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Study of Demand and Supply in the selected states in Northern Region

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1 Demand Forecasting

Introduction

The 16th Electric Power Survey Committee was constituted in March 1998 to review the electricity demand projections in detail upto 2004-05 and to project the perspective demand upto 2016-17. The methodology adopted by the EPS (Electric Power Survey) has been "Partial End Use Technique" for projecting the power demands over short and medium time spans. The forecast beyond 2004-05 and upto the year 2016-17 have been made by extrapolating the overall energy requirement.

It has been observed that the projections made by the EPS tend to differ from the actual energy requirement. In order to assess the future energy requirement accurately it is important to correct these projections by incorporating the variations that have been observed between the energy requirement projected by the EPS and the actual energy requirement recorded in the past. To incorporate these, statistical tools need to be employed to have scientific and rationale grounds for correcting the projections. This is important from the point of view of determining the accurate size of the demand for electricity.

Methodology

The data on projected energy requirement was obtained from the 13th, 14th, 15th and 16th EPS – the Electric Power Survey of India published by the CEA (Central Electricity Authority). The data on actual energy requirement was obtained from various monthly reviews of power sector performance published by the CEA and from information obtained from NREB (Northern Region Electricity Board). The following table gives information about various electric power surveys used for this study.

Table 1.1 Details of electric power surveys

EPS No.	Year Of Publication	Forecast Period	
		Medium Term	Long Term
13th EPS	1987	upto 1994-95	1994-95 to 2004-05
14th EPS	1991	upto 1994-95	1994-95 to 2009-10
15th EPS	1994	1993-94 to 2001-02	2001-02 to 2011-12
16th EPS	2000	1998-99 to 2004-05	2004-05 to 2016-17

Source: 13th, 14th, 15th and 15th Electric Power Survey of India

Step 1 : Adjusted Projections

The projections of every subsequent EPS published by CEA are an improvement over the projections made by the preceding survey as EPS revises its projections in every subsequent survey. Keeping this in mind, all the energy requirement projections obtained from EPS were adjusted with respect to the projections made by the latest available EPS, i.e., 16^{Th} EPS. For example, to correct the projections of the 15^{th} EPS, for the period during which there was an overlap between the projections of 15th and 16^{th} EPS, a correction ratio (k) was calculated as a ratio between the projections of the 16^{th} EPS to the projection of the 15^{th} EPS i.e.:

K = P16 / P15 ....(1)

Where,

K = correction ratio
P16 = Projection for year ' n ' made by 16^{th} EPS
P15 = Projection for year ' n ' made by 15^{th} EPS

This correction ratio is calculated for all the years for which there is an overlap of projections between the 15^{th} and 16^{th} EPS and using *average correction ratio* (K1) thus obtained other projections of 15^{th} EPS are corrected by multiplying them by K1.

The projections of 14^{th} EPS are corrected in two steps. In the first step, 14^{th} EPS is corrected with respect to 15^{th} EPS in a similar manner as above to obtain *average correction ratio* (K2) and in the second step these are further adjusted with respect to the 16^{th} EPS by multiplying them by K1 calculated above. Similar exercise is carried for 13^{th} EPS projections. Thus, adjusted projections (by16th EPS) are obtained by this exercise.

Step 2 : Correction Factors

The next step is to find the correction factor. This is done by taking the ratio of actual energy requirement to the adjusted projections i.e:

CF(n) = E(n)actual / E(n)projected ....(2)

Where,

CF(n) = correction factor for nth year
E(n)actual = Actual energy requirement for nth year
E(n)projected = Projected energy requirement for nth year

This was done for all the years 1991-92 to 2002-03. A time series of correction factors was thus obtained.

Once we obtain the time series of correction factors, our purpose is to forecast these correction factors and then using the forecasted correction factors to obtain the *corrected energy requirement projections.*

Step 3: Forecasting Correction Factors

The time series of correction factors obtained above is forecasted using *Autoregressive Integrated Moving Average (ARIMA)* method popularly known as, Box-Jenkins approach to economic modeling and forecasting. The emphasis of this forecasting method is on analysing the probabilistic or stochastic properties of economic time series. Unlike the regression models, in which a dependent variable, Y (t) is explained by k regressors X1, X2, X3,......,Xk, in the Box – Jenkins type time series models Y(t) might be explained by past , or lagged , values of Y itself and stochastic error terms. The method is very useful to incorporate the effect of reforms on energy requirement since it gives more weightage to the latest lag values, that is the post reform values.

An Autoregressive (AR) Process

Let Y (t) represent energy requirement at time t. If we model Y (t) as

$$(Y(t) - ø) = a1\,(Y(t-1) - ø) + U(t)$$

Where ø is the mean of Y and where U (t) is an uncorrelated random error term with zero mean and constant variance, then we say that Y (t) follows a first order autoregressive process, or AR (1), stochastic process. Here the value of Y at time t depends on its value in the previous time period and a random term; the Y values are represented as deviations from their mean value. In other words, this model says that the forecast value of Y at time t is simply some proportion of (= a1) of its value at time (t-1) plus a random shock or disturbance at time t; again the Y values are expressed around their mean values. In general,

$$(Y(t) - \emptyset) = a1\,(Y(t-1) - \emptyset) + a2\,(Y(t-2) - \emptyset) + \ldots\ldots + a(p)\,(Y(t-p) - \emptyset) + U(t)$$

Where Y(t)is a pth order autoregressive, or AR (p) process. In pure AR models, only the current and previous Y values are involved; there are no other regressors. In this sense, we say that the " data speak for themselves."

A Moving Average (MA) Process

The AR model just discussed is not the only mechanism that may have generated Y. Suppose Y is modelled as follows:

$$Y(t) = \mu + \beta o\, U(t) + \beta 1\, U(t-1)$$

Where μ is a constant and U, as before, is the stochastic error term. Here Y at time t is equal to a constant plus moving average of the current and past error terms. Thus, in the present case Y follows a first-order moving average, or an MA (1) process. More generally,

$$Y(t) = \mu + \beta o\, U(t) + \beta 1\, U(t-1) + \beta 2\, U(t-2) + \ldots\ldots\ldots + \beta(q)\, U(t-q)$$

An Autoregressive and Moving Average (ARMA) process

It is likely that Y has characteristics of both AR and MA and is therefore, ARMA. Thus, Y (t) follows an ARMA (1, 1) process if it can be written as

$$Y(t) = C + a1.\, Y(t-1) + \beta o\, U(t) + \beta 1\, U(t-1)$$

Because there is one autoregressive and one moving average term. Here, c represents a constant term.

The Box – Jenkins (BJ) Methodology

Now the question is: looking at a time series, such as the Energy Requirement, how does one know whether it follows a purely AR process (and if so, what is the value of p) or a purely MA process (and if so, what is the value of q) or an ARMA process (and if so, what are the values of p and q). The BJ methodology helps in answering t he preceding question. The method consists of four steps:

Step 1. **Identification.** That is, find out the appropriate values of p and q. Correlogram and partial Correlogram are used for this purpose

Step 2. **Estimation.** Having identified the appropriate p and q values, the next stage is to estimate the parameters of autoregressive and moving average terms included in the model.

Step 3. **Diagnostic checking.** Having chosen a particular ARMA model, and having estimated its parameters, we next see whether the chosen model fits the data reasonably well, for it is possible that another ARMA model might do the job well. That is why considerable skill is required to choose the right ARIMA model.

Step 4. **Forecasting.** One of the reasons for the popularity of the ARIMA modeling is its success in forecasting. In many cases, the forecasts obtained from this method are more reliable than those obtained from traditional econometric modeling.

Thus, the forecasted correction factors obtained using ARMA methodology, the energy requirement projections of 16^{th} EPS are corrected

Modelling Reforms

In order to capture the effect of reforms on the energy requirement in different states, reforms are treated as a qualitative variable. A dummy variable DD is used to quantify the effect of reforms on the energy requirement. It is a qualitative or indicator variable employed to estimate any structural change in the energy requirement as a result of the reform process undertaken by the different states.

The actual energy consumption data is available for the years 1991-92 to 2002-03. The variable 'time' denotes time and the dummy variable DD is introduced both in multiplicative and additive form.

$$Y = a1 + a2*DD + b1*time + b2*DD*time + e$$

Where,

DD= 0 for pre-reform period

DD= 1 for post reform period

To see the implications of this model and assuming E (e) = 0, the following is obtained:

$$E(Y/DD=0, time) = a1 + b1*time$$

$$E(Y/DD=1, time) = (a1 + a2) + (b1 + b2)*time$$

Which are respectively the mean energy requirement functions for the pre-reform and post-reform periods. In the model, 'a2' is the differential intercept indicating dummy variable in additive form to distinguish between the intercepts of the two periods. The coefficient 'b2' is the differential slope coefficient, indicating how much the slope coefficient of the pre-reform period's energy requirement function differs from the slope coefficient of the post-reform energy requirement function. The introduction of dummy variable in multiplicative form (DD*time) enables to differentiate between slope coefficients of the two periods. On running this regression for each state, tests are performed to check the statistical significance of these coefficients, to evaluate the effect the reforms have had on the energy requirement for that state.

The dummy test for a state is performed for the year when the State Electricity Regulatory Commission was set up in the state.

The following is the analysis of the results (Appendix) obtained by running the regression for different states:

1. **Delhi**: on performing the above regression for Delhi the following results are obtained.

$$\mathbf{ER = 8184.75 + 2598.35{*}DD + 1001.92{*}time - 231.12{*}DD{*}time}$$

t-statistic :	58.94	3.04	36.44	-2.74
p-value :	0.000	0.027	0.000	0.025

Both the additive and multiplicative dummy coefficients are found to be significant at 5% level of significance. This implies that there has been significant change in the energy requirement once the reforms have been initiated at the national level. The differential intercept is positive implies there was a shift in the energy requirement once the reforms started. However, the coefficient of slope is negative which means that the rate of increase in energy requirement in the post reforms period has declined.

2. **Haryana:** the results obtained by performing regression for Haryana are the following:

$$ER = 10031.71 - 7450.31*DD + 532.78*time + 924.41*DD*time$$

t-statistic :	27.00	-5.13	6.41	5.71
p-value :	0.000	0.001	0.000	0.000

In the case of Haryana also, both the differential intercept and differential slope coefficients are found to be significant at 5% level of significance. This implies that there has been significant change in the energy requirement once the reforms have been initiated at the national level. The differential intercept is negative implies there was a downward shift in the energy requirement once the reforms started. The differential slope coefficient is positive which means that the rate of increase in energy requirement in the post reforms period has increased.

3. **Rajasthan:** the results obtained for Rajasthan are the following.

$$ER = 11535.86 + 9107.97*DD + 1450.98*time - 1032.48*DD*time$$

t-statistic :	29.67	-2.684	21.004	2.173
p-value :	0.0000	0.0277	0.0000	0.0615

The coefficient of differential intercept (DD) is found to be significant at 5 % level of significance. This means that reforms have had a significant impact in the form of an upward shift in energy requirement. However the differential slope coefficient is insignificant at 5% level of significance, which means the rate of change in energy requirement in the post reform period, has not been significantly affected.

4. **Punjab:** on performing the above regression for Punjab the following results are obtained.

$$ER = 9511.4 - 15133.4*DD + 679.22*time + 1480.78*DD*time$$

t-statistic :	20.88	-1.39	9.25	1.56
p-value :	0.000	0.20	0.000	0.156

In Punjab the experience has been quite different from Delhi, Haryana and Rajasthan. Both the additive and multiplicative dummy coefficients are found to be insignificant at 5% level of significance. This implies that there has been no significant change in the energy requirement once the reforms have been initiated at the national level.

5. **Uttar Pradesh:** the following results are obtained for UP

$$ER=29618.93 + 13430.67*DD + 1706.57*time - 1427.27*DD*time$$

t-statistic :	28.24	2.08	8.22	-2.24
p-value :	0.000	0.07	0.000	0.055

In UP also the national level reforms had no significant impact on the energy requirement in the state. Both the additive and multiplicative dummy coefficients are found to be insignificant at 5% level of significance.

Results

The energy requirement and peak load projections obtained from the above analysis are given below. The peak loads for each state for the years 2003-04 to 2007-08 have been estimated after applying annual load factors used by the 16th EPS.

Table 1.2 Projections for energy requirement and peak load

	Energy Requirement (MU)	Load Factor (%)	Peak Load (MW)	Energy Requirement (MU)	Load Factor (%)	Peak Load (MW)	Energy Requirement (MU)	Load Factor (%)	Peak Load (MW)	Energy Requirement (MU)	Load Factor (%)	Peak Load (MW)	Energy Requirement (MU)	Load Factor (%)	Peak Load (MW)
	DELHI			HARYANA			Punjab			RAJASTHAN			UTTAR PRADESH		
2002-03**	19946	-	3417	20298	-	3411	30082	-	5849	25917	-	3880	44777	-	6700
2003-04	20897	0.68	3508	22787	0.60	4335	31544	0.6208	5800	27756	0.68	4660	48591	0.7115	7796
2004-05	21918	0.68	3680	24340	0.60	4631	33064	0.6207	6081	28919	0.68	4855	50565	0.7107	8122
2005-06	23003	0.68	3862	26000	0.60	4947	34680	0.6207	6378	30233	0.68	5075	52968	0.7107	8508
2006-07	24046	0.68	4037	27773	0.60	5284	36375	0.6207	6690	31540	0.68	5295	54681	0.7107	8783
2007-08	25233	0.68	4236	29666	0.60	5644	38153	0.6207	7017	32974	0.68	5535	57280	0.7107	9201

**Actual

Comparison with EPS

A comparison has been made between the energy requirement projections of TERI and 16th EPS. Since the base year for 16th EPS was 1997-98, it does not separate projections for UP and Uttaranchal. The table below gives this comparison.

Table 1.3 Energy requirement projections of TERI and 16th EPS

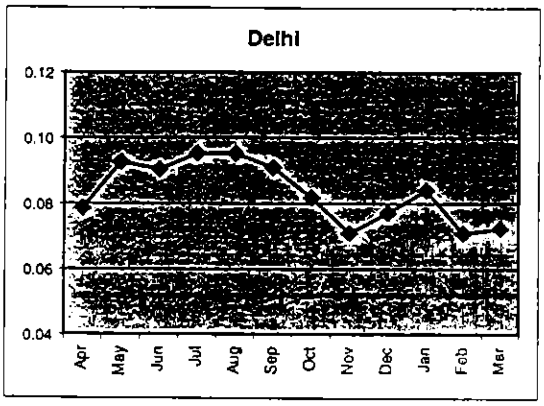
Year	Delhi		Haryana		Punjab		Rajasthan		Uttar Pradesh	
	TERI	EPS	TERI	EPS	TERI	EPS	TERI	EPS	TERI	EPS
2003-04	20897	21730	22787	20437	31544	34215	27756	32980	48591	57531
2004-05	21918	22991	24340	22089	33064	36596	28919	35216	50565	61681
2005-06	23003	24342	26000	23866	34680	39169	30233	37732	52968	66569
2006-07	24046	25672	27773	25750	36375	41922	31540	40341	54681	70803
2007-08	25233	27181	29666	27822	38153	44870	32974	43223	57280	76414

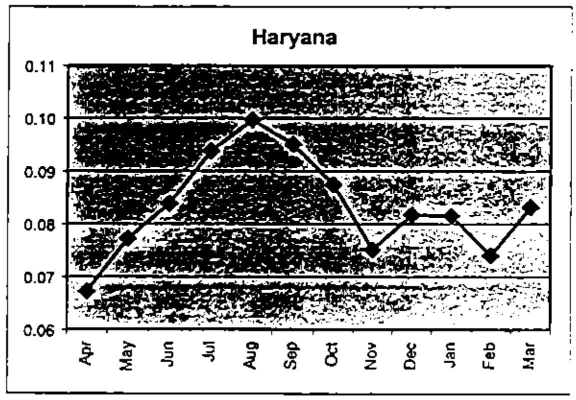
TERI's projections are different from the 16th EPS projections because they correct the 16th EPS projections by minimizing the deviation from the actual energy requirement figures. While 16th EPS takes 1997-98 as its base year to make projections, TERI utilised data till 2002-03 that include some the reform years also, in estimating future energy requirement.

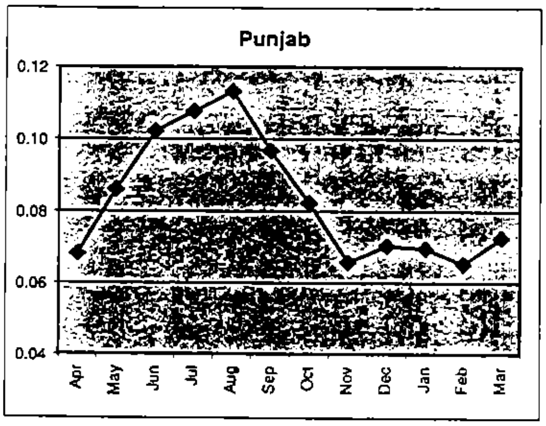
Seasonal variations in energy requirement

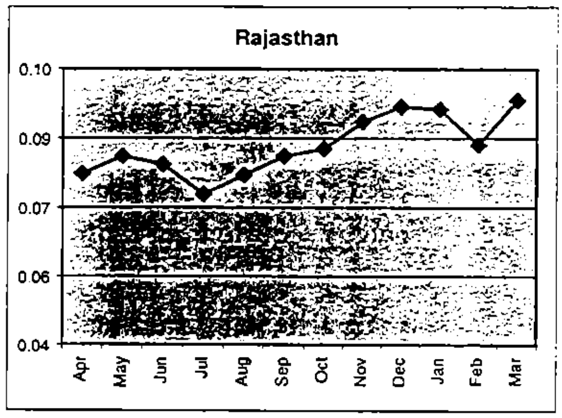
Monthly data on energy requirement for the years 1999-2000 to 2001-02 was used to calculate the average proportion of monthly energy requirement to total annual energy requirement. Strong seasonality has been observed in all the states except Uttar Pradesh. The same monthly trend is repeated year after year for all the states except UP. Hence a simple average of the month-to-annual energy requirement (for the years 1999-2000, 2000-01 and 2001-02) for each month suffice the motive of estimating the seasonality. However in the case of UP, the same monthly trend could not be observed in all the years and hence required judgemental analysis by taking trends most common to each month during the period 1999-2000 to 2001-02.

For each month the ratio of monthly energy requirement to total annual energy requirement is computed for the years 1999-00 to 2001-02. Then a simple average of these ratios is computed to get the average monthly ratios, as depicted in the graphs.

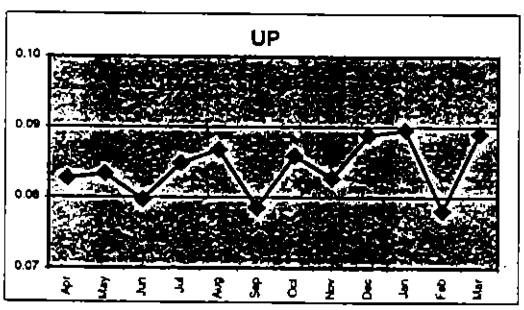








However, in case of UP it was found that the same trend was not repeating for all the years from 1999-2000 to 2001-02. In such a case average of common trends or ratios was taken, that is, if it was found that the trend in a particular month in 1999-2000 was different from the same month in years 2000-01 and 2001-02 then the average of only 2000-01 and 2001-02 was taken for that month. If the trend was similar in all the years for a particular month then again the simple average for all the years was taken. The following seasonal variations are observed in UP by performing this analysis:



The seasonality observed by computing average monthly energy requirement to total annual energy requirement ratios for different states is then used to project the monthly energy requirement for the states for the forecasted years. These average ratios are multiplied to the forecasted annual energy requirement, from 2003-04 to 2007-08, to estimate the monthly energy requirement, taking seasonality into account. The results for the states under study are given in the tables below.

Delhi

Table 1.4 Monthly energy requirement (MU) for Delhi (2003-04 to 20007-08)

Month	2003-04	2004-05	2005-06	2006-07	2007-08
Apr	1643	1723	1809	1891	1984
May	1936	2031	2131	2228	2338
Jun	1888	1981	2079	2173	2280
Jul	1989	2086	2189	2288	2401
Aug	1989	2086	2189	2288	2401
Sep	1899	1992	2091	2185	2293
Oct	1707	1791	1879	1965	2062
Nov	1483	1555	1632	1706	1790
Dec	1612	1691	1775	1855	1947
Jan	1756	1841	1933	2020	2120
Feb	1481	1553	1630	1704	1788
Mar	1514	1588	1667	1743	1829
Total	**20897**	**21918**	**23003**	**24046**	**25233**

Punjab

Table 1.5 Monthly energy requirement (MU) for Punjab (2003-04 to 20007-08)

Month	2003-04	2004-05	2005-06	2006-07	2007-08
Apr	2151	2254	2365	2480	2602
May	2718	2849	2988	3134	3287
Jun	3224	3380	3545	3718	3900
Jul	3394	3558	3732	3914	4106
Aug	3570	3742	3925	4117	4318
Sep	3051	3198	3354	3518	3690
Oct	2596	2721	2854	2994	3140
Nov	2076	2176	2282	2394	2511
Dec	2220	2327	2441	2560	2685
Jan	2196	2302	2414	2532	2656
Feb	2059	2158	2264	2374	2490
Mar	2289	2399	2517	2639	2769
Total	31544	33064	34680	36375	38153

Haryana

Table 1.6 Monthly energy requirement (MU) for Haryana (2003-04 to 20007-08)

Month	2003-04	2004-05	2005-06	2006-07	2007-08
Apr	1533	1637	1749	1868	1995
May	1760	1880	2008	2145	2291
Jun	1911	2041	2180	2329	2488
Jul	2137	2283	2438	2605	2782
Aug	2270	2424	2590	2766	2955
Sep	2166	2314	2471	2640	2820
Oct	1992	2128	2273	2428	2594
Nov	1712	1829	1954	2087	2229
Dec	1864	1991	2127	2272	2426
Jan	1859	1985	2121	2265	2420
Feb	1687	1802	1925	2057	2197
Mar	1896	2025	2163	2311	2469
Total	22787	24340	26000	27773	29666

Rajasthan

Table 1.7 Monthly energy requirement (MU) for Rajasthan (2003-04 to 20007-08)

Month	2003-04	2004-05	2005-06	2006-07	2007-08
Apr	2145	2235	2337	2438	2549
May	2251	2345	2452	2558	2674
Jun	2203	2295	2400	2503	2617
Jul	2022	2107	2202	2298	2402
Aug	2139	2228	2329	2430	2541
Sep	2252	2346	2453	2559	2675
Oct	2298	2394	2503	2611	2730
Nov	2459	2562	2678	2794	2921
Dec	2548	2655	2776	2895	3027
Jan	2533	2639	2759	2879	3009
Feb	2318	2415	2525	2634	2754
Mar	2589	2697	2820	2942	3075
Total	27756	28919	30233	31540	32974

Uttar Pradesh

Table 1.8 Monthly energy requirement (MU) for Uttar Pradesh (2003-04 to 20007-08)

Month	2003-04	2004-05	2005-06	2006-07	2007-08
Apr	3992	4154	4352	4492	4706
May	4015	4178	4377	4518	4733
Jun	3876	4033	4225	4362	4569
Jul	4076	4242	4443	4587	4805
Aug	4149	4317	4522	4669	4890
Sep	3831	3987	4176	4311	4516
Oct	4115	4283	4486	4631	4851
Nov	3994	4156	4353	4494	4708
Dec	4232	4404	4613	4762	4989
Jan	4258	4431	4642	4792	5020
Feb	3813	3968	4157	4291	4495
Mar	4239	4411	4621	4770	4997
Total	48591	50565	52968	54681	57280

2 Supply Availability Analysis

Currently, three utilities namely NTPC (for thermal power plants), NHPC (for hydro plants) and NPC (for nuclear plants) control and operate the power plants setup by the Central Government while State Electricity Boards and Electricity Departments are entrusted with the control and operation of the state owned Power Plants. These Power Plants comprise a mix of Thermal (Based on fuels like coal, oil & gas) and Hydro. In recent times, with the liberalization of generation segment of the power sector, few private players have also set up independent power plants (IPPs) based on the fossil fuel and renewable technologies.

Approach

The following steps were taken for the assessment of supply availability.

Analysis of installed capacity

This was assessed for the future after considering the existing projects and projects likely to be commissioned during the study period i.e. upto 2007-8. Discussions were held with the concerned authorities in the respective state and the CEA to know the possibility of commissioning of the new plants as per schedule taking into account the latest physical progress of the projects under execution

Analysis of PLF for thermal plants

For the existing thermal plants, energy availability has been worked out based on the analysis of the past PLF trend (plant wise). Where as for new plants and plants under construction, norms specified by the CEA have been considered to estimate the available energy taking into account the stabilisation period. In order to arrive at the energy availability from existing thermal plants, the plant wise Plant Load Factor (PLF) was taken on judgmental basis based on the past trends of PLF of each individual plant.

Availability of Energy from Central Plants

This has been arrived, after considering the availability from existing plants as well as from the future plants, taking into account the share of the respective states from the central sector stations and unallocated share. Trading arrangements with other states have also been considered. In addition to this due weightage as per the CEA norms for stabilization period has been considered while calculating the energy availability of a new plant (as a new plant will not operate to its full capacity in the first year of its commissioning).

Energy availability from Hydro Plants

For the existing as well as for the future hydro plants the available energy was arrived at by taking into account the design energy of the project for a 90% dependable year. The net energy available has been computed after considering the auxiliary consumption as per the CEA norms.

Peak Power availability

Ideally peak demand availability is computed after considering the future R&M program for each plant and past availability trends of unit installed. In view of data constraints an alternate approach was adopted which considers the relationship between energy availability and peak demand availability for the state. Based on this derived relationship, peak demand availability for the future was estimated.

Allocation of share

The allocation of power from central / joint venture projects to various concerned states is decided by the Ministry of Power based on the revised Gadgil Formula. The Gadgil Formula is based on economic growth, central assistance and many other economic and technical indicators of the concerned states.

Central Sector Plants

As discussed above NTPC, NHPC and NPC control and operate the plants of central sector. The total installed capacity of NTPC plants (for which states in the Northern region have share and unallocated capacity is reserved) is 6569 MW, Installed capacity of NHPC and NPC are 1485 MW and 1100 MW respectively. In future also both NTPC and NHPC plants are expected. All the states under consideration have share in it. The following section describes the status of forthcoming plants.

Tehri Stage I and II:

TEHRI stage I is expected to come in the current financial year whereas for Phase II CCEA approval is awaited. It is expected that the phase II will be commissioned by 2006-07. For phase I civil work is in progress for water conductor system.

Nathpa Jhakri

Major work has been completed and the delay is due to the remaining work of desilting chamber. It is expected that the plant will be commissioned in the current financial year.

Dulhasti

Civil work for HRT & TRT is in progress. Major portion of work has been completed and it is expected that the plant will be commissioned in the current financial year. The main factor, which may cause delay, is the law and order situation (as per CEA documents).

Chamera II

The project is being implemented on turn key basis Major portion of work has been completed and it is expected that the plant will be operationalised in the current financial year.

Dhauliganga

Civil work is in progress and major delay is because of acquisition of private land is in progress. It is expected that the plant will be commissioned by 2004-05.

Rihand II

The planned installed capacity of plants is 1000 MW, it was expected that both the unit will be commissioned by 2006, construction work has already been started and considering the pace of work it is now expected that one unit of 500 MW will come in 2005 and other unit of 500 MW will come in 2006.

Koteshwar

Infrastructure work is in progress and contract has been awarded for civil work. It is expected that the plant will be commissioned by 2005-06.

Dadri-II

The construction work is yet to start, but it is expected that the plant will be commissioned by 2006-07.

Kahalgaon-II

Revised capacity has been submitted by CEA to NTPC and investment approval is awaited. Ground leveling work has been started and it is excepted that one unit will come by 2006-7 and another unit will come by 2007-08.

Barsingar-II

This 500 MW capacity plant in Rajasthan is being developed by NLC. As per the available information, it is expected that this plant will be commissioned within 48 months from the date of approval by the GoI. It is thus expected that this plant will come by 2007-08.

Sewa-II

This project is yet to get the CCEA clearance, which is in progress and it is expected that plant will be commissioned in year 2006-07.

The following table gives the share of each state in the future central sector plants.

Table 2.1 Future central sector plants and state's shares

				Share of States in MW				
Project name	Type	Status	Possible date of Commissioning	Delhi	Haryana	Punjab	Rajasthan	Uttar Pradesh
Tehri Stage I	H	SOG	2003-04	95	43	76	75	147
Nathpa Jhakri	H	SOG	2003-04	142	64	114	112	220
Dulhasti	H	SOG	2004-05	48	22	39	38	75
Chamera II	H	SOG	2004-05	37	17	30	29	57
Dhauliganga	H	SOG	2004-05	35	15	28	27	54
Tala	H	SOG	2004-05	172	77	139	136	267
Rihand II	H	SOG	2005-06	127	57	102	100	196
Tehri-II	H	SOG	2005-06	95	43	76	75	147
Koteshwar	H	SOG	2006-07	38	17	30	30	29
Dadri-II	T	New	2006-07	62	38	50	49	96
Kahalgaon-II	T	New	2006-07	99	58	30	26	49
Barsingar-II	T	New	2006-07	32	28	25	50	49
Sewa-II	H	SOG	20007-08	15	7	12	12	23

Supply position in Delhi

Present Capacity

In Delhi, the total installed capacity as on 31st March 2003 was 3305 MW (excluding the micro hydel projects). DTL's (Delhi Transco Limited) capacity was 926 MW and capacity available from central sector was 2378 MW. The nuclear contribution in this was 179 MW. Plant wise details of the existing capacity are given in Table 2.2.

Table2.2 Delhi's existing installed capacity including its share in centre sector projects: 2003[a]

Project Name	Type	Capacity (MW)	Share (MW)
Center Sector Hydro Projects			
B Siul	H	198	20
Salal	H	690	80
T Pur	H	94.2	12
Chamera	H	540	43
Uri	H	480	53
Sub Total			208
Center Sector Thermal Projects			
Singrauli	T	2000	150
Anta Gas	G	419.33	44
Auriya Gas	G	663.36	72
Rihand	T	1000	100
Dadri Coal	T	840	758
Dadri Gas	G	829.58	91
Unchahar 1	T	420	24
Unchahar 2	T	420	47.5
Badrapur	T	705	705
Sub Total			1991.5
Nuclear			
Naps	N	440	47
Raps 3	N	220	55
Raps 4	N	220	77
Sub Total			179
D.T.L			
I.P.Station	T=36.6+3*62.5+60=284	284	284
Rajghat	T=2*67.5	135	135
D.V.B Gt	G	282	282
Pragati Gt	G=104X2+T=121.18	330	225.8
Sub Total			926.8
Grand Total			3305.3
Tentative Share Of Delhi Of The 15% Unallocated Share[b]			356

[a] Source: - CEA
[b] CEA

Future Projects and their status

Pragati CCPP GT 1[a]

GT-1 a 104.6 MW unit got synchronized on March 15 2002 and COD achieved on July 2 2002.

Pragati CCPP GT 2[b]

GT-2 a 104.6 MW unit got synchronized on November 9 2002 and declared on commercial operation on December 3 2002.

Pragati ST Unit[c]

A unit of 121.18 MW got synchronized on January 31 2003. The unit is running on full load. Trial run is expected to start soon.

Based on the latest information available and subsequent discussions with concerned authorities in CEA/Board, the details of tentative commissioning schedules of projects proposed during period 2003-04 to 2007-08 are given in Table 2.3.

Table 2.3 List of proposed power projects materializing during 2002-03 to 2007-08, Delhi[d]

Projects	Ownership	Likely year of commissioning	Status	Fuel Type	Share of Punjab (MW)
Pragati CCPP	DTL	2002-03	SYNCHRONISED	G+S	225.8
Monarchak CPP	NEEPCO	2006-07	CEA	GAS	125

Share of Delhi from central sector plants has already been given in Table 2.1.

Energy and Peaking Availability

The PLF of existing plants under DTL is given in table 2.4.

Table 2.4 The PLF (%) of existing plants under DTL[e]

	1999-00	2000-01	2001-02	2002-03
		%		
I.P.Station	35.30	40.00	37.60	28.60
Rajghat	79.40	67.00	58.90	70.00
D.V.B Gt	32.00	48.50	51.80	0.512
Badarpur	81.10	85.40	85.40	0.856

[a] Source:CEA

[b] Source: CEA

[c] Source:CEA

[d] Souce: CEA, Planning Wing.

[e] Source: Tariff order 2002-03, by Punjab State Electricity Regulatory Commission

Based on the above additions, the yearly power supply scenario for Delhi from 2002-03 upto 2007-08 is indicated in table 2.5.

Table 2.5 Yearly power supply scenario for Delhi (2003-04 to 2007-08)

S.No.	Year	Available Energy (MU)	Peak Availability (MW)
1.	2003-04	22313	3348
2.	2004-05	23373	3507
3.	2005-06	24360	3655
4.	2006-07	25770	3867
5.	2007-08	27838	4177

Supply position in Haryana

Present Capacity

In Haryana, the total installed capacity as on 31st March 2003 was 3243 MW (excluding the micro hydel projects). HPGC's (Haryana Power Generation Corporation) capacity was 1947 MW; including share from hydro projects of BBMB (Bhakra Beas Management Board) and capacity available from central sector was 1139 MW. The nuclear contribution in this was 28 MW. Plant wise details of the existing capacity are given in Table 2.6.

Table 2.6 Haryana's existing installed capacity including its share in central sector projects: 2003[a]

Project Name	Type	Capacity (MW)	Share (MW)
Bbmb			
Bhakra + Gangual+ Kotla	H	1492.15	492
Dehar	H	990	317
Pong	H	375	65
Sub Total			**874**
Center Sector (Hydro)			
B Siul	H	198	54.9
Salal	H	690	104
T Pur	H	94.2	6
Chamera	H	540	85
Uri	H	480	26
Sub Total			**275.9**
Center Sector (Thermal)			
Singrauli	T	2000	200
Anta Gas	G	419.33	25.3
Auriya Gas	G	663.36	38.2
Rihand	T	1000	65
Dadri Gas	G	829.58	40.6
Unchahar	T	840	34
Faridabad Gas	G	432	432
Sub Total			**835.1**
Others			
Malana	H	2x43=86	69.5

[a] Source: Tariff order 2002-03, Haryana Electricity Regulatory Commission.

Project Name	Type	Capacity (MW)	Share (MW)
Magum Liqiud Fuel	T	4X6.3	25
Napp	N	440	28.1
Ip	T	187.5	62.5
Sub Total			185.1
Hpgc			
Gneco (West Yamuna	H	48	48
Ftps - I	T	55	55
Ftps - Ii	T	55	55
Ftps - Iii	T	55	55
Total (Ftps)	T	165	165
Tdlps -I	T	110	110
Tdlps-Ii	T	110	110
Tdlps-Iii	T	110	110
Tdlps-Iv	T	110	110
Tdlps -V	T	210	210
Tdlps -Vi	T	210	210
Sub Total			1073
Grand Total			3243.1
Share Of Haryana Of 15% Unallocated Share[a]			170.8

In addition to this during FY 2002-03, Haryana also bought power through PTC (Power Trading Corporation) from Uttranchal (50 MW, Round the clock), DVC (Damodar Valley Corporation, 50 MW), Delhi (300 MW off peak) and West Bengal (100 MW) in total 552 MU of energy was bought by HVPNL (Haryana Vidyut Prasar Nigam Limited) through PTC.

Future Projects and their status

Tau Devi Lal TPS Stage V, Unit VII & VIIIb

The project is being developed by HPGC. The expected year of its commissioning is 2004-05. Both units (VII & VIII) are of 250 MW. The project got the techno-economic clearance from CEA in August 2002. The latest information about the project is that boiler erection for both units is in progress and piling work is in progress for both cooling tower and chimney.

Dhamwari Sunda Hydro Electric Project[c]

M/S Dhamwari Sunda Power Co. Ltd. (DPCL) will have two units of 35 MW each. The techno-economic clearance has been accorded by CEA in July-2002. MoEF clearance has been obtained. According to latest information land

[a] Tentative, Source: CEA
[b] Source: CEA
[c] Source: CEA

acquisition is in progress. However, the financial closure of the project is awaited. The likely year of the commissioning of the project is 2006-07.

Based on the latest information available and subsequent discussions with concerned authorities in the CEA/Board, the details of tentative commissioning schedules of projects proposed for the years from 2003-04 to 2007-08 and share of Haryana in the projects is given in Table 2.7.

Table 2.7 List of proposed power projects materializing during 2002-03 to 2007-08, Haryanaa

Projects	Ownership	Likely year of commissioning	Status	Fuel Type	Share of Punjab (MW)
TDLPS Unit 7&8	HPGC	2004-05	SOG	COAL	500
Dhamvari	PRIVATE	2005-06	CEA	H	70
Monarchak Cpp	NEEPCO	2006-07	CEA	GAS	125
Panipath	IOC	2007-08	NEW	REFRE	350

Share of Haryana from central sector plants has already been given in Table 2.1.

Energy and Peaking Availability

The future energy available has been assessed for hydro plants based on their design energy.

Table 2.8 The annual energy content for projects under HPGC/BBMB[b]

	UTILITY	Station	IC (MW)	Share (MW)	Annual energy (MU)
1	HSEB	Western Yamuna	48	48	273.6
2	BBMB	Bhakra (LB)	540	540	5255.6
3	BBMB	Bhakra (RB)	785	785	
4	BBMB	Dehar	990	990	3094.5
5	BBMB	Pong	372	372	1117.4

The PLF of existing plants under HPGC is given in the following table.

Table 2.9 The PLF of existing plants under HPGC[c]

Year	Faridabad	Tau Devi Lal TPS Panipath[d]		
	TPS 55X3=165 MW	Plf % 4 x 110 MW	PLF % 1 x 210 MW	PLF% Station
1996-97	44.41	34.39	83.89	50.38
1997-98	52.93	35.44	50.39	40.27
1998-99	63.33	34.32	84.2	50.43
1999-00	65.91	32.02	87.75	50.02
2000-01	56.91	36.32	72.19	47.91
2001-02	55.9	41.61	89.61	61.86
2002-03 up to sep 03	64.05	42.35	84.81	63.08

[a] Source: CEA

[b] Source: CEA

[c] Source: Website of HVPNL http://www.haryanaelectricity.com/hvpn.

[d] The second unit of 210 MW became operational is September 2001. Thus past records not available

During analysis it was observed that the actual available supply in Haryana at the end of year March 2003 was around 19000 MU where as the expected supply works out to be 16426 MU for year 2003-04. For year 2006-07, the energy availability by CEA has been project as 18666 MU. This is almost the same as actual of previous year (given that in future, capacity addition will be there). The reason for such a large gap was discussed with CEA and the following were found to be main reasons:

1. Availability for future is estimated based on the actual PLF instead of norms (TERI has also adopted the same approach)
2. Last year's figure may include import from other sources (in addition to allocated share) whereas future projections are made considering the contracted share (TERI has adopted the same approach)
3. This may include overdrawl from allocated shares
4. CEA does not considers the unallocated share for the state power position (TERI has included on a normative basis)

Based on the above additions, the yearly power supply scenario for the case of Haryana from 2002-03 upto 2007-08 is indicated in table 2.10.

Table 2.10 Yearly power supply scenario for Haryana (2003-04 upto 2007-08)

S.No	Year	Available Energy (MU)	Peak Availability (MW)
1.	2003-04	16426	2645
2.	2004-05	18021	2902
3.	2005-06	20747	3340
4.	2006-07	21807	3511
5.	2007-08	24806	3994

Supply position in Punjab

Present Capacity

In Punjab, the total generation capacity available to the grid as on 31st March 2003 was 5673 MW (excluding the micro hydel projects). PSEB's (Punjab State Electricity board) capacity was 4444 MW (including share from hydro plants in Rajasthan and in the BBMB (Bhakra Beas Management Board) projects) and capacity available from central sector was 1229 MW. The nuclear contribution in this was 150 MW. Plant wise details of the existing capacity are given in Table 2.11.

Table2.11 Punjab's existing installed capacity including its share in centre sector projects: 2003[a]

Project Name	Type	Unit wise	Capacity (MW)	Share (MW)
BBMB	H		2852.15	1330
RSD	H	4X150	600	452.4
			Sub Total	**1782.4**
Central Sector (Hydro)				
B siul	H	3X60	180	84
Salal	H	6X115	690	184
T Pur	H	3X40	94.2	17
Chamera	H	3X180	540	55
Uri	H	4X120	480	80
			Sub Total	**420**
Central Sector (Thermal)				
Singrauli	T	5X200+2X500	2000	200
Anta Gas	G	3X88+149	419.33	49
Auriya Gas	G	4X112+2X102	663.36	83
Rihand	T	2X500	1000	110
Dadri Gas	G	4X131+2X147	829.58	132
Unchahar Ii	T	2X210	420	50
Unchahar I	T	2X210	420	35
			Sub Total	**659**
Nuclear				
RAPS 4	N	220	220	99
NAPP	N	2X220	440	51
			Sub Total	**150**
PSEB				
GNDTP-1&II, Bhatinda	T	4X110	440	440
GGSSTP I,II,III Ropar	T	6X210	1260	1260
GHTP-I, Lehar M	T	2X210	420	420
Shanan, Joginder Nagar	H	4X15+50	110	110
UBDC, Malikpur	H	91.35	91.35	91.35
Anandpur Sahib	H	4X33.5	134	134
Mukherian	H	6X15+6X19.5	207	207
			Sub Total	**2662.35**
Total				**5673**
Share of Punjab out of 15% Unallocated Share[b] of NR				**184.35**

In addition to this, during 2002-03 PSEB also bought power through PTC (Power Trading Corporation) from Uttranchal (100 MW, Time of the day) and Goa (25 MW, off peak). In total 126.4 MU of energy was bought by PSEB through PTC[c].

[a] Source: - Tariff order 2002-03, Punjab State Electricity Regulatory Commission.
[b] Source: CEA
[c] Source: PTC.

Future Projects and their status

PSEB[a]

Guru Hargobind Thermal Plant Stage-II

The coal fired 2X250 MW, Guru Hargobind Thermal Plant Stage-II is located at Lehra Mohabbat, District Bhatinda. The latest status of the project is that all the clearances have been obtained from the CEA, and the Planning Commission has approved the investment. Negotiation for purchase main plant equipment is going on with M/s BHEL and PFC has already sanctioned loan for the project. The project is expected to be ready for commercial operation in 2006-07[4].

Shahpur Kandi HEP (68 MW)

The Project is to be executed on River Ravi. There are 4 units of 40 MW and single unit of 8 MW. This project stands cleared by CEA and the Ministry of Environment & Forest & Planning Commission. This project is expected to begin commercial operation in 2006-07[4]. However since the project is facing funds constraints for the purpose of calculations, the likely year of its commissioning has been taken as 2007-08. The annual designed energy on the basis of 90% dependable year is estimated to be 163 MU.

Govindwal Thermal Plant (IPP)

The coal fired 2X250 MW, Govindwal Thermal Plant; project is likely to be commission in the year 2006-07[4]. Government of Punjab has awarded the project to Ms G V K Power (Goindwal Sahib) Ltd an IPP. Land has been acquired for the project. Ministry of coal has allotted Tokissud North Coal Mines block to GVK power Ltd.

Based on the latest information available and subsequent discussions with concerned authorities in CEA/Board, the details of tentative commissioning schedules of projects proposed for the years for the period 2003-04 to 2007-08 and share of Punjab in the projects is given in Table 2.12.

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[a] Source: CEA, Project Monitoring wing.

Table 2.12 List of proposed power projects materializing during 2002-03 to 2007-08, Punjab[a]

	Projects	Ownership	Likely year of commissioning	Status	Fuel Type	Share of Punjab (MW)
1.	MONARCHAK CPP	NEEPCO	2006-07	CEA	GAS	78
2.	GURU-HARGO-II	PSEB	2006-07	SOG	COAL	500
3.	GOVIDWAL	G V K POWER (IPP)	2006-07	NEW	COAL	500
4.	SHAHPURKHANDI A&B	PSEB	2007-08	SOG	H	126.4
5.	SYL CANAL	PSEB	2007-08	NEW	H	50

Share of Punjab from central sector plants has already been given in Table 2.1.

Energy and Peaking Availability

The following tables give the information on design energy of existing hydro power plants.

Table 2.13 The annual energy content for projects under PSEB/BBMB/RSD[b]

	UTILITY	STATION	IC (MW)	SHARE (MW)	Annual energy (MU)
1	BBMB	BHAKRA (LB)	540	540	5255.6
2	BBMB	BHAKRA (RB)	785	785	
3	BBMB	DEHAR	990	990	3094.5
4	BBMB	GANGUWAL	83.58	83.58	5282
5	BBMB	KOTLA	81.57	81.57	
6	BBMB	PONG	372	372	1117.4
7	RSEB	RSD	600	452	1509
8	PSEB	ANANDPUR Sahib	134	134	904.5
9	PSEB	MUKHERIAN	207	207	1172.1
10	PSEB	SHANAN	110	110	582
11	PSEB	UBDC PUNJAB	90	90	539.8
12	PSEB	SHAHPURKANDI-A	160	128	620.2
13	PSEB	SHAHPURKANDI-B	8	6.4	31

The following table gives the information on PLF of existing thermal power plants:

Table 2.14 The PLF(%) of existing plants under PSEB[c]

	1997-98	1998-99	1999-2000	2000-01	2001-02	Average PLF (%)
GNDTP-1&II, BHATINDA	65.11	66.7	68.79	72.49	71.7	68.96
GGSSTP I,II,III ROPAR	70.34	70.01	74.11	76.44	80.2	74.22
GHTP-I, LEHAR M	NA	59.2	81.35	87.71	83.55	77.95

[a] Souce: CEA, Planning Wing.
[b] Source: CEA
[c] Source: Tariff order 2002-03, by Punjab State Electricity Regulatory Commission

Based on the above additions, the yearly power supply scenario for the case of Punjab from 2002-03 upto 2007-08 is indicated in table 2.15. .

Table 2.15 Yearly power supply scenario for Punjab (2003-04 upto 2007-08)

S.No	Year	Available Energy (MU)	Peak Availability (MW)
1.	2003-04	29256	5391
2.	2004-05	30111	5548
3.	2005-06	30874	5689
4.	2006-07	34063	6276
5.	2007-08	40970	7549

Supply position in Rajasthan

Power Plants in Rajasthan are controlled by the state utility - RVUNL. Private sector has also made its presence in the state. Rajasthan also gets power supply from central sector plants. Some plants that have also been set up as joint venture. The total installed capacity of Rajasthan is 4547 MW. The following table gives the plant wise details of existing installed capacity as on March 2003.

Table 2.16 Existing installed capacity in Rajasthan as on March 2003

Project name	Type	Capacity (MW	Share (MU)
State owned plants			
Kota Thermal	Thermal	850	850
Suratgarh Thermal Power Station	Thermal	1000	1000
Ramgarh Gas Thermal Power Station	Thermal	3	3
Ramgarh GTPS (Extension)	Thermal	36	36
Ramgarh CCPP St.II (RRVUNL)	Thermal	38	38
Satpura Thermal	Thermal	125	125
Mahi Hydel PH-I	Hydel	50	50
Mahi Hydel PH-II	Hydel	90	90
RMC I & II (Mahi Hydel)	Hydel	1	1
Anoopgarh Hydel	Hydel	9	9
Suratgarh Hydel	Hydel	4	4
Mangrol Hydel	Hydel	6	6
Pugal Hydel II	Hydel	1	1
Pugal Hydel I	Hydel	2	2
Charanwala Hydel	Hydel	1	1
Birsalpur MH	Hydel	1	1
BBMB Plants			
Bhakara Hydel	Hydel	1325	202
Pong (Beas Hydel)	Hydel	372	228
Dehar (Beas Hydel)	Hydel	990	198
Chambal Hydel (GS, RPS, JS)	Hydel	386	193
Kotla	Hydel	81.57	13
Ganguwal	Hydel	83.58	13
Central Sector Plants			
Singrauli STPS	Thermal	2000	300
Rihand TPS	Thermal	1000	95
Unchahar TPS Stage-I	Thermal	420	58
Anta	Thermal	413	83
Auraiya	Thermal	652	61

Project name	Type	Capacity (MW	Share (MU)
Dadri	Thermal	817	76
Tanakpur Hydel	Hydel	120	9
Salal II Hydel	Hydel	345	20
Chamera Hydel	Hydel	540	106
Uri Hydel	Hydel	480	43
R.A.P.P.	Nuclear	660	531
N.A.P.P.	Nuclear	440	44
WIND		60	60
GRAND TOTAL			4547
Unallocated share from 15%			200

Future Plants and their status

Suratgarh TPP St-III

The planned capacity for this plant is 250 MW. As per discussions held, it is expected that this plant will be commissioned in 2003-04.

Kota TPS St.-IV

The plant has a capacity of 195 MW and it is expected that the plant will be commissioned by 2003-04.

Mathania ISCC Power Project

The capacity of 140 MW additions is planned in the 10th five-year plan and excepted date of commissioning is 2006-07.

Giral TPP U-1

This plant is expected in the 11th five-year Plan. The capacity of this plant is 250 MW and the construction work is yet to start. The plant is expected to come by 2007-08.

Dholpur CCGT and Chambal CCGT

Financial closer is awaited for these two projects. It is expected that the Dholpur plant will be commissioned by 2005-06 and chambal project will be commissioned by 2006-07.

Table 2.17 Possible commissioning date of future generating plants

Project name	Owner	Type	Status	Possible date of Commissioning	Capacity (MW)
Suratgarh TPP St-III	State	T	About to be completed	2003-04	250
Kota TPS St.-IV	State	T	About to be completed	2003-04	195
Mathania ISCC Power Project	State	T	Under construction	2006-07	140
Giral TPP U-1	State	T	Yes to start the construction	2007-08	250
Barsingsar Lignite	Private	T	Yet to start the construction	2007-08	500 (2*250)
Chambal CCGT	Private	T	Waiting for financial closers	2006-07	166
Dholpur CCGT	Private	T	Waiting for financial closers	2006-07	702

Share of Rajasthan from central sector plants has already been given in Table 2.1.

Operational Performance

The following table provides the information on trend of PLF of thermal power plants.

Table 2.18 (A) PLF (%) of existing thermal power plants in Rajasthan

Projects	1997-98	1998-99	1999-00	2000-01	2001-02	2002-03
Kota Thermal	82.15	78.82	84.57	86.4	85.3	88
Suratgarh TPS		70.4	74.5	82	85	88.8
Ramgarh Gas TPS	75.55	81.33	73.09	75.55	81.33	73.09

Table 2.18 (B) Available annual energy of existing plants

Project name	IC (MW)	Share (MW)	Annual Energy (MU)
Bhakara Hydel	1325	201.657	
Kotla	81.57	12.905	5255.6
Ganguwal	83.58	12.754	
Pong (Beas Hydel)	372	231.64	1117.4
Dehar (Beas Hydel)	990	198	3094.5
Chambal Hydel (GS. RPS. JS)	386	193	1178

Energy and Peak Availability

Based on the above approach energy availability (plant wise) was assessed for Rajasthan. The yearly supply scenario of energy as well as peak availability has been given in table2.19.

Table 2.19 Yearly power supply scenario for Rajasthan (2003-04 upto 2007-08)

S.No	Year	Available Energy (MU)	Peak Availability (MW)
1	2003-04	26416	4049
2	2004-05	28458	4362
3	2005-06	31283	4795
4	2006-07	34806	5335
5	2007-08	38097	5839

Supply position in Uttar Pradesh

As on March 2003, total installed capacity of UP is 7114.3 MW comprising state owned plants and share from central sector plants. Currently in UP almost 366 MW capacity is under long-term refurbishment program or the unit has been closed, this 7114.3 MW considers the non-availability of the above-mentioned capacity. The following table gives the details of installed capacity and share of UP in other plants.

Table 2.20 UP's existing installed capacity including its share in central sector projects: 2003

Project name	Type	Capacity (MW)	Share (MU)
State owned Plants			
Obera A	T	400	400
Obera B	T	800	800
Anpara A	T	630	630
Anpara B	T	1000	1000
Panki	T	252	252
Pariccha	T	220	220
Haudaganj B	T	160	160
Haudaganj C	T	170	170
Sub Total Thermal		3632	3632
Rihand	H	300.0	300.0
Obera	H	99.0	99.0
Matatila	H	30.0	30.0
Khara	H	72.0	72.0
Uppar Ganga Stations	H	15.5	15.5
Micro Hydel	H		
Belka	H	3	3
Babail	H	2	2
Sub Total Hydro		521.5	521.5
Central Sector Plants			
Singaurli	T	2000	754
Rihand	T	1000	326
Dadri	T	829.58	242
Auriya	T	663.36	210
Dadri NCTPP	T	817	84
Anta	T	419.33	90
Unchahar	T	420	249.8
Unchahar-II	T	420	129
Tanda	T	440	440
Sub Total thermal		7009	2524.8
Uri	H	480	96.3
Salal	H	345	70
Tanakpur	H	120	22.7
Chamera	H	540	109
Sub Total hydro		1485	298
Narora	Nuclear	660	138
RARP	Nuclear	440	0
Sub Total nuclear		1100	138
Grand Total			7114.3
Unallocated Share (15%)			378

This takes care of the capacity, which will not be available either due to the closing or long term R&M program.

Future power Projects

Anapara C

The planned capacity of Anpara C is two units of 500 MW. TEC was accorded by CEA on 16.1.03 and efforts are being made for finance for this project with assistance of JBIC Japan. As per discussions held with UP officials, this plant may come by 2007-08, if there is no delay in the future work.

Paricha

The planned addition is 210 MW. Structural erection for this project was expected to start by May 2003. But there is some delay. As per the discussion actual generation from this plant will only be possible end of 2006-07, considering this possibility it is considered that the pant will come in 2007-08.

Rosa

The total planned capacity addition is 567 (two units of 283.5 MW each). The TEC was accorded by CEA in year 1999. It is expected that the plant will be commissioned in 40 month from the date of financial closer. Financial closer has still not been achieved by this plant. There is very minimal probability that this plant will come in 20007-08.

Panki

Extension of existing plant will be done by adding the capacity of 210 MW, this plant is expected to come in 2007-08.

The following table gives the information on expected plants during the study period in the UP (excluding the central sector plants).

Table 2.21 Possible date of commissioning of future generating plants

Project name	Owner	Type	Status	Possible date of Commissioning	Capacity (MW)
Anpara C	State Utility	T	Financial tie-up	2007-08	500
Panki Ext	State Utility	T	Construction is Yet to start	2007-08	210
Pariccha Ext	State Utility	T	Structural erection is expected to start by 5/03	2007-08	210
Rosa	Private sector	T	Achieving Financial Closure Achieving FSA & Fuel Transportation	2007-08	567

Share of UP from central sector plants has already been given in Table 2.1.

Operational performance

It was observed that existing plants except Anapara B are very old and their performance is very low. Currently some of the individual units are operating at a very low PLF. The following table gives the information about PLF and available energy of the hydro power plants.

Table: 2.22 (A) PLF (%) of existing power plants in UP

	H'ganj	Obra A	Obra B	Anpara A	Anpara B	Panki	Parichha
1996-97	18	20	33	79	84	40	28
1997-98	20	20	37	71	84	39	32
1998-99	21	20	28	71	80	35	43
1999-00	18	23	45	63	92	39	29
2000-01	21	26	56	75	84	41	31
2001-02	21	24	54	80	88	45	53
2002-03	25	27	68	75	88	34	55

Table 2.22 (B) Design energy of existing hydro power plants

S. No	Project	I C MW	Annual Energy MU
1	KHARA	72	434.2
2	MATATILA	30	143.3
3	OBRA HYDEL	99	288.6
4	RIHAND	300	916.4

Energy and Peak Availability

Based on the above approach energy availability (plant wise) was assessed for UP. The yearly supply scenario of energy as well as peak availability has been given in Table2.23

Table 2.23 Yearly power supply scenario for Punjab (2003-04 upto 2007-08)

S.No	Year	Available Energy (MU)	Peak Availability (MW)
1	2003-04	37404	5390
2	2004-05	38675	5573
3	2005-06	41242	5943
4	2006-07	42388	6108
5	2007-08	46950	6765

Seasonal variation in the supply side, especially w.r.t to hydro power plants

While scheduling power it is attempted to maximize the hydropower in the total requirement. Hydropower availability highly depends on the water availability and load pattern. The following table shows the actual power pumped into the system from BBMB plants. This variation actually represents the seasonal variation.

Table 2.24 Actual power pumped into the system from BBMB plants

Sl. No.	Power Station	April 2001	May 2001	June 2001	July 2001	Aug. 2001	Sept. 2001	Oct. 2001	Nov. 2001	Dec. 2001	Jan. 2002	Feb-02
		Gross MU	Gross MU	Gross MU	Gross MU	Gross MU	Gross MU	Gross MU	Gross MU	Gross MU	Gross MU	Gross MU
						Jointly owned BBMB						
1	Bhakra Complex	233	372	488	514	565	584	493	475	474	437	13
2	Dehar	156	351	422	445	458	345	171	113	98	84	42
3	Pong	33	39	68	75	147	219	140	138	139	140	60

Sl. No.	Power Station	April 2002	May 2002	June 2002	July 2002	Aug. 2002	Sep. 2002	Oct. 2002	Nov. 2002	Dec. 2002	Jan. 2003	Feb. 2003	Mar. 2003
		Ex-bus MU	Ex-bus MU	Ex-bus MU	Ex-bus MU	Ex-bus MU	Ex-bus MU	Ex-bus MU	Ex-bus MU	Ex-bus MU	Ex-bus MU	Ex-bus MU	Ex-bus MU
1	Bhakra Complex	352.72	494.16	697.57	835.35	613.13	600.75	NA	NA	599.73	471.53	334.33	399.54
2	Dehar	290.8	444.31	446.41	465.83	449.41	396.96	NA	NA	94.45	80.75	81.6	172.47
3	Pong	11.95	66.51	98.39	76.31	75.52	50.79	NA	NA	77.98	36.63	29.08	63

The following table 2.25 shows the variation in hydropower for the other central sector plants.

Table 2.25 Variation in hydropower for the other central sector plants.

Sl. No.	Power Station	April 2001	May 2001	June 2001	July 2001	Aug. 2001	Sept. 2001	Oct. 2001	Nov. 2001	Dec. 2001	Jan. 2002	Feb-02
		Gross MU	Gross MU	Gross MU	Gross MU	Gross MU	Gross MU	Gross MU	Gross MU	Gross MU	Gross MU	Gross MU
	NHPC											
1	Barasiu	63	70	61	99	93	49	25	22	17	16	68
2	Sata	172	386	436	60	490	329	155	89	82	74	63
3	Tanakpur HPS	16	35	50	62	60	62	38	25	19	11	20
4	Charrera HPS	124	234	305	378	350	158	70	54	57	47	28
5	Uri MPS	245	320	213	193	199	120	82	102	80	102	84

Annexure 2.1

Annual energy content of future hydro projects[a]

S. No	PROJECT	IC (MW)	STATE	STATUS	A ENERGY (MU)
1	BASPA- 2	300	H.P.	C	1234.5
2	CHAMERA-II	300	H.P.	S	1500
3	DHAMVARI S (HP)	70	Haryana	C	320
4	LARGI	126	H.P.	C	572
5	NATHPA JHAKRI	1500	H.P.	S	6700
6	RAMPUR	400	H.P.	N	2032
7	KSHANG-I	66	H.P.	N	200
8	BAGLIHAR	450	J&K	C	2650
9	DULHASTI	390	J&K	S	1928
10	SEWA ST II	120	J&K	C	539
11	SHAHPURK-A	32	J&K	S	155
12	SHAHPUR-B	1.6	J&K	S	7.8
13	SHAHPURKANDI-A	128	Punjab	S	620.2
14	SHAHPURKANDI-B	6.4	Punjab	S	31
15	DHAULIGANGA	280	Uttaranchal	S	1134
16	KOTESWAR	400	Uttaranchal	S	1233
17	MANERI BHALI II	304	Uttaranchal	C	1554
18	TEHRI ST-II	1000	Uttaranchal	N	200
19	TEHRI ST I	1000	Uttaranchal	S	3091
20	VISHNU PRAYAG	400	Uttaranchal	C	2060
21	TALA HYDRO	6*170	BHUTAN		3962
XI PLAN					
22	SYL CANAL	50	Punjab	C	317

[a] Source: CEA

Annexure 2.2

Details for Punjab

Project		Capacity (MW)	Share (MW)	Contribution towards supply (MU)				
				2003-04	2004-05	2005-06	2006-07	2007-08
		Existing projects (project wise)						
BBMB	H	2852	1330	4197	4197	4197	4197	4197
RSD	H	600	452.4	1138	1138	1138	1138	1138
B SIUL	H	180	84	364	364	364	364	364
SALAL	H	690	184	822	822	822	822	822
T PUR	H	94.2	17	82	82	82	82	82
CHAMERA 1	H	540	55	170	170	170	170	170
URI	H	480	80	255	509	509	509	509
SINGRAULI	T	2000	200	1430	1430	1430	1430	1430
ANTA GAS	G	419.33	49	340	340	340	340	340
AURIYA GAS	G	663.36	83	531	531	531	531	531
RIHAND	T	1000	110	737	737	737	737	737
DADRI GAS	G	829.58	132	765	765	765	765	765
UNCHAHAR II	T	420	50	390	390	390	390	390
UNCHAHAR I	T	420	35	273	273	273	273	273
RAPS 4	N	220	99	520	520	520	520	520
NAPP	N	440	51	324	324	324	324	324
GNDTP-1&II, BHATINDA	T	440	440	2658	2658	2658	2658	2658
GGSSTP I,II,III ROPAR	T	1260	1260	8192	8192	8192	8192	8192
GHTP-I, LEHAR M	T	420	420	2868	2868	2868	2868	2868
SHANAN, JOGINDER NAGAR	H	110	110	582	582	582	582	582
UBDC, MALIKPUR	H	91.35	91.35	540	540	540	540	540
ANANDPUR SAHIB	H	134	134	905	905	905	905	905
MUKHERIAN	H	207	207	1172	1172	1172	1172	1172

Projects that have commenced construction (project wise)								
NAPTHA JHAKRI	H			431	431	431	431	431
DULHASTI	H	390	39		96	193	193	193
CHAMERA II	H	300	30		75	150	150	150
DHAULIGANGA	H	280	28		57	113	113	113
KOTSHWAR	H	400	30				540	540
TALA	H	1020	69.5		135	405	46	92
RIHAND II	T	1000	51			117	474	715
THERIST.1	H	1000	76	29	143	229	229	229
Projects proposed but not yet commenced const. (project wise)								
DADRI II	T	490	50				115	329
SEWA ST II	H	120	12					27
TEHRI ST. II	H	1000	37				4	11
MONARCHACK CPP	G	331	78				179	512
KAHALGAON II	T	619	30.5				70	200
BARSINGAR LIG	T	500	25.5				59	226
GURU HARGO-II	T	500	500				1148	3285
SHAHPURKHANDI-A	H	160	120					233
SHAHPURKHANDI-B	H	8	6.4					3
SYL CANAL	H	50	50					1030
GOVINDWAL SAHIB	T	500	500				1148	3285
Grand Total				29712	30444	31145	34404	41111
Unallocated Share				1119	1242	1314	1443	1660
Auxillary Consumption				1575	1575	1585	1785	1800
Available Energy				29256	30111	30874	34063	40971

Details for Haryana

Annexure 2.3

Project		Capacity (MW)	Share (MW)	Contribution towards supply MU)				
				2003-04	2004-05	2005-06	2006-07	2007-08
Existing projects (project wise)								
BHAKRA	H	1490.15	492	1735	1735	1735	1735	1735
DEHAR	H	990	317	991	991	991	991	991
PONG	H	372	65	186	186	186	186	186
B SIUL	H	198	54.9	216	216	216	216	216
SALAL	H	690	104	465	465	465	465	465
T PUR	H	94.2	6	29	29	29	29	29
CHAMERA 1	H	540	85	262	262	262	262	262
URI	H	480	26	140	140	140	140	140
SINGRAULI	T	2000	200	1430	1430	1430	1430	1430
ANTA GAS	G	419.33	25.3	175	175	175	175	175
AURIYA GAS	G	663.36	38.2	244	244	244	244	244
RIHAND	T	1000	65	435	435	435	435	435
DADRI GAS	G	829.58	40.6	235	235	235	235	235
UNCHAHAR	T	840	34	265	265	265	265	265
FARIDABAD GAS	G	432	432	2838	2838	2838	2838	2838
MALANA	H	2x43=86	69.5	300	300	300	300	300
MAGUM LIQIUD FUEL	T	4X6.3	25	150	150	150	150	150
NAPP	N	440	28.1	178	178	178	178	178
IP	T	187.5	62.5	356	356	356	356	356
GNECO (WEST YAMUNA	H	48	48	274	274	274	274	274
FTPS	T	165	165	806	806	806	806	806
TDLPS (unit I-IV)		440	440	1542	1542	1542	1542	1542

		Projects that have commenced construction (project wise)						
TDLPS -V	T	210	210	1437	1437	1437	1437	1437
TDLPS -VI	T	210	210	1260	1260	1260	1260	1260
TDLPS-VII&VIII	T	500	500		1148	3285	3285	3285
DULHASTI	H	390	22		54	109	109	109
NATHAPA JHAKRI	H	1500	64	143	286	286	286	286
CHAMERA II	H	300	17		43	85	85	85
DHAULIGANGA	H	280	15		30	61	61	61
KOTESHWAR	H	400	17				26	52
TALA	H	1020	38.5		75	224	299	299
TEHRI ST I	H	1000	42			130	130	130
RIHAND II	T	1000	28.5			65	265	399
		Projects proposed but not yet commenced const. (project wise)						
DADRI II	T	490	28				64	184
RAMPUR	H	400	22					112
SEWA ST II	H	120	6					13
TEHRI ST II	H	1000	21				2	6
KAHALGAON-II	T	619	57.5				132	378
MONARCH CPP	G	331	125				287	821
BARSINGSAR	L(T)	500	14				32	924
PANIPATH	T	350	350					803
DHAMVARI S	H	70	70			160	320	320
Grand Total				16094	17586	20356	21334	24219
Unallocated Share				1061	1099	1147	1273	1432
Auxillary Consumption				745	745	755	800	845
Available Energy				16426	18021	20747	21807	24806

Details for Rajasthan

Annexure 2.4

Project		Capacity (MW)	Share (MW)	Contribution towards supply (MU) 2003-04	2004-05	2005-06	2006-07	2007-08
Existing projects (project wise)								
Kota Thermal	T	850	850	6035	6035	6035	6035	6035
Suratgarh Thermal Power Station	T	1000	1000	7020	7020	7020	7020	7020
Ramgarh Gas Thermal Power Station	T	3	39	20	20	20	20	20
Ramgarh CCPP St.II (RRVUNL)	T	38	38	452	452	452	452	452
Satpura Thermal	T	125	125	750	750	750	750	750
Mahi Hydel PH-I	H	50	50	200	200	200	200	200
Mahi Hydel PH-II	H	90	90	200	200	200	200	200
RMC I & II (Mahi Hydel)	H	1	1	3	3	3	3	3
Anoopgarh Hydel	H	9	9	10	10	10	10	10
Suratgarh Hydel	H	4	4	3	3	3	3	3
Mangrol Hydel	H	6	6	6	6	6	6	6
Pugal Hydel II	H	1	1	2	2	2	2	2
Pugal Hydel I	H	2	2	1	1	1	1	1
Charanwala Hydel	H	1	1	1	1	1	1	1
Birsalpur MH	H	1	1	1	1	1	1	1
Bhakara Hydel	H	1325	202	804	804	804	804	804
Pong (Beas Hydel)	H	372	228	657	657	657	657	657
Dehar (Beas Hydel)	H	990	198	619	619	619	619	619
Chambal Hydel (GS, RPS, JS)	H	386	193	590	590	590	590	590
Kotla	H	81.57	13	12	12	12	12	12
Ganguwal	H	83.58	13	12	12	12	12	12
Singrauli STPS	T	2000	300	2145	2145	2145	2145	2145

Project		Capacity (MW)	Share (MW)	Contribution towards supply (MU)				
				2003-04	2004-05	2005-06	2006-07	2007-08
Rihand TPS	T	1000	95	636	636	636	636	636
Unchahar TPS Stage-I	T	420	58	358	358	358	358	358
Unchahar TPS Stage-II	T	420	38	114	228	228	228	228
Anta	T	413	83	575	575	575	575	575
Auraiya	T	652	61	389	389	389	389	389
Dadri	T	817	76	441	441	441	441	441
Tanakpur Hydel	H	120	9	33	33	33	33	33
Salal II Hydel	H	345	20	265	265	265	265	265
Chamera Hydel	H	540	106	326	326	326	326	326
Uri Hydel	H	480	43	239	239	239	239	239
R.A.P.P.	N	660	531	2311	2311	2311	2311	2311
N.A.P.P.	N	440	44	262	262	262	262	262
Total wind energy	W	60	60	50	50	50	50	50
Projects that have commenced construction (project wise)								
Suratgarh TPP St-III	T	250	250	750	1500	1500	1500	1500
Ramgarh GTPS (Extension)	T	36	36	238	238	238	238	238
Kota TPS St.-IV	T	195	195	585	1170	1170	1170	1170
TEHRI ST-I	H	1000	75	78	155	155	155	155
NAPTHA JHAKRI	H	1500	112	250	500	500	500	500
RIHAND-II	T	1000	100			150	600	600
CHAMERA-II	H	300	29		73	145	145	145
DULHASTI	H	390	38		94	188	188	188
DHAULIGANGA	H	280	27		55	109	109	109

Project		Capacity (MW)	Share (MW)	Contribution towards supply (MU)				
				2003-04	2004-05	2005-06	2006-07	2007-08
KOTESWAR	H	400	30				46	92
TALA REPLACE.	H	1020	136		204	816	816	816
Projects proposed but not yet commenced const. (project wise)								
DADRI II	T	490	49				147	294
BARH MEGA	T	742	118				119	712
BARSINAGAR LIG.	T	250	50					150
KHALGAON-II	T	619	26				92	339
SEWA ST. II	H	120	12					27
TEHRI ST-II	H	1000	75			8	15	15
Barsingsar Lignite	T	250	250					750
Dholpur CCGT	T							
GT- 1	T	231	231			695	1391	1391
GT- 2	T	231	231			695	1391	1391
ST	T	239	239			718	1435	1435
Chambal CCGT	T	166	166				498	996
Mathania ISCC Power Project	T	140	140	0	0	0	420	840
Giral TPP U-1	T	250	250	0	0	0	0	750
Grand Total				27443	29645	32744	36632	40261
Unallocated Share				1187	1187	1187	1187	1187
Auxillary Consumption				2214	2374	2648	3013	3351
Available Energy				26416	28458	31283	34806	38097

Details for Uttar Pradesh

Annexure 2.5

Project		Capacity (MW)	Share (MW)	Contribution towards supply (MU)				
				2003-04	2004-05	2005-06	2006-07	2007-08
				Existing projects (project wise)				
Obera A	T	550	550	796	796	796	796	796
Obera B	T	1000	1000	3212	3212	3212	3212	3212
Anpara A	T	630	630	4043	4043	4043	4043	4043
Anpara B	T	1000	1000	7506	7506	7506	7506	7506
Panki	T	169	169	859	859	859	859	859
Pariccha	T	110	110	750	750	750	750	750
Haudaganj B	T	150	150	298	298	298	298	298
Haudaganj C	T	165	165	317	317	317	317	317
Rihand	H	300	300	920	920	920	920	920
Obera	H	99	99	279	279	279	279	279
Matatila	H	30	30	123	123	123	123	123
Khara	H	72	72	385	385	385	385	385
Uppar Ganga Stations	H	16	16	160	160	160	160	160
Micro Hydel	H	5	5	30	30	30	30	30
Singauli	T	2000	754	5391	5391	5391	5391	5391
Rihand	T	1000	326	2184	2184	2184	2184	2184
Dadri	T	829.58	242	1402	1402	1402	1402	1402
Auriya	T	663.36	210	1344	1344	1344	1344	1344
Dadri NCTPP	T	840	84	487	487	487	487	487
Anta	T	419.33	90	624	624	624	624	624
Unchahar	T	420	250	1542	1542	1542	1542	1542
Unchahar-II	T	420	129	796	796	796	796	796

Project		Capacity (MW)	Share (MW)	Contribution towards supply (MU)				
				2003-04	2004-05	2005-06	2006-07	2007-08
Tanda	T	440	440	2640	2640	2640	2640	2640
Uri	H	480	96.3	535	535	535	535	535
Salal	H	345	70	216	216	216	216	216
Tanakpur	H	120	22.7	104	104	104	104	104
Chamera	H	540	109	338	338	338	338	338
Narora	N	660	138	822	822	822	822	822
Projects that have commenced construction (project wise)								
NAPTHA JHAKRI	H	1500	220	250	500	500	500	500
TEHRI ST-I	H	1000	147	77	155	155	155	155
CHAMERA-II	H	300	57	0	73	145	145	145
DULHASTI	H	390	75	0	94	188	188	188
DHAULIGANGA	H	280	54	0	55	109	109	109
Paricha Ext	T	210	210					630
RIHAND-II	T	1000	196			1776	1776	1776
KOTESWAR	H	400	29	0	0	0	92	92
Projects proposed but not yet commenced const. (project wise)								
DADRI II	T	490	96				870	870
Anpara C	T	500	500					1752
Panki Ext	T	210	210					630
Rosa	T	567	567					1701
BARSINAGAR LIG.	T	250	49					294
KHALGAON-II	T	619	49				294	294
TALA REPLACE.	T	1020	267		801	1602	1602	1602

Project		Capacity (MW)	Share (MW)	Contribution towards supply (MU)				
				2003-04	2004-05	2005-06	2006-07	2007-08
SEWA ST. II	H	120	23	0	0	0	0	54
TEHRI ST-II	H	1000	147	0	0	15	15	15
Grand Total				38431	39781	42594	42981	48042
Unallocated Share				2250	2250	2250	2250	2250
Auxillary Consumption				3277	3356	3602	3713	4212
Available Energy				37404	38675	41242	42388	46950

Details for Delhi

Annexure 2.6

Project		Capacity (MW)	Share (MW)	Contribution towards supply (MU)				
				2003-04	2004-05	2005-06	2006-07	2007-08
			Existing projects (project wise)					
B SIUL	H	198	20	79	79	79	79	79
SALAL	H	690	80	357	357	357	357	357
T PUR	H	94.2	12	58	58	58	58	58
CHAMERA	H	540	43	133	133	133	133	133
NATHPA JHAKRI	H	1500	142	317	634	634	634	634
TEHRI ST I	H	1000	23.2	36	180	287	287	287
URI	H	480	53	286	286	286	286	286
SINGRAULI	T	2000	150	1072	1072	1072	1072	1072
ANTA GAS	G	419.33	44	305	305	305	305	305
AURIYA GAS	G	663.36	72	461	461	461	461	461
RIHAND	T	1000	100	670	670	670	670	670
DADRI COAL	T	840	758	5557	5557	5557	5557	5557
DADRI GAS	G	829.58	91	527	527	527	527	527
UNCHAHAR 1	T	420	24	187	187	187	187	187
UNCHAHAR 2	T	420	47.5	370	370	370	370	370
BADRAPUR	T	705	705	5211	5211	5211	5211	5211
NAPS	N	440	47	298	298	298	298	298
RAPS 3	N	220	55	289	289	289	289	289
RAPS 4	N	220	77	405	405	405	405	405
I.P.STATION	T	284	284	880	880	880	880	880
RAJGHAT	T	135	135	814	814	814	814	814
D.V.B GT	G	282	282	1089	1089	1089	1089	1089
PRAGATI GT	G	330	225.8	1484	1484	1484	1484	1484

		Projects that have commenced construction (project wise)						
CHAMERA II	H	300	37		93	185	185	185
DHAULIGANGA	H	280	34		69	138	138	138
KOTESHWAR	H	400	37				57	114
TALA REPLACE	H	1020	86		167	501	668	668
DULHASTI	H	390	48		119	237	237	237
RIHAND II	T	1000	63.5			146	590	890
		Projects proposed but not yet commenced const. (project wise)						
SEWA II	H	120	15					34
TEHRI ST II	H	1000	46.5				5	14
KAHALGAON	T	619	115				264	806
MONARCHAK	G	280	125				287	821
DADRI II	T	490	62				143	407
Grand Total				20885	21793	22660	24027	25768
Unallocated Share				2448	2600	2739	2874	3201
Auxillary Consumption				1020	1020	1040	1131	1131
Available Energy				22313	23373	24360	25770	27838

3 Demand - Supply Gap

The demand and supply gap (year wise peak and energy surplus/deficit) for each of the states covered in the study, i.e., Delhi, Haryana, Punjab, Rajasthan and Uttar Pradesh for the study period is given in the tables below.

Delhi

Table 3.1 (a) Demand-supply gap for Delhi (2003-04 to 2007-08)

Year	Total Available Energy (MU)	From Existing Projects (MU)	From Future Projects (MU)	Unallocated share (MU)	Peak availability (MW)	Energy Requirement (MU)
1	2	3	4	5	6	7
2003-04	22313	19865	0	2448	3348	20897
2004-05	23373	20346	426	2600	3507	21918
2005-06	24360	20469	1151	2739	3655	23003
2006-07	25770	20444	2452	2874	3867	24046
2007-08	27838	20511	4125	3201	4177	25233

Table 3.1 (b) Demand-supply gap for Delhi (2003-04 to 2007-08)

Year	Available Energy (MU)	Peak availability (MW)	Energy Requirement (MU)	Peak Load (MW)	Energy Surplus (+)/Deficit (-)	Peak Surplus (+)/Deficit (-)	Energy Surplus/Deficit %	Peak Surplus/Deficit %
1	2	3	4	5	6	7	8	9
2003-04	22313	3348	20897	3508	1416	-160.39	6.77%	-4.57%
2004-05	23373	3507	21918	3680	145-5	-172.67	6.64%	-4.69%
2005-06	24360	3655	23003	3862	1356	-206.90	5.90%	-5.36%
2006-07	25770	3867	24046	4037	1724	-170.25	7.17%	-4.22%
2007-08	27838	4177	25233	4236	2605	-59.27	10.32%	-1.40%

Punjab

Table 3.2 (a) Demand-supply gap for Punjab (2003-04 to 200708)

Year	Total Available Energy (MU)	From Existing Projects (MU)	From Future Projects (MU)	Unallocated share (MU)	Peak availability (MW)	Energy Requirement (MU)
1	2	3	4	5	6	7
2003-04	29256	27701	435	1119	5391	31544
2004-05	30111	27980	889	1242	5548	33064
2005-06	30874	28005	1555	1314	5689	34680
2006-07	34063	27976	4644	1443	6276	36375
2007-08	40970	28215	11096	1660	7549	38153

Table 3.2 (b) Demand-supply gap for Punjab (2003-04 to 2007-08)

Year	Available Energy (MU)	Peak availability (MW)	Energy Requirement (MU)	Peak Load (MW)	Energy Surplus (+)/Deficit (-)	Peak Surplus (+)/Deficit (-)	Energy Surplus /Deficit %	Peak Surplus /Deficit %
1	2	3	4	5	6	7	8	9
2003-04	29256	5391	31544	5800	-2288	-410	-7.25%	-7.07%
2004-05	30111	5548	33064	6081	-2953	-533	-8.93%	-8.76%
2005-06	30874	5689	34680	6378	-3807	-690	-10.98%	-10.81%
2006-07	34063	6276	36375	6690	-2312	-414	-6.36%	-6.18%
2007-08	40970	7549	38153	7017	2817	532	7.38%	7.58%

Haryana

Table 3.2 (a) Demand-supply gap for Haryana (2003-04 to 2007-08)

Year	Total Available Energy (MU)	From Existing Projects (MU)	From Future Projects (MU)	Unallocated share (MU)	Peak availability (MW)	Energy Requirement (MU)
1	2	3	4	5	6	7
2003-04	16426	12656	2709	1061	2645	22787
2004-05	18021	12773	4149	1099	2902	24340
2005-06	20747	12762	6839	1147	3340	26000
2006-07	21807	12756	7778	1273	3511	27773
2007-08	24806	12791	10583	1432	3994	29666

Table 3.2 (b) Demand-supply gap for Haryana (2003-04 to 2007-08)

Year	Available Energy (MU)	Peak availability (MW)	Energy Requirement (MU)	Peak Load (MW)	Energy Surplus (+)/Deficit (-)	Peak Surplus (+)/Deficit (-)	Energy Surplus /Deficit %	Peak Surplus /Deficit %
1	2	3	4	5	6	7	8	9
2003-04	16426	2645	22787	4335	-6361	-1691	-27.91%	-39.00%
2004-05	18021	2902	24340	4631	-6319	-1729	-25.96%	-37.35%
2005-06	20747	3340	26000	4947	-5253	-1606	-20.20%	-32.47%
2006-07	21807	3511	27773	5284	-5965	-1773	-21.48%	-33.55%
2007-08	24806	3994	29666	5644	-4860	-1650	-16.38%	-29.24%

Rajasthan

Table 3.2 (a) Demand-supply gap for Rajasthan (2003-04 to 2007-08)

Year	Total Available Energy (MU)	From Existing Projects (MU)	From Future Projects (MU)	Unallocated share (MU)	Peak availability (MW)	Energy Requirement (MU)
1	2	3	4	5	6	7
2003-04	26416	23481	1748	1187	4049	27756
2004-05	28458	23602	3669	1187	4362	28919
2005-06	31283	23582	6514	1187	4795	30233
2006-07	34806	23546	10073	1187	5335	31540
2007-08	38097	23521	13389	1187	5839	32974

Table 3.2 (b) Demand-supply gap for Rajasthan (2003-04 to 2007-08)

Year	Available Energy (MU)	Peak availability (MW)	Energy Requirement (MU)	Peak Load (MW)	Energy Surplus (+)/Deficit (-)	Peak Surplus (+)/Deficit (-)	% Energy Surplus (+)/Deficit (-)	%Peak Surplus (+)/Deficit (-)
1	2	3	4	5	6	7	8	9
2003-04	26416	4049	27756	4660	-1340	-611	-4.83%	-13.10%
2004-05	28458	4362	28919	4855	-461	-493	-1.59%	-10.15%
2005-06	31283	4795	30233	5075	1050	-280	3.47%	-5.53%
2006-07	34806	5335	31540	5295	3266	40	10.35%	0.76%
2007-08	38097	5839	32974	5535	5123	304	15.54%	5.48%

Uttar Pradesh

Table 3.2 (a) Demand-supply gap for Uttar Pradesh (2003-04 to 2007-08)

Year	Total Available Energy (MU)	From Existing Projects (MU)	From Future Projects (MU)	Unallocated share (MU)	Peak availability (MW)	Energy Requirement (MU)
1	2	3	4	5	6	7
2003-04	37404	34855	299	2250	5390	48591
2004-05	38675	34890	1535	2250	5573	50565
2005-06	41242	34882	4111	2250	5943	52968
2006-07	42388	34878	5260	2250	6108	54681
2007-08	46950	34822	9877	2250	6765	57280

Table 3.2 (b) Demand-supply gap for Uttar Pradesh (2003-04 to 2007-08)

Year	Available Energy (MU)	Peak availability (MW)	Energy Requirement (MU)	Peak Load (MW)	Energy Surplus (+)/Deficit (-)	Peak Surplus (+)/Deficit (-)	% Energy Surplus (+)/Deficit (-)	%Peak Surplus (+)/Deficit (-)
1	2	3	4	5	6	7	8	9
2003-04	37404	5390	48591	7796	-11187	-2406	-23.02%	-30.86%
2004-05	38675	5573	50565	8122	-11890	-2549	-23.51%	-31.38%
2005-06	41242	5943	52968	8508	-11726	-2565	-22.14%	-30.15%
2006-07	42388	6108	54681	8783	-12293	-2675	-22.48%	-30.46%
2007-08	46950	6765	57280	9201	-10330	-2436	-18.03%	-26.47%

4 Transmission System

Introduction

The evolution of transmission systems in India in terms of voltage levels, technology reach etc. has closely followed the growth pattern of power generation facilities. The evolution has also been influenced by the structural changes that were taking place in the industry. As a result, five Regional Grid Systems comprising an extensive network of EHV (extra high voltage) transmission lines in the states, central and to a small extent in the private sector (where licenses are operating) are in existence today. About 52,000-circuit km of 400 kV lines constitute the backbone of this network. HVDC (high voltage direct current) technology is being utilized for long distance bulks power transmission and for interregional interconnections where necessary. A 800 kV transmission line between Kishanpur (J&K) and Moga (Punjab) has already been completed in the Northern Region. The transmission net works has also transcended national boundaries. A few EHV links have been established with Bhutan and Nepal.

The growth of the transmission network has yet not been commensurate with the needs of the power system especially from the viewpoint of redundancy, grid stability, and power transfer across the regions. Paucity of funds has been one of the main constraints in this regard. Various policy initiatives have been taken by the government to overcome this problem and facilitate focused development of transmission systems. The Electricity Laws (Amendment) Act 1998 (and now the Electricity Act, 2003) enables establishment of independent power transmission companies and private sector participation in power transmission and distribution. The establishment of the ERCs (electricity regulatory commissions) and the restructuring of the SEBs (State electricity boards) including unbundling and corporatization of transmission activities are also expected to provide a boost to the development of transmission systems in different states. Thus the constraints in the transfer of power within and across the states/regions are expected to ease in the coming years.

The following sections present some salient features of the Northern Regional grid and the system associated with evacuation of Power from Baspa HEP - II in particular.

Northern Regional grid

The Northern Region comprises the states of Punjab, Haryana, Delhi, Rajasthan, Uttar Pradesh, Uttaranchal, Himachal Pradesh and Jammu and Kashmir. The region has a vast network of transmission and distribution lines and all the constituents in the Northern Region are operating in parallel. A grid map of the Region showing the 220 kV and above inter state and intra state network in the various states of the Northern Region is shown as Exhibition-I. The Exhibit II shows the grid map of Himachal Pradesh State indicating various transmission lines at 132 and above voltages as well as the Baspa HEP –II evacuation system.

The Northern Region has strong interconnections already existing with the Western and Eastern Regions of the country. The inter links of the Northern Region with the Western and Eastern Regions are asynchronous having an exchange capacity of about 500 MW. This is in addition to the alternate current links that allows exchange of power in radial mode between the neighbouring regions.

Baspa HEP - II transmission system

The power generated at Baspa HEP - II is stepped up to 400 kV. For evacuation of power from Baspa HEP - II, the following 400 kV transmission systems was identified and also completed.

Baspa HEP-II - Naphtha Jakri 400 kV grid 2 × Single Circuit with higher size (Triple Snow Bird) conductor.

The above transmission system and grid substations associated with Baspa HEP - II have been evolved to evacuate the full output of generated power conforming to CEA's transmission planning criteria under various feasible load generation scenarios. The full power output from Baspa HEP-II is stepped up to 400 KV and transmitted over the associated system to be pooled at the existing 400 kv Grid Station at Naphtha-Jakri . The following 400 kv transmission system emanating from Naptha –Jakri would be utilized to evacuate the full output both from Baspa (300MW) and Naptha-Jakri (1500 MW) Hydro Electric Projects.

1. N.Jhakri - Hissar via Nalagarh Double Circuit with higher size conductor.
2. N.Jhakri - Bawana / Abdullapur Double Circuit with higher size conductor.
3. Nalagarh 400/220 KV Substation 2 x 315 MVA
4. Bawana 400/220 KV Substation 2 x 315 MVA
5. Abdullapur 400/220 KV Substation 2 x 315 MVA + 1x 315 MVA (Under Const.).

From the above 400 Grid Stations in the state of Haryana, the power flow to the neigh boring systems will be through displacement by utilizing the existing intra and inter state links at 220 kv and above. This is further elaborated by the Power System Studies of the Northern Region carried out corresponding to full evacuation of Baspa generation. The results of these system studies are plotted in the enclosed Exhibit – III. The analysis of the result of these studies indicate that the existing and the already under construction system in the region, no transmission constraints are envisaged for transfer of power from Baspa, to other states if need be.

5 Competitive price of power

Introduction

The competitive price of power has been estimated for the five states selected for the purpose of the study, namely, Delhi, Haryana, Punjab, Uttar Pradesh and Rajasthan. The main source of the information for the various states is the tariff order as issued by the respective state electricity regulatory commissions and the inputs received from PTC & NRLDC.

In the following sections we would be indicating the price of power approved by the various State Commissions. However, it may be noted that from some plants power were purchased due to contractual agreement signed by the State utility/utilities. For instance,

1) Under the ABT scenario, the states would be liable to pay the fixed cost to the central generating stations
2) Similarly, PPAs and other contractual agreements are binding for the utility/utilities operating in the states.

In the analysis, wherever required, we have mentioned the approved quantum and price of power through other sources, mainly where the states don't have any liability.

Delhi

The average power purchase price of Delhi TRANSCO Limited as approved by the Delhi Electricity Regulatory Commission on June 2003 is Rs. 2.07/kWh excluding transmission and other charges. The summary of power purchase approved from Central generating stations and the own generating stations are summarised in the table 5.1 and table 5.2.

Table 5.1 Power purchase price from Central generating stations (2003-04)

Station	Energy Purchase (MU)	Price (Rs/kWh)
NTPC	9767	1.88
Dadri Thermal	5284	2.25
NHPC	875	1.25
Uri	219	2.61
NPC	824	2.84
RAPP 3	97	2.98
RAPP 4	368	3.25

Table 5.2 Power purchase price from own generating stations (2003-04)

Source	MU	Price (Rs/kWh)
BTPS (Badarpur Thermal Power Station)	1088	2.32
Genco (State generating thermal Stations)	444	1.96
PPCL (Pragati Power Corporation Limited)	428	2.21

Apart from this, the Delhi TRANSCO has also proposed to purchase power from Nathpa Jhakri Power Corporation (NJPC) at Rs.3.02 per unit. The proposed quantum of purchase was 160 MU for the year 2003-04. However, the Commission has not considered any power purchase from NJPC while estimating the power purchase and power purchase costs. The summary of power purchase and costs from other sources for FY 2003-04 as approved by the Commission is given in table 5.3. It may be mentioned here that these purchases were made either through PTC or through short-term contract between the Transco and the generating station.

Table 5.3 Power purchase price from other sources (2003-04)

Source	Units Purchased (MU)	Price per unit (Rs/kWh)
WBPDCL (PTC)	545	1.88
UPCL (PTC)	575	2.60
HPSEB (Own)	440	2.50
NJPC	0	3.02
UPPCL (Own)	412	2.60

As is evident from the above table, the highest power purchase price from other sources approved by the Commission was from UPCL (Uttaranchal Power Corporation Limited) and UPPCL (Uttar Pradesh Power Corporation Limited) at Rs.2.60 per unit.

As far as transmission charges are concerned, in its petition, the TRANSCO has submitted that the transmission wheeling charges are payable to the Power Grid for the transmission of power from Central Generation Stations and other sources. The actual transmission charges for the period July 2002 to March 2003 was 13.85 paise/kwh. This amounts to a total of Rs 117 crore for the period July 2002 to March 2003 in addition to the total power purchase costs.

Rajasthan

The average power purchase price of Rajasthan Rajya Vidyut Prasaran Nigam Ltd. (RRVPNL) as approved by the Rajasthan Electricity Regulatory Commission (RERC) on 24, March 2001 is Rs. 2.02/kWh. The highest purchase made by RRVPN was from RAPP III at Rs.2.84/kWh and the quantum of power purchase approved by the Commission for the year 2001-02 was 1914 MU. The Commission has approved power purchase from wind plant of RSPCL. The quantum of power purchase was meagre 6 MU and the price was Rs.3.03 per unit.

Apart from this, the Commission has approved the power purchase from Dadri thermal (NTPC plant) and Uri hydro (NHPC plant) at Rs. 2.48 per unit and Rs. 2.32 per unit respectively. The volume of power purchase approved for the year 2001-02 was 200 MU and 232 MU respectively from these stations.
It may be highlighted that the price of certain plants may not reconcile with other states because of the difference of year. In case of Rajasthan the available information is for the year 2001-02.

Punjab

After examining the tariff petition filled by the Punjab State Electricity Board (PSEB) for the year 2002-03, the Punjab State Electricity Regulatory Commission (PSERC) has approved the following power purchase cost:

Table 5.4 Power Purchase cost

Source	Rs./kWh
2001-02	1.65
2002-03	1.74

For 2002-03, the highest power purchase price in the approved merit order was from NHPC Uri plant at Rs. 2.92 per unit and the quantum approved was 330 MU, where as the highest power purchase made from outside the central generating stations was from Malana plant at Rs. 2.80 per unit and the volume approved was 70 MU. The Commission has also approved power purchase from NTPC Unchahar II at Rs. 2.43 per unit and units approved for the year 2002-03 was 420 MU. In regard to the transmission charges, for 2002-03 these rates are inclusive of the transmission charges payable to PGCIL and separate estimates for the same are not available. However, the average transmission charges for 2001-02 was 12.71 paise per kWh, which amounted to Rs. 85.97 crore for the entire year.

In respect of power purchase from RAPP, the Commission in the tariff order has mentioned that *the weighted average price* were negotiated between NPCIL and Northern States and was fixed at Rs. 3.08 per unit for combined purchase from unit III and unit IV upto November 2005 for each year. However, the Commission has not approved any quantum of power purchase from NPCIL RAPP units.

Haryana

The highest power purchase cost approved by the Haryana Electricity Regulatory Commission (HERC) was from Magnum plant at Rs. 3.71 per unit and the units approved to be purchased for the year 2002-03 was 100 MU. The average power purchase cost approved by the HERC was Rs.1.61 per unit. The summary of the power purchase quantum and cost is shown in the table 5.5 below:

Table 5.5 Power Purchase price from major sources

	MU approved	Per unit cost Rs/kWh
NTPC	6595	1.72
Unchahar 1 & 2	302	2.31
NHPC	1035	1.32
Uri	102	3.11
NPC	150	2.44
Narora Atomic PS	150	2.44
HPGCL	5196	2.11
Magnum	100	3.71
PTC	300	1.85
Average power purchase		1.61

The Haryana Vidyut Prasaran Nigam Limited (HVPNL) pays to the PGCIL wheeling charges from the generating stations to its boundary for purchase of power from NTPC, NHPC and NPC in addition to this, an additional wheeling charge for Salal and Bairasuil is also paid to the State Grids through which power from these two sources is wheeled. For 2002-03, the wheeling charges payable by HVPNL for wheeling NTPC, NHPC and NPC was 13 paise per kWh; for Faridabad Gas 4 paise per unit and 35 paise per kWh for PTC power. In addition to this, 3 paise per unit additional wheeling charges for Salal and Bairasuil power payable for using state transmission system was also approved by the HERC.

Uttar Pradesh

After examining the tariff petition filled by the Uttar Pradesh Power Corporation Limited (UPPCL) for the year 2003-04, the Uttar Pradesh Electricity Regulatory Commission (UPERC) has approved the following volume and power purchase price from UPRVUNL plants (Table 5.6).

Table 5.6 Power Purchase from UPRVUNL plants (2003-04)

Station	Net Energy (MU)	Per unit price
Harduaganj	676	3.20
Panki	894	2.11
Paricha	929	1.97
Obra A	930	1.83
Obra B	4990	1.38
Anpara A	4163	1.12
Anpara B	6876	1.74
Total	**19460**	1.60

The approved highest power purchase price was from Harduaganj at Rs. 3.20 per unit 2003-04. The break up of the power purchase quantum and price from other major sources is shown in the table 5.7 below.

Table 5.7 Power Purchase from Major plants

	Volume approved (MU)	Av. Cost (Rs/unit)
NTPC		
Singrauli	5310	1.15
Auriya	1421	1.76
Rihand	2132	1.29
Anta	615	1.33
Dadri Thermal	591	2.22
Dadri Gas	1636	1.82
Unchahar I	1689	1.91
Unchahar II	870	2.17
Tanda	1958	2.34
NPC		
NAPP	943	2.77
RAPP	803	3.50
Average NPC		*3.11*
NHPC		
Salal	208	1.22
Tanakpur	99	2.21
Chamera	412	3.14
Uri	417	3.97
Average NHPC		*3.01*

The highest power purchase price approved by the Commission was Rs. 3.97 per unit from NHPC Uri plant and the volume approved was 417 MU for the year

2003-04. The highest power purchase price from NPC was from RAPP plant at Rs.3.50 per unit and the volume approved was 803 MU for the year 2003-04, whereas the highest power purchase price from NTPC was from Tanda at Rs. 2.34 per unit.

Availability based tariff

Availability based tariff is:

1. A performance-based tariff for the supply of electricity by generators owned and controlled by the central government

2. A new system of scheduling and despatch, which requires both generators and beneficiaries to commit to day-ahead schedules.

3. A system of rewards and penalties seeking to enforce day ahead pre-committed schedules, though variations are permitted if notified One and one half hours in advance.

4. Emphasises prompt payment of dues. Non-payment of prescribed charges will be liable for appropriate action under sections 44 and 45 of the ERC Act.

ABT has three parts:

(i) A fixed charge (FC) payable every month by each beneficiary to the generator for making capacity available for use. The FC is not the same for each beneficiary. It varies with the share of a beneficiary in a generators capacity. The FC, payable by each beneficiary, will also vary with the level of availability achieved by a generator.

   a) In the case of thermal stations like those of NLC, where the fixed charge has not already been defined separately by GOI notification, it will comprise interest on loan, depreciation, O &M expenses, ROE, Income Tax and Interest on working capital.
   b) In the case of hydro stations it will be the residual cost after deducting the variable cost calculated as being 90% of the lowest variable cost of thermal stations in a region.

ii. An energy charge (defined as per the prevailing operational cost norms) per kwh of energy supplied as per a pre-committed schedule of supply drawn upon a daily basis.

iii. A charge for Unscheduled Interchange (UI charge) for the supply and consumption of energy in variation from the pre-committed daily schedule. This charge varies inversely with the system frequency prevailing at the time of supply/consumption. Hence it reflects the marginal value of energy at the time of supply.

Conclusion

The average price of power purchased in various states along with the highest power purchase price approved by the State Commissions is indicated in table 5.7 below:

Table 5.8 Power Purchase cost of various States

	Av. Cost (Rs/unit)
Delhi (2003-04)	
Average	2.03
RAPP IV	3.25
RAPP III	2.98
UPCL & UPPCL	2.60
Rajasthan (2001-02)	
Average	2.04
RAPP	2.84
Haryana (2002-03)	
Average	1.61
Magnum	3.71
PTC	1.85
Punjab (2002-03)	
Average	1.73
Uri	2.92
Malana	2.80
Uttar Pradesh (2003-04)	
Average	1.68
Uri	3.97

Further, as per the information received from the NRLDC, at present the off-peak price and peak price in the northern region is Rs.2.16 per unit and Rs.2.40 to Rs.2.60 per unit respectively.

From the above analysis following things emerges:

1) The price of competitive power varies state to state and the prices indicated in the chapter are current prices and in future, prices may increase or decrease depending on the fuel cost fluctuation and recovery of fixed cost component.
2) The contractual agreement is already in place and tariff principals like ABT could influence the competitive price.

3) To beef up their energy security, the northern states are creating buffers by entering into flexible power purchase contracts with PTC, other states and Central utilities[x]. Surplus power is exchanged between states through bilateral contracts and through PTC. These are short term and medium term contract. The electricity Act 2003, have further enabled the establishment of the trading companies. This could help in easier trade of surplus power based on market condition prevailing that time. These factors might influence the future pricing strategy of new generating plants.