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Scenario of power sector in Delhi

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Abstract
This paper is oriented toward the electricity services growth in the Delhi NCR region. With the huge energy demand and old structure of the distribution sector of Delhi, Delhi government is erecting and establishing new transmission lines and power plants. The yearly electricity supply reflects the demand and supply gap to encourage the requirement of new service facilities to manage the gap. The services and facilities provided by the Delhi Transco Limited, is shown by the collected data in terms of the data charts. Delhi has three power plants serving the whole region with total installed capacity of 951MW. There are three capacity enhancement programs approved by the authorities to meet the deficit power. Delhi power servicing companies are also targeting to reduce transmission and distribution losses for enhanced efficiency, power quality and customer satisfaction. The area and locality covered under the project is discussed in details in the subsequent sections.

Keywords: power sector, privatization, electricity consumption, transmission losses

1. Introduction
Power is an originator segment of monetary advancement. In present day time frames, Millennium Development Goals (MDGs) and World Summit support on Sustainable Development (WSSD), are the two primary universal approvals towards the economic advancement, these have referred the overall energy access as a critical point. In India, where the population is around 1210 million individuals [1], approximately 67% of the family units approached the power. The decision that the nation makes toward stimulating the rest of the populace, will have an imperative effect on other economic development factors for example, farming, water, and wellbeing.

On the basis of population after Mumbai, New Delhi is at second position in India [2]. National Capital Territory (NCT) region of Delhi is a metropolitan area set in northern India, including national capital New Delhi. NCT of Delhi goes under administrative division of Union Territory. Notwithstanding, it has unique position and has its own chose administrative affiliation.

NCT has whole introduced power age limit of 7,163 MW. This incorporates introduced limit of energy utilities in Delhi incorporating appointed parts in joint and focal division utilities [3]. The focal and state division sort out 75% and 23% of the aggregate introduced power age limit separately; which is generally from non-renewable energy sources, for example, coal. Sustainable power frames 10% of the aggregate introduced limit (Including little hydro).The private division has around 2% share in the aggregate introduced limit.

Delhi is an urban state with falling country zones and rural exercises. The push on energy requirement of Delhi is basically for relentless electricity and to deal with expanding power request. Delhi's Government introduced control segment changes amid the establishment of the 10th Five Year Plan by corporatization of the electricity transmission, age and introduction of privatization in dispersion of energy. This has strikingly changed the power advancement and appropriation [4] misfortune and it is the main cause for negative returns in Delhi.

Fig 1: Electricity Installed Capacity of Delhi (*Source--IPGCL & PPCL)*

From 2003-04 to 2011-12, the power supply of Delhi expanded from 20634MU to 33390MU respectively and the offer of power from 2007-08 to 2011-12, expanded from 15984MU to 22833MU for different classifications of clients respectively. This observation shows that, there is approximately 43% rise in energy consumption in five years [5].

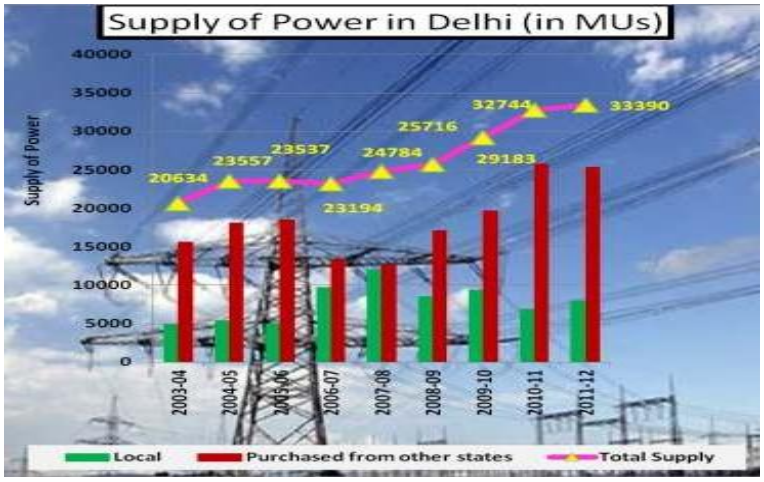


Fig 2: Electric Power Supply in Delhi (in MUS) (Source: -Handbook Delhi Statistical, 2012)

The pinnacle request from 2004-05 to 2011-2012, was increased by 1540 MW. Energy utilization recorded a yearly development at 2.87 for each penny and yearly development at 5.51 for every penny [3].

The electricity consumers in Delhi are increasing day by day, as from 2003-03 to 2011-12 the rise was 25.65 lakh to 43.01 lakh. The jump in domestic consumers as well as the change in other types of electricity user is shown by the pi-chart figure 2.

Framework accessibility is dependably 98 for every penny or additionally amid the period secured under the investigation. The data with respect to completed demand in MW and electricity consumed in million units are delineated [6]. Government of India , Focal Electricity Authority and Ministry of Energy anticipated that greatest request of power in Delhi (in the 17th Power Survey done by Committee) will increment to the match the 6092 MW before end of eleventh Five Year Plan (March-2012).

Table 1: Yearly Electricity Sale in Delhi

Sale of Energy (MU)	2007-08	2008-09	2009-10	2010-11	2011-12 (E)
Domestic	7128	7747	9058	9860	10861
Non Domestic	4430	4958	5164	5262	5921
Industrial	2831	2857	2964	3055	3218
DMRC/Railways/Street Lighting	522	576	624	812	982
Others	1074	1085	1301	1723	1853
Grand Total	**15984**	**17222**	**19112**	**20714**	**22833**

***Source*:** Website of DERC

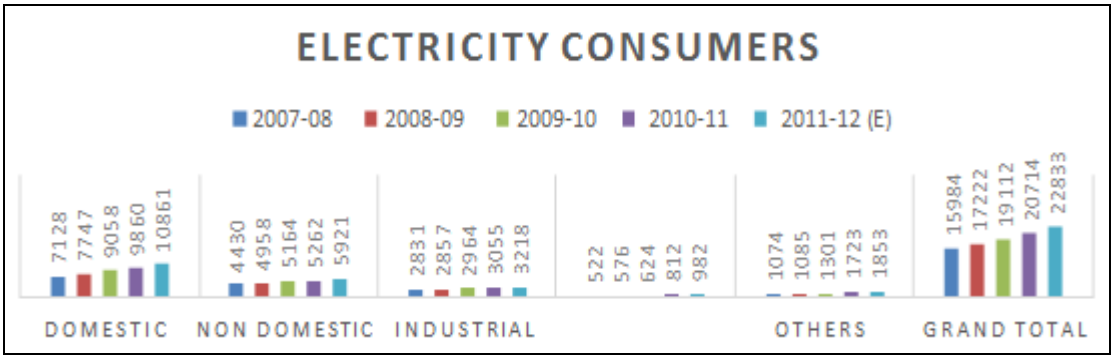


Fig 3: Electricity Consumers in Year 2011-12 in Delhi

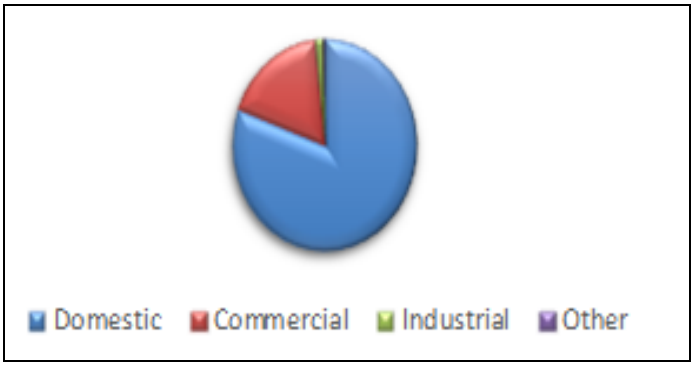
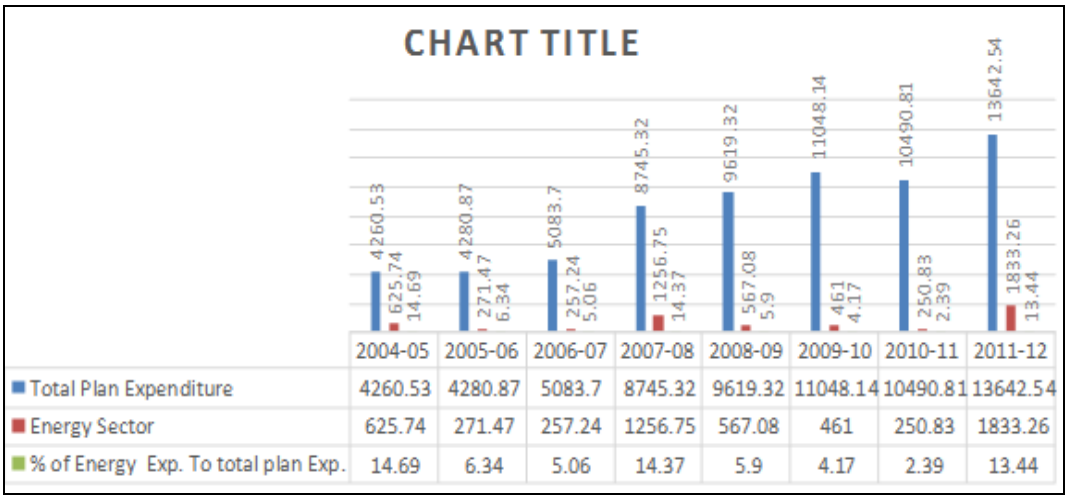


Fig 4: Electricity Consumers in Year 2011-12 in Delhi.

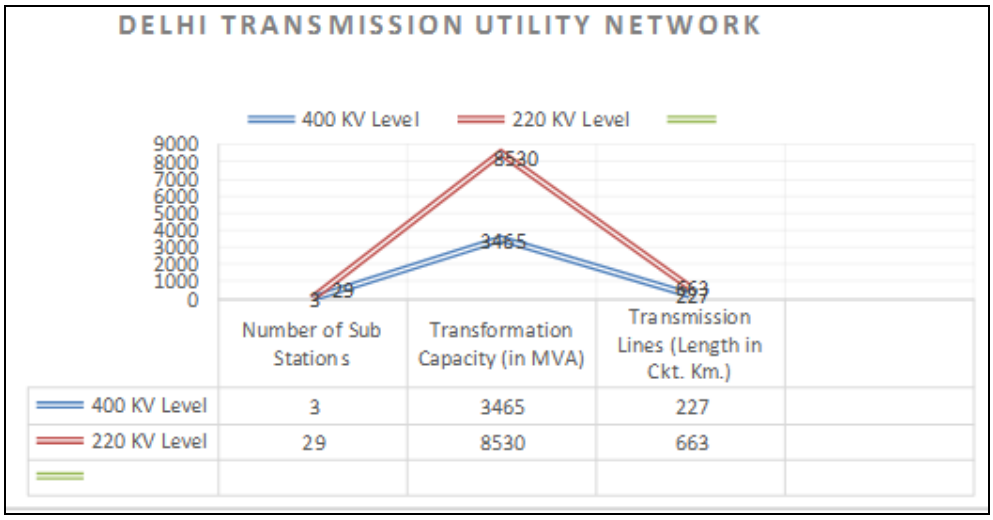
Investment in development and installation of electricity sector is critical for evolving structure of any nation [7]. Electricity consumption of and country reflects the living standard of its citizens [8]. Fifteen percent of Delhi total investment was invested in power sector during the year 2004-05.

Delhi Transmission Company Ltd is accountable for constitution of the 220000V and 400000 V systems required for power trading to the new engaged Discos. Three number of 400 KV and twenty nine number of 220 KV substations has successfully completed by Delhi Transmission Company Ltd and it is maintained by State Transmission Utility [9]. Delhi Transmission Utility graph during 2011-12, is shown below.



	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
Total Plan Expenditure	4260.53	4280.87	5083.7	8745.32	9619.32	11048.14	10490.81	13642.54
Energy Sector	625.74	271.47	257.24	1256.75	567.08	461	250.83	1833.26
% of Energy Exp. To total plan Exp.	14.69	6.34	5.06	14.37	5.9	4.17	2.39	13.44

Fig 5: Delhi Energy Sector Expenditure (in crore)



	Number of Sub Stations	Transformation Capacity (in MVA)	Transmission Lines (Length in Ckt. Km.)
400 KV Level	3	3465	227
220 KV Level	29	8530	663

Fig 6: Delhi 2011-12, Delhi Transmission Utility Network

In the last eight years transmission business has improved its efficiency, reduced losses and good system availability [10]. Table below reflects the Delhi Transco Limited performance of last eight years between 2004-12.

The change in maximum demand from year 2011-12 to 2004-05 was 5.51percent. Energy consumption recorded for the same duration shows annual growth of approximately 2.9%. Whereas 98% system availability is maintained in the period covered. Government of India, Central Electricity Authority and Ministry of Energy of India has concluded that the projected electricity demand in Delhi will be 6093 MW before the 11th Five Year Plan's end.

Table 2: Performance of Delhi Transco Limited 2004-12

Sl.No	Details	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
1.	Peak Demand met in MW	3490	3626	3736	4030	4034	4408	4720	5028
2.	Load Growth (%)	--	3.9	3.0	7.9	0.10	9.30	7.10	6.50
3.	Energy Consumption in MUs	20810	21184	21977	22372	21768	23349	25581	25593
4.	Shedding in MU	176	322	411	136	128	185	74	83
5.	Shedding % Energy Consumption	0.84	1.50	1.87	0.61	0.61	0.80	0.29	0.32
6.	Transmission Losses (%)	1.30	0.72	0.95	1.42	1.59	1.38	1.28	1.20
7.	System Availability (%)	--	97.71	98.87	98.50	98.78	98.39	98.58	98.39

Source: *Delhi Transco Limited*

1.1 Power Generation

MW was the Delhi's own particularly introduced age limit as stated on first April 2011. Amid the year 2011-12, Pragati III (GT-1) power venture and limit of Bawana 216 MW, was proclaimed COD on 27th December 2011. Indira Gandhi coal based power plant's Unit No. 1and Jhajjar STPP region was proclaimed COD on fifth March 2011[11]. The age of power in Delhi is embraced by two GNCTD possessed organizations to be specific IPGCL and PPCL with the accompanying force Plants.

Table 3: Delhi's Installed Electricity Capacity (As on 31st January 2012)

Sl. No	Companies/Station	Fuel	Units
1.	Indraprastha Power Generation Company Limited		
	a. Rajghat Power House	Coal	2X67.5 MW= 135 MW
	b. GTPS	Gas	6X30 MW (GTs) Plus 3X30 MW (STGs)= 270MW
2.	Pragati Power Corporation Limited		
	Pragati –I Power Station	Gas	2X104 MW (GTs) Plus 1X122 MW (STGs) = 330 MW
3.	Pragati III Power Project Bawana	Gas	1X216 MW (GT)
	Total	--	**951MW**

1.2 Plant Load Factor

In the power business, stack factor is an amount of the yield of a power plant contrasted with the most extreme yield it could deliver. The power generation limits in a specific period of time are determined by the availability factor of plant [19-25]. Events where just incomplete limit is accessible could conceivably be expelled [12]. The accessibility factor of a power plant contrasts critically relying upon the kind of information sources, i.e. principally on the basis of the fuel, the plant outline and working of the plant. Rest is being equivalent; plants running at low frequency are more prominent availability factor since they need less upkeep. The vast majority of the warm power plants, for example, the accessibility factors of coal, earth's crust energy and atomic power plant in the vicinity of 70-90%. More up to date plants have a tendency to have altogether higher accessibility factors, however preventive support is as critical as enhancements in outline and innovation. Gas turbines have moderately high accessibility factors, going from 80% to 99%. Gas turbines are ordinarily utilized for cresting power plants, co-age plants and the main phase of joined cycle plants [13].

Table 4: Delhi's Plant Load Factor--2004-11(Percentage)

S. No	Year	Indraprastha Power Station	Rajghat Power House	Gas Turbine Plants	Pragati Power Station	Total
1.	2004-05	42.45	58.96	62.32	88.27	65.53
2.	2005-06	45.42	48.57	70.76	79.53	64.35
3.	2006-07	43.92	53.69	57.17	77.99	60.31
4.	2007-08	47.26	76.04	60.38	84.72	67.31
5.	2008-09	44.05	74.16	53.05	83.07	64.06
6.	2009-10	35.04 (64.09)	54.64(54.64)	63.21(73.28)	84.85(85.50)	71.38(75.34)**
7.	2010-11	Decommissioned	66.05(75.98)	57.85(81.91)	80.80(86.32)	68.23(81.40)
8.	2011-12*	--	69.41(68.55)	56.11(75.90)	87.12(90.97)	70.88(78.47)

Source: *IPG and Pragati Power Corporation Limited*

The plant stacsk factor of energy plants in Delhi amid 2011-12 up to December 2011 was 70.88 for every penny and accessibility factor at 78.47 for each penny.

1.3 Capacity Addition Program: Keeping in mind the end goal to take care of the increase in energy consumption of the Delhi; two gas based CCGT (Combined Cycle Gas Turbine) control tasks of 750 MW and 1500 MW limit at Bamnauli and Bawana are established by Pragati Power Corporation Limited (PPCL) [14].

Table 5: Capacity Enhancement Programme Status of Delhi

Sl. No	Projects	Present Status
1.	1500 MW (N) Combined Cycle Gas Turbine Power Project at Bawana, Pragati III	Turn-key order was placed on BHEL on 30th April 2008. GT No.1 & GT No. 2 were synchronized with the system on 11th October 2010 and 9th February 2011 respectively. CT -1 has been declared COD on 27th December 2011. STG 1 has been test synchronized on 3rd October 2011. Module 2(750 MW) is expected to be commissioned in 2012-13.
2.	750 MW(N), Combined Cycle Gas Turbine Power Project at Bamnauli, Pragati III	All inputs have been tied up and clearances obtained. Land acquired (except two pockets). Notice of award for shifting of 400 KV overhead conductor and for execution of main plant has been placed on BHEL by 29th March 2011 and project to be commissioned in 2014-15 provided Gas allocation is made.
3.	1500 MW Indira Gandhi Super Thermal Power Project (Coal Based) in Jhajjar district, Haryana	First unit of 500 MW has been synchronized with the system on 10th October 2010 and commercial operation started on 5th March 2011.Second unit had achieved a full load on 5th November 2011. Third unit is expected to be completed by December 2012.

***Source*:** IPG and Pragati Power Corporation Limited

A 1.5GW coal power venture (Indira Gandhi Super Thermal Power Project) is additionally set up by Joint Venture Company of NTPC, IPGCL and HPGCL in Jhajjar District of Haryana for combined energy use by Delhi and Haryana.

2. AT& C Losses (Aggregate technical and commercial losses)

It is the distinction between energy units put into the framework and the units for which the installment is gathered. Transmission and dispersion misfortune don't catch misfortunes by virtue of non-acknowledgment of installments. AT&C misfortune is the genuine measure of general effectiveness of the circulation business as it quantifies both specialized and addition business misfortunes. The primary explanations behind specialized misfortunes might be because of substation gear and over-burdening of existing lines, nonattendance of up gradation of old lines and hardware, low HT:LT Ratio, poor repair and support of gear, non-establishment of capacitors for influence redress etc. [15]. In actuality, business misfortunes might be because of low metering/charging/gathering productivity, robbery, altering of metering framework, low responsibility of workers, nonattendance of energy review and bookkeeping and so forth. After changes in control segment the AT and C misfortunes in Delhi diminished altogether from 52 for every penny in the pre-change period to 18.5 for each penny in 2010-11.

Table 6: During Post Power Sector Reforms AT&C Losses (Percentage)

Sl. No.	Year		BYPL	BRPL	NDPL
1.	Opening Level of AT&C Losses		57.20	48.10	48.01
2.	2002-03	a. Target	56.45	47.55	47.60
		b. Achievement	61.89	47.47	47.79
3.	2003-04	a. Target	54.70	46.00	45.35
		b. Achievement	54.29	45.06	44.86
4.	2004-05	a. Target	50.70	42.70	40.85
		b. Achievement	50.12	40.64	33.79
5.	2005-06	a. Target	44.65	36.70	35.35
		b. Achievement	43.88	35.53	26.52
6.	2006-07	a. Target	39.95	31.10	31.10
		b. Achievement	39.03	29.92	23.73
7.	2007-08	a. Target	34.77	27.34	22.03
		b. Achievement	29.82	27.91	18.31
8.	2008-09	a. Target	30.52	23.46	20.35
		b. Achievement	24.02	20.59	15.41
9.	2009-10	a. Target	26.26	20.23	18.68
		b. Achievement	23.10	20.53	14.47

Sources: *DERC, Discoms and websites.*

Delhi Electricity Regulatory Commission (DERC), targeted AT&C loss level for the three distribution companies in the multi-year Tariff regulations by the end of 2007-08 to 2011-12. The table below shows the annual loss reduction target set by Delhi Electricity Regulatory Commission for all companies.

With the increase in the electricity demand it is essential [26-34] to improve the infrastructure used. All companies are installing high capacity transformers, extra high voltage cables and many other additional components to enhance the power condition in Delhi. Table below shows the investment made by all three companies after the power sector reform in Delhi.

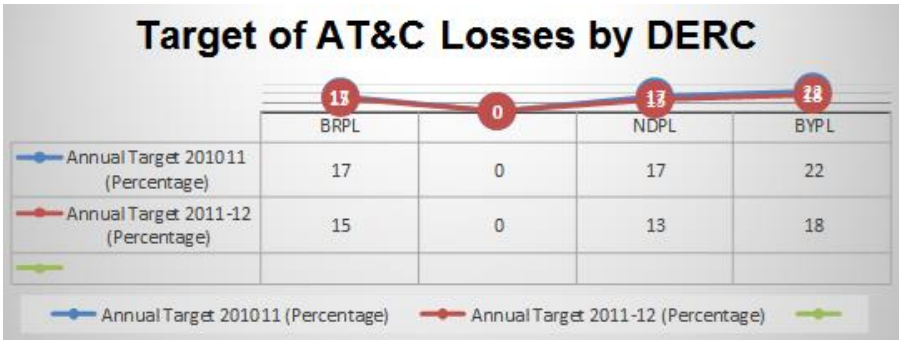


Fig 7: Target of AT&C Losses by DERC

Table 7: Power Companies Infrastructure in Delhi (In crore)

Sl. No.	Year	BRPL	BYPL	NDPL	Total
1.	2002-03	76.38	56.36	48.51	181.25
2.	2003-04	114.56	87.69	281.00	483.25
3.	2004-05	538.75	414.42	338.20	1291.37
4.	2005-06	618.54	298.92	430.93	1348.39
5.	2006-07	306.21	209.08	270.51	785.80
6.	2007- 08	128.24	117.53	245.11	490.88
7.	2008-09	390.85*	300.00*	288.57	979.42
9.	2009-10	475.00*	300.00*	374.09	1149.09
	SUM	**2648.53**	**1784.00**	**2276.92**	**6709.45**

* As per DERC MYT order

3. Major substation Works

1. **Mundaka 400/220KV substation :** With a specific end goal to clear the energy from Aravalli producing at Jhajjhar station (Haryana) a request for erection of 2x315 MVA, 400/220/66 KV substation. The change limit was set in 2008 at an investment of 126.18 Crores. A 400000V switchyard officially dispatched in 2010-11 with a 315 MVA Transformer. 66kV and 220kV switchyard somewhat charged alongside 60 MVA Pr. Transformer in 2011-12. The remaining work is under authorizing stage which nearly finished in 2012-13 [16].
2. **Harish Chandra Mathur Lane's 220 KV Substation:** On 30.10.2009, a 220 KV GIS Substation with 2x100 MVA transformer for expanding and cementing the consistency of supply to the North Delhi Municipal Commission zone, transformer on turnkey premise has been put on M/s. Areava, France at a cost of 54.22 crore. Electrical Inspector, GNCTD on 30th March 2012 has given the electrical freedom for charging the substation. The substation is authorized in May 2012 [17].

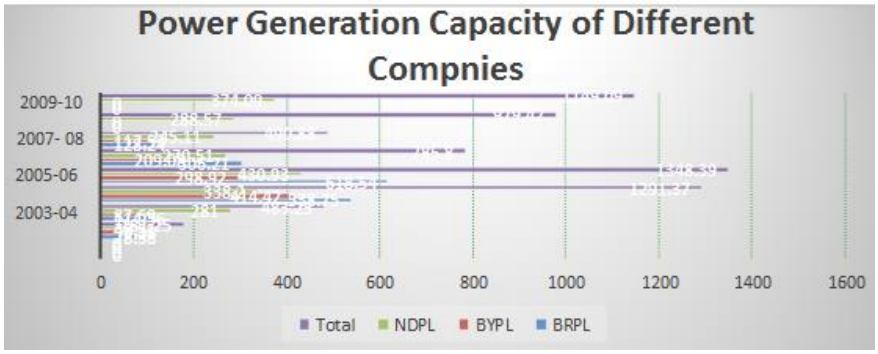


Fig 8: Power geneartion of different Compnies

3. **220 KV Peeragarhi and Wazirpur Substation:** To empty the power from 400 KV substation at Mundka and supplementing electricity supply in north Delhi the foundation of 220/33 KV GIS Substation on turnkey premise has been set to M/s. CGL, India on November 2011 and 28th May 2010 to M/s. EMCO Limited respectively.
4. **220 KV Substation at Rohini II and Lodhi Road:** For the electricity demand of Phase IV and V of Rohini, the foundation of 220 kV substation on turnkey premise and plan for change of 220 KV AIS substation to GIS substation was conceptualized. The project was finished in 2013-14.
5. **400 KV Substation at Bawana Extension and Harsh Vihar (East of Loni Road):** To empty the power from Bawana CCGT and Dadri producing station, Stage II, equest for the foundation of 400 kV and 220 kV on turnkey premise has been set in July 2009 and March 2010 respectively. The cost of the projects was around 230 Crore. Erection and testing works finished in 2011-2013.

4. Work on major transmission lines

1. **Maharani Bagh:** On 31 August 2009, transmission line from Maharani Bagh with a total cost of 105 Crore approx is installed. The twofold 22kV circuit underground XLPE link has been granted to M/s. LS Cable.
2. **Ridge Valley to Trauma Center:** An additional substation existing at Nariana built to assist the structure. The twofold 22kV circuit underground XLPE link has been granted to M/s. LS Cable link from Ridge valley to Trauma Center substation at an approximate cost of 74 crore.
3. **Maharani Bagh to Gazipur:** A sum of rupees 25 crore was invested to lay down 220kV transmission line at Gazipur substation from Maharani Bagh in March 2009. The establishment of 33 towers completed out of 40 towers.

Plans to lay down 220 KV two-fold circuits underground XLPE link of transmission lines from Shalimar Bagh to Wazirpur, Peeragarhi to Wazirpur and Peeragarhi to Mundaka are conceptualized, the work was probably finished in March 2013 [18].

5. Conclusions

This paper represents the study of the power sector development in Delhi region. To fulfill the requirements of the consumers i.e., the domestic, industrial and commercial in the Delhi region, the DERC is establishing new infrastructure. Renovation of the existing structure as well as the development of the new one is going on large scale. Various transmission lines to carry extra power and new generating plants are built by DERC. To improve the efficiency and power quality, addition components are installed.

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