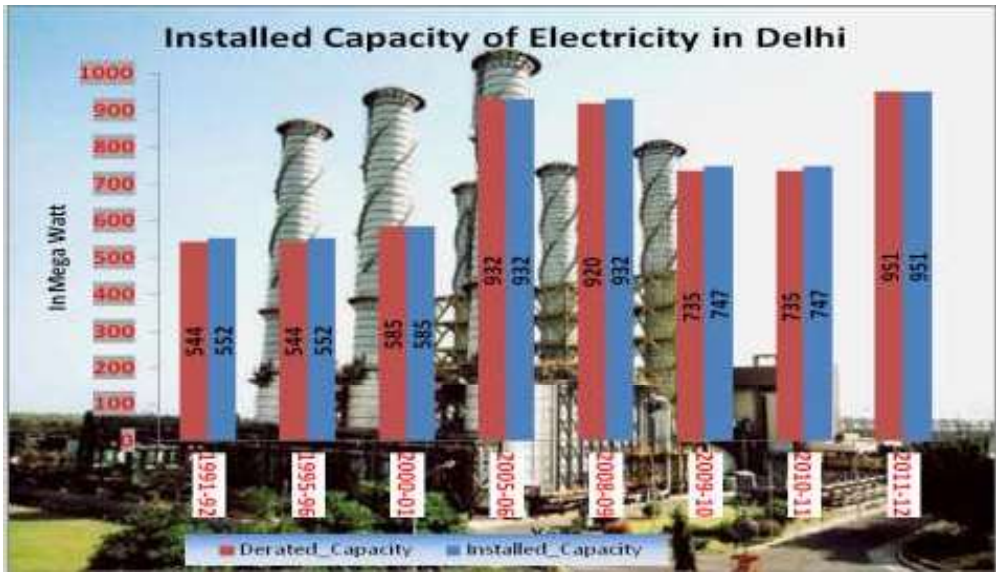
CHAPTER 11
ENERGY

Energy is a prime mover sector of economic growth. In recent times, the two major international endorsements towards sustainable development have come in the form of Millennium Development Goals (MDGs) and recommendation of the World Summit on Sustainable Development (WSSD), which have recognized universal access to energy as an important goal. In India, with a population of over a 1210 million people, it is estimated that 67% of the households have access to electricity. The choices that the country makes towards energizing the remaining population will have a significant impact on other sustainable development parameters such as agriculture, water, health.

2. Delhi being a city state with diminishing rural areas and agricultural activities, the thrust on energy front in Delhi is mainly to have uninterrupted power supply and to take care of increasing power demand. Government of Delhi introduced power sector reforms during the beginning of the 10th Five Year Plan with the corporatisation of transmission and generation and privatization of distribution of power. This has dramatically changed the power scenario of Delhi as the transmission and distribution loss, which was responsible for negative returns in this sector, has been significantly reduced.

3. The information regarding Delhi's own installed capacity of electricity is presented in Chart11.1.

CHART 11.1
INSTALLED CAPACITY OF ELECTRICITY IN DELHI

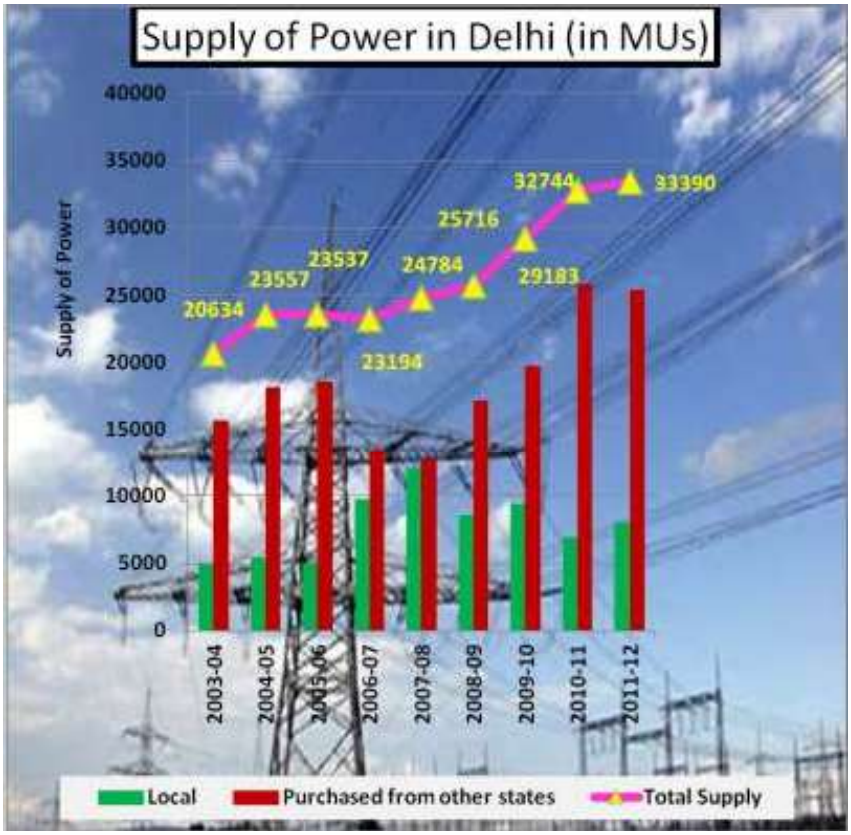


Source: - PPCL & IPGCL

Note *(i) GT Station was derated from 282 MW capacity to 270MW w.e.f. 16.9.2008 as approved by CEA*
(ii) IP station of 247.5 MW capacity de-commissioned completely on 31.12.2009 as a step of reducing coal based generation in the city to have cleaner energy to improve the air quality.
(iii) the 1st GT of Pragati III Power Project, Bawana of Capacity 216 MW has been declared COD on 27.12.2011.

4. It may be observed from Chart11.1 that both the installed and derated capacity of electricity in Delhi was highest and both of them were same at 951 mega watt in 2011-12. The information regarding the supply of electricity in Delhi during 2003-12 is presented in Chart11.2.

Chart 11.2
SUPPLY OF POWER IN DELHI (IN MUS)



Source: - Delhi Statistical Handbook, 2012

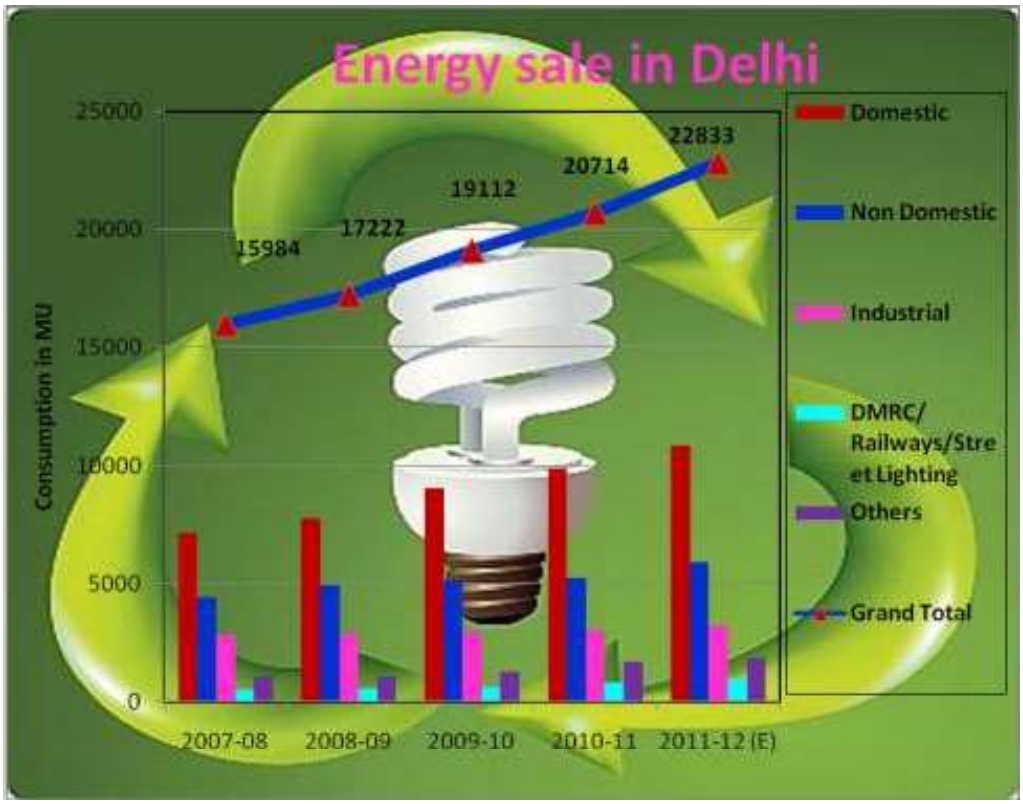
5. It may be inferred from Chart 11.2 that supply of electricity in Delhi periphery increased from 20634 million units in 2003-04 to 33390 million units in 2011-12.

6. The sale of electricity in Delhi to various categories of consumers increased from 15984 million units in 2007-08 to 22833 million units in 2011-12 registering an increase of 43% over a period of five years. The information regarding the local consumption of electricity in Delhi during 2007-11 is presented in Chart11.3.

Statement 11.1
SALE OF ENERGY 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**

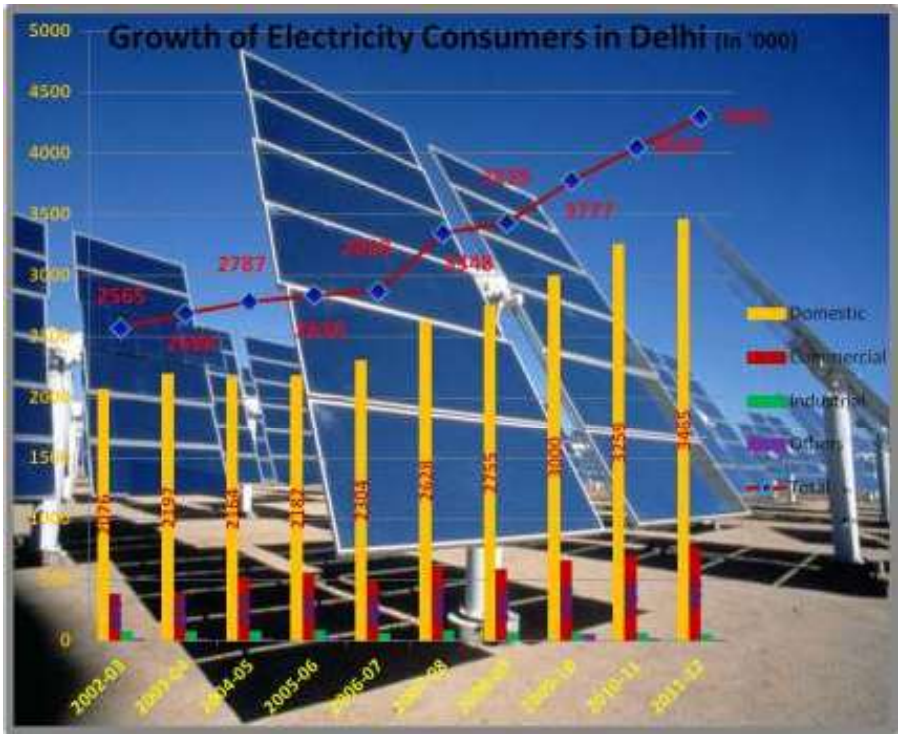
Chart 11.3
ENERGY SALE IN DELHI



Source: - DERC Website, E: Estimated

7. It may be seen from Chart11.3 that the consumption of electricity in Delhi increased from 15984 million units in 2007-08 to 22833 million units in 2011-12 recorded an annual growth at around 8.5 per cent. During the period 2002-03 to 2011-12, the number of consumers of electricity in Delhi increased from 25.65 lakh to 43.00 lakh. The information regarding number of consumers of electricity in Delhi during 2002-12 is presented in Chart 11.4.

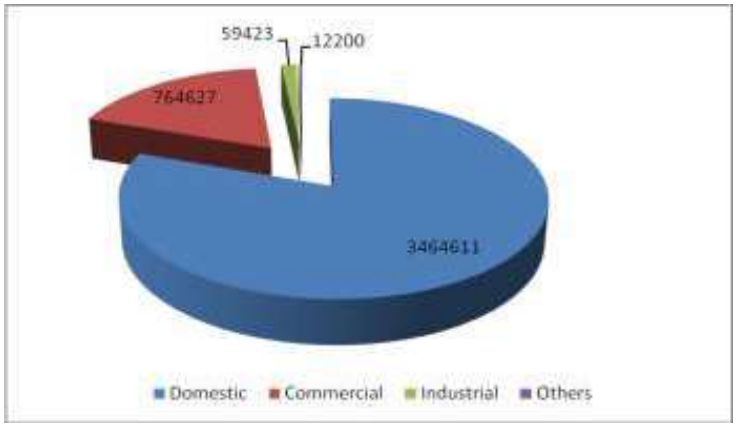
Chart 11.4
GROWTH OF ELECTRICITY CONSUMERS IN DELHI (IN '000)



Source: - Delhi Statistical Handbook, 2012

8. It may be inferred from Chart 11.4 that the number of electricity consumers in Delhi increased from 25.65 lakh in 2002-03 to 43.01 lakh in 2011-12. Number of consumers in domestic increased every year in the period covered under the study. While all other consumers mentioned in the table showed an up and down situation in the period covered. The information regarding number of consumers of electricity in Delhi during 2011-12 is depicted in Chart11.5.

Chart 11.5
NUMBER OF CONSUMERS OF ELECTRICITY IN DELHI: 2011-12



9. Investment in Energy Sector

9.1 Investment in energy sector is crucial for developing infrastructure of any nation. It not only increases the level of infrastructure of the nation but also increase the quality of life of citizens. Investment in this sector during the last five year showed an up and down ward trend. During the year 2004-05 the share of investment in energy sector in Delhi was to the level of ` 625.74 crore, i.e. 15 per cent of the total expenditure to ` 1833.26 crore in 2011-12, i.e. 13 per cent of the total expenditure. The share of investment in energy sector in Delhi during the last eight years is presented in Statement 11.2.

Statement 11.2
EXPENDITURE UNDER ENERGY SECTOR IN DELHI

(` in crore)

Sl. No	Years	Expenditure		
		Total Plan Expenditure	Energy Sector	% of Energy Exp. to Total Plan Exp.
1.	2004-05	4260.53	625.74	14.69
2.	2005-06	4280.87	271.47	6.34
3.	2006-07	5083.70	257.24	5.06
4.	2007-08	8745.32	1256.75	14.37
5.	2008-09	9619.32	567.08	5.90
6.	2009-10	11048.14	461.00	4.17
7.	2010-11	10490.81	250.83	2.39
8.	2011-12	13642.54	1833.26	13.44

9.2 Delhi Transco Ltd is responsible for planning, designing, construction & maintenance of the 400 KV and 220 KV systems that are necessary for importing and transmitting power to the new distribution companies.

9.3 Delhi Transco Limited has successfully met the power transmission network consisting of three number of 400 KV and twenty nine 220 KV substations associated with transmission lines. The maintenance of the system is the core business of State Transmission Utility. The existing network consists of 400 KV ring around the periphery of Delhi interlinked with the 220 KV network spread all over Delhi. The network of Delhi Transmission Utility during the year 2011-12 is presented in Statement 11.3.

Statement 11.3
NETWORK OF DELHI TRANSMISSION UTILITY: 2011-12

Sl. No.	Details	400 KV Level	220 KV Level
1.	Number of Sub Stations	3	29
2.	Transformation Capacity (in MVA)	3465	8530
3.	Transmission Lines (Length in Ckt. Km.)	227	663

Source: - Delhi Transco Limited.

9.4 The performance of the transmission business improved significantly over the last eight years. During the last eight years system has improved mainly in system availability, reduction in transmission losses, significant reduction of load shedding etc. The performance of Delhi Transco Limited during the last eight years is presented in Statement 11.4.

Statement 11.4
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 as % of 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.

9.5 It may be observed from Statement 11.4 that the peak demand increased from 3490 MW in 2004-05 to 5028 in 2011-12, recorded an annual growth at 5.51 per cent. Like-wise energy consumption recorded an annual growth at 2.87 per cent. System availability is always 98 per cent or more during the period covered under the study. The information regarding peak demand met in MW and energy consumption in MUs are depicted in Charts 11.6 and 11.7 respectively.

Chart 11.6
PEAK DEMAND MET (MW) IN DELHI

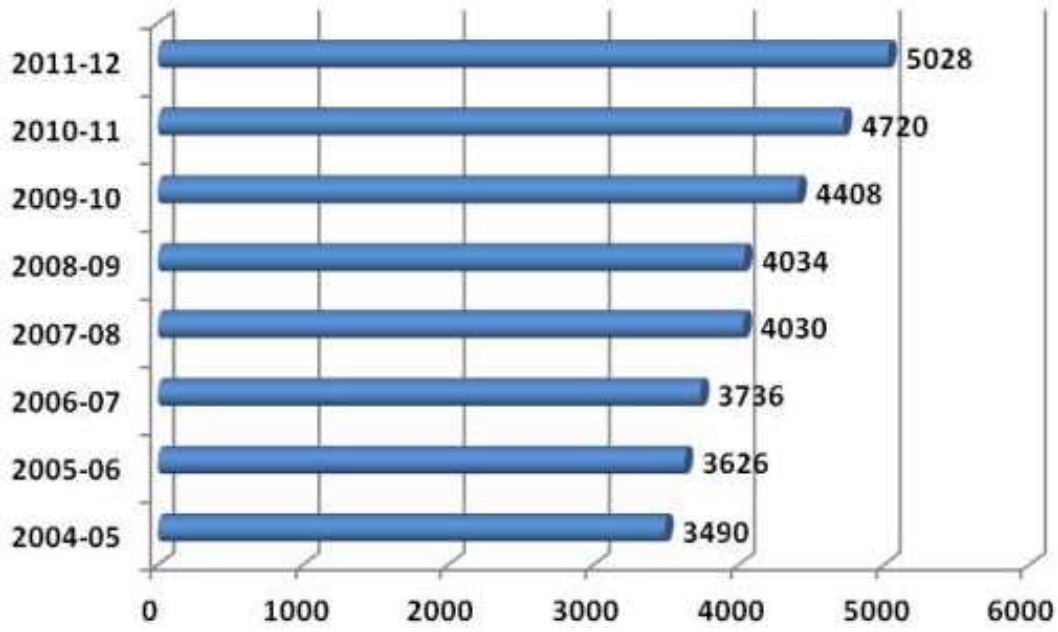
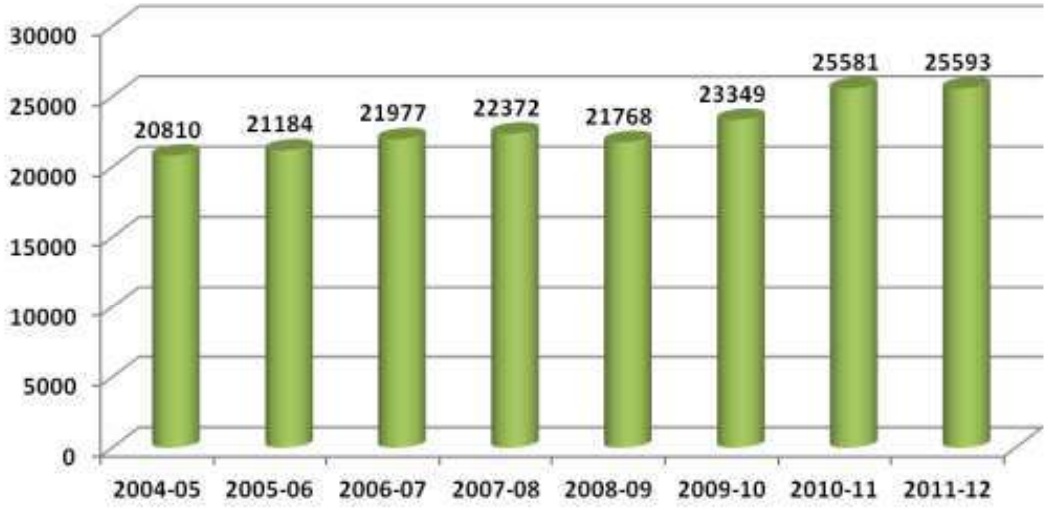


Chart 11.7
ENERGY CONSUMPTION IN DELHI- 2004-12 (IN MUS)



9.6 Central Electricity Authority, Ministry of Energy, Government of India projected that maximum demand of electricity in Delhi (17th Power Survey Committee) will increase to the tune of 6092 MW by the end of 11th Five Year Plan (March-2012).

10. Power Generation

Delhi's own installed generation capacity as on 1st April 2011 was 735 MW. During the year 2011-12, GT- 1 of Pragati III power project, Bawana of capacity 216 MW has been declared COD on 27th December 2011. Unit No. 1 (500 MW) of 1500 MW coal based Indira Gandhi STPP in district of Jhajjar, Haryana (by APCPL- a joint venture of Indraprastha Power Generation Company Limited and HPGCL and NTPC Limited for sharing power equally by Delhi and Haryana) has been declared COD on 5th March 2011. The power generation in Delhi is undertaken by two GNCTD owned companies namely IPGCL and PPCL with the following power Plants.

Statement 11.5
INSTALLED GENERATION OF ELECTRICITY IN DELHI

(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**

Source:- Indraprastha Power Generation Company Limited and Pragati Power Corporation Limited.

11. Plant Load Factor

11.1 In the electricity industry, load factor is a measure of the output of a power plant compared to the maximum output it could produce.

11.2 The availability factor of a power plant is the amount of time that it is able to produce electricity over a certain period, divided by the amount of the time in the period. Occasions where only partial capacity is available may or may not be deducted. The availability factor of a power plant varies greatly depending on the type of inputs, i.e. mainly fuel, the design of the plant and how the plant is operated. Everything else being equal, plants that are run less frequently have higher availability factors because they require less maintenance. Most of the thermal power plants, such as coal, geothermal and nuclear power plants, have

availability factors between 70% and 90%. Newer plants tend to have significantly higher availability factors, but preventive maintenance is as important as improvements in design and technology. Gas turbines have relatively high availability factors, ranging from 80% to 99%. Gas turbines are commonly used for peaking power plants, co-generation plants and the first stage of combined cycle plants. The information regarding plant load factor and availability factor of power plants in Delhi during the last six years is presented in Statement 11.6.

Statement 11.6

PLANT LOAD FACTOR/ AVAILABILITY FACTOR OF POWER PLANTS IN DELHI-2004-11

(Percentage)

Sl. 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)

Sources: 1. *Indraprastha Power Generation Company Limited and Pragati Power Corporation Limited.*
2. *Economic Survey of Delhi, 2008-09.*

Notes: * *means upto December 2011.*
** *means Excluding Indraprastha Power Station.*
Figures in parenthesis relates to availability factor

11.3 It may be inferred from Statement 11.6 that the plant load factor of power plants in Delhi during 2011-12 upto December 2011 was 70.88 per cent and availability factor at 78.47 per cent.

12. Capacity Addition Programme

12.1 In order to meet the growing demand of power of the national capital city, Delhi; two gas based Combined Cycle Gas Turbine (CCGT) power projects of 1500 MW and 750 MW capacity at Bawana and Bamnauli are being set up by Pragati Power Corporation Limited (PPCL). One 1500 MW coal based power project (Indira Gandhi Super Thermal Power Project) is also being set up by Aravali Power Company Limited (a Joint Venture Company of NTPC, IPGCL and HPGCL) in Jhajjar District, Haryana for sharing of power equally by Delhi and Haryana. The present status of capacity addition programme of electricity is presented in Statement 11.7.

Statement 11.7
STATUS OF CAPACITY ADDITION PROGRAMME 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 30 th April 2008. GT No.1 & GT No. 2 were synchronized with the system on 11 th October 2010 and 9 th February 2011 respectively. CT -1 has been declared COD on 27 th 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, Prag ati 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 29 th March 2011 and project to be commiss ioned 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 10 th October 2010 and commercial operation start ed on 5 th March 2011.Second unit had achieved a full load on 5 th November 2011 . Third unit is expected to be completed by December 2012.

Source: - Indraprastha Power Generation Company Limited and Pragati Power Corporation Limited.

13. Aggregate Technical and Commercial Losses (AT& C)

13.1 It is the difference between energy units put into the system and the units for which the payment is collected. Transmission and distribution loss do not capture losses on account of non-realization of payments. AT&C loss is the actual measure of overall efficiency of the distribution business as it measures both technical as well as commercial losses. The main reasons for technical losses may be due to overloading of existing lines and substation equipments, absence of upgradation of old lines and equipments, low HT:LT Ratio, poor repair and maintenance of equipments, non- installation of capacitors for power correction, etc. On the contrary, commercial losses may be due to low metering/billing/collection efficiency, theft, tampering of metering system, low accountability of employees, absence of energy audit and accounting etc.

13.2 After reforms in power sector the AT & C losses in Delhi reduced significantly from 52 per cent in the pre-reform era to 18.5 per cent in 2010-11. The information regarding AT&C losses in Delhi during 2002-10 is presented in Statement 11.8.

Statement 11.8
AT&C LOSSES IN DELHI DURING POST POWER SECTOR REFORMS

(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.

13.3 The loss level of AT&C losses targeted by Delhi Electricity Regulatory Commission (DERC) in the multiyear Tariff regulations for the three distribution companies by the end of control period 2007-08 to 2011-12 and the annual loss reduction target during the control period as stipulated by DERC for the companies is presented in Statement 11.9.

Statement 11.9
TARGET OF AT&C LOSSES BY DERC

Sl. No	Companies	Annual Target 2010-11 (Percentage)	Annual Target 2011-12 (Percentage)
1.	BRPL	17	15
2.	NDPL	17	13
3.	BYPL	22	18

14. Improved Distribution Infrastructure

14.1 As the demand for power increases, the demand for improved infrastructure for power also increases. For improving the power conditions in Delhi, all the three companies are creating the addition of infrastructure like power transformers, EHV cables, installation and 11 KV feeders, shunt capacitors, etc. The capital investment made by the three companies since the introduction of reforms in power sector in Delhi is presented in Statement 11.10.

Statement 11.10
INFRASTRUCTURE CREATED BY POWER COMPANIES 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
	Total	**2648.53**	**1784.00**	**2276.92**	**6709.45**

** As per DERC MYT order.*

15. Status of Transmission Projects:

a. Major Substation Works

1. **Establishment of 400/220KV substation at Mundaka**:- In order to evacuate the power from Aravali generating station at Jhajhar, Haryana an order for establishment of 400/220/66 KV substation of 2x315 MVA transformation capacity was placed in August 2008 at a cost of ` 126.18 Crore. 400KV switch yard already commissioned in 2010-11 along with 1X315 MVA Transformer. 220KV and 66 KV switch yard partly commissioned along with 1X160 MVA Pr. Transformer in 2011-12. Rest of work is under commissioning stage which to be completed in 2012-13.
2. **220 KV Substation at Harish Chandra Mathur Lane:-** For increasing and strengthening the reliability of supply to the NDMC area, an order for establishment of 220 KV GIS Substation with 2x100 MVA transformer on turnkey basis has been placed on M/s. Areava, France on 30.10.2009 at a cost of ` 54.22 crore. Erection and testing work completed. Electrical clearance for charging the substation has been received from the Electrical Inspector, GNCTD on 30th March 2012. The substation is commissioned in May 2012.

3. **Establishment of 220 KV Substation at Peeragarhi:-** In order to evacuate the power from 400 KV substation at Mundka, an order to establishment of 220/33 KV GIS Substation on turnkey basis has been placed to M/s. CGL, India on November 2011. Work is under progress and likely to be completed in February 2013.

4. **Establishment of 220 KV Substation at Wazirpur:-** For augmenting power supply in north Delhi as well as off loading of 220 KV substation at Shalimarbagh and to evacuate the power from 400 KV substation at Mundaka, a 220 KV/33 KV substation was envisaged on turnkey basis. The work for the substation was awarded on 28th May 2010 to M/s. EMCO Limited and the same was supposed to be completed for inauguration on 26-January-2013.

5. **Establishment of 220 KV Substation at Rohini II:-** In order to meet the load requirement of Rohini Phase IV and V and to off load the existing substation at Rohini an order for the establishment of 220 KV AIS Substation on turnkey basis has been awarded on M/s.U B Engineering in March 2010 at a cost of ` 36 core. Eighty per cent of civil works completed. (0 per cent structure of 220/66KV equipment completed. 2X160 MVA Pr. Transformer has also been erected and testing to be commenced. Substation is likely to be commissioned by October 2013.

6. **Composite Scheme of ETC of 220 KV Substation at Lodhi Road:-** A scheme for conversion of 220 KV AIS Substation to GIS Substation was conceptualized. The work has been awarded to M/s CGL on turnkey basis in June 2010. 33 KV GIS work is under progress. The substation is likely to be commissioned in 2012-13.

7. **Establishment of 400 KV Substation at Bawana Extension**:- To evacuate the power from CCGT Bawana, an order for the establishment of 400 KV and 220 KV bays along with 2Nos. 315 MVA 400/220 KV Power transformers on turnkey basis has been placed to M/s. UB Engineering Limited in July 2009 at a cost of ` 52.11 crore. Erection and testing works completed. 220 KV bays test charge in October 2011 and 2X315 MVA Pr. Transformer test charge in November 2011. Commissioning of all bays and transformers are pending for load shifting of 2 Nos existing 315 MVA due to non readiness of PPCL Project.

8. **Establishment of 400/220 Substation at Harsh Vihar (East of Loni Road):-** In order to evacuate the power from Dadri generating station, Stage II an order of establishment of 400/220KV GIS Substation on turnkey basis has been awarded on March 2010 at a total cost of ` 180.70 Crore. All GIS equipment has been receipt at site. 3X315 MVA and 3X160 MVA transformer is placed on foundation. The substation was to be commissioned by January 2013.

b. Major Transmission Line works

1. **Maharani Bagh – Electric lane (Harish Chandra Mathur Lane):-** In order to give feed to the upcoming 220 KV Electric Lane substation from Maharani Bagh substation an order for supply, laying, jointing, testing and commissioning of 220 KV double circuit underground XLPE cable has been awarded to M/s. LS Cables on 31st August 2009 at a total cost of ` 104.5 crore. Circuit No. 2 at electric lane substation charged on 30th March 2012 and Circuit No. 1 will be charged after getting clearance from protection Department. The work is likely to be completed in 2012-13.

2. **Ridge Valley- Trauma Centre:-** In order to give the feed to upcoming 220 KV Ridge Valley substation as well as existing substation at Nariana, an order for supply, laying, jointing testing, and commissioning of 220 KV double circuit underground XLPE cable from Ridge valley to Trauma Centre substation has been awarded to M/s. LS Cables on 11th November 2009 at a total cost of ` 73.92 crore and the same is likely to be completed in 2012-13.

3. **Maharani Bagh- Gazipur:-** In order to feed the substation at Gazipur an order for laying of 220 KV double circuit underground cum overhead transmission link from Maharani Bagh substation was placed in March 2009 at a total cost of ` 25 crore. Out of 40 Nos. tower foundation, 33 Nos tower foundation completed. 32 Nos towers have been erected. The work is held up due to non receipt of approval of NOIDA for 5 Nos, tower locations in UP area.

4. **Shalimar Bagh to Wazirpur:-** A scheme for laying of 220 KV double circuit underground XLPE cable between Shalimar Bagh 220KV substation and upcoming Wazirpur substation is conceptualized. An order has been placed in May 2010 and the work is likely to be completed by March 2013.

5. **Peeragarhi- Wazirpur:-** A scheme for laying 220 KV double circuit underground XLPE cable between upcoming Peeragarhi and Wazirpur substation is conceptualized. An order has been awarded to M/s. TBEA on 28th May 2010 at a total cost of ` 87.70 crore and the work is likely to complete by March 2013.

6. **Peeragarhi- Mundaka:-** A scheme for laying 220 KV double circuit underground XLPE cable between upcoming Perragarhi 220 KV substation and Mundaka substation is conceptualized on May 2010 and an order has been awarded to M/s. TBEA on 28th May 2010 at a cost of ` 117.70 crore and the work is likely to be completed by March 2013.