	5	5
Total (Energy Consumption)	**35707**	**38484**	**41692**	**45194**	**48972**	**53114**	**57515**	**62620**	**66852**	**71365**	**76059**
T&D losses -MU	5995	6259	6575	6914	7273	7660	8060	8533	8856	9195	9537
T&D losses -in %	14.49	14.11	13.75	13.40	13.06	12.74	12.44	12.14	11.86	11.58	11.32
Energy Requirement - MU	**41371**	**44363**	**47830**	**51605**	**55666**	**60109**	**64810**	**70272**	**74696**	**79396**	**84257**
Annual Load Factor - %	53.51	53.85	54.19	54.53	54.88	55.23	55.58	55.93	56.28	56.64	57.00
Peak Load - MW	**8827**	**9405**	**10076**	**10803**	**11580**	**12425**	**13312**	**14343**	**15150**	**16002**	**16874**

(Table 6.2: Haryana Sub Region Forecast)

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CHAPTER 7

Demand Forecast of Rajasthan sub region

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 2031, the share is estimated as 10% approximately with total population of 92 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.[7]

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. Some areas of Bharatpur District

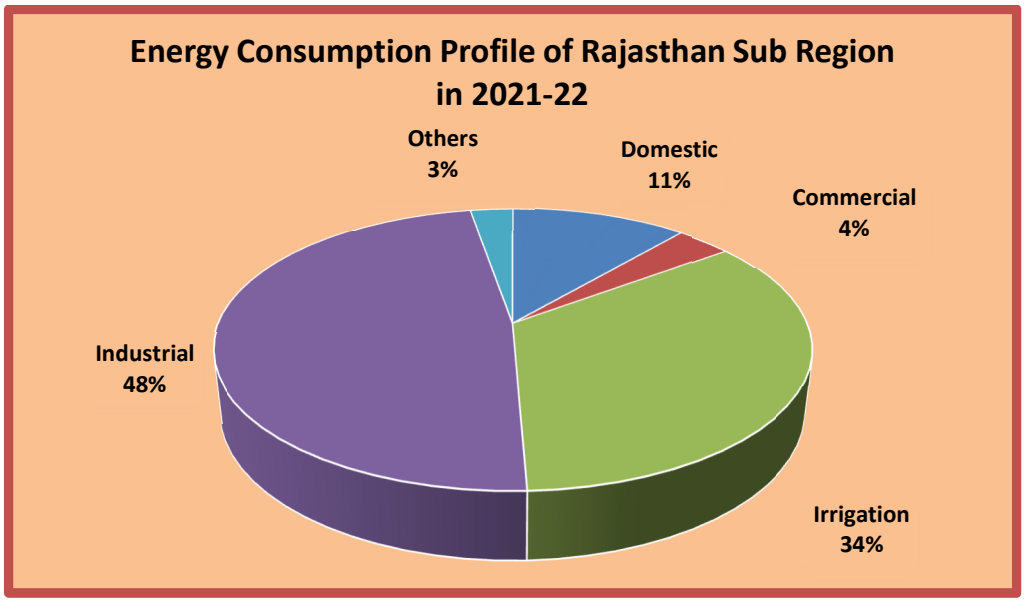
[7] Economic Profile of NCR Report , NCRPB 2015

is served by Bharatpur Electricity Services Limited (BESL) - A franchisee of JVVNL & a wholly-owned subsidiary of CESC Limited.

Existing Power Scenario:

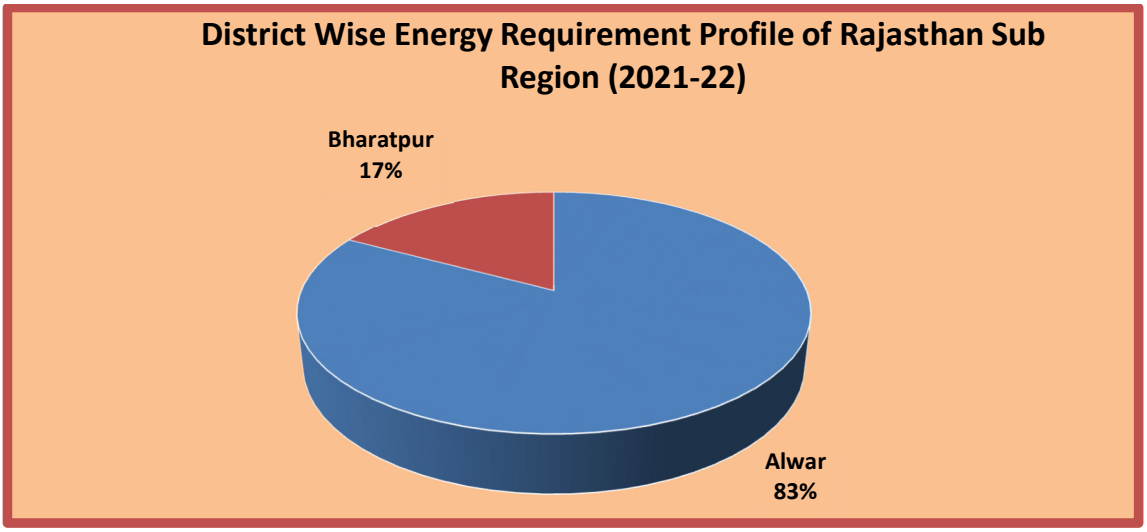
The total electricity consumption of Rajasthan Sub Region of NCR in year 2021-22 was 8214 MU and with 21.95% T&D losses, the requirement was 10524 MU that was 11.72% of the energy requirement of the entire Rajasthan state and 8.78% of the total NCR. During the last decade (2010-11 to 2019-20), the Rajasthan Sub Region has observed annual growth rate of 7.79% in terms of electrical energy requirement. The Peak Demand for this sub region was 1751 MW in year 2021-22.

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 (48%) that clearly indicates presence of various large scale industries in these areas mainly in Alwar district. Irrigation sector is the next one consuming about 34% of electricity. The consumption in domestic sector is very low (11% only) that is in sharp contrast to Delhi-NCT wherein this sector has more than 50% share in energy requirement.



(Figure 7.1: Energy Consumption Profile of Rajasthan Sub-Region in 2021-22)

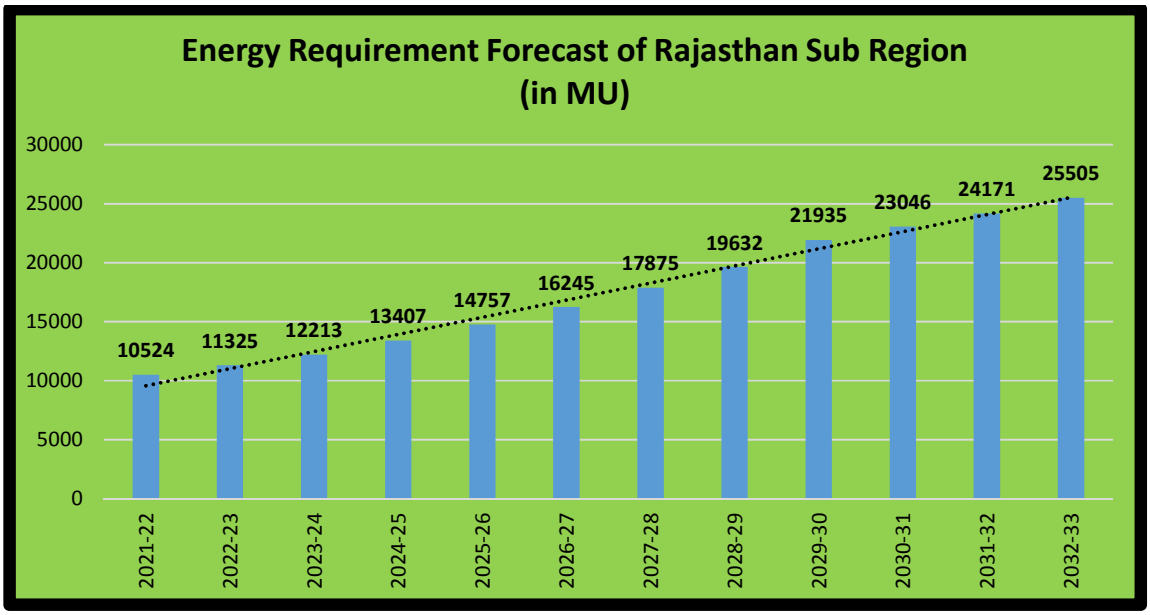
Among the districts of this sub region, the energy requirement of Alwar district alone is more than 4/5th of the total requirement of this sub region whereas the difference in population is not that much in proportion (as per Census 2011, the population of Alwar and Bharatpur were 36.74 & 25.48 lakhs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



(Figure 7.2: District Wise Energy Requirement Profile of Rajasthan Sub-Region in 2021-22)

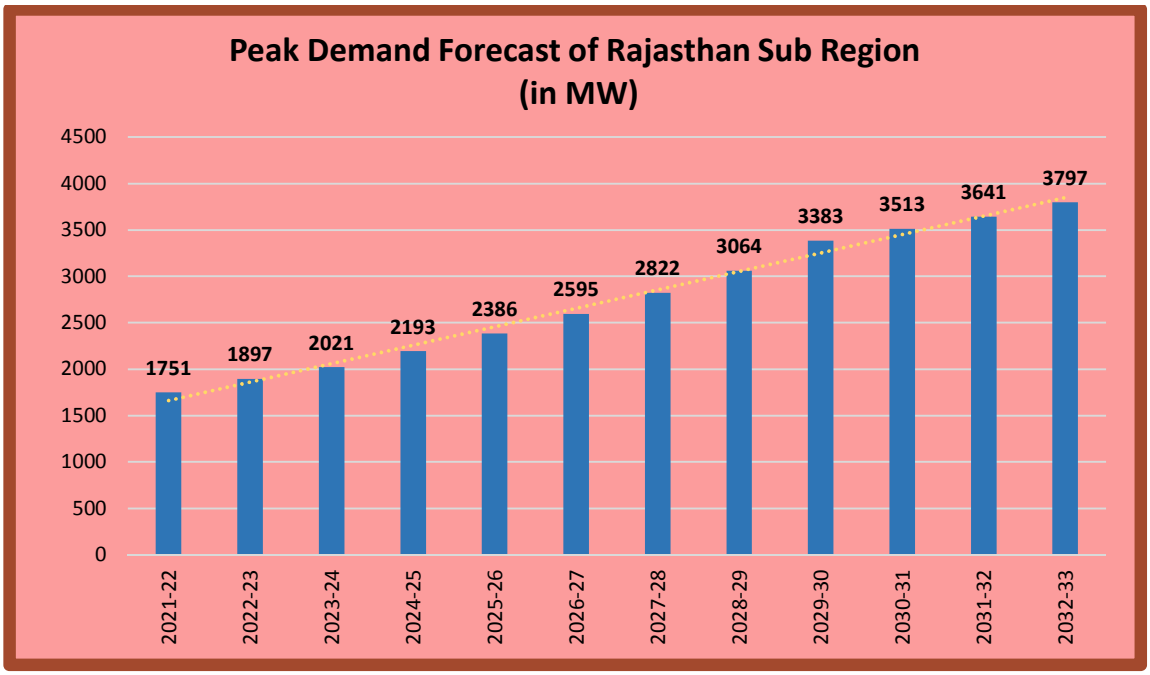
Power Forecast:

Based on total electricity consumption and T&D Losses, the total energy requirement of Rajasthan Sub Region of NCR is estimated as 11325 MU in Year 2022-23. It is expected that the energy requirement of this sub-region will reach to 17875 MU in 2027-28 with 9.56% CAGR for the period 2022-23 to 2027-28. With CAGR of 7.37% for the period 2027-28 to 2032-33, its energy requirement is estimated as 25505 MU by the year 2032-33. The CAGR of energy requirement for the next ten years (2022-23 to 2032-33) is expected as 8.46%.



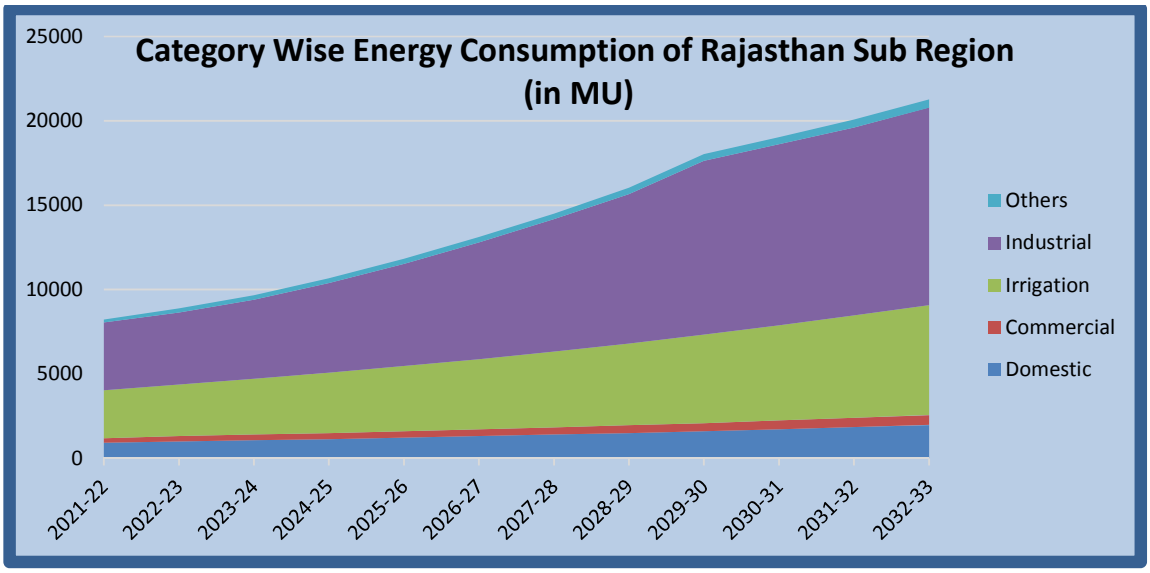
(Figure 7.3: Energy Requirement Forecast of Rajasthan Sub-Region)

Peak Demand of this sub-region is expected to see 8.28% CAGR upto 2027-28 and will reach 2822 MW in comparison to 1897 MW in year 2022-23. The Peak Demand is expected to reach 3797 MW in year 2032-33 with a CAGR of 6.11% after 2027-28. The CAGR of peak energy demand for the next ten years (2022-23 to 2032-33) is expected as 7.19%.



(Figure 7.4: Peak Demand Forecast of Rajasthan Sub-Region)

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



(Figure 7.5: Category Wise Energy Consumption Forecast of Rajasthan Sub-Region)

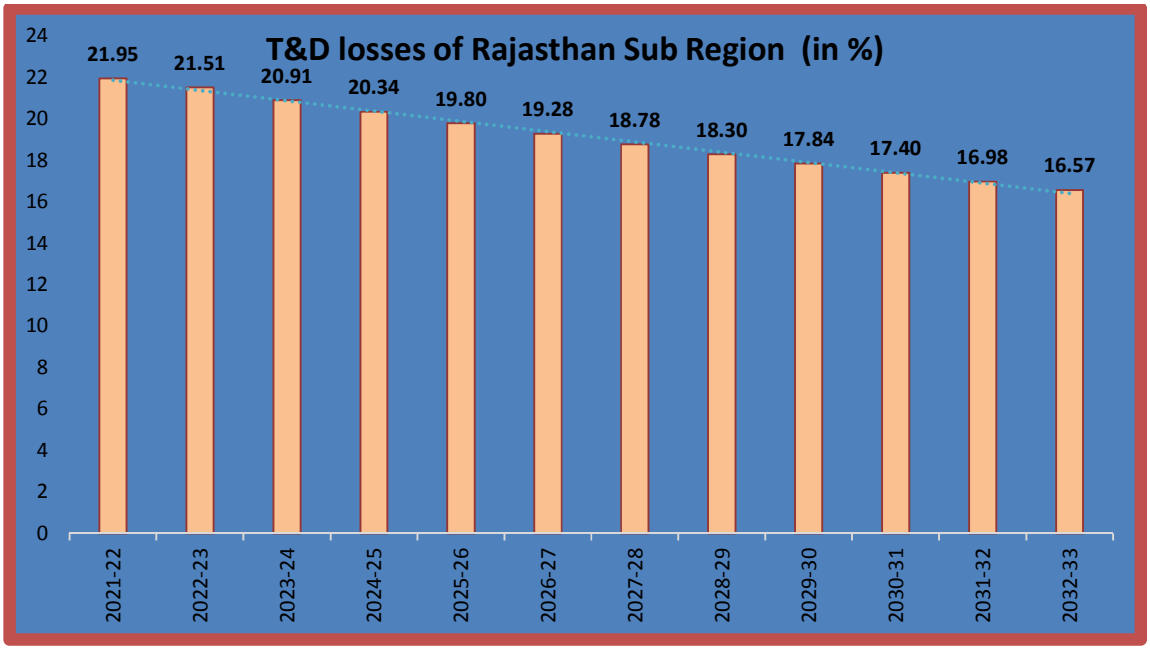
The CAGR expected in the next ten years (2022-23 to 2032-33) along with its break up in five years (2022-23 to 2027-28 & 2027-28 to 2032-33) is tabulated below:

Sl No.	Category	Energy Consumption CAGR in %		
		2022-23 to 2027-28	2027-28 to 2032-33	2022-23 to 2032-33
1.	Domestic	6.92	7.01	6.97
2.	Commercial	6.12	6.67	6.39
3.	Irrigation	7.99	7.69	7.84
4.	Industrial	12.98	8.36	10.65
5.	Others	7.29	7.02	7.15
6.	Total	10.31	7.94	9.12

(Table 7.1: 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 21.51% in year 2022-23. The target level is to bring it down to about 18.78% and 16.57% by the end of 2027-28 & 2032-33 respectively.



(Figure 7.6: 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	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33
Domestic	1007	1078	1153	1232	1317	1407	1505	1612	1732	1851	1975
Commercial	316	336	356	377	401	426	453	485	521	557	588
Public lighting	28	30	33	35	38	41	45	48	52	56	61
Public Water Works	116	125	134	145	156	167	180	193	208	223	239
Irrigation	3063	3311	3575	3859	4171	4498	4849	5225	5627	6056	6515
LT Industries	306	321	336	351	366	381	395	409	422	434	457
HT Industries	3954	4354	4980	5717	6538	7461	8466	9893	10310	10717	11258
Railway Traction	63	67	70	74	78	82	86	90	94	98	103
Bulk Supply	36	39	43	46	51	55	60	65	70	76	83
Others	0	0	0	0	0	0	0	0	0	0	0
Total (Energy Consumption)	**8889**	**9659**	**10680**	**11836**	**13114**	**14518**	**16039**	**18021**	**19035**	**20067**	**21278**
T&D losses -MU	2436	2554	2727	2922	3132	3357	3593	3914	4011	4104	4227
T&D losses -in %	21.51	20.91	20.34	19.80	19.28	18.78	18.30	17.84	17.40	16.98	16.57
Energy Requirement - MU	**11325**	**12213**	**13407**	**14757**	**16245**	**17875**	**19632**	**21935**	**23046**	**24171**	**25505**
Annual Load Factor - %	68.17	68.98	69.79	70.62	71.45	72.30	73.15	74.02	74.90	75.78	76.68
Peak Load - MW	**1897**	**2021**	**2193**	**2386**	**2595**	**2822**	**3064**	**3383**	**3513**	**3641**	**3797**

(Table 7.2: Rajasthan Sub Region Forecast)

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CHAPTER 8

Demand Forecast of Uttar Pradesh sub region

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 increase in 2031 to 33% with total population of 295 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.[8]

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.

[8] 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:

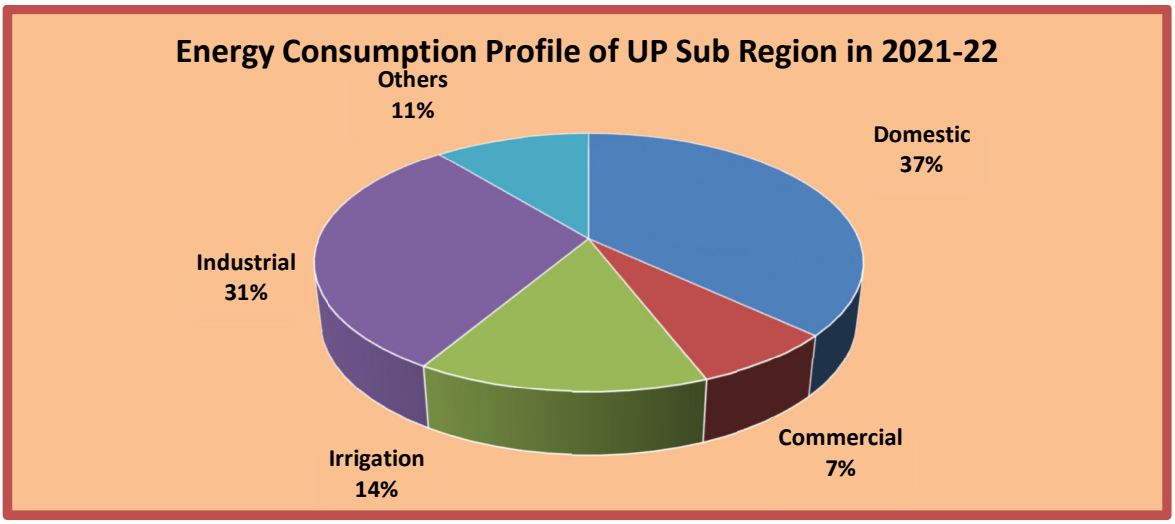
- Madhyanchal Vidyut Vitran Nigam Limited (MVVNL), Lucknow
- Paschimanchal Vidyut Vitran Nigam Limited (PVVNL), Meerut
- Purvanchal Vidyut Vitran Nigam Limited (PuVVNL), Varanasi
- Dakshinanchal Vidyut Vitran Nigam Limited (DVVNL), Agra
- Kanpur Electric Supply Company(KESCO), Kanpur

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.

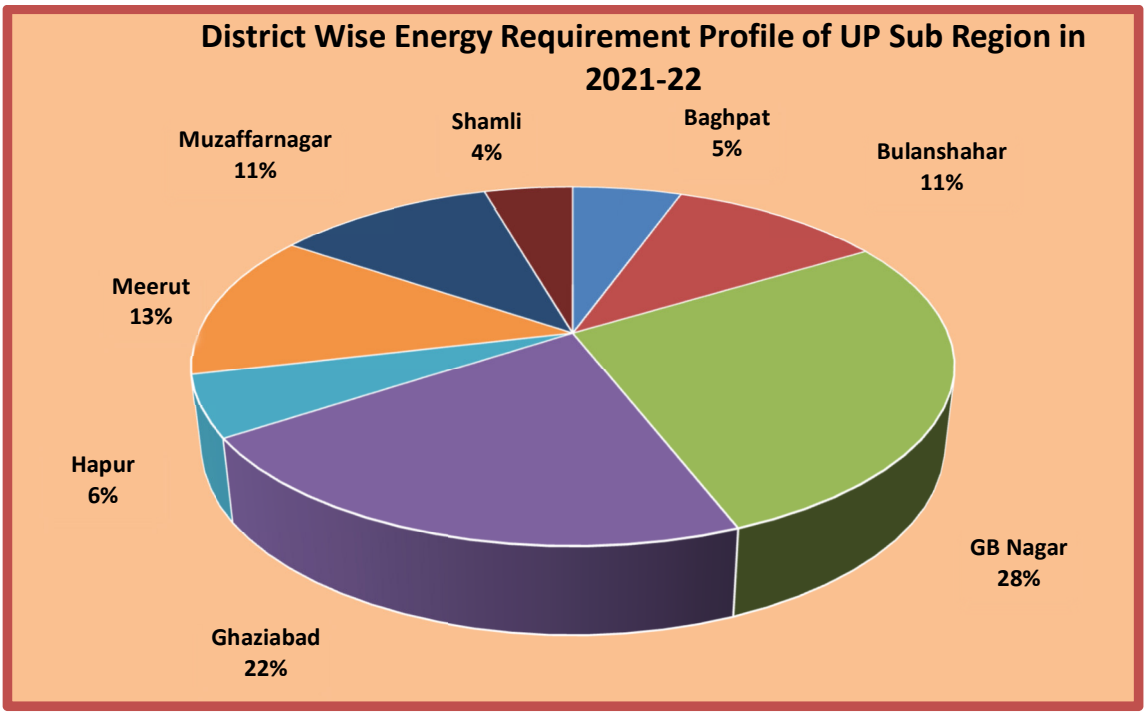
Existing Power Scenario:

The total electricity consumption of Uttar Pradesh Sub Region of NCR in year 2021-22 was 24850 MU and with 15.74% T&D losses, the requirement was 29493 MU that was 23 % of the energy requirement of the entire Uttar Pradesh state and 27 % of the total NCR.The Peak Demand for this sub region was 5567 MW in year 2021-22. 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%). 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 8.1: Energy Consumption Profile of UP Sub-Region in 2021-22)

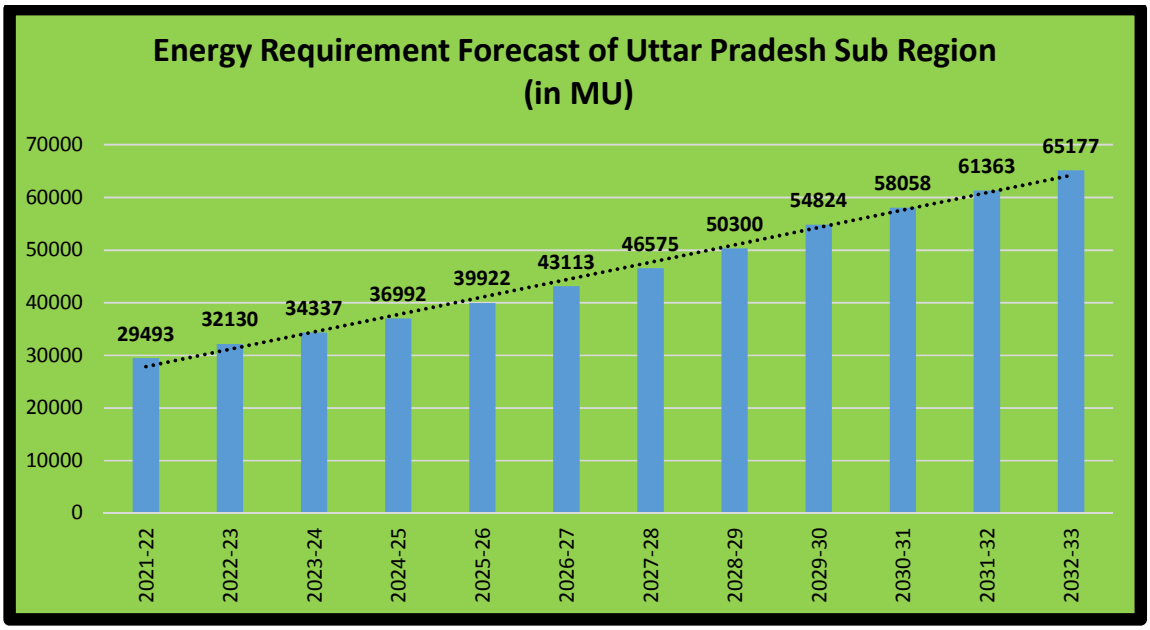
Among the districts of this sub region, the energy requirement of Ghaziabad and Gautam Buddha Nagar are very similar and together these two districts had about half of the total energy requirement of this sub region. The energy requirement shares of Meerut, Muzaffarnagar and Bulandshahar were in the range of 11-13 % whereas shares of Shamli, Bhagpat and Hapur districts were in the range of 4-6 % only.



(Figure 8.2: District Wise Energy Requirement Profile of UP Sub-Region in 2021-22)

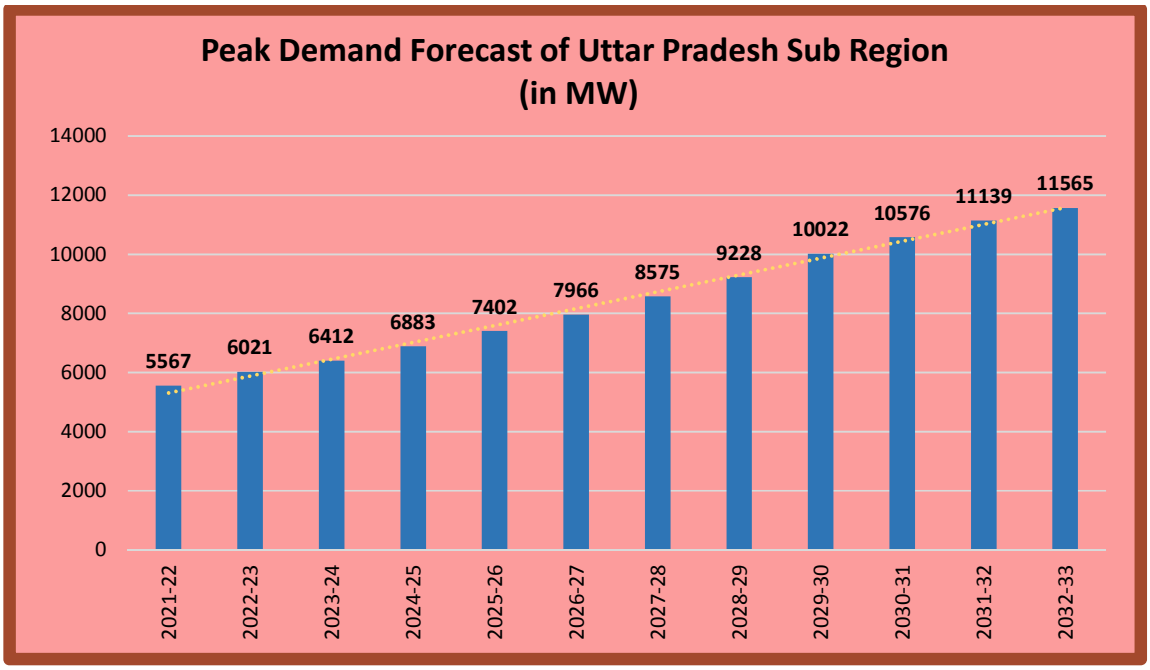
Power Forecast:

Based on total electricity consumption and T&D Losses, the total energy requirement of Uttar Pradesh Sub Region of NCR is estimated as 32130 MU in Year 2022-23. It is expected that the energy requirement of this sub-region will reach to 46575 MU with 7.71% CAGR for the period 2022-23 to 2027-28. With CAGR of 6.95% for the period 2027-28 to 2032-33, its energy requirement is estimated as 65177 MU by the year 2032-33. The CAGR of energy requirement for the next ten years (2022-23 to 2032-33) is expected as 7.33%.



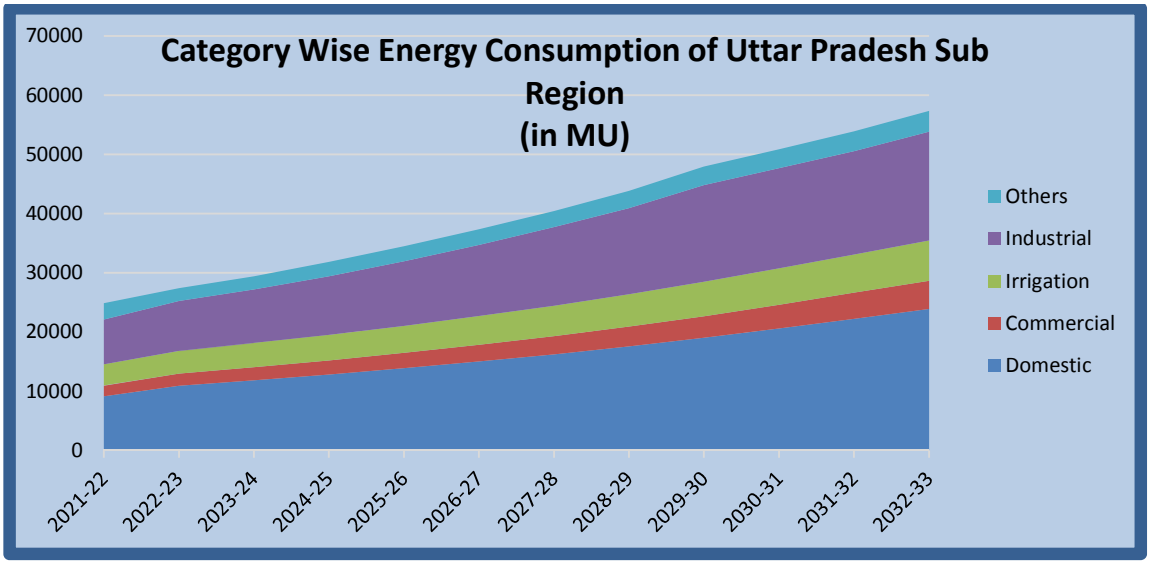
(Figure 8.3: Energy Requirement Forecast of UP Sub-Region)

Peak Demand of this sub-region is expected to see 7.33% CAGR upto 2027-28 and will reach 8575 MW in comparison to 6021 MW in year 2022-23. The Peak Demand is expected to reach 11565 MW in year 2032-33 with a CAGR of 6.17% after 2027-28. The CAGR of peak energy demand for the next ten years (2022-23 to 2032-33) is expected as 6.75 %.



(Figure 8.4: Peak Demand Forecast of UP Sub-Region)

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



(Figure 8.5: Category Wise Energy Consumption Forecast of UP Sub-Region)

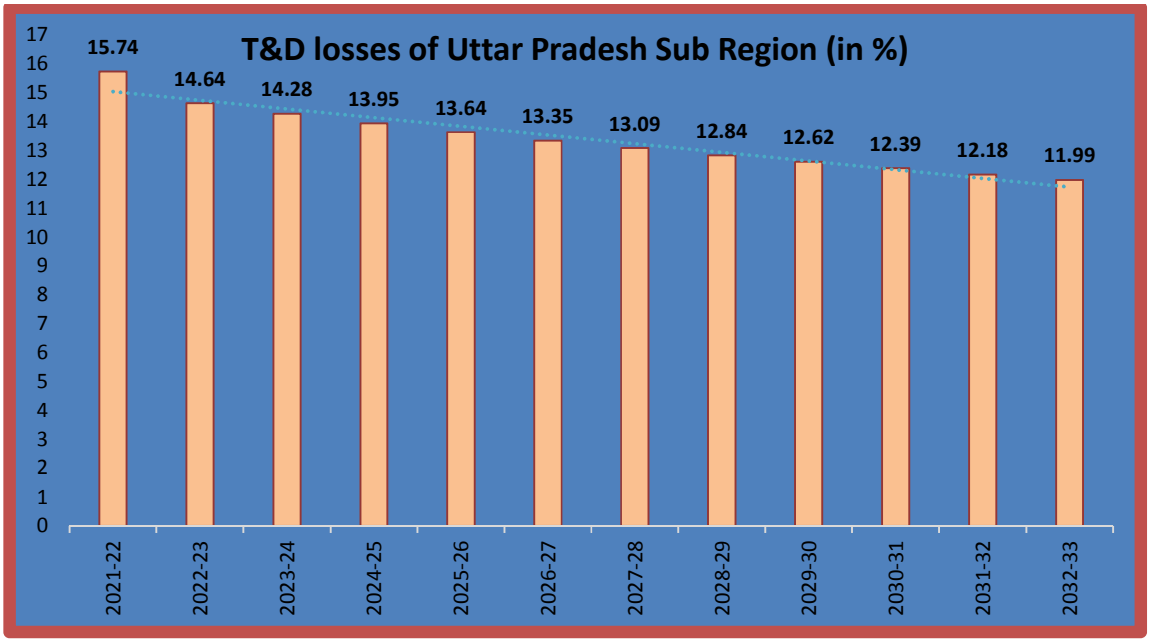
The CAGR expected in the next ten years (2022-23 to 2032-33) along with its break up in five years (2022-23 to 2027-28 & 2027-28 to 2032-33) is tabulated below:

Sl No.	Category	Energy Consumption CAGR in %		
		2022-23 to 2027-28	2027-28 to 2032-33	2022-23 to 2032-33
1.	Domestic	8.20	8.04	8.12
2.	Commercial	8.72	9.15	8.93
3.	Irrigation	6.09	5.66	5.87
4.	Industrial	9.35	6.75	8.05
5.	Others	5.20	5.09	5.15
6.	Total	8.10	7.22	7.66

(Table 8.1: 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 14.64% in year 2022-23. The target level is to bring it down to about 13.09% and 11.99% by the end of 2027-28 & 2032-33 respectively.



(Figure 8.6: T&D Loss Forecast of UP Sub-Region)

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Uttar Pradesh Sub Region											
Electrical Energy Consumption, Energy Requirement and Peak Electricity Demand											
(Category Wise and Year Wise Summary)											
Year	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32	2032-33
Domestic	10958	11869	12848	13900	15032	16253	17574	19014	20595	22229	23921
Commercial	2023	2197	2387	2594	2821	3072	3353	3672	4042	4427	4760
Public lighting	207	212	217	221	226	230	234	238	242	246	250
Public Water Works	453	480	509	538	569	602	636	671	708	746	786
Irrigation	3840	4076	4324	4584	4871	5159	5460	5773	6100	6440	6795
LT Industries	1150	1199	1249	1300	1351	1403	1456	1507	1558	1606	1675
HT Industries	7311	7840	8659	9608	10658	11826	13088	14884	15365	15832	16669
Railway Traction	91	96	101	106	112	117	123	128	134	140	147
Bulk Supply	289	307	326	346	368	390	413	437	462	487	514
Others	1106	1157	1214	1279	1349	1427	1505	1582	1660	1737	1847
Total (Energy Consumption)	**27427**	**29433**	**31832**	**34476**	**37356**	**40479**	**43841**	**47907**	**50864**	**53890**	**57363**
T&D losses -MU	4703	4904	5160	5446	5758	6096	6459	6917	7194	7472	7815
T&D losses - in %	14.64	14.28	13.95	13.64	13.35	13.09	12.84	12.62	12.39	12.18	11.99
Energy Requirement - MU	**32130**	**34337**	**36992**	**39922**	**43113**	**46575**	**50300**	**54824**	**58058**	**61363**	**65177**
Annual Load Factor - %	60.92	61.13	61.35	61.57	61.79	62.00	62.22	62.44	62.67	62.89	63.11
Peak Load - MW	**6021**	**6412**	**6883**	**7402**	**7966**	**8575**	**9228**	**10022**	**10576**	**11139**	**11565**

(Table 8.2: Uttar Pradesh Sub Region Forecast)

CHAPTER 9

Perspective Electricity Demand Projection (2037-38 and 2042-43)

This chapter covers the long term projection of electrical energy consumption, electrical energy requirement, peak electricity demand, T&D losses and load factor for the years 2037-38 and 2042-43. The projection has been done for NCR and its sub region by extrapolating the electricity consumption figures with suitable growth rates. The electrical energy requirement has been worked out by adding T&D losses estimated by extending the T&D losses trajectories further. The Peak electricity demand of each sub region has been derived by assuming suitable load factor. The long term electricity demand projection on all-India basis is summarized in Table 9.1.

Table 9.1: Long term electricity demand projection for the years 2032-33, 2037-38 & 2042-43 for NCR region

Particulars	Year			CAGR (in %)	
	2032-33	2037-38	2042-43	2032-33 to 2037-38	2037-38 to 2042-43
Total Energy Consumption - MU	2,04,973	2,76,211	3,64,362	6.15	5.70
T&D losses –MU	26,501	31,536	36,292		
T&D losses (Ex- Bus) - %	11.45	10	9		
Energy Requirement (Ex-Bus) - MU	2,31,474	3,07,747	4,00,654	5.86	5.42
Annual Load Factor - %	66.21	65.64	65.71		
Peak Demand (Ex-Bus) – MW	39,908	53,228	69,401	5.93	5.45

The Sub region wise electricity demand projection for the years 2032-33, 2037-38 & 2042-43 is summarized in Table 9.2.

Table 9.2: Summary of sub region wise electrical energy requirement & peak electricity demand for the years 2032-33, 2037-38 & 2042-43

Region	Energy Requirement (in MU)			Peak Demand (in MW)		
	2032-33	2037-38	2042-43	2032-33	2037-38	2042-43
NCT -Delhi	55,196	66,772	79,194	12,859	15,652	18,640
Haryana Sub-region	84,257	1,17,043	1,55,684	16,874	23,358	31,344
Rajasthan Sub-region	25,505	36,004	49,136	3,797	5,380	7,371
Uttar Pradesh Sub-region	65,177	87,929	1,16,639	11,565	15,757	21,068
Total (NCR)	2,31,474	3,07,747	4,00,654	39,908	53,228	69,401

Summary of Electricity Demand Projection:

Electrical energy requirement and peak electricity demand for the year 2022-23 to 2042-43 are summarized in Table 9.3. CAGR of electrical energy requirement and peak electricity demand is summarized in Table 9.4.

Table 9.3: Electrical Energy Requirement and Peak Electricity Demand from the year 2022-23 to 2042-43 for NCR region

Year	Energy Requirement	Peak Demand
	(MU)	(MW)
2022-23	120873	21694
2027-28	169673	29885
2032-33	231474	39908
2037-38	307747	53228
2042-43	400654	69401

Table 9.4: CAGR of Electrical Energy Requirement and Peak Electricity Demand from the year 2022-23 to 2042-43 for NCR region

Year	Growth in Energy Requirement	CAGR of Energy Requirement	Growth in Peak Demand	CAGR of Peak Demand
	(MU)	(%)	(MW)	(%)
2022-23 to 2027-28	48800	7.02	8191	6.62
2027-28 to 2032-33	61801	6.41	10023	5.95
2032-33 to 2037-38	76273	5.86	13320	5.93
2037-38 to 2042-43	92906	5.42	16173	5.45

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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. In case of Delhi, since the actuals till now is not in much deviations with the forecast of 20th EPS (volume I), the same figures have been taken in this report also.

iv. The electrical energy growth trends have been estimated on the basis of the data till 2021-22 only for estimating more reliable trends as for some districts only provisional data for FY 2022-23 were available.

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

vi. 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 2031.

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 NCR has been calculated after summing up estimated population of each sub region of NCR.

vi. 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		Projected Population
		2001	2011	2031
1	Delhi – NCT	138,50,507	167,87,941	246,63,855
2	Haryana Sub Region	133,88,603	164,27,524	260,68,819
3	Rajasthan Sub Region	50,93,734	62,22,641	92,87,491
4	Uttar Pradesh Sub Region	151,10,452	187,19,180	294,68,151
5	NCR (Total)	474,43,296	581,57,286	894,88,317

(Table A2.1: Sub Region Wise Population of NCR)

Sl. No.	Region	Population - As Per Census		CAGR	Projected Population
		2001	2011	2001-2011	2031
	Delhi Sub Region				
1	Delhi	138,50,507	167,87,941	1.94	246,63,855
	Rajasthan Sub Region				
2	Alwar	29,92,592	36,74,179	2.07	55,38,420
3	Bharatpur	21,01,142	25,48,462	1.95	37,49,071
	Haryana Sub Region				
4	Bhiwani (Including Charkhi Dadri)	14,25,022	16,34,445	1.38	21,50,145
5	Faridabad	13,65,465	18,09,733	2.86	31,78,940
6	Gurugram	8,70,539	15,14,432	5.69	45,83,243
7	Karnal	12,74,183	15,05,324	1.68	21,01,001
8	Jhajjar	8,80,072	9,58,405	0.86	11,36,608
9	Jind	11,89,827	13,34,152	1.15	16,77,445
10	Mahendragarh	8,12,521	9,22,088	1.27	11,87,539
11	Nuh	7,89,750	10,89,263	3.27	20,72,139
12	Palwal	8,29,121	10,42,708	2.32	16,49,120
13	Panipat	9,67,449	12,05,437	2.22	18,71,446
14	Rohtak	9,40,128	10,61,204	1.22	13,52,143
15	Rewari	7,65,351	9,00,332	1.64	12,45,910
16	Sonepat	12,79,175	14,50,001	1.26	18,63,138
	UP Sub Region				
17	Bhagpat	11,63,991	13,03,048	1.13	16,32,984
18	Bulandshahr	29,13,122	34,99,171	1.85	50,48,684
19	Gautam Buddha Nagar	12,02,030	16,48,115	3.21	30,98,360
20	Ghaziabad (Including Hapur)	32,90,586	46,81,645	3.59	94,76,521
21	Meerut	29,97,361	34,43,689	1.40	45,45,626
22	Muzaffarnagar (including Shamli)	35,43,362	41,43,512	1.58	56,65,976

(Table A2.2: District Wise Population of NCR)

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