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विद्युत मंत्रालय
Ministry of Power
केन्द्रीय विद्युत प्राधिकरण
Central Electricity Authority

भारत के उन्नीसवे विद्युत शक्ति सर्वेक्षण की रिपोर्ट (भाग -तृतीय) खण्ड - II
(मेगा सिटी)

REPORT ON NINETEENTH ELECTRIC POWER SURVEY OF INDIA
(VOLUME-III) Part - II
(Mega Cities)



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Abbreviations

AGR	-	Annual Growth Rate
Ajmer VVNL	-	Ajmer Vidyut Vitran Nigam Limited
APCPDCL	-	Central Power Distribution Company of Andhra Pradesh Limited
APEPDCL	-	Eastern Power Distribution Company of Andhra Pradesh Limited
APGENCO	-	Andhra Pradesh Power Generation Corporation
APNPDCL	-	Northern Power Distribution Company of Andhra Pradesh Limited
APSPDCL	-	Southern Power Distribution Company of Andhra Pradesh Limited
APTRANSCO	-	Transmission Corporation of Andhra Pradesh Limited
BESCOM	-	Bangalore Electricity Supply Company Limited
BEST	-	Brihanmumbai Electric Supply and Transport
CAGR	-	Compounded Annual Growth
CEA	-	Central Electricity Authority
DGVCL	-	Dakshin Gujarat Vij Company Ltd.
DISCOM	-	Distribution Company
DPL	-	Durgapur Projects Ltd.
DVC	-	Damodar Valley Corporation
DVVNL	-	Dakshinanchal Vidyut Vitran Nigam Limited
EER	-	Electrical Energy Requirement
EPS	-	Electric Power Survey
GEB	-	Gujarat Electricity Board
GESCOM	-	Gulbarga Electricity Supply Company Limited
GETCO	-	Gujarat Energy Transmission Corp. Ltd.
GSECL	-	Gujarat State Electricity Corp. Ltd.
GUVNL	-	Gujarat Urja Vikas Nigam Ltd.
HESCOM	-	Hubli Electricity Supply Company Limited
HT	-	High Tension

IPCL	-	India Power Co. Ltd.
JBVNL	-	Jharkhand Bijli Vitaran Nigam Ltd.
JDVVNL	-	Jodhpur Vidyut Vitran Nigam Limited
JSEB	-	Jharkhand State Electricity Board
JUSCO	-	Jamshedpur Utility Services Company Limited
JUSNL	-	Jharkhand Urja Sancharan Nigam Ltd.
JUUNL	-	Jharkhand Urja Utpadan Nigam Ltd.
JUVNL	-	Jharkhand Urja Vikas Nigam Ltd.
JVVNL	-	Jaipur Vidyut Vitran Nigam Limited
KEB	-	Karnataka Electricity Board
KERC	-	Karnataka Electricity Regulatory Commission
KESCO	-	Kanpur Electric Supply Company
KPCL	-	Karnataka Power Corporation Ltd.
KPTCL	-	Karnataka Power Transmission Corporation Ltd.
LT	-	Low Tension
Mahagenco	-	Maharashtra State Power Generation Co. Ltd.
Mahatransco	-	Maharashtra State Electricity Transmission Co. Ltd.
Mahavitaran	-	Maharashtra State Electricity Distribution Co. Ltd.
MESCOM	-	Mangalore Electricity Supply Company Limited
MGVCL	-	Madhya Gujarat Vij Company Ltd.
MVVNL	-	Madhyanchal Vidyut Vitran Nigam Limited
NCR	-	National Capital Region
NPCL	-	Noida Power Company Limited
PEUM	-	Partial End Use Method
PGVCL	-	Paschim Gujarat Vij Company Ltd.
PuVVNL	-	Purvanchal Vidyut Vitran Nigam Limited
PVVNL	-	Paschimanchal Vidyut Vitran Nigam Limited

RRVPNL	-	Rajasthan Rajya Vidyut Prasharan Nigam Limited
RVUNL	-	Rajasthan Vidyut Utpadan Nigam Limited
SPDCL	-	Sikkim Power Development Corporation Limited
STU	-	State Transmission Utility
T&D	-	Transmission & Distribution
TSGENCO	-	Telangana Genco
TSNPDCL	-	Northern Power Distribution Company of Telangana Ltd
TSSPDCL	-	The Telangana Southern Power Distribution Company Limited
TSTRANSCO	-	Transmission Corporation of Telangana Limited
TSUISL	-	Tata Steel Utilities and Infrastructure Services Ltd.
UGVCL	-	Uttar Gujarat Vij Company Ltd.
UPPCL	-	Uttar Pradesh Power Corporation Limited
UPPTCL	-	Uttar Pradesh Power Transmission Corporation Limited
UPRJVUNL	-	Uttar Pradesh Rajya Jal Vidyut Utpadan Nigam Limited
UPRVUNL	-	Uttar Pradesh Rajya Vidyut Utpadan Nigam Limited
UPSEB	-	Uttar Pradesh Electricity Board
WBPDC	-	West Bengal Power Development Corporation Ltd.
WBSEB	-	West Bengal State Electricity Board
WBSEDCL	-	West Bengal State Electricity Distribution Company Ltd.
WBSETCL	-	West Bengal State Electricity Transmission Company Ltd.

Executive Summary

The electricity demand forecast is an important input for the planning of the power sector to meet the future power requirement of various sectors of electricity consumption. Therefore, a periodic Electric Power Survey (EPS) of the country is conducted by the Central Electricity Authority (CEA) to assess electricity demand on medium and long term basis. So far, 18 EPS have been conducted. The 19th EPS Committee, constituted by the CEA in June 2015, has decided for carrying out Electric Power Survey of Mega Cities also. Accordingly, this volume III of Electric Power Survey of Mega Cities has been prepared. It was envisaged to include 45 Mega Cities, as detailed below, under this exercise.

Sl. No.	Region	Mega Cities
1.	Northern (12)	Agra, Allahabad, Amritsar, Dehradun, Jammu, Jaipur, Jodhpur, Kanpur, Kota, Lucknow, Srinagar & Varanasi
2.	Western (12)	Ahmedabad, Aurangabad, Bhopal, Gwalior, Indore, Jabalpur, Mumbai, Nagpur, Panaji, Pune, Raipur & Surat
3.	Southern (8)	Bengaluru, Chennai, Coimbatore, Hyderabad, Madurai, Thiruvananthapuram, Tiruchirappalli & Vishakhapatnam
4.	Eastern (6)	Bhubaneswar, Gangtok, Kolkata, Patna, Port Blair & Ranchi
5.	North Eastern (7)	Agartala, Aizawl, Guwahati, Imphal, Itanagar, Kohima & Shillong

(Table 1: List of Mega Cities)

The EPS of Mega Cities covering 19 Mega Cities viz. Agartala, Aizawl, Allahabad, Amritsar, Bhopal, Bhubaneswar, Chennai, Coimbatore, Dehradun, Guwahati, Gwalior, Indore, Jabalpur, Jaipur, Madurai, Raipur, Shillong, Tiruchirappalli, and Thiruvananthapuram are included in Part 1 of the Report. This, Part II of the Report, covers 20 Mega Cities viz. Agra, Aurangabad, Bengaluru, Gangtok, Hyderabad, Jammu, Jodhpur, Kanpur, Kolkata, Kota, Lucknow, Mumbai, Nagpur, Srinagar, Port Blair, Pune, Ranchi, Surat, Varanasi & Vishakhapatnam. The report for six other remaining Mega

Cities viz. Ahmedabad, Imphal, Itanagar, Kohima, Panaji and Patna could not be prepared because of the non-availability of requisite past data.

Methodology

In this report, the Partial End Use Methodology (PEUM) has been used to forecast electricity demand. The electricity demand forecast for each Mega City has been carried out by considering electricity consumption under various categories of electricity consumers viz. Domestic, Commercial, Public Lighting, Public Water Works (LT, HT < 1 MW, HT >1 MW), Irrigation, Industrial (LT, HT < 1 MW, HT >1 MW), Railway Traction & Bulk Supply (Non-Industrial Consumers & Licences).

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

Forecast Summary

Summary of Energy Requirement Forecast

Sl. No.	Mega City	Energy Requirement in MU			CAGR in %		
		2019-20	2024-25	2029-30	2019-20 to 2024-25	2024-25 to 2029-30	2019-20 to 2029-30
1.	Agra	3734	4489	5225	3.75	3.08	3.42
2.	Aurangabad	2461	3062	3737	4.47	4.07	4.27
3.	Bengaluru	14983	17267	19678	2.88	2.65	2.76
4.	Gangtok	84	96	109	2.68	2.58	2.63
5.	Hyderabad	21799	30054	39267	6.63	5.49	6.06
6.	Jammu	2555	2791	3045	1.78	1.76	1.77
7.	Jodhpur	2029	2656	3424	5.53	5.21	5.37
8.	Kanpur	3605	4465	5297	4.37	3.48	3.92
9.	Kolkata	19450	23284	27338	3.66	3.26	3.46
10.	Kota	1501	1897	2394	4.79	4.77	4.78
11.	Lucknow	6257	8371	10965	6.00	5.55	5.77
12.	Mumbai	21977	24709	27657	2.37	2.28	2.33
13.	Nagpur	2418	2894	3409	3.66	3.33	3.50
14.	Port Blair	256	289	326	2.47	2.43	2.45
15.	Pune	10204	12980	16034	4.93	4.32	4.62
16.	Ranchi	1986	2794	3836	7.07	6.55	6.81
17.	Srinagar	2602	3382	4184	5.38	4.35	4.86
18.	Surat	10354	13362	16761	5.23	4.64	4.93
19.	Varanasi	2125	2794	3642	5.63	5.44	5.54
20.	Vishakhapatnam	4891	6653	8353	6.35	4.65	5.50

(Table 2: Summary of Energy Requirement Forecast)

Summary of Peak Demand Forecast

Sl. No.	Mega City	Peak Demand in MW			CAGR in %		
		2019-20	2024-25	2029-30	2019-20 to 2024-25	2024-25 to 2029-30	2019-20 to 2029-30
1.	Agra	746	929	1122	4.49	3.85	4.17
2.	Aurangabad	333	422	524	4.84	4.45	4.65
3.	Bengaluru	3067	3599	4178	3.25	3.03	3.14
4.	Gangtok	39	47	55	3.55	3.49	3.52
5.	Hyderabad	3390	4805	6458	7.22	6.09	6.66
6.	Jammu	519	605	707	3.10	3.16	3.13
7.	Jodhpur	301	402	528	5.95	5.64	5.79
8.	Kanpur	732	949	1180	5.32	4.47	4.89
9.	Kolkata	3263	3950	4690	3.89	3.49	3.69
10.	Kota	264	324	397	4.16	4.15	4.15
11.	Lucknow	1450	1955	2579	6.15	5.70	5.92
12.	Mumbai	3710	4234	4812	2.68	2.59	2.63
13.	Nagpur	642	775	917	3.83	3.43	3.63
14.	Port Blair	40	51	60	4.98	3.30	4.14
15.	Pune	2011	2698	3525	6.05	5.50	5.77
16.	Ranchi	307	434	598	7.17	6.65	6.91
17.	Srinagar	580	757	942	5.48	4.45	4.97
18.	Surat	2086	2741	3501	5.61	5.02	5.31
19.	Varanasi	613	776	976	4.85	4.69	4.77
20.	Vishakhapatnam	872	1235	1616	7.20	5.53	6.36

(Table 3: Summary of Peak Demand Forecast)

Year Wise Summary of Energy Requirement Forecast:

(All figures are in MU)

Sl. No.	Mega City	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30
1.	Agra	3734	3883	4034	4185	4337	4489	4640	4790	4938	5083	5225
2.	Aurangabad	2461	2570	2684	2804	2930	3062	3186	3315	3449	3590	3737
3.	Bengaluru	14983	15397	15832	16287	16766	17267	17706	18166	18647	19151	19678
4.	Gangtok	84	86	88	90	93	96	98	100	103	106	109
5.	Hyderabad	21799	23236	24772	26415	28173	30054	31696	33432	35268	37212	39267
6.	Jammu	2555	2596	2640	2687	2738	2791	2836	2884	2935	2988	3045
7.	Jodhpur	2029	2140	2257	2381	2514	2656	2794	2938	3092	3254	3424
8.	Kanpur	3605	3760	3922	4093	4274	4465	4618	4778	4944	5117	5297
9.	Kolkata	19450	20161	20899	21665	22460	23284	24038	24817	25645	26477	27338
10.	Kota	1501	1563	1641	1722	1808	1897	1983	2079	2180	2284	2394
11.	Lucknow	6257	6634	7033	7454	7900	8371	8838	9329	9846	10391	10965
12.	Mumbai	21977	22493	23024	23570	24131	24709	25253	25829	26422	27031	27657
13.	Nagpur	2418	2506	2598	2693	2792	2894	2990	3090	3193	3299	3409
14.	Port Blair	256	262	268	275	282	289	296	303	311	318	326
15.	Pune	10204	10706	11232	11786	12368	12980	13539	14124	14733	15370	16034
16.	Ranchi	1986	2125	2275	2436	2608	2794	2976	3170	3378	3600	3836
17.	Srinagar	2602	2727	2876	3034	3202	3382	3527	3680	3840	4008	4184
18.	Surat	10354	10891	11459	12058	12692	13362	13978	14625	15303	16015	16761
19.	Varanasi	2125	2242	2367	2503	2642	2794	2944	3102	3271	3451	3642
20.	Vishakhapatnam	4891	5234	5584	5939	6296	6653	7008	7358	7701	8033	8353

(Table 4: Year Wise Summary of Energy Requirement Forecast)

Year Wise Summary of Peak Demand Forecast:

(All figures are in MW)

Sl. No.	Mega City	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30
1.	Agra	746	781	817	854	891	929	968	1006	1045	1084	1122
2.	Aurangabad	333	349	366	383	402	422	440	460	480	502	524
3.	Bengaluru	3067	3163	3264	3371	3482	3599	3704	3815	3930	4051	4178
4.	Gangtok	39	41	42	43	45	47	48	50	52	53	55
5.	Hyderabad	3390	3633	3895	4176	4479	4805	5096	5405	5735	6085	6458
6.	Jammu	519	534	550	567	585	605	623	642	662	684	707
7.	Jodhpur	301	318	337	357	379	402	424	448	473	500	528
8.	Kanpur	732	770	811	854	900	949	990	1034	1081	1129	1180
9.	Kolkata	3263	3390	3522	3659	3801	3950	4087	4228	4379	4532	4690
10.	Kota	264	273	285	297	310	324	336	351	365	381	397
11.	Lucknow	1450	1540	1635	1736	1842	1955	2066	2184	2309	2440	2579
12.	Mumbai	3710	3809	3910	4015	4123	4234	4341	4453	4569	4689	4812
13.	Nagpur	642	666	692	718	746	775	801	829	857	886	917
14.	Port Blair	40	45	48	49	50	51	52	53	54	57	60
15.	Pune	2011	2132	2261	2397	2543	2698	2845	3001	3166	3340	3525
16.	Ranchi	307	329	352	377	405	434	462	493	526	561	598
17.	Srinagar	580	608	642	678	717	757	791	826	863	901	942
18.	Surat	2086	2202	2325	2456	2594	2741	2878	3022	3173	3333	3501
19.	Varanasi	613	642	672	706	740	776	812	850	890	932	976
20.	Vishakhapatnam	872	941	1012	1085	1159	1235	1312	1388	1465	1541	1616

(Table 5: Year Wise Summary of Peak Demand Forecast)

Year Wise T&D Losses Forecast:

(in %)

Sl. No.	Mega City	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30
1.	Agra	15.00	14.75	14.50	14.25	14.00	13.75	13.50	13.25	13.00	12.75	12.50
2.	Aurangabad	15.00	14.60	14.20	13.80	13.40	13.00	12.60	12.20	11.80	11.40	11.00
3.	Bengaluru	9.24	9.04	8.84	8.64	8.44	8.24	8.04	7.84	7.64	7.44	7.24
4.	Gangtok	21.64	20.84	20.04	19.24	18.44	17.64	16.84	16.04	15.24	14.44	13.64
5.	Hyderabad	12.33	8.75	10.00	10.00	9.90	9.80	9.70	9.60	9.50	9.40	9.30
6.	Jammu	32.71	30.91	29.11	27.31	25.51	23.71	21.91	20.11	18.31	16.51	14.71
7.	Jodhpur	11.48	11.30	11.12	10.94	10.76	10.58	10.40	10.22	10.04	9.86	9.68
8.	Kanpur	12.31	12.01	11.71	11.41	11.11	10.81	10.51	10.21	9.91	9.61	9.31
9.	Kolkata	9.78	9.67	9.56	9.45	9.34	9.23	9.12	9.01	8.90	8.79	8.68
10.	Kota	15.00	14.50	14.00	13.50	13.00	12.50	12.00	11.50	11.00	10.50	10.00
11.	Lucknow	15.00	14.70	14.40	14.10	13.80	13.50	13.20	12.90	12.60	12.30	12.00
12.	Mumbai	6.54	6.53	6.52	6.51	6.50	6.49	6.48	6.47	6.46	6.45	6.44
13.	Nagpur	7.57	7.46	7.35	7.24	7.13	7.02	6.91	6.80	6.69	6.58	6.47
14.	Port Blair	15.00	14.85	14.70	14.55	14.40	14.25	14.10	13.95	13.80	13.65	13.50
15.	Pune	8.70	8.50	8.30	8.10	7.90	7.70	7.50	7.30	7.10	6.90	6.70
16.	Ranchi	15.00	14.80	14.60	14.40	14.20	14.00	13.80	13.60	13.40	13.20	13.00
17.	Srinagar	48.00	46.00	44.00	42.00	40.00	38.00	36.00	34.00	32.00	30.00	28.00
18.	Surat	4.92	4.91	4.90	4.89	4.88	4.87	4.86	4.85	4.84	4.83	4.82
19.	Varanasi	15.00	14.80	14.60	14.40	14.20	14.00	13.80	13.60	13.40	13.20	13.00
20.	Vishakhapatnam	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80

(Table 6: Year Wise Summary of T&D Losses Forecast)

Introduction

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.

With the aforementioned aim, a periodic Electric Power Survey (EPS) of the country is conducted by the Central Electricity Authority (CEA) to assess electricity demand on medium and long term basis. So far, 18 EPS have been conducted. The 19th EPS Committee, constituted by the CEA in June 2015, decided that the 19th EPS would be brought out in four volumes, as detailed below:

- 1) Volume I: Discom-wise, state/UT-wise, region-wise and all-India electricity demand projection by partial end use method (PEUM).
- 2) Volume II: Electric Power Survey of National Capital Region (NCR).
- 3) Volume III: Electric Power Survey of Mega Cities.
- 4) Volume IV: Electricity demand projection by econometric method.

Accordingly, this volume III of Electric Power Survey of Mega Cities has been prepared. It was envisaged to include 45 Mega Cities, as detailed below, under this exercise.

Sl. No.	Region	Mega Cities
1.	Northern (12)	Agra, Allahabad, Amritsar, Dehradun, Jammu, Jaipur, Jodhpur, Kanpur, Kota, Lucknow, Srinagar & Varanasi
2.	Western(12)	Ahmedabad, Aurangabad, Bhopal, Gwalior, Indore, Jabalpur, Mumbai, Nagpur, Panaji, Pune, Raipur & Surat
3.	Southern(8)	Bengaluru, Chennai, Coimbatore, Hyderabad, Madurai, Thiruvananthapuram, Tiruchirappalli & Vishakhapatnam
4.	Eastern (6)	Bhubaneswar, Gangtok, Kolkata, Patna, Port Blair & Ranchi
5.	North Eastern(7)	Agartala, Aizawl, Guwahati, Imphal, Itanagar, Kohima & Shillong

(Table 1.1: List of Mega Cities)

The Electric Power Survey of Mega Cities covering 19 Mega Cities viz. Agartala, Aizawl, Allahabad, Amritsar, Bhopal, Bhubaneswar, Chennai, Coimbatore, Dehradun, Guwahati, Gwalior, Indore, Jabalpur, Jaipur, Madurai, Raipur, Shillong, Tiruchirappalli, and Thiruvananthapuram are included in Part 1 of the Report. This, Part II of the Report, covers 20 Mega Cities viz. Agra, Aurangabad, Bengaluru, Gangtok, Hyderabad, Jammu, Jodhpur, Kanpur, Kolkata, Kota, Lucknow, Mumbai, Nagpur, Srinagar, Port Blair, Pune, Ranchi, Surat, Varanasi & Vishakhapatnam. The report for six other remaining Mega Cities viz. Ahmedabad, Imphal, Itanagar, Kohima, Panaji and Patna could not be prepared because of the non-availability of requisite past data.

Power Forecast – Methodology

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 Mega Cities. It is a bottom up approach based on the energy need of end users.

As working out electricity demand by considering electricity consumption of individual end users would be exhaustive, a partial approach has been taken and electricity demand forecast has been carried out for various categories of electricity consumers viz. Domestic, Commercial, Public Lighting, Public Water Works (LT, HT < 1 MW, HT > 1 MW), Irrigation, Industrial (LT, HT < 1 MW, HT > 1 MW), Railway Traction & Bulk Supply (Non- Industrial Consumers & Licences). The time series method has been used to derive growth indicators for each category of consumer for each Mega Cities with assigning higher weight to recent trends so as to incorporate benefits of energy conservation initiatives and the impacts of technological changes.

The input data for this study comprises of the category wise data of all Mega Cities from the year 2003-04 to 2018-19. The category wise historical data required for assessment of future demand has been provided by the DISCOMs operating in respective cities. These furnished data were scrutinized by comparing it with the data available with CEA and reconciled further with all the concerned utilities.

The input data for the period 2003-04 to 2018-19 was scrutinized for the study and the year-wise EER was worked out up to 2029-30 by taking 2018-19 as the base year. The Annual Growth Rate (AGR) and Compounded Annual Growth (CAGR) for No. of consumers, Connected Load and Energy Consumption for the past years of various categories of Load has been analysed thoroughly and then forecast of electricity requirement for various categories of Load for each Mega City has been made using the aforesaid method. The forecasts of electricity demand were discussed with respective

DISCOMS to elicit their views/suggestions on the likely growth rate for various categories of electricity consumption & policies/programs which would have bearing on the future electricity demand.

Agra



Agra

Introduction:

Agra is a historic city and one of the world's best-known tourist destinations. The city boasts of two world heritage sites –Taj Mahal, one of the seven wonders of the world and Agra Fort, apart from numerous historical monuments in and around the city. It is situated on the Western Bank of river Yamuna at about 200 Kms from Delhi in Uttar Pradesh. The city is an important node on the golden triangle tourist circuit (Jaipur-Delhi-Agra). It records the highest foreign tourist footfall (about 17% of total foreign tourists) in the country. In addition to its historic importance, Agra is also a main center of political, economic, commercial and cultural activities.

As of 2011 census, the population of city was 15,85,704. The total municipal area of the city is 120.57 sq. km.



(Figure 3.1: Location of Agra City)

Economy¹

The principal economic driver for Agra is tourism, along with crafts based industries for stone carving, marble inlay work, and carpets. The city is famous for its leather and footwear. Agra is the largest footwear manufacturing hub in India. Other industries include iron foundries, handicrafts, garments, zari and zardosi work, sweets, automobiles, and cold storage.

Climate²

The climate of the city is generally dry except during the monsoon season. The summer is hotter. The average annual maximum temp. is 32.9 °C with mean maximum temp. of the hottest month (May) and the coldest month (Jan) are about 41.9 °C and 22.7 °C respectively. The average annual minimum temp. is 17.7 °C with mean minimum temp. of the hottest and the coldest months are about 24.6 °C and 7.5 °C respectively. The average annual rainfall of the city is 75.4 cm. The rainfall during the southwest monsoon season is about 88% of the annual rainfall. The values of relative humidity are about 59% to 81% in the morning and 40% to 73% in the afternoon.

Brief description of Power Utilities:

Uttar Pradesh Electricity Board (UPSEB) which was responsible for generation, transmission and distribution of electricity in Uttar Pradesh, was divided into following companies by the State Government after Uttar Pradesh 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.

¹ Official Site of Agra Smart City Limited (http://agrasmartcity.in/exploreagra.aspx?expid=9&exp_id=28)

² <http://www.imdpune.gov.in/caui/smartcities.html>

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

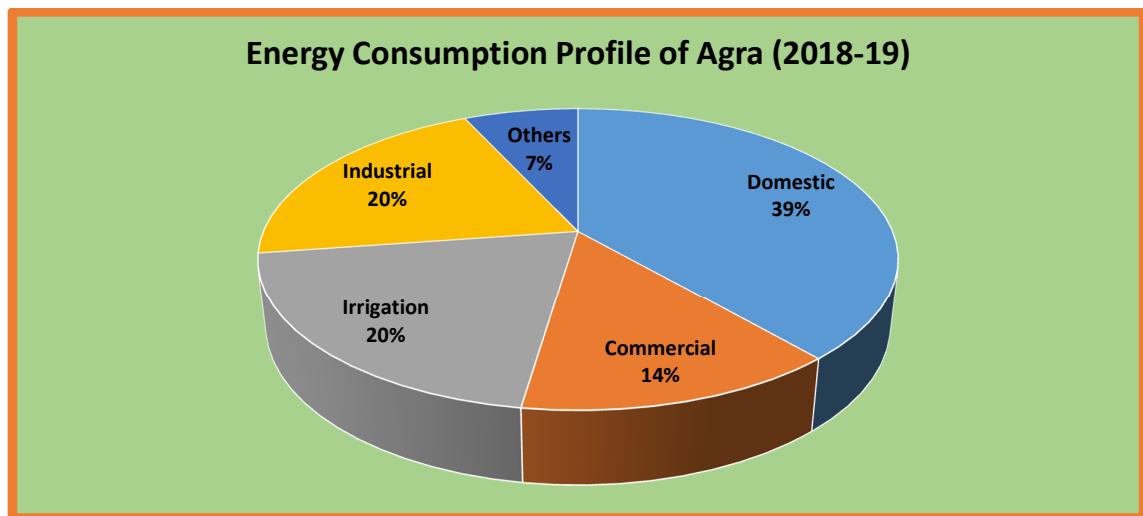
UPPCL was further divided into the following five distribution companies on 12.08.2003:

- 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. The power distribution in Agra city is done by of DVVNL and also by Torrent Power, a distribution franchisee, from 1st April, 2010.

Existing Power Scenario:

The total electricity consumption of Agra in the year 2018-19 was 3040 MU and with 20.78% T&D losses, the requirement was 3837 MU. The peak demand recorded for the city was 767 MW. The Domestic sector was the biggest consumer of electricity (39%) followed by Industrial & Irrigation (20% each).



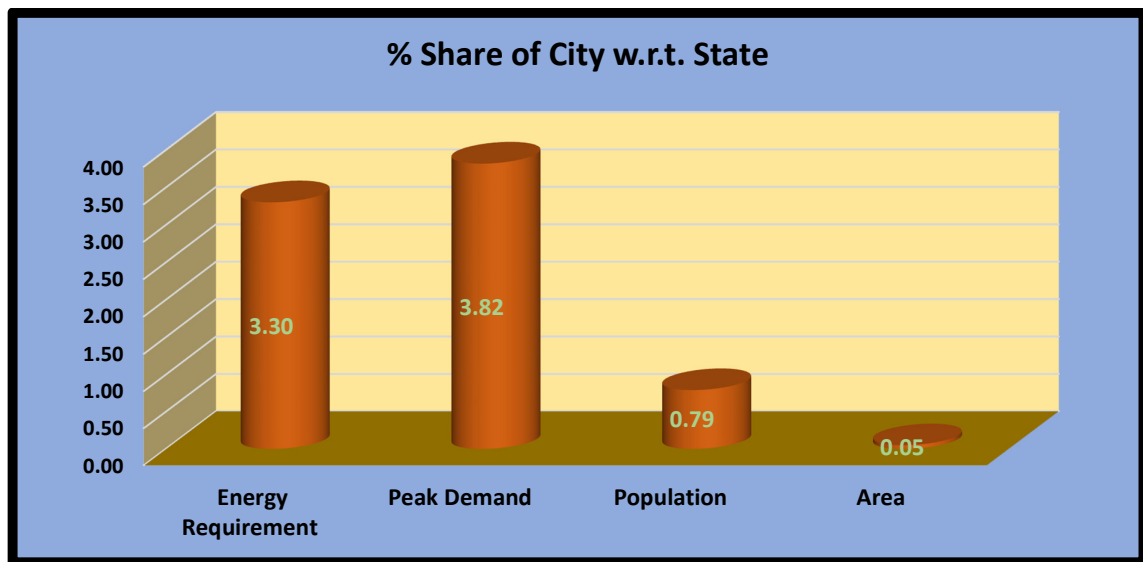
(Figure 3.2: Energy Consumption Profile of Agra in 2018-19)

During the last five years (2013-14 to 2018-19), the city has observed CAGR of 0.38% & 4.79% in electricity energy requirement and peak demand respectively.

On comparison of Agra with Uttar Pradesh for the year 2018-19, it is observed that the energy requirement of Agra was 3.30% of the total energy requirement of the state whereas its contribution in population and area were only 0.79 % and 0.05 % respectively.

Sl. No.	Particulars	Agra	Uttar Pradesh	Agra as % of Uttar Pradesh
1.	Energy Requirement (in MU)	3837	116149	3.30
2.	Peak Demand (in MW)	767	20062	3.82
3.	Population (2011 Census)	15,85,704	19,98,12,341	0.79
4.	Area (in sq km)	120.57	2,40,928	0.05

(Table 3.1: Comparison of Agra with Uttar Pradesh in 2018-19)

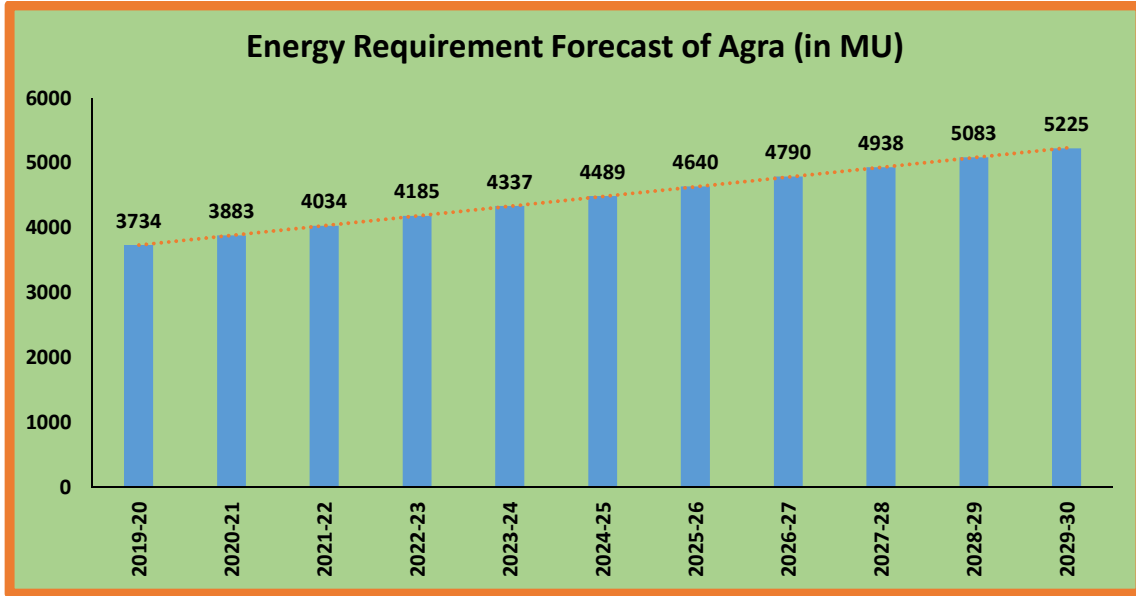


(Figure 3.3: Comparison between Agra and Uttar Pradesh in 2018-19)

Power Forecast:

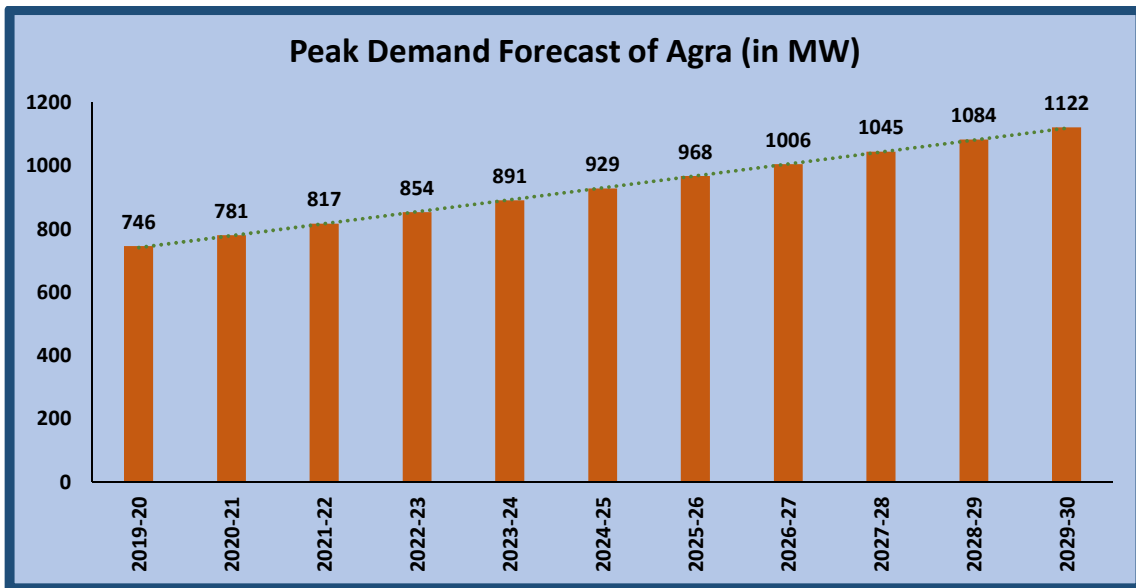
Based on total electricity consumption and T&D Losses, the total energy requirement of Agra is estimated as 3734 MU in year 2019-20. The energy

requirement of the city is expected to reach 4489 MU by the year 2024-25 with 3.75% CAGR for the period 2019-20 to 2024-25. With CAGR of 3.08% for the next five years, its energy requirement is estimated as 5225 MU by the year 2029-30.



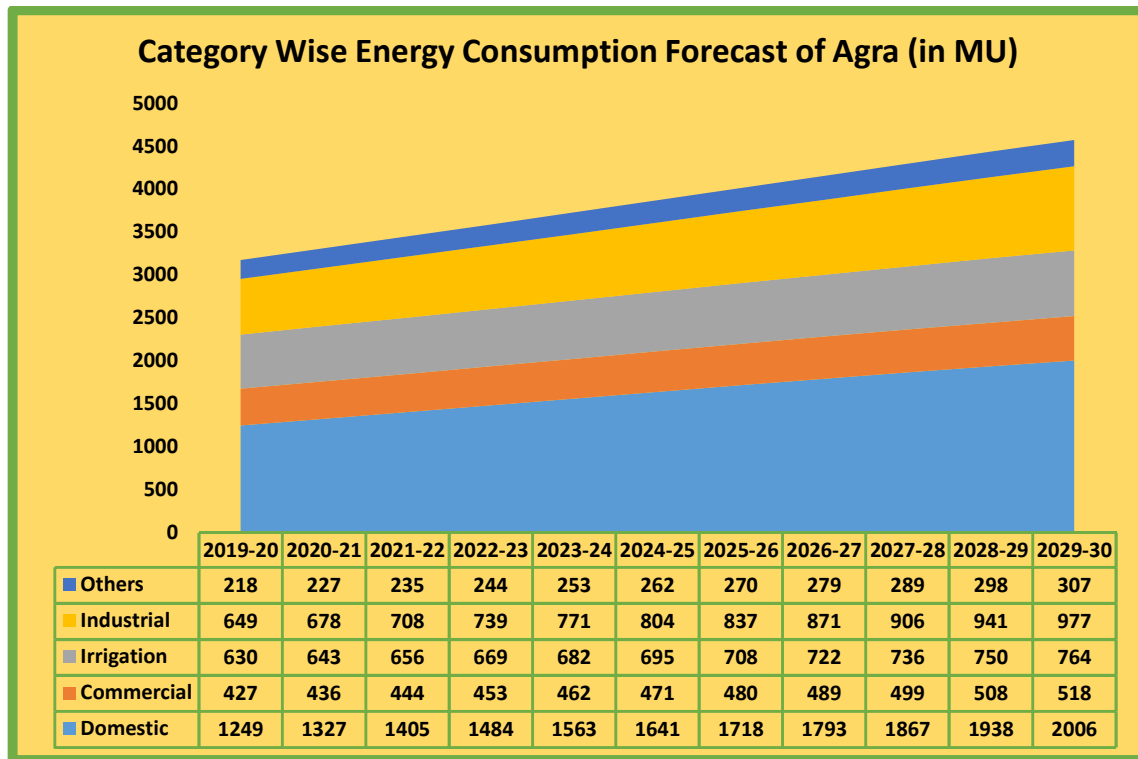
(Figure 3.4: Energy Requirement Forecast of Agra in MU)

Peak Demand of the Agra is expected to see 4.49% CAGR upto 2024-25 and will reach 929 MW in comparison to 746 MW in year 2019-20. It is expected to reach 1122 MW in year 2029-30 with a CAGR of 3.85% after 2024-25.



(Figure 3.5: Peak Demand Forecast of Agra in MW)

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



(Figure 3.6: Category Wise Energy Consumption forecast of Agra)

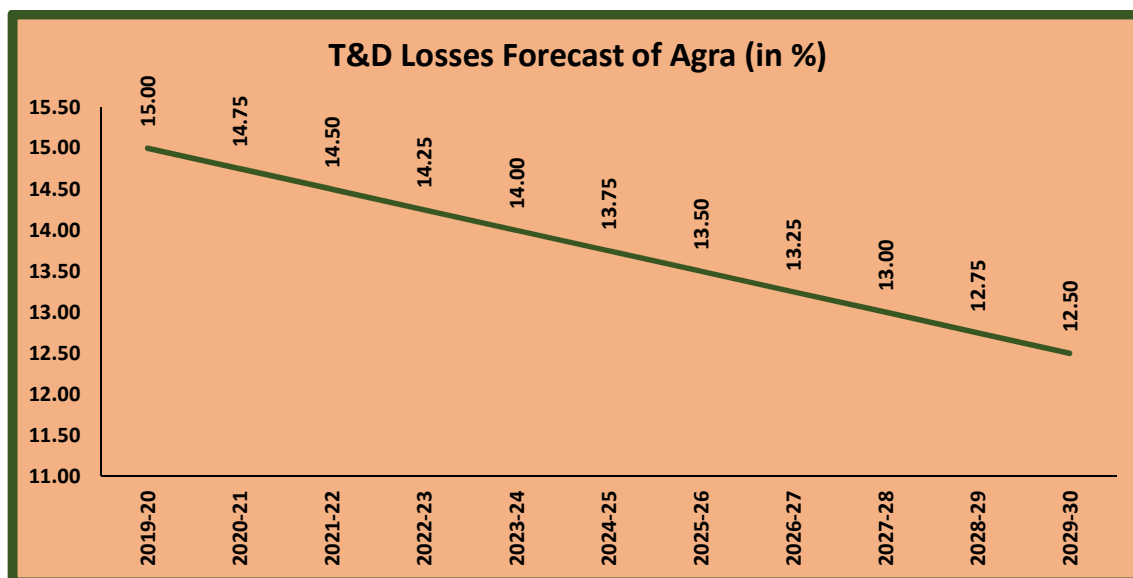
The category wise CAGR expected in energy consumption for the next ten years (2019-20 to 2029-30) along with its break up in five years (2019-20 to 2024-25 & 2025-26 to 2029-30) is tabulated below:

Sl. No.	Category	Energy Consumption (in MU)			CAGR in %		
		2019-20	2024-25	2029-30	2019-20 to 2024-25	2024-25 to 2029-30	2019-20 to 2029-30
1.	Domestic	1249	1641	2006	5.60	4.10	4.85
2.	Commercial	427	471	518	1.97	1.92	1.94
3.	Irrigation	630	695	764	1.97	1.92	1.94
4.	Industrial	649	804	977	4.37	3.99	4.18
5.	Others	218	262	307	3.70	3.25	3.47
6.	Total	3174	3872	4572	4.05	3.38	3.72

(Table 3.2: Expected CAGR of Agra - Category Wise Consumption)

Transmission & Distribution Losses:

T&D losses of Agra were estimated as 20.78% in year 2018-19. The target level is to bring it down to about 13.75% and 12.50% by the end of 2024-25 & 2029-30 respectively.



(Figure 3.7: T&D Loss Forecast of Agra)

The power forecast of Agra city is summarized below:

Sl. No.	Particulars	2019-20	2024-25	2029-30	CAGR in %	
					2019-20 to 2024-25	2024-25 to 2029-30
1.	Energy Requirement in MU	3734	4489	5225	3.75	3.08
2.	Peak Demand in MW	746	929	1122	4.49	3.85
3.	T&D Losses in %	15.00	13.75	12.50	-	-

(Table 3.3: Power forecast summary of Agra)

Analysis of Forecast:

A comparison of actual CAGR witnessed for the Agra city during the last five years and the CAGR for future power forecast is tabulated below:

Sl. No.	City/State/Country	CAGR in %		
		2013-14 to 2018-19	2019-20 to 2024-25	2024-25 to 2029-30
1.	Energy Requirement	0.38	3.75	3.08
2.	Peak Demand	4.79	4.49	3.85

(Table 3.4: Actual CAGR in past vis-a-vis CAGR forecast for future for Agra)

The above table indicates that the energy requirement growth of Agra in recent past is negligible and the city has observed CAGR of 0.38% only during the period of 2013-14 to 2018-19. Interestingly, the energy consumption of the city grew with 8.47% rate during the same period as observed from the table below:

Sl. No.	Category	Energy Consumption in MU		CAGR in %
		2013-14	2018-19	
1.	Domestic	638	1173	12.94
2.	Commercial	332	419	4.76
3.	Irrigation	355	618	11.74
4.	Industries	465	620	5.92
5.	Others	197	210	1.24
6.	Total	1988	3040	8.87

(Table 3.5: Category Wise Consumption CAGR of Agra during 2013-14 to 2018-19)

The decline in energy requirement growth was primarily on account of reduction in T&D losses that fell down from around 47% to 20.78% during the same period. The T&D losses are expected to reduce further and the same is considered in forecast also that explains why the quantum of energy requirement in 2019-20 is less (i.e. 3734 MU) compared to 2018-19 (i.e. 3837 MU). However, the pace of this reduction is expected to slow down subsequently once T&D losses come within reasonable range. Therefore, the present curve of lower energy requirement growth is expected to see upward trends in future for the city.

The domestic sector had witnessed more than 12% growth in energy consumption during the last five years mainly because of huge increase in number of new connections given. However, this trend has shown stagnation during the past two years. Accordingly, moderate growth in the range of 4-6% for domestic sector is considered for the next decade. Similarly, for irrigation and industrial categories also, higher growth was observed during 2013-14 to 2015-16 but subsequently, very moderate growths were witnessed that explains the lower growth considered for future.

Agra

Electrical Energy Consumption, Energy Requirement and Peak Electricity Demand

(Category Wise and Year Wise Summary)												
Year	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	
Domestic	1249	1327	1405	1484	1563	1641	1718	1793	1867	1938	2006	
Commercial	427	436	444	453	462	471	480	489	499	508	518	
Public lighting	36	36	37	38	39	39	40	41	41	42	42	
Public Water Works	96	100	105	109	113	117	121	125	129	133	137	
Irrigation	630	643	656	669	682	695	708	722	736	750	764	
LT Industries	182	188	195	202	209	216	223	231	239	247	255	
HT Industries	467	490	514	538	562	588	614	640	667	694	722	
Railway Traction	0	0	0	0	0	0	0	0	0	0	0	
Bulk Supply	0	0	0	0	0	0	0	0	0	0	0	
Others (if any)	86	90	93	97	101	105	109	114	118	123	128	
Total (Energy Consumption)	3174	3310	3449	3589	3730	3872	4014	4155	4296	4435	4572	
T&D losses -MU	560	573	585	596	607	617	626	635	642	648	653	
T&D losses -in %	15.00	14.75	14.50	14.25	14.00	13.75	13.50	13.25	13.00	12.75	12.50	
Energy Requirement - MU	3734	3883	4034	4185	4337	4489	4640	4790	4938	5083	5225	
Annual Load Factor - %	57.14	56.74	56.34	55.94	55.54	55.14	54.74	54.34	53.94	53.54	53.14	
Peak Load - MW	746	781	817	854	891	929	968	1006	1045	1084	1122	

Table 3.6: Power Forecast of Agra

Aurangabad



Aurangabad

Introduction:

The Aurangabad city is located in Maharashtra state of India. The city is an excellent confluence of ancient cultural heritage and rapid modernization. It is famous for its rich cultural heritage as well as for the pioneered educational development in the region. The city is a tourism hub often called “Tourism Capital of Maharashtra”. It is surrounded by many historical monuments, including the Ajanta Caves and Ellora Caves, which are UNESCO World Heritage Sites, Bibi Ka Maqbara (replica of Taj Mahal) and Panchakki. It is also known as "The City of Gates" due to presence of 52 gates in the city.

As of 2011 census, the total municipal area of the city was 138.5 sq. km. and the corresponding population was 11,75,116. The total municipal area of the city now stands at 170 Sq. km³ after inclusion of Satara & Deolai area. The report has covered an area of 180.12 sq. km. that includes municipal as well as cantonment area. The corresponding population was 12,43,744 as per Census – 2011.

Economy

The city was a major silk and cotton textile production centre. It was a trading hub for four centuries. Now, the retail and tourism industries have emerged very strongly in Aurangabad and the city has also evolved as a developing industrial power house. Himroo textiles and Paithani silk wear are made in Aurangabad. The education sector has also rapidly developed in Aurangabad and the city houses several prestigious educational institutes. The Information Technology (IT) industry is also taking shape in the city.

³ Aurangabad Smart City Proposal (<https://smartnet.niua.org/sites/default/files/resources/RevisedAurangabadSmartCityPlan.pdf>)



(Figure 4.1: Location of Aurangabad City)

Climate⁴

The climate of the city is characterized by a hot summer and general dryness throughout the year except during the southwest monsoon season. The average annual maximum temp. is 32.5 °C with mean maximum temp. of the hottest month (May) and the coldest month (Dec) are about 39.4 °C and 28.7 °C respectively. The average annual minimum temp. is 18.8 °C with mean minimum temp. of the hottest and the coldest months are about 24.4 °C and 11.8 °C respectively. The average annual rainfall of the city is 75.4 cm. The rainfall during the southwest monsoon season is about 80% of the annual rainfall. The values of relative humidity are about 39% to 87% in the morning and 25% to 73% in the afternoon.

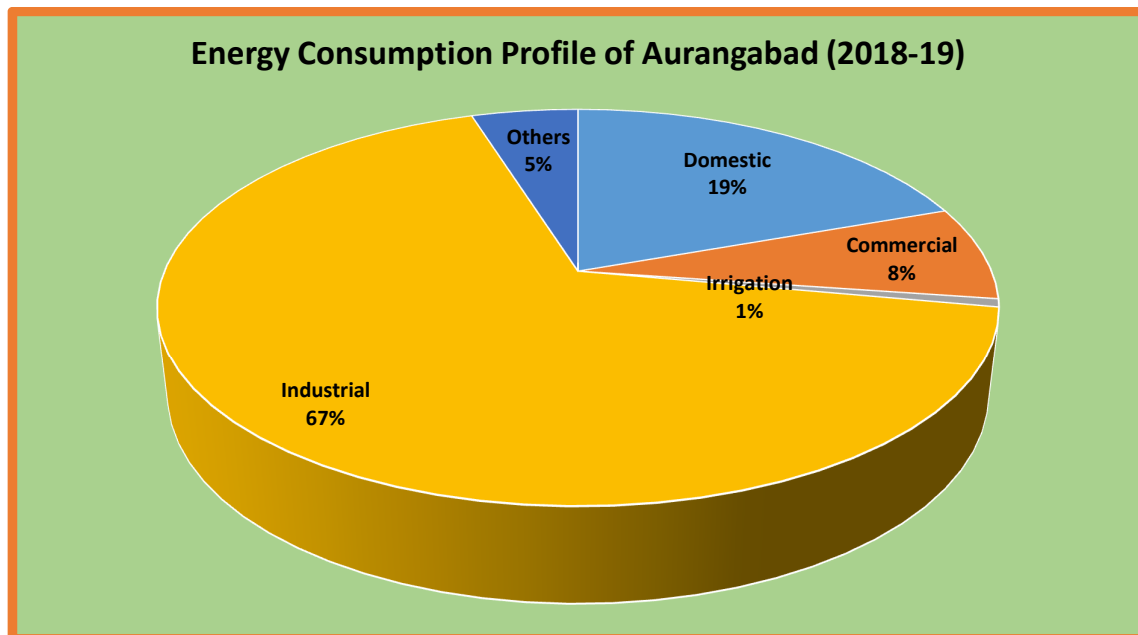
⁴ <http://www.imdpune.gov.in/caui/smartcities.html>

Brief description of Power Utilities:

The erstwhile Maharashtra State Electricity Board (MSEB) was looking after Generation, Transmission & Distribution of Electricity in Maharashtra barring Mumbai. After the enactment of Electricity Act 2003, MSEB was restructured into 4 Companies viz. MSEB Holding Co. Ltd., Maharashtra State Electricity Distribution Co. Ltd. (Mahavitaran), Maharashtra State Power Generation Co. Ltd. (Mahagenco) and Maharashtra State Electricity Transmission Co. Ltd. (Mahatransco) on 6th June 2005. Mahavitaran distributes electricity to consumers across the state except for some parts of Mumbai where Brihanmumbai Electric Supply and Transport(BEST)- an autonomous body under Municipal Corporation of Greater Mumbai, Tata Power and Adani Power also distribute power.

Existing Power Scenario:

The total electricity consumption of Aurangabad in the year 2018-19 was 1994 MU and with 17.85% T&D losses, the requirement was 2427 MU. The peak demand of the city was 327 MW. The Industrial sector was the biggest consumer of electricity (67%) followed by Domestic (19%) & Commercial (8%).



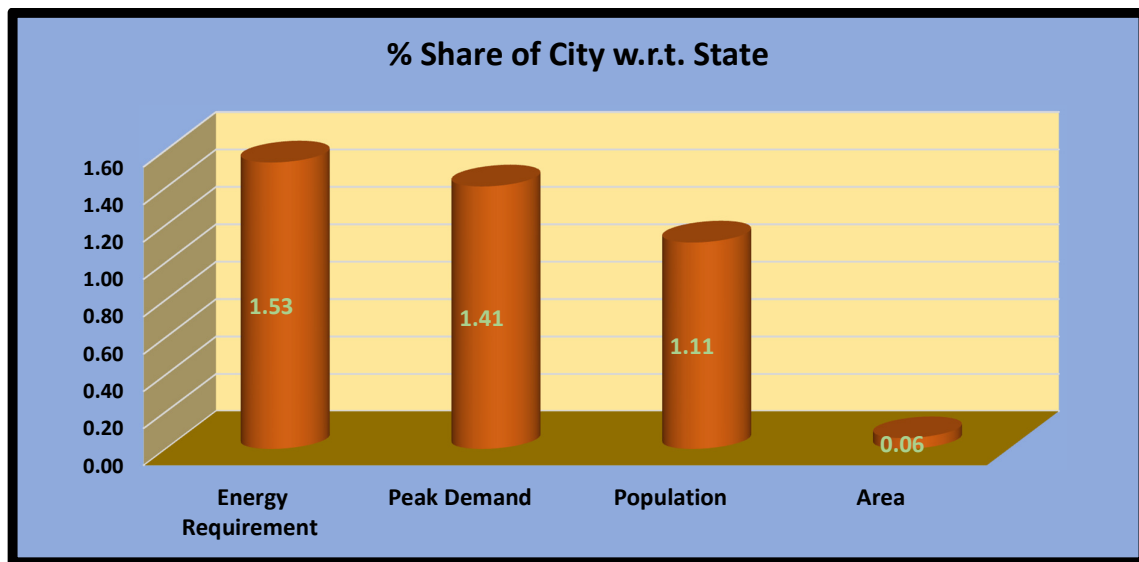
(Figure 4.2: Energy Consumption Profile of Aurangabad in 2018-19)

During the last five years (2013-14 to 2018-19), the city has observed CAGR of 4.28% & 6.24% in electricity energy requirement and peak demand respectively.

On comparison of Aurangabad with Maharashtra for the year 2018-19, it is observed that the energy requirement of Aurangabad was 1.53% of the total energy requirement of the state whereas its contribution in population and area were only 1.11% and 0.06% respectively.

Sl. No.	Particulars	Aurangabad	Maharashtra	Aurangabad as % of Maharashtra
1.	Energy Requirement (in MU)	2427	158157	1.53
2.	Peak Demand (in MW)	327	23254	1.41
3.	Population (2011 Census)	12,43,744	11,23,74,333	1.11
4.	Area (in sq km)	180.12	3,07,713	0.06

(Table 4.1: Comparison of Aurangabad with Maharashtra in 2018-19)

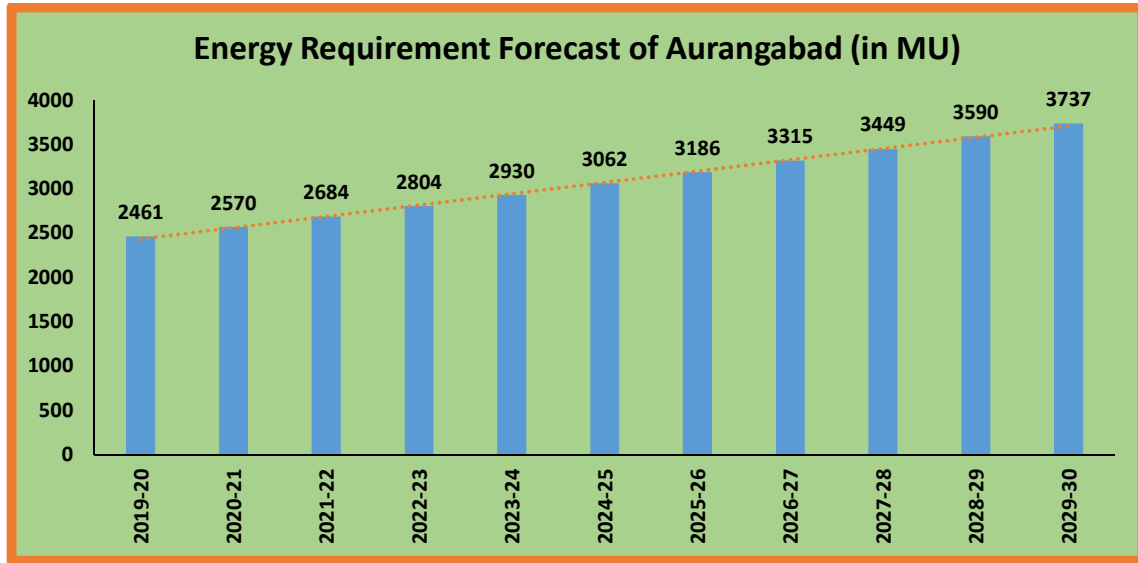


(Figure 4.3: Comparison between Aurangabad and Maharashtra in 2018-19)

Power Forecast:

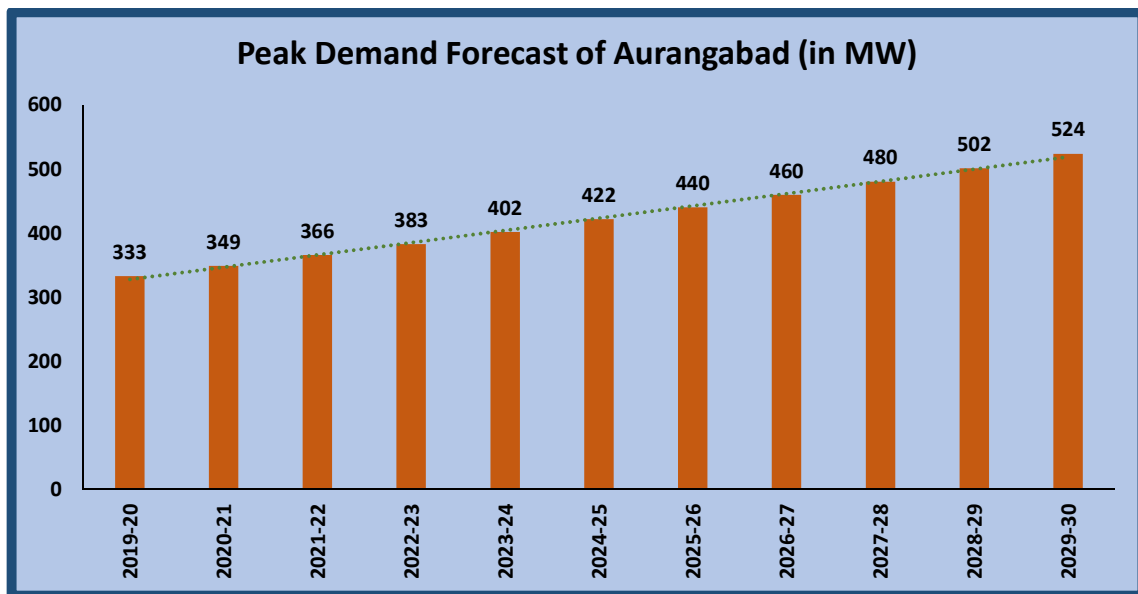
Based on total electricity consumption and T&D Losses, the total energy requirement of Aurangabad is estimated as 2461 MU in year 2019-20. It is

expected that the energy requirement of the city will reach 3062 MU by the year 2024-25 with 4.47% CAGR for the period 2019-20 to 2024-25. With CAGR of 4.07% for the period 2024-25 to 2029-30, its energy requirement is estimated as 3737 MU by the year 2029-30.



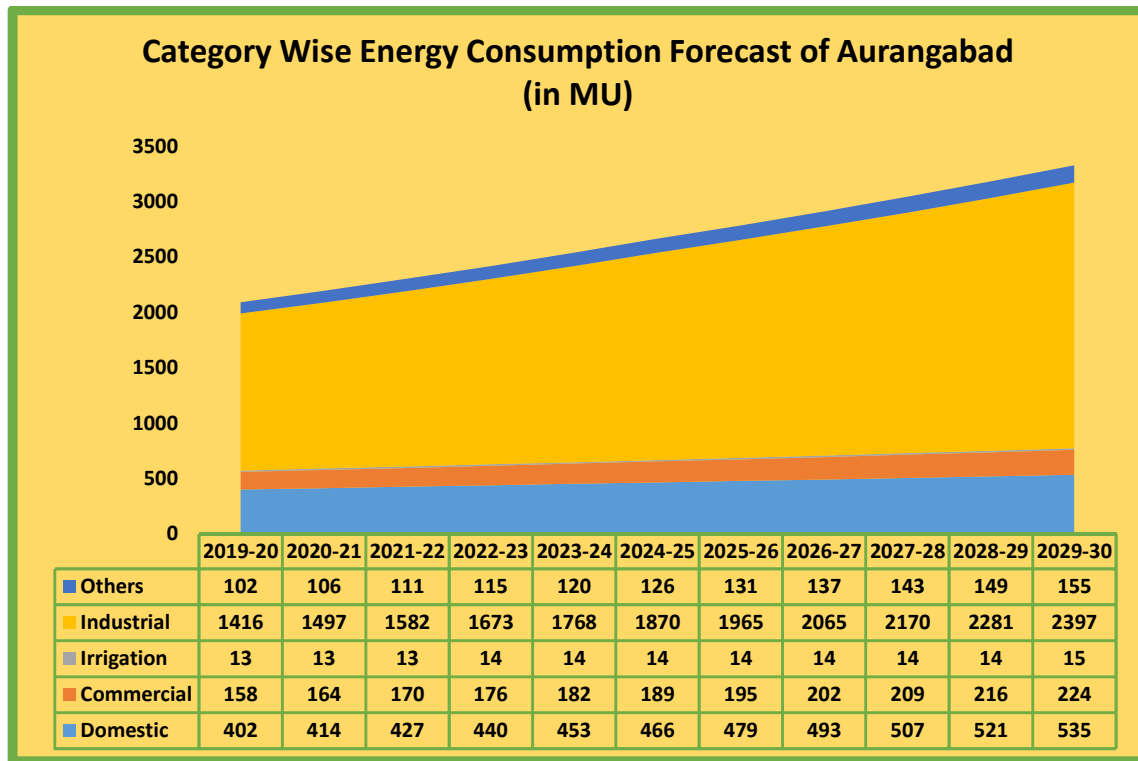
(Figure 4.4: Energy Requirement Forecast of Aurangabad in MU)

Peak Demand of the Aurangabad is expected to see 4.84% CAGR upto 2024-25 and will reach 422 MW in comparison to 333 MW in year 2019-20. It is expected to reach 524 MW in year 2029-30 with a CAGR of 4.45% after 2024-25.



(Figure 4.5: Peak Demand Forecast of Aurangabad in MW)

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



(Figure 4.6: Category Wise Energy Consumption forecast of Aurangabad)

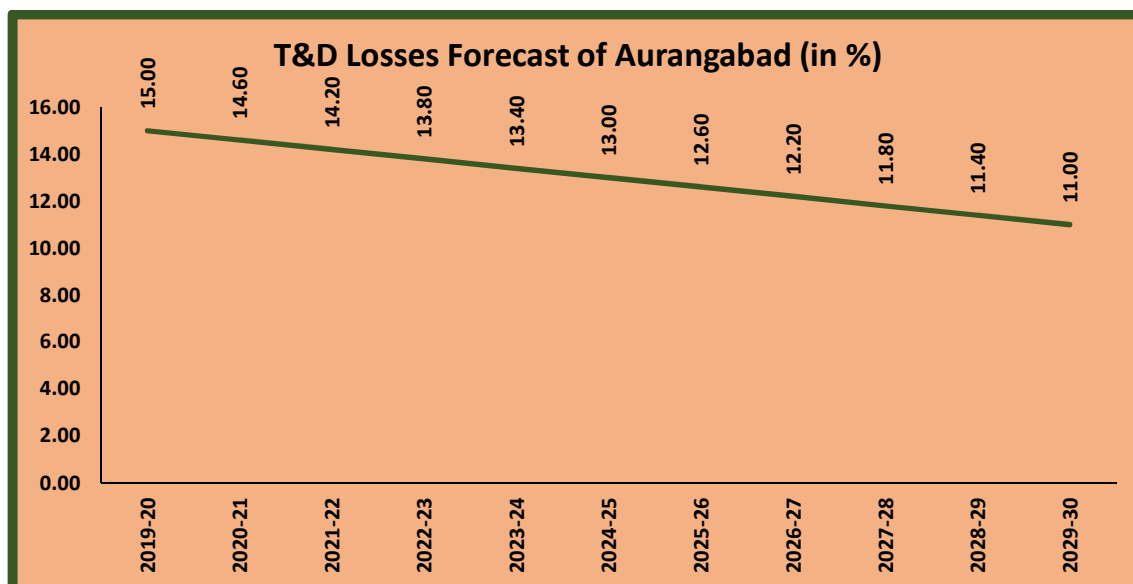
The category wise CAGR expected in energy consumption for the next ten years (2019-20 to 2029-30) along with its break up in five years (2019-20 to 2024-25 & 2025-26 to 2029-30) is tabulated below:

Sl. No.	Category	Energy Consumption (in MU)			CAGR in %		
		2019-20	2024-25	2029-30	2019-20 to 2024-25	2024-25 to 2029-30	2019-20 to 2029-30
1.	Domestic	402	466	535	3.00	2.80	2.90
2.	Commercial	158	189	224	3.60	3.50	3.55
3.	Irrigation	13	14	15	1.00	1.00	1.00
4.	Industrial	1416	1870	2397	5.71	5.09	5.40
5.	Others	102	126	155	4.31	4.34	4.32
6.	Total	2092	2664	3326	4.96	4.54	4.75

(Table 4.2: Expected CAGR of Aurangabad - Category Wise Consumption)

Transmission & Distribution Losses:

T&D losses of Aurangabad were estimated as 17.85% in year 2018-19. The target level is to bring it down to about 13.00% and 11.00% by the end of 2024-25 & 2029-30 respectively.



(Figure 4.7: T&D Loss Forecast of Aurangabad)

The power forecast of Aurangabad city is summarized below:

Sl. No.	Particulars	2019-20	2024-25	2029-30	CAGR in %	
					2019-20 to 2024-25	2024-25 to 2029-30
1.	Energy Requirement in MU	2461	3062	3737	4.47	4.07
2.	Peak Demand in MW	333	422	524	4.84	4.45
3.	T&D Losses in %	15.00	13.00	11.00	-	-

(Table 4.3: Power forecast summary of Aurangabad)

Analysis of Forecast:

A comparison of actual CAGR witnessed for the Aurangabad city during the last five years and the CAGR for future power forecast is tabulated below:

Sl. No.	City/State/Country	CAGR in %		
		2013-14 to 2018-19	2019-20 to 2024-25	2024-25 to 2029-30
1.	Energy Requirement	4.28	4.47	4.07
2.	Peak Demand	6.24	4.84	4.45

(Table 4.4: Actual CAGR in past vis-a-vis CAGR forecast for future for Aurangabad)

The above table indicates that although the peak demand growth rate of Aurangabad was more compared to the energy requirement growth rate, the forecast estimates that the peak demand growth rate will follow the energy requirement growth in future as per the trends witnessed in the more recent years.

Aurangabad

Electrical Energy Consumption, Energy Requirement and Peak Electricity Demand

(Category Wise and Year Wise Summary)

Year	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30
Domestic	402	414	427	440	453	466	479	493	507	521	535
Commercial	158	164	170	176	182	189	195	202	209	216	224
Public lighting	19	19	20	20	21	21	22	23	23	24	25
Public Water Works	23	24	25	26	27	28	29	30	31	32	33
Irrigation	13	13	13	14	14	14	14	14	14	14	15
LT Industries	149	154	159	164	169	174	179	185	190	196	202
HT Industries	1267	1343	1424	1509	1600	1696	1785	1880	1980	2085	2195
Railway Traction	0	0	0	0	0	0	0	0	0	0	0
Bulk Supply	0	0	0	0	0	0	0	0	0	0	0
Others (if any)	60	63	66	69	73	76	80	84	88	93	97
Total (Energy Consumption)	2092	2194	2303	2417	2537	2664	2784	2910	3042	3181	3326
T&D losses -MU	369	375	381	387	393	398	401	404	407	409	411
T&D losses -in %	15.00	14.60	14.20	13.80	13.40	13.00	12.60	12.20	11.80	11.40	11.00
Energy Requirement - MU	2461	2570	2684	2804	2930	3062	3186	3315	3449	3590	3737
Annual Load Factor - %	84.41	84.11	83.81	83.51	83.21	82.91	82.61	82.31	82.01	81.71	81.41
Peak Load - MW	333	349	366	383	402	422	440	460	480	502	524

Table 4.5: Power Forecast of Aurangabad

Bengaluru



Bengaluru

Introduction:

Bengaluru is the capital of the Indian State of Karnataka. It is located on the Deccan Plateau in the south-eastern part of Karnataka. It is often referred to as the Garden city as there are 13 sq. km. of recreational and open spaces within the city. The city is a popular business destination for numerous multi nationals to set up their offices, premier educational institutions that attract students and researchers and multi-speciality healthcare facilities. Recent years have seen Bengaluru as a growing e-commerce and start up hub.

As of 2011 census, the total municipal area of the city was 709.5 sq. km. and the corresponding population was 84,43,675. The. However, the report has covered the Bruhat Bangalore Urban Agglomeration of 748.42 sq. km. that includes Guddahalli, Totadaguddadahalli, Srikantapura Anchepalya, Kodigehalli, Ramasandra, Doddathoguru, Doddagubbi, Chikkagubbi, Kannur, Suggatta, Vaderapura, Hunasamaranahalli, Chikkabidarakallu area also. The corresponding population was 85,20,435 as per Census-2011.

Economy⁵

Bengaluru is one of the fastest growing cities in India and is branded as the 'Silicon Valley of India' for spearheading the growth of Information and Communication Technology (ICT) based industries. It has become a cosmopolitan city attracting people and businesses alike, within India and internationally and has become a symbol of India's integration with the global economy. With the growth of IT and industries in other sectors (e.g. textiles, light engineering and defence) and the onset of economic liberalization since the early 1990s, Bengaluru has taken a lead in service-based industries fuelling growth of the city both economically and spatially. The city has grown rapidly in the past few decades from pensioner's paradise to the information

⁵ Bengaluru Smart City Proposal ([http://smartcities.gov.in/upload/uploadfiles/files/01_SCP_BLR%20\(A4\).pdf](http://smartcities.gov.in/upload/uploadfiles/files/01_SCP_BLR%20(A4).pdf))

technology capital of India. The presence of IT/ITES industries, large public sector undertakings like BEL, BEML and HAL, along with major hardware garment industries has led to in-migration and rapid growth of the city. It has also emerged as the start-up hub of the nation, bringing innovation and contribution to GDP, diversity of economy and adding to employment opportunities. The city is also a major education hub with a very large number of higher educational institutions in and around the city.



(Figure 5.1: Location of Bengaluru City)

Climate⁶

The climate of the city is salubrious throughout the year. The average annual maximum temp. is 29.6 °C with mean maximum temp. of the hottest month (April) and the coldest month (Jan) are about 34.0 °C and 27.9 °C respectively. The average annual minimum temp. is 19.2 °C with mean minimum temp. of the hottest and the coldest months are about 22.0 °C and 15.8 °C respectively. The average annual rainfall of the city is 102.1 cm. The rainfall during the

⁶ <http://www.imdpune.gov.in/caui/smartcities.html>

southwest monsoon season is about 87% of the annual rainfall. The values of relative humidity are about 84% to 88% in the morning and 62% to 67% in the afternoon during the southwest monsoon season.

Brief description of Power Utilities⁷:

Karnataka was the first state to have separate entities for generation and distribution. Karnataka Power Corporation Ltd. (KPCL), was formed in 1970 owning generation plants while the transmission and distribution sectors were owned by Karnataka Electricity Board (KEB). In 1999, Karnataka Electricity Reforms Act was passed by the state legislature and led to major reforms in the power sector. Along with the corporatization of KEB into Karnataka Power Transmission Corporation Ltd. (KPTCL), Karnataka Electricity Regulatory Commission (KERC) was also constituted in the year 1999 as an autonomous body to regulate all aspects of the power sector in the state.

In 2002, KPTCL was further unbundled to form a transmission company and the following four distribution companies -

- Bangalore Electricity Supply Company Limited (BESCOM)
- Hubli Electricity Supply Company Limited (HESCOM)
- Gulbarga Electricity Supply Company Limited (GESCOM)
- Mangalore Electricity Supply Company Limited (MESCOM)

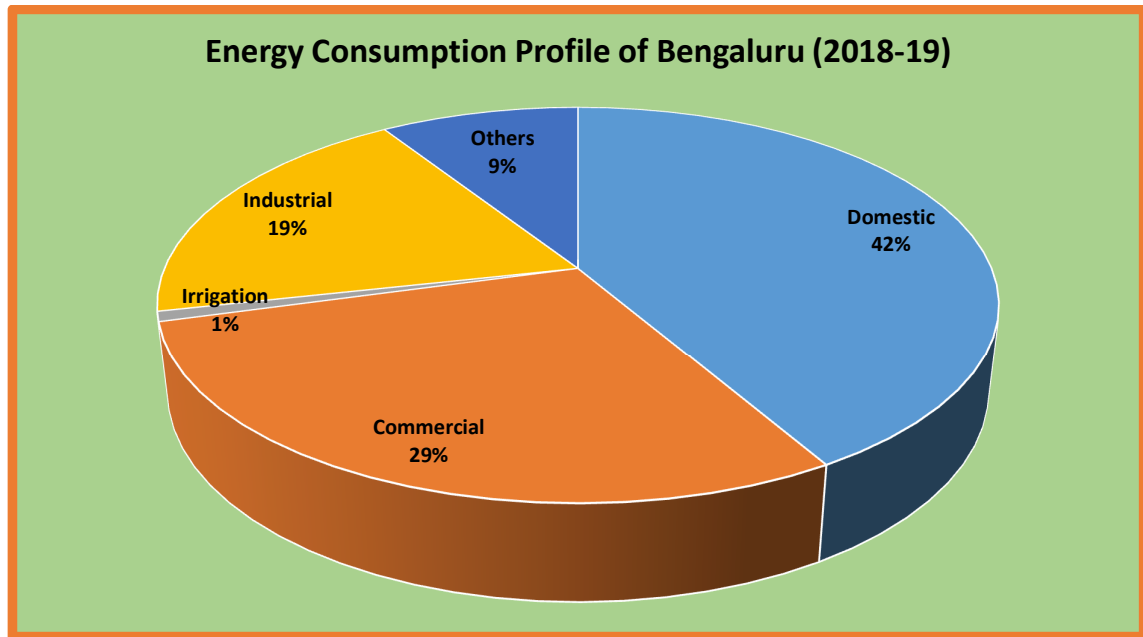
In 2005, a 5th distribution company viz., Chamundeshwari Electricity Supply Corporation Ltd. (CESC) was also formed with a mandate for power distribution and retail supply of electricity to consumers in the state. BESCOM is responsible for Power distribution in Bengaluru city.

Existing Power Scenario:

The total electricity consumption of Bengaluru in the year 2018-19 was 13212 MU and with 9.44% T&D losses, the requirement was 14589 MU. The peak demand recorded for the city was 2976 MW. The Domestic sector was the

⁷ https://powermin.nic.in/sites/default/files/uploads/joint_initiative_of_govt_of_india_and_karnataka.pdf

biggest consumer of electricity (42%) followed by Commercial (29%) & Industrial (19%) sectors.



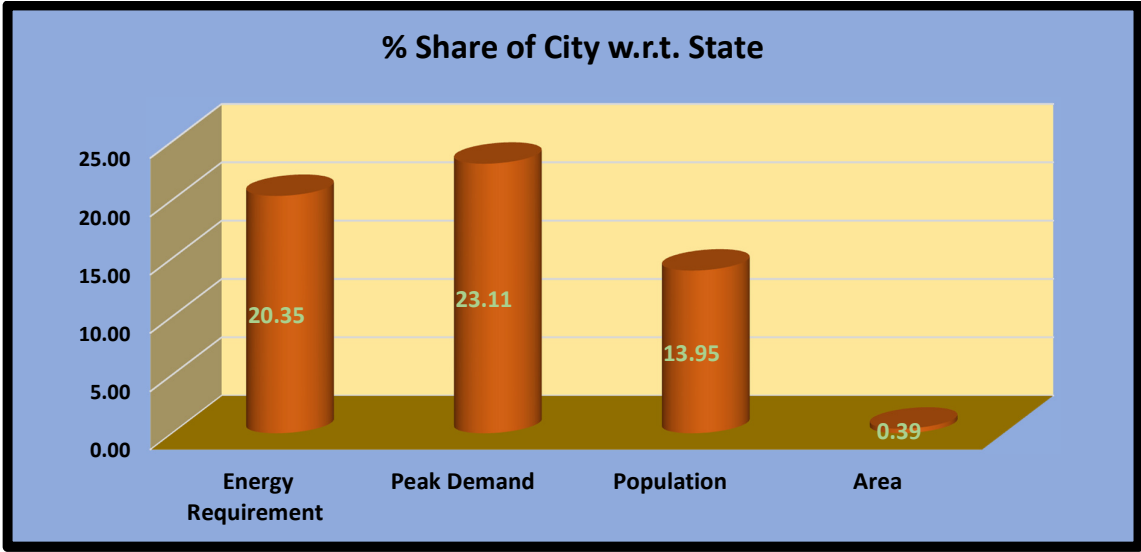
(Figure 5.2: Energy Consumption Profile of Bengaluru in 2018-19)

During the last five years (2013-14 to 2018-19), the city has observed CAGR of 1.25% & 5.18% in electricity energy requirement and peak demand respectively.

On comparison of Bengaluru with Karnataka for the year 2018-19, it is observed that the energy requirement of Bengaluru was 20.35% of the total energy requirement of the state whereas its contribution in population and area were only 13.95% and 0.39% respectively.

Sl. No.	Particulars	Bengaluru	Karnataka	Bengaluru as % of Karnataka
1.	Energy Requirement (in MU)	14589	71695	20.35
2.	Peak Demand (in MW)	2976	12877	23.11
3.	Population (2011 Census)	85,20,435	6,10,95,297	13.95
4.	Area (in sq km)	748.42	1,91,791	0.39

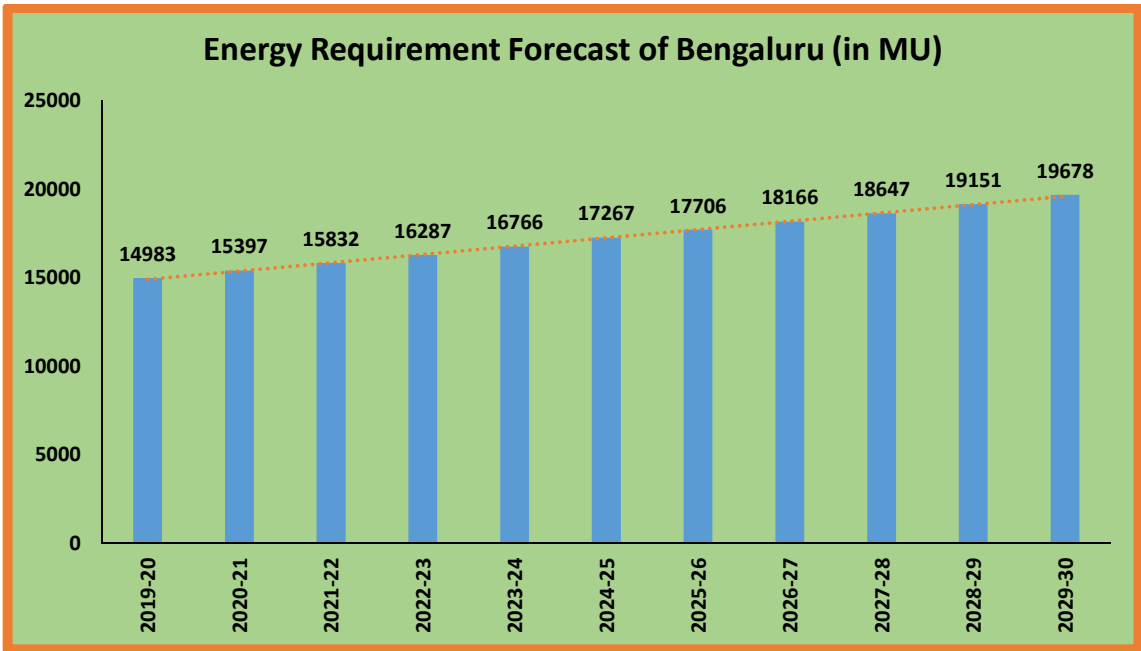
(Table 5.1: Comparison of Bengaluru with Karnataka in 2018-19)



(Figure 5.3: Comparison between Bengaluru and Karnataka in 2018-19)

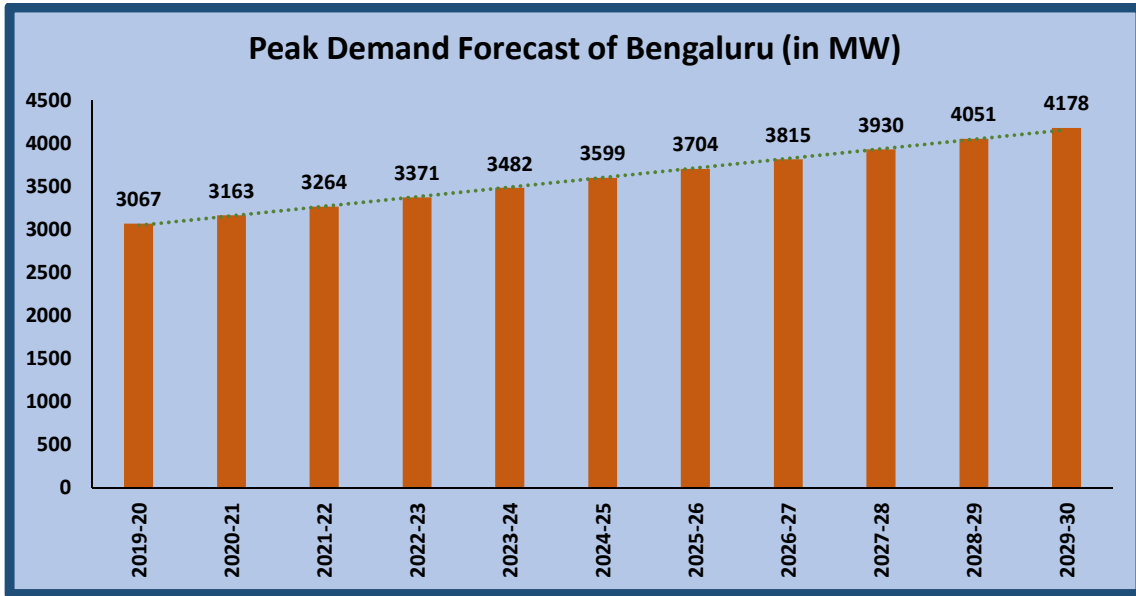
Power Forecast:

Based on total electricity consumption and T&D Losses, the total energy requirement of Bengaluru is estimated as 14983 MU in year 2019-20. It is expected that the energy requirement of the city will reach to 17267 MU by the year 2024-25 with 2.88% CAGR for the period 2019-20 to 2024-25. With CAGR of 2.65% for the period 2024-25 to 2029-30, its energy requirement is estimated as 19678 MU by the year 2029-30.



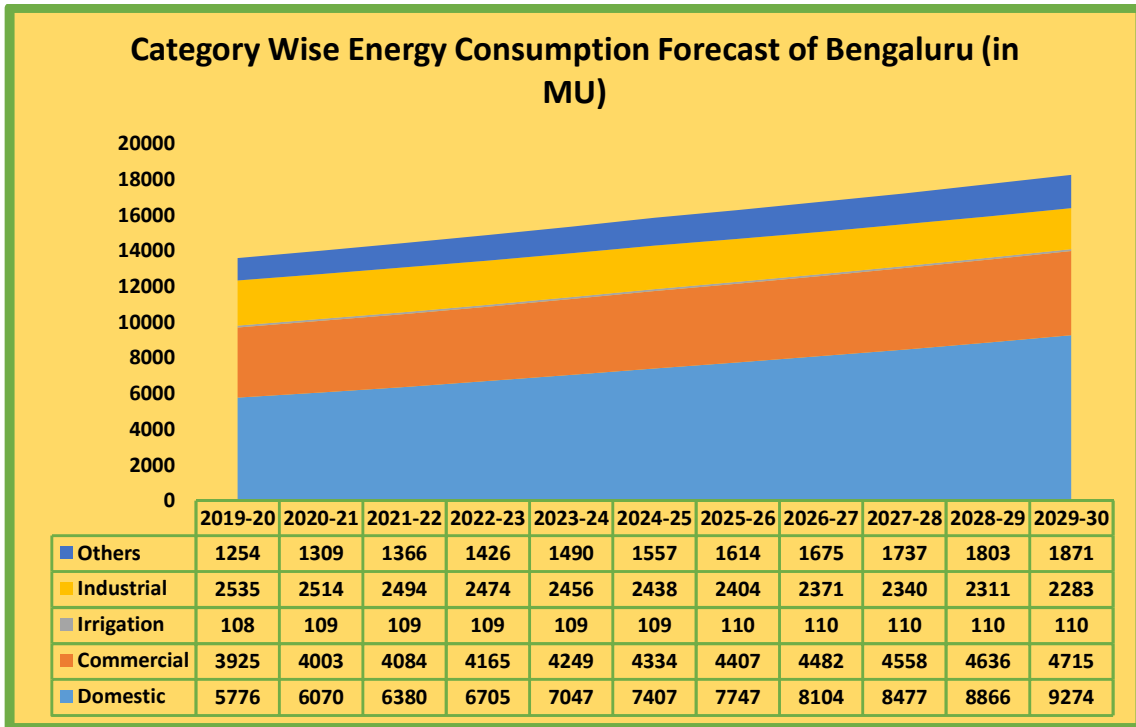
(Figure 5.4: Energy Requirement Forecast of Bengaluru in MU)

Peak Demand of the Bengaluru is expected to see 3.25% CAGR upto 2024-25 and will reach 3599 MW in comparison to 3067 MW in year 2019-20. It is expected to reach 4178 MW in year 2029-30 with a CAGR of 3.03% after 2024-25.



(Figure 5.5: Peak Demand Forecast of Bengaluru in MW)

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



(Figure 5.6: Category Wise Energy Consumption forecast of Bengaluru)

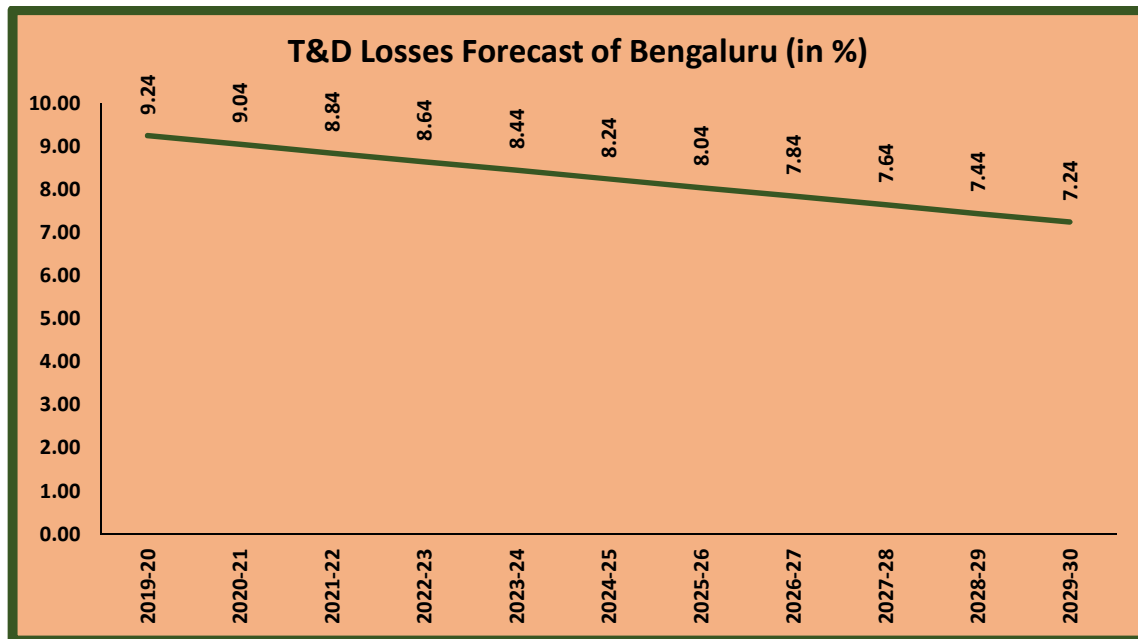
The category wise CAGR expected in energy consumption for the next ten years (2019-20 to 2029-30) along with its break up in five years (2019-20 to 2024-25 & 2025-26 to 2029-30) is tabulated below:

Sl. No.	Category	Energy Consumption (in MU)			CAGR in %		
		2019-20	2024-25	2029-30	2019-20 to 2024-25	2024-25 to 2029-30	2019-20 to 2029-30
1.	Domestic	5776	7407	9274	5.10	4.60	4.85
2.	Commercial	3925	4334	4715	2.00	1.70	1.85
3.	Irrigation	108	109	110	0.17	0.14	0.15
4.	Industrial	2535	2438	2283	-0.78	-1.31	-1.04
5.	Others	1254	1557	1871	4.41	3.75	4.08
6.	Total	13599	15844	18253	3.10	2.87	2.99

(Table 5.2: Expected CAGR of Bengaluru - Category Wise Consumption)

Transmission & Distribution Losses:

T&D losses of Bengaluru were estimated as 9.44% in year 2018-19. The target level is to bring it down to about 8.24% and 7.24% by the end of 2024-25 & 2029-30 respectively.



(Figure 5.7: T&D Loss Forecast of Bengaluru)

The power forecast of Bengaluru city is summarized below:

Sl. No.	Particulars	2019-20	2024-25	2029-30	CAGR in %	
					2019-20 to 2024-25	2024-25 to 2029-30
1.	Energy Requirement in MU	14983	17267	19678	2.88	2.65
2.	Peak Demand in MW	3067	3599	4178	3.25	3.03
3.	T&D Losses in %	9.24	8.24	7.24	-	-

(Table 5.3: Power forecast summary of Bengaluru)

Analysis of Forecast:

A comparison of actual CAGR witnessed for the Bengaluru city during the last five years and the CAGR for future power forecast is tabulated below:

Sl. No.	City/State/Country	CAGR in %		
		2013-14 to 2018-19	2019-20 to 2024-25	2024-25 to 2029-30
1.	Energy Requirement	1.25	2.88	2.65
2.	Peak Demand	5.18	3.25	3.03

(Table 5.4: Actual CAGR in past vis-a-vis CAGR forecast for future for Bengaluru)

The above table indicates that Bengaluru has witnessed very less growth in energy requirements in the recent past and this trend is expected to continue in the future. The peak demand growth of the city is expected to be more in comparison to its energy requirement growth.

Bengaluru

Electrical Energy Consumption, Energy Requirement and Peak Electricity Demand

(Category Wise and Year Wise Summary)

Year	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30
Domestic	5776	6070	6380	6705	7047	7407	7747	8104	8477	8866	9274
Commercial	3925	4003	4084	4165	4249	4334	4407	4482	4558	4636	4715
Public lighting	302	310	318	327	336	345	353	362	370	379	388
Public Water Works	498	513	528	543	559	575	589	604	619	635	650
Irrigation	108	109	109	109	109	109	110	110	110	110	110
LT Industries	819	832	845	859	872	886	899	911	924	937	950
HT Industries	1717	1683	1649	1616	1584	1552	1505	1460	1416	1374	1333
Railway Traction	0	0	0	0	0	0	0	0	0	0	0
Bulk Supply	0	0	0	0	0	0	0	0	0	0	0
Others (if any)	454	486	520	556	595	637	672	709	748	789	832
Total (Energy Consumption)	13599	14005	14432	14880	15351	15844	16282	16741	17222	17726	18253
T&D losses -MU	1384	1392	1399	1407	1415	1423	1424	1424	1425	1425	1425
T&D losses -in %	9.24	9.04	8.84	8.64	8.44	8.24	8.04	7.84	7.64	7.44	7.24
Energy Requirement - MU	14983	15397	15832	16287	16766	17267	17706	18166	18647	19151	19678
Annual Load Factor - %	55.76	55.56	55.36	55.16	54.96	54.76	54.56	54.36	54.16	53.96	53.76
Peak Load - MW	3067	3163	3264	3371	3482	3599	3704	3815	3930	4051	4178

Table 5.5: Power Forecast of Bengaluru

Gangtok



Gangtok

Introduction:

⁸Gangtok is a municipality, the capital and the largest town of Sikkim state that was an independent monarchy before integration with the Union of India in 1975. It is also the headquarters of the East Sikkim district. It is located in the Eastern Himalayan range. Nestled within higher peaks of the Himalaya and enjoying a year-round mild temperate climate, Gangtok is at the centre of Sikkim's tourism industry. It is a centre of Tibetan Buddhist culture and learning, with the presence of several monasteries, religious educational institutions, and centres for Tibetology. As of 2011 census, the population of the city was 1,00,286. The total municipal area of the city is 19.28 sq. km.



(Figure 6.1: Location of Gangtok City)

⁸ <https://www.gmsikkim.in/index.php/only-home/8-hidden-module/12-city-profile>

Economy:

Tourism is one of the cornerstones of Gangtok's economy. Ecotourism has emerged as an important economic activity in the region which includes trekking, mountaineering, river rafting and other nature oriented activities. It does not have a large manufacturing base but has a thriving cottage industry in watch-making, country-made alcohol and handicrafts.

Climate⁹

The climate of the city is characterized by chilly weather in winter, cold and humid throughout the year. The average annual maximum temp. is 18.7 °C with mean maximum temp. of the hottest month (Aug) and the coldest month (Jan) are about 22.2 °C and 12.3 °C respectively. The average annual minimum temp. is 11.7 °C with mean minimum temp. of the hottest and the coldest months are about 16.9 °C and 4.7 °C respectively. The average annual rainfall of the city is 365.9 cm. The rainfall during the southwest monsoon season is about 64% of the annual rainfall. The relative humidity is high throughout the year. Its values are about 93% to 95% in the morning and 89% to 92% in the afternoon during the southwest monsoon season.

Brief description of Power Utilities¹⁰:

The Energy & Power Department of Sikkim is engaged in the generation of electricity, its transmission to various load centers and finally distribution to the consumers of all categories. The State Government has also constituted Sikkim Power Development Corporation Limited (SPDCL) for development of small Hydel projects.

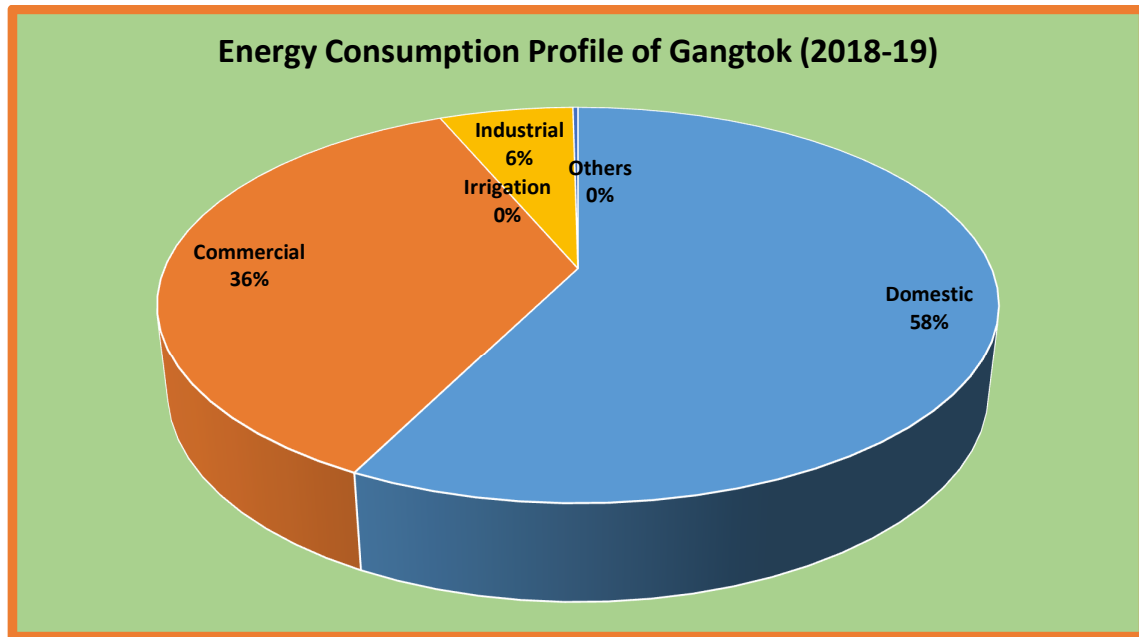
Existing Power Scenario:

The total electricity consumption of Gangtok in the year 2018-19 was 62 MU and with 22.24% T&D losses, the requirement was 80 MU. The peak demand

⁹ <http://www.imdpune.gov.in/caui/smartcities.html>

¹⁰ https://powermin.nic.in/sites/default/files/uploads/joint_initiative_of_govt_of_india_and_sikkim.pdf

of the city was 37 MW. The Domestic sector was the biggest consumer of electricity (58%) followed by Commercial (36%) & Industrial (6%).



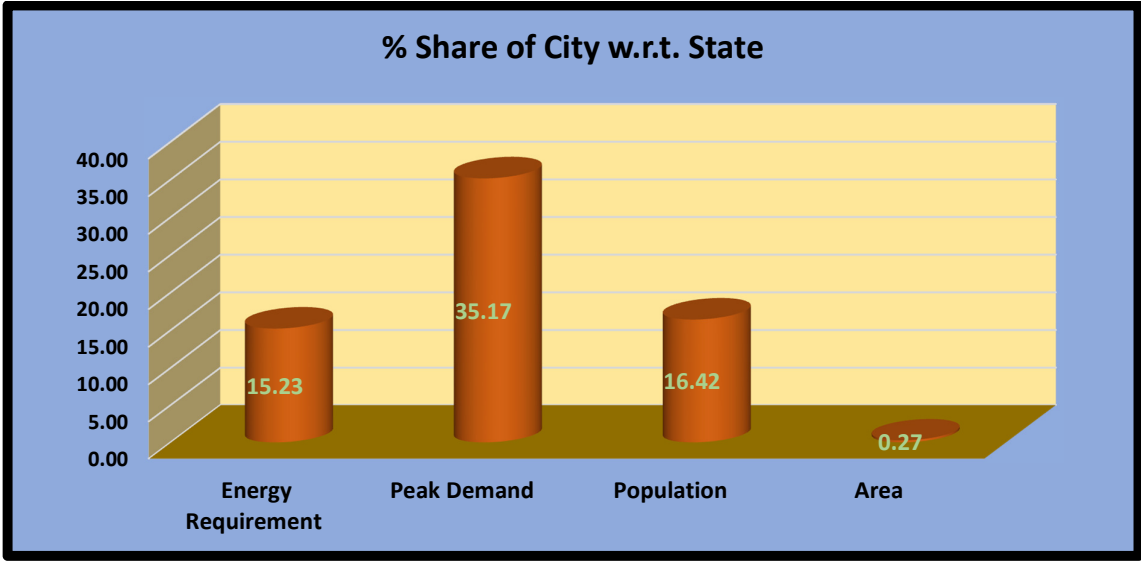
(Figure 6.2: Energy Consumption Profile of Gangtok in 2018-19)

During the last five years (2013-14 to 2018-19), the city has observed CAGR of 1.88% & 5.89% in electricity energy requirement and peak demand respectively.

On comparison of Gangtok with Sikkim for the year 2018-19, it is observed that the energy requirement of Gangtok was 15.23% of the total energy requirement of the state whereas its contribution in population and area were only 16.42% and 0.27% respectively.

Sl. No.	Particulars	Gangtok	Sikkim	Gangtok as % of Sikkim
1.	Energy Requirement (in MU)	80	527	15.23
2.	Peak Demand (in MW)	37	106	35.17
3.	Population (2011 Census)	1,00,286	6,10,577	16.42
4.	Area (in sq km)	19.28	7,096	0.27

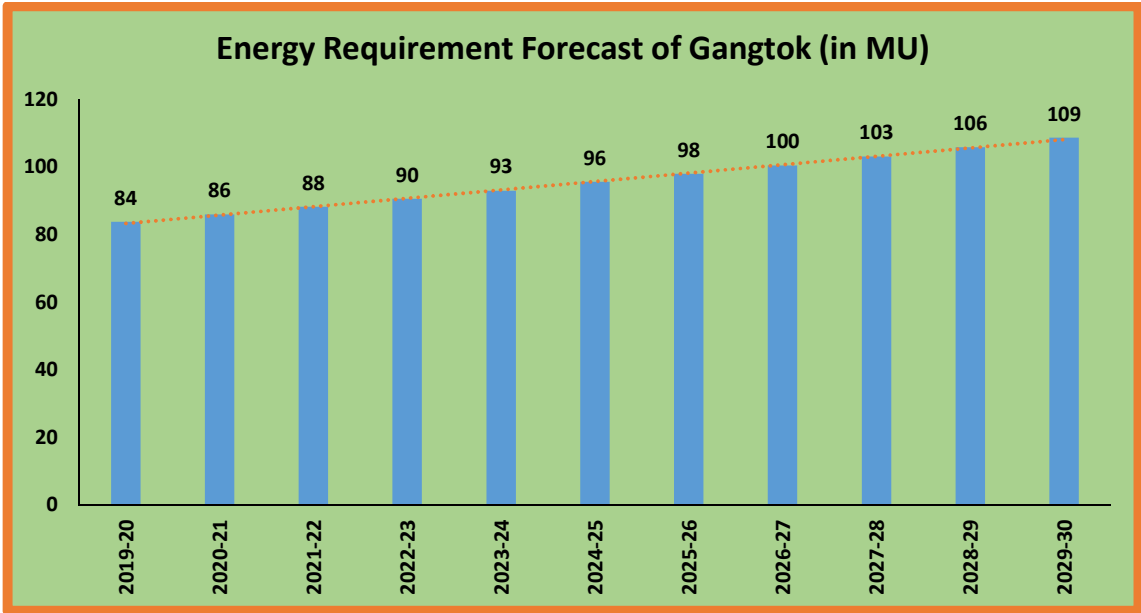
(Table 6.1: Comparison of Gangtok with Sikkim in 2018-19)



(Figure 6.3: Comparison between Gangtok and Sikkim in 2018-19)

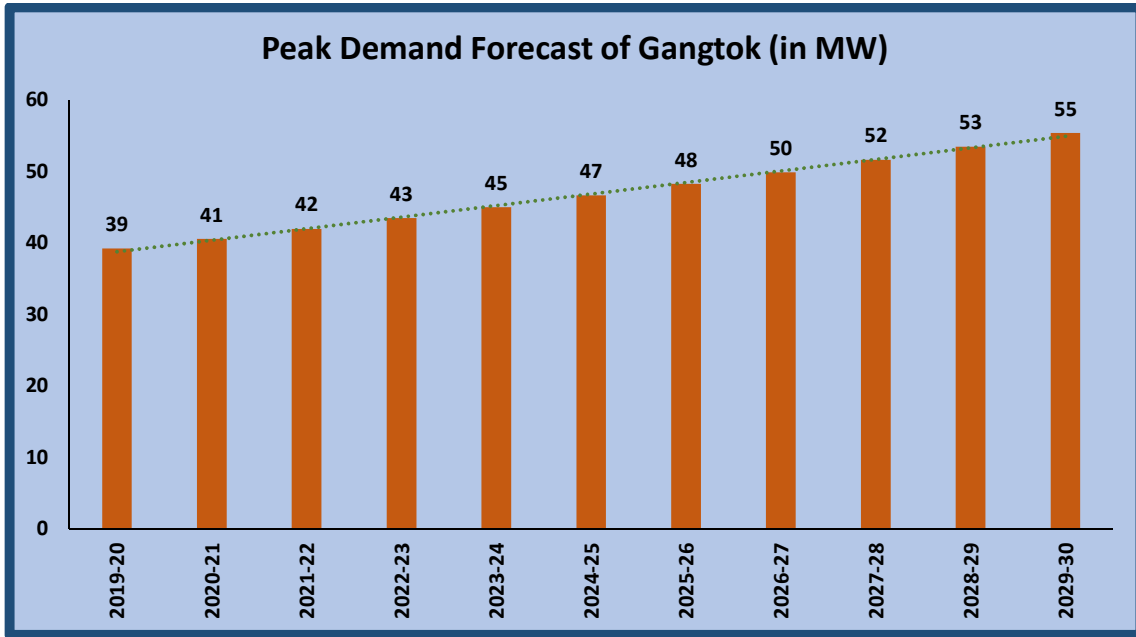
Power Forecast:

Based on total electricity consumption and T&D Losses, the total energy requirement of Gangtok is estimated as 84 MU in year 2019-20. It is expected that the energy requirement of the city will reach to 96 MU by the year 2024-25 with 2.68% CAGR for the period 2019-20 to 2024-25. With CAGR of 2.58% for the period 2024-25 to 2029-30, its energy requirement is estimated as 109 MU by the year 2029-30.



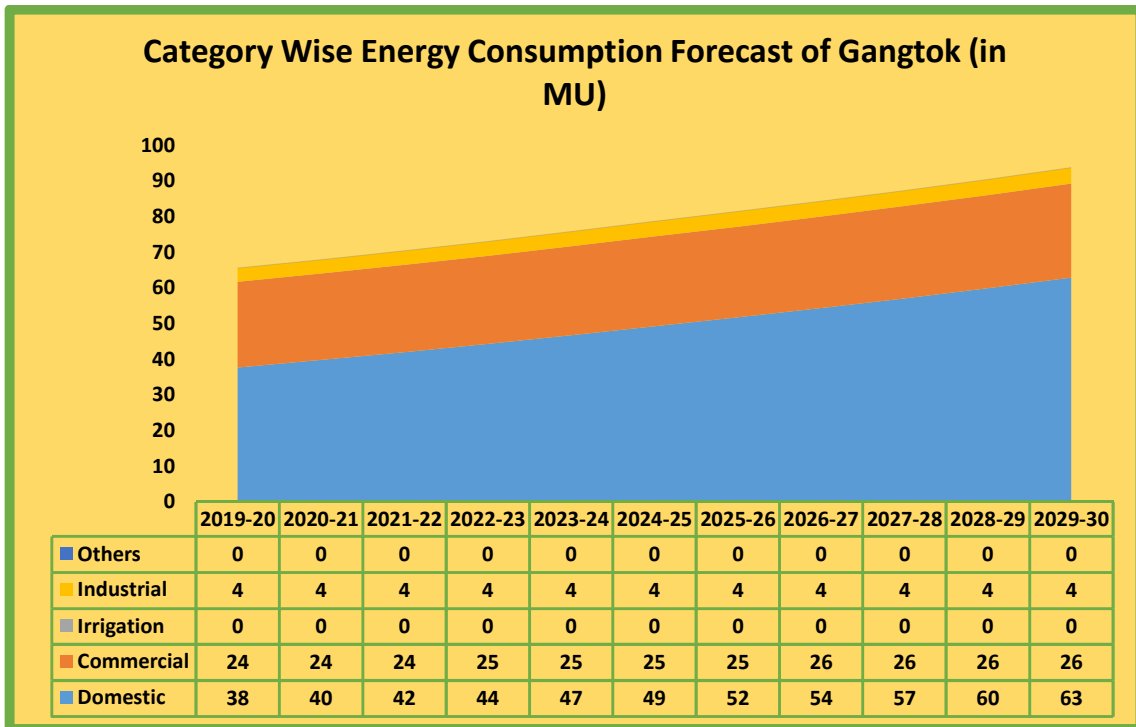
(Figure 6.4: Energy Requirement Forecast of Gangtok in MU)

Peak Demand of the Gangtok is expected to see 3.55% CAGR upto 2024-25 and will reach 47 MW in comparison to 39 MW in year 2019-20. It is expected to reach 55 MW in year 2029-30 with a CAGR of 3.49% after 2024-25.



(Figure 6.5: Peak Demand Forecast of Gangtok in MW)

The category wise energy consumption forecast of Gangtok is as follows:



(Figure 6.6: Category Wise Energy Consumption forecast of Gangtok)

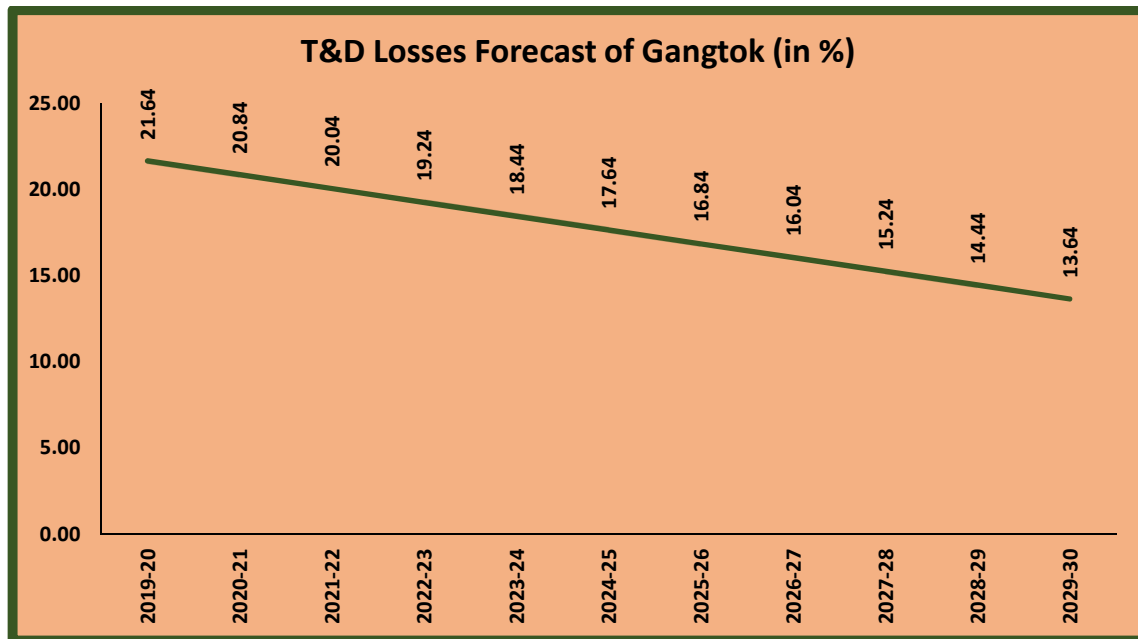
The category wise CAGR expected in energy consumption for the next ten years (2019-20 to 2029-30) along with its break up in five years (2019-20 to 2024-25 & 2025-26 to 2029-30) is tabulated below:

Sl. No.	Category	Energy Consumption (in MU)			CAGR in %		
		2019-20	2024-25	2029-30	2019-20 to 2024-25	2024-25 to 2029-30	2019-20 to 2029-30
1.	Domestic	38	49	63	5.50	5.00	5.25
2.	Commercial	24	25	26	1.00	0.90	0.95
3.	Irrigation	0	0	0	-	-	-
4.	Industrial	4	4	4	1.50	1.30	1.40
5.	Others	0	0	0	-	-	-
6.	Total	66	79	94	3.71	3.56	3.64

(Table 6.2: Expected CAGR of Gangtok - Category Wise Consumption)

Transmission & Distribution Losses:

T&D losses of Gangtok were estimated as 22.24% in year 2018-19. The target level is to bring it down to about 17.64% and 13.64% by the end of 2024-25 & 2029-30 respectively.



(Figure 6.7: T&D Loss Forecast of Gangtok)

The power forecast of Gangtok city is summarized below:

Sl. No.	Particulars	2019-20	2024-25	2029-30	CAGR in %	
					2019-20 to 2024-25	2024-25 to 2029-30
1.	Energy Requirement in MU	84	96	109	2.68	2.58
2.	Peak Demand in MW	39	47	55	3.55	3.49
3.	T&D Losses in %	21.64	17.64	13.64	-	-

(Table 6.3: Power forecast summary of Gangtok)

Analysis of Forecast:

A comparison of actual CAGR witnessed for the Gangtok city during the last five years and the CAGR for future power forecast is tabulated below:

Sl. No.	City/State/Country	CAGR in %		
		2013-14 to 2018-19	2019-20 to 2024-25	2024-25 to 2029-30
1.	Energy Requirement	1.88	2.68	2.58
2.	Peak Demand	5.89	3.55	3.49

(Table 6.4: Actual CAGR in past vis-a-vis CAGR forecast for future for Gangtok)

The above table indicates that Gangtok has witnessed very less growth in energy requirements in the recent past and this trend is expected to continue in the future. The peak demand growth of the city is expected to be more in comparison to its energy requirement growth and it is expected to be moderate in comparison to the growth seen in the past.

Gangtok

Electrical Energy Consumption, Energy Requirement and Peak Electricity Demand

(Category Wise and Year Wise Summary)

Year	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30
Domestic	38	40	42	44	47	49	52	54	57	60	63
Commercial	24	24	24	25	25	25	25	26	26	26	26
Public lighting	0	0	0	0	0	0	0	0	0	0	0
Public Water Works	0	0	0	0	0	0	0	0	0	0	0
Irrigation	0	0	0	0	0	0	0	0	0	0	0
LT Industries	0	0	0	0	0	0	0	0	0	0	0
HT Industries	4	4	4	4	4	4	4	4	4	4	4
Railway Traction	0	0	0	0	0	0	0	0	0	0	0
Bulk Supply	0	0	0	0	0	0	0	0	0	0	0
Others (if any)	0	0	0	0	0	0	0	0	0	0	0
Total (Energy Consumption)	66	68	70	73	76	79	81	84	87	90	94
T&D losses -MU	18	18	18	17	17	17	16	16	16	15	15
T&D losses -in %	21.64	20.84	20.04	19.24	18.44	17.64	16.84	16.04	15.24	14.44	13.64
Energy Requirement - MU	84	86	88	90	93	96	98	100	103	106	109
Annual Load Factor - %	24.36	24.16	23.96	23.76	23.56	23.36	23.16	22.96	22.76	22.56	22.36
Peak Load - MW	39	41	42	43	45	47	48	50	52	53	55

Table 6.5: Power Forecast of Gangtok

Hyderabad



Hyderabad

Introduction:

Hyderabad is the capital of one of the most techno savvy state in India, Telangana. It is located on the crossroads of the rivers, Krishna and Godavari in the peneplain Telengana. This city is also known as the City of Pearls, as it had once flourished as a global centre for trade of rare diamonds, emeralds as well as natural pearls.

The Greater Hyderabad Municipal Corporation (GHMC) is the civic body that oversees Hyderabad. It was formed on 16 April 2007 by merging 12 municipalities (Lal Bahadur Nagar, Gaddi Annaram, Secunderabad, Malkajgiri, Kapra, Alwal, Qutubullapur, Kukatpally, Serilingampalle, Rajendranagar, Ramachandrapuram, and Patancheru) and 8 gram panchayats (Shamshabad, Satamarai, Jallapalli, Mamdipalli, Mankhal, Almasguda, Sardanagar and Ravirala) with the Municipal Corporation of Hyderabad.¹¹

The report has covered the total area of 962.3 sq. km. served by the Greater Hyderabad Municipal Corporation (GHMC). As of 2011 census, the corresponding population was 69,71,622.

Economy:

The economy of Hyderabad, the capital of Telangana, India, is based on traditional manufacturing, the knowledge sector, and tourism. During the 1950s and 1960s, most of the Indian premier public enterprises—BHEL, NMDC, HMT, BEL, IDPL, ECIL, DRDO and HAL—were established in Hyderabad making it a major industrial hub. Thereafter, the growth of the financial services sector has helped Hyderabad evolve from a traditional manufacturing city to a cosmopolitan industrial service centre. Since the 1990s, the growth of information technology (IT), IT-enabled services (ITES),

¹¹ <https://csr.ghmc.gov.in/AboutGhmc.aspx>

insurance and financial institutions has expanded the service sector, and these primary economic activities have boosted the ancillary sectors of trade and commerce, transport, storage, communication, real estate and retail. The city emerged as one of the major IT hubs in the country during the IT boom of the late 1990s and early 2000s and has consistently retained its position as an IT centre of significance.



(Figure 7.1: Location of Hyderabad City)

Climate¹²

The climate of the city is characterized by hot and dry in summer and humid in other seasons. The average annual maximum temp. is 32.7 °C with mean maximum temp. of the hottest month (May) and the coldest month (Dec & Jan) are about 39.4 °C and 29.0 °C respectively. The average annual

¹² <http://www.imdpune.gov.in/caui/smartcities.html>

minimum temp. is 20.9 °C with mean minimum temp. of the hottest and the coldest months are about 26.3 °C and 15.5 °C respectively. The average annual rainfall of the city is 84 cm. The rainfall during the southwest monsoon season is about 74% of the annual rainfall. The values of relative humidity are about 70% to 82% in the morning and 51% to 69% in the afternoon during the southwest monsoon season.

Brief description of Power Utilities:

The Andhra Pradesh State Electricity Board, which came into existence in 1959, was unbundled into Andhra Pradesh Power Generation Corporation (APGENCO) & Transmission Corporation of Andhra Pradesh Limited (APTRANSCO) on 01.02.1999 after the enactment in Andhra Pradesh Electricity Reforms Act in 1998. APTRANSCO was further unbundled w.e.f. 01.04.2000 into "Transmission Corporation" (APTRANSCO) and four "Distribution Companies"(APDISCOMs) viz. Eastern Power Distribution Company of Andhra Pradesh Limited (APEPDCL), Central Power Distribution Company of Andhra Pradesh Limited (APCPDCL), Northern Power Distribution Company of Andhra Pradesh Limited (APNPDCL) and Southern Power Distribution Company of Andhra Pradesh Limited (APSPDCL).

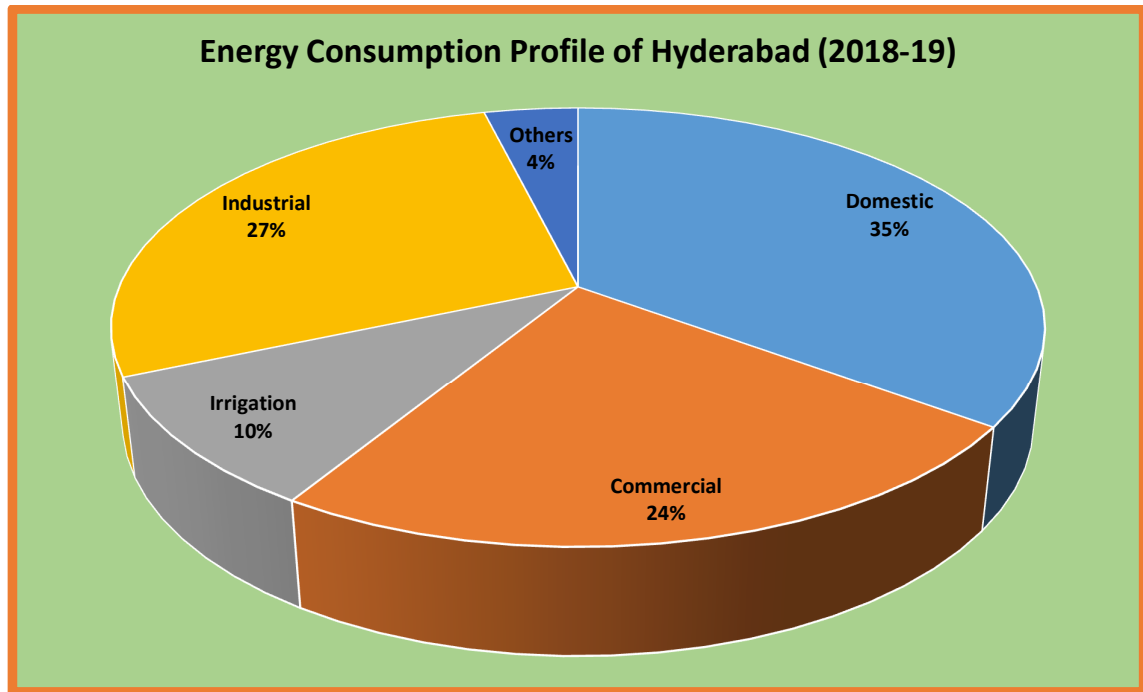
Later on, when the state was bifurcated on 2 June 2014, Telangana Genco (TSGENCO) and Transmission Corporation of Telangana Limited (TSTRANSCO) were formed for the newly formed Telangana state¹³. The Telangana Southern Power Distribution Company Limited (TSSPDCL) and Northern Power Distribution Company of Telangana Ltd (TSNPDCL) were incorporated under the Companies Act, 1956 as public limited companies on 02.06.2014 and 30.03.2000 with headquarters at Hyderabad and Warangal respectively¹⁴. Telangana Southern Power Distribution Company Limited (TSSPDCL) is responsible for power distribution in Hyderabad city.

¹³ <https://www.tstransco.in/>

¹⁴ <http://www.tsnpdcl.in/> and <https://www.tssouthernpower.com/>

Existing Power Scenario:

The total electricity consumption of Hyderabad in the year 2018-19 was 18053 MU and with 10.00% T&D losses, the requirement was 20059 MU. The peak demand of the city was 2958 MW. The Domestic sector was the biggest consumer of electricity (35%) followed by Industrial (27%) & Commercial (24%).



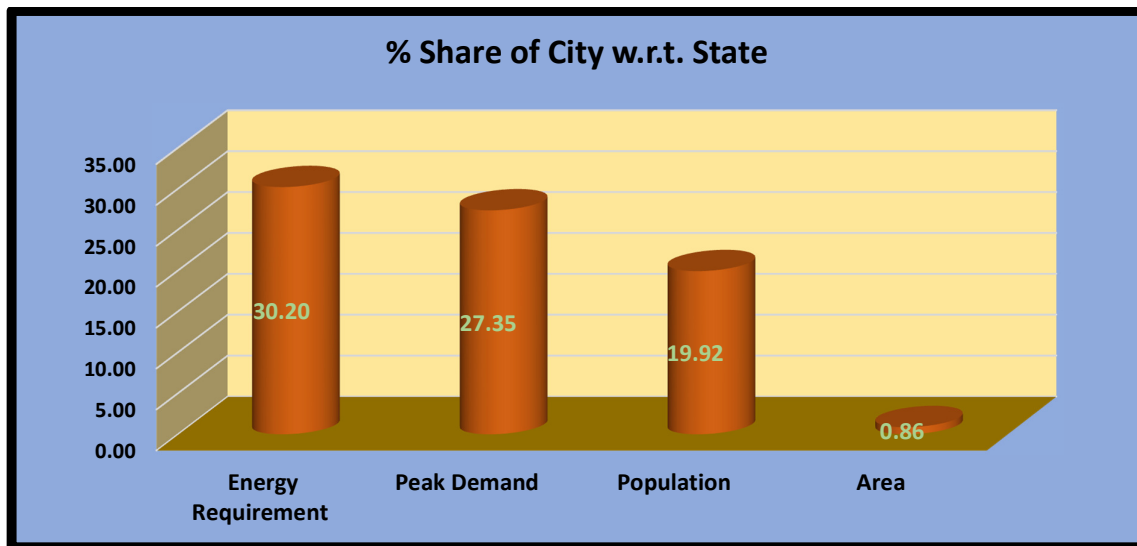
(Figure 7.2: Energy Consumption Profile of Hyderabad in 2018-19)

During the last three years (2016-17 to 2018-19), the city has observed CAGR of 12.88% & 6.95% in electricity energy requirement and peak demand respectively.

On comparison of Hyderabad with Telangana for the year 2018-19, it is observed that the energy requirement of Hyderabad was 30.20% of the total energy requirement of the state whereas its contribution in population and area were only 19.92% and 0.86% respectively.

Sl. No.	Particulars	Hyderabad	Telangana	Hyderabad as % of Telangana
1.	Energy Requirement (in MU)	20059	66427	30.20
2.	Peak Demand (in MW)	2958	10815	27.35
3.	Population (2011 Census)	69,71,622	3,50,03,675	19.92
4.	Area (in sq km)	962.3	1,12,077	0.86

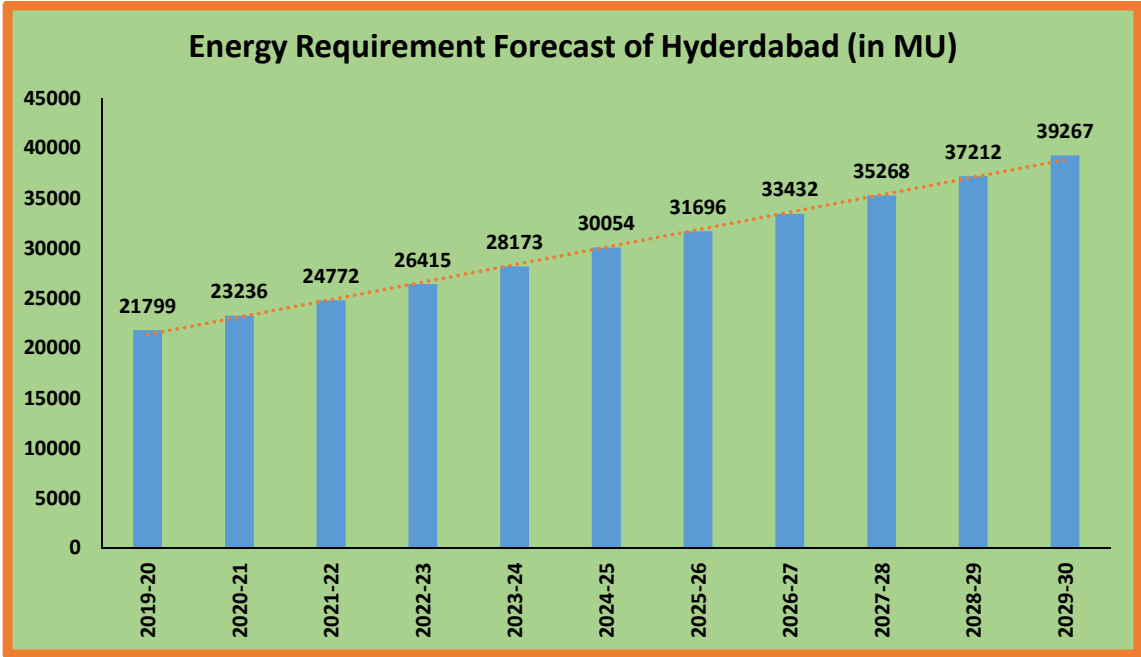
(Table 7.1: Comparison of Hyderabad with Telangana in 2018-19)



(Figure 7.3: Comparison between Hyderabad and Telangana in 2018-19)

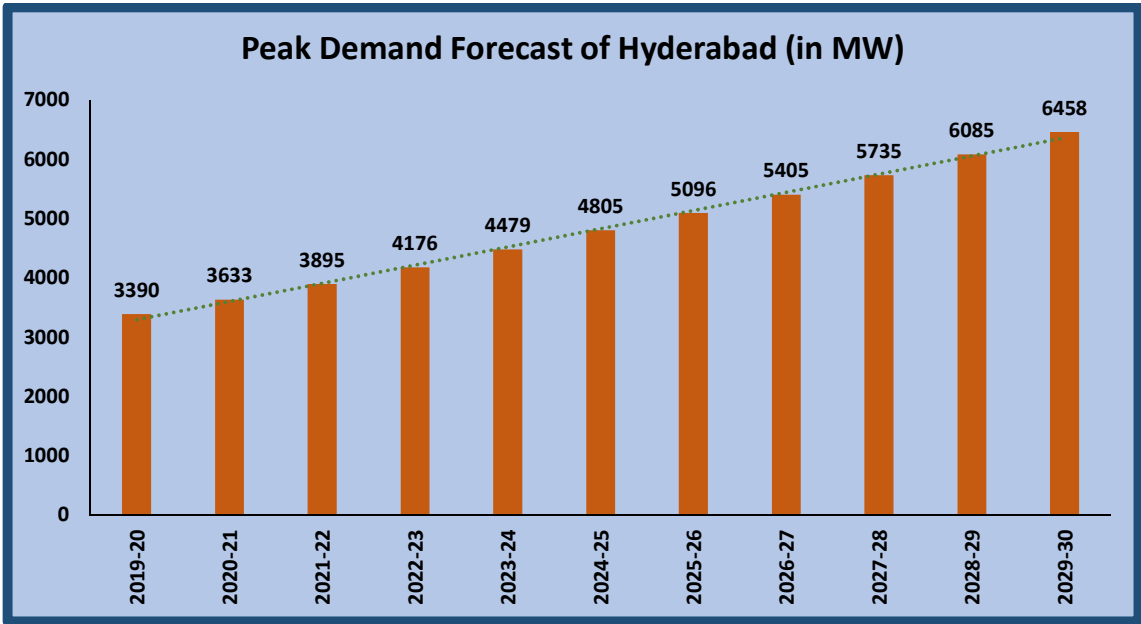
Power Forecast:

Based on total electricity consumption and T&D Losses, the total energy requirement of Hyderabad is estimated as 21799 MU in year 2019-20. It is expected that the energy requirement of the city will reach to 30054 MU by the year 2024-25 with 6.63% CAGR for the period 2019-20 to 2024-25. With CAGR of 5.49% for the period 2024-25 to 2029-30, its energy requirement is estimated as 39267 MU by the year 2029-30.



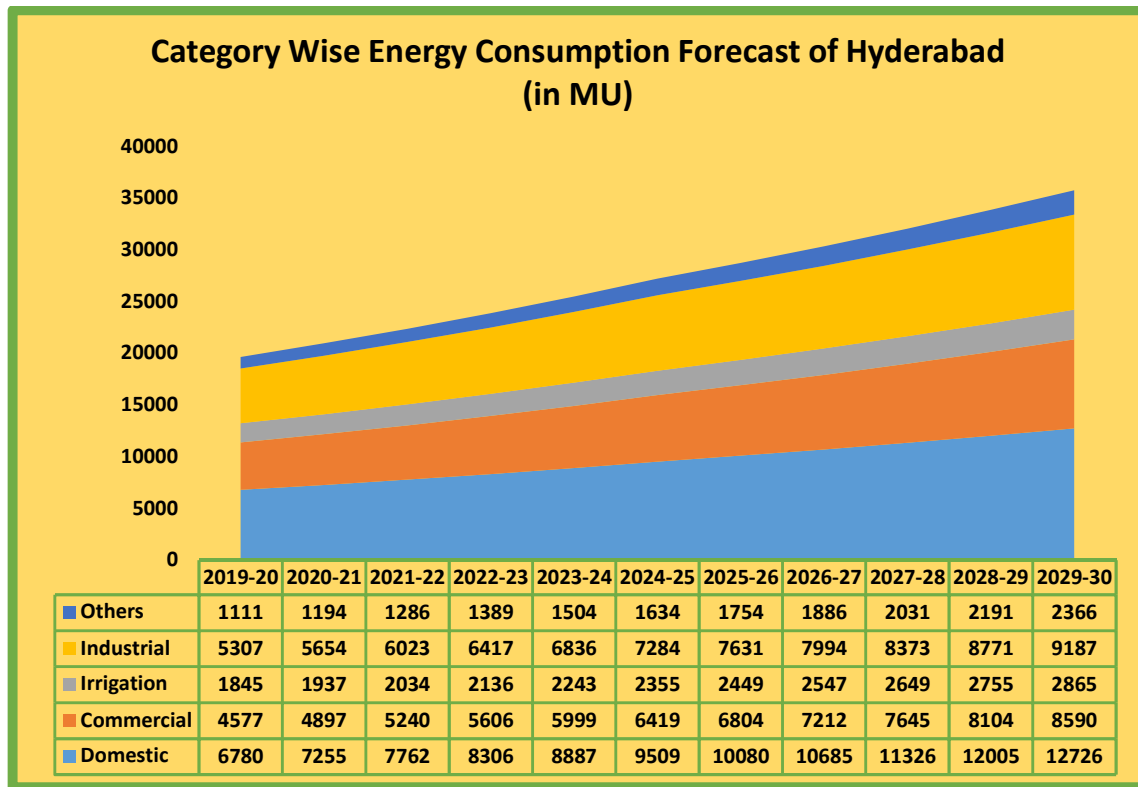
(Figure 7.4: Energy Requirement Forecast of Hyderabad in MU)

Peak Demand of the Hyderabad is expected to see 7.22% CAGR upto 2024-25 and will reach 4805 MW in comparison to 3390 MW in year 2019-20. It is expected to reach 6458 MW in year 2029-30 with a CAGR of 6.09% after 2024-25.



(Figure 7.5: Peak Demand Forecast of Hyderabad in MW)

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



(Figure 7.6: Category Wise Energy Consumption forecast of Hyderabad)

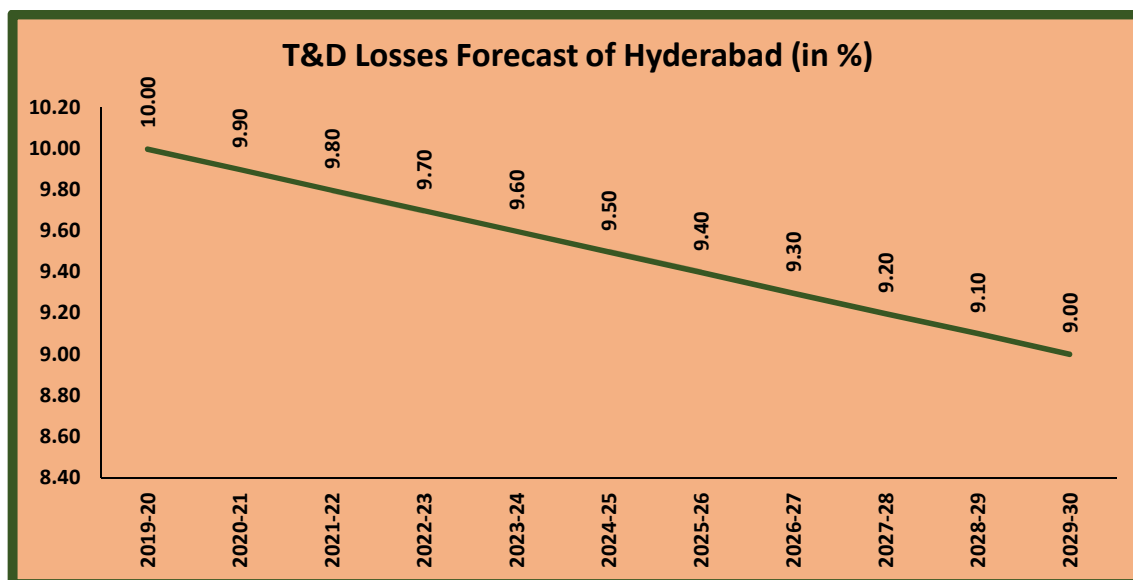
The category wise CAGR expected in energy consumption for the next ten years (2019-20 to 2029-30) along with its break up in five years (2019-20 to 2024-25 & 2025-26 to 2029-30) is tabulated below:

Sl. No.	Category	Energy Consumption (in MU)			CAGR in %		
		2019-20	2024-25	2029-30	2019-20 to 2024-25	2024-25 to 2029-30	2019-20 to 2029-30
1.	Domestic	6780	9509	12726	7.00	6.00	6.50
2.	Commercial	4577	6419	8590	7.00	6.00	6.50
3.	Irrigation	1845	2355	2865	5.00	4.00	4.50
4.	Industrial	5307	7284	9187	6.54	4.75	5.64
5.	Others	1111	1634	2366	8.01	7.69	7.85
6.	Total	19620	27200	35733	6.75	5.61	6.18

(Table 7.2: Expected CAGR of Hyderabad - Category Wise Consumption)

Transmission & Distribution Losses:

T&D losses of Hyderabad were estimated as 10.00% in year 2018-19. The target level is to bring it down to about 9.50% and 9.00% by the end of 2024-25 & 2029-30 respectively.



(Figure 7.7: T&D Loss Forecast of Hyderabad)

The power forecast of Hyderabad city is summarized below:

Sl. No.	Particulars	2019-20	2024-25	2029-30	CAGR in %	
					2019-20 to 2024-25	2024-25 to 2029-30
1.	Energy Requirement in MU	21799	30054	39267	6.63	5.49
2.	Peak Demand in MW	3390	4805	6458	7.22	6.09
3.	T&D Losses in %	10.00	9.50	9.00	-	-

(Table 7.3: Power forecast summary of Hyderabad)

Analysis of Forecast:

A comparison of actual CAGR witnessed for the Hyderabad city during the last five years and the CAGR for future power forecast is tabulated below:

Sl. No.	City/State/Country	CAGR in %		
		2013-14 to 2018-19	2019-20 to 2024-25	2024-25 to 2029-30
1.	Energy Requirement	12.88	6.63	5.49
2.	Peak Demand	6.95	7.22	6.09

(Table 7.4: Actual CAGR in past vis-a-vis CAGR forecast for future for Hyderabad)

The higher energy requirement growth rate (12.88%) witnessed for Hyderabad city for the period of 2015-16 to 2018-19 was mainly on account of the reorganization of the municipal boundary of the city during that period. As the per capita consumption of the city has not grown in that proportion, a slower energy requirement growth rate has been considered for the future.

It is interesting to note that the city has witnessed moderate peak demand growth in comparison to its energy requirement growth that is in contrast to most of the other mega cities. This could also be explained on account of the inclusion of other areas that had changed category wise consumption profile of the city considerably by increasing Industrial and agricultural share. It has resulted in increasing the load factor of the city significantly during the last three years (77.41% in 2018-19 in comparison to 69.50% in 2016-17). This trend is not expected to continue in the future unless other areas would again be added to the city and therefore, the load factor is expected to reduce from the present level in future as is the case with other cities. Accordingly, the peak demand of the city is expected to grow faster in future in comparison to the growth witnessed in past.

Hyderabad

Electrical Energy Consumption, Energy Requirement and Peak Electricity Demand

(Category Wise and Year Wise Summary)

Year	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30
Domestic	6780	7255	7762	8306	8887	9509	10080	10685	11326	12005	12726
Commercial	4577	4897	5240	5606	5999	6419	6804	7212	7645	8104	8590
Public lighting	160	168	175	183	191	198	206	213	221	228	234
Public Water Works	105	114	125	135	146	157	168	179	190	200	210
Irrigation	1845	1937	2034	2136	2243	2355	2449	2547	2649	2755	2865
LT Industries	672	694	716	738	760	782	804	826	847	869	889
HT Industries	4635	4960	5307	5679	6076	6501	6826	7168	7526	7902	8298
Railway Traction	441	446	450	454	459	463	467	472	476	480	484
Bulk Supply	0	0	0	0	0	0	0	0	0	0	0
Others (if any)	405	466	536	616	709	815	913	1022	1145	1282	1436
Total (Energy Consumption)	19620	20936	22345	23854	25469	27200	28718	30324	32024	33825	35733
T&D losses -MU	2179	2300	2427	2561	2704	2854	2978	3108	3244	3386	3534
T&D losses -in %	10.00	9.90	9.80	9.70	9.60	9.50	9.40	9.30	9.20	9.10	9.00
Energy Requirement - MU	21799	23236	24772	26415	28173	30054	31696	33432	35268	37212	39267
Annual Load Factor - %	73.41	73.01	72.61	72.21	71.81	71.41	71.01	70.61	70.21	69.81	69.41
Peak Load - MW	3390	3633	3895	4176	4479	4805	5096	5405	5735	6085	6458

Table 7.5: Hyderabad Power Forecast

Jammu



Jammu

Introduction:

¹⁵Jammu, located in J&K union territory, falls in the sub mountainous region at the foothills of Himalayas. It is known as the “City of Temples” and is very famous for its inherent Dogri heritage. Jammu acts as the gateway city in terms of tourism, pilgrimage and trade activities in J&K. Almost 20% of the total tourists visit temples in Jammu city and then proceed towards Katra/ Kashmir. The city is the main cultural and economic centre of Jammu province and the state.

As of 2011 census, the Jammu Municipal Area was of 112 sq. km. with corresponding population of 5,02,197. However, this report has considered the entire Jammu City Area of 159.36 sq. km. which includes Kamini, Khanpur, Setani, Narwal Bala, Rakh Bahu, Chhani Raman, Chhani Beja, Chhani Kamala, Chak Jalu, Sunjwan, Deeli, Gangial, Gadi Garh, Raipur, Rakh Raipur, Chak Gulami, Gajral, Hazuri Bagh, Muthi, Barnayi, Dharmal, Chanor, Chwadi, Keran & Satwari area also. The corresponding population was 5,76,198 as per Census-2011.

Economy¹⁶

Tourism is the largest industry in Jammu. The city is also a focal point of pilgrims going to Vaishno Devi and also to the Kashmir Valley. Many small and medium-scale industries in the traditional sectors and areas like food processing, agro-based units and metallic and non-metallic products are also located in the city. It also has several plastics, polythene, paint, printing, polish, hardware, bakery industries, food-grain mills, art and crafts, woollen mills and artistic embroidery.

¹⁵ Jammu Smart City Proposal

(http://smartcities.gov.in/upload/uploadfiles/files/3_%20Smart%20City%20Jammu_SCP%20Document.pdf)

¹⁶ <https://jammu.nic.in/economy/> & Jammu Master Plan 2032 (<https://www.jdajammu.in/JMP2032.pdf>)



(Figure 8.1: Location of Jammu City)

Climate¹⁷

The climate of the city is characterized by sub-tropical extreme climate while it is hot and dry in summer and cold in winter. The average annual maximum temp. is 29.7 °C with mean maximum temp. of the hottest month (June) and the coldest month (Jan) are about 38.6 °C and 18.6 °C respectively. The average annual minimum temp. is 17.9 °C with mean minimum temp. of the hottest and the coldest months are about 25.8 °C and 7.5 °C respectively. The average annual rainfall of the city is 140 cm. The rainfall during the southwest monsoon season is about 74% of the annual rainfall. The values of relative humidity are about 55% to 84% in the morning and 39% to 72% in the afternoon during the southwest monsoon season.

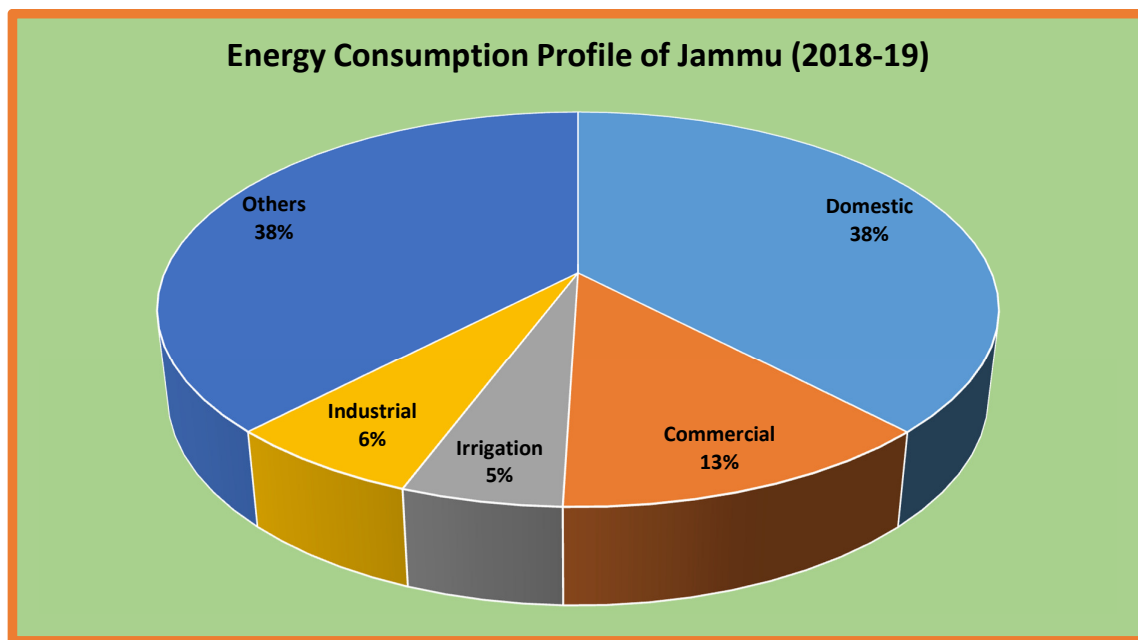
¹⁷ <http://www.imdpune.gov.in/caui/smartcities.html>

Brief description of Power Utilities¹⁸:

The Power Development Department (PDD) of J&K was earlier responsible for generation, transmission & distribution of electricity in the UT of J&K. Subsequently, the Power Development Corporation (JKPDC), a fully owned Government Company, was established in the year 1995, when the operation and maintenance of existing generating stations and setting up of future generating stations were entrusted to this corporation except for one small hydel power station and few very small diesel stations that still remain with PDD, besides the Transmission and Distribution Sector.

Existing Power Scenario:

The total electricity consumption of Jammu in the year 2018-19 was 1648 MU and with 34.51% T&D losses, the requirement was 2516 MU. The peak demand of the city was 505 MW. The Domestic sector was the biggest consumer of electricity (38%).



(Figure 8.2: Energy Consumption Profile of Jammu in 2018-19)

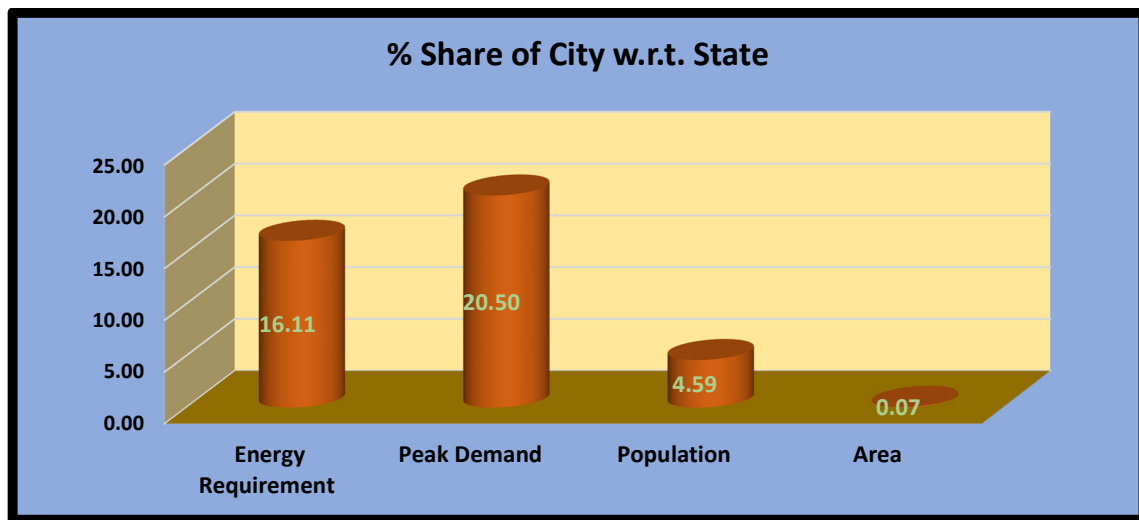
¹⁸ <http://www.jkpdd.gov.in/profile.aspx>

During the last five years (2013-14 to 2018-19), the city has observed CAGR of 1.61% & 3.80% in electricity energy requirement and peak demand respectively.

On comparison of Jammu with J&K for the year 2018-19, it is observed that the energy requirement of Jammu was 16.11% of the total energy requirement of the state whereas its contribution in population and area were only 4.59% and 0.07% respectively.

Sl. No.	Particulars	Jammu	J&K	Jammu as % of J&K
1.	Energy Requirement (in MU)	2516	15616	16.11
2.	Peak Demand (in MW)	505	2464	20.50
3.	Population (2011 Census)	5,76,198	1,25,41,302	4.59
4.	Area (in sq km)	159.36	2,22,236	0.07

(Table 8.1: Comparison of Jammu with J&K in 2018-19)

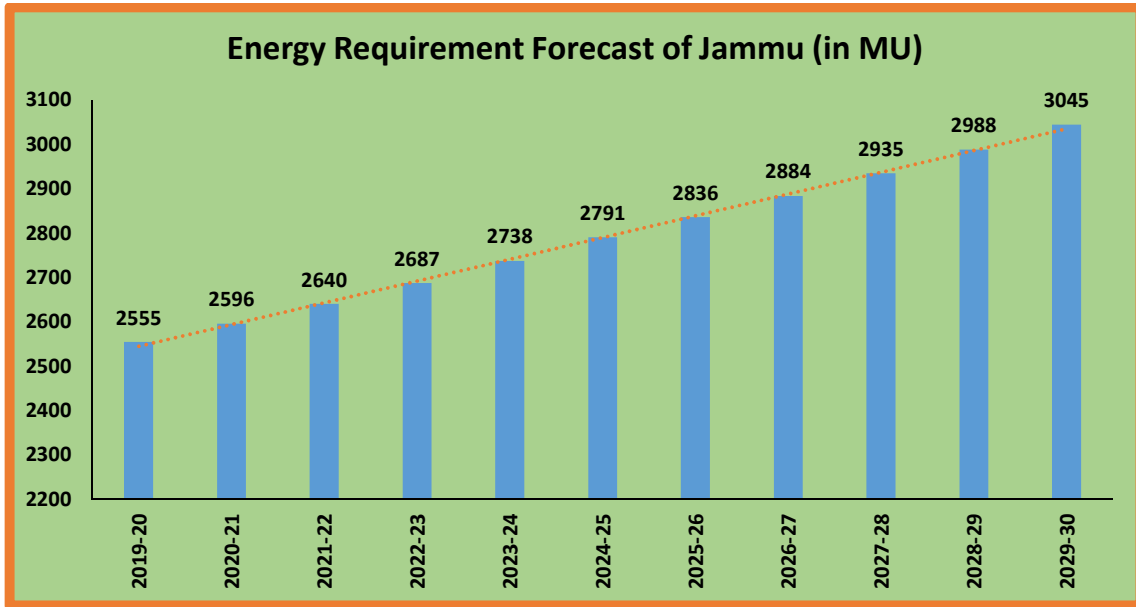


(Figure 8.3: Comparison between Jammu and J&K in 2018-19)

Power Forecast:

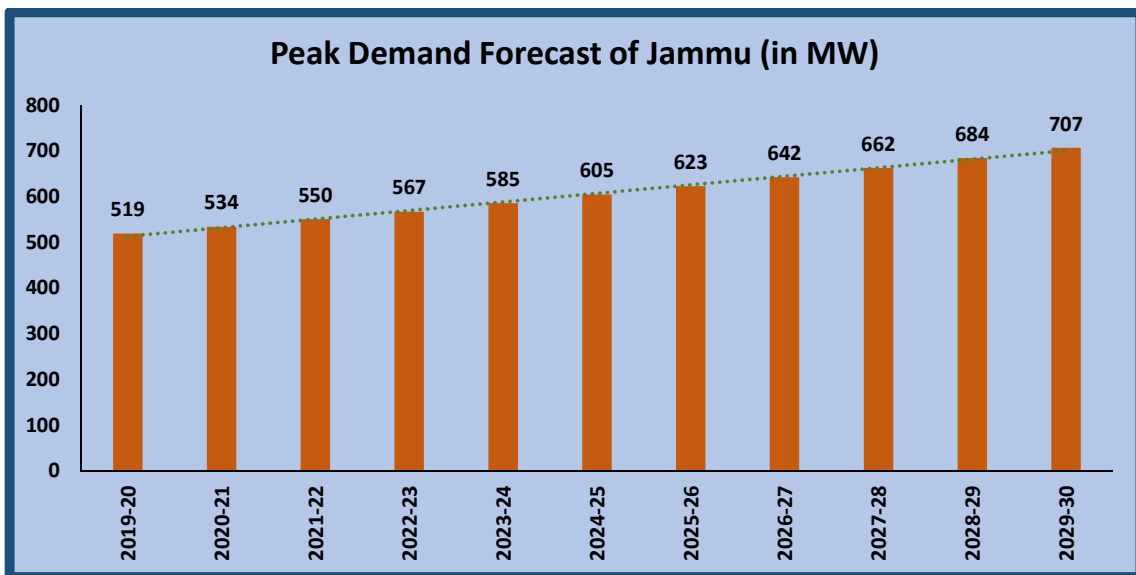
Based on total electricity consumption and T&D Losses, the total energy requirement of Jammu is estimated as 2555 MU in year 2019-20. It is expected that the energy requirement of the city will reach to 2791 MU by the

year 2024-25 with 1.78% CAGR for the period 2019-20 to 2024-25. With a CAGR of 1.76% for the period 2024-25 to 2029-30, its energy requirement is estimated as 3045 MU by the year 2029-30.



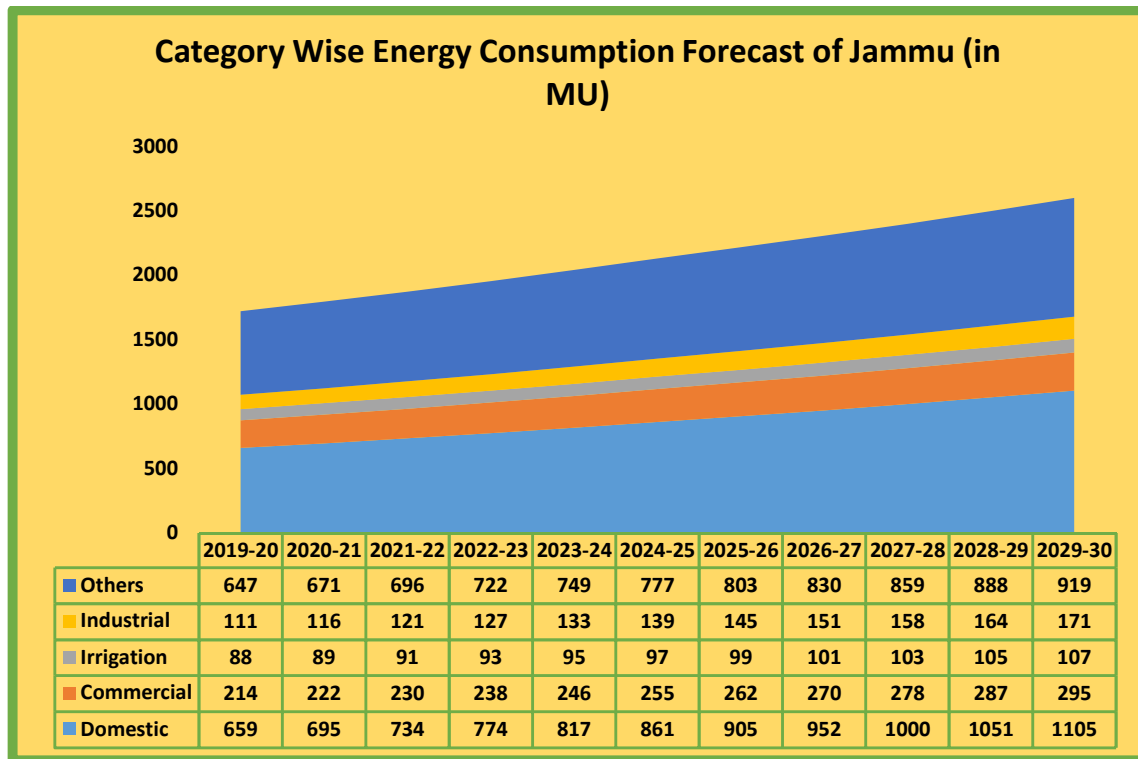
(Figure 8.4: Energy Requirement Forecast of Jammu in MU)

Peak Demand of the Jammu is expected to see 3.10% CAGR upto 2024-25 and will reach 605 MW in comparison to 519 MW in year 2019-20. It is expected to reach 707 MW in year 2029-30 with a CAGR of 3.16% after 2024-25.



(Figure 8.5: Peak Demand Forecast of Jammu in MW)

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



(Figure 8.6: Category Wise Energy Consumption forecast of Jammu)

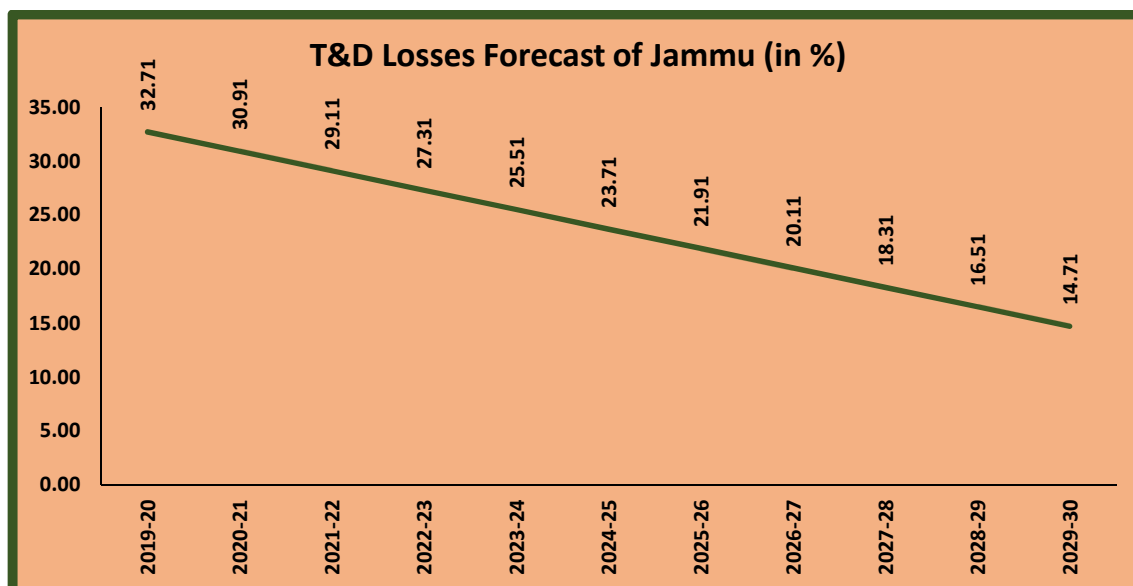
The category wise CAGR expected in energy consumption for the next ten years (2019-20 to 2029-30) along with its break up in five years (2019-20 to 2024-25 & 2025-26 to 2029-30) is tabulated below:

Sl. No.	Category	Energy Consumption (in MU)			CAGR in %		
		2019-20	2024-25	2029-30	2019-20 to 2024-25	2024-25 to 2029-30	2019-20 to 2029-30
1.	Domestic	659	861	1105	5.50	5.10	5.30
2.	Commercial	214	255	295	3.50	3.00	3.25
3.	Irrigation	88	97	107	2.00	2.00	2.00
4.	Industrial	111	139	171	4.68	4.20	4.44
5.	Others	647	777	919	3.73	3.41	3.57
6.	Total	1719	2129	2597	4.37	4.05	4.21

(Table 8.2: Expected CAGR of Jammu - Category Wise Consumption)

Transmission & Distribution Losses:

T&D losses of Jammu were estimated as 34.51% in year 2018-19. The target level is to bring it down to about 23.71% and 14.71% by the end of 2024-25 & 2029-30 respectively.



(Figure 8.7: T&D Loss Forecast of Jammu)

The power forecast of Jammu city is summarized below:

Sl. No.	Particulars	2019-20	2024-25	2029-30	CAGR in %	
					2019-20 to 2024-25	2024-25 to 2029-30
1.	Energy Requirement in MU	2555	2791	3045	1.78	1.76
2.	Peak Demand in MW	519	605	707	3.10	3.16
3.	T&D Losses in %	32.71	23.71	14.71	-	-

(Table 8.3: Power forecast summary of Jammu)

Analysis of Forecast:

A comparison of actual CAGR witnessed for the Jammu city during the last five years and the CAGR for future power forecast is tabulated below:

Sl. No.	City/State/Country	CAGR in %		
		2013-14 to 2018-19	2019-20 to 2024-25	2024-25 to 2029-30
1.	Energy Requirement	1.61	1.78	1.76
2.	Peak Demand	3.80	3.10	3.16

(Table 8.4: Actual CAGR in past vis-a-vis CAGR forecast for future for Jammu)

The above table indicates that the city is expected to see moderate growth in the future as T&D losses are expected to decrease fast as witnessed in the recent past. The peak demand of the city is expected to see higher growth in comparison to energy requirement growth.

Jammu

Electrical Energy Consumption, Energy Requirement and Peak Electricity Demand

(Category Wise and Year Wise Summary)												
Year	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	
Domestic	659	695	734	774	817	861	905	952	1000	1051	1105	
Commercial	214	222	230	238	246	255	262	270	278	287	295	
Public lighting	75	78	81	84	88	91	94	98	101	105	108	
Public Water Works	236	241	245	250	255	260	266	271	276	282	287	
Irrigation	88	89	91	93	95	97	99	101	103	105	107	
LT Industries	42	44	46	49	51	54	57	59	62	65	67	
HT Industries	69	72	75	78	82	85	89	92	96	100	104	
Railway Traction	0	0	0	0	0	0	0	0	0	0	0	
Bulk Supply	84	90	97	104	111	119	126	134	142	150	159	
Others (if any)	252	262	272	283	295	306	317	328	340	352	364	
Total (Energy Consumption)	1719	1794	1872	1953	2039	2129	2215	2304	2398	2495	2597	
T&D losses -MU	836	802	769	734	698	662	621	580	537	493	448	
T&D losses -in %	32.71	30.91	29.11	27.31	25.51	23.71	21.91	20.11	18.31	16.51	14.71	
Energy Requirement - MU	2555	2596	2640	2687	2738	2791	2836	2884	2935	2988	3045	
Annual Load Factor - %	56.18	55.48	54.78	54.08	53.38	52.68	51.98	51.28	50.58	49.88	49.18	
Peak Load - MW	519	534	550	567	585	605	623	642	662	684	707	

Table 8.5: Power Forecast of Jammu

Jodhpur



Jodhpur

Introduction:

¹⁹Jodhpur is the second largest city in Rajasthan, after Jaipur. It is situated in the western part of Rajasthan. The city was the capital of the once great kingdom of Marwar and the Meherangarh fort located here is one of the mightiest castles ever built anywhere. It is popularly known as “Blue City” and “Sun City” and also the cultural capital of Rajasthan state. As of 2011 census, the population of city was 10,33,756. The total municipal area of the city is 75.5 sq. km.



(Figure 9.1: Location of Jodhpur City)

¹⁹ <http://urban.rajasthan.gov.in/content/raj/udh/nagar-nigam-jodhpur/en/city-profile.html>

Economy

The main economy of the city is based on handicrafts industry and tourism. Other items manufactured in the city include textiles, metal utensils, bicycles, ink and sporting goods. A flourishing cottage industry also exists for the manufacture of items such as glass bangles, cutlery, carpets and marble products. Jodhpur is also known for its solid wooden furniture market. The city also serves as an important marketplace for wool and agricultural products.

Climate²⁰

The city climate is warm and semi dry. The summers are very hot and characterised by warm wind called “loo” whereas winters are very cold. The average annual maximum temp. is 33.6 °C with mean maximum temp. of the hottest month (May) and the coldest month (Jan) are about 41.4 °C and 25.0 °C respectively. The average annual minimum temp. is 19.8 °C with mean minimum temp. of the hottest and the coldest months are about 28.2 °C and 9.6 °C respectively. The average annual rainfall of the city is 36 cm. The values of relative humidity are about 52% in the morning and 32% in the afternoon.

Brief description of Power Utilities²¹:

After the enactment of Rajasthan Power Sector Reforms Act, 1999, the state government of Rajasthan established Rajasthan Electricity Regulatory Commission (RERC) in January 2000. Subsequently, the erstwhile Rajasthan State Electricity Board (RSEB) was unbundled into the following five entities on 19th July 2000:

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

²⁰ <http://www.imdpune.gov.in/caui/smartcities.html>

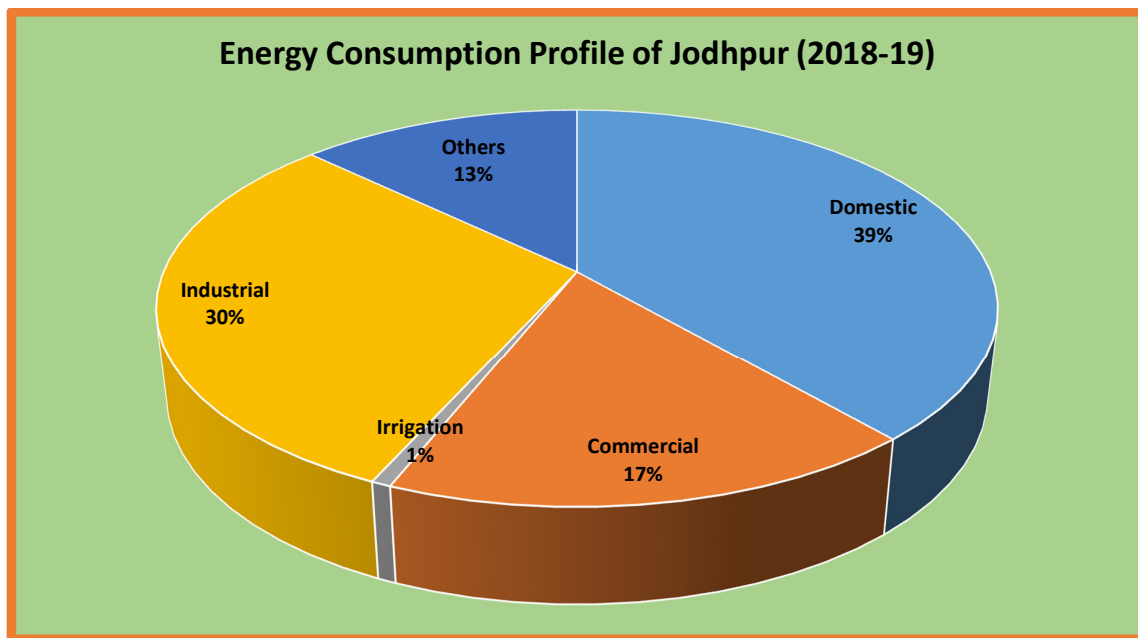
²¹ <https://energy.rajasthan.gov.in/content/raj/energy-department/jodhpur-vidyut-vitran-nigam-limited/en/about-us.html>

- Jodhpur Vidyut Vitran Nigam Limited (JDVVNL)

Jodhpur Vidyut Vitran Nigam Limited (JDVVNL) has the responsibility of power distribution in Jodhpur City.

Existing Power Scenario:

The total electricity consumption of Jodhpur in the year 2018-19 was 1697 MU and with 11.66% T&D losses, the requirement was 1921 MU. The peak demand of the city was 284 MW. The Domestic sector was the biggest consumer of electricity (39%) followed by Industrial (30%) & Commercial (17%).



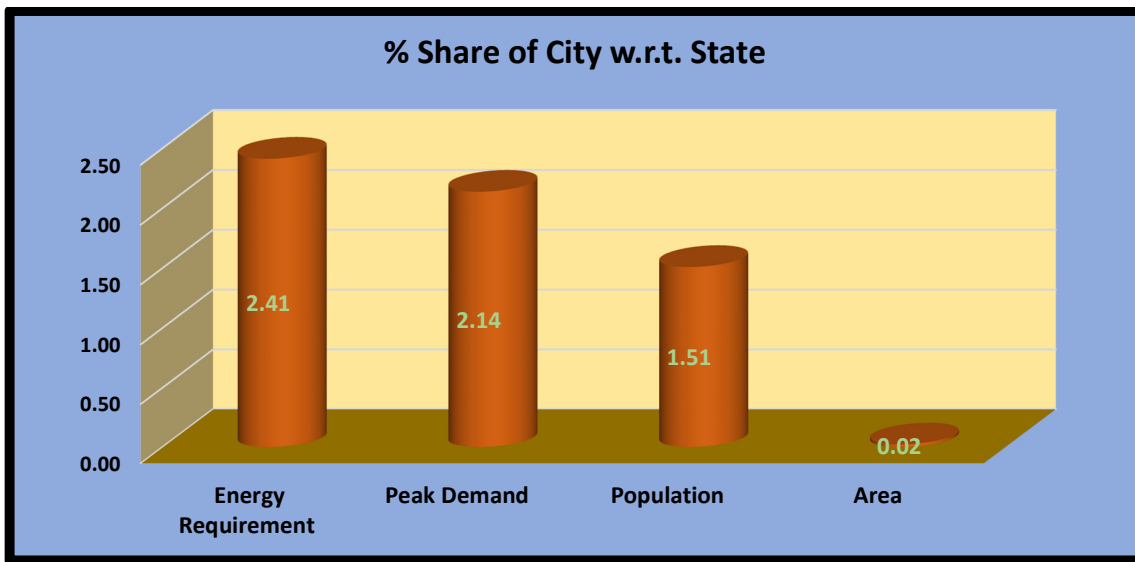
(Figure 9.2: Energy Consumption Profile of Jodhpur in 2018-19)

During the last five years (2013-14 to 2018-19), the city has observed CAGR of 5.54% & 9.87% in electricity energy requirement and peak demand respectively.

On comparison of Jodhpur with Rajasthan for the year 2018-19, it is observed that the energy requirement of Jodhpur was 2.41% of the total energy requirement of the state whereas its contribution in population and area were only 1.51% and 0.02% respectively.

Sl. No.	Particulars	Jodhpur	Rajasthan	Jodhpur as % of Rajasthan
1.	Energy Requirement (in MU)	1921	79626	2.41
2.	Peak Demand (in MW)	284	13276	2.14
3.	Population (2011 Census)	10,33,756	6,85,48,437	1.51
4.	Area (in sq km)	75.5	3,42,239	0.02

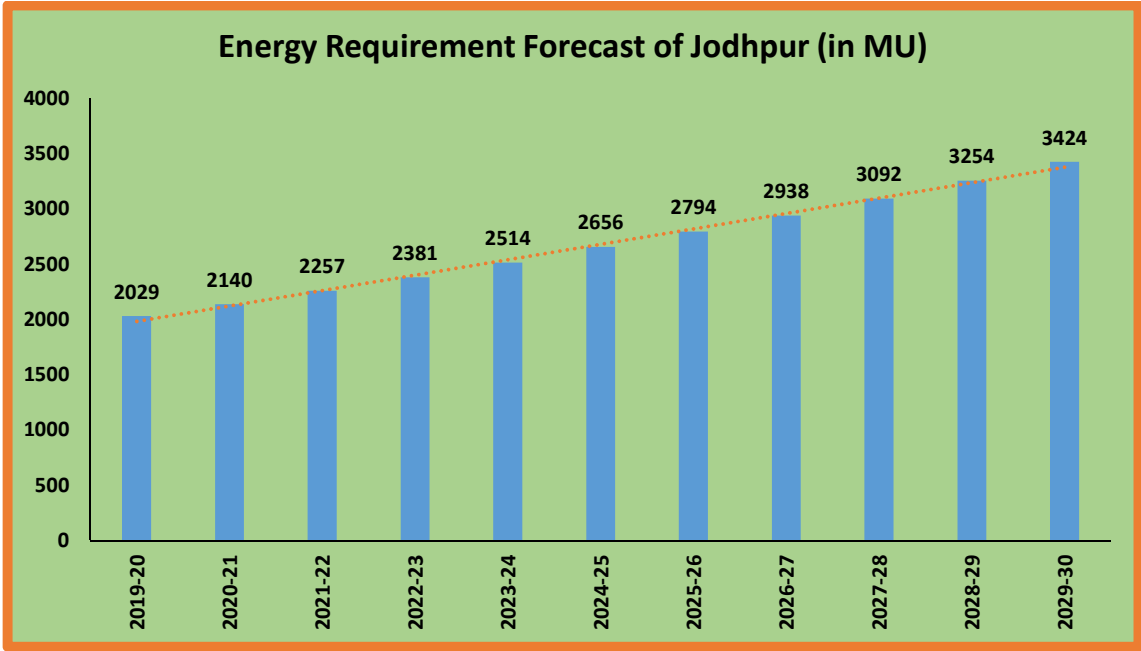
(Table 9.1: Comparison of Jodhpur with Rajasthan in 2018-19)



(Figure 9.3: Comparison between Jodhpur and Rajasthan in 2018-19)

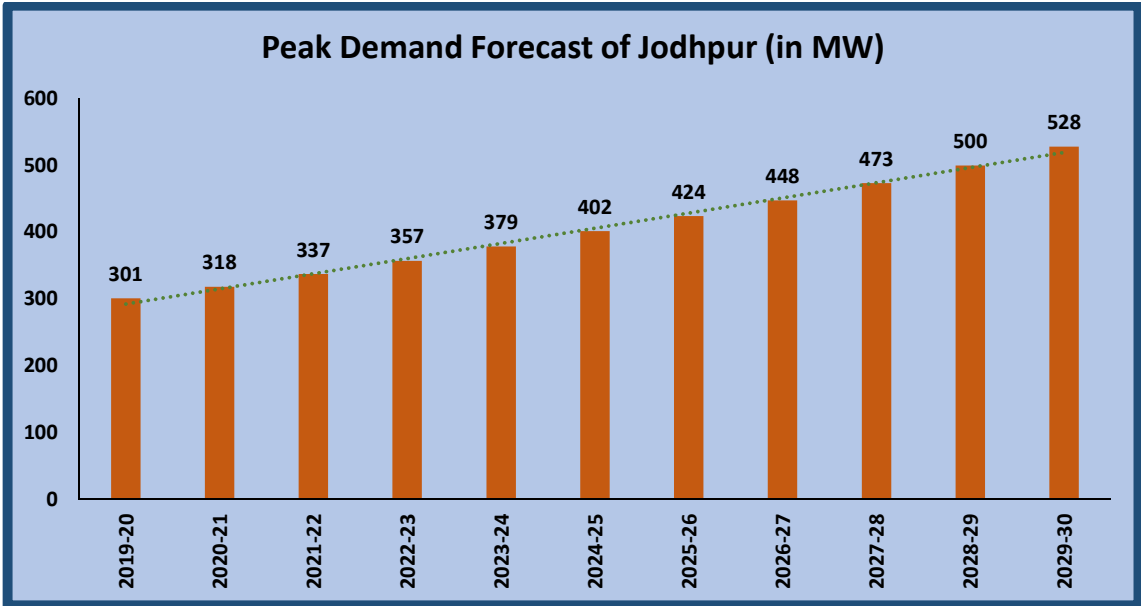
Power Forecast:

Based on total electricity consumption and T&D Losses, the total energy requirement of Jodhpur is estimated as 2029 MU in year 2019-20. It is expected that the energy requirement of the city will reach to 2656 MU by the year 2024-25 with 5.53% CAGR for the period 2019-20 to 2024-25. With CAGR of 5.21% for the period 2024-25 to 2029-30, its energy requirement is estimated as 3424 MU by the year 2029-30.



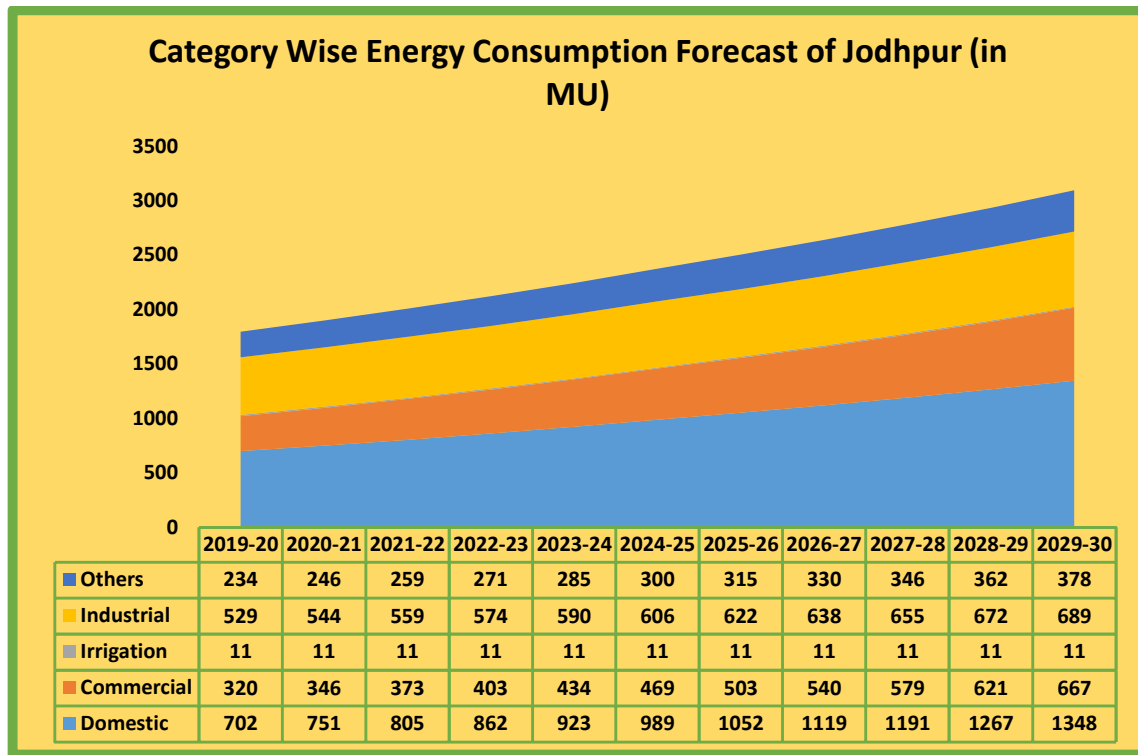
(Figure 9.4: Energy Requirement Forecast of Jodhpur in MU)

Peak Demand of the Jodhpur is expected to see 5.95% CAGR upto 2024-25 and will reach 402 MW in comparison to 301 MW in year 2019-20. It is expected to reach 528 MW in year 2029-30 with a CAGR of 5.64% after 2024-25.



(Figure 9.5: Peak Demand Forecast of Jodhpur in MW)

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



(Figure 9.6: Category Wise Energy Consumption forecast of Jodhpur)

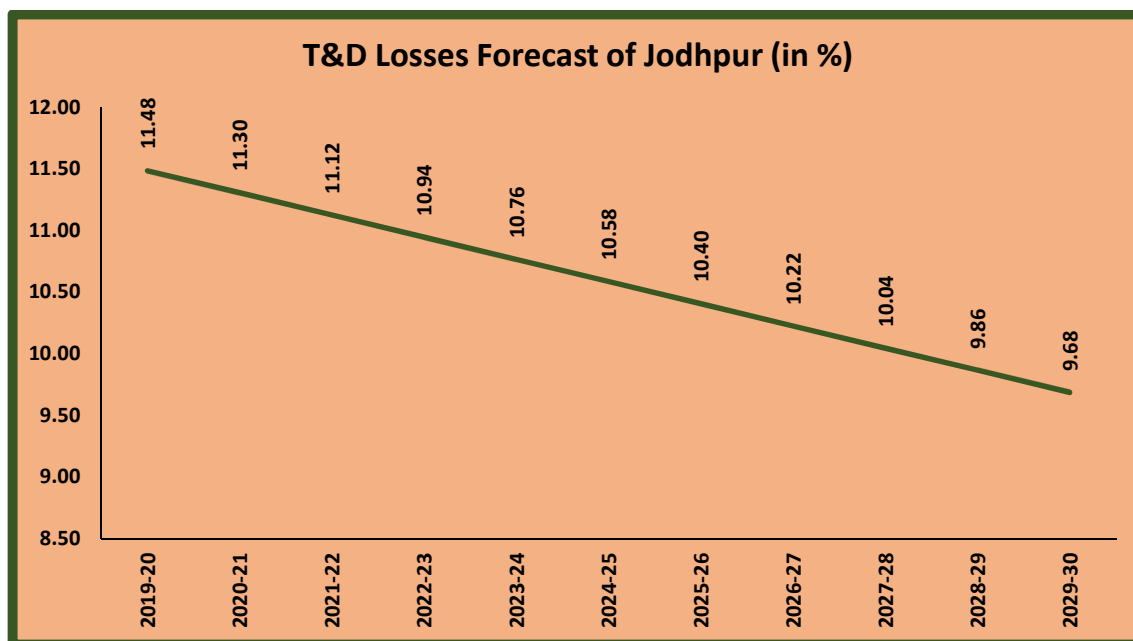
The category wise CAGR expected in energy consumption for the next ten years (2019-20 to 2029-30) along with its break up in five years (2019-20 to 2024-25 & 2025-26 to 2029-30) is tabulated below:

Sl. No.	Category	Energy Consumption (in MU)			CAGR in %		
		2019-20	2024-25	2029-30	2019-20 to 2024-25	2024-25 to 2029-30	2019-20 to 2029-30
1.	Domestic	702	989	1348	7.10	6.40	6.75
2.	Commercial	320	469	667	7.90	7.30	7.60
3.	Irrigation	11	11	11	0.00	0.00	0.00
4.	Industrial	529	606	689	2.76	2.60	2.68
5.	Others	234	300	378	5.11	4.69	4.90
6.	Total	1796	2375	3093	5.74	5.42	5.58

(Table 9.2: Expected CAGR of Jodhpur - Category Wise Consumption)

Transmission & Distribution Losses:

T&D losses of Jodhpur were estimated as 11.66% in year 2018-19. The target level is to bring it down to about 10.58% and 9.68% by the end of 2024-25 & 2029-30 respectively.



(Figure 9.7: T&D Loss Forecast of Jodhpur)

The power forecast of Jodhpur city is summarized below:

Sl. No.	Particulars	2019-20	2024-25	2029-30	CAGR in %	
					2019-20 to 2024-25	2024-25 to 2029-30
1.	Energy Requirement in MU	2029	2656	3424	5.53	5.21
2.	Peak Demand in MW	301	402	528	5.95	5.64
3.	T&D Losses in %	11.48	10.58	9.68	-	-

(Table 9.3: Power forecast summary of Jodhpur)

Analysis of Forecast:

A comparison of actual CAGR witnessed for the Jodhpur city during the last five years and the CAGR for future power forecast is tabulated below:

Sl. No.	City/State/Country	CAGR in %		
		2013-14 to 2018-19	2019-20 to 2024-25	2024-25 to 2029-30
1.	Energy Requirement	5.54	5.53	5.21
2.	Peak Demand	9.87	5.95	5.64

(Table 9.4: Actual CAGR in past vis-a-vis CAGR forecast for future for Jodhpur)

The above table indicates that Jodhpur has witnessed appreciable power demand growth in the recent past. The forecast suggests that the same trend will be continued in the future also although the pace of Peak Demand growth is estimated to be moderate and expected to follow the energy requirement growth trajectory.

Jodhpur

Electrical Energy Consumption, Energy Requirement and Peak Electricity Demand

(Category Wise and Year Wise Summary)

Year	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30
Domestic	702	751	805	862	923	989	1052	1119	1191	1267	1348
Commercial	320	346	373	403	434	469	503	540	579	621	667
Public lighting	62	65	68	71	75	78	81	85	88	92	96
Public Water Works	45	46	48	48	50	52	55	56	59	60	61
Irrigation	11	11	11	11	11	11	11	11	11	11	11
LT Industries	168	171	173	176	179	182	185	188	191	195	198
HT Industries	361	373	385	398	411	424	437	450	463	477	492
Railway Traction	0	0	0	0	0	0	0	0	0	0	0
Bulk Supply	0	0	0	0	0	0	0	0	0	0	0
Others (if any)	127	135	143	152	161	170	179	189	199	210	221
Total (Energy Consumption)	1796	1898	2006	2121	2243	2375	2503	2638	2782	2933	3093
T&D losses -MU	233	242	251	261	271	281	291	300	311	321	332
T&D losses -in %	11.48	11.30	11.12	10.94	10.76	10.58	10.40	10.22	10.04	9.86	9.68
Energy Requirement - MU	2029	2140	2257	2381	2514	2656	2794	2938	3092	3254	3424
Annual Load Factor - %	77.01	76.71	76.41	76.11	75.81	75.51	75.21	74.91	74.61	74.31	74.01
Peak Load - MW	301	318	337	357	379	402	424	448	473	500	528

Table 9.5: Power Forecast of Jodhpur

Kanpur



Kanpur

Introduction:

Kanpur is situated on the southern bank of Ganga River and is the biggest city of Uttar Pradesh and is a main centre of commercial and industrial activities. It is an ancient city between Ganga & Pandu Rivers and is strategically placed at the centre of Uttar Pradesh with good rail and road connectivity. The city has been renowned producer and exporter of leather and textile goods, which started as the inception of industrial revolution in the country.

As of 2011 Census, the total municipal area of the city was 266.74 sq. km. and the corresponding population was 27,65,348. However, the report has covered 301.16 sq. km. of the Kanpur Urban Agglomeration that includes Rawatpur Station Yard, Central Railway Colony, Armapur Estate, Northern Railway Colony, Chakeri also. The corresponding population was 29,20,496 as per Census-2011.

Economy²²

The City formerly known as Manchester of the country is now also called the commercial capital of the state. It is one of the biggest producers of textile and leather products. Apart from leather and textile industry, the fertilizer, chemicals, two wheelers, soaps, pan masala, hosiery and engineering industries are also operating prominently in the city.

²² Official Site of Kanpur Municipal Corporation
(http://kmc.up.nic.in/PDF_Files/Chapter%202-%20City%20Profile.pdf)



(Figure 10.1: Location of Kanpur City)

Climate²³

The climate of the city is characterized by a hot summer and general dryness except during the southwest monsoon. The average annual maximum temp. is 31.9 °C with mean maximum temp. of the hottest month (May) and the coldest month (Jan) are about 39.8 °C and 22.3 °C respectively. The average annual minimum temp. is 18.8 °C with mean minimum temp. of the hottest and the coldest months are about 25.1 °C and 8.2 °C respectively. The average annual rainfall of the city is 79.2 cm. The rainfall during the southwest monsoon season is about 86% of the annual rainfall. The values of relative humidity are about 60% to 85% in the morning and 45% to 77% in the afternoon during the southwest monsoon season.

²³ <http://www.imdpune.gov.in/caui/smartcities.html>

Brief description of Power Utilities:

Uttar Pradesh Electricity Board (UPSEB) which was responsible for generation, transmission and distribution of electricity in Uttar Pradesh, was divided into following companies by the State Government after Uttar Pradesh 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.
- Uttar Pradesh Rajya Jal Vidyut Utpadan Nigam Limited (UPRJVN) is responsible for hydro power generation in state.

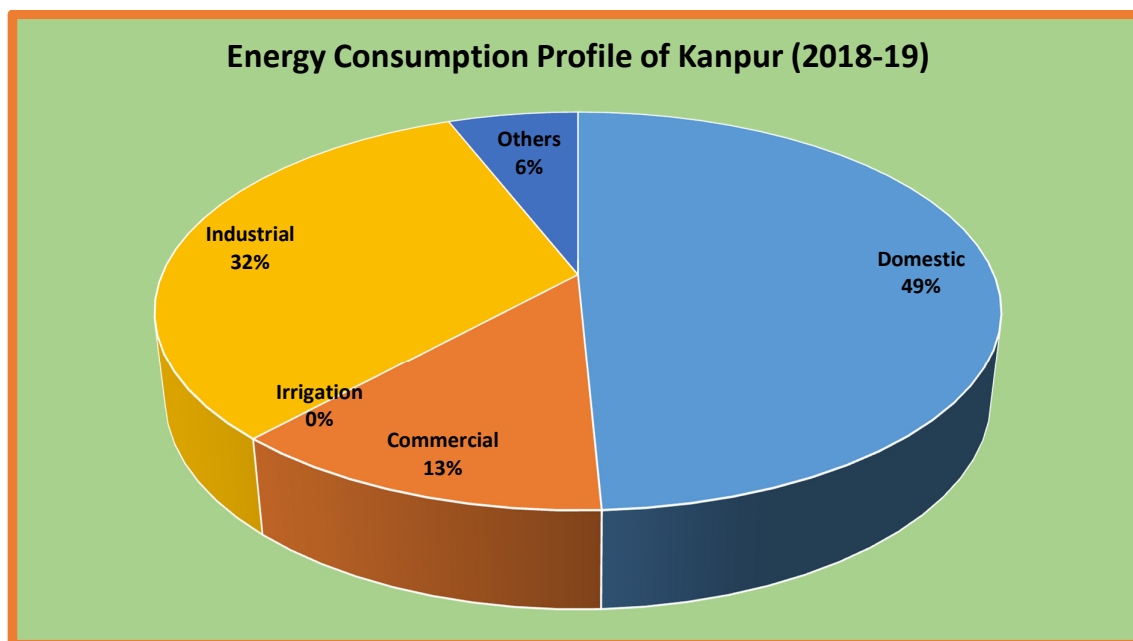
UPPCL has been further divided into following five distribution companies on 12.08.2003:

- 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. Kanpur Electric Supply Company (KESCO) is responsible for distribution of power in Kanpur City.

Existing Power Scenario:

The total electricity consumption of Kanpur in the year 2018-19 was 3023 MU and with 12.61% T&D losses, the requirement was 3459 MU. The peak demand of the city was 696 MW. The Domestic sector was the biggest consumer of electricity (49%) followed by Industrial (32%) & Commercial (13%).



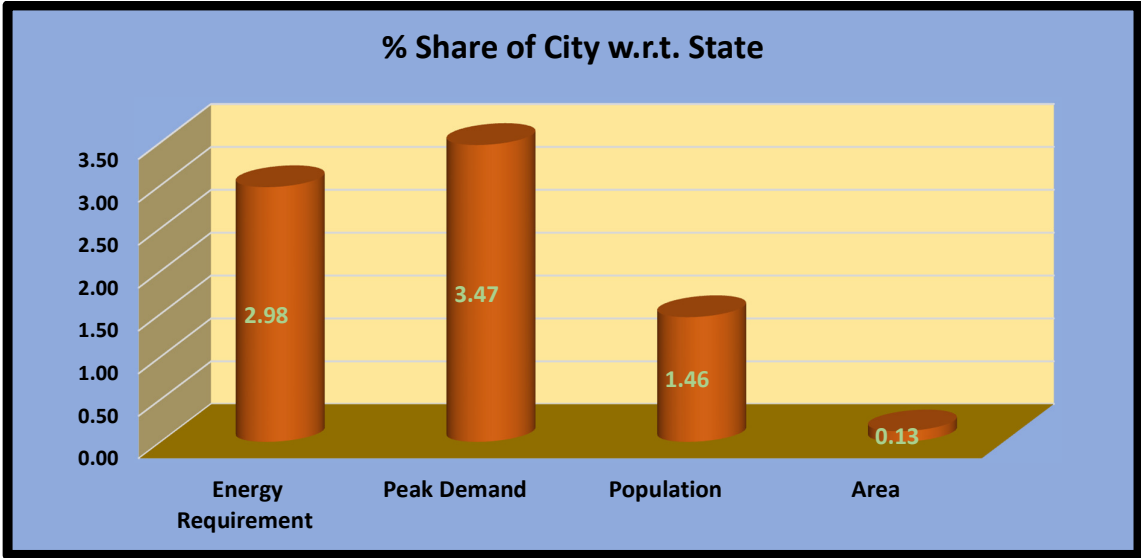
(Figure 10.2: Energy Consumption Profile of Kanpur in 2018-19)

During the last five years (2013-14 to 2018-19), the city has observed CAGR of -0.65% & 1.53% in electricity energy requirement and peak demand respectively.

On comparison of Kanpur with Uttar Pradesh for the year 2018-19, it is observed that the energy requirement of Kanpur was 2.98% of the total energy requirement of the state whereas its contribution in population and area were only 1.46% and 0.13% respectively.

Sl. No.	Particulars	Kanpur	Uttar Pradesh	Kanpur as % of Uttar Pradesh
1.	Energy Requirement (in MU)	3459	116149	2.98
2.	Peak Demand (in MW)	696	20062	3.47
3.	Population (2011 Census)	29,20,496	19,98,12,341	1.46
4.	Area (in sq km)	301.16	2,40,928	0.13

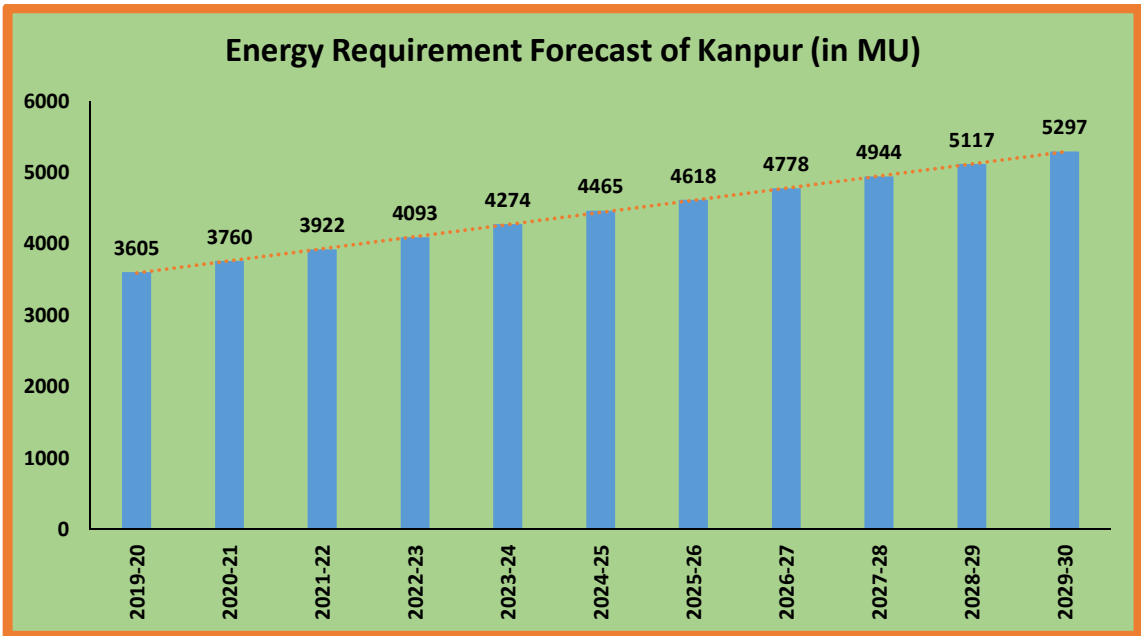
(Table 10.1: Comparison of Kanpur with Uttar Pradesh in 2018-19)



(Figure 10.3: Comparison between Kanpur and Uttar Pradesh in 2018-19)

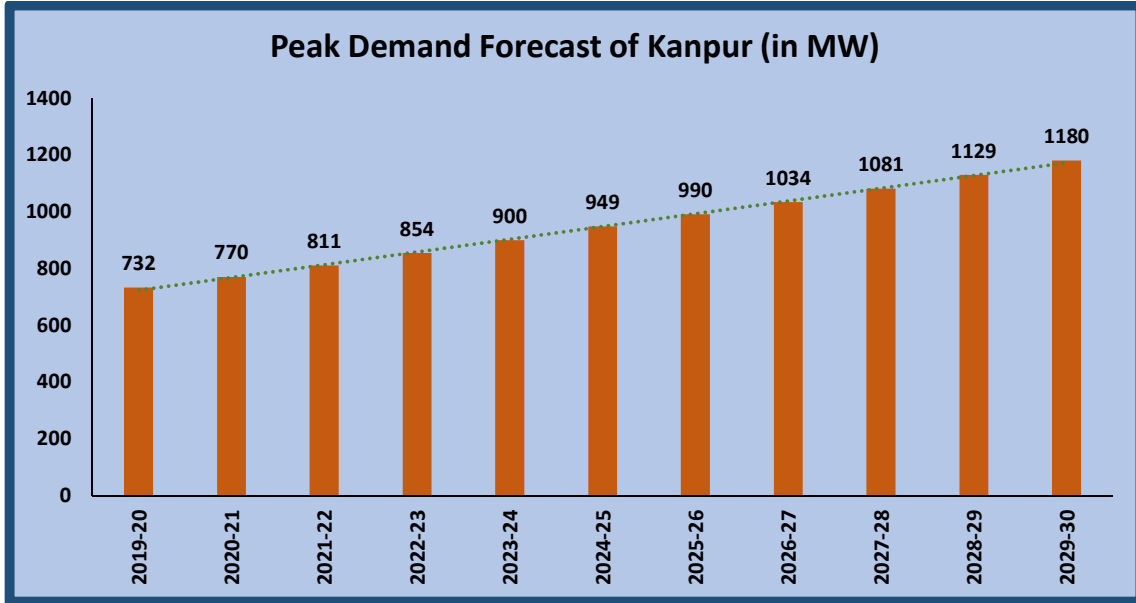
Power Forecast:

Based on total electricity consumption and T&D Losses, the total energy requirement of Kanpur is estimated as 3605 MU in year 2019-20. It is expected that the energy requirement of the city will reach to 4465 MU by the year 2024-25 with 4.37% CAGR for the period 2019-20 to 2024-25. With CAGR of 3.48% for the period 2024-25 to 2029-30, its energy requirement is estimated as 5297 MU by the year 2029-30.



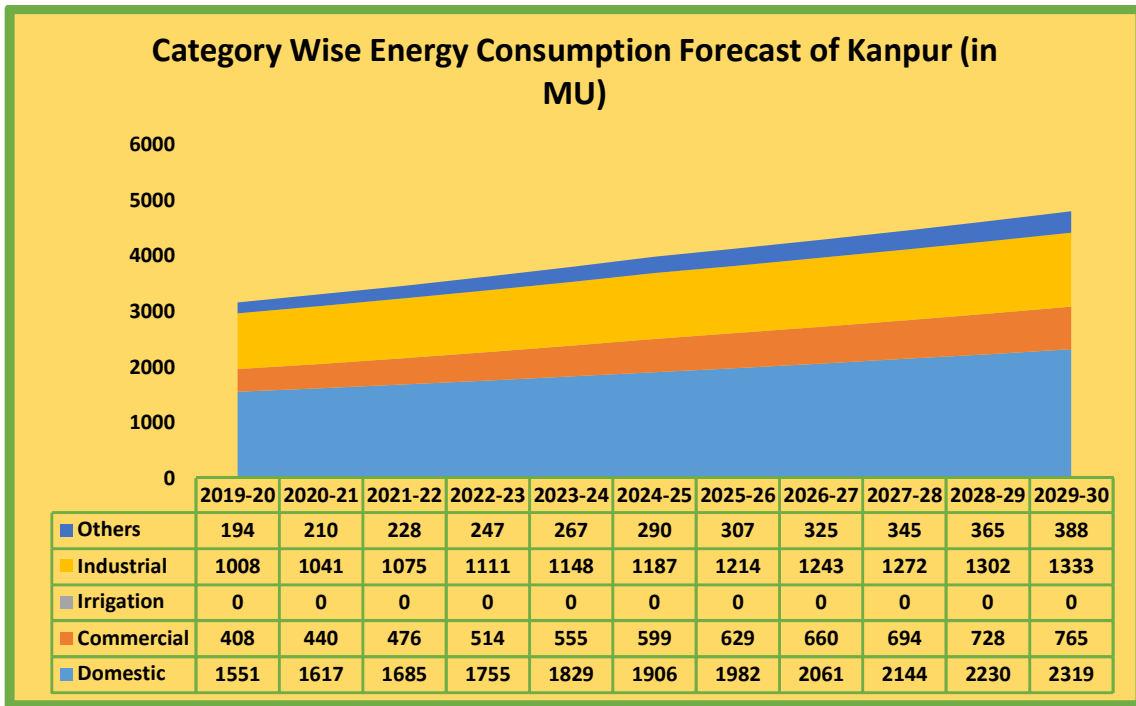
(Figure 10.4: Energy Requirement Forecast of Kanpur in MU)

Peak Demand of the Kanpur is expected to see 5.32% CAGR upto 2024-25 and will reach 949 MW in comparison to 732 MW in year 2019-20. It is expected to reach 1180 MW in year 2029-30 with a CAGR of 4.47% after 2024-25.



(Figure 10.5: Peak Demand Forecast of Kanpur in MW)

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



(Figure 10.6: Category Wise Energy Consumption forecast of Kanpur)

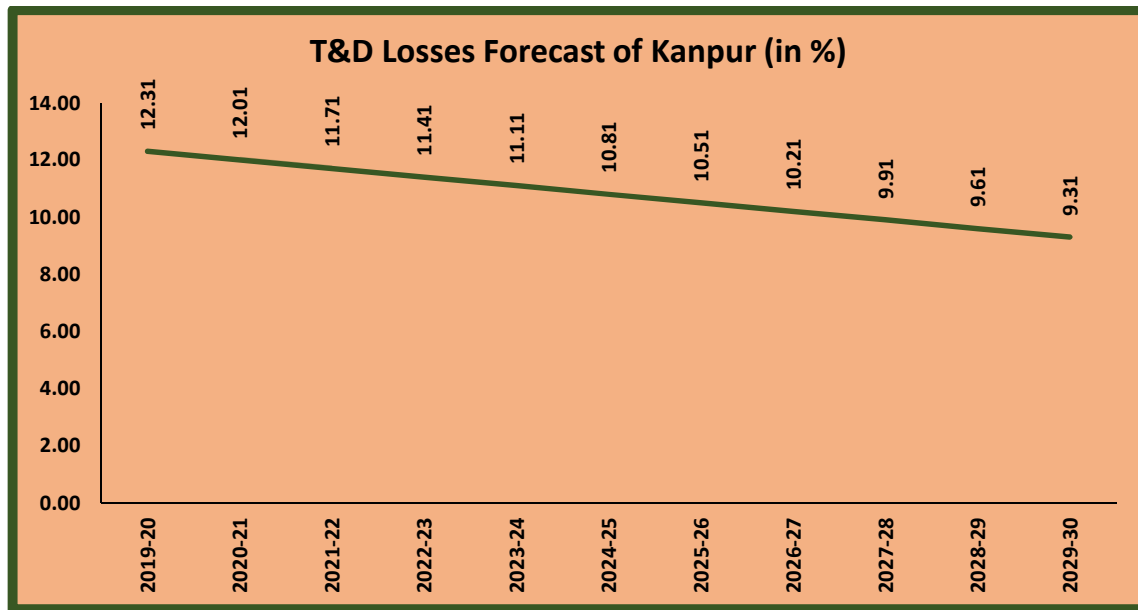
The category wise CAGR expected in energy consumption for the next ten years (2019-20 to 2029-30) along with its break up in five years (2019-20 to 2024-25 & 2025-26 to 2029-30) is tabulated below:

Sl. No.	Category	Energy Consumption (in MU)			CAGR in %		
		2019-20	2024-25	2029-30	2019-20 to 2024-25	2024-25 to 2029-30	2019-20 to 2029-30
1.	Domestic	1551	1906	2319	4.20	4.00	4.10
2.	Commercial	408	599	765	8.00	5.00	6.49
3.	Irrigation	0	0	0	-	-	-
4.	Industrial	1008	1187	1333	3.32	2.35	2.83
5.	Others	194	290	388	8.38	5.96	7.16
6.	Total	3162	3982	4804	4.72	3.82	4.27

(Table 10.2: Expected CAGR of Kanpur - Category Wise Consumption)

Transmission & Distribution Losses:

T&D losses of Kanpur were estimated as 12.61% in year 2018-19. The target level is to bring it down to about 10.81% and 9.31% by the end of 2024-25 & 2029-30 respectively.



(Figure 10.7: T&D Loss Forecast of Kanpur)

The power forecast of Kanpur city is summarized below:

Sl. No.	Particulars	2019-20	2024-25	2029-30	CAGR in %	
					2019-20 to 2024-25	2024-25 to 2029-30
1.	Energy Requirement in MU	3605	4465	5297	4.37	3.48
2.	Peak Demand in MW	732	949	1180	5.32	4.47
3.	T&D Losses in %	12.31	10.81	9.31	-	-

(Table 10.3: Power forecast summary of Kanpur)

Analysis of Forecast:

A comparison of actual CAGR witnessed for the Kanpur city during the last five years and the CAGR for future power forecast is tabulated below:

Sl. No.	City/State/Country	CAGR in %		
		2013-14 to 2018-19	2019-20 to 2024-25	2024-25 to 2029-30
1.	Energy Requirement	-0.65	4.37	3.48
2.	Peak Demand	1.53	5.32	4.47

(Table 10.4: Actual CAGR in past vis-a-vis CAGR forecast for future for Kanpur)

Although the energy requirement CAGR of the Kanpur city for the last five years (2013-14 to 2018-19) was showing negative growth and the peak demand growth was also moderate, it was mainly because energy consumption in the year 2013-14 was unusually high and energy consumption in the year 2018-19 was unusually low. Therefore, the trends for future growth have been calculated after ignoring the data for these two years.

Sl. No.	Category	Energy Consumption in MU		CAGR in %	Energy Consumption in MU		CAGR in %
		2013-14	2018-19		2012-13	2017-18	
		1.	Domestic		1274	1489	
2.	Commercial	302	378	4.56	295	426	7.65
3.	Irrigation	0	0	-	0	0	-
4.	Industries	1015	977	-0.77	711	1021	7.49
5.	Others	164	179	1.83	161	182	2.46
6.	Total	2755	3023	1.87	2363	3171	6.06

(Table 10.5: CAGR of Kanpur during 2013-14 to 2018-19 & during 2012-13 to 2017-18)

Also, there is a huge reduction in T& D losses in the recent past and it has come down to 12.61% in the year 2018-19 that was hovering around 25% five years before. As the energy consumption is increasing and the T&D losses may not sharply reduce further in future, the energy requirement is expected to grow at a faster rate comparatively.

Kanpur

Electrical Energy Consumption, Energy Requirement and Peak Electricity Demand

(Category Wise and Year Wise Summary)													
Year	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30		
Domestic	1551	1617	1685	1755	1829	1906	1982	2061	2144	2230	2319		
Commercial	408	440	476	514	555	599	629	660	694	728	765		
Public lighting	44	48	51	55	59	63	67	71	74	79	83		
Public Water Works	104	114	125	137	150	165	176	188	201	215	230		
Irrigation	0	0	0	0	0	0	0	0	0	0	0		
LT Industries	316	334	354	374	396	419	435	453	471	490	509		
HT Industries	693	707	722	737	753	768	779	790	801	812	824		
Railway Traction	0	0	0	0	0	0	0	0	0	0	0		
Bulk Supply	0	0	0	0	0	0	0	0	0	0	0		
Others (if any)	46	49	52	55	58	61	64	66	69	72	75		
Total (Energy Consumption)	3162	3308	3463	3627	3799	3982	4133	4290	4454	4625	4804		
T&D losses-MU	444	451	459	467	475	483	485	488	490	492	493		
T&D losses-in %	12.31	12.01	11.71	11.41	11.11	10.81	10.51	10.21	9.91	9.61	9.31		
Energy Requirement - MU	3605	3760	3922	4093	4274	4465	4618	4778	4944	5117	5297		
Annual Load Factor - %	56.23	55.73	55.23	54.73	54.23	53.73	53.23	52.73	52.23	51.73	51.23		
Peak Load - MW	732	770	811	854	900	949	990	1034	1081	1129	1180		

Table 10.6: Power Forecast of Kanpur

Kolkata



Kolkata

Introduction:

Kolkata, earlier known as Calcutta, is the capital of the state of West Bengal and is the principal commercial, cultural and educational centre of East India. It is one of India's oldest urban areas. In 1773, Kolkata became the Capital of India, but later the Capital was shifted to Delhi in 1912²⁴. Historically, the city was the trading and commercial capital of India and is located on the eastern bank of the river Hoogly, a distributary of the River Ganges.

As of 2011 census, the total area served by the Kolkata Municipal Corporation city was 185 square km and the corresponding population was 44,96,694. However, this report has considered the entire Kolkata Metropolitan Area of 1886.67 sq. km. that is served by four municipal corporations (Bidhannagar Chandan Nagar, Howrah & Kolkata), 37 Municipalities and 24 Panchayat Samitis. ²⁵ It holds a population of 1,41,12,536²⁶ as per Census-2011.

Economy

Kolkata's economy is mainly based on its manufacturing industries, its financial and trade activities and its role as a major port. It is also a major centre for printing, publishing, and newspaper circulation, as well as for recreation and entertainment. Kolkata has a diversified industrial base with major industrial sectors including steel, mining, minerals, heavy engineering, pharmaceuticals, cement, textiles, food processing and jute. IT industries are also growing very fast. It is also a major tourist place.

²⁴ Brief Industrial Profile of Kolkata , Ministry of MSME (<http://dcmsme.gov.in/dips/KOLKATA.pdf>)

²⁵ https://www.kmdaonline.org/home/about_us , <https://link.springer.com/content/pdf/bbm%3A978-94-007-4698-5%2F1.pdf> & <http://www.bmcwb.gov.in/>

²⁶ http://censusindia.gov.in/2011-prov-results/paper2/data_files/india2/Million_Plus_UAs_Cities_2011.pdf



(Figure 11.1: Location of Kolkata City)

Climate²⁷

Kolkata has a tropical wet and dry climate. The average annual maximum temp. is 31.6 °C with mean maximum temp. of the hottest month (May) and the coldest month (Dec) are about 35.3 °C and 27.0 °C respectively. The average annual minimum temp. is 22.6 °C with mean minimum temp. of the hottest and the coldest months are about 26.4 °C and 15.2 °C respectively. The average annual rainfall of the city is 177.8 cm. The rainfall during the southwest monsoon season is about 74% of the annual rainfall. The values of relative humidity are about 80% to 84% in the morning and 77% to 83% in the afternoon during the southwest monsoon season.

²⁷ <http://www.imdpune.gov.in/caui/smartcities.html>

Brief description of Power Utilities²⁸

Power sector in West Bengal is characterized by restructured State Electricity Board, presence of multiple distribution utilities, including privately owned and those owned by State and Central Governments. The process of reforms in power sector in West Bengal began in 2005, with restructuring of erstwhile West Bengal State Electricity Board (WBSEB) into the following Transmission and Distribution utilities in 2007:

- West Bengal State Electricity Distribution Company Ltd. (WBSEDCL) – Distribution Company
- West Bengal State Electricity Transmission Company Ltd. (WBSETCL) - Transmission Company

The generation function of erstwhile state utility has been organized under a separate entity, West Bengal Power Development Corporation Ltd. (WBPDC). Established in 1985, WBPDC is responsible for thermal power generation in the State, while hydro generation was being undertaken by the then WBSEB till the time of unbundling and currently transferred of hydro assets to WBSEDCL.

Four distribution utilities are operating in the State, with two being private licensees, one owned by State Government and one owned by Central Govt., as detailed below:

- WBSEDCL - West Bengal State Electricity Distribution Company Limited is a State Govt. owned utility responsible for electricity distribution in the State.²⁹
- Calcutta Electric Supply Corporation (CESC) – CESC Limited is a fully integrated private utility, owning and operating distribution system in Kolkata as well as parts of Howrah, Hooghly, 24 Parganas (North) and 24 Parganas (South) districts.³⁰

²⁸ https://powermin.nic.in/sites/default/files/uploads/joint_initiative_of_govt_of_india_and_West_Bengol.pdf

²⁹ As per Govt. of West Bengal Notification No 328/PO/C-IV/IE-60/13(Pt-VA) Dt 26.12.18, The Electricity Distribution Business of DPL has been taken over by WBSEDCL. (<http://thedpl.in/industry/>)

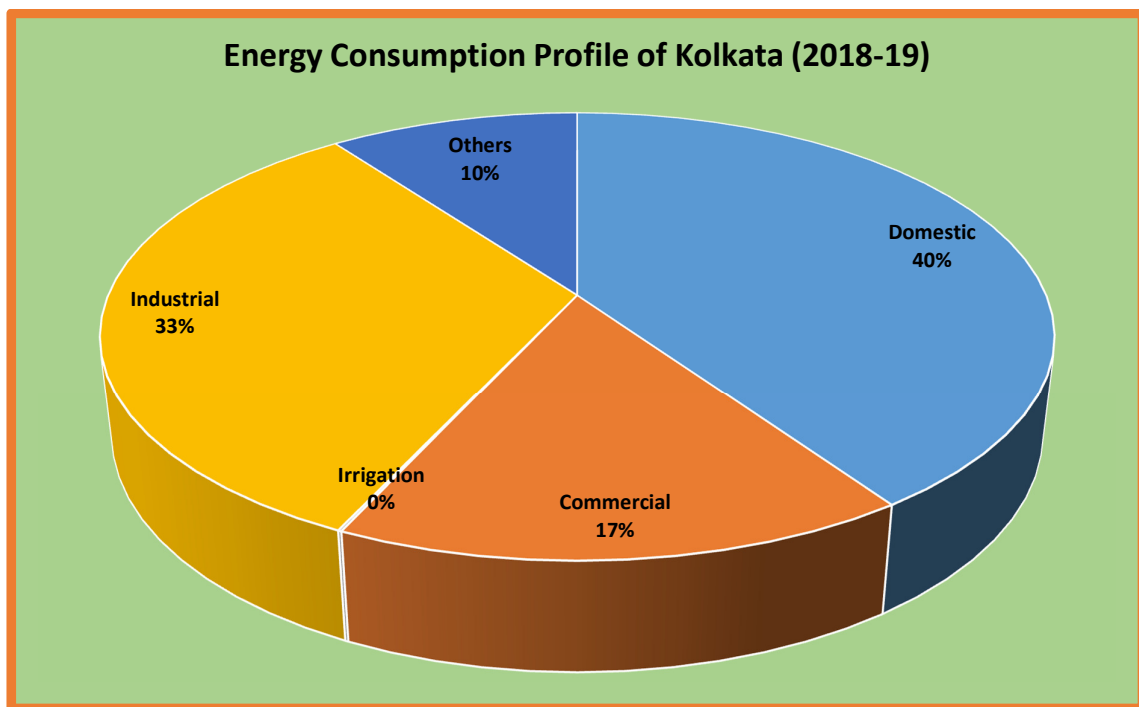
³⁰ Input Received from CESC

- India Power Co. Ltd. (IPCL) (Formerly DPSC) – IPCL is a privately owned utility which owns and operates distribution system in coal rich Asansol and Raniganj area.
- Damodar Valley Corporation (DVC) – DVC is a Central Govt. owned utility, supplying power at 33kV level and above in the DVC command area spanning across West Bengal and Jharkhand.

WBSEDCL & CESC have the responsibility of power distribution in Kolkata city.

Existing Power Scenario:

The total electricity consumption of Kolkata in the year 2018-19 was 16910 MU and with 9.89% T&D losses, the requirement was 18765 MU. The peak demand of the city was 3141 MW. The Domestic sector was the biggest consumer of electricity (40%) followed by Industrial (33%) & Commercial (17%).



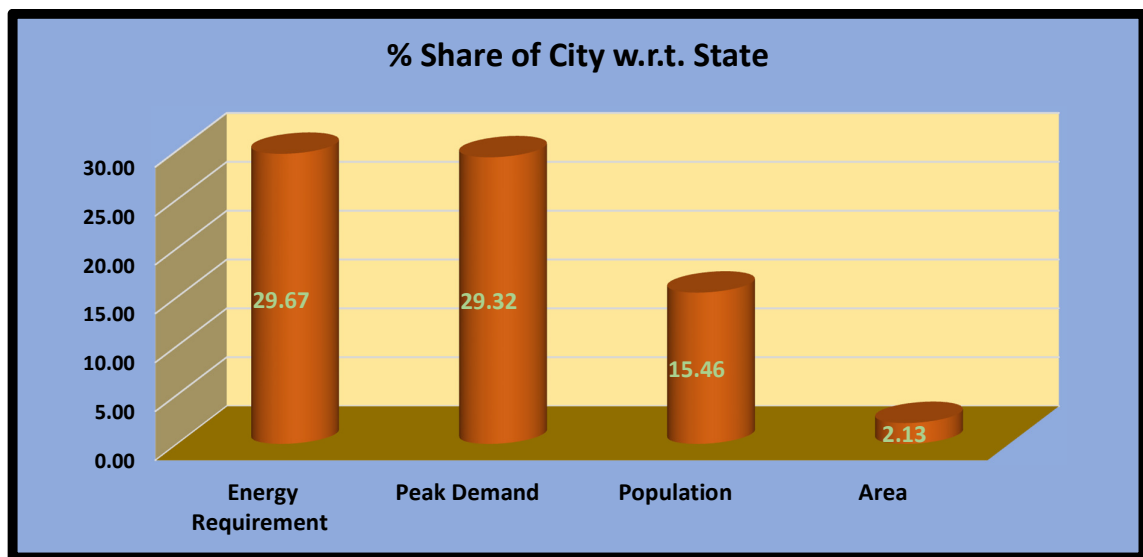
(Figure 11.2: Energy Consumption Profile of Kolkata in 2018-19)

During the last five years (2013-14 to 2018-19), the city has observed CAGR of 3.43% & 3.61% in electricity energy requirement and peak demand respectively.

On comparison of Kolkata with West Bengal for the year 2018-19, it is observed that the energy requirement of Kolkata was 29.67% of the total energy requirement of the state whereas its contribution in population and area were only 15.46% and 2.13% respectively.

Sl. No.	Particulars	Kolkata	West Bengal	Kolkata as % of West Bengal
1.	Energy Requirement (in MU)	18765	63,247	29.67
2.	Peak Demand (in MW)	3141	10,714	29.32
3.	Population (2011 Census)	1,41,12,536	9,12,76,115	15.46
4.	Area (in sq km)	1886.67	88,752	2.13

(Table 11.1: Comparison of Kolkata with West Bengal in 2018-19)

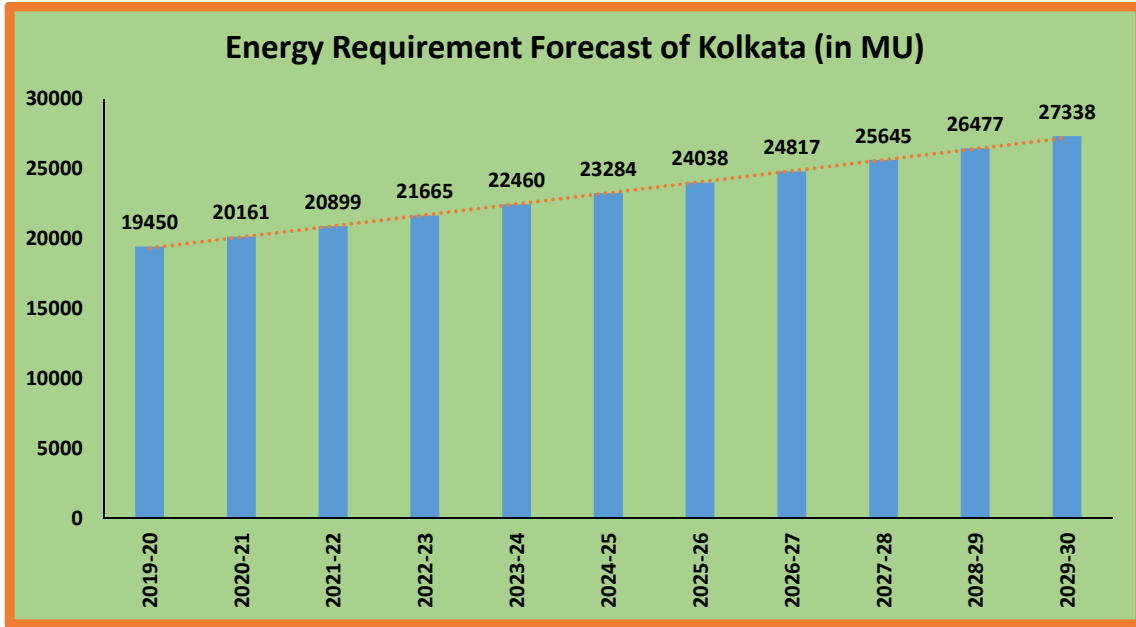


(Figure 11.3: Comparison between Kolkata and West Bengal in 2018-19)

Power Forecast:

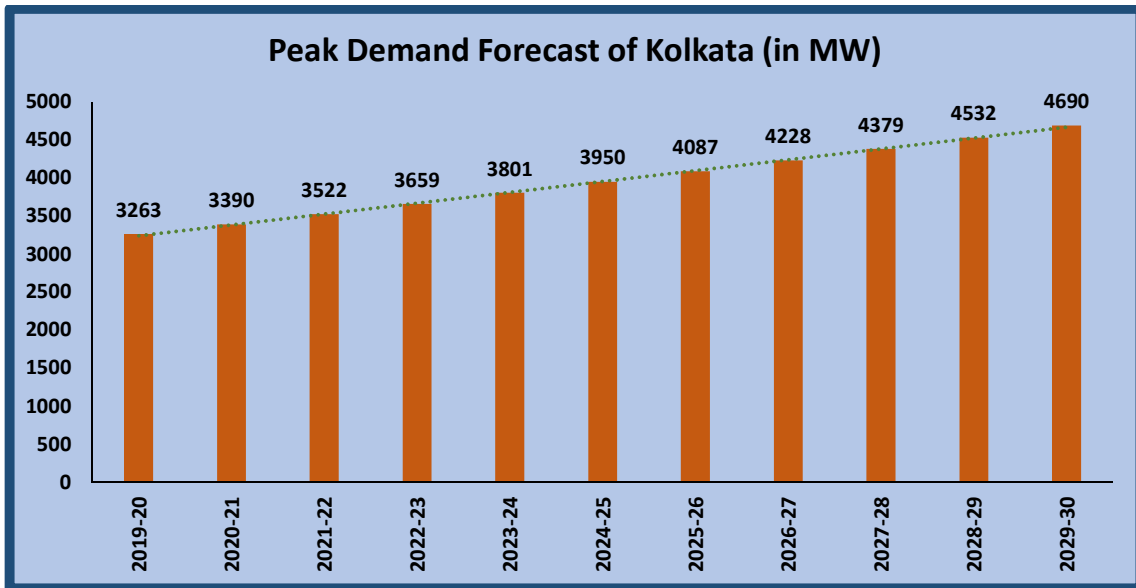
Based on total electricity consumption and T&D Losses, the total energy requirement of Kolkata is estimated as 19450 MU in year 2019-20. It is expected that the energy requirement of the city will reach to 23284 MU by the year 2024-25 with 3.66% CAGR for the period 2019-20 to 2024-25. With

CAGR of 3.26% for the period 2024-25 to 2029-30, its energy requirement is estimated as 27338 MU by the year 2029-30.



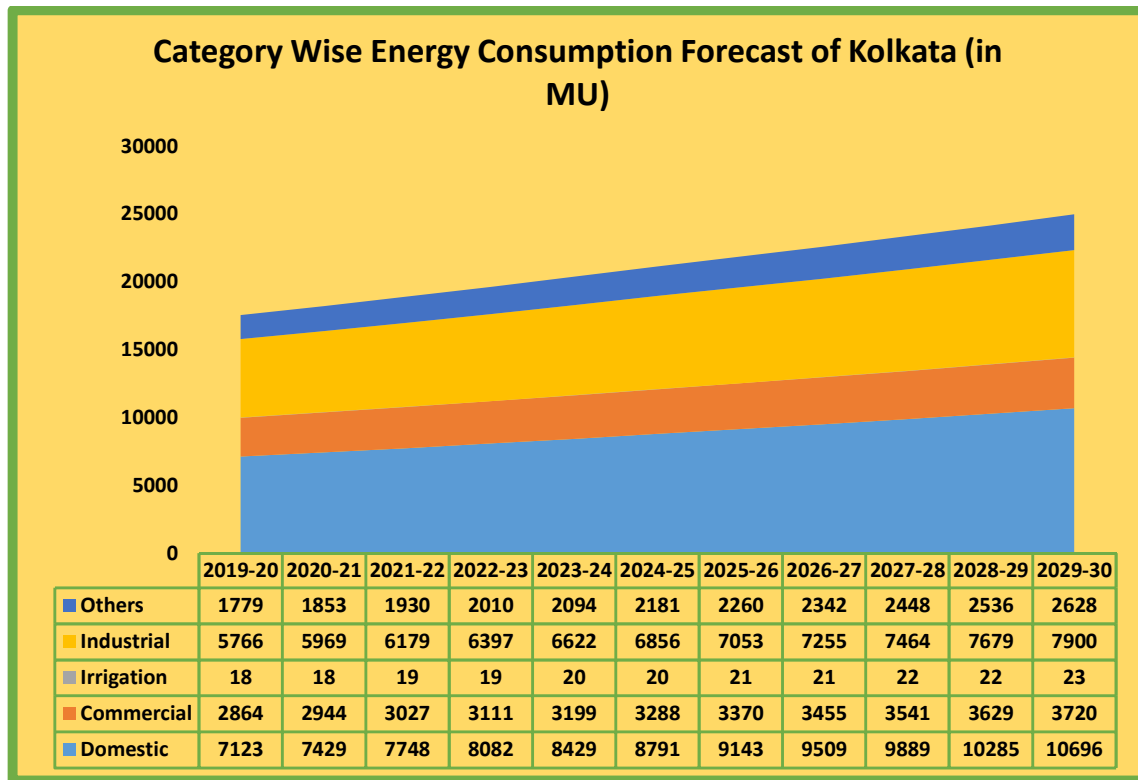
(Figure 11.4: Energy Requirement Forecast of Kolkata in MU)

Peak Demand of the Kolkata is expected to see 3.89% CAGR upto 2024-25 and will reach 3950 MW in comparison to 3263 MW in year 2019-20. It is expected to reach 4690 MW in year 2029-30 with a CAGR of 3.49% after 2024-25.



(Figure 11.5: Peak Demand Forecast of Kolkata in MW)

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



(Figure 11.6: Category Wise Energy Consumption forecast of Kolkata)

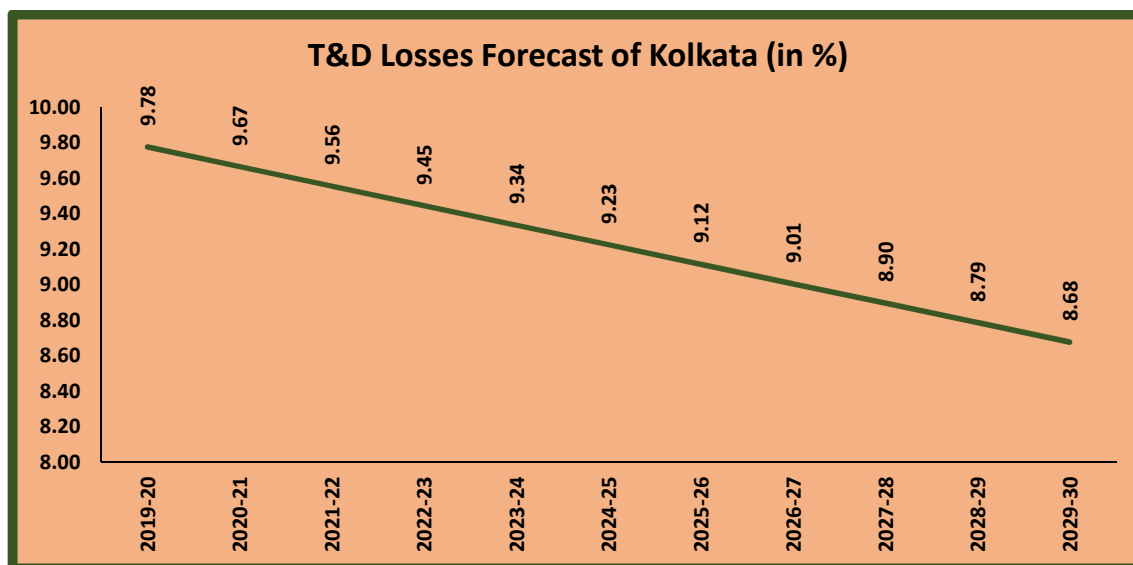
The category wise CAGR expected in energy consumption for the next ten years (2019-20 to 2029-30) along with its break up in five years (2019-20 to 2024-25 & 2025-26 to 2029-30) is tabulated below:

Sl. No.	Category	Energy Consumption (in MU)			CAGR in %		
		2019-20	2024-25	2029-30	2019-20 to 2024-25	2024-25 to 2029-30	2019-20 to 2029-30
1.	Domestic	7123	8791	10696	4.30	4.00	4.15
2.	Commercial	2864	3288	3720	2.80	2.50	2.65
3.	Irrigation	18	20	23	3.00	2.50	2.75
4.	Industrial	5766	6856	7900	3.52	2.88	3.20
5.	Others	1779	2181	2628	4.16	3.80	3.98
6.	Total	17549	21136	24967	3.79	3.39	3.59

(Table 11.2: Expected CAGR of Kolkata - Category Wise Consumption)

Transmission & Distribution Losses:

T&D losses of Kolkata were estimated as 9.89% in year 2018-19. The target level is to bring it down to about 9.23% and 8.68% by the end of 2024-25 & 2029-30 respectively.



(Figure 11.7: T&D Loss Forecast of Kolkata)

The power forecast of Kolkata city is summarized below:

Sl. No.	Particulars	2019-20	2024-25	2029-30	CAGR in %	
					2019-20 to 2024-25	2024-25 to 2029-30
1.	Energy Requirement in MU	19450	23284	27338	3.66	3.26
2.	Peak Demand in MW	3263	3950	4690	3.89	3.49
3.	T&D Losses in %	9.78	9.23	8.68	-	-

(Table 11.3: Power forecast summary of Kolkata)

Analysis of Forecast:

A comparison of actual CAGR witnessed for the Kolkata city during the last five years and the CAGR for future power forecast is tabulated below:

Sl. No.	City/State/Country	CAGR in %		
		2013-14 to 2018-19	2019-20 to 2024-25	2024-25 to 2029-30
1.	Energy Requirement	3.43	3.66	3.26
2.	Peak Demand	3.61	3.89	3.49

(Table 11.4: Actual CAGR in past vis-a-vis CAGR forecast for future for Kolkata)

The above table indicates that Kolkata is expected to witness moderate growth in the future for energy requirement & peak demand as witnessed in the recent past. The peak demand growth of the city is expected to follow the energy requirement growth trajectory.

Kolkata

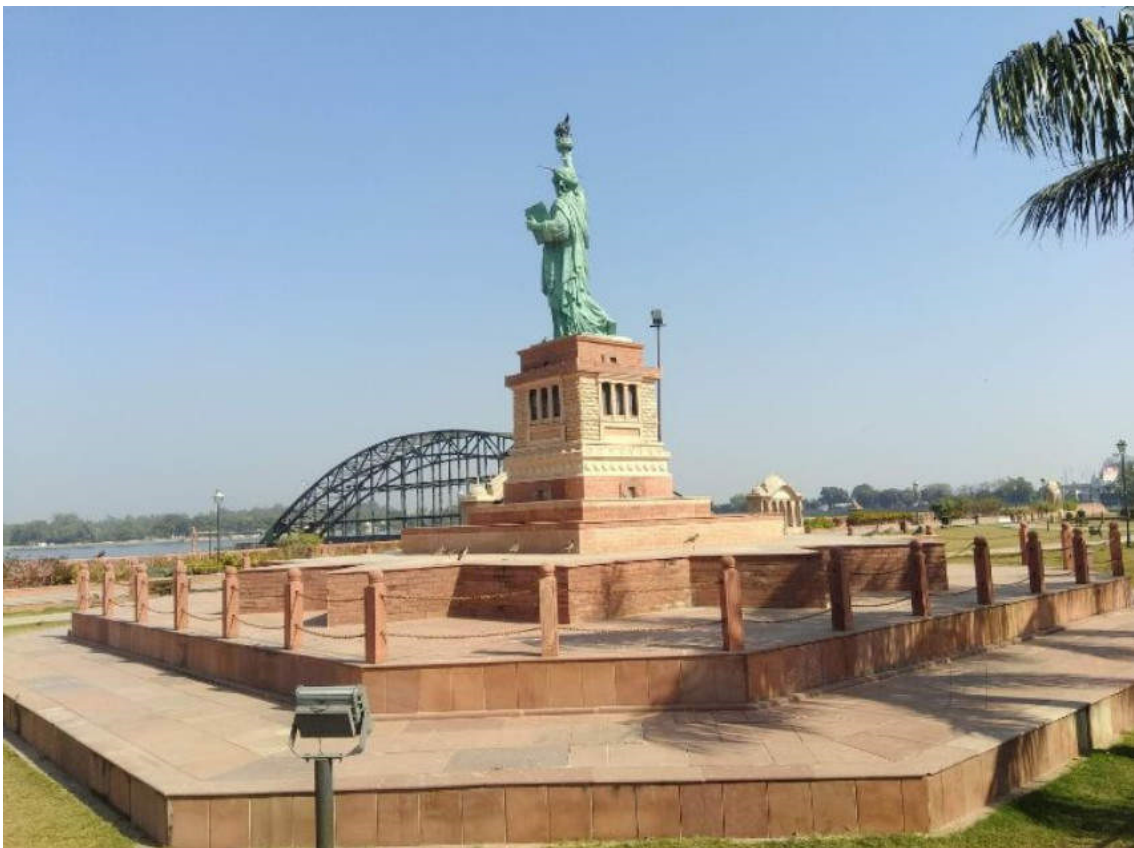
Electrical Energy Consumption, Energy Requirement and Peak Electricity Demand

(Category Wise and Year Wise Summary)

Year	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30
Domestic	7123	7429	7748	8082	8429	8791	9143	9509	9889	10285	10696
Commercial	2864	2944	3027	3111	3199	3288	3370	3455	3541	3629	3720
Public lighting	364	383	402	422	443	465	484	503	523	544	566
Public Water Works	557	577	599	621	644	668	688	708	730	752	774
Irrigation	18	18	19	19	20	20	21	21	22	22	23
LT Industries	948	973	998	1024	1051	1078	1102	1126	1151	1176	1202
HT Industries	4818	4996	5181	5373	5572	5778	5951	6130	6313	6503	6698
Railway Traction	710	739	770	803	837	872	907	943	981	1020	1061
Bulk Supply	135	140	146	151	157	164	169	175	181	188	194
Others (if any)	13	13	13	13	13	13	13	13	33	33	33
Total (Energy Consumption)	17549	18213	18902	19619	20363	21136	21847	22582	23364	24151	24967
T&D losses -MU	1901	1949	1997	2046	2097	2148	2191	2235	2281	2326	2372
T&D losses -in %	9.78	9.67	9.56	9.45	9.34	9.23	9.12	9.01	8.90	8.79	8.68
Energy Requirement - MU	19450	20161	20899	21665	22460	23284	24038	24817	25645	26477	27338
Annual Load Factor - %	68.05	67.90	67.75	67.60	67.45	67.30	67.15	67.00	66.85	66.70	66.55
Peak Load - MW	3263	3390	3522	3659	3801	3950	4087	4228	4379	4532	4690

Table 11.5: Power Forecast of Kolkata

Kota



Kota

Introduction:

Kota city, located in the south eastern region of Rajasthan, sprawls on the eastern banks of Chambal, the perennial river of Rajasthan. The city is undergoing radical urban transformation. It crossed the 10 lakh population mark in 2011 and is currently the third most populous city in Rajasthan. The city is dotted with magnificent monuments and havelis adorned with frescoes as well as several hi-tech industrial units. As of 2011 census, the population of city was 10,01,694. The total municipal area of the city is 221.36 sq. km³¹.



(Figure 12.1: Location of Kota City)

³¹ Official Website of Kota Municipal Corporation (<http://kotamc.org/UI/Static/cityprofile.aspx>)

Economy³²

Kota is one of the important industrial centres in Rajasthan. Its industrial base includes a well-developed RIICO Industrial park with over 2100 units comprising units engaged in cotton and oilseed milling, textile weaving, agro food processing, fertiliser, cement, metal handicrafts and Kota Stone.³³ Kota is widely known for its Kota stone, Kota sarees and Kota kachoris amongst locals as well as tourists from across India. It also boasts of one of the largest fertilizer plants in Asia, precision unit and atomic power station. More recently, Kota has been in the limelight for laying the foundation for the careers of thousands of young minds to study at the best institutes in India – the Indian Institutes of Technology, AIIMS, etc.

Climate³⁴

The climate of the city is characterized by hot summer and bracing cold winters. The average annual maximum temp. is 33.0 °C with mean maximum temp. of the hottest month (May) and the coldest month (Jan) are about 42.3 °C and 23.5 °C respectively. The average annual minimum temp. is 21.8 °C with mean minimum temp. of the hottest and the coldest months are about 29.9 °C and 11.5 °C respectively. The average annual rainfall of the city is 72.2 cm. The rainfall during the southwest monsoon season is about 93% of the annual rainfall. The values of relative humidity are about 49% to 79% in the morning and 31% to 67% in the afternoon during the southwest monsoon season.

Brief description of Power Utilities³⁵:

After the enactment of Rajasthan Power Sector Reforms Act, 1999, the state government of Rajasthan established Rajasthan Electricity Regulatory Commission (RERC) in January 2000. Subsequently, the erstwhile Rajasthan

³² Official Site for Smart City Kota (<https://smartcitykota.com/>)

³³ Kota Smart City Proposal (http://smartcities.gov.in/upload/uploadfiles/files/Kota_SCP.pdf)

³⁴ <http://www.imdpune.gov.in/caui/smartcities.html>

³⁵ <https://energy.rajasthan.gov.in/content/raj/energy-department/jodhpur-vidyut-vitran-nigam-limited/en/about-us.html>

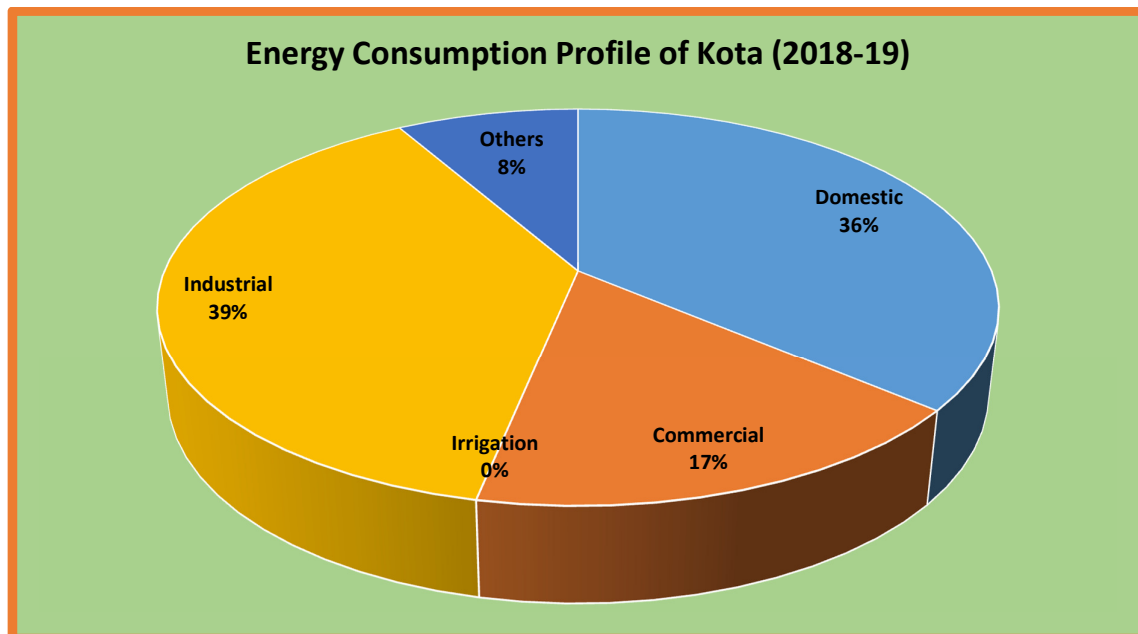
State Electricity Board (RSEB) was unbundled into the following five entities on 19th July 2000:

- 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 (JDVVNL) has the responsibility of power distribution in Kota City.

Existing Power Scenario:

The total electricity consumption of Kota in the year 2018-19 was 1197 MU and with 20.03% T&D losses, the requirement was 1496 MU. The peak demand of the city was 261 MW. The Industrial sector was the biggest consumer of electricity (39%) followed by Domestic (36%) & Commercial (17%).



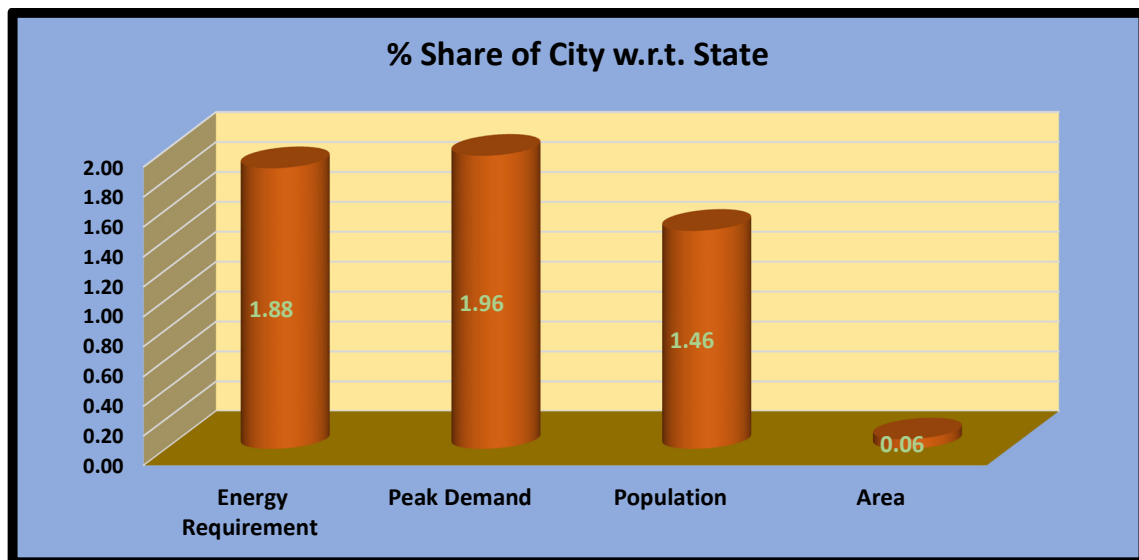
(Figure 12.2: Energy Consumption Profile of Kota in 2018-19)

During the last five years (2013-14 to 2018-19), the city has observed CAGR of 8.83% & 3.54% in electricity energy requirement and peak demand respectively.

On comparison of Kota with Rajasthan for the year 2018-19, it is observed that the energy requirement of Kota was 1.88% of the total energy requirement of the state whereas its contribution in population and area were only 1.46% and 0.06% respectively.

Sl. No.	Particulars	Kota	Rajasthan	Kota as % of Rajasthan
1.	Energy Requirement (in MU)	1496	79626	1.88
2.	Peak Demand (in MW)	261	13276	1.96
3.	Population (2011 Census)	10,01,694	6,85,48,437	1.46
4.	Area (in sq km)	221.36	3,42,239	0.06

(Table 12.1: Comparison of Kota with Rajasthan in 2018-19)

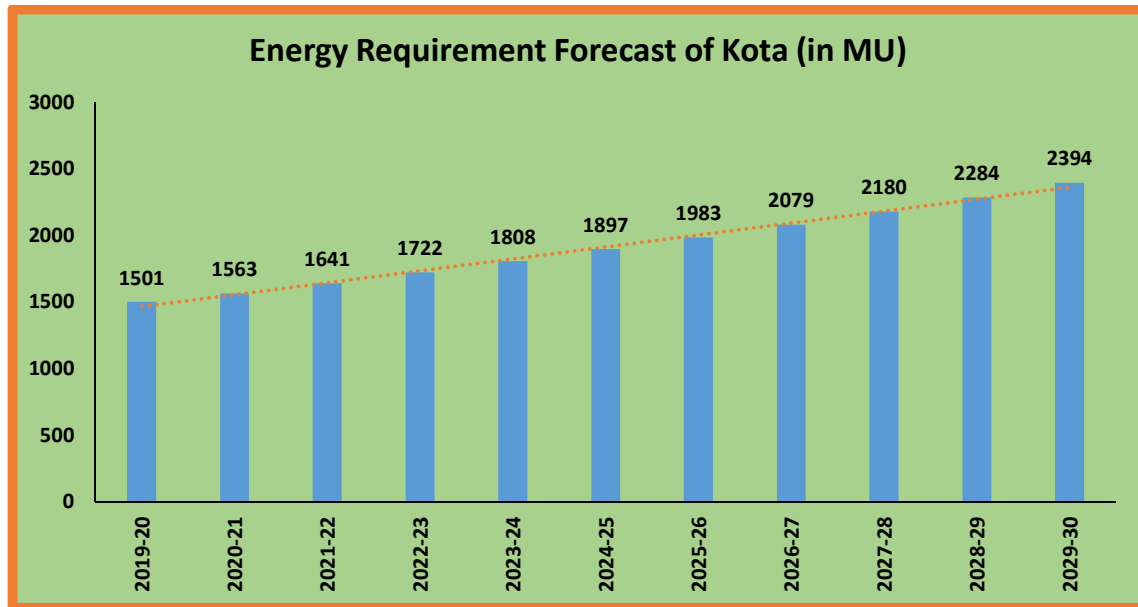


(Figure 12.3: Comparison between Kota and Rajasthan in 2018-19)

Power Forecast:

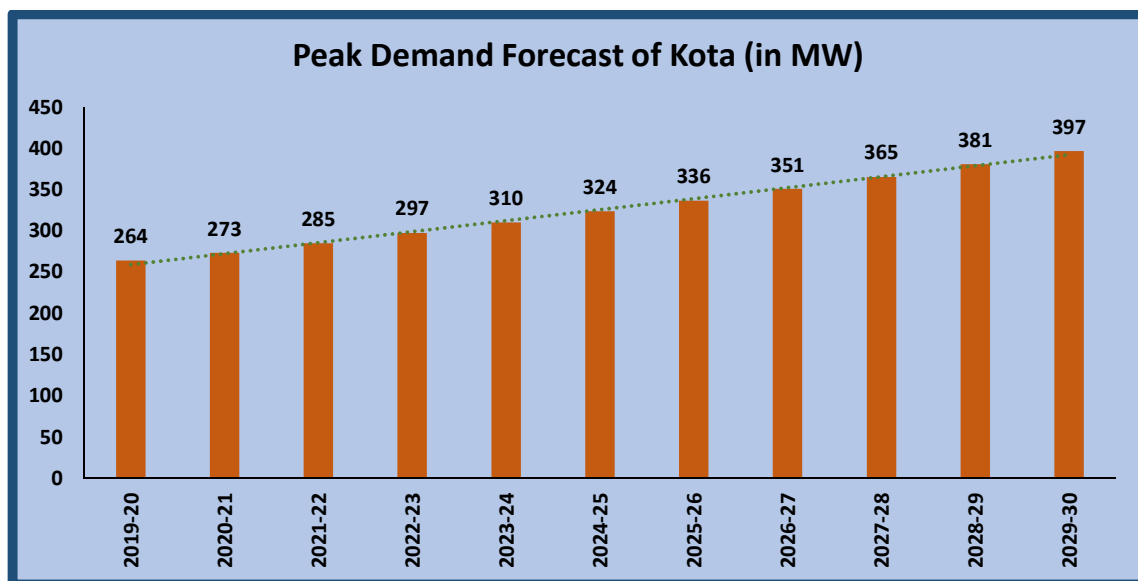
Based on total electricity consumption and T&D Losses, the total energy requirement of Kota is estimated as 1501 MU in year 2019-20. It is expected

that the energy requirement of the city will reach to 1897 MU by the year 2024-25 with 4.79% CAGR for the period 2019-20 to 2024-25. With CAGR of 4.77% for the period 2024-25 to 2029-30, its energy requirement is estimated as 2394 MU by the year 2029-30.



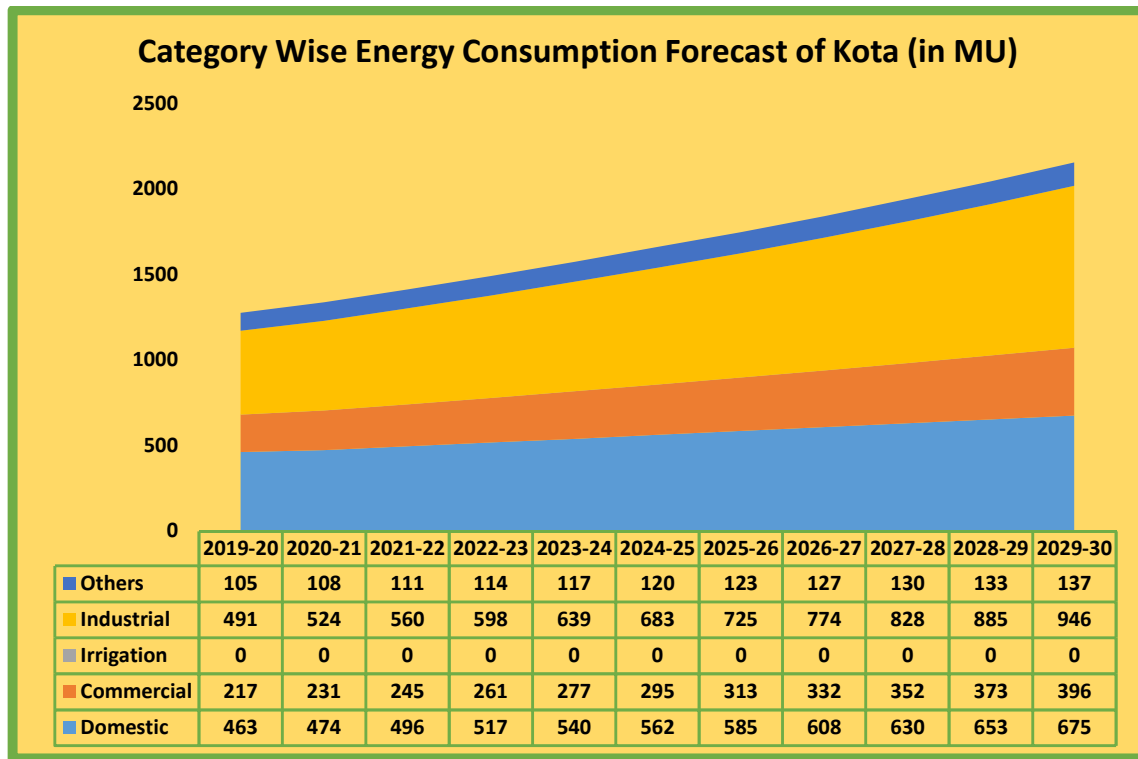
(Figure 12.4: Energy Requirement Forecast of Kota in MU)

Peak Demand of the Kota is expected to see 4.16% CAGR upto 2024-25 and will reach 324 MW in comparison to 264 MW in year 2019-20. It is expected to reach 397 MW in year 2029-30 with a CAGR of 4.15% after 2024-25.



(Figure 12.5: Peak Demand Forecast of Kota in MW)

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



(Figure 12.6: Category Wise Energy Consumption forecast of Kota)

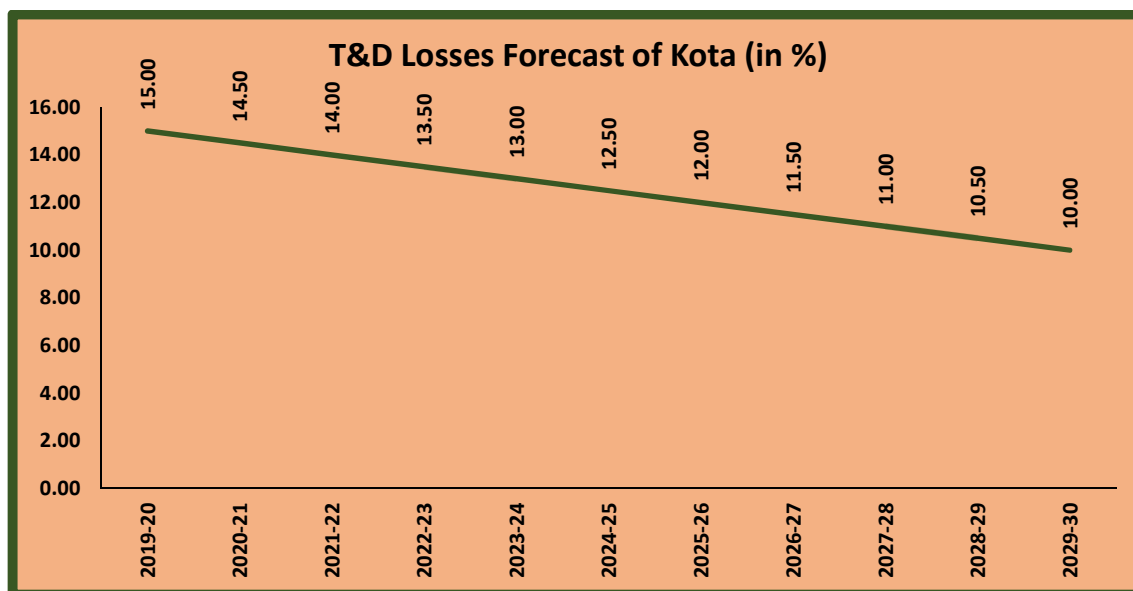
The category wise CAGR expected in energy consumption for the next ten years (2019-20 to 2029-30) along with its break up in five years (2019-20 to 2024-25 & 2025-26 to 2029-30) is tabulated below:

Sl. No.	Category	Energy Consumption (in MU)			CAGR in %		
		2019-20	2024-25	2029-30	2019-20 to 2024-25	2024-25 to 2029-30	2019-20 to 2029-30
1.	Domestic	463	562	675	3.96	3.72	3.84
2.	Commercial	217	295	396	6.30	6.10	6.20
3.	Irrigation	0	0	0	-	-	-
4.	Industrial	491	683	946	6.82	6.75	6.78
5.	Others	105	120	137	2.77	2.67	2.72
6.	Total	1276	1659	2154	5.40	5.36	5.38

(Table 12.2: Expected CAGR of Kota - Category Wise Consumption)

Transmission & Distribution Losses:

T&D losses of Kota were estimated as 20.03% in year 2018-19. The target level is to bring it down to about 12.50% and 10.00% by the end of 2024-25 & 2029-30 respectively.



(Figure 12.7: T&D Loss Forecast of Kota)

The power forecast of Kota city is summarized below:

Sl. No.	Particulars	2019-20	2024-25	2029-30	CAGR in %	
					2019-20 to 2024-25	2024-25 to 2029-30
1.	Energy Requirement in MU	1501	1897	2394	4.79	4.77
2.	Peak Demand in MW	264	324	397	4.16	4.15
3.	T&D Losses in %	15.00	12.50	10.00	-	-

(Table 12.3: Power forecast summary of Kota)

Analysis of Forecast:

A comparison of actual CAGR witnessed for the Kota city during the last five years and the CAGR for future power forecast is tabulated below:

Sl. No.	City/State/Country	CAGR in %		
		2013-14 to 2018-19	2019-20 to 2024-25	2024-25 to 2029-30
1.	Energy Requirement	8.83	4.79	4.77
2.	Peak Demand	3.54	4.16	4.15

(Table 12.4: Actual CAGR in past vis-a-vis CAGR forecast for future for Kota)

The above table indicates that Kota has witnessed huge growth in energy requirement during the last five years. However, the trends are suggesting comparatively lesser growth in recent past years. Therefore, moderate energy requirement growth has been considered for the future.

As per the trend witnessed in the past for the city, it's peak demand is expected to grow less in comparison to energy requirement unlike most of the other Mega Cities.

Kota

Electrical Energy Consumption, Energy Requirement and Peak Electricity Demand

(Category Wise and Year Wise Summary)

Year	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30
Domestic	463	474	496	517	540	562	585	608	630	653	675
Commercial	217	231	245	261	277	295	313	332	352	373	396
Public lighting	22	22	23	23	23	24	24	24	25	25	25
Public Water Works	55	57	59	62	64	67	70	72	75	78	81
Irrigation	0	0	0	0	0	0	0	0	0	0	0
LT Industries	23	23	24	24	25	25	26	26	27	27	28
HT Industries	468	501	536	574	614	657	699	748	801	858	919
Railway Traction	0	0	0	0	0	0	0	0	0	0	0
Bulk Supply	28	28	29	29	29	30	30	30	30	31	31
Others (if any)	0	0	0	0	0	0	0	0	0	0	0
Total (Energy Consumption)	1276	1337	1411	1490	1573	1659	1745	1840	1940	2044	2154
T&D losses -MU	225	227	230	233	235	237	238	239	240	240	239
T&D losses -in %	15.00	14.50	14.00	13.50	13.00	12.50	12.00	11.50	11.00	10.50	10.00
Energy Requirement - MU	1501	1563	1641	1722	1808	1897	1983	2079	2180	2284	2394
Annual Load Factor - %	64.89	65.29	65.69	66.09	66.49	66.89	67.29	67.69	68.09	68.49	68.89
Peak Load - MW	264	273	285	297	310	324	336	351	365	381	397

Table 12.5: Power Forecast of Kota

Lucknow



Lucknow

Introduction:

Lucknow is the capital city of Uttar Pradesh. Being a tehsil headquarter, a divisional headquarter and the state capital, it is a prominent administrative and commercial centre of the state. It has always been known as a multicultural city that flourished as a North Indian cultural and artistic hub and seat of Nawab power in the 18th and 19th centuries. It is popularly known as the “The City of Nawabs” also. Courtly manners, beautiful gardens, poetry, music, and fine cuisine of the city are well known. It continues to be an important centre of government, education, commerce, aerospace, finance, pharmaceuticals, technology, design, culture, tourism, music and poetry. As of 2011 census, the population of city was 28,17,105. The total municipal area of the city is 348.80 sq. km³⁶.



(Figure 13.1: Location of Lucknow City)

³⁶ Census Official Site (<http://www.censusindia.gov.in/2011census/PCA/A4.html>)

Economy³⁷

The service sector forms the main economic base of the city. Lucknow is a major centre for research and development (R&D) and houses several research and development institutions. It is also an education centre, especially for primary and secondary education. Lucknow has traditionally been associated with chikan embroidery work on readymade garments, sarees, etc. with most units being small scale and household based and located in the old city area. Besides that, the other major industries in the Lucknow include aeronautics, machine tools, distillery chemicals and furniture.

Climate³⁸

The climate of the city is mild and generally warm and temperate. The average annual maximum temp. is 32.0 °C with mean maximum temp. of the hottest month (May) and the coldest months (Jan-Dec) are about 39.6 °C and 22.1 °C respectively. The average annual minimum temp. is 18.6 °C with mean minimum temp. of the hottest and the coldest months are about 24.7 °C and 7.9 °C respectively. The average annual rainfall of the city is 100 cm. The rainfall during the southwest monsoon season is about 88% of the annual rainfall. The values of relative humidity are about 64% to 85% in the morning and 49% to 77% in the afternoon during the southwest monsoon season.

Brief description of Power Utilities:

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

³⁷ City Development Plan , Lucknow (<http://lmc.up.nic.in/pdf/nfinal.pdf>); City Master Plan, Lucknow (<http://www.ldaonline.in/doc/LDA/welcome/homepage/DOWNLOADS/46/MasterPlan2031.pdf;jsessionid=FE95CA1042B314F610E4EDB647E3C670>)

³⁸ <http://www.imdpune.gov.in/caui/smartcities.html>

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

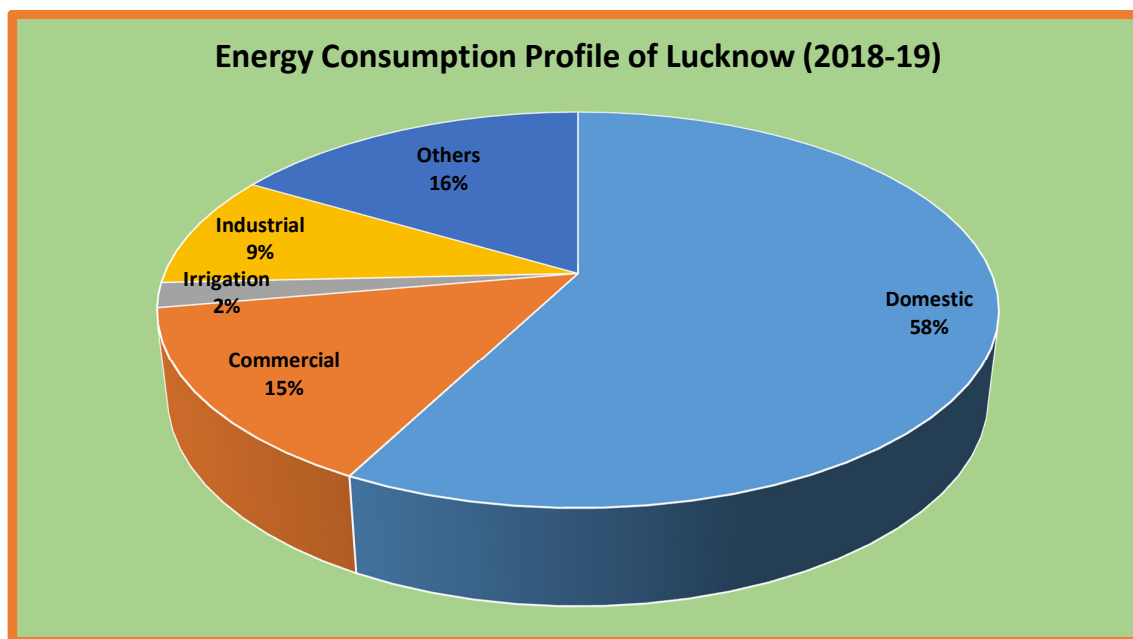
UPPCL has been further divided into following five distribution companies on 12.08.2003:

- Madhyanchal Vidyut Vitran Nigam Limited (MNVNL), 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. Madhyanchal Vidyut Vitran Nigam Limited (MNVNL), Lucknow is responsible for the distribution of power in Lucknow city.

Existing Power Scenario:

The total electricity consumption of Lucknow in the year 2018-19 was 4978 MU and with 20.20% T&D losses, the requirement was 6238 MU. The peak demand of the city was 1413 MW. The Domestic sector was the biggest consumer of electricity (58%) followed by Commercial (15%).



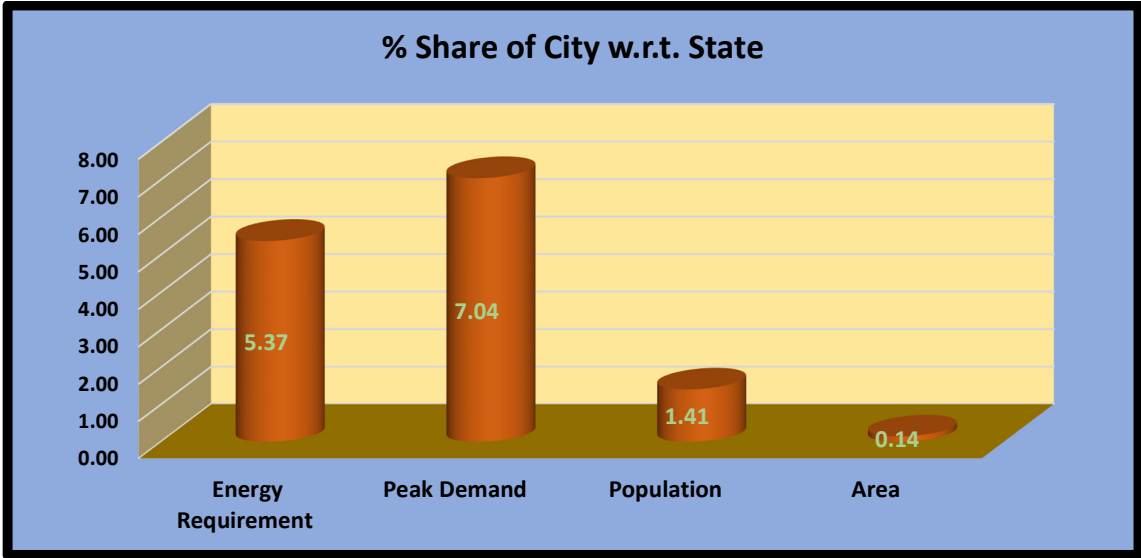
(Figure 13.2: Energy Consumption Profile of Lucknow in 2018-19)

During the last five years (2013-14 to 2018-19), the city has observed CAGR of 6.59% & 5.82% in electricity energy requirement and peak demand respectively.

On comparison of Lucknow with Uttar Pradesh for the year 2018-19, it is observed that the energy requirement of Lucknow was 5.37% of the total energy requirement of the state whereas its contribution in population and area were only 1.41% and 0.14% respectively.

Sl. No.	Particulars	Lucknow	Uttar Pradesh	Lucknow as % of Uttar Pradesh
1.	Energy Requirement (in MU)	6238	116149	5.37
2.	Peak Demand (in MW)	1413	20062	7.04
3.	Population (2011 Census)	28,17,105	19,98,12,341	1.41
4.	Area (in sq km)	348.80	2,40,928	0.14

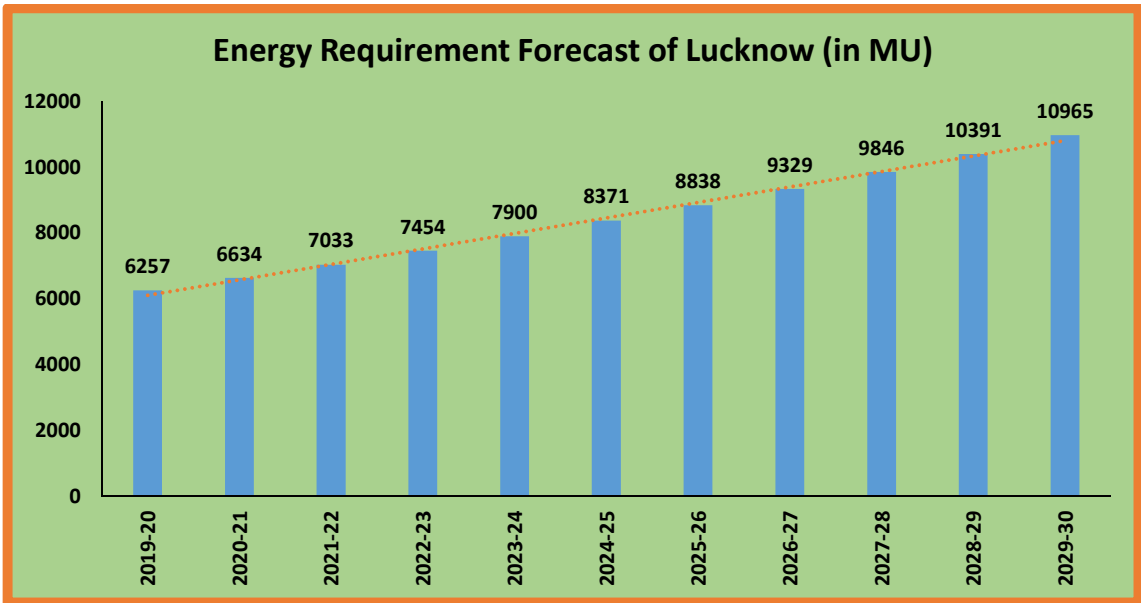
(Table 13.1: Comparison of Lucknow with Uttar Pradesh in 2018-19)



(Figure 13.3: Comparison between Lucknow and Uttar Pradesh in 2018-19)

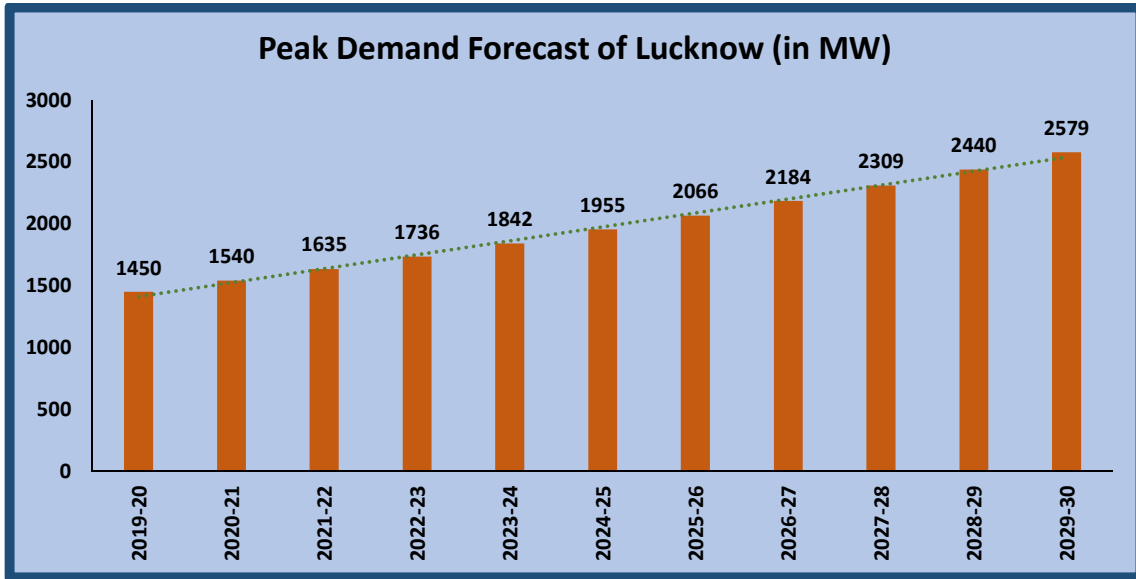
Power Forecast:

Based on total electricity consumption and T&D Losses, the total energy requirement of Lucknow is estimated as 6257 MU in year 2019-20. It is expected that the energy requirement of the city will reach to 8371 MU by the year 2024-25 with 6.00% CAGR for the period 2019-20 to 2024-25. With CAGR of 5.55% for the period 2024-25 to 2029-30, its energy requirement is estimated as 10965 MU by the year 2029-30.



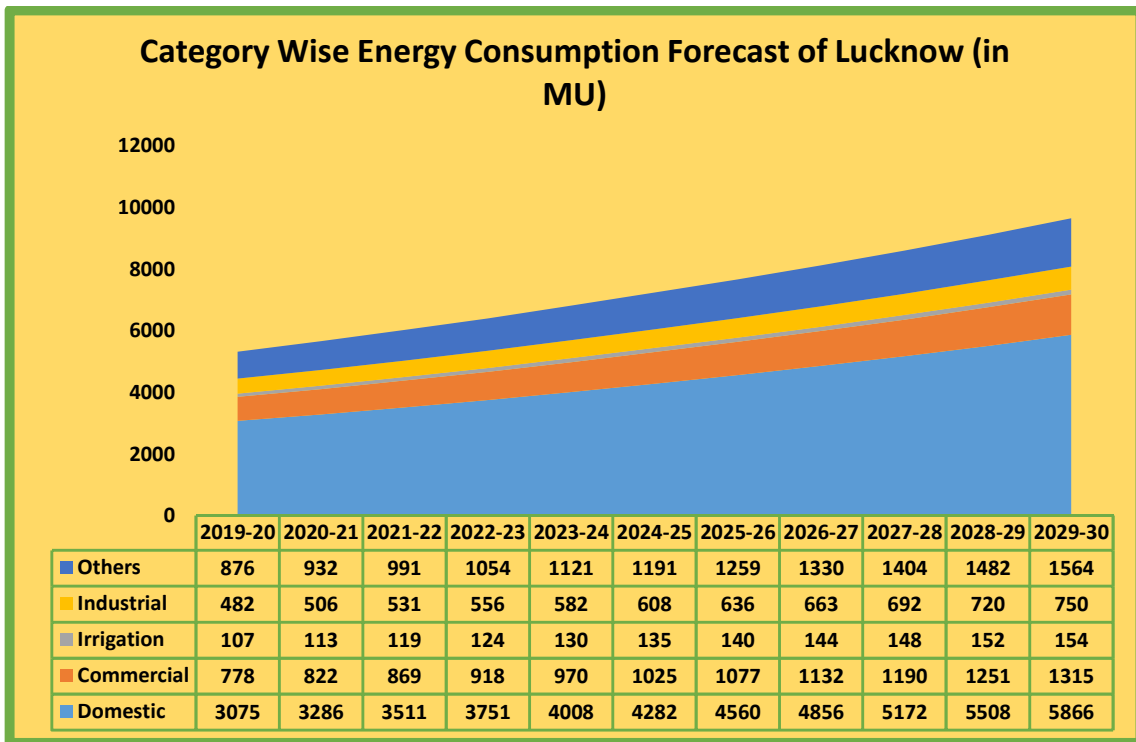
(Figure 13.4: Energy Requirement Forecast of Lucknow in MU)

Peak Demand of the Lucknow is expected to see 6.15% CAGR upto 2024-25 and will reach 1955 MW in comparison to 1450 MW in year 2019-20. It is expected to reach 2579 MW in year 2029-30 with a CAGR of 5.70% after 2024-25.



(Figure 13.5: Peak Demand Forecast of Lucknow in MW)

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



(Figure 13.6: Category Wise Energy Consumption forecast of Lucknow)

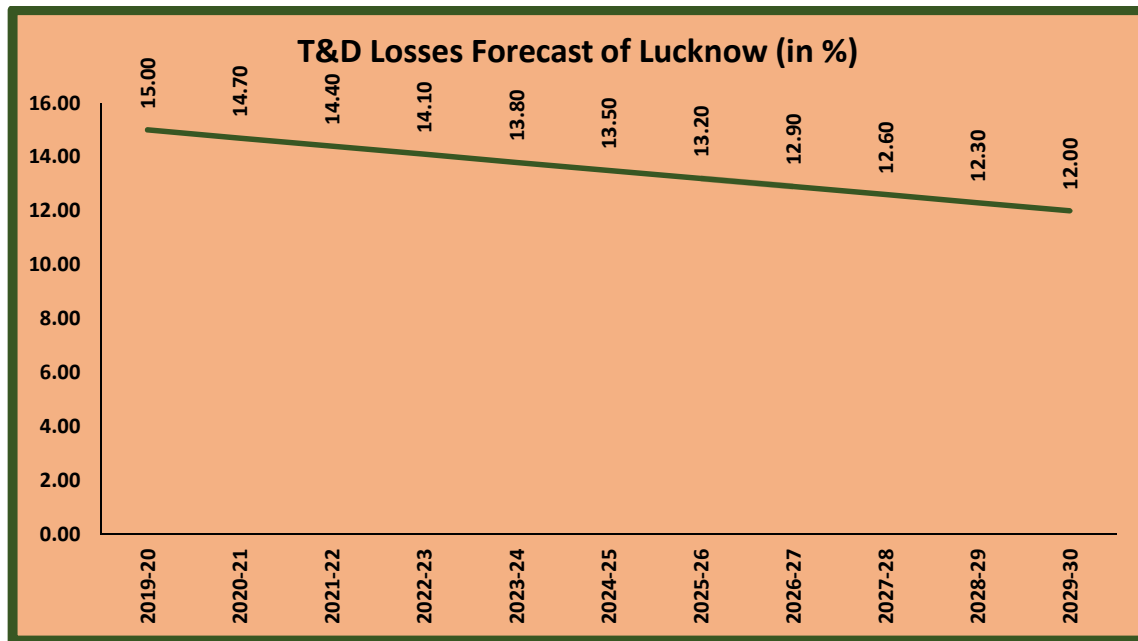
The category wise CAGR expected in energy consumption for the next ten years (2019-20 to 2029-30) along with its break up in five years (2019-20 to 2024-25 & 2025-26 to 2029-30) is tabulated below:

Sl. No.	Category	Energy Consumption (in MU)			CAGR in %		
		2019-20	2024-25	2029-30	2019-20 to 2024-25	2024-25 to 2029-30	2019-20 to 2029-30
1.	Domestic	3075	4282	5866	6.84	6.50	6.67
2.	Commercial	778	1025	1315	5.67	5.11	5.39
3.	Irrigation	107	135	154	4.75	2.75	3.74
4.	Industrial	482	608	750	4.76	4.26	4.51
5.	Others	876	1191	1564	6.35	5.60	5.97
6.	Total	5318	7241	9649	6.37	5.91	6.14

(Table 13.2: Expected CAGR of Lucknow - Category Wise Consumption)

Transmission & Distribution Losses:

T&D losses of Lucknow were estimated as 20.20% in year 2018-19. The target level is to bring it down to about 13.50% and 12.00% by the end of 2024-25 & 2029-30 respectively.



(Figure 13.7: T&D Loss Forecast of Lucknow)

The power forecast of Lucknow city is summarized below:

Sl. No.	Particulars	2019-20	2024-25	2029-30	CAGR in %	
					2019-20 to 2024-25	2024-25 to 2029-30
1.	Energy Requirement in MU	6257	8371	10965	6.00	5.55
2.	Peak Demand in MW	1450	1955	2579	6.15	5.70
3.	T&D Losses in %	15.00	13.50	12.00	-	-

(Table 13.3: Power forecast summary of Lucknow)

Analysis of Forecast:

A comparison of actual CAGR witnessed for the Lucknow city during the last five years and the CAGR for future power forecast is tabulated below:

Sl. No.	City/State/Country	CAGR in %		
		2013-14 to 2018-19	2019-20 to 2024-25	2024-25 to 2029-30
1.	Energy Requirement	6.59	6.00	5.55
2.	Peak Demand	5.82	6.15	5.70

(Table 13.4: Actual CAGR in past vis-a-vis CAGR forecast for future for Lucknow)

The above table indicates that Lucknow has witnessed good growth in the power demand in the recent past and the city is expected to follow a similar growth pattern in the future also.

Lucknow

Electrical Energy Consumption, Energy Requirement and Peak Electricity Demand

(Category Wise and Year Wise Summary)

Year	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30
Domestic	3075	3286	3511	3751	4008	4282	4560	4856	5172	5508	5866
Commercial	778	822	869	918	970	1025	1077	1132	1190	1251	1315
Public lighting	199	210	221	233	246	260	273	287	301	316	333
Public Water Works	413	445	480	517	558	601	642	686	733	782	836
Irrigation	107	113	119	124	130	135	140	144	148	152	154
LT Industries	107	112	117	122	127	132	137	142	148	153	158
HT Industries	375	394	414	434	455	477	499	521	544	567	591
Railway Traction	36	38	40	43	45	47	50	52	55	58	61
Bulk Supply	228	239	250	261	272	283	294	305	315	325	335
Others (if any)	0	0	0	0	0	0	0	0	0	0	0
Total (Energy Consumption)	5318	5659	6020	6403	6810	7241	7671	8126	8606	9113	9649
T&D losses -MU	938	975	1013	1051	1090	1130	1167	1203	1241	1278	1316
T&D losses -in %	15.00	14.70	14.40	14.10	13.80	13.50	13.20	12.90	12.60	12.30	12.00
Energy Requirement - MU	6257	6634	7033	7454	7900	8371	8838	9329	9846	10391	10965
Annual Load Factor - %	49.24	49.17	49.10	49.03	48.96	48.89	48.82	48.75	48.68	48.61	48.54
Peak Load - MW	1450	1540	1635	1736	1842	1955	2066	2184	2309	2440	2579

Table 13.5: Power Forecast of Lucknow

Mumbai



Mumbai

Introduction:

Mumbai is the capital city of Maharashtra. Located on the western coast facing the Arabian Sea, the city, which serves as an important seaport and trade hub, is also the financial nerve-centre of the country.

Mumbai is usually referred to as three different geographic entities - Mumbai City, Greater Mumbai, and Mumbai Metropolitan Region. The Mumbai Island City plus the Mumbai Suburban areas comprise as Greater Mumbai that comes under Brihanmumbai Municipal Corporation (BMC). The report has covered the Greater Mumbai area that has population of 1,24,42,373 as per Census- 2011. The total geographic area is 603 sq. km.



(Figure 14.1: Location of Mumbai City)

Economy³⁹

Mumbai has enjoyed a leadership position in all spheres of economic activity including manufacturing, information technology, banking, insurance, financial services and entertainment. However, since the 80s, manufacturing activity led by textile sector declined and service sector became more prominent. While the decline of the textile industry was due to a variety of factors, the intention of the Government to decongest the City and to disperse industrial activity saw re-location of many manufacturing units. Further, with the unleashing of economic reforms in 1991, new economic opportunities were opened up in sectors such as IT & ITES, entertainment, hospitality, banking, financial services and insurance. Mumbai which already had a firm base in some of these sectors established its leadership in these new services activities.

Climate⁴⁰

The climate of the city is characterised by an oppressive summer, dampness in the atmosphere throughout the year and heavy southwest monsoon rainfall. The average annual maximum temp. is 31.6 °C with mean maximum temp. of the hottest month (May) and the coldest month (Jan) are about 33.8 °C and 30.2 °C respectively. The average annual minimum temp. is 23.8 °C with mean minimum temp. of the hottest and the coldest months are about 27.1 °C and 19.3 °C respectively. The average annual rainfall of the city is 212.3 cm. The rainfall during the southwest monsoon season is about 95% of the annual rainfall. The relative humidity is generally high throughout the year and it ranges from 76% to 89% in the morning and from 63% to 85% in the afternoon.

Brief description of Power Utilities:

The erstwhile Maharashtra State Electricity Board (MSEB) was looking after Generation, Transmission & Distribution of Electricity in Maharashtra

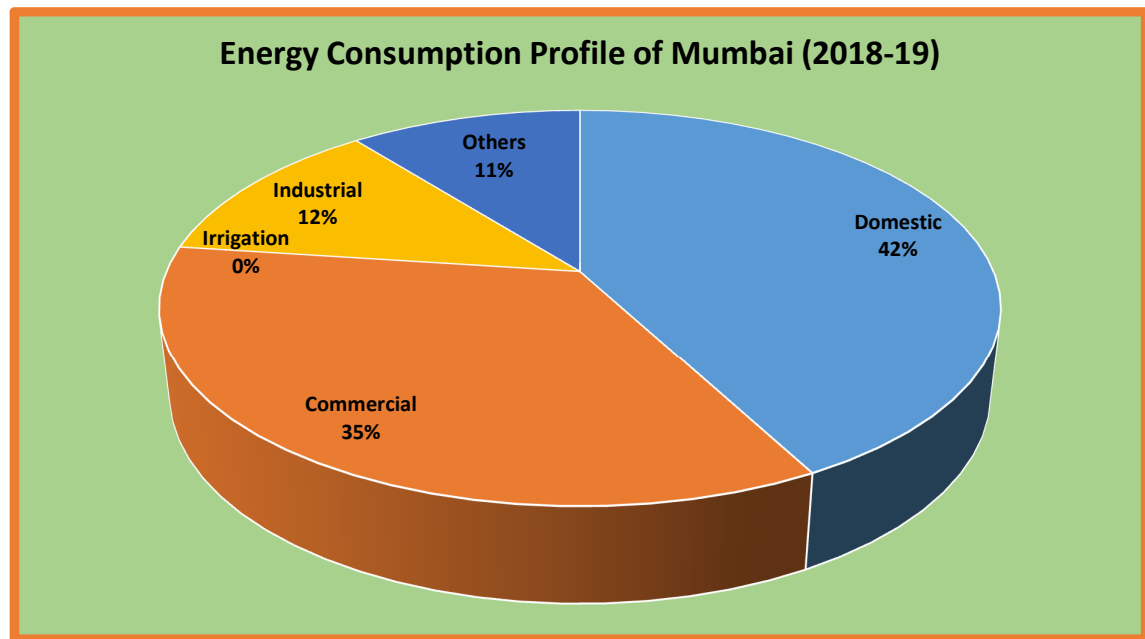
³⁹ Draft Development Plan 2034, Greater Mumbai (https://s3.ap-south-1.amazonaws.com/wp-gmr-assets/Mumbai_Development_Plan_DP_2034_Draft_in_English.pdf)

⁴⁰ <http://www.imdpune.gov.in/caui/smartcities.html>

barring Mumbai. After the enactment of Electricity Act 2003, MSEB was restructured into 4 Companies viz. MSEB Holding Co. Ltd., Maharashtra State Electricity Distribution Co. Ltd. (Mahavitaran), Maharashtra State Power Generation Co. Ltd. (Mahagenco) and Maharashtra State Electricity Transmission Co. Ltd. (Mahatransco) on 6th June 2005. Mahavitaran distributes electricity to consumers across the state except for some parts of Mumbai where Brihanmumbai Electric Supply and Transport(BEST) - an autonomous body under Municipal Corporation of Greater Mumbai, Tata Power and Adani Power also distribute power.

Existing Power Scenario:

The total electricity consumption of Mumbai in the year 2018-19 was 20069 MU and with 6.55% T&D losses, the requirement was 21475 MU. The peak demand of the city was 3615 MW. The Domestic sector was the biggest consumer of electricity (42%) followed by Commercial (35%) and Industrial (12%).



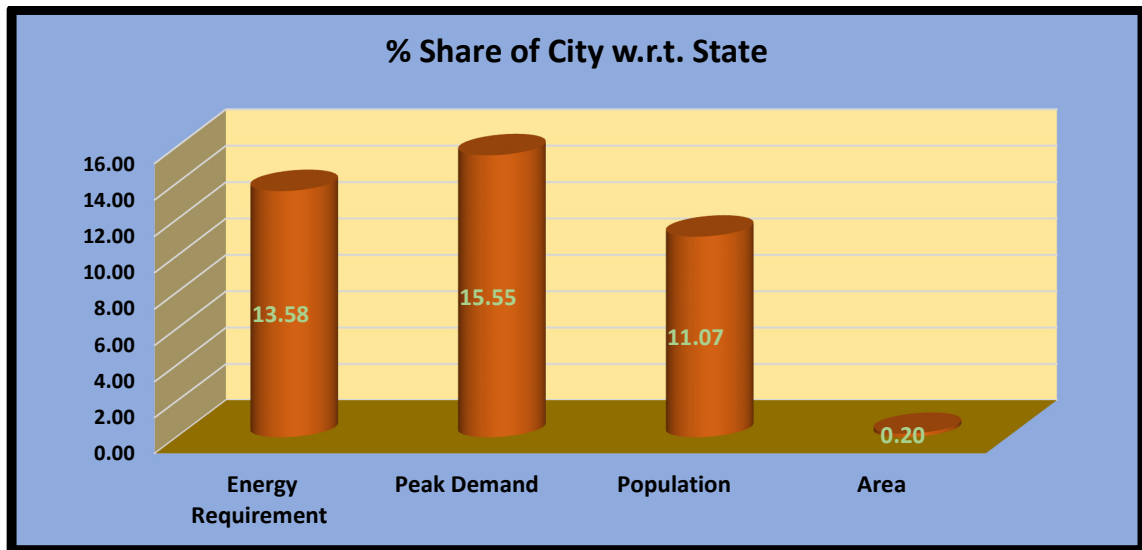
(Figure 14.2: Energy Consumption Profile of Mumbai in 2018-19)

During the last five years (2013-14 to 2018-19), the city has observed CAGR of 1.91% & 2.33% in electricity energy requirement and peak demand respectively.

On comparison of Mumbai with Maharashtra for the year 2018-19, it is observed that the energy requirement of Mumbai was 13.58% of the total energy requirement of the state whereas its contribution in population and area were only 11.07% and 0.20% respectively.

Sl. No.	Particulars	Mumbai	Maharashtra	Mumbai as % of Maharashtra
1.	Energy Requirement (in MU)	21475	158157	13.58
2.	Peak Demand (in MW)	3615	23254	15.55
3.	Population (2011 Census)	1,24,42,373	11,23,74,333	11.07
4.	Area (in sq km)	603	3,07,713	0.20

(Table 14.1: Comparison of Mumbai with Maharashtra in 2018-19)

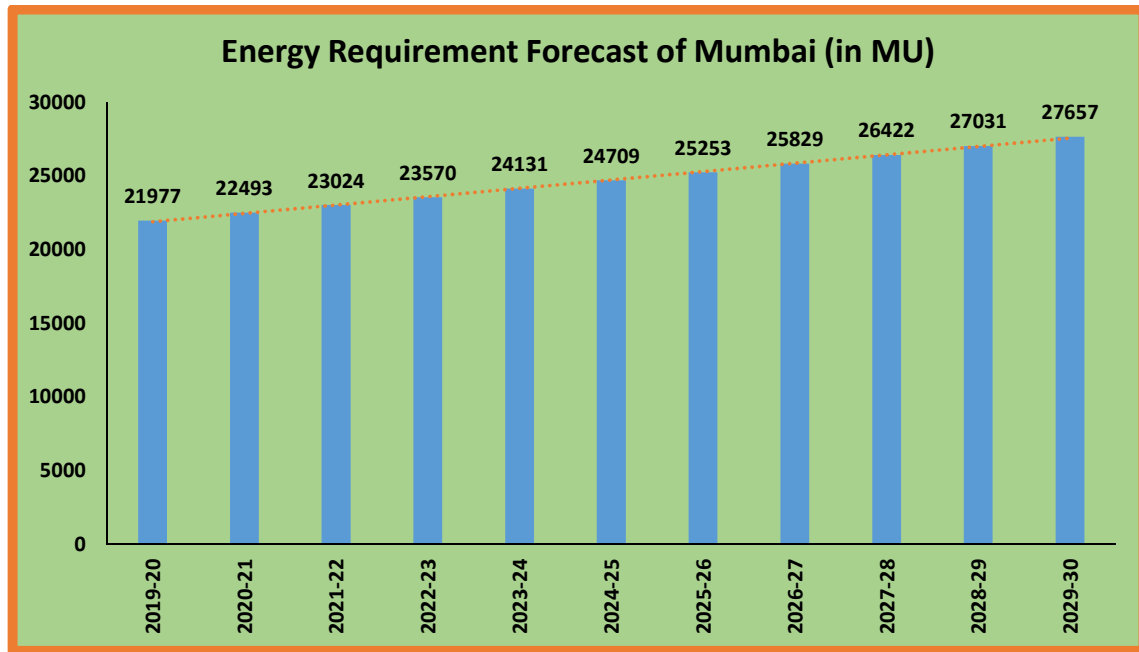


(Figure 14.3: Comparison between Mumbai and Maharashtra in 2018-19)

Power Forecast:

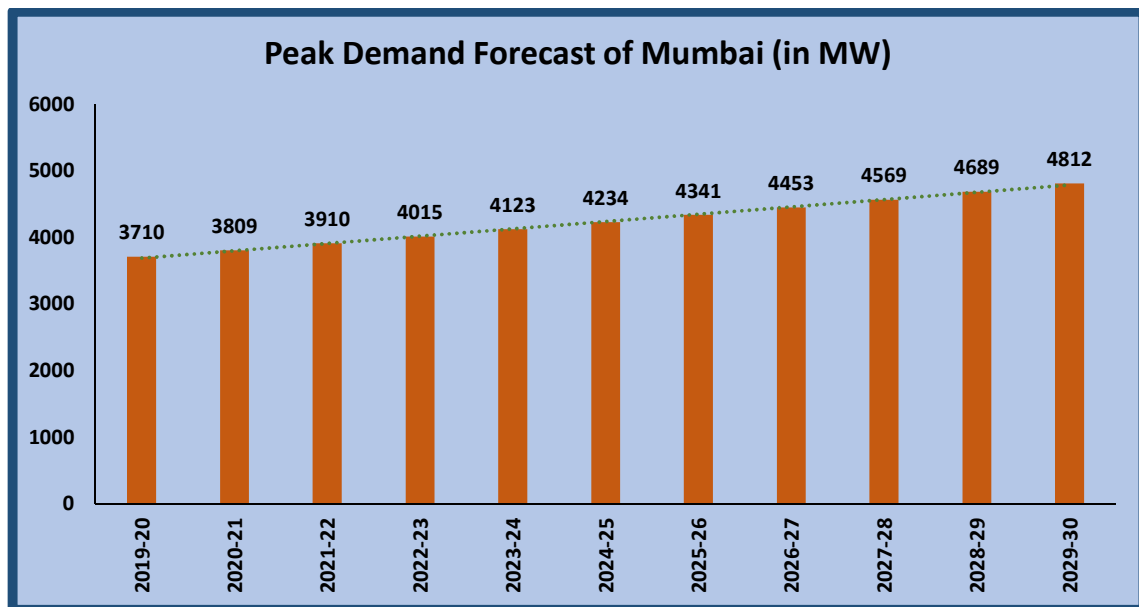
Based on total electricity consumption and T&D Losses, the total energy requirement of Mumbai is estimated as 21977 MU in year 2019-20. It is expected that the energy requirement of the city will reach to 24709 MU by the year 2024-25 with 2.37% CAGR for the period 2019-20 to 2024-25. With

CAGR of 2.28% for the period 2024-25 to 2029-30, its energy requirement is estimated as 27657 MU by the year 2029-30.



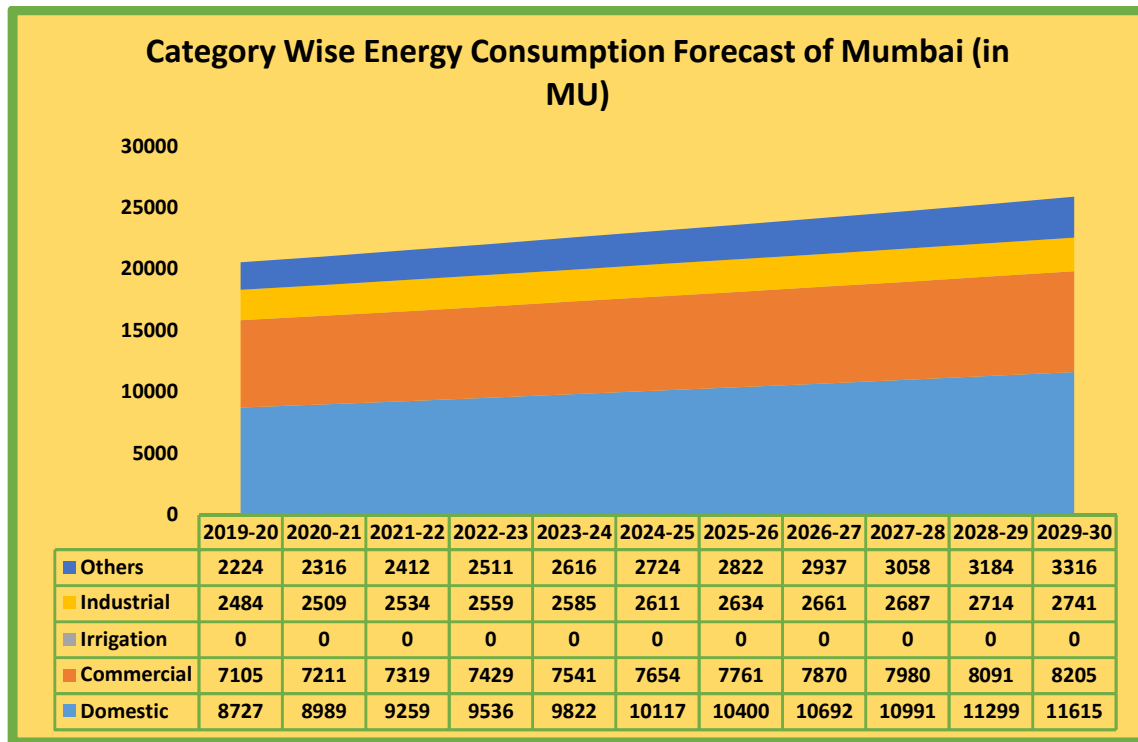
(Figure 14.4: Energy Requirement Forecast of Mumbai in MU)

Peak Demand of the Mumbai is expected to see 2.68% CAGR upto 2024-25 and will reach 4234 MW in comparison to 3710 MW in year 2019-20. It is expected to reach 4812 MW in year 2029-30 with a CAGR of 2.59% after 2024-25.



(Figure 14.5: Peak Demand Forecast of Mumbai in MW)

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



(Figure 14.6: Category Wise Energy Consumption forecast of Mumbai)

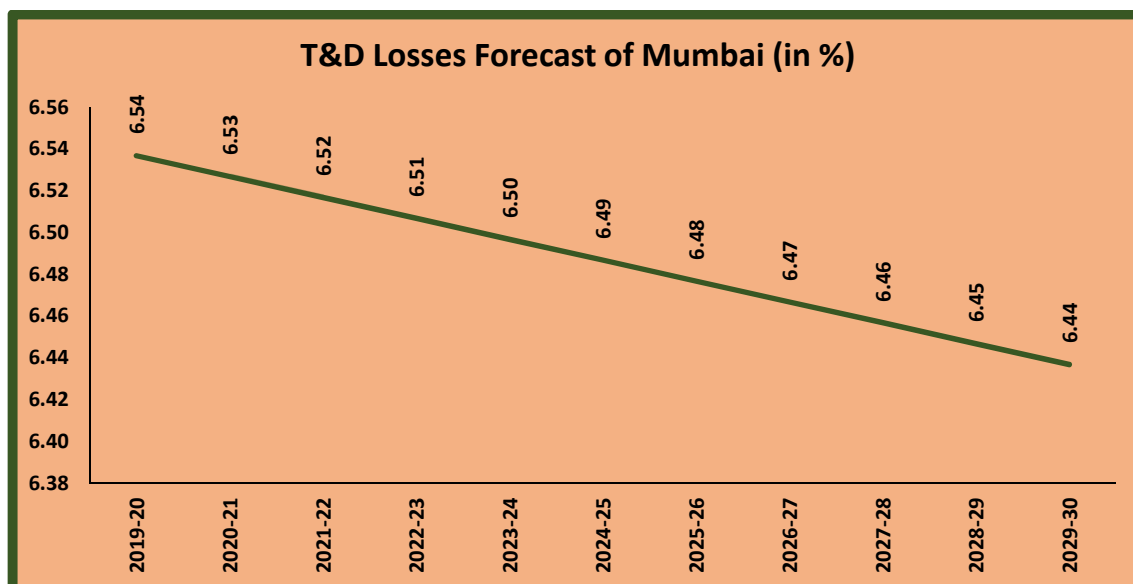
The category wise CAGR expected in energy consumption for the next ten years (2019-20 to 2029-30) along with its break up in five years (2019-20 to 2024-25 & 2025-26 to 2029-30) is tabulated below:

Sl. No.	Category	Energy Consumption (in MU)			CAGR in %		
		2019-20	2024-25	2029-30	2019-20 to 2024-25	2024-25 to 2029-30	2019-20 to 2029-30
1.	Domestic	8727	10117	11615	3.00	2.80	2.90
2.	Commercial	7105	7654	8205	1.50	1.40	1.45
3.	Irrigation	0	0	0	-	-	-
4.	Industrial	2484	2611	2741	1.00	0.98	0.99
5.	Others	2224	2724	3316	4.14	4.01	4.07
6.	Total	20540	23106	25877	2.38	2.29	2.34

(Table 14.2: Expected CAGR of Mumbai - Category Wise Consumption)

Transmission & Distribution Losses:

T&D losses of Mumbai were estimated as 6.55% in year 2018-19. The target level is to bring it down to about 6.49% and 6.44% by the end of 2024-25 & 2029-30 respectively.



(Figure 14.7: T&D Loss Forecast of Mumbai)

The power forecast of Mumbai city is summarized below:

Sl. No.	Particulars	2019-20	2024-25	2029-30	CAGR in %	
					2019-20 to 2024-25	2024-25 to 2029-30
1.	Energy Requirement in MU	21977	24709	27657	2.37	2.28
2.	Peak Demand in MW	3710	4234	4812	2.68	2.59
3.	T&D Losses in %	6.54	6.49	6.44	-	-

(Table 14.3: Power forecast summary of Mumbai)

Analysis of Forecast:

A comparison of actual CAGR witnessed for the Mumbai city during the last five years and the CAGR for future power forecast is tabulated below:

Sl. No.	City/State/Country	CAGR in %		
		2013-14 to 2018-19	2019-20 to 2024-25	2024-25 to 2029-30
1.	Energy Requirement	1.91	2.37	2.28
2.	Peak Demand	2.33	2.68	2.59

(Table 14.4: Actual CAGR in past vis-a-vis CAGR forecast for future for Mumbai)

The above table indicates that Mumbai is observing a more or less stagnation phase in power demand and the same trend is expected to continue in the future. Unlike Delhi, that is also witnessing stagnation in energy requirement but higher growth in peak demand lately, the peak demand growth of Mumbai city has not shown much growth that may mainly be attributed to the difference in the energy consumption profile of the two cities. In Delhi, a huge share of electricity is consumed by domestic category consumers whereas apart from the domestic category, commercial category consumption is also very prominent in Mumbai City. The difference in peak demand growth is also because of the different climatic conditions of the two cities.

Mumbai

Electrical Energy Consumption, Energy Requirement and Peak Electricity Demand

(Category Wise and Year Wise Summary)

Year	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30
Domestic	8727	8989	9259	9536	9822	10117	10400	10692	10991	11299	11615
Commercial	7105	7211	7319	7429	7541	7654	7761	7870	7980	8091	8205
Public lighting	92	93	94	95	96	97	98	99	100	101	102
Public Water Works	160	170	180	191	203	215	225	237	248	261	274
Irrigation	0	0	0	0	0	0	0	0	0	0	0
LT Industries	1080	1091	1102	1113	1124	1135	1146	1157	1169	1180	1192
HT Industries	1404	1418	1432	1446	1461	1475	1489	1504	1519	1534	1549
Railway Traction	1037	1071	1106	1143	1181	1220	1257	1299	1342	1386	1432
Bulk Supply	0	0	0	0	0	0	0	0	0	0	0
Others (if any)	935	982	1031	1082	1136	1193	1241	1303	1368	1436	1508
Total (Energy Consumption)	20540	21025	21523	22036	22563	23106	23617	24159	24716	25289	25877
T&D losses -MU	1437	1468	1500	1534	1568	1603	1636	1670	1706	1743	1780
T&D losses -in %	6.54	6.53	6.52	6.51	6.50	6.49	6.48	6.47	6.46	6.45	6.44
Energy Requirement - MU	21977	22493	23024	23570	24131	24709	25253	25829	26422	27031	27657
Annual Load Factor - %	67.61	67.41	67.21	67.01	66.81	66.61	66.41	66.21	66.01	65.81	65.61
Peak Load - MW	3710	3809	3910	4015	4123	4234	4341	4453	4569	4689	4812

Table 14.5: Power Forecast of Mumbai

Nagpur



Nagpur

Introduction:

⁴¹Nagpur city, situated in the eastern part of Maharashtra, is the winter capital of the state. It has also recently been ranked as the cleanest city and the second greenest city of India. It is a major commercial and political centre of the Vidarbha region of Maharashtra. Nagpur is also famous throughout the country as “Orange City” for being a major trade centre of oranges that are cultivated in the region. Nagpur lies precisely at the centre of the country with the “Zero Mile Marker” indicating the geographical centre of India.

As of 2011 census, the total municipal area of the city was 217.56 sq. km. and the corresponding population was 24,05,665. However, the report has covered 229.2 sq. km. of the Nagpur Urban Agglomeration that includes Digdoh and Wadi area also. The corresponding population was 24,97,870 as per Census-2011.

Economy⁴²

The pillars for the city’s economy are trade and commerce, service sector, industries, health, and education sector. Nagpur has the presence of industries located in the periphery of the city and in region, which are contributing to city’s economy and support the local economic development. Chemicals, Cements, Coal based, Engineering, Electrical, Electronics, Food Processing, Paper products, Wood based, Pharmaceuticals are some of the industries present in Nagpur. Apart from the industries, there is trade and commerce in the city that comprises of retail and wholesale trade. It is emerging as the largest trading centre for goods and services.

⁴¹ <https://nagpur.gov.in/about-district/>

⁴² City Development Plan 2041, Nagpur (http://www.metrotrainnagpur.com/pdf/Final%20CDP_Nagpur%20-Mar%2015%20of%20NMC.pdf)



(Figure 15.1: Location of Nagpur City)

Climate⁴³

The climate of the city is tropical savannah with dry conditions prevailing for most of the year. The summers are extremely hot and last from March to June. The average annual maximum temp. is 33.8 °C with mean maximum temp. of the hottest month (May) and the coldest month (Dec & Jan) are about 42.7 °C and 29.0 °C respectively. The average annual minimum temp. is 20.6 °C with mean minimum temp. of the hottest and the coldest months are about 27.8 °C and 13.0 °C respectively. The average annual rainfall of the city is 112.8 cm. The rainfall during the southwest monsoon season is about 84% of the annual rainfall. The values of relative humidity are about 61% to 85% in the morning and 49% to 76% in the afternoon during the southwest monsoon season.

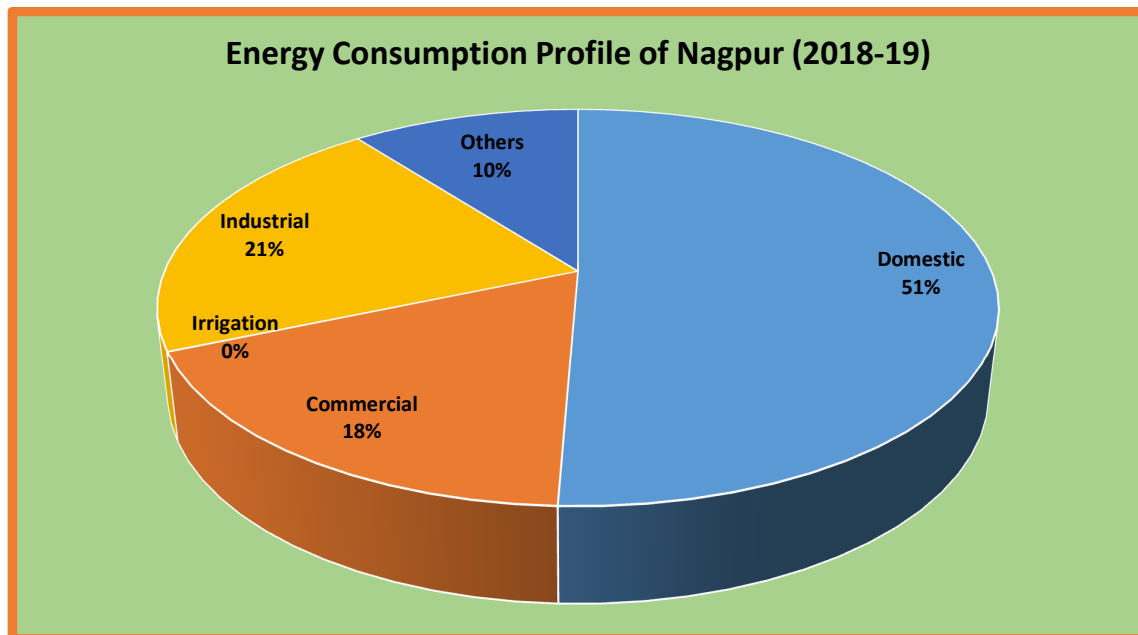
⁴³ <http://www.imdpune.gov.in/caui/smartcities.html>

Brief description of Power Utilities:

The erstwhile Maharashtra State Electricity Board (MSEB) was looking after Generation, Transmission & Distribution of Electricity in Maharashtra barring Mumbai. After the enactment of Electricity Act 2003, MSEB was restructured into 4 Companies viz. MSEB Holding Co. Ltd., Maharashtra State Electricity Distribution Co. Ltd. (Mahavitaran), Maharashtra State Power Generation Co. Ltd. (Mahagenco) and Maharashtra State Electricity Transmission Co. Ltd. (Mahatransco) on 6th June 2005. Mahavitaran distributes electricity to consumers across the state except for some parts of Mumbai where Brihanmumbai Electric Supply and Transport(BEST)- an autonomous body under Municipal Corporation of Greater Mumbai, Tata Power and Adani Power also distribute power.

Existing Power Scenario:

The total electricity consumption of Nagpur in the year 2018-19 was 2153 MU and with 7.68% T&D losses, the requirement was 2332 MU. The peak demand of the city was 632 MW. The Domestic sector was the biggest consumer of electricity (51%) followed by Industrial (21%) and Commercial (18%).



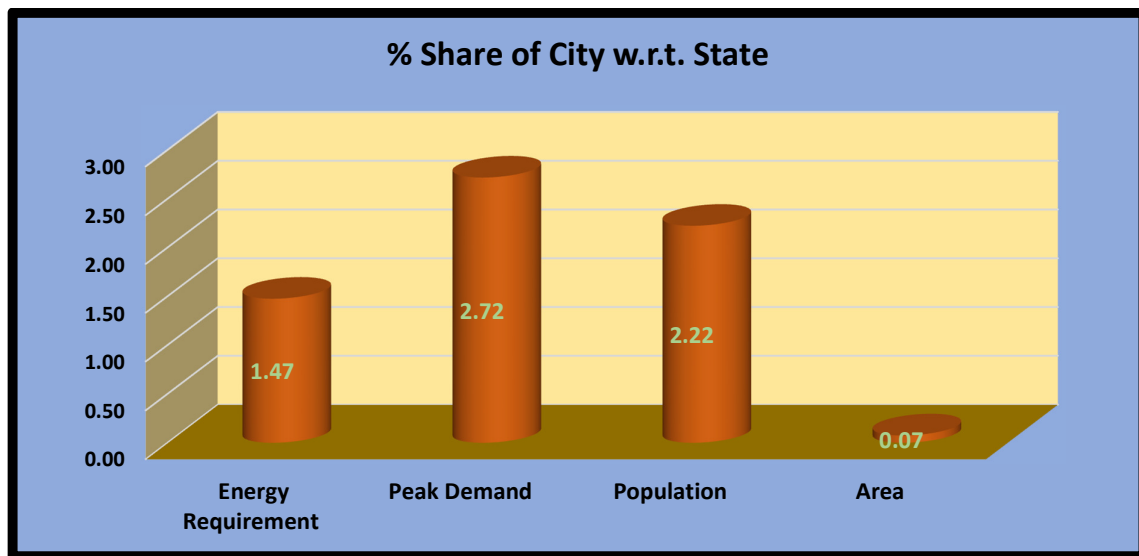
(Figure 15.2: Energy Consumption Profile of Nagpur in 2018-19)

During the last five years (2013-14 to 2018-19), the city has observed CAGR of 2.93% & 4.29% in electricity energy requirement and peak demand respectively.

On comparison of Nagpur with Maharashtra for the year 2018-19, it is observed that the energy requirement of Nagpur was 1.47% of the total energy requirement of the state whereas its contribution in population and area were 2.22% and 0.07% respectively.

Sl. No.	Particulars	Nagpur	Maharashtra	Nagpur as % of Maharashtra
1.	Energy Requirement (in MU)	2332	158157	1.47
2.	Peak Demand (in MW)	632	23254	2.72
3.	Population (2011 Census)	24,97,870	11,23,74,333	2.22
4.	Area (in sq km)	229.20	3,07,713	0.07

(Table 15.1: Comparison of Nagpur with Maharashtra in 2018-19)

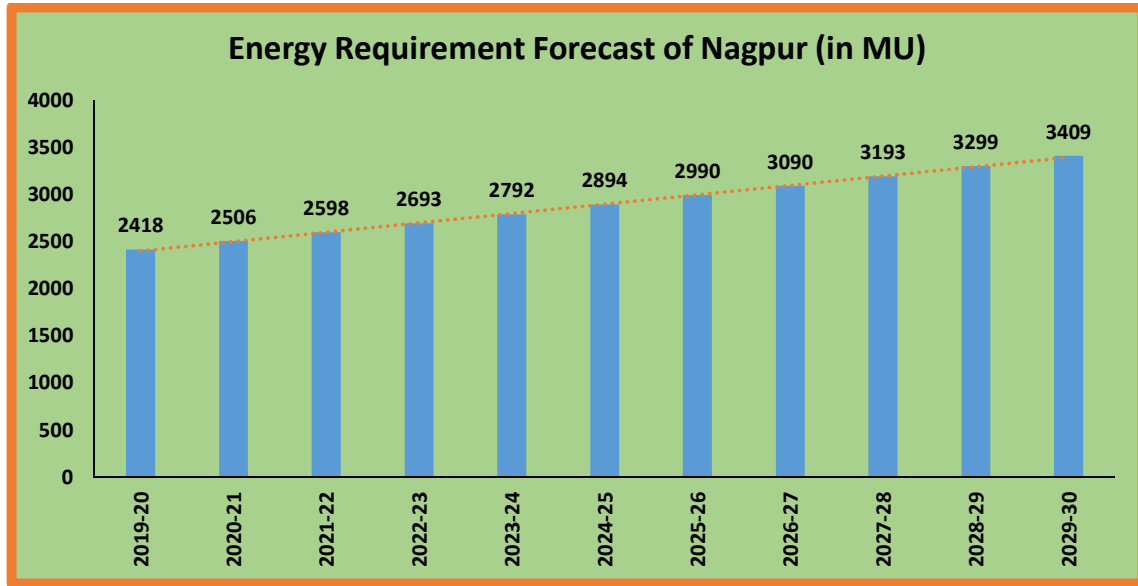


(Figure 15.3: Comparison between Nagpur and Maharashtra in 2018-19)

Power Forecast:

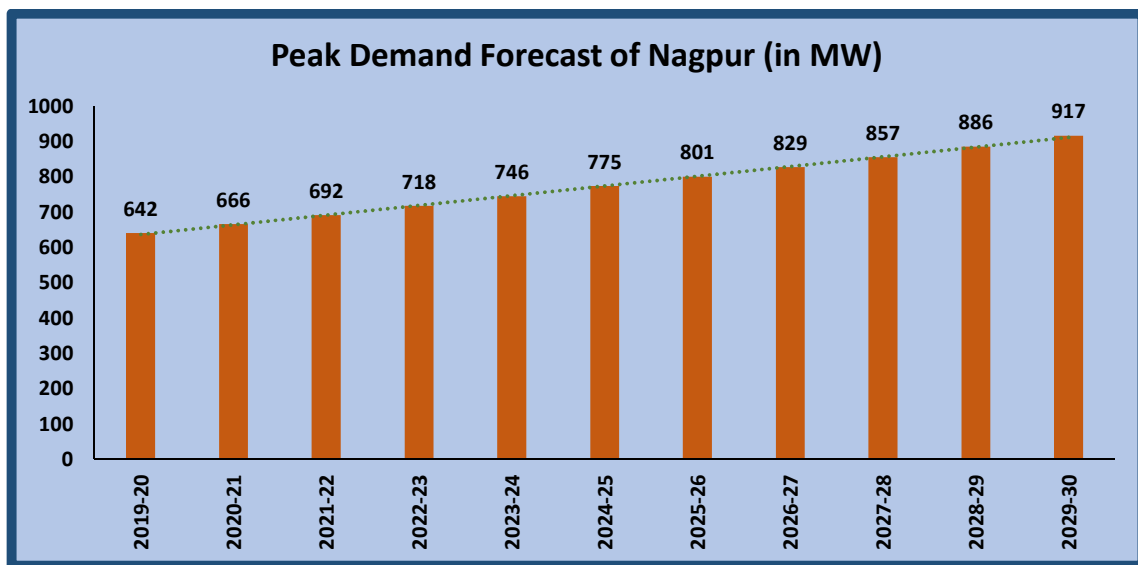
Based on total electricity consumption and T&D Losses, the total energy requirement of Nagpur is estimated as 2418 MU in year 2019-20. It is

expected that the energy requirement of the city will reach to 2894 MU by the year 2024-25 with 3.66% CAGR for the period 2019-20 to 2024-25. With CAGR of 3.33% for the period 2024-25 to 2029-30, its energy requirement is estimated as 3409 MU by the year 2029-30.



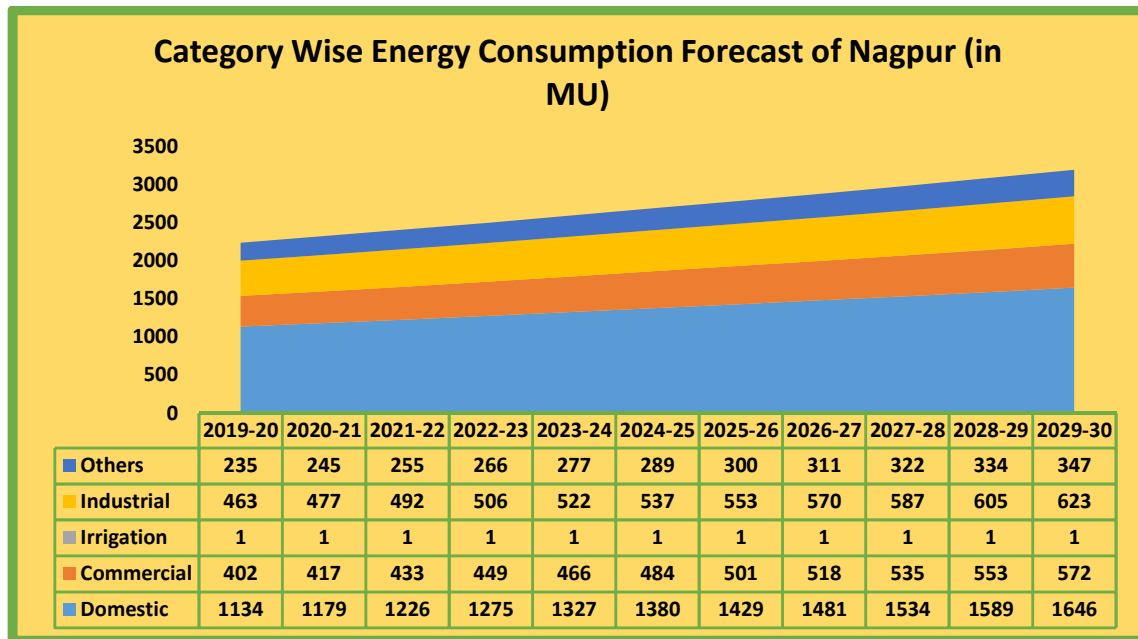
(Figure 15.4: Energy Requirement Forecast of Nagpur in MU)

Peak Demand of the Nagpur is expected to see 3.83% CAGR upto 2024-25 and will reach 775 MW in comparison to 642 MW in year 2019-20. It is expected to reach 917 MW in year 2029-30 with a CAGR of 3.43% after 2024-25.



(Figure 15.5: Peak Demand Forecast of Nagpur in MW)

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



(Figure 15.6: Category Wise Energy Consumption forecast of Nagpur)

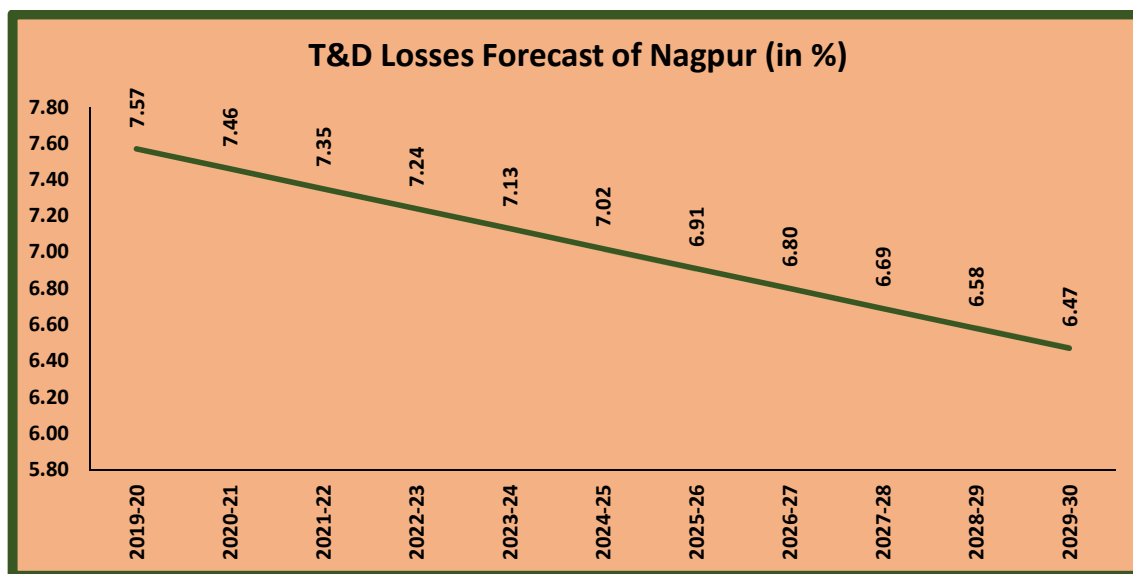
The category wise CAGR expected in energy consumption for the next ten years (2019-20 to 2029-30) along with its break up in five years (2019-20 to 2024-25 & 2025-26 to 2029-30) is tabulated below:

Sl. No.	Category	Energy Consumption (in MU)			CAGR in %		
		2019-20	2024-25	2029-30	2019-20 to 2024-25	2024-25 to 2029-30	2019-20 to 2029-30
1.	Domestic	1134	1380	1646	4.00	3.60	3.80
2.	Commercial	402	484	572	3.80	3.40	3.60
3.	Irrigation	1	1	1	1.00	1.00	1.00
4.	Industrial	463	537	623	3.00	3.00	3.00
5.	Others	235	289	347	4.25	3.70	3.97
6.	Total	2235	2691	3189	3.79	3.46	3.62

(Table 15.2: Expected CAGR of Nagpur - Category Wise Consumption)

Transmission & Distribution Losses:

T&D losses of Nagpur were estimated as 7.68% in year 2018-19. The target level is to bring it down to about 7.02% and 6.47% by the end of 2024-25 & 2029-30 respectively.



(Figure 15.7: T&D Loss Forecast of Nagpur)

The power forecast of Nagpur city is summarized below:

Sl. No.	Particulars	2019-20	2024-25	2029-30	CAGR in %	
					2019-20 to 2024-25	2024-25 to 2029-30
1.	Energy Requirement in MU	2418	2894	3409	3.66	3.33
2.	Peak Demand in MW	642	775	917	3.83	3.43
3.	T&D Losses in %	7.57	7.02	6.47	-	-

(Table 15.3: Power forecast summary of Nagpur)

Analysis of Forecast:

A comparison of actual CAGR witnessed for the Nagpur city during the last five years and the CAGR for future power forecast is tabulated below:

Sl. No.	City/State/Country	CAGR in %		
		2013-14 to 2018-19	2019-20 to 2024-25	2024-25 to 2029-30
1.	Energy Requirement	2.93	3.66	3.33
2.	Peak Demand	4.29	3.83	3.43

(Table 15.4: Actual CAGR in past vis-a-vis CAGR forecast for future for Nagpur)

The above table indicates that Nagpur has witnessed moderate power demand growth in the past and the same trend is expected to continue in future. The peak demand growth of the city is expected to follow its energy growth trajectory.

Nagpur

Electrical Energy Consumption, Energy Requirement and Peak Electricity Demand

(Category Wise and Year Wise Summary)

Year	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30
Domestic	1134	1179	1226	1275	1327	1380	1429	1481	1534	1589	1646
Commercial	402	417	433	449	466	484	501	518	535	553	572
Public lighting	46	48	49	51	52	54	55	57	59	60	62
Public Water Works	58	60	62	64	67	69	71	74	77	79	82
Irrigation	1	1	1	1	1	1	1	1	1	1	1
LT Industries	123	127	131	135	139	143	147	151	156	161	165
HT Industries	340	350	361	372	383	394	406	418	431	444	457
Railway Traction	0	0	0	0	0	0	0	0	0	0	0
Bulk Supply	0	0	0	0	0	0	0	0	0	0	0
Others (if any)	130	137	144	151	159	167	173	180	187	195	203
Total (Energy Consumption)	2235	2319	2407	2498	2592	2691	2784	2880	2979	3082	3189
T&D losses -MU	183	187	191	195	199	203	207	210	214	217	221
T&D losses -in %	7.57	7.46	7.35	7.24	7.13	7.02	6.91	6.80	6.69	6.58	6.47
Energy Requirement - MU	2418	2506	2598	2693	2792	2894	2990	3090	3193	3299	3409
Annual Load Factor - %	43.00	42.93	42.86	42.79	42.72	42.65	42.61	42.57	42.53	42.49	42.45
Peak Load - MW	642	666	692	718	746	775	801	829	857	886	917

Table 15.5: Power Forecast of Nagpur

Port Blair



Port Blair

Introduction:

⁴⁴Port Blair is the capital of Andaman and Nicobar Islands and it is the largest city of the Union Territory. The city has a rich history associated with the freedom struggle. The many historical structures and the pristine beaches make it a happening tourist destination attracting 2.5 lakh tourists per year. The city is connected with the mainland through air and sea from Chennai, Kolkata and Visakhapatnam. As of 2011 census, the population of city was 1,08,058. The total municipal area of the city is 17.91 sq. km.



(Figure 16.1: Location of Port Blair City)

⁴⁴ Port Blair Smart City Proposal(http://smartcities.gov.in/upload/uploadfiles/files/PBMC_SCP.pdf)

Economy

As an isolated island, the city is relatively lagging in economic development and employment generation. Primary sector of economy is non-existent and high transportation cost to mainland makes its secondary sector products, if any, non-competitive. In this scenario, economic growth is dominated by the tertiary sector of economy. The economy of the city is driven chiefly by tourism and fisheries industry.

Climate⁴⁵

The climate of the city is tropical monsoon type with little variation in average temperature and large amount of precipitation throughout the year except January to April. The average annual maximum temp. is 30.1 °C with mean maximum temp. of the hottest month (April) and the coldest month (Feb) are about 32.3 °C and 30.2 °C respectively. The average annual minimum temp. is 23.3 °C with mean minimum temp. of the hottest and the coldest months are about 24.1 °C and 22.1 °C respectively. The average annual rainfall of the city is 304.0 cm. The rainfall during the southwest monsoon season is about 59% of the annual rainfall. The values of relative humidity are about 82% to 84% in the morning and 84% to 87% in the afternoon during the southwest monsoon season.

Brief description of Power Utilities⁴⁶:

The Electricity Department of Andaman & Nicobar is operating & maintaining power generation, transmission & distribution system and networks in this UT. This department also functions as a Nodal Agency for implementing Renewable Energy Programme of the Ministry of New & Renewable Energy Sources.

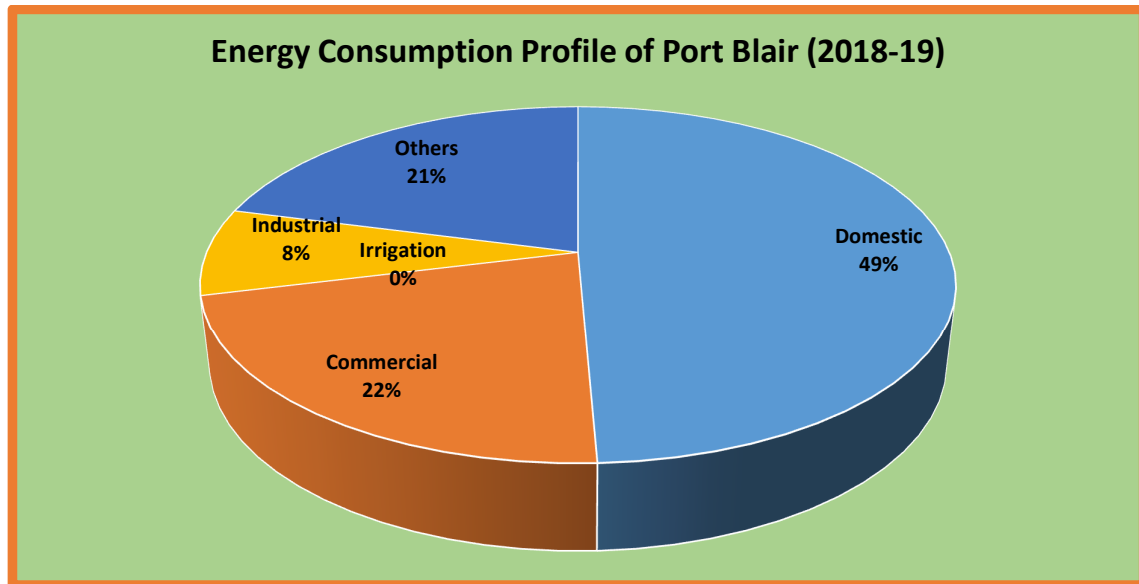
Existing Power Scenario:

The total electricity consumption of Port Blair in the year 2018-19 was 189 MU and with 20.09% T&D losses, the requirement was 237 MU. The peak

⁴⁵ <http://www.imdpune.gov.in/caui/smartcities.html>

⁴⁶ Official site of energy department of A&N (<http://electricity.and.nic.in/>)

demand of the city was 36 MW. The Domestic sector was the biggest consumer of electricity (49%) followed by Commercial (22%).



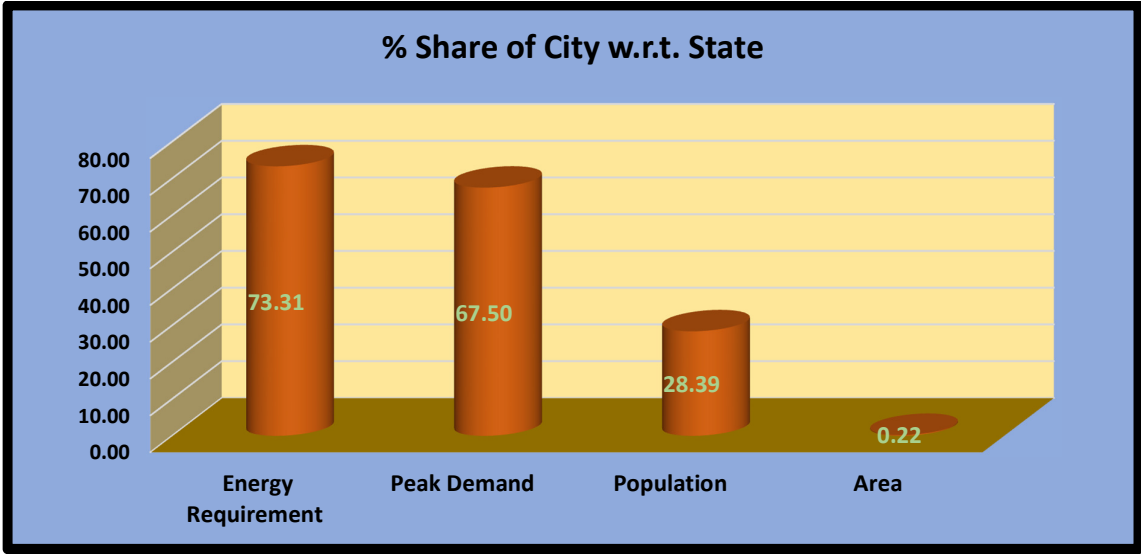
(Figure 16.2: Energy Consumption Profile of Port Blair in 2018-19)

During the last five years (2013-14 to 2018-19), the city has observed CAGR of 3.11% & 2.99% in electricity energy requirement and peak demand respectively.

On comparison of Port Blair with Andaman & Nicobar for the year 2018-19, it is observed that the energy requirement of Port Blair was 73.31% of the total energy requirement of the state whereas its contribution in population and area were only 28.39% and 0.22% respectively.

Sl. No.	Particulars	Port Blair	Andaman & Nicobar	Port Blair as % of Andaman & Nicobar
1.	Energy Requirement (in MU)	237	323	73.31
2.	Peak Demand (in MW)	36	54	67.50
3.	Population (2011 Census)	1,08,058	3,80,581	28.39
4.	Area (in sq km)	17.91	8,249	0.22

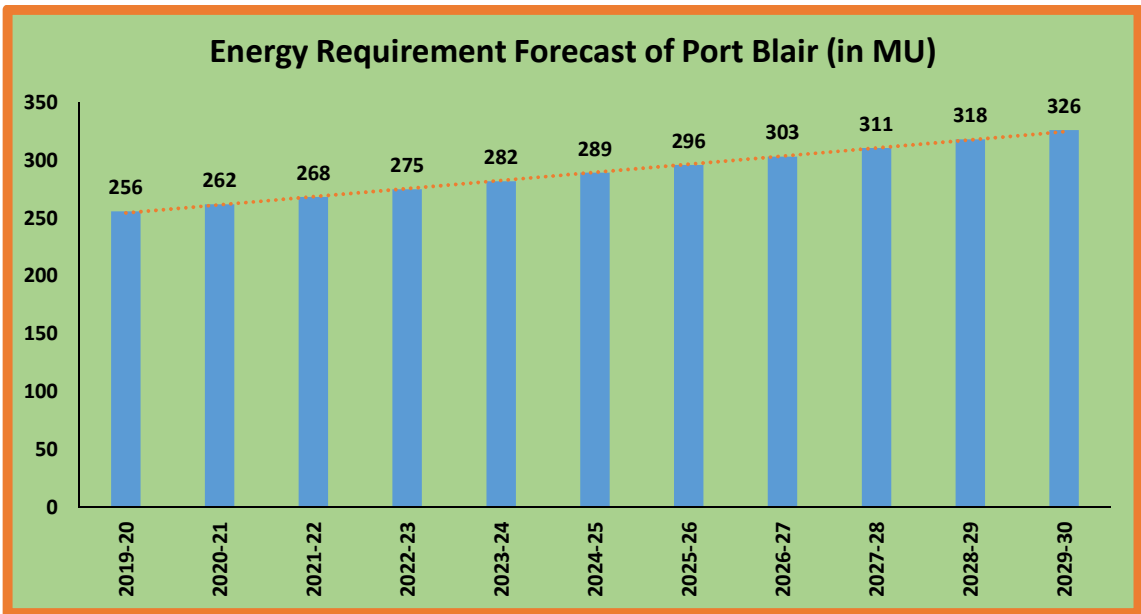
(Table 16.1: Comparison of Port Blair with Andaman & Nicobar in 2018-19)



(Figure 16.3: Comparison between Port Blair and Andaman & Nicobar in 2018-19)

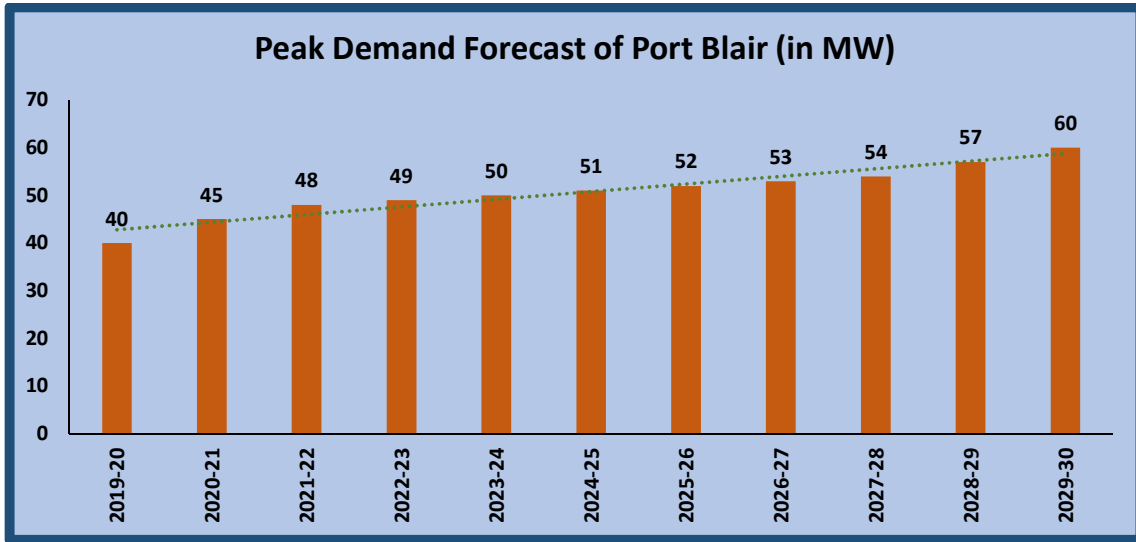
Power Forecast:

Based on total electricity consumption and T&D Losses, the total energy requirement of Port Blair is estimated as 256 MU in year 2019-20. It is expected that the energy requirement of the city will reach to 289 MU by the year 2024-25 with 2.47% CAGR for the period 2019-20 to 2024-25. With CAGR of 2.43% for the period 2024-25 to 2029-30, its energy requirement is estimated as 326 MU by the year 2029-30.



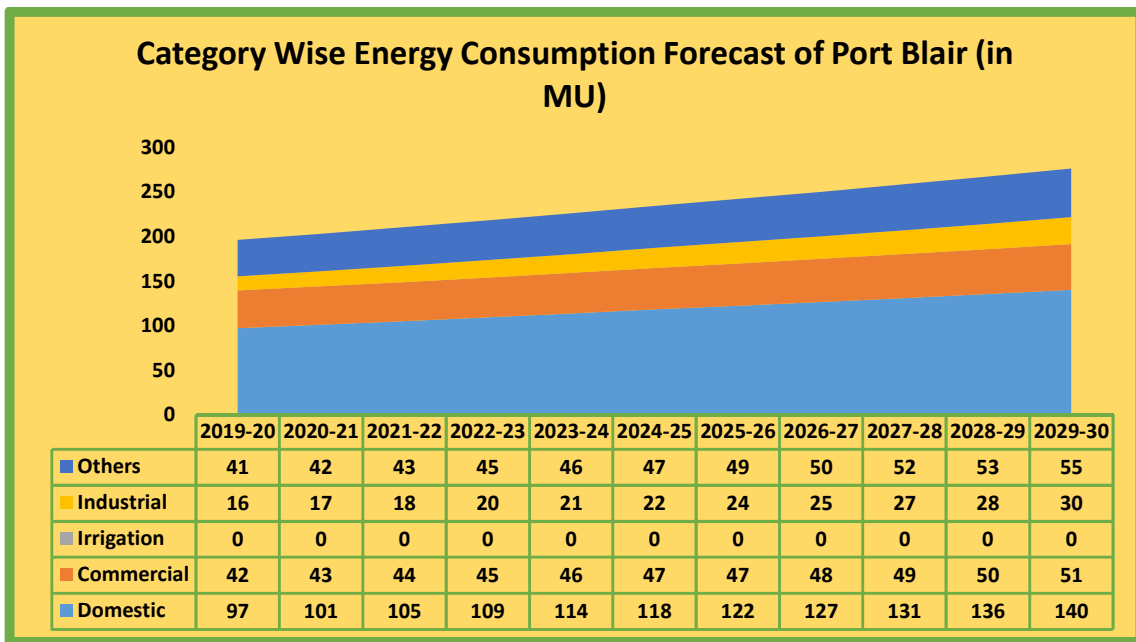
(Figure 16.4: Energy Requirement Forecast of Port Blair in MU)

Peak Demand of the Port Blair is expected to see 4.98% CAGR upto 2024-25 and will reach 51 MW in comparison to 40 MW in year 2019-20. It is expected to reach 60 MW in year 2029-30 with a CAGR of 3.30% after 2024-25.



(Figure 16.5: Peak Demand Forecast of Port Blair in MW)

The category wise energy consumption forecast of Port Blair are as follows:



(Figure 16.6: Category Wise Energy Consumption forecast of Port Blair)

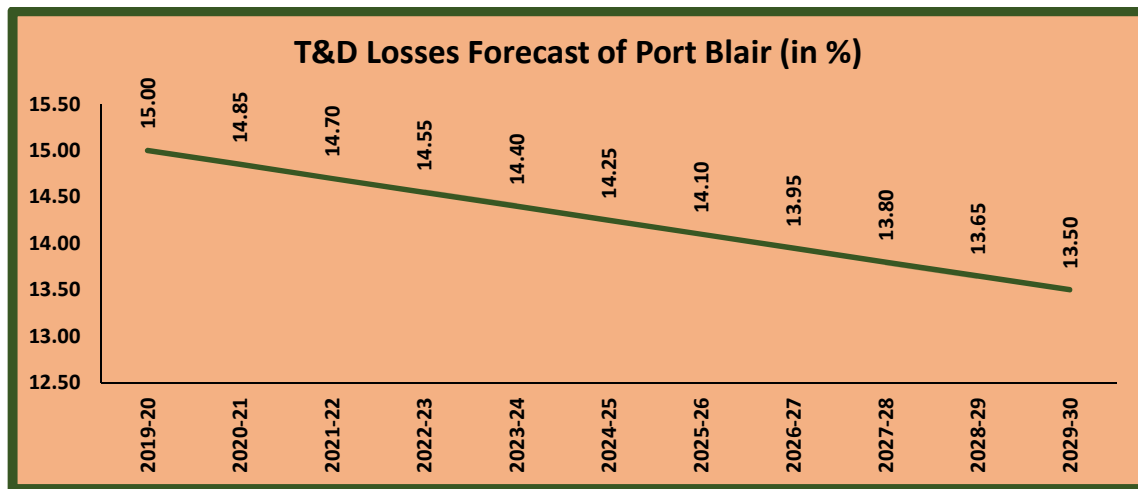
The category wise CAGR expected in energy consumption for the next ten years (2019-20 to 2029-30) along with its break up in five years (2019-20 to 2024-25 & 2025-26 to 2029-30) is tabulated below:

Sl. No.	Category	Energy Consumption (in MU)			CAGR in %		
		2019-20	2024-25	2029-30	2019-20 to 2024-25	2024-25 to 2029-30	2019-20 to 2029-30
1.	Domestic	97	118	140	4.00	3.50	3.75
2.	Commercial	42	47	51	2.00	2.00	2.00
3.	Irrigation	0	0	0	-	-	-
4.	Industrial	16	22	30	7.00	6.00	6.50
5.	Others	41	47	55	2.97	2.94	2.95
6.	Total	196	234	276	3.63	3.35	3.49

(Table 16.2: Expected CAGR of Port Blair - Category Wise Consumption)

Transmission & Distribution Losses:

T&D losses of Port Blair were estimated as 20.09% in year 2018-19. The target level is to bring it down to about 14.25% and 13.50% by the end of 2024-25 & 2029-30 respectively.



(Figure 16.7: T&D Loss Forecast of Port Blair)

The power forecast of Port Blair city is summarized below:

Sl. No.	Particulars	2019-20	2024-25	2029-30	CAGR in %	
					2019-20 to 2024-25	2024-25 to 2029-30
1.	Energy Requirement in MU	256	289	326	2.47	2.43
2.	Peak Demand in MW	40	51	60	4.98	3.30
3.	T&D Losses in %	15.00	14.25	13.50	-	-

(Table 16.3: Power forecast summary of Port Blair)

Analysis of Forecast:

A comparison of actual CAGR witnessed for the Port Blair city during the last five years and the CAGR for future power forecast is tabulated below:

Sl. No.	City/State/Country	CAGR in %		
		2013-14 to 2018-19	2019-20 to 2024-25	2024-25 to 2029-30
1.	Energy Requirement	3.11	2.47	2.43
2.	Peak Demand	2.99	4.98	3.30

(Table 16.4: Actual CAGR in past vis-a-vis CAGR forecast for future for Port Blair)

The power generation and distribution system of Andaman and Nicobar Islands are served by standalone systems and each island has its own generation & distribution system and there is no single power grid. Due to geographical isolation of islands by sea over great distances, the consumption of electrical energy is heavily restricted by the generation capacity of the individual island. Accordingly, the power demand growth of the Port Blair is estimated by keeping in view the generation capacity augmentation plan of the South Andaman also in addition to the energy consumption trends witnessed in the past.

Port Blair

Electrical Energy Consumption, Energy Requirement and Peak Electricity Demand

Year	(Category Wise and Year Wise Summary)												
	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30		
Domestic	97	101	105	109	114	118	122	127	131	136	140		
Commercial	42	43	44	45	46	47	47	48	49	50	51		
Public lighting	5	5	5	5	5	5	5	6	6	6	6		
Public Water Works	0	0	0	0	0	0	0	0	0	0	0		
Irrigation	0	0	0	0	0	0	0	0	0	0	0		
LT Industries	16	17	18	20	21	22	24	25	27	28	30		
HT Industries	0	0	0	0	0	0	0	0	0	0	0		
Railway Traction	0	0	0	0	0	0	0	0	0	0	0		
Bulk Supply	0	0	0	0	0	0	0	0	0	0	0		
Others (if any)	36	37	38	39	41	42	43	44	46	47	49		
Total (Energy Consumption)	196	203	210	218	226	234	242	250	259	267	276		
T&D losses -MU	60	59	58	57	56	55	54	53	52	51	50		
T&D losses -in %	15.00	14.85	14.70	14.55	14.40	14.25	14.10	13.95	13.80	13.65	13.50		
Energy Requirement - MU	256	262	268	275	282	289	296	303	311	318	326		
Annual Load Factor - %	73.06	66.48	63.83	64.08	64.38	64.75	65.00	65.30	65.65	63.73	62.07		
Peak Load - MW	40	45	48	49	50	51	52	53	54	57	60		

Table 16.5: Power Forecast of Port Blair

Pune



Pune

Introduction:

Pune is the second largest city in Maharashtra and the ninth most populous city in India. The metropolitan area consists of two municipal corporations (including Pune) and three cantonments. Pune is located 150 km south-east of Mumbai, and the two cities are connected by an express highway.

As per Census 2011, the total population of the Pune city was 31,24,458 lakhs and it had grown with annual rate of 2.08% for the period 2001 to 2011. The total municipal area of the city is 249.29 sq. km. However, the report has covered 502.78 sq. km. of the Pune Urban Agglomeration spanning over two municipal corporations viz. Pune Municipal Corporation and Pimpri Chinchwad Corporation that includes Pune Cantonment, Kirkee Cantonment, Pimpri Chinchwad, Dehu Road Cantonment, Dehu area also. The corresponding population was 50,57,709 as per Census-2011.

Economy⁴⁷

Pune has historically been an important economic hub in Maharashtra and continues to be so today, owing to the growing number of industries in the region - the automotive sector being most prominent. The industrial township of Pimpri-Chinchwad, just north of Pune city, houses over 4000 manufacturing units that contribute to the city's economy. Pune is also the headquarters (south command) of the Indian Air Force and a large military training base. IT and education are the other dominant sectors that attract a large population of young professionals to the city.

⁴⁷ Pune Smart City Plan (http://smartcities.gov.in/upload/uploadfiles/files/Maharashtra_Pune.pdf)



(Figure 17.1: Location of Pune City)

Climate⁴⁸

The climate of the city is characterized by hot and dry in summer and cool in winter season. The average annual maximum temp. is 31.7 °C with mean maximum temp. of the hottest months(April-May) and the coldest months(Jan-Dec) are about 37.3 °C and 29.7 °C respectively. The average annual minimum temp. is 17.8 °C with mean minimum temp. of the hottest and the coldest months are about 21.1 °C and 11.3 °C respectively. The average annual rainfall of the city is 76.3 cm. The rainfall during the southwest monsoon season is about 79% of the annual rainfall. The values of relative humidity during southwest monsoon are about 77% to 86% in the morning and 66% to 79% in the afternoon.

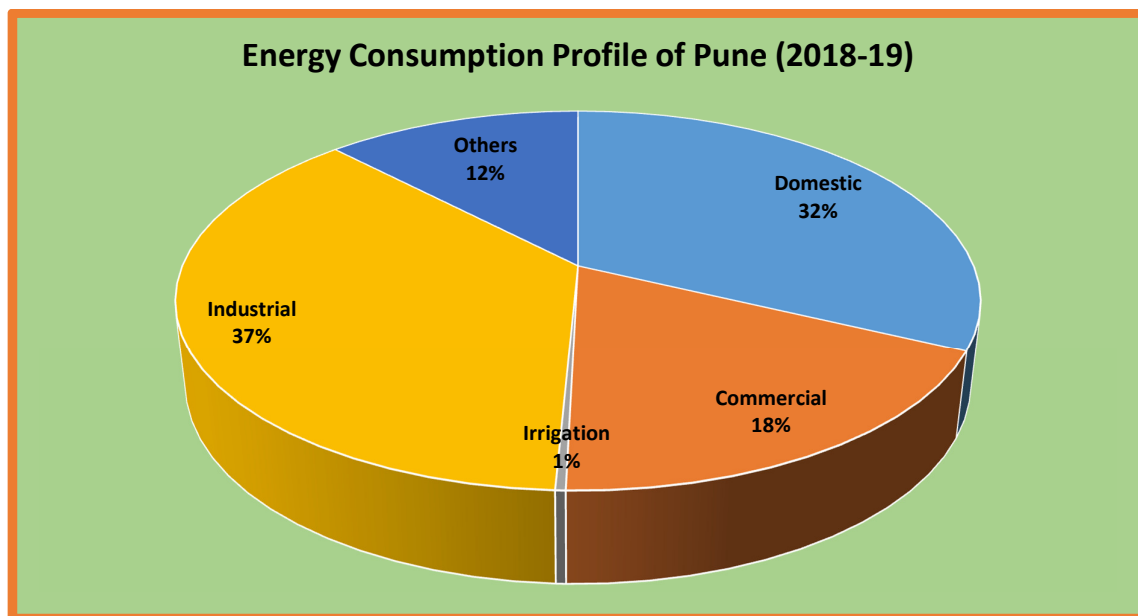
⁴⁸ <http://www.imdpune.gov.in/caui/smartcities.html>

Brief description of Power Utilities: ⁴⁹

The erstwhile Maharashtra State Electricity Board (MSEB) was looking after Generation, Transmission & Distribution of Electricity in Maharashtra barring Mumbai. After the enactment of Electricity Act 2003, MSEB was restructured into 4 Companies viz. MSEB Holding Co. Ltd., Maharashtra State Electricity Distribution Co. Ltd. (Mahavitaran), Maharashtra State Power Generation Co. Ltd. (Mahagenco) and Maharashtra State Electricity Transmission Co. Ltd. (Mahatransco) on 6th June 2005. Mahavitaran distributes electricity to consumers across the state except for some parts of Mumbai where Brihanmumbai Electric Supply and Transport (BEST)- an autonomous body under Municipal Corporation of Greater Mumbai, Tata Power and Adani Power also distribute power.

Existing Power Scenario:

The total electricity consumption of Pune in the year 2018-19 was 8877 MU and with 8.58% T&D losses, the requirement was 9710 MU. The peak demand of the city was 1894 MW. The Industrial sector was the biggest consumer of electricity (37%) followed by Domestic (32%) and Commercial (18%).



(Figure 17.2: Energy Consumption Profile of Pune in 2018-19)

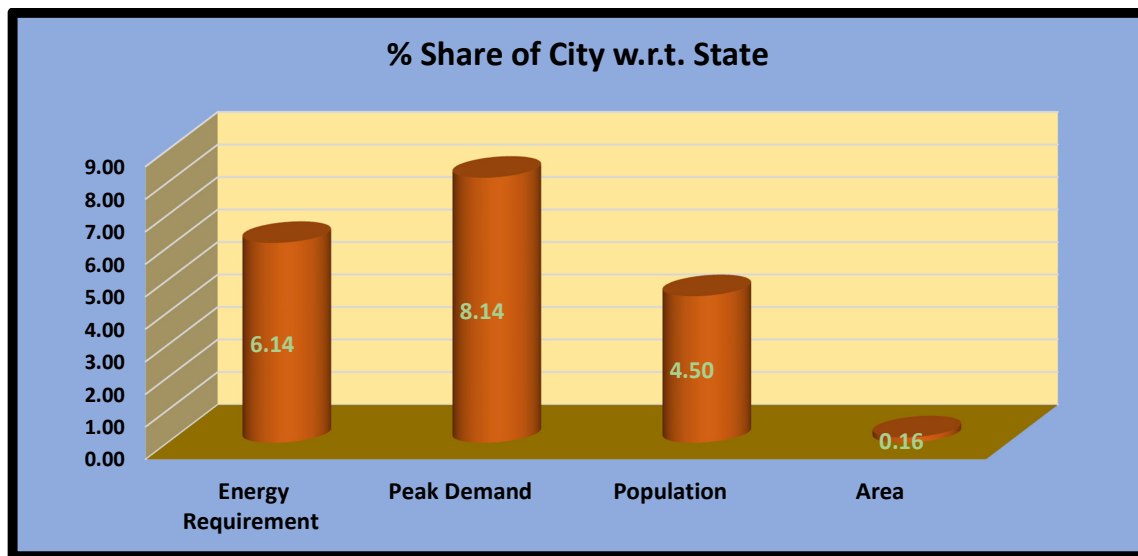
⁴⁹ Official Website of Mahavitaran (<http://www.mahadiscom.in/msedcl-profile/>)

During the last five years (2013-14 to 2018-19), the city has observed CAGR of 5.36% & 6.50% in electricity energy requirement and peak demand respectively.

On comparison of Pune with Maharashtra for the year 2018-19, it is observed that the energy requirement of Pune was 6.14% of the total energy requirement of the state whereas its contribution in population and area were only 4.50% and 0.16% respectively.

Sl. No.	Particulars	Pune	Maharashtra	Pune as % of Maharashtra
1.	Energy Requirement (in MU)	9710	158157	6.14
2.	Peak Demand (in MW)	1894	23254	8.14
3.	Population (2011 Census)	50,57,709	11,23,74,333	4.50
4.	Area (in sq km)	502.78	3,07,713	0.16

(Table 17.1: Comparison of Pune with Maharashtra in 2018-19)

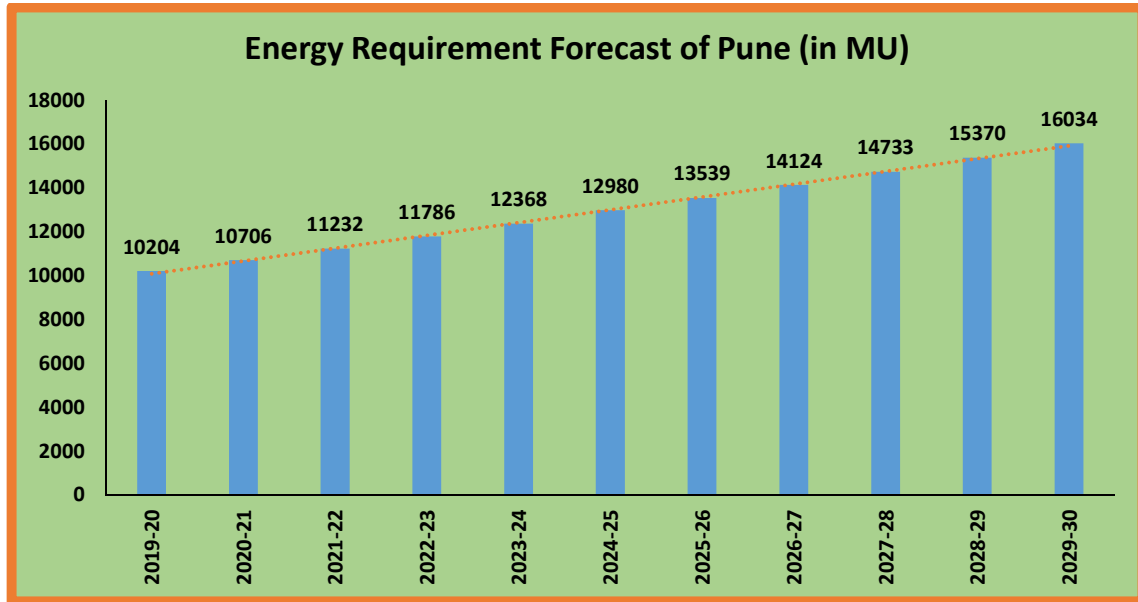


(Figure 17.3: Comparison between Pune and Maharashtra in 2018-19)

Power Forecast:

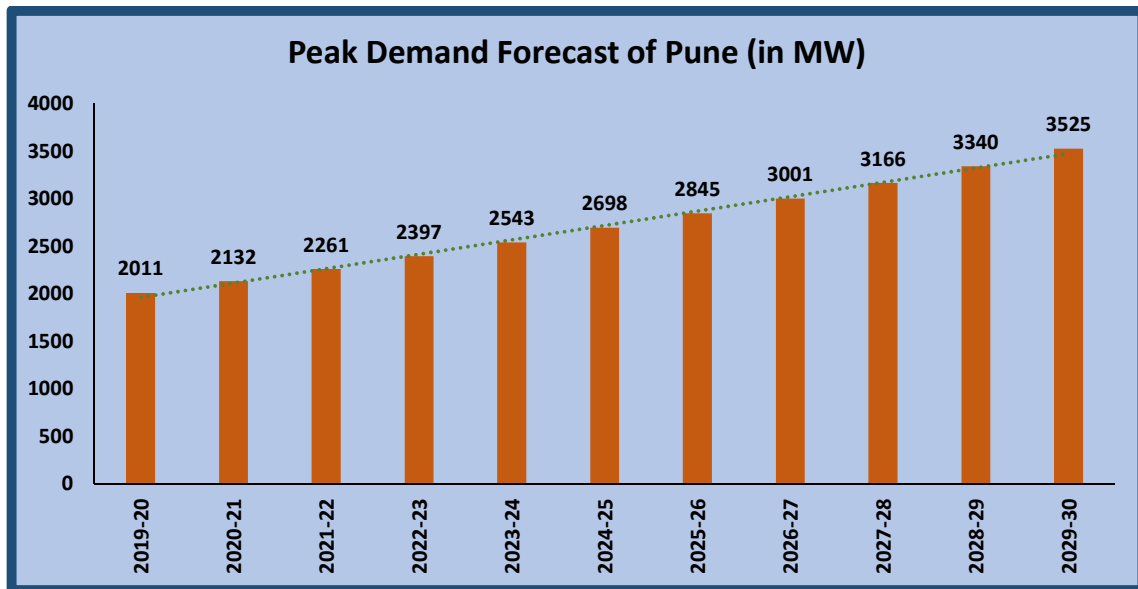
Based on total electricity consumption and T&D Losses, the total energy requirement of Pune is estimated as 10204 MU in year 2019-20. It is expected

that the energy requirement of the city will reach to 12980 MU by the year 2024-25 with 4.93% CAGR for the period 2019-20 to 2024-25. With CAGR of 4.32% for the period 2024-25 to 2029-30, its energy requirement is estimated as 16034 MU by the year 2029-30.



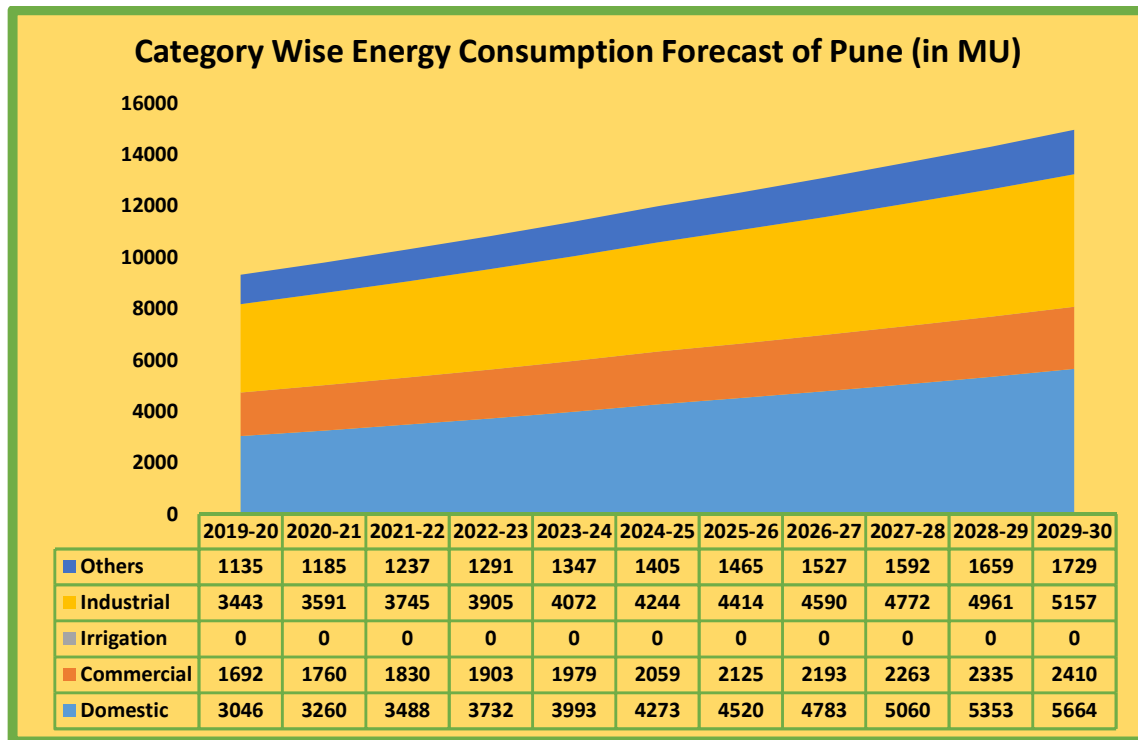
(Figure 17.4: Energy Requirement Forecast of Pune in MU)

Peak Demand of the Pune is expected to see 6.05% CAGR upto 2024-25 and will reach 2698 MW in comparison to 2011 MW in year 2019-20. It is expected to reach 3525 MW in year 2029-30 with a CAGR of 5.50% after 2024-25.



(Figure 17.5: Peak Demand Forecast of Pune in MW)

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



(Figure 17.6: Category Wise Energy Consumption forecast of Pune)

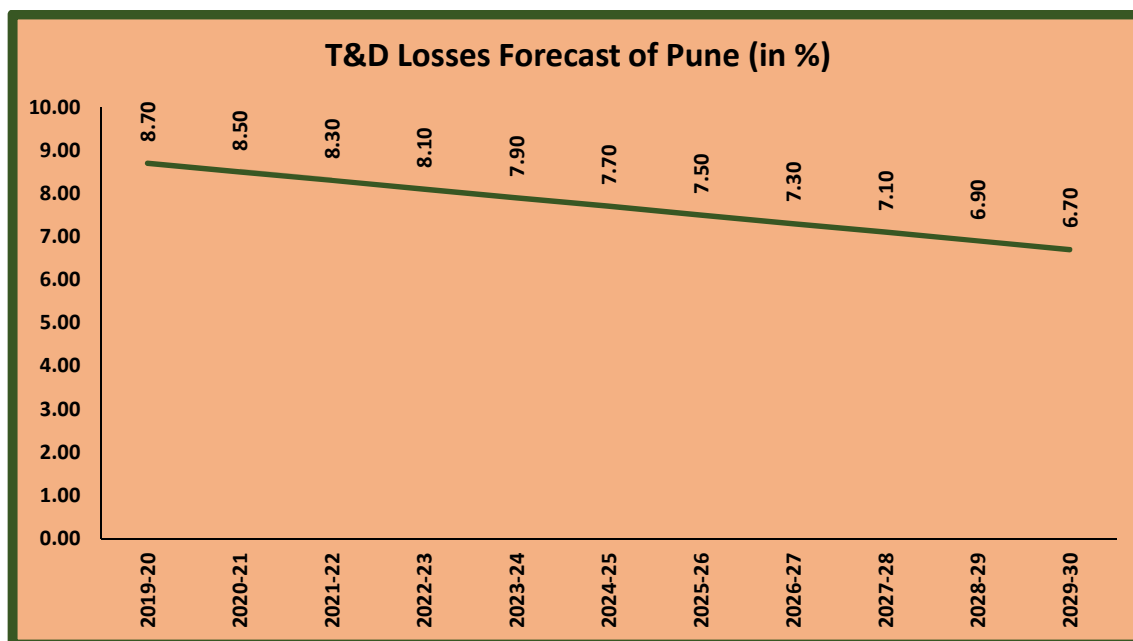
The category wise CAGR expected in energy consumption for the next ten years (2019-20 to 2029-30) along with its break up in five years (2019-20 to 2024-25 & 2025-26 to 2029-30) is tabulated below:

Sl. No.	Category	Energy Consumption (in MU)			CAGR in %		
		2019-20	2024-25	2029-30	2019-20 to 2024-25	2024-25 to 2029-30	2019-20 to 2029-30
1.	Domestic	3046	4273	5664	7.00	5.80	6.40
2.	Commercial	1692	2059	2410	4.00	3.20	3.60
3.	Irrigation	0	0	0	-	-	-!
4.	Industrial	3443	4244	5157	4.27	3.97	4.12
5.	Others	1135	1405	1729	4.36	4.25	4.30
6.	Total	9317	11980	14960	5.16	4.54	4.85

(Table 17.2: Expected CAGR of Pune - Category Wise Consumption)

Transmission & Distribution Losses:

T&D losses of Pune were estimated as 8.58% in year 2018-19. The target level is to bring it down to about 7.70% and 6.70% by the end of 2024-25 & 2029-30 respectively.



(Figure 17.7: T&D Loss Forecast of Pune)

The power forecast of Pune city is summarized below:

Sl. No.	Particulars	2019-20	2024-25	2029-30	CAGR in %	
					2019-20 to 2024-25	2024-25 to 2029-30
1.	Energy Requirement in MU	10204	12980	16034	4.93	4.32
2.	Peak Demand in MW	2011	2698	3525	6.05	5.50
3.	T&D Losses in %	8.70	7.70	6.70	-	-

(Table 17.3: Power forecast summary of Pune)

Analysis of Forecast:

A comparison of actual CAGR witnessed for the Pune city during the last five years and the CAGR for future power forecast is tabulated below:

Sl. No.	City/State/Country	CAGR in %		
		2013-14 to 2018-19	2019-20 to 2024-25	2024-25 to 2029-30
1.	Energy Requirement	5.36	4.93	4.32
2.	Peak Demand	6.50	6.05	5.50

(Table 17.4: Actual CAGR in past vis-a-vis CAGR forecast for future for Pune)

The above table indicates that the power demand growth of Pune is expected to follow the trends witnessed in the past. The peak demand growth rate of the city is expected to be more in comparison to its energy requirement growth. Among the mega cities of the state of Maharashtra covered in the report (i.e. Mumbai, Pune, Nagpur & Aurangabad), the Pune city is expected to witness the highest power demand growth.

Pune

Electrical Energy Consumption, Energy Requirement and Peak Electricity Demand

(Category Wise and Year Wise Summary)												
Year	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	
Domestic	3046	3260	3488	3732	3993	4273	4520	4783	5060	5353	5664	
Commercial	1692	1760	1830	1903	1979	2059	2125	2193	2263	2335	2410	
Public lighting	126	132	139	146	154	161	169	177	185	193	202	
Public Water Works	330	340	349	358	368	377	386	395	403	412	421	
Irrigation	0	0	0	0	0	0	0	0	0	0	0	
LT Industries	742	777	814	851	890	929	969	1009	1051	1093	1135	
HT Industries	2702	2814	2931	3054	3182	3316	3446	3581	3722	3868	4021	
Railway Traction	0	0	0	0	0	0	0	0	0	0	0	
Bulk Supply	0	0	0	0	0	0	0	0	0	0	0	
Others (if any)	679	713	749	786	826	867	910	956	1004	1054	1107	
Total (Energy Consumption)	9317	9796	10300	10831	11391	11980	12524	13093	13687	14309	14960	
T&D losses -MU	888	910	932	955	977	999	1015	1031	1046	1060	1074	
T&D losses -in %	8.70	8.50	8.30	8.10	7.90	7.70	7.50	7.30	7.10	6.90	6.70	
Energy Requirement - MU	10204	10706	11232	11786	12368	12980	13539	14124	14733	15370	16034	
Annual Load Factor - %	57.92	57.32	56.72	56.12	55.52	54.92	54.32	53.72	53.12	52.52	51.92	
Peak Load - MW	2011	2132	2261	2397	2543	2698	2845	3001	3166	3340	3525	

Table 17.5: Power Forecast of Pune

Ranchi



Ranchi

Introduction:

Ranchi is the capital of the Indian state of Jharkhand, and now it is the most populous city of the state. The city is located in the southern part of the Chota Nagpur Plateau and is growing and expanding at a rapid pace. Increased economic activities and infrastructure development have resulted in extensive urbanization, as a result of which urban and semi-urban areas are expanding.

As of 2011 census, the population of city was 10,73,427. The total municipal area of the city is 175.12 sq. km. However, the report has covered 197 sq. km. of the Ranchi Urban Agglomeration that includes Kanke, Arsande, Ara, Bargarwa and Tundiul area also. The corresponding population was 11,26,720 as per Census-2011.



(Figure 18.1: Location of Ranchi City)

Economy⁵⁰

Ranchi is an important center of trade & commerce and also an important industrial center in Jharkhand. Due to the presence of good reserves of forest and mineral resources is considered to be a good place for setting up medium and large scale industries. A large number of engineering & mining industries present in the city provide employment opportunities to a major portion of its population. The city is surrounded by a large & green forest area, which provides many basic raw materials to a large number of industries like construction, furniture, match box, paper, rayon, railway slippers, wooden poles, etc.

Climate⁵¹

The climate of the city is characterized by a dry hot summer, mild humid post monsoon season and well distributed rainfall during the monsoon season. The average annual maximum temp. is 29.6 °C with mean maximum temp. of the hottest month (May) and the coldest month (Dec & Jan) are about 36.8 °C and 24.0 °C respectively. The average annual minimum temp. is 18.0 °C with mean minimum temp. of the hottest and the coldest months are about 23.3 °C and 10.0 °C respectively. The average annual rainfall of the city is 143.3 cm. The rainfall during the southwest monsoon season is about 82% of the annual rainfall. The values of relative humidity are about 42% to 87% in the morning and 29% to 83% in the afternoon. The values of relative humidity are high during southwest monsoon season and vary from 64% to 87%.

Brief description of Power Utilities:

In compliance of the Electricity Act, 2003, the State has restructured the erstwhile Jharkhand State Electricity Board (JSEB) with effect from January 6, 2014, into the following four entities⁵²:

⁵⁰ <https://ranchi.nic.in/economy/>

⁵¹ <http://www.imdpune.gov.in/caui/smartcities.html>

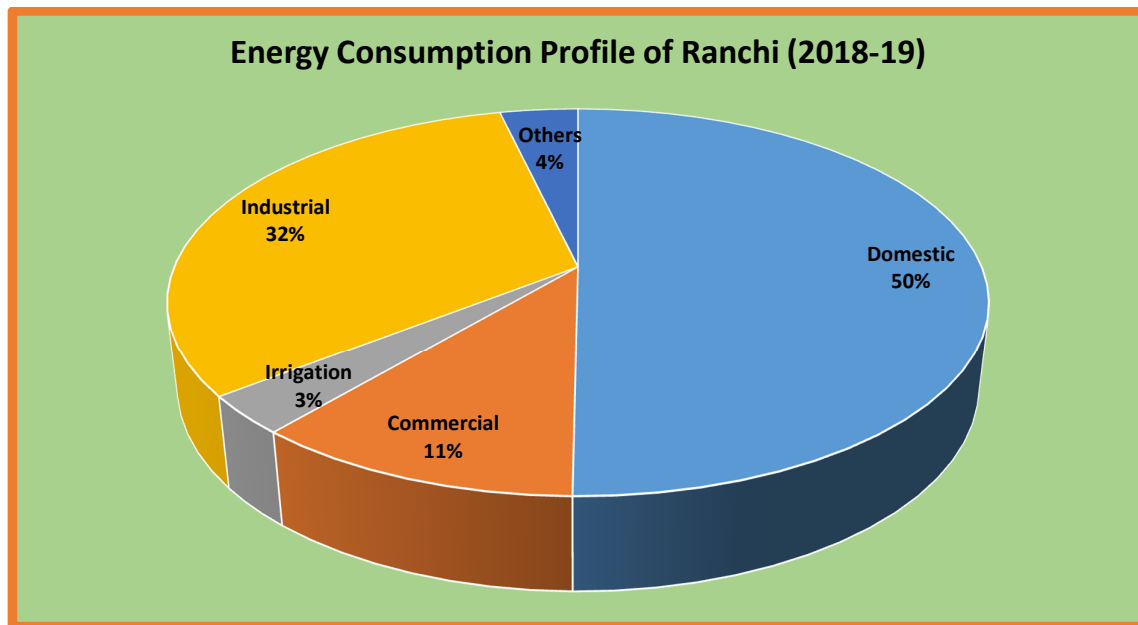
⁵² https://powermin.nic.in/sites/default/files/uploads/joint_initiative_of_govt_of_india_and_jharkhand.pdf

- Jharkhand Urja Vikas Nigam Ltd. (JUVNL) - Holding Company
- Jharkhand Urja Utpadan Nigam Ltd. (JUUNL) - Generating Company
- Jharkhand Urja Sancharan Nigam Ltd. (JUSNL) - Transmission Company & SLDC
- Jharkhand Bijli Vitaran Nigam Ltd.(JBVNL) - Distribution Company

Jharkhand is amongst the few states in the country to have multiple distribution licensees with overlapping areas of supply. JBVNL is the largest distribution company whereas Damodar Valley Corporation (DVC), Tata Steel, SAIL & Tata Steel Utilities and Infrastructure Services Ltd. (TSUISL)⁵³ are other distribution licensees operating in the state. The city of Ranchi is served by JBVNL.

Existing Power Scenario:

The total electricity consumption of Ranchi in the year 2018-19 was 1573 MU and with 16.24% T&D losses, the requirement was 1879 MU. The peak demand of the city was 290 MW. The Domestic sector was the biggest consumer of electricity (50%) followed by Industrial (32%) and Commercial (11%).



(Figure 18.2: Energy Consumption Profile of Ranchi in 2018-19)

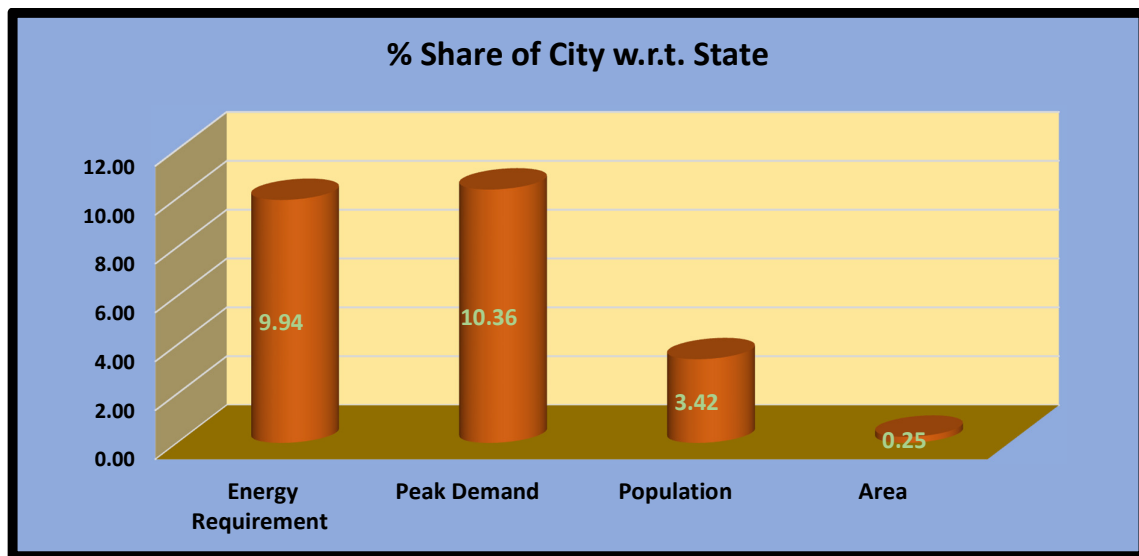
⁵³ Earlier named as Jamshedpur Utility Services Company Limited (JUSCO)

During the last five years (2013-14 to 2018-19), the city has observed CAGR of 3.44% & 5.08% in electricity energy requirement and peak demand respectively.

On comparison of Ranchi with Jharkhand for the year 2018-19, it is observed that the energy requirement of Ranchi was 9.94% of the total energy requirement of the state whereas its contribution in population and area were only 3.42% and 0.25% respectively.

Sl. No.	Particulars	Ranchi	Jharkhand	Ranchi as % of Jharkhand
1.	Energy Requirement (in MU)	1879	18902	9.94
2.	Peak Demand (in MW)	290	2798	10.36
3.	Population (2011 Census)	11,26,720	3,29,88,134	3.42
4.	Area (in sq km)	197	79,716	0.25

(Table 18.1: Comparison of Ranchi with Jharkhand in 2018-19)

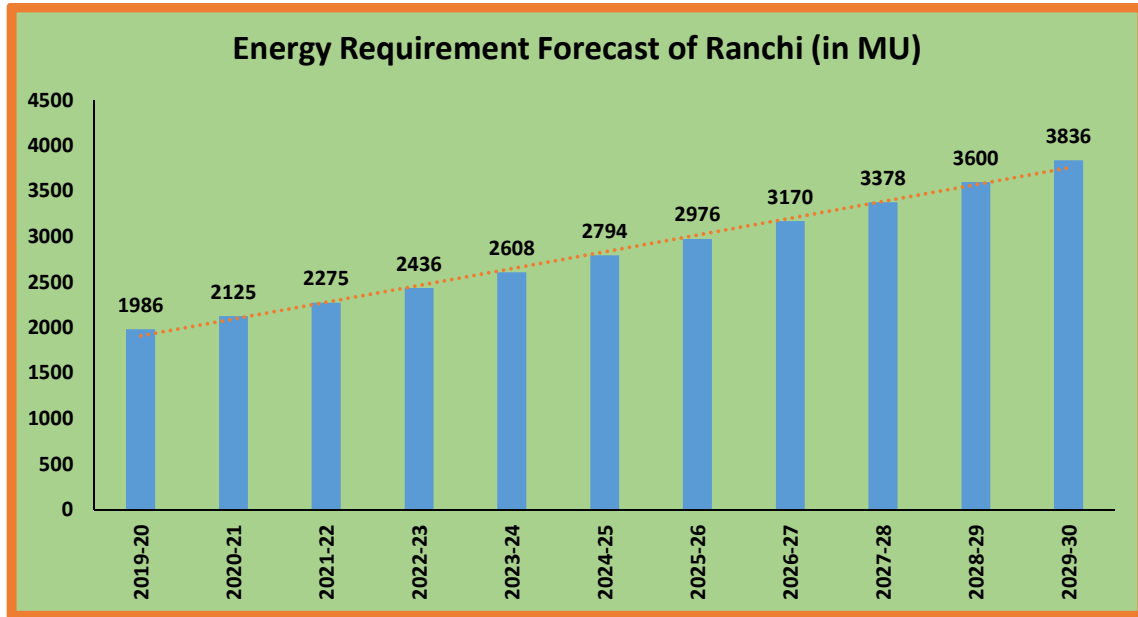


(Figure 18.3: Comparison between Ranchi and Jharkhand in 2018-19)

Power Forecast:

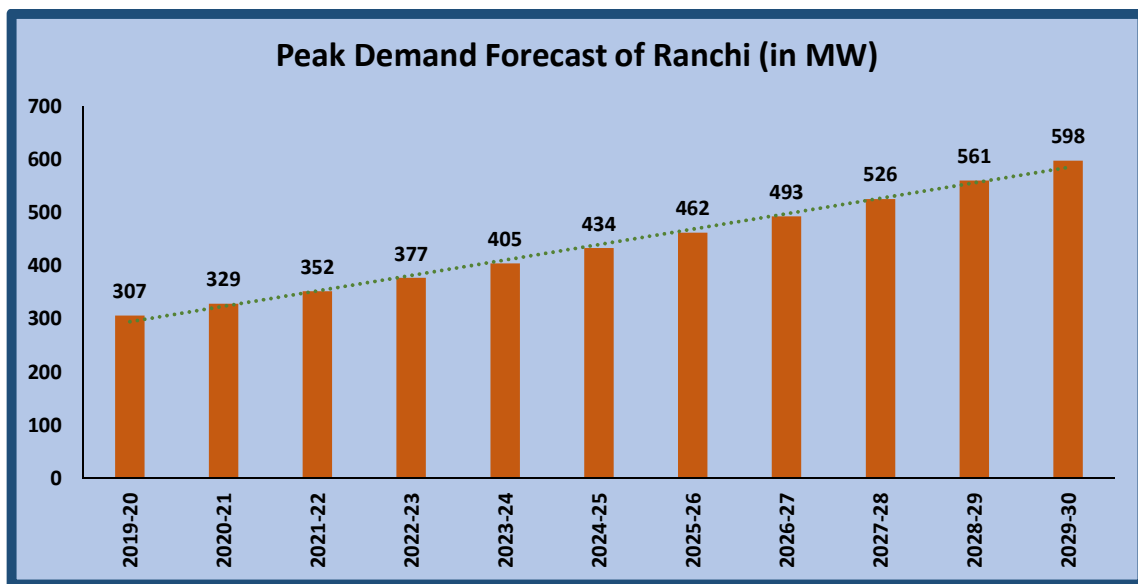
Based on total electricity consumption and T&D Losses, the total energy requirement of Ranchi is estimated as 1986 MU in year 2019-20. It is expected

that the energy requirement of the city will reach to 2794 MU by the year 2024-25 with 7.07% CAGR for the period 2019-20 to 2024-25. With CAGR of 6.55% for the period 2024-25 to 2029-30, its energy requirement is estimated as 3836 MU by the year 2029-30.



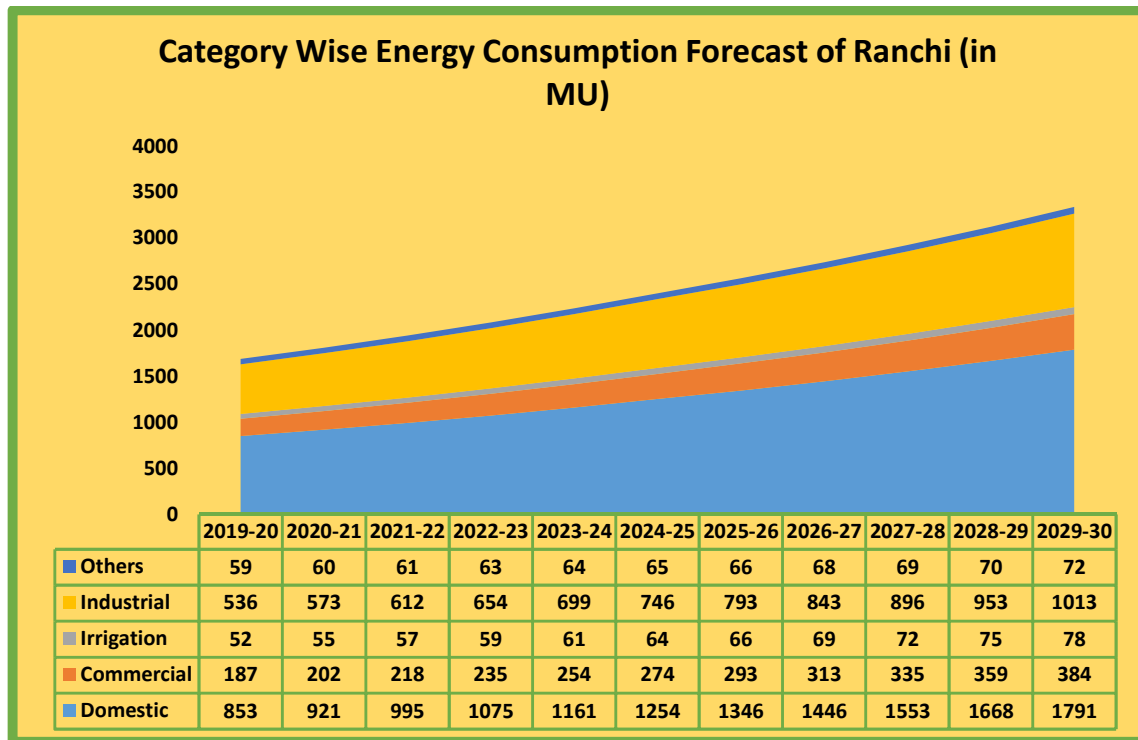
(Figure 18.4: Energy Requirement Forecast of Ranchi in MU)

Peak Demand of the Ranchi is expected to see 7.17% CAGR upto 2024-25 and will reach 434 MW in comparison to 307 MW in year 2019-20. It is expected to reach 598 MW in year 2029-30 with a CAGR of 6.65% after 2024-25.



(Figure 18.5: Peak Demand Forecast of Ranchi in MW)

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



(Figure 18.6: Category Wise Energy Consumption forecast of Ranchi)

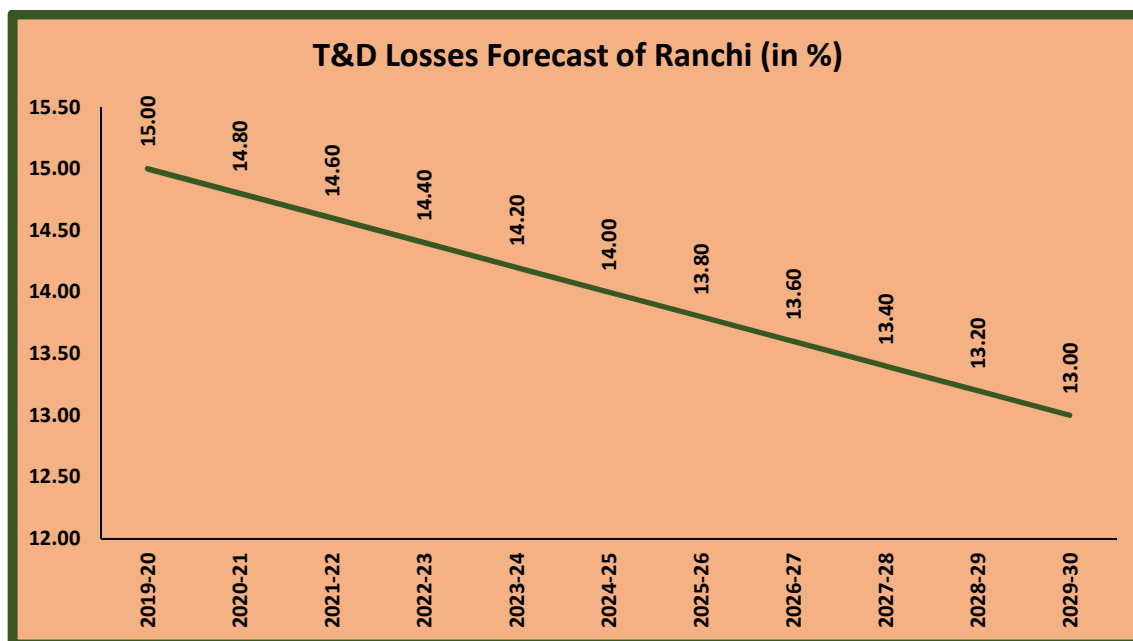
The category wise CAGR expected in energy consumption for the next ten years (2019-20 to 2029-30) along with its break up in five years (2019-20 to 2024-25 & 2025-26 to 2029-30) is tabulated below:

Sl. No.	Category	Energy Consumption (in MU)			CAGR in %		
		2019-20	2024-25	2029-30	2019-20 to 2024-25	2024-25 to 2029-30	2019-20 to 2029-30
1.	Domestic	853	1254	1791	8.01	7.40	7.70
2.	Commercial	187	274	384	7.89	7.01	7.45
3.	Irrigation	52	64	78	4.02	3.99	4.00
4.	Industrial	536	746	1013	6.83	6.30	6.56
5.	Others	59	65	72	2.01	2.00	2.00
6.	Total	1688	2402	3338	7.32	6.80	7.06

(Table 18.2: Expected CAGR of Ranchi - Category Wise Consumption)

Transmission & Distribution Losses:

T&D losses of Ranchi were estimated as 16.24% in year 2018-19. The target level is to bring it down to about 14.00% and 13.00% by the end of 2024-25 & 2029-30 respectively.



(Figure 18.7: T&D Loss Forecast of Ranchi)

The power forecast of Ranchi city is summarized below:

Sl. No.	Particulars	2019-20	2024-25	2029-30	CAGR in %	
					2019-20 to 2024-25	2024-25 to 2029-30
1.	Energy Requirement in MU	1986	2794	3836	7.07	6.55
2.	Peak Demand in MW	307	434	598	7.17	6.65
3.	T&D Losses in %	15.00	14.00	13.00	-	-

(Table 18.3: Power forecast summary of Ranchi)

Analysis of Forecast:

A comparison of actual CAGR witnessed for the Ranchi city during the last five years and the CAGR for future power forecast is tabulated below:

Sl. No.	City/State/Country	CAGR in %		
		2013-14 to 2018-19	2019-20 to 2024-25	2024-25 to 2029-30
1.	Energy Requirement	3.44	7.07	6.55
2.	Peak Demand	5.08	7.17	6.65

(Table 18.4: Actual CAGR in past vis-a-vis CAGR forecast for future for Ranchi)

It is also observed that energy requirement growth in Ranchi in the recent past is on lower side and the city has observed CAGR of only 3.44% for energy requirement. However, the energy consumption of the city grew with 9.42% rate during the same period as observed from the table below:

Sl. No.	Category	Energy Consumption in MU		CAGR in %
		2013-14	2018-19	
1.	Domestic	463	790	11.29
2.	Commercial	112	173	9.16
3.	Irrigation	11	50	35.59
4.	Industries	346	502	7.71
5.	Others	71	58	-4.19
6.	Total	1003	1573	9.42

(Table 18.5: Category Wise Consumption CAGR of Ranchi during 2013-14 to 2018-19)

The decline in energy requirement growth was primarily on account of reduction in T&D losses that fell down from around 37% to 16% during the same period. As T&D losses are henceforth not expected to reduce further so sharply, the power demand is expected to see comparatively more growth than growth trends witnessed in the recent past.

Ranchi

Electrical Energy Consumption, Energy Requirement and Peak Electricity Demand

(Category Wise and Year Wise Summary)

Year	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30
Domestic	853	921	995	1075	1161	1254	1346	1446	1553	1668	1791
Commercial	187	202	218	235	254	274	293	313	335	359	384
Public lighting	59	60	61	63	64	65	66	68	69	70	72
Public Water Works	0	0	0	0	0	0	0	0	0	0	0
Irrigation	52	55	57	59	61	64	66	69	72	75	78
LT Industries	53	55	58	60	63	65	68	71	74	77	80
HT Industries	483	518	554	594	636	681	725	772	823	876	933
Railway Traction	0	0	0	0	0	0	0	0	0	0	0
Bulk Supply	0	0	0	0	0	0	0	0	0	0	0
Others (if any)	0	0	0	0	0	0	0	0	0	0	0
Total (Energy Consumption)	1688	1811	1943	2085	2238	2402	2565	2739	2925	3125	3338
T&D losses -MU	298	315	332	351	370	391	411	431	453	475	499
T&D losses -in %	15.00	14.80	14.60	14.40	14.20	14.00	13.80	13.60	13.40	13.20	13.00
Energy Requirement - MU	1986	2125	2275	2436	2608	2794	2976	3170	3378	3600	3836
Annual Load Factor - %	73.88	73.81	73.74	73.67	73.60	73.53	73.46	73.39	73.32	73.25	73.18
Peak Load - MW	307	329	352	377	405	434	462	493	526	561	598

Table 18.6: Power Forecast of Ranchi

Srinagar



Srinagar

Introduction:

⁵⁴Srinagar, the capital of Jammu and Kashmir Union Territory, is situated on the banks of River Jhelum and is geographically located in the centre of the valley of Kashmir. It is one of the prime tourist centres of the country and is famous for its picturesque sites, sweet water lakes, pleasant gardens, mountain views and tourist places. The city is also popularly known as the ‘Venice of the East’. It has gained prominence in various functions of Tourism, Administration, Commerce and Economic development.

As of 2011 census, the total municipal area of the Srinagar city was 278.1 sq. km and its population was 11,80,570. However, this report has covered 284.5 sq. km. area that includes Bagh-I Mehtab and Badami Bagh Cantonment area also along with the city municipal area. The corresponding population was 12,09,081.



(Figure 19.1: Location of Srinagar City)

⁵⁴ Official Site of Srinagar Municipal Corporation (<https://smcsite.org/index.php?link=Srinagar%20City>)

Economy⁵⁵

Tourism is thus the major industry in the district and its promotion and development has direct bearing on livelihood and prosperity. Agriculture is an important economic activity of Srinagar and the main agricultural produce comprises rice, vegetables, saffron, cereals and pulses. Horticulture and fisheries are another important sector. It does not have a robust industrial base though many small and medium-scale industries have come up in the traditional sectors and areas like food processing, agro-based units and metallic and non-metallic products. The city has some service and small scale industrial units besides centuries old local craft like wood-carving, shawl and carpet making, stone polishing, paper machine, etc.

Climate⁵⁶

The climate of the city is mild and generally warm and temperate. The rainfall is significant, with precipitation even during the driest month. The average annual maximum temp. is 20.0 °C with mean maximum temp. of the hottest months (July & August) and the coldest month (Jan) are about 29.6 °C and 6.7 °C respectively. The average annual minimum temp. is 7.5 °C with mean minimum temp. of the hottest and the coldest months are about 18.0 °C and -1.9 °C respectively. The average annual rainfall of the city is 70.9 cm. The rainfall during pre-monsoon season is about 38%, during the southwest monsoon season is about 29%, and during winter is about 25% of the annual rainfall. The values of relative humidity are about 70% to 91% in the morning and 46% to 69% in the afternoon.

Brief description of Power Utilities:

The Power Development Department (PDD) of J&K was earlier responsible for generation, transmission & distribution of electricity in the UT of J&K. Subsequently, the Power Development Corporation (JKPDC), a fully owned Government Company, was established in the year 1995, when the operation

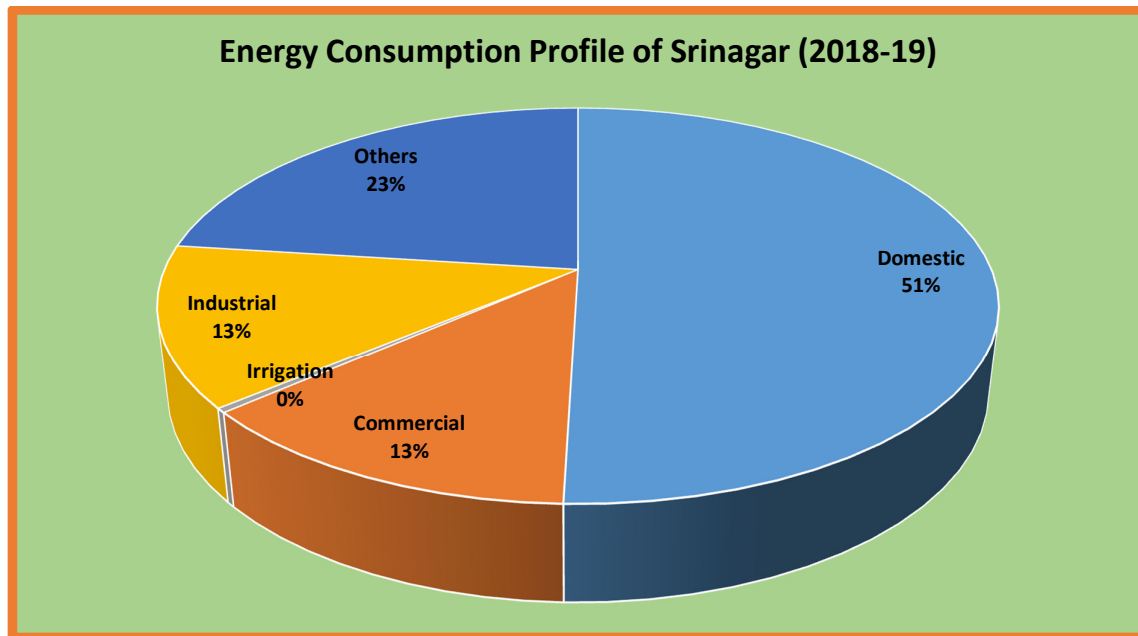
⁵⁵ Srinagar Master Plan 2035 (<http://www.sdasinagar.com/wp-content/uploads/2019/03/Master-Plan-2035-ReportFinal.pdf>)

⁵⁶ <http://www.imdpune.gov.in/caui/smartcities.html>

and maintenance of existing generating stations and setting up of future generating stations were entrusted to this corporation except for one small hydel power station and few very small diesel stations that still remain with PDD, besides the Transmission and Distribution Sector.

Existing Power Scenario:

The total electricity consumption of Srinagar in the year 2018-19 was 1229 MU and with 51.42% T&D losses, the requirement was 2531 MU. The peak demand of the city was 530 MW. The Domestic sector was the biggest consumer of electricity (51%).



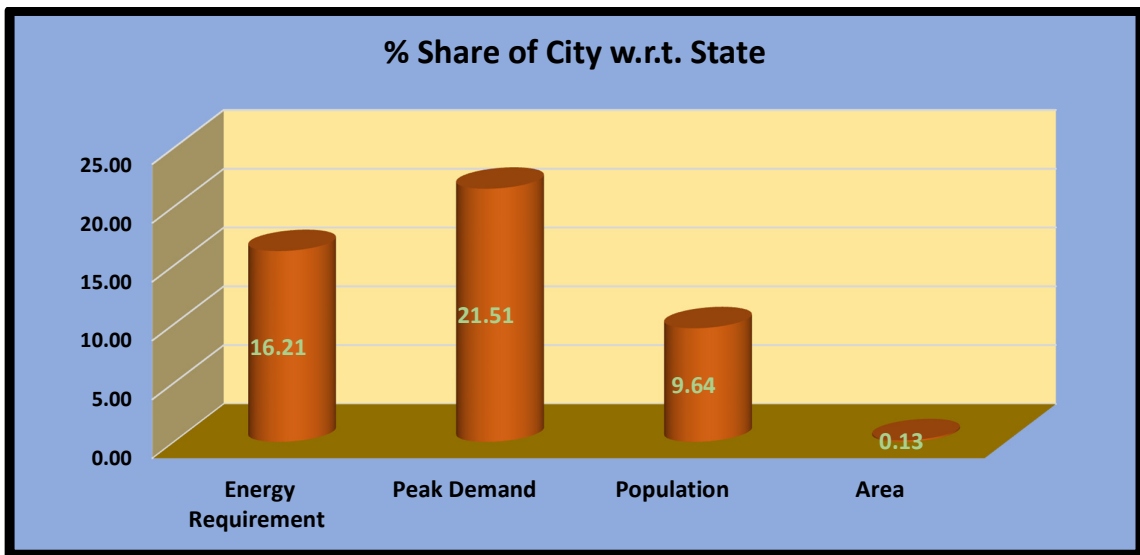
(Figure 19.2: Energy Consumption Profile of Srinagar in 2018-19)

During the last five years (2013-14 to 2018-19), the city has observed CAGR of 10.22% & 10.28 % in electricity energy requirement and peak demand respectively.

On comparison of Srinagar with J&K for the year 2018-19, it is observed that the energy requirement of Srinagar was 16.21% of the total energy requirement of the state whereas its contribution in population and area were only 9.64% and 0.13% respectively.

Sl. No.	Particulars	Srinagar	J&K	Srinagar as % of J&K
1.	Energy Requirement (in MU)	2531	15616	16.21
2.	Peak Demand (in MW)	530	2464	21.51
3.	Population (2011 Census)	12,09,081	1,25,41,302	9.64
4.	Area (in sq km)	284.5	2,22,236	0.13

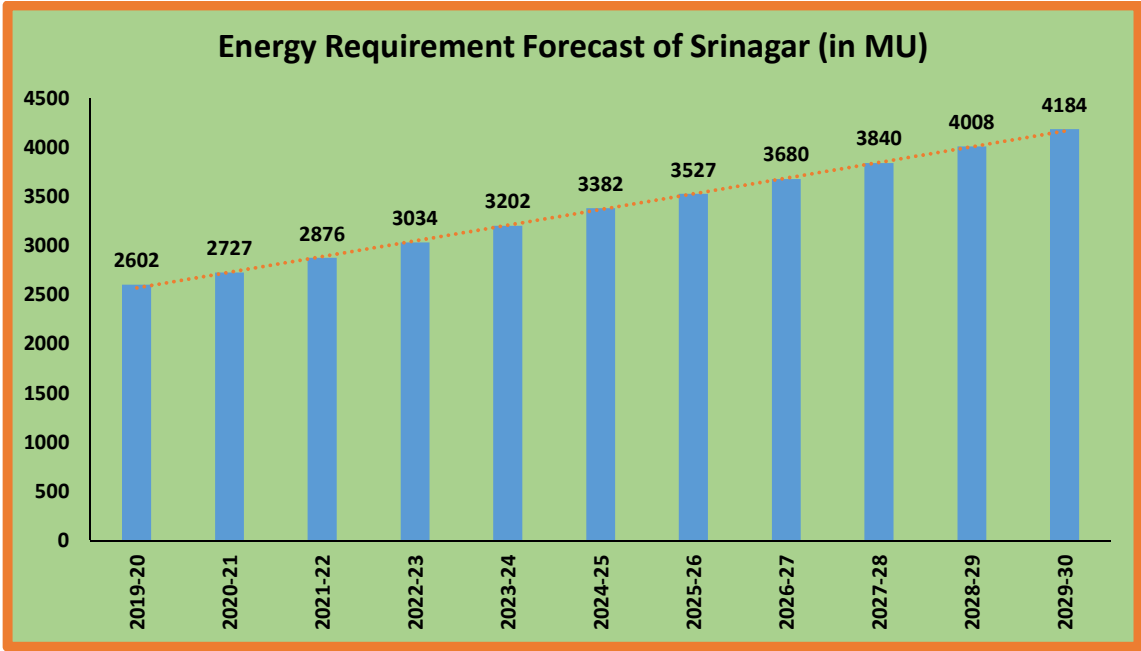
(Table 19.1: Comparison of Srinagar with J&K in 2018-19)



(Figure 19.3: Comparison between Srinagar and J&K in 2018-19)

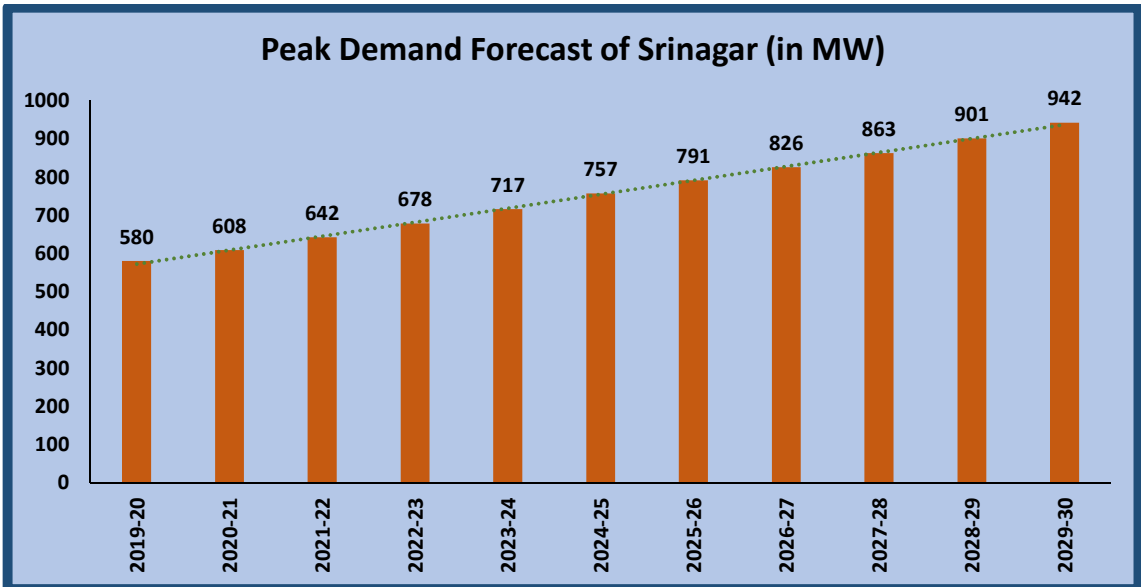
Power Forecast:

Based on total electricity consumption and T&D Losses, the total energy requirement of Srinagar is estimated as 2602 MU in year 2019-20. It is expected that the energy requirement of the city will reach to 3382 MU by the year 2024-25 with 5.38% CAGR for the period 2019-20 to 2024-25. With CAGR of 4.35% for the period 2024-25 to 2029-30, its energy requirement is estimated as 4184 MU by the year 2029-30.



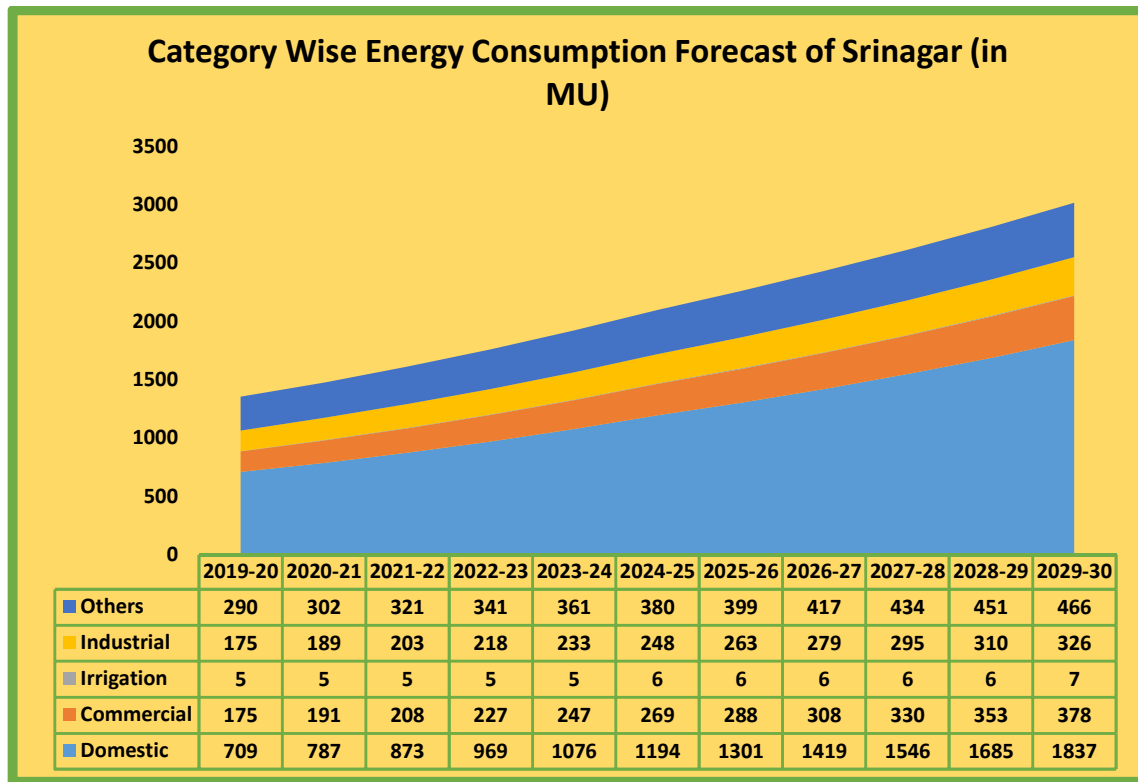
(Figure 19.4: Energy Requirement Forecast of Srinagar in MU)

Peak Demand of the Srinagar is expected to see 5.48% CAGR upto 2024-25 and will reach 757 MW in comparison to 580 MW in year 2019-20. It is expected to reach 942 MW in year 2029-30 with a CAGR of 4.45% after 2024-25.



(Figure 19.5: Peak Demand Forecast of Srinagar in MW)

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



(Figure 19.6: Category Wise Energy Consumption forecast of Srinagar)

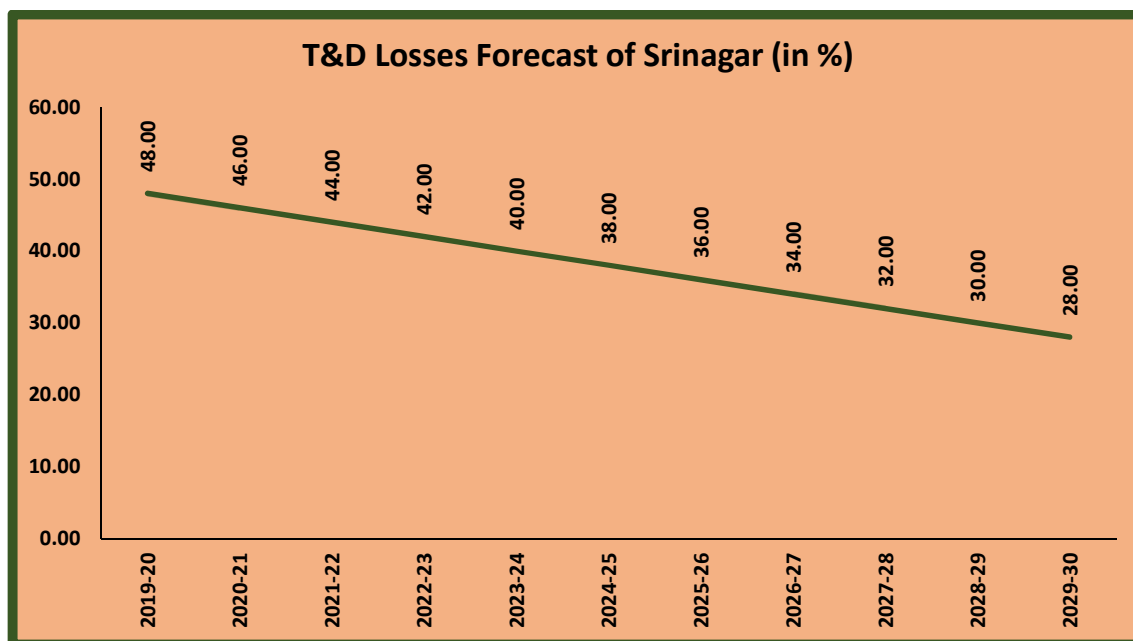
The category wise CAGR expected in energy consumption for the next ten years (2019-20 to 2029-30) along with its break up in five years (2019-20 to 2024-25 & 2025-26 to 2029-30) is tabulated below:

Sl. No.	Category	Energy Consumption (in MU)			CAGR in %		
		2019-20	2024-25	2029-30	2019-20 to 2024-25	2024-25 to 2029-30	2019-20 to 2029-30
1.	Domestic	709	1194	1837	11.00	9.00	10.00
2.	Commercial	175	269	378	9.00	7.00	8.00
3.	Irrigation	5	6	7	4.20	3.20	3.70
4.	Industrial	175	248	326	7.25	5.60	6.42
5.	Others	290	380	466	5.53	4.16	4.85
6.	Total	1353	2097	3013	9.15	7.52	8.33

(Table 19.2: Expected CAGR of Srinagar - Category Wise Consumption)

Transmission & Distribution Losses:

T&D losses of Srinagar were 51.42% in year 2018-19. The target level is to bring it down to about 38.00% and 28.00% by the end of 2024-25 & 2029-30 respectively.



(Figure 19.7: T&D Loss Forecast of Srinagar)

The power forecast of Srinagar city is summarized below:

Sl. No.	Particulars	2019-20	2024-25	2029-30	CAGR in %	
					2019-20 to 2024-25	2024-25 to 2029-30
1.	Energy Requirement in MU	2602	3382	4184	5.38	4.35
2.	Peak Demand in MW	580	757	942	5.48	4.45
3.	T&D Losses in %	48.00	38.00	28.00	-	-

(Table 19.3: Power forecast summary of Srinagar)

Analysis of Forecast:

A comparison of actual CAGR witnessed for the Srinagar city during the last five years and the CAGR for future power forecast is tabulated below:

Sl. No.	City/State/Country	CAGR in %		
		2013-14 to 2018-19	2019-20 to 2024-25	2024-25 to 2029-30
1.	Energy Requirement	10.22	5.38	4.35
2.	Peak Demand	10.28	5.48	4.45

(Table 19.4: Actual CAGR in past vis-a-vis CAGR forecast for future for Srinagar)

Although the city has witnessed good growth in the recent past, the future forecast is comparatively moderate as the T&D losses are expected to decrease fast which is hovering around 50% at present. The peak demand is expected to follow the growth trajectory of energy requirements as witnessed in the past.

Srinagar

Electrical Energy Consumption, Energy Requirement and Peak Electricity Demand

(Category Wise and Year Wise Summary)

Year	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30
Domestic	709	787	873	969	1076	1194	1301	1419	1546	1685	1837
Commercial	175	191	208	227	247	269	288	308	330	353	378
Public lighting	8	8	9	9	10	10	10	11	11	12	12
Public Water Works	71	77	83	89	95	101	107	114	119	125	131
Irrigation	5	5	5	5	5	6	6	6	6	6	7
LT Industries	25	27	28	30	31	33	35	36	38	39	41
HT Industries	150	162	175	188	201	215	229	243	257	271	285
Railway Traction	0	0	0	0	0	0	0	0	0	0	0
Bulk Supply	180	183	193	204	214	224	233	242	250	258	264
Others (if any)	32	34	37	40	42	45	48	51	53	56	59
Total (Energy Consumption)	1353	1473	1610	1760	1921	2097	2258	2429	2611	2806	3013
T&D losses -MU	1249	1254	1265	1274	1281	1285	1270	1251	1229	1202	1172
T&D losses -in %	48.00	46.00	44.00	42.00	40.00	38.00	36.00	34.00	32.00	30.00	28.00
Energy Requirement - MU	2602	2727	2876	3034	3202	3382	3527	3680	3840	4008	4184
Annual Load Factor - %	51.22	51.17	51.12	51.07	51.02	50.97	50.92	50.87	50.82	50.77	50.72
Peak Load - MW	580	608	642	678	717	757	791	826	863	901	942

Table 19.5: Power Forecast of Srinagar

Surat



Surat

Introduction:

Surat is the second largest city in Gujarat and it constitutes the ninth largest metropolitan area in India and has won multiple national and international recognitions such as the fourth fastest developing city in the world (City Mayors Foundation 2011), and first 'smart IT' city in India (Microsoft 2014). In 1994 Surat was hit by a plague epidemic, which forced the city to reinvent itself and as a result, Surat is today ranked the third cleanest city in India. As per Census 2011, the total population of the city was 44,67,797 and it had grown with annual rate of 6.07% for the period 2001 to 2011. The total municipal area of the city is 335.82 sq. km.



(Figure 20.1: Location of Surat City)

Economy⁵⁷

Surat is one of the top ten GDP contributors in the country, owing to its robust diamond and textile industry. In recent years, it has seen a boom in small and medium enterprises (SMEs), with many national and multinational companies setting up offices here. Machinery, machine tools and its parts, textiles, chemicals and petrochemical products are the major industries located in the city.

Climate⁵⁸

The climate of the city is characterized by hot summer and general dryness except during the southwest monsoon season. The average annual maximum temp. is 33.4 °C with mean maximum temp. of the hottest months (April & May) and the coldest month (Jan) as 36.3 °C and 30.8 °C respectively. The average annual minimum temp. is 22.2 °C with mean minimum temp. of the hottest and the coldest month are 25.4 °C and 15.2 °C respectively. The average annual rainfall of the city is 12.1 cm. The rainfall during the southwest monsoon season is about 96% of the annual rainfall. The values of relative humidity are about 78% to 86% in the morning and 70% to 80% in the afternoon during the southwest monsoon season.

Brief description of Power Utilities⁵⁹:

Under the provisions of the Gujarat Electricity Industry (Re-organization & Regulation) Act, 2003 passed by the Government of Gujarat to restructure the Electricity Industry with an aim to improve efficiency in management and delivery of services to consumers, the erstwhile Gujarat Electricity Board (GEB) was reorganized into the following seven companies w.e.f. 1st April 2005:

⁵⁷ Surat Smart City Plan (http://smartcities.gov.in/upload/uploadfiles/files/Gujarat_Surat.pdf)

⁵⁸ <http://www.imdpune.gov.in/caui/smartcities.html>

⁵⁹ Official Site of GUVNL (<https://www.gseb.com/guvnl/Content.aspx?ContentId=2>)

- | | | |
|---|---|-----------------|
| 1. Gujarat Urja Vikas Nigam Ltd. (GUVNL) | - | Holding Company |
| 2. Gujarat State Electricity Corp. Ltd.(GSECL) | - | Generation |
| 3. Gujarat Energy Transmission Corp. Ltd.(GETCO)- | | Transmission |
| 4. Uttar Gujarat Vij Company Ltd. (UGVCL) | - | Distribution |
| 5. Dakshin Gujarat Vij Company Ltd. (DGVCL) | - | Distribution |
| 6. Madhya Gujarat Vij Company Ltd. (MGVCL) | - | Distribution |
| 7. Paschim Gujarat Vij Company Ltd. (PGVCL) | - | Distribution |

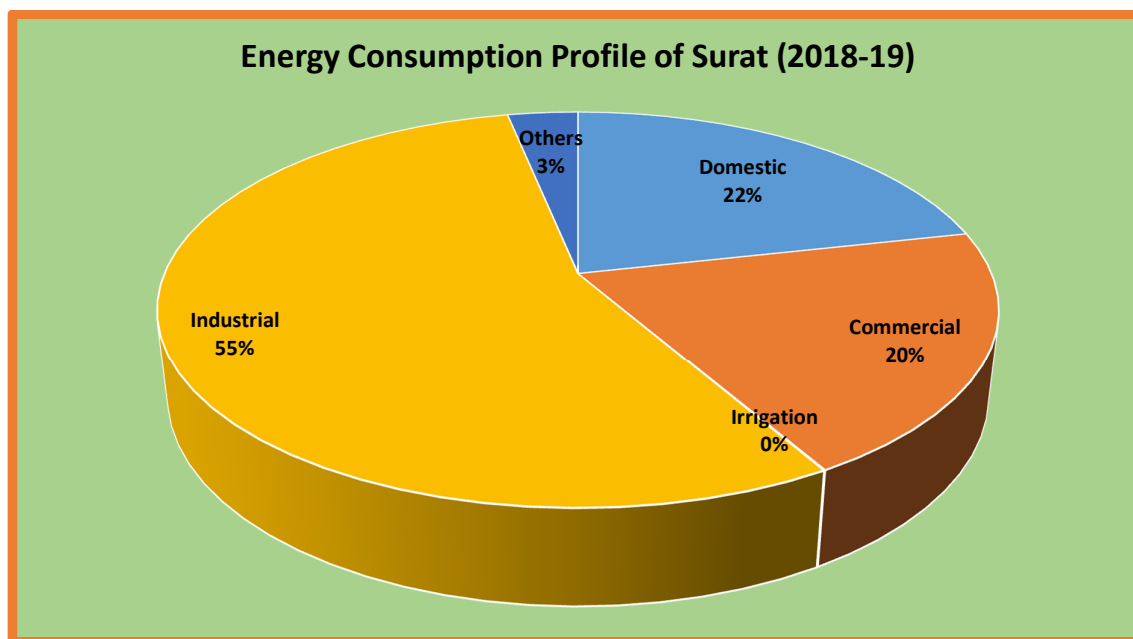
GUVNL is the holding company and all other six companies have been structured as its subsidiaries. It is engaged in the business of bulk purchase and sale of electricity, supervision, co-ordination and facilitation of the activities of its six subsidiary companies. The GSECL is engaged in the business of generation of Electricity. The GETCO is engaged in the business of transmission of Electricity. The UGVCL, DGVCL, MGVCL and PGVCL are engaged in the business of distribution of Electricity in the Northern, Southern, Central and Western areas of Gujarat respectively. In addition to these distribution companies, torrent power, a private sector company, also distributes power in Ahmedabad, Gandhinagar, Surat, Dahej SEZ areas of Gujarat⁶⁰. MPSEZ Utilities Pvt. Ltd. (MUPL), Kandla Port Trust (KPT) & ASPEN Infrastructure limited are other power distribution licensees operating in Gujarat.⁶¹ The utilities responsible for power distribution in Surat are DGVCL & torrent power.

Existing Power Scenario:

The total electricity consumption of Surat in the year 2018-19 was 9364 MU and with 4.93% T&D losses, the requirement was 9849 MU. The peak demand of the city was 1978 MW. The Industrial sector was the biggest consumer of electricity (55%) followed by Domestic (22%) and Commercial (20%).

⁶⁰ Official Site of Torrent Power (<https://www.torrentpower.com/index.php/site/info/businessAreas>)

⁶¹<https://www.gseb.com/DownloadFiles/File/Research%20Report%20on%20Energy%20Sector%20in%20Gujarat.pdf>



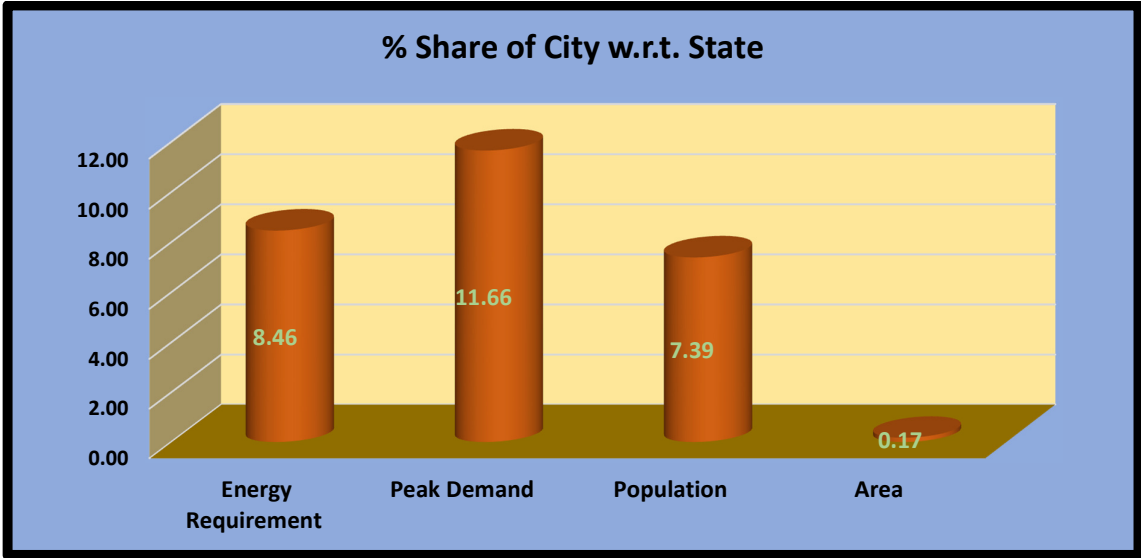
(Figure 20.2: Energy Consumption Profile of Surat in 2018-19)

During the last five years (2013-14 to 2018-19), the city has observed CAGR of 5.28% & 6.36% in electricity energy requirement and peak demand respectively.

On comparison of Surat with Gujarat for the year 2018-19, it is observed that the energy requirement of Surat was 8.46% of the total energy requirement of the state whereas its contribution in population and area were only 7.39% and 0.17% respectively.

Sl. No.	Particulars	Surat	Gujarat	Surat as % of Gujarat
1.	Energy Requirement (in MU)	9849	116356	8.46
2.	Peak Demand (in MW)	1978	16963	11.66
3.	Population (2011 Census)	44,67,797	6,04,39,692	7.39
4.	Area (in sq km)	335.82	1,96,244	0.17

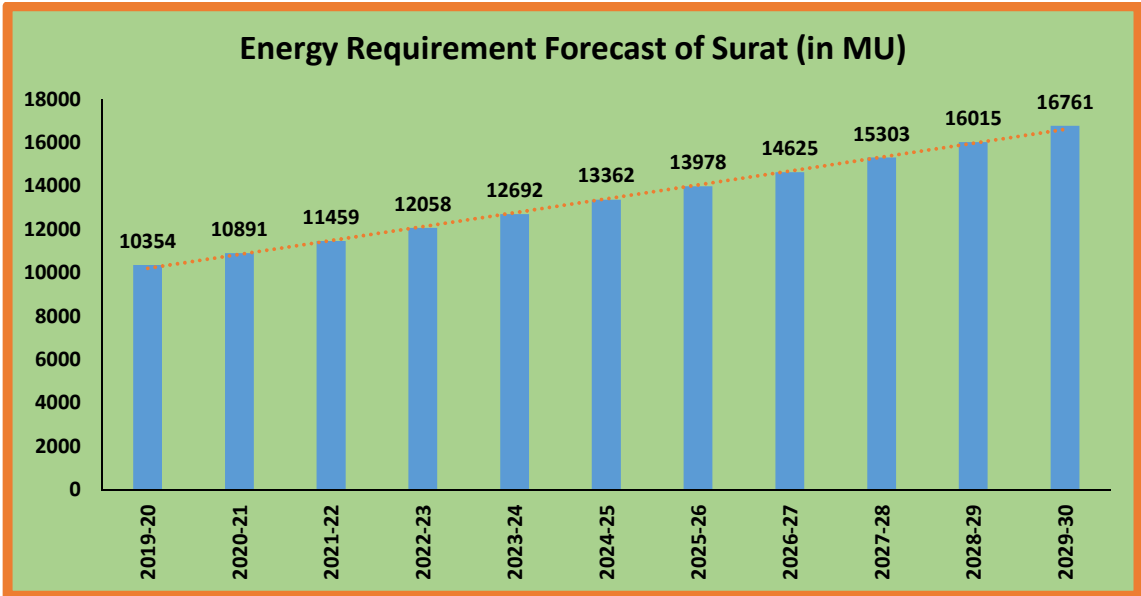
(Table 20.1: Comparison of Surat with Gujarat in 2018-19)



(Figure 20.3: Comparison between Surat and Gujarat in 2018-19)

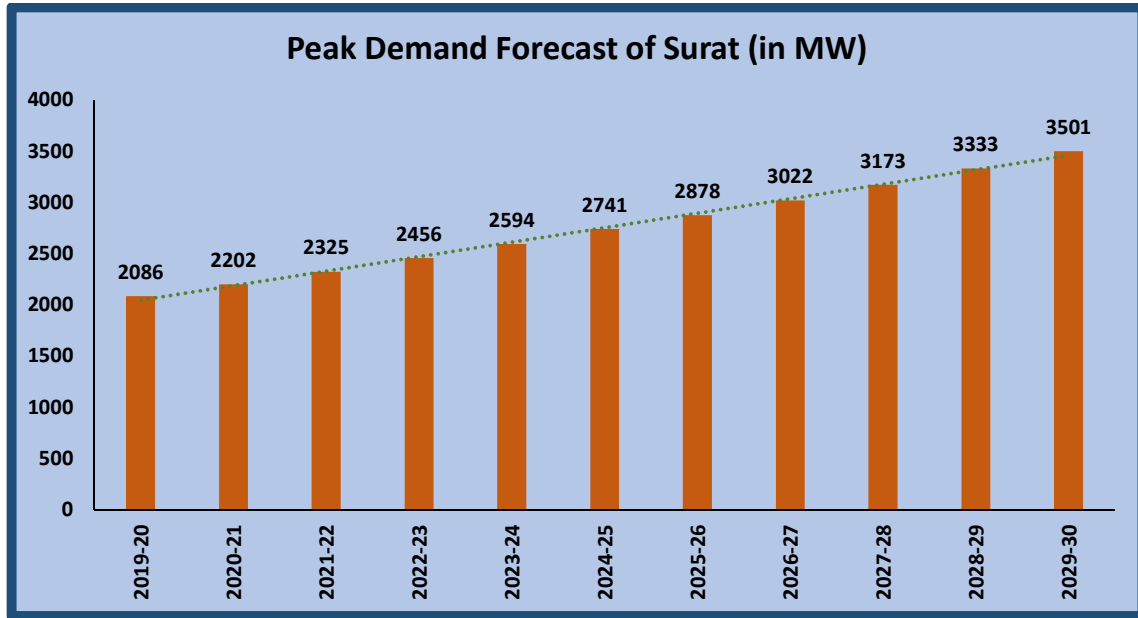
Power Forecast:

Based on total electricity consumption and T&D Losses, the total energy requirement of Surat is estimated as 10354 MU in year 2019-20. It is expected that the energy requirement of the city will reach to 13362 MU by the year 2024-25 with 5.23% CAGR for the period 2019-20 to 2024-25. With CAGR of 4.64% for the period 2024-25 to 2029-30, its energy requirement is estimated as 16761 MU by the year 2029-30.



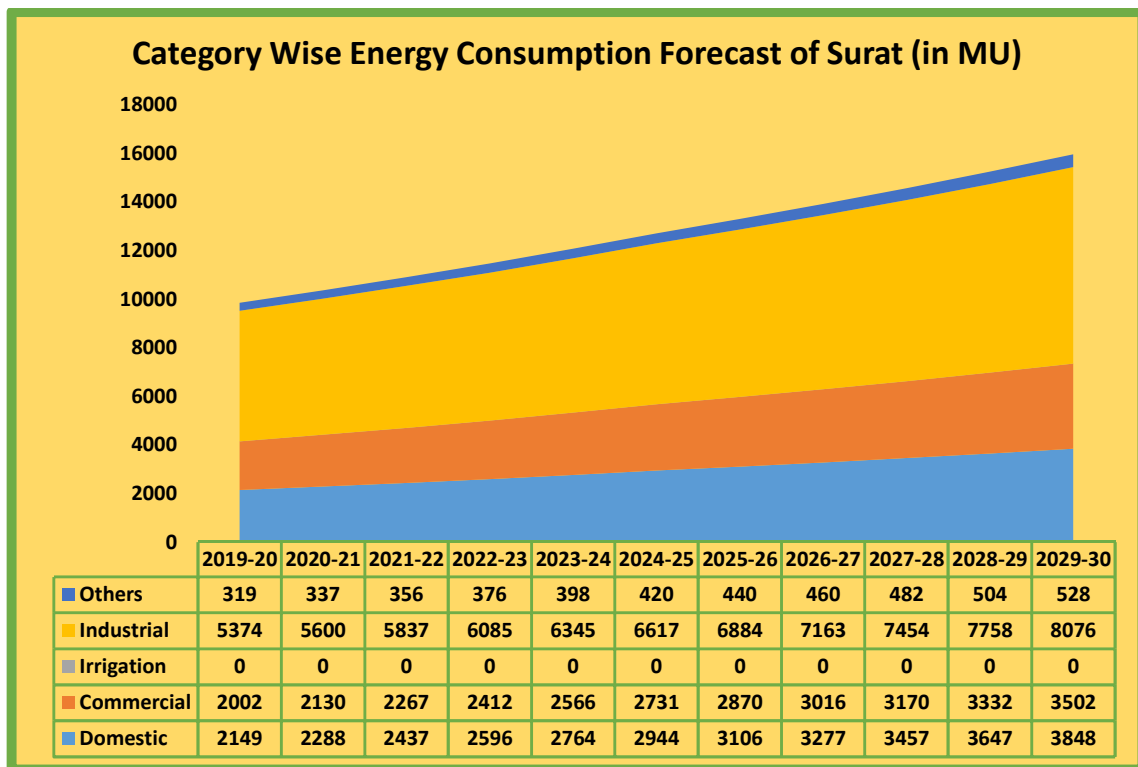
(Figure 20.4: Energy Requirement Forecast of Surat in MU)

Peak Demand of the Surat is expected to see 5.61% CAGR upto 2024-25 and will reach 2741 MW in comparison to 2086 MW in year 2019-20. It is expected to reach 3501 MW in year 2029-30 with a CAGR of 5.02% after 2024-25.



(Figure 20.5: Peak Demand Forecast of Surat in MW)

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



(Figure 20.6: Category Wise Energy Consumption forecast of Surat)

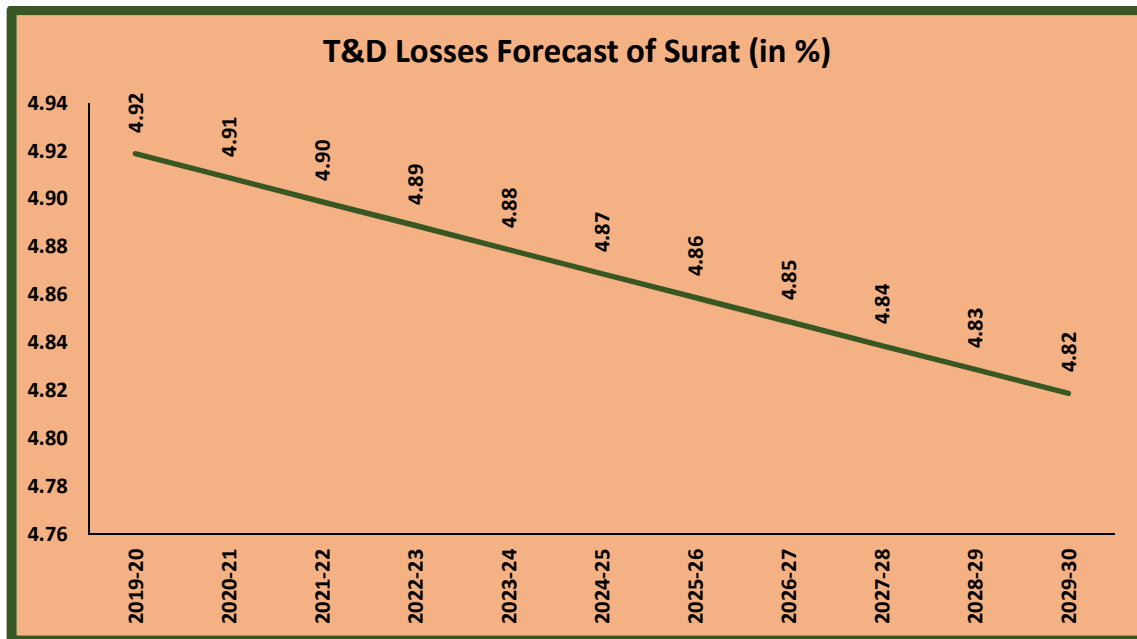
The category wise CAGR expected in energy consumption for the next ten years (2019-20 to 2029-30) along with its break up in five years (2019-20 to 2024-25 & 2025-26 to 2029-30) is tabulated below:

Sl. No.	Category	Energy Consumption (in MU)			CAGR in %		
		2019-20	2024-25	2029-30	2019-20 to 2024-25	2024-25 to 2029-30	2019-20 to 2029-30
1.	Domestic	2149	2944	3848	6.50	5.50	6.00
2.	Commercial	2002	2731	3502	6.40	5.10	5.75
3.	Irrigation	0	0	0	-	-	-
4.	Industrial	5374	6617	8076	4.25	4.07	4.16
5.	Others	319	420	528	5.65	4.66	5.16
6.	Total	9845	12711	15953	5.24	4.65	4.95

(Table 20.2: Expected CAGR of Surat - Category Wise Consumption)

Transmission & Distribution Losses:

T&D losses of Surat were 4.93% in year 2018-19. The target level is to bring it down to about 4.87% and 4.82% by the end of 2024-25 & 2029-30 respectively.



(Figure 20.7: T&D Loss Forecast of Surat)

The power forecast of Surat city is summarized below:

Sl. No.	Particulars	2019-20	2024-25	2029-30	CAGR in %	
					2019-20 to 2024-25	2024-25 to 2029-30
1.	Energy Requirement in MU	10354	13362	16761	5.23	4.64
2.	Peak Demand in MW	2086	2741	3501	5.61	5.02
3.	T&D Losses in %	4.92	4.87	4.82	-	-

(Table 20.3: Power forecast summary of Surat)

Analysis of Forecast:

A comparison of actual CAGR witnessed for the Surat city during the last five years and the CAGR for future power forecast is tabulated below:

Sl. No.	City/State/Country	CAGR in %		
		2013-14 to 2018-19	2019-20 to 2024-25	2024-25 to 2029-30
1.	Energy Requirement	5.28	5.23	4.64
2.	Peak Demand	6.36	5.61	5.02

(Table 20.4: Actual CAGR in past vis-a-vis CAGR forecast for future for Surat)

The above table indicates that Surat is expected to follow the same power demand trend it has witnessed in the recent past. The peak demand growth of the city is expected to be very similar to its energy growth considering its dominant industrial profile.

Surat

Electrical Energy Consumption, Energy Requirement and Peak Electricity Demand

(Category Wise and Year Wise Summary)

Year	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30
Domestic	2149	2288	2437	2596	2764	2944	3106	3277	3457	3647	3848
Commercial	2002	2130	2267	2412	2566	2731	2870	3016	3170	3332	3502
Public lighting	43	46	48	50	53	55	58	60	62	65	67
Public Water Works	207	219	232	246	261	276	290	305	320	336	353
Irrigation	0	0	0	0	0	0	0	0	0	0	0
LT Industries	3215	3312	3411	3513	3619	3727	3835	3947	4061	4179	4300
HT Industries	2159	2289	2426	2572	2726	2889	3048	3216	3393	3580	3776
Railway Traction	0	0	0	0	0	0	0	0	0	0	0
Bulk Supply	0	0	0	0	0	0	0	0	0	0	0
Others (if any)	69	73	76	80	84	88	92	95	99	103	107
Total (Energy Consumption)	9845	10356	10897	11469	12073	12711	13299	13916	14563	15241	15953
T&D losses -MU	509	535	561	590	619	651	679	709	740	773	808
T&D losses -in %	4.92	4.91	4.90	4.89	4.88	4.87	4.86	4.85	4.84	4.83	4.82
Energy Requirement - MU	10354	10891	11459	12058	12692	13362	13978	14625	15303	16015	16761
Annual Load Factor - %	56.65	56.45	56.25	56.05	55.85	55.65	55.45	55.25	55.05	54.85	54.65
Peak Load - MW	2086	2202	2325	2456	2594	2741	2878	3022	3173	3333	3501

Table 20.5: Power Forecast of Surat

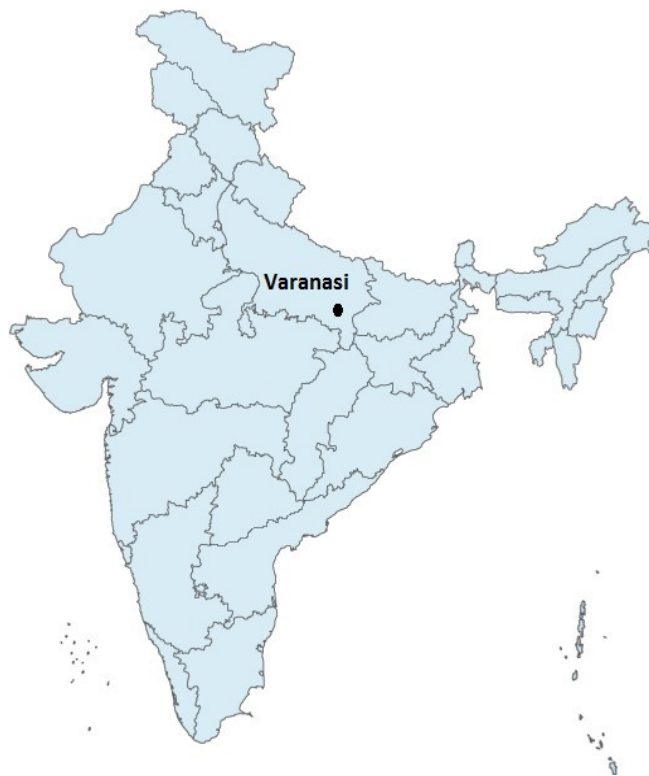
Varanasi



Varanasi

Introduction:

The city of Varanasi is located in the middle Ganga valley of North India, in the Eastern part of Uttar Pradesh. Today, Varanasi remains the hub of cultural and holy activities and in the field of learning, especially of Religion, Philosophy, Yoga, Ayurveda, Astrology, Dance and Music, the city is unparalleled. The Banarasi Silk Sarees and Brocades are known worldwide for its elegance.⁶² It is also renowned for its rich tapestry of music, arts, crafts and education. Some of the world renowned exponents India has produced in these fields were schooled in Varanasi's cultural ethos.⁶³



(Figure 21.1: Location of Varanasi City)

⁶² <http://varanasi.gov.in/en/destination>

⁶³ Official Site of Nagar Nigam Varanasi (<http://nnvns.org/varanasi.html>)

As per Census 2011, the total municipal area of the city was 82.1 sq. km with corresponding population as 11,98,491. However, the report has covered 118.68 sq. km. area of the entire Varanasi Urban Agglomeration including Varanasi cantonment area, Maruadih Railway Settlement, Ramnagar, Shivdaspur, Phulwaria, Chandpur, Maheshpur, Kakarmatta, Susuwahi, Sir Gobardhan, Chhitpur, Bhagawanpur, Lerhupur, Asapur, Salarpur, Sarai Mohana, Kotwa, Lahartara, Maruadih area also along with Varanasi Municipal Area. The corresponding population was 14,32,280 as per Census 2011.

Economy⁶⁴:

The overall economy of the city is dependent on tourism and tourist related activities. Apart from religious activities, Varanasi has been a centre of spiritual and educational activities since time immemorial. These activities have played an important role in shaping the character of this religious and pilgrimage town. Apart from this, primary economic activities such as horticulture (for betel leaves and mangoes) and household industry (silk weaving) are major occupations. Varanasi grew as an important industrial centre and is famous for its silk industry, perfumes, ivory works, and sculpture.

Climate⁶⁵

The climate of the city is characterized by moist and relaxing except in cold and summer season. The average annual maximum temp. is 32.1 °C with mean maximum temp. of the hottest month (May) and the coldest month (Jan) are about 40.1 °C and 22.5 °C respectively. The average annual minimum temp. is 19.3 °C with mean minimum temp. of the hottest and the coldest months are about 25.3 °C and 8.9 °C respectively. The average annual rainfall of the city is 101.1 cm. The rainfall during the southwest monsoon season is about 88% of the annual rainfall. The values of relative humidity are about 63% to 85% in the morning and 50% to 78% in the afternoon.

⁶⁴ City Development Plan 2041, Varanasi (<http://nnvns.org/data/Final%20CDP%20Varanasi.pdf>)

⁶⁵ <http://www.imdpune.gov.in/caui/smartcities.html>

Brief description of Power Utilities:

Uttar Pradesh Electricity Board (UPSEB) which was responsible for generation, transmission and distribution of electricity in Uttar Pradesh, was divided into following companies by the State Government after Uttar Pradesh 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.
- Uttar Pradesh Rajya Jal Vidyut Utpadan Nigam Limited (UPRVUNL) is responsible for hydro power generation in state.

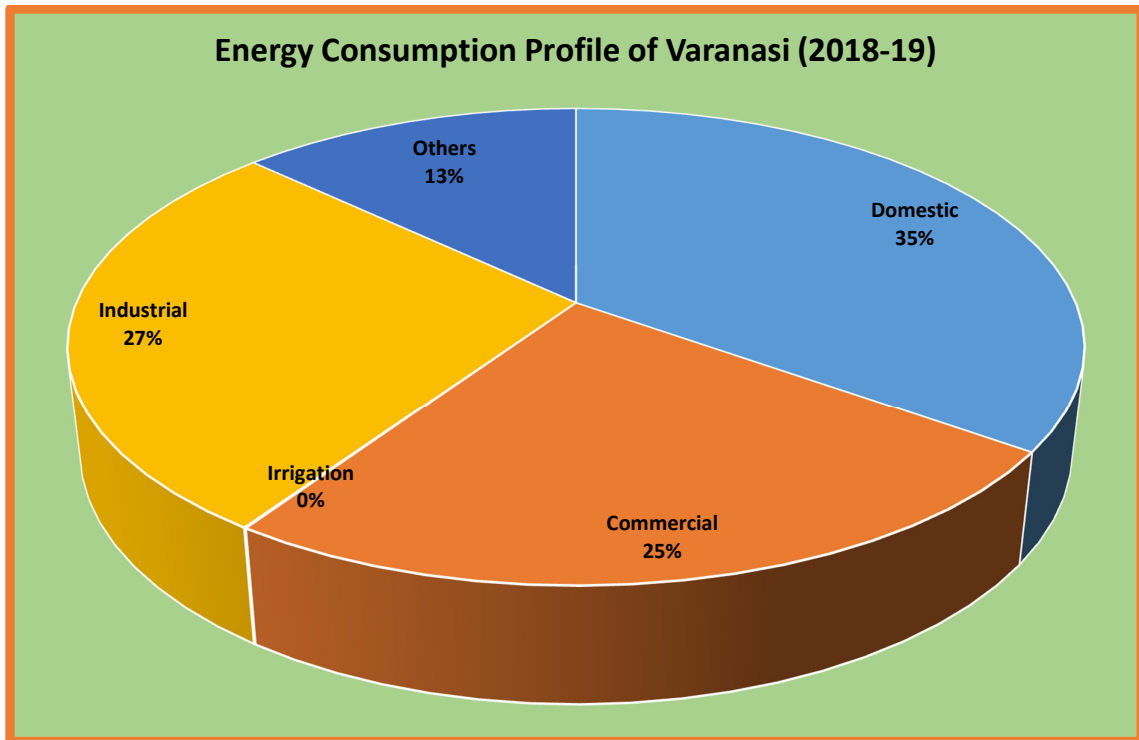
UPPCL has been further divided into following five distribution companies on 12.08.2003:

- 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. PuVVNL is responsible for distribution of power in Varanasi.

Existing Power Scenario:

The total electricity consumption of Varanasi in the year 2018-19 was 1708 MU and with 16.87% T&D losses, the requirement was 2054 MU. The peak demand of the city was 597 MW. The Domestic sector was the biggest consumer of electricity (35%) followed by Industrial (27%) & Commercial (25%).



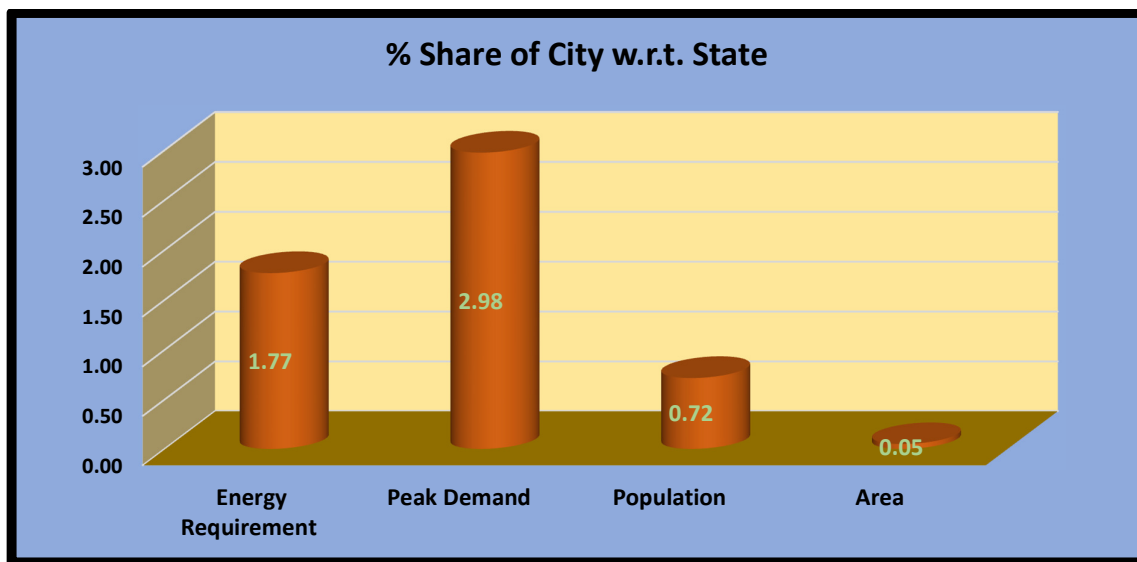
(Figure 21.2: Energy Consumption Profile of Varanasi in 2018-19)

During the last five years (2013-14 to 2018-19), the city has observed CAGR of 7.13% & 1.40% in electricity energy requirement and peak demand respectively.

On comparison of Varanasi with Uttar Pradesh for the year 2018-19, it is observed that the energy requirement of Varanasi was 1.77% of the total energy requirement of the state whereas its contribution in population and area were only 0.72% and 0.05% respectively.

Sl. No.	Particulars	Varanasi	Uttar Pradesh	Varanasi as % of Uttar Pradesh
1.	Energy Requirement (in MU)	2054	116149	1.77
2.	Peak Demand (in MW)	597	20062	2.98
3.	Population (2011 Census)	14,32,280	19,98,12,341	0.72
4.	Area (in sq km)	118.68	2,40,928	0.05

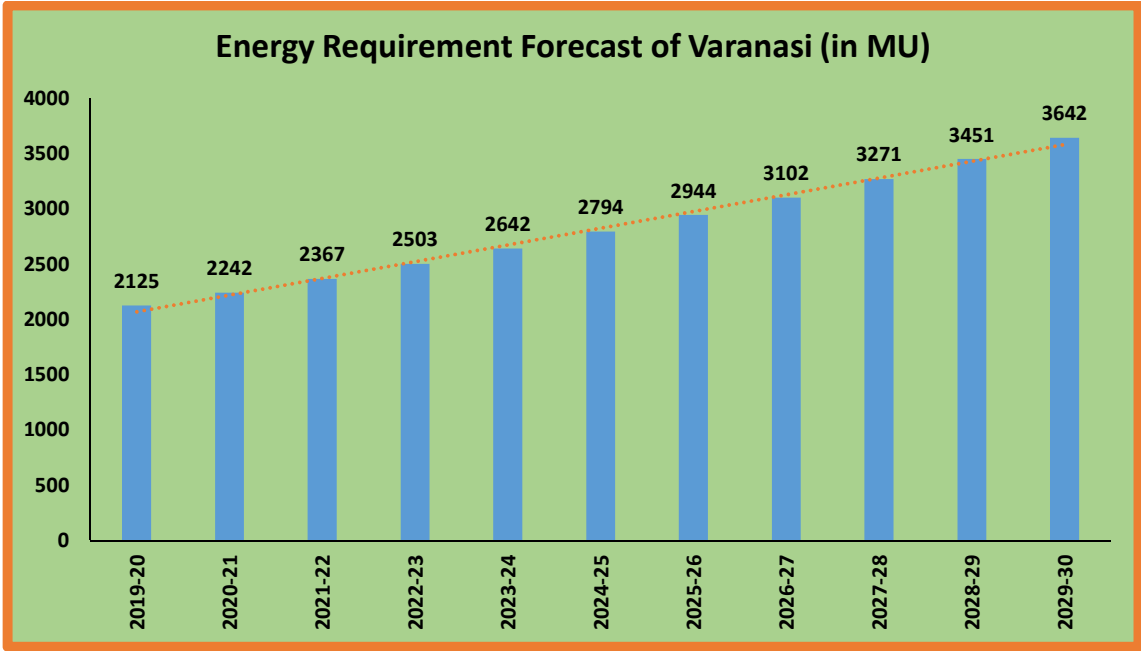
(Table 21.1: Comparison of Varanasi with Uttar Pradesh in 2018-19)



(Figure 21.3: Comparison between Varanasi and Uttar Pradesh in 2018-19)

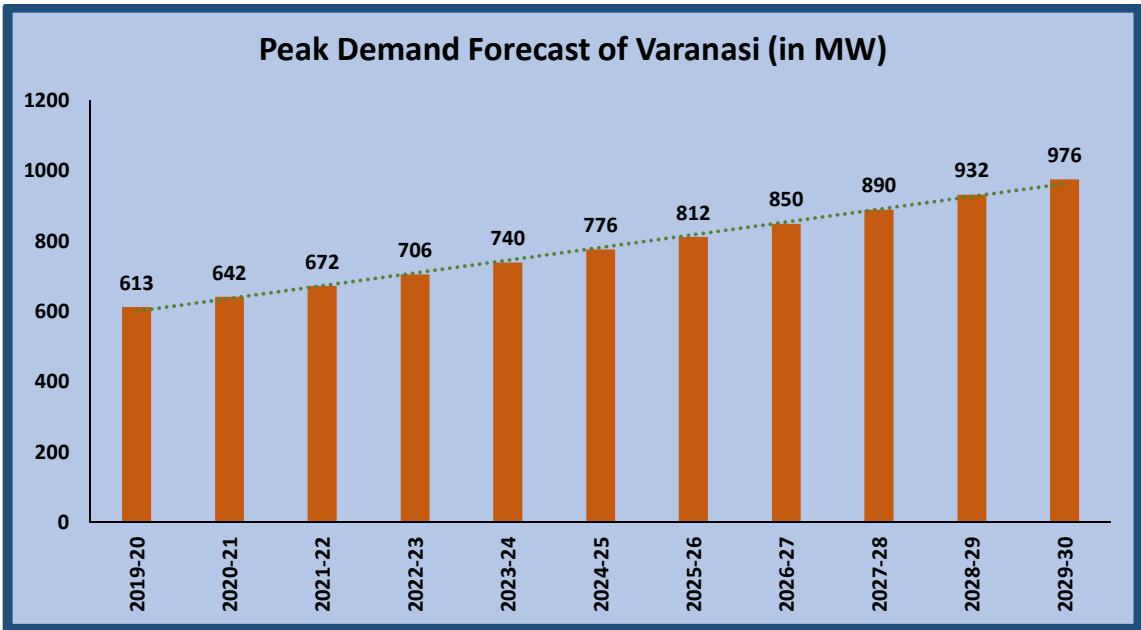
Power Forecast:

Based on total electricity consumption and T&D Losses, the total energy requirement of Varanasi is estimated as 2125 MU in year 2019-20. It is expected that the energy requirement of the city will reach to 2794 MU by the year 2024-25 with 5.63% CAGR for the period 2019-20 to 2024-25. With CAGR of 5.44% for the period 2024-25 to 2029-30, its energy requirement is estimated as 3642 MU by the year 2029-30.



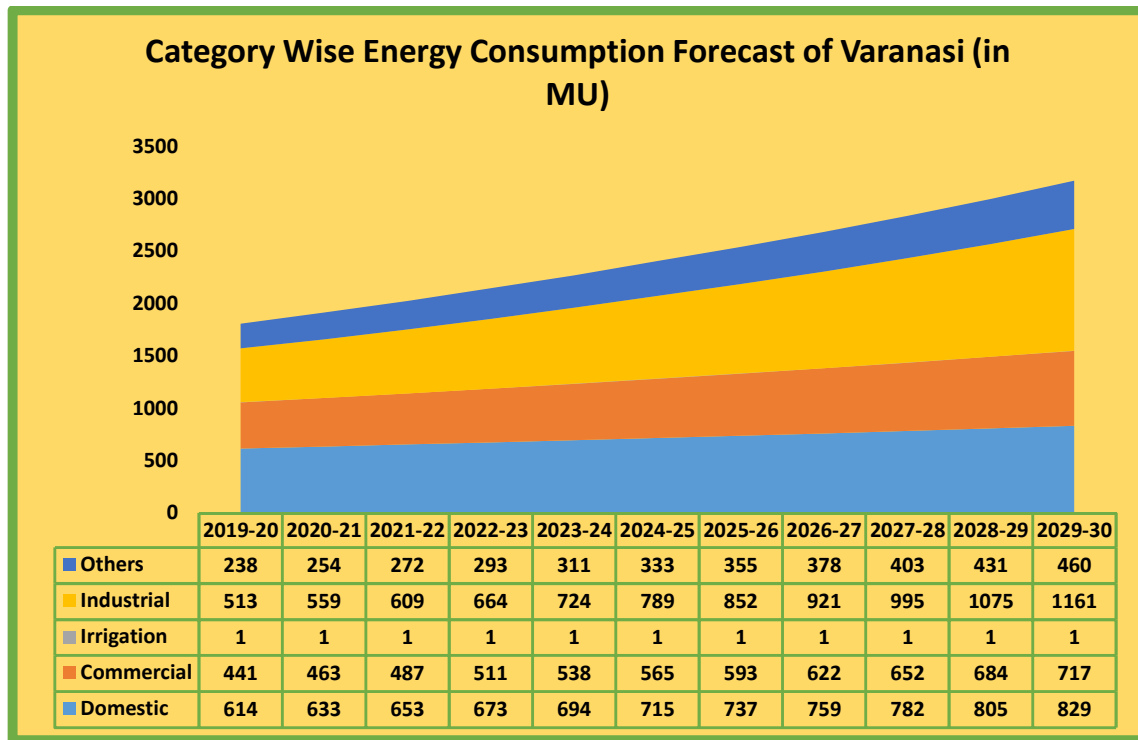
(Figure 21.4: Energy Requirement Forecast of Varanasi in MU)

Peak Demand of the Varanasi is expected to see 4.85% CAGR upto 2024-25 and will reach 776 MW in comparison to 613 MW in year 2019-20. It is expected to reach 976 MW in year 2029-30 with a CAGR of 4.69% after 2024-25.



(Figure 21.5: Peak Demand Forecast of Varanasi in MW)

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



(Figure 21.6: Category Wise Energy Consumption forecast of Varanasi)

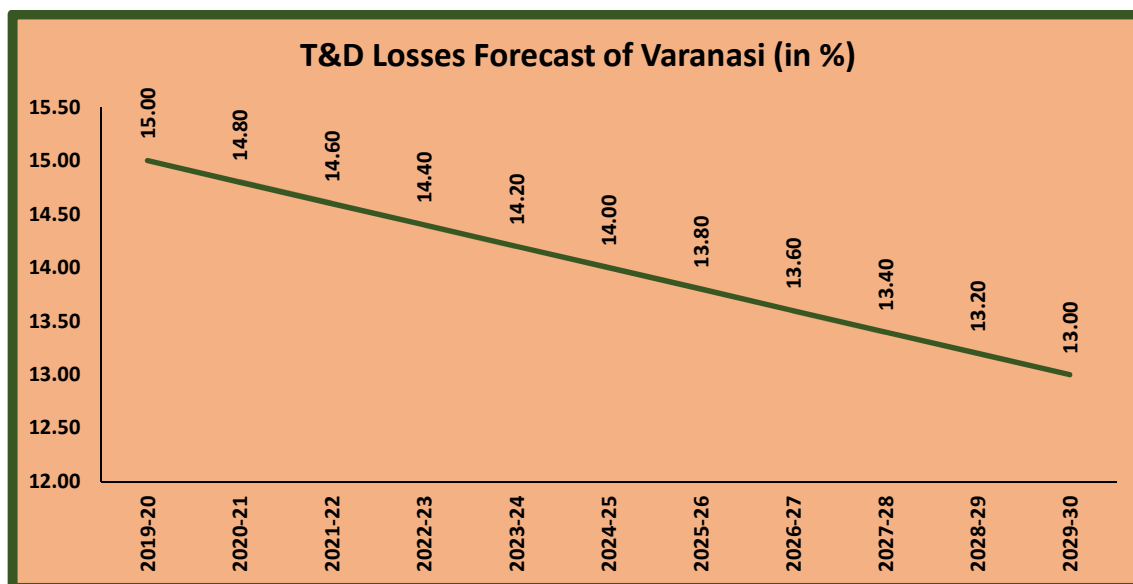
The category wise CAGR expected in energy consumption for the next ten years (2019-20 to 2029-30) along with its break up in five years (2019-20 to 2024-25 & 2025-26 to 2029-30) is tabulated below:

Sl. No.	Category	Energy Consumption (in MU)			CAGR in %		
		2019-20	2024-25	2029-30	2019-20 to 2024-25	2024-25 to 2029-30	2019-20 to 2029-30
1.	Domestic	614	715	829	3.10	3.00	3.05
2.	Commercial	441	565	717	5.10	4.89	4.99
3.	Irrigation	1	1	1	2.00	2.00	2.00
4.	Industrial	513	789	1161	9.01	8.03	8.52
5.	Others	238	333	460	6.95	6.69	6.82
6.	Total	1806	2403	3169	5.88	5.69	5.78

(Table 21.2: Expected CAGR of Varanasi - Category Wise Consumption)

Transmission & Distribution Losses:

T&D losses of Varanasi were 16.87% in year 2018-19. The target level is to bring it down to about 14.00% and 13.00% by the end of 2024-25 & 2029-30 respectively.



(Figure 21.7: T&D Loss Forecast of Varanasi)

The power forecast of Varanasi city is summarized below:

Sl. No.	Particulars	2019-20	2024-25	2029-30	CAGR in %	
					2019-20 to 2024-25	2024-25 to 2029-30
1.	Energy Requirement in MU	2125	2794	3642	5.63	5.44
2.	Peak Demand in MW	613	776	976	4.85	4.69
3.	T&D Losses in %	15.00	14.00	13.00	-	-

(Table 21.3: Power forecast summary of Varanasi)

Analysis of Forecast:

A comparison of actual CAGR witnessed for the Varanasi city during the last five years and the CAGR for future power forecast is tabulated below:

Sl. No.	City/State/Country	CAGR in %		
		2013-14 to 2018-19	2019-20 to 2024-25	2024-25 to 2029-30
1.	Energy Requirement	7.13	5.63	5.44
2.	Peak Demand	1.40	4.85	4.69

(Table 21.4: Actual CAGR in past vis-a-vis CAGR forecast for future for Varanasi)

It is interesting to note that the city has witnessed moderate peak demand growth in comparison to its energy requirement growth that is in contrast to most of the other mega cities. This could be explained on account of higher increase in industrial consumption in recent years, as observed from the table below, that has changed the category wise consumption profile of the city considerably. It has resulted in increasing the load factor of the city significantly during the last five years (39.28% in 2018-19 in comparison to 29.84% in 2013-14).

Sl. No.	Category	Energy Consumption in MU		CAGR in %
		2013-14	2018-19	
1.	Domestic	510	596	3.14
2.	Commercial	325	419	5.20
3.	Irrigation	1	1	6.15
4.	Industries	196	470	19.09
5.	Others	148	222	8.41
6.	Total	1181	1708	7.66

(Table 21.5: Category Wise Consumption CAGR of Varanasi during 2013-14 to 2018-19)

The present energy consumption profile is expected to remain similar in the future and therefore, the peak demand of the city is expected to follow energy requirement growth trajectory in the future.

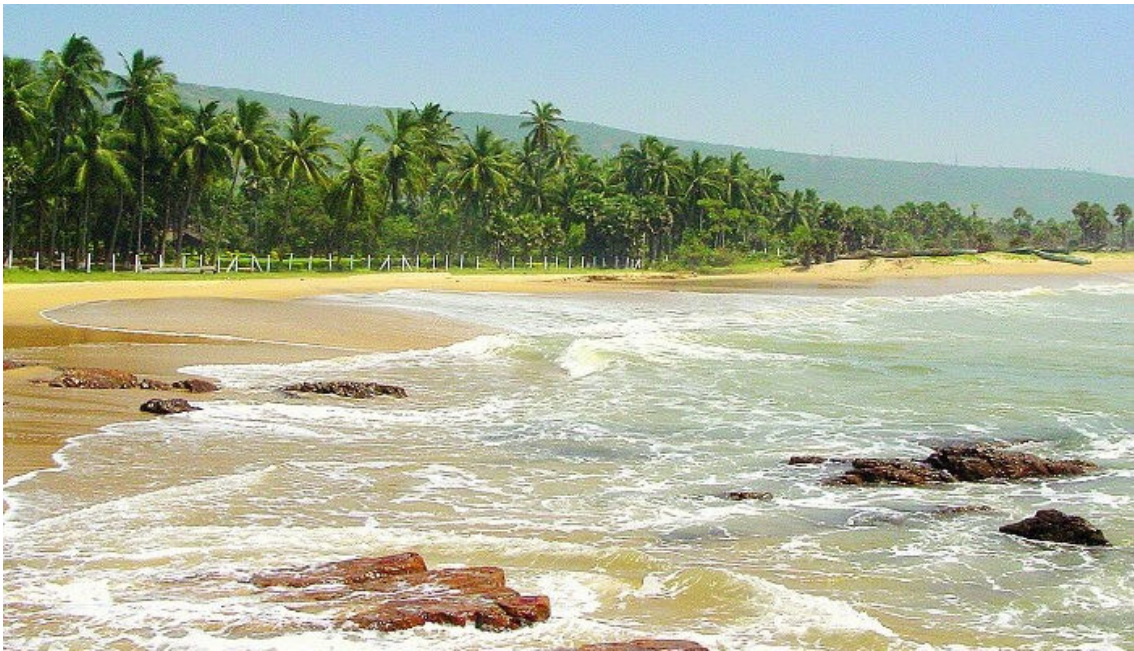
Varanasi

Electrical Energy Consumption, Energy Requirement and Peak Electricity Demand

(Category Wise and Year Wise Summary)												
Year	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30	
Domestic	614	633	653	673	694	715	737	759	782	805	829	
Commercial	441	463	487	511	538	565	593	622	652	684	717	
Public lighting	9	9	10	10	11	11	11	12	12	13	13	
Public Water Works	130	139	148	161	169	180	193	206	221	237	255	
Irrigation	1	1	1	1	1	1	1	1	1	1	1	
LT Industries	103	111	120	130	140	152	162	174	186	199	214	
HT Industries	410	447	489	534	583	637	690	747	809	875	947	
Railway Traction	0	0	0	0	0	0	0	0	0	0	0	
Bulk Supply	0	0	0	0	0	0	0	0	0	0	0	
Others (if any)	99	106	114	122	132	142	150	160	170	180	192	
Total (Energy Consumption)	1806	1910	2021	2143	2267	2403	2537	2680	2833	2995	3169	
T&D losses -MU	319	332	346	360	375	391	406	422	438	456	473	
T&D losses -in %	15.00	14.80	14.60	14.40	14.20	14.00	13.80	13.60	13.40	13.20	13.00	
Energy Requirement - MU	2125	2242	2367	2503	2642	2794	2944	3102	3271	3451	3642	
Annual Load Factor - %	39.58	39.88	40.18	40.48	40.78	41.08	41.38	41.68	41.98	42.28	42.58	
Peak Load - MW	613	642	672	706	740	776	812	850	890	932	976	

Table 21.6: Power Forecast of Varanasi

Vishakhapatnam



Vishakhapatnam

Introduction:

Vishakhapatnam, popularly known as Vizag, is Andhra Pradesh's largest city - both by population and economy. It has an international airport and India's fifth busiest sea port. It is also a popular tourist destination.

As per Census 2011, the total population of the city was 17,28,128 and it had grown with annual rate of 5.64% for the period 2001 to 2011. The total municipal area of the city is 513.61 sq. km.



(Figure 22.1: Location of Vishakhapatnam City)

Economy⁶⁶

The city is an industrial hub, with a host of SEZs, and is one of the world's fastest growing city in terms of population. The major industries located in the cities are ship building, alloy wheels, food processing & chemicals.

Climate⁶⁷

The climate of the city is characterized by oppressive summer and humid in all seasons. The average annual maximum temp. is 30.6 °C with mean maximum temp. of the hottest months (May and June) and the coldest month (Jan) are about 32.8 °C and 27.7 °C respectively. The average annual minimum temp. is 24.7 °C with mean minimum temp. of the hottest and the coldest months are about 27.5 °C and 20.7 °C respectively. The average annual rainfall of the city is 101.6 cm. The rainfall during the southwest monsoon season is about 58% of annual rainfall. The values of relative humidity are generally high throughout the year and vary from 66% to 79%.

Brief description of Power Utilities⁶⁸:

The Andhra Pradesh State Electricity Board, which came into existence in 1959, was unbundled into Andhra Pradesh Power Generation Corporation (APGENCO) & Transmission Corporation of Andhra Pradesh Limited (APTRANSCO) on 01.02.99 after the enactment in AP Electricity Reforms Act in 1998. APTRANSCO was further unbundled w.e.f. 01.04.2000 into "Transmission Corporation" (APTRANSCO) and four "Distribution Companies"(APDISCOMs) viz. Eastern Power Distribution Company of Andhra Pradesh Limited (APEPDCL), Central Power Distribution Company of Andhra Pradesh Limited (APCPDCL), Northern Power Distribution Company of Andhra Pradesh Limited (APNPDCL) and Southern Power Distribution Company of Andhra Pradesh Limited (APSPDCL). APEPDCL is responsible for power distribution in Vishakhapatnam.

⁶⁶ Vishakhapatnam Smart City

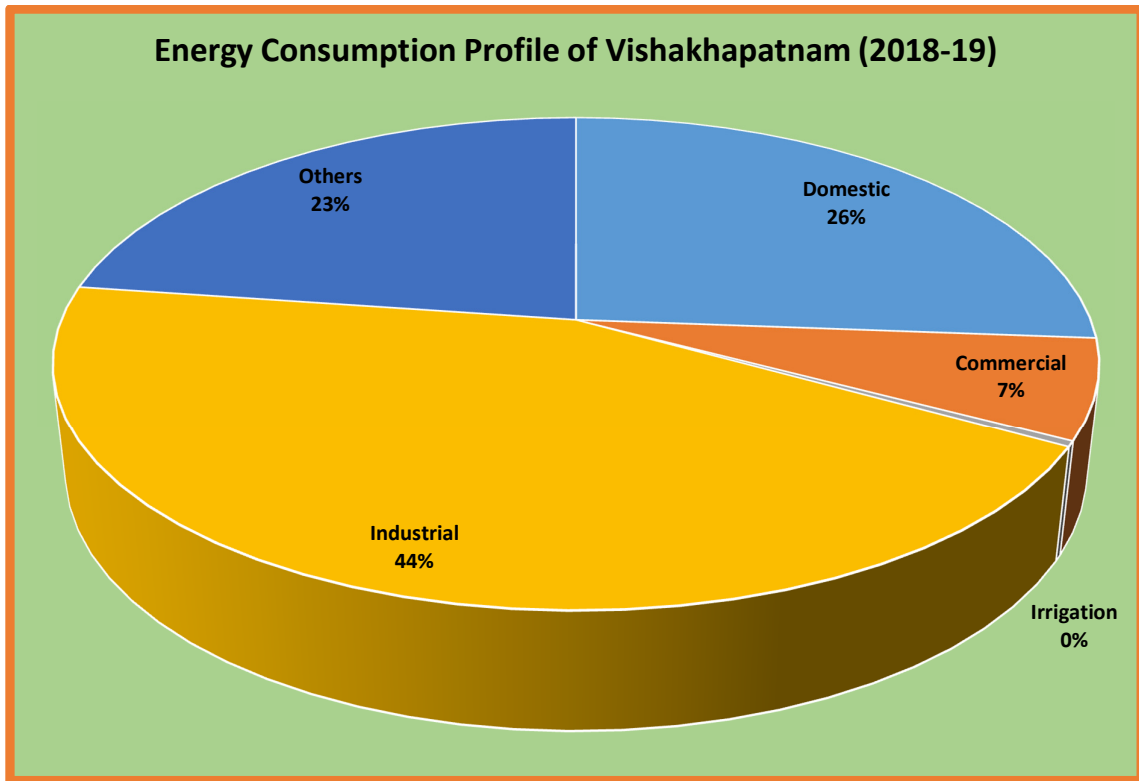
Plan(http://smartcities.gov.in/upload/uploadfiles/files/AndhraPradesh_Vishakhapatnam.pdf)

⁶⁷ IMD Official Site (<http://www.imdpune.gov.in/caui/smartcities.html>)

⁶⁸ Official Site of APGENCO (<https://apgenco.gov.in/getInfo.do>)

Existing Power Scenario:

The total electricity consumption of Vishakhapatnam in the year 2018-19 was 4383 MU and with 3.80% T&D losses, the requirement was 4556 MU. The peak demand of the city was 834 MW. The Industrial sector was the biggest consumer of electricity (44%) followed by Domestic (26%).



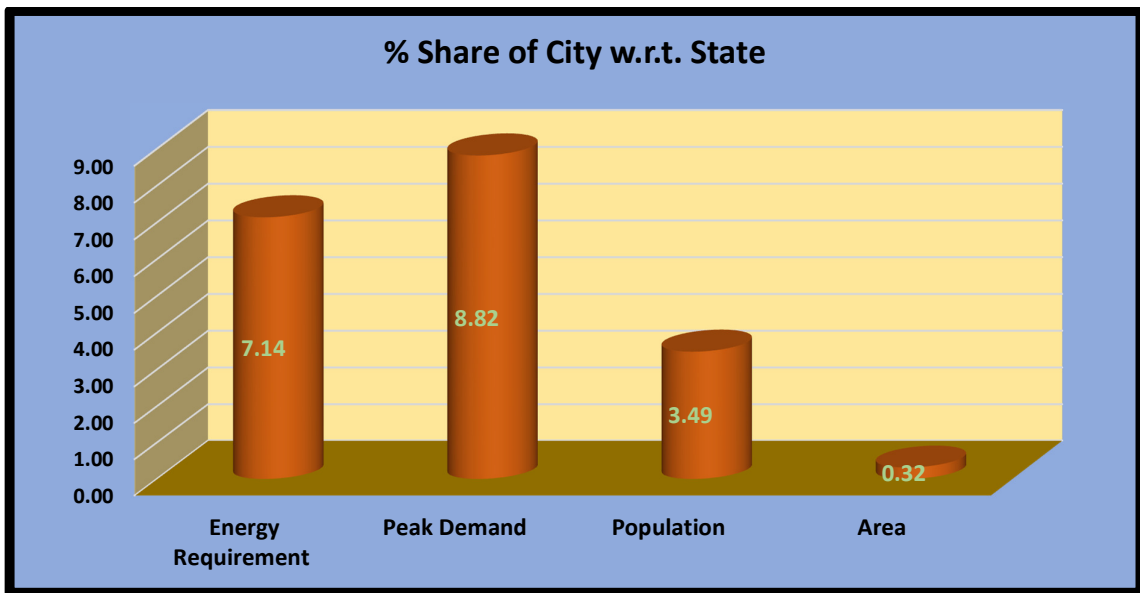
(Figure 22.2: Energy Consumption Profile of Varanasi in 2018-19)

During the last five years (2013-14 to 2018-19), the city has observed CAGR of 7.42% & 14.38% in electricity energy requirement and peak demand respectively.

On comparison of Vishakhapatnam with Andhra Pradesh for the year 2018-19, it is observed that the energy requirement of Vishakhapatnam was 7.14% of the total energy requirement of the state whereas its contribution in population and area were only 3.49% and 0.32% respectively.

Sl. No.	Particulars	Vishakhapatnam	Andhra Pradesh	Vishakhapatnam as % of Andhra Pradesh
1.	Energy Requirement (in MU)	4556	63804	7.14
2.	Peak Demand (in MW)	834	9453	8.82
3.	Population (2011 Census)	17,28,128	4,95,77,103	3.49
4.	Area (in sq km)	513.61	1,62,970	0.32

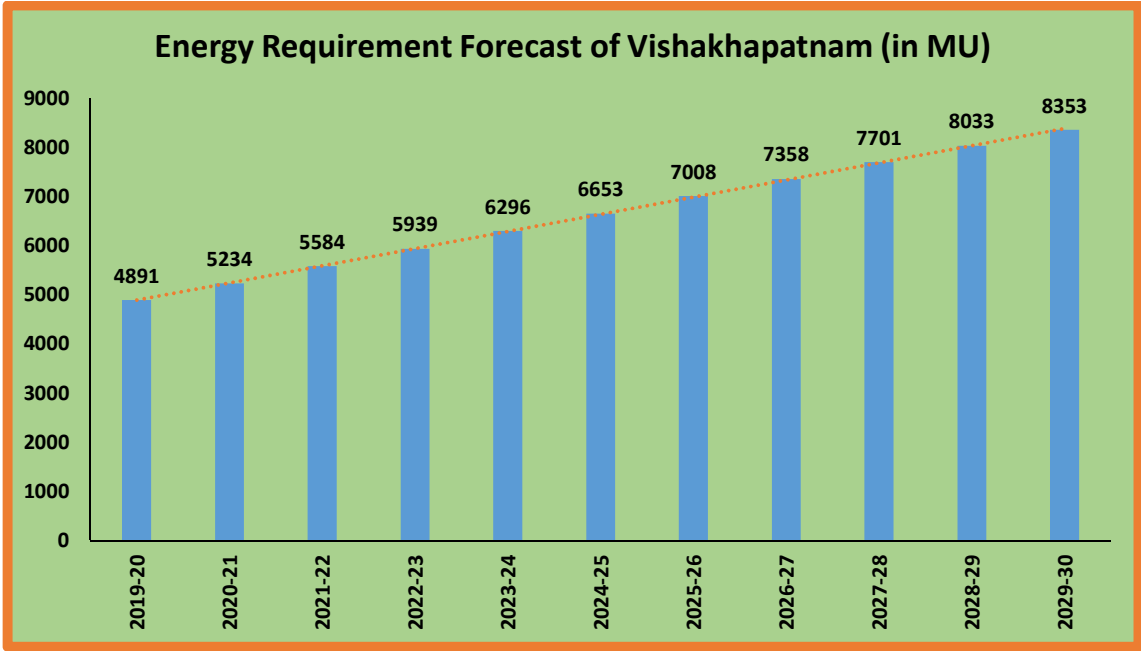
(Table 22.1: Comparison of Vishakhapatnam with Andhra Pradesh in 2018-19)



(Figure 22.3: Comparison between Vishakhapatnam and Andhra Pradesh in 2018-19)

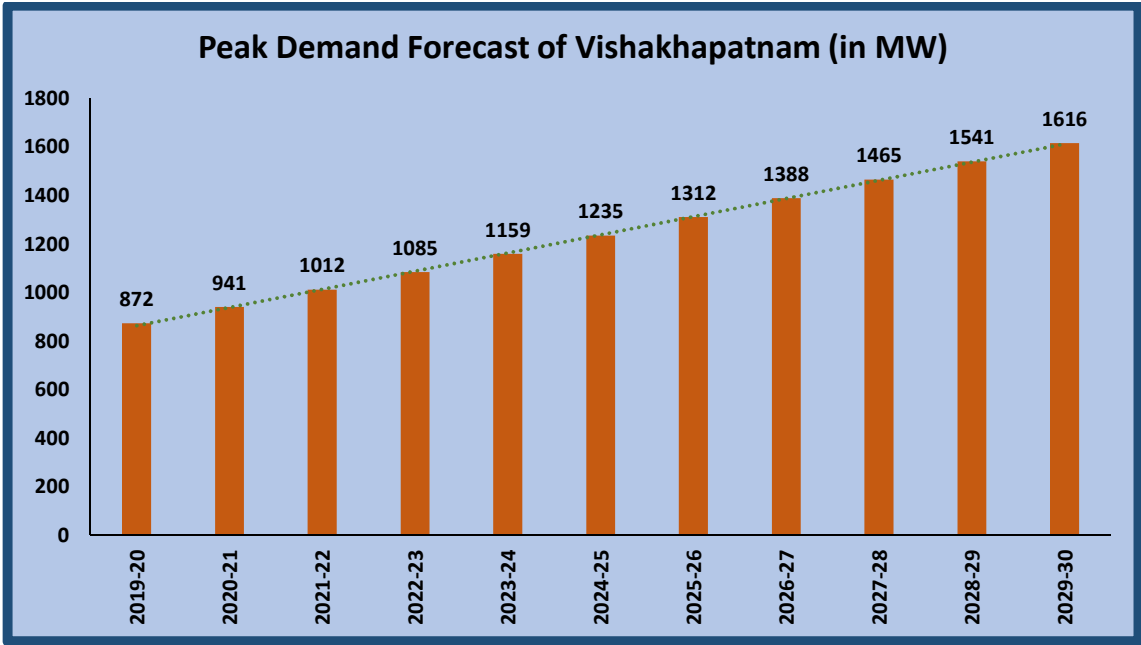
Power Forecast:

Based on total electricity consumption and T&D Losses, the total energy requirement of Vishakhapatnam is estimated as 4891 MU in year 2019-20. It is expected that the energy requirement of the city will reach to 6653 MU by the year 2024-25 with 6.35% CAGR for the period 2019-20 to 2024-25. With CAGR of 4.65% for the period 2024-25 to 2029-30, its energy requirement is estimated as 8353 MU by the year 2029-30.



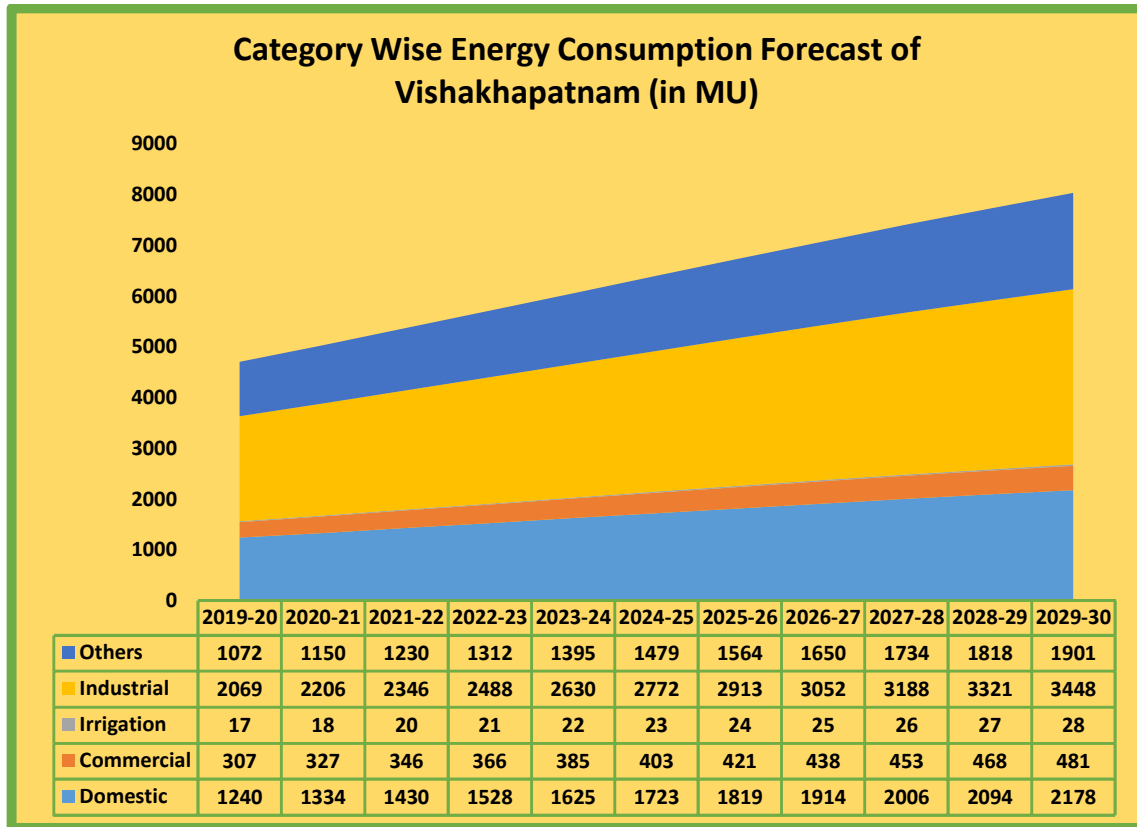
(Figure 22.4: Energy Requirement Forecast of Vishakhapatnam in MU)

Peak Demand of the Vishakhapatnam is expected to see 7.20% CAGR upto 2024-25 and will reach 1235 MW in comparison to 872 MW in year 2019-20. It is expected to reach 1616 MW in year 2029-30 with a CAGR of 5.53% after 2024-25.



(Figure 22.5: Peak Demand Forecast of Vishakhapatnam in MW)

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



(Figure 22.6: Category Wise Energy Consumption forecast of Vishakhapatnam)

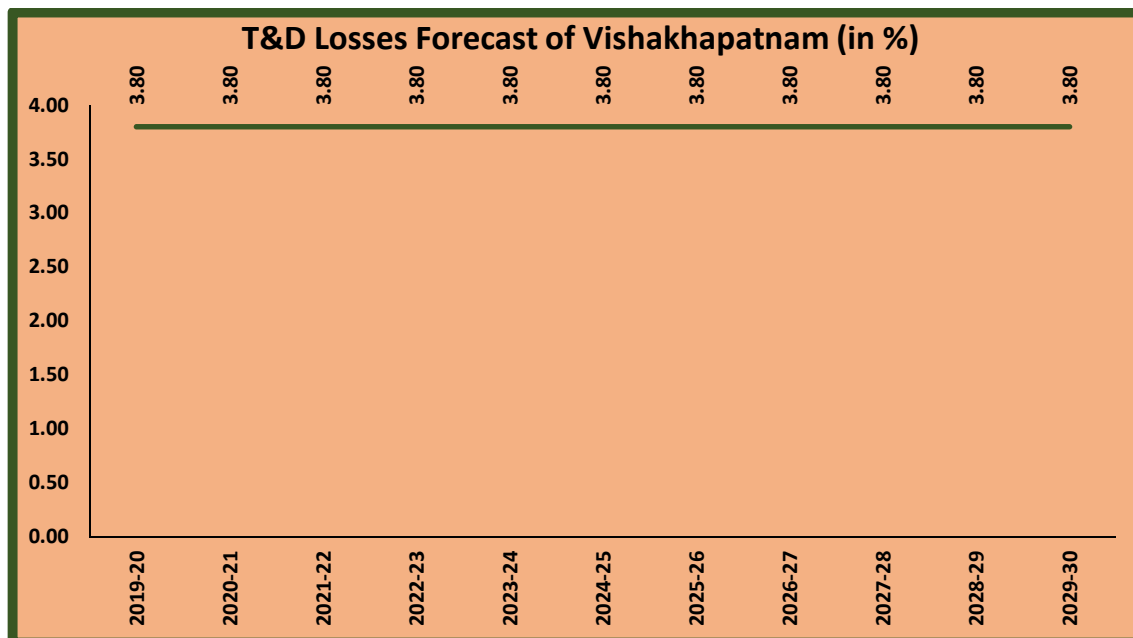
The category wise CAGR expected in energy consumption for the next ten years (2019-20 to 2029-30) along with its break up in five years (2019-20 to 2024-25 & 2025-26 to 2029-30) is tabulated below:

Sl. No.	Category	Energy Consumption (in MU)			CAGR in %		
		2019-20	2024-25	2029-30	2019-20 to 2024-25	2024-25 to 2029-30	2019-20 to 2029-30
1.	Domestic	1240	1723	2178	6.80	4.80	5.79
2.	Commercial	307	403	481	5.60	3.60	4.59
3.	Irrigation	17	23	28	6.30	3.80	5.04
4.	Industrial	2069	2772	3448	6.03	4.46	5.24
5.	Others	1072	1479	1901	6.65	5.14	5.89
6.	Total	4705	6400	8035	6.35	4.65	5.50

(Table 22.2: Expected CAGR of Vishakhapatnam - Category Wise Consumption)

Transmission & Distribution Losses:

T&D losses of Vishakhapatnam were 3.80%⁶⁹ in the year 2018-19 and are expected to remain so in the future.



(Figure 22.7: T&D Loss Forecast of Vishakhapatnam)

The power forecast of Vishakhapatnam city is summarized below:

Sl. No.	Particulars	2019-20	2024-25	2029-30	CAGR in %	
					2019-20 to 2024-25	2024-25 to 2029-30
1.	Energy Requirement in MU	4891	6653	8353	6.35	4.65
2.	Peak Demand in MW	872	1235	1616	7.20	5.53
3.	T&D Losses in %	3.80	3.80	3.80	-	-

(Table 22.3: Power forecast summary of Vishakhapatnam)

⁶⁹ Vishakhapatnam Smart City Proposal
http://smartcities.gov.in/upload/uploadfiles/files/AndhraPradesh_Vishakhapatnam.pdf)

Analysis of Forecast:

A comparison of actual CAGR witnessed for the Vishakhapatnam city during the last five years and the CAGR for future power forecast is tabulated below:

Sl. No.	City/State/Country	CAGR in %		
		2013-14 to 2018-19	2019-20 to 2024-25	2024-25 to 2029-30
1.	Energy Requirement	7.42	6.35	4.65
2.	Peak Demand	14.38	7.20	5.53

(Table 22.4: Actual CAGR in past vis-a-vis CAGR forecast for future for Vishakhapatnam)

The above table indicates that Vishakhapatnam is expected to witness good growth in power demand as witnessed in the past. The huge peak demand growth witnessed in the past is expected to slow down and forecast to follow energy requirement growth pattern.

Vishakhapatnam

Electrical Energy Consumption, Energy Requirement and Peak Electricity Demand

(Category Wise and Year Wise Summary)

Year	2019-20	2020-21	2021-22	2022-23	2023-24	2024-25	2025-26	2026-27	2027-28	2028-29	2029-30
Domestic	1240	1334	1430	1528	1625	1723	1819	1914	2006	2094	2178
Commercial	307	327	346	366	385	403	421	438	453	468	481
Public lighting	20	20	21	21	21	22	22	22	22	23	23
Public Water Works	49	52	54	57	60	63	67	70	73	77	80
Irrigation	17	18	20	21	22	23	24	25	26	27	28
LT Industries	45	47	49	51	54	56	58	60	63	65	68
HT Industries	2024	2159	2297	2436	2576	2716	2855	2992	3126	3255	3380
Railway Traction	184	194	204	215	226	237	249	261	273	286	299
Bulk Supply	603	649	695	743	790	838	885	931	975	1018	1059
Others (if any)	216	235	255	276	297	320	343	366	390	415	440
Total (Energy Consumption)	4705	5036	5372	5713	6057	6400	6742	7079	7408	7728	8035
T&D losses -MU	186	199	212	226	239	253	266	280	293	305	317
T&D losses -in %	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80
Energy Requirement - MU	4891	5234	5584	5939	6296	6653	7008	7358	7701	8033	8353
Annual Load Factor - %	64.00	63.50	63.00	62.50	62.00	61.50	61.00	60.50	60.00	59.50	59.00
Peak Load - MW	872	941	1012	1085	1159	1235	1312	1388	1465	1541	1616

Table 22.5: Power Forecast of Vishakhapatnam

Assumptions

General Assumptions:

- i. The geographical area of the Mega Cities will remain largely in its present shape with no abrupt alteration in its boundary.
- 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. For future, the T&D losses have been calculated on the basis of past trends and the target fixed by Government of India i.e. less than 15% by 2020.
- iv. The impacts of solar rooftop and electric vehicles have not been considered exclusively. It is assumed that the impact would be negligible as both have still not come up in a big way. Also, additional demand on the grid due to electric vehicles are expected to be off shouldered by rooftop solar to some extent.
- v. The energy requirement & peak demand data for All India and each state has been taken from Monthly Power Supply Position prepared by CEA.
- vi. Where more than one Discoms are operating within a city, the peak demand has been calculated on the basis of diversity factors prevailing in the respective states. The details of diversity factor considered are at **Annexure-I**.

- vii. For the cities where traction loads are not indicated separately as Railways is increasing drawing power from grid as an open access consumer, the traction load is included in the “Others” Category.
- viii. The area of the city has been taken as the total municipal area of the city indicated in Census- 2011 report unless stated otherwise.

City Specific Assumptions:

- i. In case of Gangtok city, as the T&D losses are hovering around 22-23% at present and the trends were also not encouraging in the recent past, exception has been made for reducing the T&D losses to 15% by 2020 since it does not appear practically possible.
- ii. In case of Hyderabad city, there were complete mismatch of data before 2015-16 & afterward as the city boundary was re-organized. Therefore, the growth trends have been worked out broadly on the data for the year 2003-04 to 2015-16.
- iii. In case of Jammu city, as the T&D losses are hovering around 34-35% at present and the trends were also not encouraging in the recent past, exception has been made for reducing the T&D losses to 15% by 2020 since it does not appear practically possible.
- iv. In case of Kanpur city, as energy consumption in the year 2013-14 was unusually high and energy consumption in the year 2018-19 was unusually low, the trends for future growth have been calculated after ignoring data of these two years.
- v. The power generation and distribution system of Andaman and Nicobar Islands are served by standalone systems and each island has its own generation & distribution system and there is no single power grid. Due to geographical isolation of islands by sea over a great distance, the consumption of electrical energy is heavily restricted by the generation

capacity of individual islands. Accordingly, the power demand growth of the Port Blair is estimated by keeping in view the generation capacity augmentation plan of the South Andaman also in addition to the energy consumption trends witnessed in the past.

- vi. In case of Srinagar city, as the T&D losses are hovering around 51-52% at present and the trends were also not encouraging in the recent past, exception has been made for reducing the T&D losses to 15% by 2020 since it does not appear to practically possible.
- vii. The electricity data of DVC for the year 2018-19 are distributed to Jharkhand & West Bengal as per their average respective share existed in the past. Accordingly, the energy requirement of DVC is apportioned in the ratio of (46.54) :(53.56) & its Peak Demand is apportioned in (48.65) :(51.35) ratio to Jharkhand & West Bengal respectively. The detailed calculations are at **Annexure-II**.
- viii. The comparison of Jammu & Srinagar cities has been done with corresponding data of the erstwhile J&K State.

Diversity Factor of the States

Sl.	State	Diversity Factor
1.	Gujarat	1.059
2.	Maharashtra	1.035
3.	Uttar Pradesh	1.015
4.	West Bengal	1.030

(Table AI.1: Diversity Factor of the States)

West Bengal & Jharkhand Power Scenario including DVC

Sl. No	Particulars	DVC	DVC Share for West Bengal (in %)	DVC Share for West Bengal	West Bengal excluding DVC	West Bengal (Total)
1.	Peak demand (in MW)	3098	51.35	1591	9123	10714
2.	Energy Requirement (in MU)	22372	53.46	11960	51287	63247

(Table AII.1: West Bengal Power Scenario in 2018-19 after including DVC)

Sl. No.	Particulars	DVC	DVC Share for Jharkhand (in %)	DVC Share for Jharkhand	Jharkhand excluding DVC	Jharkhand (Total)
1.	Peak Demand (in MW)	3098	48.65	1507	1291	2798
2.	Energy Requirement (in MU)	22372	46.54	10412	8490	18902

(Table AII.2: Jharkhand Power Scenario in 2018-19 after including DVC)

Population & Area of the Mega Cities as per Census-2011

Sl. No.	Mega City	Population	Area (in sq. km.)
1	Agra	15,85,704	120.57
2	Aurangabad	12,43,744	180.12
3	Bengaluru	85,20,435	748.42
4	Gangtok	1,00,286	19.28
5	Hyderabad	69,71,622	962.30
6	Jammu	5,76,198	159.36
7	Jodhpur	10,33,756	75.50
8	Kanpur	29,20,496	301.16
9	Kolkata	1,41,12,536	1886.67
10	Kota ⁷⁰	10,01,694	221.36
11	Lucknow	28,17,105	348.80
12	Mumbai	1,24,42,373	603.00
13	Nagpur	24,97,870	229.20
14	Port Blair	1,08,058	17.91
15	Pune	50,57,709	502.78
16	Ranchi	11,26,720	197.00
17	Srinagar	12,09,081	284.50
18	Surat	44,67,797	335.82
19	Varanasi	14,32,280	118.68
20	Vishakhapatnam	17,28,128	513.61

(Table AIII.1: Population and Area of the Mega Cities as per Census-2011)

⁷⁰ Official Website of Kota Municipal Corporation (<http://kotamc.org/UI/Static/cityprofile.aspx>)

Population & Area of the States as per Census-2011

Sl. No.	Mega City	Population	Area (in sq. km.)
1	Andaman & Nicobar	3,80,581	8,249
2	Andhra Pradesh*	4,95,77,103	1,62,970
3	Bihar	10,40,99,452	94,163
4	Gujarat	6,04,39,692	1,96,244
5	Jammu & Kashmir	1,25,41,302	2,22,236
6	Jharkhand	3,29,88,134	79,716
7	Karnataka	6,10,95,297	1,91,791
8	Maharashtra	11,23,74,333	3,07,713
9	Rajasthan	6,85,48,437	3,42,239
10	Sikkim	6,10,577	7,096
11	Telangana**	3,50,03,674	1,12,077
12	Uttar Pradesh	19,98,12,341	2,40,928
13	West Bengal	9,12,76,115	88,752

(Table AIV.1: Population and Area of the States as per Census-2011)

*Source: <https://core.ap.gov.in/CMDashBoard/Download/Publications/Statistical%20Abstract%202018.pdf>.

**Source: <https://www.telangana.gov.in/about/state-profile>.

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