

CHAPTER 8.2

POWER

8.2.1. Power is one of the prime movers of economic development. The level of availability and accessibility of affordable and quality power is also one of the main determinants of the quality of life. The Government has, since Independence, been giving priority to this sector while fixing the Plan outlays. As a result, the installed generation capacity has risen from a mere 1,300 megawatt (MW) at the time of Independence to more than 1,00,000 MW today. Along with the growth in installed generation capacity, there has also been a phenomenal increase in the transmission and distribution (T&D) capacity. However, despite these achievements, the power sector has not kept pace with the growth in demand with the result that the country has always faced energy and peaking shortages.

8.2.2. The state electricity boards (SEBs), have, in the past, played a significant role in the generation and supply of power. But the present financial health of the SEBs is not sound, to say the least. This is mainly due to un-economic tariffs for agriculture, lower slabs of domestic consumption and high T&D losses, which often disguise large-scale theft, and low billing and collection efficiency. This is the main roadblock to attracting the much-needed private investment and, in fact, has been one of the main reasons for the shortfall in capacity addition from private sector projects during the Ninth Plan. The actual capacity addition during the Ninth Plan was 19,015 MW against a target of 40,245 MW. The other major reasons for shortfall in the capacity addition were delay in land acquisition and environmental clearances, unresolved issues in fuel linkages, contractual problems, resettlement and rehabilitation (R&R) problems and law and order problems.

8.2.3. As far as the Tenth Plan is concerned, the Working Group Report on Power has envisaged a capacity addition requirement of 46,939 MW during the Plan period. However, keeping in view the status

of the ongoing, sanctioned and new projects in the pipeline, the Planning Commission assessed that a capacity addition target of the order of 41,110 MW (comprising 18,659 MW from on-going, 9,193 MW from projects cleared by the Central Electricity Authority (CEA) and 13,258 MW from new schemes) would be more realistic.

8.2.4. The Government proposes to enhance public funding for the sector as well as encourage the public sector undertakings (PSUs) to take up projects in joint ventures with private investors and state governments during the Tenth Plan period. As part of these efforts, the Accelerated Generation and Supply Programme (AG&SP) is proposed to be extended during the Tenth Plan to provide funds to critical on-going schemes at subsidised interest rates. There is also a focus on initiating suitable policy measures to accelerate the pace of hydro power development as well as to make nuclear power generation as competitive as power generation from other fuels. The Government is making concerted efforts to channelise adequate investment to ensure the completion of the National Grid by the end of the Eleventh Plan. This would enhance the inter-regional transfer of power and facilitate the optimum utilisation of existing assets.

8.2.5. Power sector reforms were initiated in 1991 to encourage competition in each sub element of the sector, namely, generation, transmission and distribution under an independent and transparent regulatory regime. With this objective in mind a Central Electricity Regulatory Commission (CERC) has already been set up at the national level and State Electricity Regulatory Commissions (SERCs) set up in 19 states, 11 of which have issued tariff orders. Private sector participation has also been set in motion with the enactment of the Electricity Laws (Amendment) Act in 1998. The draft Electricity Bill, 2001 has been introduced in Parliament which will replace the existing three laws relating to

electricity: the Indian Electricity Act, 1910 as amended from time to time; the Electricity (Supply) Act, 1948 as amended from time to time; and the Electricity Regulatory Commission Act, 1998.

8.2.6. The Electricity Bill recognises trading of power as a distinct activity and permits SERCs to allow open access in distribution of electricity in phases that would ultimately encourage efficiency and competition.

8.2.7 These reforms have to be carried forward aggressively to improve the financial health of the SEBs. The issue of one-time settlement of dues payable by SEBs to central power utilities (CPUs) has been addressed by securitising the dues. It is likely to facilitate further reforms in the sector. Reforms in the distribution sector have been identified as the key area of reform. The Accelerated Power Development Programme (APDP) was initiated in 2000-01 in order to give a fillip to the reform process in the power sector. One of the main strategies identified in this regard is the development of distribution plans/projects for all distribution circles as centres of excellence that can be replicated by the states in the later phase of distribution reforms. Sixty-three such circles have been taken up initially under APDP funding, which envisages metering of 11 KiloVolt (KV) feeders, improvement/strengthening of sub-transmission and distribution network, 100 per cent metering, establishment of a management information system (MIS) to improve billing, collection etc.

8.2.8 To ensure better utilisation of funds for reforms, an Accelerated Power Development and Reforms Programme (APDRP) has been formulated by making certain modifications in the APDP scheme. It is aimed at promoting investment for distribution reforms. The funding under APDRP is proposed to be 50 per cent on investment stream and 50 per cent on incentive stream. The focus is to ensure that investment must result in quantifiable physical and financial benefits in the selected circles.

8.2.9. Out of the estimated 80,000 villages yet to be electrified, the Tenth Plan proposes to electrify 62,000 villages through grid supply. The balance 18,000 remote villages are proposed to be electrified

by 2011-12 through the use of decentralised non-conventional sources of energy. In order to facilitate the flow of funds, the rural electrification programme has been included as a component of the Pradhan Mantri Gramodaya Yojana (PMGY) and the states are being encouraged to pool resources from other schemes under the Minimum Need Programme (MNP) and Rural Infrastructure Development Fund (RIDF) to meet the objective of 100 per cent electrification. A new scheme called Accelerated Rural Electrification Programme (AREP), with provision for interest subsidy, is being launched. The participation of decentralised power producers will be encouraged, especially for electrification of remote villages. Village-level organisations like panchayat raj institutions (PRIs), rural cooperatives and non-government organisations (NGOs) will play a crucial role in the rural electrification programme. Community participation is essential for success of the programme.

8.2.10. The restructuring of the existing renewable energy programmes towards gradual commercialisation as initiated during the Ninth Plan would be continued during the Tenth Plan period. In this context, a draft Renewable Energy Policy formulated by the Ministry of Non-Conventional Sources of Energy is under the consideration of the Cabinet.

8.2.11. Private sector investments in renewable energy sources are to be encouraged by promoting a bidding process for available subsidies. The contracts should be awarded to private entrepreneurs who provide the maximum benefit with the lowest amount of subsidies.

POWER SECTOR REFORMS

8.2.12. Apart from envisaging the setting up of the CERC, the Common Minimum Plan formulated at the Chief Minister's conference in December 1996 also accepted the need for rationalisation of tariffs so that subsidised sectors like agriculture would pay at least 50 per cent of the average cost of supply within three years. The establishment of SERCs had been envisaged by the State Power Ministers' conference, also in December 1996.

8.2.13. Besides licensing and setting of performance norms, the CERC was expected to set tariffs for all generation and transmission utilities supplying power across several states. The SERCs were expected to discharge a similar function for state utilities. Most importantly, the regulatory bodies were expected to encourage competition, on a level playing field, in each sub sector, namely generation, transmission, distribution and supply. Such competition under an independent adequate and transparent regulatory regime was expected to yield the desired efficiency gains. Accordingly, the Electricity Regulatory Commissions Act, was passed in July 1998.

8.2.14. Nineteen states — Orissa, Haryana, Andhra Pradesh, Uttar Pradesh, Karnataka, West Bengal, Tamil Nadu, Punjab, Delhi, Gujarat, Madhya Pradesh, Arunachal Pradesh, Maharashtra, Rajasthan, Himachal Pradesh, Assam, Chhatisgarh, Kerala and Uttaranchal — have either constituted or notified the constitution of SERCs. The SERCs of Orissa, Andhra Pradesh, Uttar Pradesh, Maharashtra, Gujarat, Karnataka, Rajasthan, Delhi, Madhya Pradesh, Himachal Pradesh and West Bengal have issued tariff orders.

8.2.15. The Electricity Laws (Amendment) Act was passed in 1998 to enable private participation in the power transmission sector. The Indian Electricity Grid Code (IEGC) was established by the CERC in January 2000 to ensure grid discipline and set

operation and governance parameters for individual players in the T&D sector. Trading of power has been recognised as a distinct activity that would encourage efficiency and competition. The Power Trading Corporation (PTC) was set up to facilitate inter-state trading in power. The Availability Based Tariff order notified by the CERC in January, 2000 is a step towards encouraging greater reliability and efficiency in generation.

8.2.16. Orissa, Haryana, Andhra Pradesh, Uttar Pradesh, Karnataka, Rajasthan, Madhya Pradesh and Delhi have enacted State Electricity Reforms Acts which provide for unbundling/corporatisation of SEBs, setting up of SERCs etc. The SEBs of Orissa, Haryana, Andhra Pradesh, Karnataka, Uttar Pradesh, Delhi and Rajasthan have been unbundled/ corporatised. (Table 8.2.1)

8.2.17. Hundred per cent metering of 11 KV feeders have either been completed or is in the final stages of completion in Goa, Maharashtra, Gujarat, Andhra Pradesh, Karnataka, Tamil Nadu, Kerala, Lakshadweep, Haryana, Himachal Pradesh, Delhi, Uttar Pradesh, Madhya Pradesh, Rajasthan and Punjab. The Ministry of Power has signed memorandums of understanding (MoUs) with 20 states to undertake reforms in a time-bound manner. These MoUs provide for time-bound metering in two phases i.e. (i) metering of 11 KV feeders and (ii) all consumers. Monitoring is being done to ensure that the agreed milestones are achieved.

Table 8.2.1
Progress Along with Reform Path by States leading the Process

State/ Reform Path	Orissa	Haryana	Uttar Pradesh	Andhra Pradesh	Karnataka	Rajasthan	Delhi
Date of instituting Reform Act	April 1996	March 1998	September 1998	October 1998	June 1999	June 2000	March 2001
Regulatory Commission Established	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Utility Unbundled	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Separate Distribution companies established.	Yes	Yes	No	Yes	No	Yes	Yes
Distribution Privatised	Yes	No	No	No	No	No	Yes

8.2.18. Measures initiated for reducing T&D losses have largely been unsatisfactory with only six states (Andhra Pradesh, Haryana, Rajasthan, Karnataka, Orissa and Uttar Pradesh) taking steps in the direction. None of the states, (except Haryana to some extent) have initiated any measures towards 100 per cent metering, billing and collection. Energy audit is also pending.

8.2.19. A Conference of Chief Ministers and Power Ministers was held on 3 March 2001 to discuss the challenges confronting the power sector. There was general consensus on the urgent need to depoliticise power sector reforms and speed up their implementation. The resolutions adopted in the meeting are in Annexure-8.2.1.

8.2.20. In addition to reforms in the sector, the Tenth Plan priorities include the achievement of a more optimal primary energy mix for the country. Hence the Tenth Plan proposes to raise the share of power sector investment in hydro, nuclear and renewable energy resources from the Ninth Plan levels.

Electricity Bill, 2001

8.2.21. The main features of the Electricity Bill, 2001 are:

- The central government is to prepare a National Electricity Policy in consultation with state governments.
- Thermal generation is to be delicensed and captive generation permitted freely. Hydro projects would, however, need the approval of the state governments and clearance from the CEA.
- The regulatory commissions may also permit open access to the distribution network in phases to promote competition and efficiency.
- Trading is recognised as a distinct activity. The regulatory commissions are authorised to fix ceilings on trading margins, if necessary.

- Provision for payment of subsidy through budget.
- Consumer tariff should progressively reduce cross subsidies and move towards actual cost of supply.
- Thrust towards 100 per cent rural electrification, with provisions for the management of rural distribution by panchayats, cooperative societies, NGOs, franchisees, etc.
- Provision for generation and distribution in the rural areas without licences.
- Non-conventional energy sources and stand alone systems to be freely permitted.
- SEBs to be corporatised within one year and unbundled into one or more companies through a statutory transfer of assets, liabilities and staff. However, the state governments would have the flexibility to continue with the SEBs through a notification.
- Metering to be made mandatory and 100 per cent metering of all supply is to be done within two years. Where necessary, the concerned regulatory commission may give additional time for completing the task of metering.
- Constituting of SERCs is a mandatory requirement.
- An appellate tribunal to hear appeals against the decision of the CERC and SERCs.
- Provisions relating to theft of electricity have been made more stringent.

REVIEW OF THE NINTH PLAN

Power Generation

8.2.22. The gross energy generation from power utilities at the beginning of the Ninth Plan

Table 8.2.2
Additions to Installed Capacity during the Ninth Plan

Ninth Plan (1997-2002)								
Type	Target				Achievement (MW)			
	Central Sector	State Sector	Private Sector	Total	Central Sector	State Sector	Private Sector	Total
Hydro	3,455	5,815	550	9,820	540	3,912	86	4,538
Thermal	7,574	4,933	17,038	29,545	3,084	5,538	4,975	13,597
Nuclear	880	-	-	880	880	-	-	880
Total	11,909	10,748	17,588	40,245	4,504	9,450	5,061	19,015

was 394.5 billion units (BU). The Ninth Plan envisaged a gross energy generation target of 606.7 BU for the utilities in the terminal year of the Ninth Plan (2001-02). As against this, the actual energy generation has been 515.3 BU. This works out to a compound annual growth rate (CAGR) of about 5.5 per cent during the Ninth Plan period. The shortfall of 91.4 BU in 2001-02 is mainly due to the shortfall in generation capacity addition and hydro generation due to inadequate rainfall in the catchment areas of hydro power stations.

Capacity Addition

8.2.23. The all-India installed generating capacity of utilities at the beginning of the Ninth Plan was 84,893 MW (excluding wind capacity of 902 MW). This included 21,568 MW of hydro, 61,012 MW of thermal and 2,225 MW of nuclear power. The Ninth Plan programme envisaged a capacity addition of 40,245 MW. As against this, the actual capacity addition was 19,015 MW during the Ninth Plan (Table 8.2.2).

8.2.24. The capacity addition of 19,015 MW during the Ninth Plan represents 47 per cent of the targeted addition. In contrast, capacity addition during the Eighth Plan was 54 per cent of the target (16,422 MW against the target of 30,538 MW). The sector-wise shortfalls during the Ninth Plan were : central sector 62.2 per cent, state sector 12.1 per cent and private sector 71.2 per cent. The achievement of 19,015 MW represents an addition of 3,803 MW per annum, compared to the target of 8,049 MW per annum.

8.2.25. The main reasons for the shortfall in capacity addition are: inability to get private sector projects off the ground in the absence of adequate arrangements for ensuring payment security, delay in land acquisition and environmental clearances, unresolved issues relating to fuel linkages, contractual problems, resettlement and rehabilitation problems and law and order problems.

8.2.26. The cumulative capacity at the end of the Ninth Plan in March 2002 was 1,04,917.50 MW, including 1,507.5 MW wind energy (Table- 8.2.3).

Table – 8.2.3
All India Cumulative Capacity Addition

(MW)

	HYDRO	THERMAL	NUCLEAR	TOTAL
Centre	3,049.00	25,836.51	2,720.00	31,605.51
State/UTs	22,636.02	39,546.59	0.00	62,182.61
Private	576.20	9,045.72	0.00	9,621.92
TOTAL	26,261.22	74,428.82	2,720.00	1,03,410.04*

* excludes the capacity of 1,507.46 MW from wind (State-62.86 MW; Private-1,444.60 MW)

Performance of Thermal Power Plants

8.2.27. The performance of the country's thermal power plants registered an overall improvement during the Ninth Plan. The all-India average Plant Load Factor (PLF) of the thermal power plants was 64.4 per cent at the beginning of the Ninth Plan and had increased to at 69.9 per cent by the end of the Plan period. This is mainly due to a reduction in the weighted average of the generating stations, improvement in the design of the new units and better plant maintenance practices. The year-wise actual achievement of PLF during the Ninth Plan period is given in Table-8.2.4 :

Table – 8.2.4
All-India Sector-Wise Thermal PLF (per cent)

Year	State	Central	Private	All India
1997-1998	60.9	70.4	71.2	64.7
1998-1999	60.8	71.1	68.3	64.6
1999-2000	64.3	72.5	68.9	67.3
2000-2001	65.6	74.3	73.1	69.0
2001-2002	67.0	74.3	74.7	69.9

Power Supply Position

8.2.28. At the beginning of the Ninth Plan, it was estimated that the energy and peak deficits were 11.5 per cent and 18 per cent respectively. However, at the end of the Plan period, despite achieving only 47 per cent of the envisaged capacity addition, the energy and peak deficits were restricted to 7.5 per cent and 12.6 per cent respectively. This is mainly due to a marked improvement in PLF of the thermal plants and a lower than projected growth in demand during the Ninth Plan.

Central Share in Total Installed Generation Capacity

8.2.29. The central sector undertakings viz. the National Thermal Power Corporation (NTPC), the National Hydro Electric Power Corporation (NHPC), Nuclear Power Corporation India Ltd. (NPCIL) and North Eastern Electric Power Corporation (NEEPCO), continue to play an important role in

adding new generation capacities in different parts of the country. The central sector share in the total installed generation capacity increased from 25.6 per cent at the end of the Seventh Plan to 31.52 per cent at the end of the Eighth Plan and stood at 30.1 per cent at the end of the Ninth Plan due to shortfalls in capacity addition.

Renovation, Modernisation and Life Extension

8.2.30. Since 1984, renovation & modernisation (R&M) has been considered the most cost-effective option to maximise generation from the existing capacity. Phase-I of the R&M programme, taken up in September 1984 for execution during the Seventh Plan, covered 163 thermal units with a total capacity of 13,570 MW at 34 selected power stations. The programme was successfully completed in 1991-92 at a total cost of Rs.1,066 crore. An average additional generation of 10,000 million units (MU)/year was achieved as against the targeted benefits of 7000 MU/year after completion of the programme.

8.2.31. Encouraged with the results of Phase-I of the R&M programme, Phase-II was taken up in 1990-91 for 44 thermal power stations comprising 198 units with a total capacity of 20,870 MW. The programme was estimated to cost Rs. 2,383 crore and was scheduled to be completed during the Eighth Plan. An additional generation of 7,864 MU/year was expected on completion of the programme. However, many utilities could not implement their R&M schemes on schedule due to the non-availability of funds. As a result, by the end of the Eighth Plan, only around 50 per cent of the works could be completed, yielding an additional generation of 5,000 MU/year. The remaining R&M activities under Phase II, were taken up during the Ninth Plan period. The works for 153 thermal units are at various stages of completion.

8.2.32. By the end of the Ninth Plan, Life Extension Work on 28 units (with a total of 1,981 MW) is likely to be completed. The life of the units covered by the programme is likely to be extended by 12-15 years.

8.2.33. The R&M and Life Extension Programmes face various constraints. These include:

- Non-availability of timely and adequate funds due to poor financial health of most SEBs/utilities.
- Delay in obtaining loans from the Power Finance Corporation (PFC) due to non-fulfilment of loan conditionalities.
- Procedural delays in the formulation of schemes and finalisation of orders by SEBs/utilities.
- Reluctance on the part of the SEBs to undertake renovation and modernisation since this leads to the units going out of the system temporarily, thereby lowering generation.

R&M and Upgrading of Hydro Power Stations

8.2.34. In the Ninth Plan, 36 hydro schemes (23 under Phase-I and 13 under Phase II), with an aggregate installed capacity of 9,001 MW, were identified for Renovation, Modernisation and Upgrading (RM&U) work at an estimated cost of Rs. 917.30 crore. The RM&U programme was estimated to add 1,609 MW of capacity and enhance generation by 4,987 MU.

8.2.35. Of these 36 schemes, RM&U work has so far been completed on 18 hydro schemes with an aggregate installed capacity of 4,860 MW at

an estimated cost of Rs. 554 crore and benefits expected to accrue are to the tune of 1,123 MW/3,350 MU. Of the remaining 18 RM&U schemes, five, with an aggregate installed capacity of 369 MW, have been declared 'closed' and work on four, with an aggregate installed capacity of 380 MW, is yet to commence. The balance nine schemes, with an aggregate installed capacity of 3,392 MW, are under various stages of implementation,

8.2.36 The status of hydro RM&U schemes as on 30 June 2001, is given in Table 8.2.5:

Transmission and Distribution Facilities

8.2.37. The major portion of the 400 KV transmission network planned to be set up during the Ninth Plan was in the central sector, while that of the 220 KV network was in the state sector. Most of the targeted additions under the transmission programme are likely to be achieved during the Ninth Plan. Capacity addition was adequate as neither the targeted generation nor the projected demand was realised. The details of the targets and achievements during the Ninth Plan in respect of major transmission projects are given in Table –8.2.6:

8.2.38. By the end of Ninth Plan, the country is likely to have 52,482 ckm of 400 KV lines and 99,178 ckm of 220 KV lines.

Table 8.2.5
Status of Renovation, Modernisation & Upgrading of Hydro Schemes

Details of schemes	Nos.	Installed capacity(MW)	Estimated cost Rs. Crore.	Expected Benefits MW	MU
Phase-I					
Programmed	23	5,863.75	647.03	1,472.63	3,890.06
Completed	14	4,269.00	422.43	1,069.48	2,565.46
Phase-II					
Programmed	13	3,137.60	270.27	136.10	1,096.50
Completed	4	591.40	131.43	53.90	784.50
Phase I & II					
Programmed	36	9,001.35	917.30	1,608.73	4,986.56
Completed	18	4,860.40	553.86	1,123.38	3,349.96

Table 8.2.6
Targets and Achievements in Major Transmission Lines During the Ninth Plan

Sector	400 KV (ckm) Target based on annual Achievement programmes		220 KV (ckm) Target Based on annual Achievement programmes	
Central	5,799	6,344	2,280	2,123
State	7,076	6,892	16,605	15,270
Total	12,875	13,236	18,885	17,393

ckm=circuit km

Transmission and Distribution (T & D) Losses

8.2.39. T&D losses continued to remain high during the Ninth Plan. The reported all-India average T&D losses increased from 19.8 per cent in 1992-93 to 26.45 per cent in 1998-99 and is anticipated to increase to 27.8 per cent by the end of the Ninth Plan. There is a wide variation in losses reported by different states for 2000-01 (RE), ranging from 17 per cent to 56 per cent. Based on the experience of a few states that have unbundled their utilities, actual T&D losses for the country as a whole are estimated to be in the 35-45 per cent range. The high T&D losses are attributed to:-

- Weak and inadequate sub-transmission and distribution systems due to haphazard growth of demand to meet the short-term objective of extension of power supply to new areas.
- Long transmission and distribution lines.
- Inappropriate size of conductors.
- Improper load management, resulting in overloading of systems.
- Pilferage and theft of energy.
- Unmetered supply.
- Financial constraints to undertake system improvement schemes.

8.2.40. In order to reduce T&D losses, it is necessary that various electricity supply

organisations take up system studies and carry out energy audits for identification of the causes of excessive losses. Based on these studies, system improvement projects should be formulated for strengthening and revamping the distribution system, improving the MIS and addressing issues of governance.

Transmission and Distribution Losses

- The current level of T&D losses is very high. Although the all-India T&D loss is reported to be about 28 per cent, actual loss levels are estimated to be in the range of 35-45 per cent. Further, losses in some states are much higher than in others. Losses in Delhi and Jammu & Kashmir were as high as 47 per cent and 56 per cent respectively in 2000-01.
- While part of the T&D losses are due to technical deficiencies in the system and the extensive low voltage distribution network in rural areas, a large portion of the loss is attributed to theft and pilferage compounded by connivance on the part of line personnel.
- There are a large number of unmetered connections particularly in the agriculture sector. Even if supply of electricity to agriculture is to be subsidised, it should be metered so that proper accounting can be maintained.
- Indiscriminate grid extension despite low load densities (as measured by demand in MW divided by the length of the T&D system) has resulted in a high ratio of low tension (LT) to high tension (HT) lines. This has also led to a large amount of pilferage.
- There is a need to introduce energy audits to help generate reliable data for analyses in a systematic and meaningful manner.

Accelerated Generation and Supply Programme Scheme

8.2.41. The Accelerated Generation and Supply Programme (AG&SP) was launched in 1997-98

initially for one year and was later extended up to the end of Ninth Plan. The scheme covers the following activities:

1. R&M and life extension/rehabilitation.
2. Ongoing generation projects.
3. Missing transmission links and system improvement.
4. Grant for studies.

8.2.42. The Ministry of Power provides a grant from its budget to fund an interest subsidy of 4 per cent on normal lending rates of the PFC to SEBs/State Generation Corporations (SGCs). R&M schemes costing less than Rs. 100 crores are currently also being financed under APDP. It is proposed that in the Tenth Plan, all R&M schemes would be financed under AG&SP only and no financing would be made through APDP.

Programme for Central Assistance under APDP

8.2.43 Projects relating to the following areas are financed under the APDP, which was initiated in 2000-01 in order to give a fillip to power sector reforms:

- i) R&M/life extension/uprating of old power plants (thermal and hydel).
- ii) Upgradation of the sub-transmission and distribution network (below 33 KV or 66 KV) including energy accounting and metering.

8.2.44. One of the main strategies identified for distribution reforms is the development of distribution plans/projects for all distribution circles. Sixty-three such circles have been identified initially in which 11 KV feeders will be taken as profit centres. Improvement/strengthening of the sub-transmission and distribution network, 100 per cent metering, establishing of an MIS to improve billing, collection etc. will be taken up in the selected circles. It has been decided to utilise APDP funds to develop the selected circles as centres of excellence that can be replicated by the states in the later phase of distribution reforms.

8.2.45. Funds under APDP are released to state governments as additional Central Plan by the Ministry of Finance under advice from the Ministry of Power. The funding modality (a combination of grants and loans) is given in the Table – 8.2.7 :

Table – 8.2.7
Funding pattern under APDP schemes

S. No.	Category of states	% of projects/ scheme cost from APDP as		% of projects/ scheme Cost from PFC/ REC/Own/ Other Sources
		Grant	Loan	
1	Special category states	90	10	-
2	Non-special category states	25	25	50

8.2.46. An amount of Rs.1,000 crore and Rs.1,500 crore were provided under APDP during 2000-01 and 2001-02 respectively. An amount of Rs. 3,500 crore has been provided for the Annual Plan 2002-03, which is the first year of the Tenth Plan.

8.2.47. There is a need to restructure the concept of APDP from being merely an investment window to a mechanism for supporting power sector reforms in the states, linked to the fulfilment of certain performance criteria by way of benchmarks. This is necessary to reduce the burden of transition and to ensure that the reform is sustainable and irreversible. The existing APDP may be revised to provide enhanced investment to cover all the distribution circles during the Tenth Plan and also provide for transition finance based on the financial performance of SEBs/utilities. However, the funding and financing pattern for investment in distribution will be the same as APDP. Transition finance may be based on actual cash loss reductions effected by the SEBs/utilities, net of tariff increases given by the regulator, additional purchase of power and increase in fuel costs. In order to avail of transition assistance, states may have to conform to minimum eligibility conditions:

- The state should have set up a SERC.
- The SEB/utility should have filed its first tariff petition before the SERC.
- The SEB/utility should have achieved a minimum prescribed percentage reduction in cash losses compared to the previous year.

8.2.48. The modified APDP could be named as Accelerated Power Development and Reform Programme (APDRP).

Financial performance of the SEBs

8.2.49 The financial health of the SEBs has deteriorated over the years mainly due to higher level of technical and commercial losses and

Table –8.2.8.
Financial Performance of the State Power Sector

(Rs. Crore)

	1991-92	2000-01 (Prov.)	2001-02(AP)	2001-02 (RE)	2002-03 (AP)
A.					
(i) Subsidy involved on account of sale of electricity to					
(a) Agriculture	5,938.00	24,074.13	29,461	25,571.10	26,959.30
(b) Domestic	1,310.00	9,968.04	11,267	10,894.14	11,651.01
(c) Inter-state sales	201.00	385.51	510	247.36	225.89
Gross subsidy	7,449.00	34,427.68	41,238	36,712.59	38,836.20
(ii) Subventions received from state governments.	2,045.00	8,820.33	8,370	10,099.16	7,980.84
(iii) Net subsidy	5,404.00	25,607.35	32,868	26,613.43	30,855.36
(iv) Surplus generated by sale to other sectors	2,173.00	3,434.93	5,526	3,614.88	7,499.00
(v) Uncovered subsidy	3,231.00	22,172.42	27,342	22,998.56	23,356.37
B. @ Commercial losses	4,117.00	25,394.89	28,445	27,306.44	24,320.99
Commercial losses (net of state subvention)		16,574.56		17,207.28	16,340.15
C. Revenue Mobilisation					
(i) Rate of Return (ROR) #	-12.70	-41.82	-38.20	-39.48	-32.08
(ii) Additional revenue mobilisation from achieving					
(a) 3 per cent ROR	4,959.00	27,216.62	30,280	29,403.65	26,226.42
(b) From introducing 50 paise/ unit from agriculture/irrigation	2,176.00	1,637.83	1,840	1,350.44	1,329.71

RE : Revised Estimates, **AP** : Annual Plan Projections,

In percent

@ Commercial losses are different from uncovered subsidy because they include financial results of other activities undertaken by the SEBs.

Note:-

- (i) The information relating to the subsidy for agriculture, domestic and inter-state sales for 1999-2000, 2000-01 and 2001-02 in respect of Orissa is not available, as the distribution is now with private companies. The information regarding commercial losses pertains to GRIDCO only.
- (ii) Information in case of Andhra Pradesh, Haryana, Rajasthan, Uttar Pradesh and Karnataka relates to T&D companies set up after the reforms. In the case of other states, the information pertains to SEBs.
- (iii) The estimates do not include information relating to Uttaranchal as these have not been furnished by the state.

subsidised sale of electricity to agricultural and domestic consumers. Table 8.2.8 gives the financial performance of the state power sector. The net subsidy of Rs. 5,404 crore on agriculture and domestic sectors in 1991-92 was 46 per cent of Central Plan assistance flowing to states/Union Territories in that year. The same has increased substantially to Rs. 25,607 crore in 2000-01 and is likely to be 69 per cent of the funds flowing from Central Plan assistance. Further, the subsidy on account of the sale of electricity to the agricultural sector has come down from Rs. 29,461 crore in 2001-02 annual plan (AP) and is expected to come down to Rs. 26,959.30 crore for 2002-03 (AP). This may be partly due to the reform and restructuring process initiated by some of the states.

8.2.50. The March 2001 conference of Chief Ministers/Power Ministers noted that the large amount of dues owed by the SEBs to central public sector undertakings (CPSUs) was a major impediment to power sector reforms. The conference resolved that an expert group should be set up to recommend a one time settlement of the past dues of SEBs to CPSUs and dues of the SEBs from CPSUs. The outstanding dues payable by SEBs to CPSUs as on September, 2001 was Rs. 41,852.63 crore including interest liability of about Rs. 16,000 crore.

8.2.51 The recommendations of the expert group headed by Shri. Montek Singh Ahluwalia for securitisation of dues through the issue of tax-free bonds by the respective state governments have been accepted by the Government with certain modifications. Under the arrangement, 60 per cent of the surcharge would be waived while securitising the dues. But the SEBs would have to pay the current dues in future, failing which certain steps like graded reduction in the supply of power from central power stations and in coal supplies would be taken. The SEBs should accept reform-based performance milestones such as setting up of

SERCs, metering of distribution feeders and improvement in revenue realisation. The milestones should be specified in the MoU to be signed with the Ministry of Power.

Plan expenditure during the Ninth Plan

8.2.52. An analysis of the Plan expenditure on the basis of actuals for 1997-98, 1998-99 and 1999-2000 (for central/state and Union Territories) and the actual/RE (2000-01) for central/state and revised estimates for 2001-02 for the central and state sector reveal the following:

Central Sector

8.2.53. The actual expenditure on power by the Central sector during the first four years of the Ninth Plan (1997-2001) and approved provision for 2001-02 accounted only for 83.30 per cent of the approved Ninth Plan outlay at current prices. Similarly, at constant prices, it accounts for only 69.4 per cent of the Plan outlay. The estimated domestic budgetary support (gross budgetary support minus external aid) during the Ninth Plan was Rs.14,381 crore which works out to about 98 per cent (at current price) of the approved amount of Rs. 14,380 crore. At constant prices, it works out to Rs.11,662 crore, at 81 per cent of the approved provision. The major shortfall in the central sector was due to the non-mobilisation of resources through internal resources and bonds and because four gas-based extension projects of the NTPC were not taken up.

State Sector

8.2.54. The Plan expenditure for the state sector during the first three years of the Ninth Plan was 53.4 per cent of outlay at current prices. The major shortfalls were in the states of Assam, Bihar, Haryana, Meghalaya, Orissa and Uttar Pradesh. The areas most affected by the shortfalls were transmission and distribution.

SUCCESS STORIES OF THE POWER SECTOR

- The Plant Load Factor (PLF) of thermal stations improved from 63.0 per cent at the beginning of the Ninth Plan to 69.90 per cent at the end of the Plan period. The PLF of the nuclear power stations improved from 55.90 per cent to 79.4 per cent over the same period.
- Thirteen States have constituted and operationalised State Electricity Regulatory Commissions (SERC) while six others have notified the constitution of the SERCs.
- The SERCs of Orissa, Andhra Pradesh, Uttar Pradesh, Maharashtra, Gujarat, Karnataka, Rajasthan, Delhi, Madhya Pradesh, Himachal Pradesh and West Bengal have issued tariff orders.
- Seven States have unbundled/corporatised their SEBs into separate companies for generation, transmission and distribution. Of these, Orissa and Delhi have privatised distribution.
- A three-stage clearance procedure has been introduced for central sector hydro electric projects to minimise time and cost overruns.
- The Accelerated Generation and Supply Programme (AG&SP) initiated during Ninth Plan provided incentives in the form of interest subsidy to SEBs/states and central power utilities. This has helped in carrying out power development activities particularly in the state sector. The capacity addition in the state sector achieved was around 88 per cent of the target, in which the contribution of AG&SP was around 55 per cent. The scheme has also given boost to the renovation and modernisation (R&M) programme during the Ninth Plan period. The additional generation due to the incentives given through AG&SP is estimated to be about 10,000 MU/annum.
- The Accelerated Power Development Programme (APDP) scheme was initiated in 2000-01 with the objective of giving a fillip

to reforms in the distribution segment. The scheme is now proposed to be modified as the Accelerated Power Development and Reform Programme (APDRP), which is a critical investment for providing distribution reforms. Under the modified scheme, there would be an element of incentive linked to achievement of certain reform-based parameters besides provision for investment in the distribution sector.

- In order to liquidate the outstanding dues of CPSUs, a mechanism was evolved for one time settlement of these dues payable by states.
- In the programme of electrification of remote villages, there has been success in electrifying the Sagar Island situated in the Sundarban region of West Bengal through solar energy. About 1,400 families on this island are benefited from the community and individual solar photovoltaic systems. The community is totally involved in the operation and revenue collection in this programme.

APPROACH TO THE TENTH PLAN

Capacity Additions Required During the Tenth Plan

8.2.55. According to the Sixteenth Electric Power Survey (EPS), the electricity requirement at the busbar (utilities only) in 2006-07 will be as follows (Table-8.2.9):

Table No.- 8.2.9
Demand for power in 2006-07 as per Sixteenth EPS

Region	Energy Requirement (MKWh)	Peak Load (MW)
Northern	2,20,820	35,540
Western	2,24,927	35,223
Southern	1,94,102	31,017
Eastern	69,467	11,990
North-Eastern	9,501	1,875
Andaman & Nicobar Isl.	236	49
Lakshadweep	44	11
All India	7,19,097	1,15,705

Table - 8.2.10
Benefits from Sanctioned/CEA-Cleared and New Schemes During the Tenth Plan (MW)

Source	Ongoing/ sanctioned schemes	CEA- cleared schemes	New schemes	Total
Hydro	9,184	3,962	1,247	14,393
Thermal	8,175	5,231	12,011	25,417
Nuclear	1,300	-	-	1,300
Total	18,659	9,193	13,258	41,110

Table - 8.2.10 A
**Sector-wise *vis-a-vis* Mode-wise Capacity Addition
During the Tenth Plan (MW)**

Source	Central	State	Private	Total
Hydro	8,742	4,481	1,170	14,393
Thermal	12,790	6,676	5,951	25,417
Nuclear	1,300	-	-	1,300
Total	22,832	11,157	7,121	41,110

8.2.56. The Tenth Plan Working Group Report on Power has envisaged a capacity addition requirement of 46,939 MW during the Plan period, with 24,405 MW coming from the central sector, 12,033 MW from the state sector and 10,501 MW from the private sector.

8.2.57. However, keeping in view the status of the ongoing, sanctioned and new projects in the pipeline, the Planning Commission felt that a target capacity addition of 41,110 MW — 18,659 MW from ongoing projects, 9,193 MW from projects cleared by the CEA and 13,258 MW from new schemes — would be more realistic. Even under this lower estimate for capacity addition, only 27,852 MW appears to be firmed up so far. Vigorous and urgent steps have to be taken for the balance capacity addition programme. A summary on the feasible capacity addition of 41,110 MW is given in Table 8.2.10:

8.2.58. Out of the total addition of 41,110 MW envisaged for the Tenth Plan period, 22,832 MW (55.6 per cent) is accounted for by the central sector and 11,157 MW (27.1 per cent) is accounted for by the state sector. The balance of 7,121 MW (17.3 per cent) is expected to be

added by the private sector (Table 8.2.10 A). Thus, the public sector will continue to play a dominant role during the Tenth Plan while progress along the reform path helps clear the roadblock for greater private participation in the medium to long term.

8.2.59. A major portion of this incremental capacity can materialise only during the later years of the Tenth Plan. This implies the likelihood of power shortages increasing beyond current levels during the first three years of the Tenth Plan. To overcome this, at least partially, it is imperative that all-out efforts are made to take up R&M work at existing plants aggressively and operate the power system efficiently.

8.2.60. The capacity addition will be contingent upon fuel linkages being firmed up and early start of work on new projects. For the new projects, particularly in the central sector, it is essential to simplify and streamline procedures for input linkages/techno-economic clearance/investment clearance. Based on this, the cumulative generation capacity in the country by the end of 2006-07 will be as follows (Table 8.2.11):

Table-8.2.11
Generating Capacity Anticipated at the End of the Tenth Plan (in MW)

	Hydro	Thermal	Nuclear	Total
Installed Capacity as on 31.3.2002	26,261.22	74,428.82	2,720.00	1,03,410.04*
Addition During Tenth Plan	14,393.20	25,416.64	1300.00	41,109.84
Total Capacity on 31.3.2007	40,654.42	99,845.46	4,020.00	1,44,519.88

* excludes the capacity of 1,507.46 MW from wind

Power Supply Position

8.2.61 The energy and peaking shortages at the end of the Ninth Plan are 7.5 per cent and 12.6 per cent respectively. The Working Group on Power estimated that if capacity addition targets are met, the energy and peaking shortages would be 11.6 per cent and 9.5 per cent respectively by the end of the Tenth Plan. Lower capacity addition targets proposed above will raise these projected deficits unless there are significant improvements in management and plant operations.

Hydro Power Development

8.2.62. The share of hydel capacity in the total generating capacity of the country has declined from 34 per cent at the end of the Sixth Plan to 25 per cent at the end of the Ninth Plan. The share is likely to decline even further unless suitable corrective measures are initiated immediately. Hydel power projects, with storage facilities provide peak time support to the power system. Inadequate hydel support in some regions is adversely affecting the performance of the thermal power plants. In the western and eastern regions, peaking power is being provided by thermal plants. This is a costly and inefficient use of thermal capacity. It is proposed to add 14,393 MW capacity from hydro in the total capacity addition of 41,110 MW during the Tenth Plan period.

8.2.63. Geological uncertainty, contract management, resettlement & rehabilitation, delay in land acquisition and infrastructure development have been the main reasons for time and cost overruns in hydro projects. In order to avoid delays in project implementation, the following steps need

to be taken before the zero date of the project implementation.

1. Bankable detailed project report (DPR), based on a detailed survey, should be prepared to avoid geological uncertainty.
2. Contract monitoring, as distinct from project monitoring, should be emphasised.
3. Land acquisition and infrastructure development should be settled and completed before the start of the project.

8.2.64. Further, the following steps need to be taken in order to accelerate the pace of hydro development:

- Although the preliminary ranking study of the remaining hydro potential sites of all the basins in the country has been completed by the CEA, detailed ranking study and preparation of detailed feasibility report based on economic viability needs to be done.
- Adopt a national rehabilitation policy (supported by appropriate legislative changes and the apex court directives) and implement the policy uniformly.
- Streamline clearances for pursuing priority projects.
- Simplify approval procedures.
- Facilitate the early financial closure of projects through a concerted approach

(comprising centre, states, Indian financial institutions, private sector promoters) towards multilateral agencies and other international funding sources.

Nuclear Power

8.2.65. Atomic energy is an important source of electric power which has environmental advantages and is also likely to be economical in the longer run. At present, nuclear energy accounts for only 2.4 per cent of total primary energy consumption, against the global average of 13 per cent. This is far too low.

8.2.66. Nuclear power plants have shown progressive improvement in generating performance. The PLF of NPCIL stations has increased from 60 per cent in 1995-96 to 82 per cent in 2000-01. During the Ninth Plan, NPCIL completed the refurbishment and upgradation of Rajasthan Atomic Power Station (RAPS)-2 (200MWe), and commissioned Kaiga 1 & 2 (2x220MWe) and RAPS 3 and 4 (2x220 MWe). It is proposed to add 1,300 MWe of new capacity during the Tenth Plan period and 5,915 MWe during the Eleventh Plan so as to achieve about 10,000 MWe by 2011-12. The NPCIL has demonstrated the capability of setting up and operating nuclear energy power plants with high levels of technical efficiency and safety. It is desirable to plan for a significant expansion in nuclear power generation capacity. An expanded programme would also make it possible to reduce the costs of construction.

8.2.67. In the context of moderate uranium and vast thorium resources in India, a three-stage nuclear power programme is envisaged. This programme consists of setting up of Pressurised Heavy Water Reactors (PHWRs) in the first stage, Fast Breeder Reactors (FBRs) in the second stage and reactors based on the Uranium 233-Thorium 232 cycle in the third stage. It is also envisaged that in the first stage of the programme, capacity addition will be supplemented by electricity generation through Light Water Reactors (LWRs) initially through imports of technology with the long-term objective of indigenisation. PHWR technology was selected for the first stage, as these reactors

are efficient users of natural uranium for yielding plutonium fuel required for the second stage FBR programme. The FBRs will be fuelled by plutonium and will also recycle uranium for breeding more plutonium fuel for electricity generation. Thorium as blanket material in FBRs will produce Uranium 233 to start the third stage. An Advanced Heavy Water Reactor (AHWRs) is being developed by the Bhabha Atomic Research Centre (BARC), Mumbai, for demonstration of technology to utilise thorium for electricity generation. AHWR will be a forerunner of reactors to be set up under the third stage of the nuclear power programme.

8.2.68. The first stage programme of PHWR has progressed well and the technology has reached a state of maturity. A beginning has been made in the introduction of LWRs with the inter-governmental agreement between India and the Russian Federation for co-operation in setting up of 2x1,000 MWe LWRs at Kudankulam, Tamil Nadu. A 40 MWe Fast Breeder Test Reactor (FBTR) has been set up at Kalpakkam to gain experience in the technology. This has been followed by progress in the development of technology for the first Prototype Fast Breeder Reactor (PFBR) of 500 MWe capacity, which has reached an advanced stage. Pre-project activities for commencing construction of the PFBR are in progress as is research and development on the utilisation of thorium.

8.2.69. Aggressive nuclear power development is essential in the context of energy security, environmental advantages and changing perceptions about nuclear power in developed countries such as the United States and the United Kingdom. Improvements in nuclear technology are likely to make nuclear power more economical and total life cycle costs more competitive in comparison to other fuels. Therefore, India needs to:

- Aggressively build capabilities and capacity in nuclear power to progressively raise its share in India's fuel mix.
- Actively promote research and development on FBRs and thorium-based technologies.

- The reactor/dome in nuclear power plant facilities is highly technical and sensitive. This should be implemented by NPCIL/ Department of Atomic Energy. Other components of nuclear power plant area like turbo generator (TG) facilities etc. should be permitted for private sector participation. The Department of Atomic Energy should decide on the components of the nuclear power plant which could be entrusted to the private sector.
- Encourage innovative financing mechanisms (infrastructure debt from financial institutions/banks, supplier credit/ equity, long term bonds, private sector equity in non-nuclear island).
- Measure NPCIL's investment and operational performance against international benchmarks.

Private Sector

8.2.70. The initial response of domestic and foreign investors to the policy of private participation in the power sector had been encouraging. However, many projects have encountered unforeseen delays in the finalisation of power purchase agreements, guarantees and counter-guarantees, environmental clearances, matching transmission networks and legally enforceable contracts for fuel supplies. One of the most important impediments to private participation was the bankruptcy of the monopoly purchaser – the SEBs. That necessitated complex payment security mechanisms for achieving financial closure. Further, the high tariff of power from some of the commissioned independent power projects (IPPs) due to factors such as high cost of liquid fuels, risk factors involved and unrealistic forecast for future growth of demand etc. have prevented full utilisation of available capacities. With the power sector reforms already set in motion, these problems are expected to be sorted out in due course.

8.2.71. The status of private power projects as on 1 February 2002 is as follows:-

DESCRIPTION	NUMBER	CAPACITY (MW)
Projects techno-economically cleared by CEA	58	29,614.50
Private power projects fully commissioned	15	4,427
Private power projects under Construction	7	3,432

8.2.72. In addition, 18 private projects not requiring techno-economic clearance of the CEA, with a total capacity of about 2,340 MW, have been commissioned and two projects with total capacity of 36 MW are under construction.

Private Sector participation

The policy of inducting private investment into the power sector, initiated in 1991, was expected to result in the addition of 17,588 MW of power capacity in the Ninth Plan. The actual achievement was 5,061 MW, a mere 29 per cent of the target. The achievement ratio for the central and state sectors comparatively were higher at 38 per cent and 88 per cent respectively. The main impediments have been:

The chronic financial weakness of SEBs.

Unviable tariffs to IPPs, due to factors such as high cost of liquid fuels, risk factors involved and slow growth in demand for future power below the expected levels etc.

The absence of an enabling regulatory, legislative and market environment.

The slow pace of reform in the power sector and related sectors such as coal, transport.

The inability to deliver bankable contractual frameworks.

The lack of recognition of the fact that the distribution segment would need to be made efficient and bankable before private investment and competition emerges in generation.

Formation of National Grid

8.2.73. The National Powergrid will comprise a transmission system associated with the central generating projects and inter-regional lines. It is expected that the first phase of the National Powergrid will be completed with a 500 MW High Voltage Direct Current (HVDC) Transmission System back-to-back at Sasaram in Bihar coming up by December 2002 connecting the eastern and northern region. This will enhance the cumulative inter-regional power transfer capacity to a level of about 4,850 MW.

8.2.74. It is proposed that in the subsequent phase, a strong synchronous National Powergrid would be established, including schemes to evacuate the power from major generating resources, covering hydro projects in the north-eastern region and large-sized thermal power plants in Bihar, Orissa and Madhya Pradesh. The transmission scheme for the ultimate National Powergrid would involve the development of a high capacity transmission corridor in the Chicken Neck area in the northeast and the establishment of a ring of 765 KV lines interconnecting the eastern, western and northern regions. With the completion of these links, the cumulative inter-regional power transfer capacity would increase to a level of about 30,000 MW by 2012.

Captive Power Generation

8.2.75. The industrial sector is the largest consumer of electricity. Besides purchasing power from the utilities, a number of industries, viz. aluminium, cement, fertiliser, iron, steel, paper, sugar etc. have their own captive power plants either to supplement the electricity supply from the utilities or for generating electricity as a by-product through co-generation. Captive power plants are being set up by industries to meet their own power requirements to enable them to tide over problems due to power shortages and poor quality of supply. The Electricity Bill, 2001 proposes to free captive generation and enable captive generators to sell directly to other consumers by wheeling power through the grid under an open access regime. However, the Tenth Plan capacity addition has been finalised based on the demand as per the Sixteenth

Electric Power Survey that excludes the demand met by captive power plants.

8.2.76. In accordance with the guidelines issued by the Ministry of Power, the following categories would be eligible to install captive power plants:

- (a) A consumer of electricity.
- (b) A group comprising more than one consumer as a joint venture.
- (c) An actual user of power but not a consumer.
- (d) A group of actual users of power, but not consumers, as a joint venture.
- (e) A group comprising both consumers and actual users of power as a joint venture but excluding 'Generating Company' as defined under Section 2(4A) of the Electricity (Supply) Act, 1948.
- (f) If the captive plant falls under the category of hydro or co-generation plant, such plant may be permitted, irrespective of its size and the power supply position in the state.
- (g) If the captive power plant is based on coal or liquid fuel or gas and if the state is deficit in power supply, the installation of the plant could normally be allowed and the plant can be permitted to have a capacity up to 200 per cent of the requirement of the host industry.
- (h) If the captive power plant is based on coal, liquid fuel or gas and the state is surplus in power, the installation of such captive plants can still be considered in cases where the state/SEB cannot guarantee uninterrupted supply or stipulated quality of supply (within prescribed voltage and frequency variations) required by the industry or a particular process. Further, captive generation may also be permitted if it is found, after a review of costs and tariffs, to be more economical than grid supply.

- (i) Banking facilities may also be provided to the captive plants so that available capacities are utilised to the extent possible and when required. The rates for banking may be determined on mutually agreed terms.
- (j) Units in Special Economic Zones (SEZ) and industrial estates may be allowed to set up captive power plants liberally.

Rural Electrification

8.2.77. The rural electrification programme is one of the important components in rural development and as important as rural drinking water supply, health, nutrition, primary education, shelter and rural connectivity. The availability of power in rural areas will lead to economic development and its attendant spin-off benefits like food security, better health, literacy, etc. With this in view, the Government has been focussing on village electrification since the beginning of the planning process. While this has resulted in the electrification of around 86 per cent of the country's villages, the use of electricity in villages for productive and subsistence needs is still very limited. About 70 per cent of the rural households are yet to get electric connections and power-based economic activities in the electrified villages are minimal. The actual benefits of the investments made in the rural electrification programme can only be realised if the people are in a position to use electricity for their day-to-day activities as well as for industrial and commercial activity. Therefore, the second phase of the rural electrification programme, apart from seeking 100 per cent electrification, must also ensure more widespread use of electricity by the rural people in a time-bound manner.

8.2.78. The existing definition of an electrified village has been found to be inadequate as it does not meet the requirements of the rural people. The existing definition states that 'A village will be deemed to be electrified if electricity is used in the inhabited locality within the revenue boundary of the village for any purpose whatsoever.' There is need to change this definition so as to declare a village as electrified only if a minimum number of households in that village are provided with

electricity connections. According to the 1991 Census, there are 5,87,000 villages of which 5,00,000 (86 per cent) are declared to be electrified on the basis of the existing definition. Further, available data shows that only 31 per cent of the rural households are electrified. Finally, against the total estimated potential of 19.5 million electric pumpsets for irrigation, only 12 million pumpsets have been energised. The expansion of the programme of energising pumpsets needs to take into account issues like energy efficiency, water conservation, watershed management, rain water harvesting and other matters related to the optimum use of ground water and the danger of over exploiting this scarce resource.

8.2.79. Around 80,000 villages in the country are yet to be electrified even on the basis of the current definition of village electrification. Thirteen states have declared 100 per cent electrification of their villages. The villages yet to be electrified are mostly in Assam, Arunachal Pradesh, Bihar, Jharkhand, Madhya Pradesh, Meghalaya, Orissa, Rajasthan, Uttar Pradesh, Uttaranchal and West Bengal. Of these 80,000 villages, it may be feasible to electrify only around 62,000 through the conventional grid expansion. The balance 18,000 villages are located in remote areas, hilly terrains, islands, deserts etc. and are also thinly populated. Such villages can be electrified more economically through decentralised and non-conventional energy sources like solar, wind, small hydro and biomass.

8.2.80. The strategy and time-frame for rural electrification will be as follows:

- The Tenth Plan proposes to cover all 62,000 villages that can be electrified through grid extension. The balance 18,000 remote villages are to be electrified by 2011-12 through the use of non-conventional technologies. A survey to identify these villages is required.
- In order to facilitate the flow of funds, the Rural Electrification Programme was included as a component of the PMGY in 2001-02. Special category states are eligible to receive 90 per cent of the funds as grant and 10 per cent as loan. For other

states, the funds will be made available in a grant-loan ratio of 30:70.

- In addition, the funds available under Minimum Need Programme for Rural Electrification will be pooled to meet the objective of 100 per cent electrification.
- The funds available under Member of Parliament Local Area Development Scheme (MPLADS) and Jawahar Gram Siddhi Yojana (JGSY) should also be utilised for supplementing the funding of village electrification.
- Involvement of MPs through district-level committees in the selection and monitoring of village electrification may be made mandatory. The states would also be well advised to try and persuade MPs to provide funds under the MPLAD for extending village electrification. They could consider evolving arrangements where the provision of, say, 25 to 50 per cent of the cost of electrification of an area could ensure automatic provision of the remaining funds under PMGY.
- SEBs may receive an interest subsidy on debt raised for rural electrification through the proposed Accelerated Rural Electrification Programme. Interest subsidy would be provided for the loans to be taken by the state governments for the electrification of unelectrified villages including dalit bastis. Rural electrification could be done through conventional as well as non-conventional sources of energy.
- A suitable mechanism to disburse funds directly from the central government to states may be followed for which the states will be required to maintain a separate account so as to ensure that the funds are not diverted for purposes other than rural electrification.
- Given the positive impact of this programme on poverty alleviation it is a legitimate claimant for soft International Development Agency (IDA) funding. This should be pursued through the Department of Economic Affairs which may indicate to the World Bank the high priority that the Government gives to this programme.
- Village electrification would also include the electrification of dalit/tribal bastis, wherever applicable.
- The Kutir Jyoti programme to extend single point light connections to rural households below the poverty line (BPL) will be revamped so that 100 per cent coverage of such households will be achieved by 2012. The norms of expenditure for rural BPL households has already been enhanced from the present Rs. 1,000 to Rs. 1,800 per household in special category states and Rs. 1,500 in other states.
- The Rural Electrification Corporation (REC) will continue to carry out system improvement and load intensification activities in electrified villages. It will finance these activities through the Rural Infrastructure Development Fund (RIDF) and issue of bonds under Section 54 EC of Income Tax Act that provides tax exemption on capital gains.
- The proposals of the states for rural electrification will be scrutinised and appraised by the REC and the present arrangement of monitoring by the REC and the CEA will be continued with the Ministry of Power acting as the central nodal ministry.
- The participation of decentralised power producers will be encouraged specially for electrification of remote villages. Village-level organisations like PRIs, rural cooperatives and NGOs will play a crucial role in the rural electrification programme. Community participation is essential for the success of the programme. The concept of barefoot solar engineers may be adopted.

- States which are to electrify the left-out villages are required to finalise a year-wise action plan for completing the electrification of all villages to be connected through grid during the Tenth Plan. Local elected representatives should be involved by the implementing agencies both at the planning and implementation stage, which would ensure proper monitoring of the programme.
- Electrification of remote villages will be done through the Ministry of Non-Conventional Energy Sources in association with the Indian Renewable Energy Development Agency (IREDA), the financial institution under the Ministry.
- The Electricity Bill, 2001 contains an enabling provision in regard to decentralised generation so that cooperatives/PRIs and NGOs can also bid for and supply electricity to dispersed communities.

Environmental Management / Sustainable Power Development

8.2.81. The utilisation rate of fly ash in India is of the order of 2 per cent as compared to 80 per cent in Germany followed by 20 per cent in the Netherlands. The poor rate of utilisation is attributed to the non-availability of proper machinery, ignorance regarding the potential of the use of fly ash in various applications and lack of clear policies to promote fly ash utilisation, among other things. The following steps are necessary to promote the use of fly ash:

1. Private entrepreneurs should be encouraged to set up facilities to utilise fly ash in building materials such as bricks, cement etc. To this end, state governments may exempt the end products of ash from sales tax, on the lines of the excise duty exemption given by the central government to products having a minimum 25 per cent ash content.

2. Financial institutions may extend loans on a priority basis for the manufacture of ash-based industrial products.
3. In order to promote manufacture of fly-ash based Portland Pozzland Cement (FAPPC) government departments like the CPWD, DDA and power utilities should be advised to use FAPPC for a majority of applications.
4. All new thermal power stations should be advised to earmark land in the planning stage itself for ash-based industries.
5. Stowing of underground mines using fly ash in place of river sand is to be considered in all coal projects.

8.2.82. Concerns relating to pollution and the disposal of the large amount of ash from coal-based power stations, which are the mainstay of India's power generation, are being addressed through strategies to promote environmentally sustainable power development. In order to undertake fruitful channelising of investment for afforestation works, the project authority should actively involve the state government and set up a specific cell with a forest officer on deputation, if need be, to monitor the implementation of afforestation work.

Energy Efficiency/Conservation

8.2.83. Energy efficiency and energy conservation involve all the sectors of the economy. Although energy efficiency and energy conservation have been discussed for nearly ten years now, the efforts on the ground have been fragmented and half-hearted. There has also been a lack of adequate focus on the institutional arrangements which will devise suitable incentives and disincentives appropriate to each sector, backed by adequate statutory power of enforcement.

8.2.84. During the Ninth Plan, it was realised that it is necessary to have an Energy Conservation Act. Accordingly, the Government has enacted the Energy Conservation Act, 2001 to meet the legal requirement needed to enforce energy efficiency and conservation measures. The Act provides for:

- The establishment of the Bureau of Energy Efficiency (BEE) in place of the existing Energy Management Centre (EMC).
- Declaring a user or class of users of energy as a designated consumer.
- Laying down minimum energy consumption standards and labelling for identified appliances/equipments and norms for industrial processes for energy-intensive industries.
- Formulation of energy consumption codes.
- Establishment of an Energy Conservation Fund both at the central and state levels.
- Penalties and adjudication. No penalties would be effective during the first five years as the focus during this period would be on promotional activities and creating the infrastructure for implementing the Act.
- The BEE would facilitate the evolution of a self-regulatory system and organisations that will regulate on their own because saving energy also makes good commercial sense.

8.2.85. The central government has established the BEE with effect from 1 March 2002. Further, the provisions of Section 1 to 29 and Sections 46 to 62 of the Energy Conservation Act relating to this have come into force from the same date.

Demand Side Management

8.2.86. In India, demand side management measures have a key role in eliminating power shortages to a considerable extent. Demand side management would ultimately result in saving of electricity, in keeping with the concept of energy conservation. It also has an important role in the context of safeguarding the electrical power industry. The demand for electricity fluctuates within a 24-hour cycle as well as between seasons. This has an important implication for planning generating

capacities. In a developing country like India, where per capita availability of energy is very low, need-based demand for energy can be unlimited. But the supply side is limited by the lack of investible resources and the demand side is constrained by lack of purchasing power. In such a situation, it is clear that the capacity to provide additional energy is always likely to lag behind rising demand, unless the consumption of energy is also restrained. The new approach to mitigating power shortages is based on demand side management.

8.2.87. One of the basic reasons for energy inefficiency in India is energy pricing. Electricity rates, kept deliberately low for a large block of consumers, do not send correct price signals to consumers to alter consumption behaviour. There

Demand Side Management

The peaking problem can be reduced, if not eliminated, by adopting demand side management techniques to flatten the load curve i.e to reduce the peak load and shift demand to off-peak hours in the following way:

- Introduce differential pricing according to time of day, thus giving incentives to users to shift their demand to the off-peak period. This requires introduction of electronic time of day (T.O.D) metering.
- Institute a two-part tariff for all categories of consumers in which the consumers have to pay an amount that depends on the maximum demand for power, plus a charge for each unit of energy consumed.
- Segregate irrigation feeders so as to allow power to the agricultural load at off-peak hours.
- Staggering of office timings.
- Create incentives and commercial arrangements for the transfer of power between regions to take advantage of different peak times. Introduction of more than one time zone in the country would help this process. The development of the National Powergrid needs to be expedited to facilitate greater inter-regional transfer of power.

is, therefore, an urgent need to look into the issue of economic pricing that delivers the desired behaviour. Innovative pricing options which have proved successful in managing electricity demand in several developed and developing countries, such as time-of-day tariffs, interruptible tariffs and seasonal tariffs, should be taken up by the utilities.

8.2.88. The target for energy savings during the

Table – 8.2.12
Tenth Plan Energy Savings Potential

End-use type	Potential Energy Savings(MkWh)
Motors and drive systems (Industry and agriculture sector)	80,000
Lighting (domestic, commercial and industrial sector)	10,000
Energy intensive industries	5,000
TOTAL	95,000

Tenth Plan is given in Table 8.2.12:

8.2.89. The Tenth Plan programme on energy conservation would address issues like pricing of electricity for different categories of consumers, generating awareness on the necessity of energy conservation and the need for an institutional arrangement to coordinate the different programmes of energy conservation. It will also deal with mobilising resources for funding the energy conservation programmes.

Resettlement and Rehabilitation (R & R)

8.2.90. The setting up of large hydel and thermal plants often necessitates clearing of large tracts of land, affecting the lives of people, flora and fauna. Since displacement of people becomes unavoidable, the Government has already evolved certain compensation measures that need to be implemented rigorously. These include: (a) providing early financial compensation and settlement; (b) resettlement of people including construction of dwellings in new areas; (c) providing subsidy for farming in the new areas; (d) starting special training programmes in poultry, breeding, handicrafts and cottage industries; (e) providing employment opportunities in the project; and (f) provision of

education, medical and drinking water facilities.

Manpower Development

8.2.91. The additional manpower requirement for the power sector in the Tenth Plan has been projected to be to the tune of 1,25,000. The total manpower in the power sector is expected to reach around one million by the end of Tenth Plan. Different indices have been considered for thermal, hydro and nuclear capacity and power system to arrive at the above estimate.

8.2.92. The overall training load expected during the Tenth Plan is 4.37 lakh man-months per year against the available training infrastructure of only 74,000 man-months per year.

8.2.93. The major observations and recommendations of the Working Group on Manpower Development in 2001 are:

- The success of the process of power sector reforms requires human resource development (HRD) intervention to ensure its success. It is proposed that everybody be provided training of minimum one week per year. The level of training may be refresher/advanced/managerial, depending on the actual need. Induction-level training should also be made compulsory for T&D personnel. The duration of the training could be three months for executives and one month for non-executives. Training must also be arranged for each individual on promotion/transfer to assignments that call for performing new/different roles and working conditions.
- Backward integration of the power training programmes of National Power Training Institute (NPTI) with All India Council of Technical Education (AICTE) approved degree/diploma courses providing relevant education should be gainfully utilised by the power sector. A full-fledged Hydro Power Training Institute, with necessary training tools including a simulator, needs to be established. Networking with the

training/academic institutions like NPTI, Indian Institutes of Management (IIMs), Administrative Staff College of India (ASCI) and other reputed institutions for providing training to power sector personnel and other stakeholders is recommended.

- Central assistance should be provided for augmenting training facilities, procurement of simulators and diversification of existing recognised training institutes. At least 5 per cent of a power sector organisation's salary budget should be spent on training personnel.

Research and Development

8.2.94. Since the power sector is highly technology-intensive, technological upgradation and modernisation assume an important role, especially in realising economy in generation, T&D and efficient utilisation of electrical energy.

8.2.95. The research and development programmes must necessarily provide inputs to future power programmes relating to both generation as well as T&D. Full advantage should be taken of the large base of existing research and development capabilities. Emphasis must be laid on solving field problems adversely affecting the production of power, creating bottlenecks in the operation of the power system and affecting the quality of power supplied.

8.2.96. Various areas of research and technology development in the field of hydro, thermal, nuclear and power system have been identified where R&D activities could be focused on achieving improved performance of existing facilities, optimum utilisation of resources and to keep pace with the state-of-art technologies suiting our environment and prevailing conditions. Thrust areas identified are:

- a) Development of Integrated Gasification Combined Cycle (IGCC) as a demonstration project to prove the technology based on Indian coal.
- b) Coal beneficiation and use of alternate fuel

for power generation.

- c) Improvement in power station performance relating to availability, reliability, efficiency and safety.
- d) Studies on T&D networks relating to grid operation and control, geographical information system (GIS) and T&D losses.
- e) Hydro power generation related proposals covering silt erosion, and performances improvement.
- f) Renovation and modernisation.

8.2.97. The Working Group on Power has identified 71 projects - 23 in the thermal sector, 39 in the power system field and nine in the hydro sector – to promote research and development activities. It is suggested that 1 per cent of the power sector outlay may be included in the Plan for R&D.

8.2.98 The following action points have been identified for research and development in the power sector:

- a) Creation of a Research and Technology Demonstration Fund for demonstration projects with the major portion as grant and the balance as long-term interest-free loan for research and demonstration of new technologies.
- b) Making technology transfer mandatory in the case of foreign direct investment. The Government may consider liberalising the import of technology at par with the import of materials and capital goods.
- c) Encouraging the commercialisation of indigenous technology leading to their full-scale development.
- d) Enhancing bilateral / multilateral cooperation with developed countries for state-of-the-art technological transfer and exchange of technical experts.
- e) Enabling the CEA to oversee the progress and status of research and development facilities in the country.
- f) Networking and mapping the research and development resources, including intellectual capital.

Power Sector in Total Plan Outlay
Table - 8.2.13
Share of Power Sector Outlay in Total Plan Outlay (per cent)

Plan Period	Power sector share in total outlay of central and state governments	Share of state power sector outlay in total sector outlay of states	Central power sector outlay in total power sector outlay	Share of central power sector in total central sector outlay
1991-92	18.33	26.09	38.70	13.70
1992-93	18.50	27.19	38.12	10.88
1993-94	17.15	26.24	43.83	11.52
1994-95	16.45	23.77	41.40	11.43
1995-96	15.26	23.48	39.28	10.21
1996-97	13.38	19.14	35.99	9.03
Eighth Plan Actual	15.80	23.90	39.20	12.60
Ninth Plan(Approved)	14.49	19.26	42.80	10.80
1997-98	13.36	19.30	35.30	9.70
1998-99	13.85	18.50	38.10	9.70
1999-2000	13.95	17.57	42.90	12.10
2000-2001	13.09	17.81	43.72	9.90

8.2.99. Table 8.2.13 shows that while the power sector outlay as a proportion of the total outlay by the central and state governments has been declining, the central power sector outlay as a proportion of total power sector outlay has remained in the range of 38-43 per cent in the 1991-2001 period. The share of the state sector has shown a declining trend, coming down from 27 per cent in 1991-92 to 17 per cent in 2000-01. This has been mainly on account of the drive to enhance private sector investment in the power sector since 1991-92. The states have practically stopped investing in new generation projects. The share of the central power sector in the total central sector outlay has also declined from 13 per cent to 10 per cent during the same period. Keeping in view the low level of investment by the private sector, it would be desirable, in the short term, to step up public sector investment even as efforts continue to put the SEBs back on the rails in order to attract private sector investment. The schemewise break-up for the Tenth Plan outlay in respect of Ministry of Power & Deptt. of Atomic Energy (Power) is given in the Appendix.

THE PATH AHEAD

8.2.100. The roadmap for the Tenth Plan will have

the following reform objectives:-

- Rationalising power tariffs and making the tariff setting process transparent.
- Reflecting cost of service in the tariffs and transferring all subsidies explicitly to state budgets.
- Improving efficiency in all the three segments viz. generation, transmission and distribution, either by creating separate profit centres with full accountability within the vertically integrated structure, or unbundling SEBs into generation, transmission and distribution entities or through other models of reform depending on the choice of the state government.
- Encouraging competition and private participation in each element of the electricity value chain.
- Instituting open access by separating the carriage (transmission & distribution network) from the content (power and energy) thereby enabling customers to source their requirements from the most

- efficient source.
- Strengthening the T&D system to reduce losses, improve metering, instituting energy audits and improving billing & collection.
- Redesigning APDP as APDRP with provision for release of funds linked to the achievement of certain parameters and benchmarks.
- Integrating captive generation (especially co-generation) into the power system.
- Stepping up public funding for the sector even as steps are taken to attract private investment.
- Encouraging NTPC to take up projects through joint ventures with private

promoters and the state governments.

RENEWABLE SOURCES OF ENERGY

8.2.101. The development model followed so far, with an excessive reliance on fossil fuel resources like coal, oil and natural gas to meet the energy requirement of the country, is not only unsustainable in the long-run, but also has an adverse impact on the environment and ecology. The increase in land, water and air pollution levels during the energy conversion process in this model has become an area of serious concern. The depleting nature of these fossil fuel resources compels the search for other alternatives. It is in this backdrop that non-conventional or renewable sources of energy have attracted global attention as a viable option to achieve the goal of sustainable development. While it may not be possible, at this stage, to substitute conventional energy sources with renewable energy sources, the latter would help in supplementing energy supply efforts.

Table 8.2.14
Renewable Energy Potential and Achievements

Source/System Achievements	Potential	Approximate (as on 31.12.2002)
Biogas plants (No.)	120 lakh	32.62 lakh
CBP/IBP/NBP plants (No.)	-	3,520
Improved chulha (No.)	1,200 lakh	343 lakh
Biomass		
a. Biomass power	19,500 MW *	358 MW
b. Biomass gasifier		42 MW
Solar Photovoltaic		
	20 MW/sq.km.	
a. Solar street lighting systems (Nos.)	-	41,403
b. Home lighting systems (Nos.)	-	1,76,962
c. Solar lanterns (Nos.)	-	3,83,929
d. SPV power plants	-	1,172 kWp
Solar water heating system collector area	30 million sq.m.	0.59 million sq.km
Solar cookers (Nos.)	-	5,15,000
Wind power	45,000 MW	1,507 MW
Small hydro power (upto 25 MW)	15,000 MW	1,406 MW
Urban and municipal wastes	1,700 MW	17 MW
Battery Operated Vehicles (Nos.)	-	247

CBP=Community Biogas Plant, IBP=Institutional Biogas Plant,
NBP=Nightsoil Linked Biogas Plant, SPV=Solar Photo-Voltaic, kWp=kilo Watt Peak

* Including Biomass gasifier

8.2.102. The different renewable sources of energy include hydel power, wind power, solar power, biomass power and ocean energy etc. In addition, there is a significant potential to recycle the industrial, urban and agriculture waste to extract the energy content for useful application. This method leads to environment-friendly waste disposal and also helps to recover the energy contained in these wastes to supplement different energy supply options. Since the transport sector consumes huge quantities of hydro-carbons, alternate environment-friendly fuels such as electricity (stored in batteries), compressed natural gas (CNG) and fuel cells can be used.

8.2.103. The estimated potential of different non-conventional energy sources and the achievements up to 31 December 2001 are given in Table 8.2.14:

8.2.104. The economics and other constraints faced in development of the renewable energy programmes are:

Hydel Power

8.2.105. India is endowed with a vast and viable hydro potential for power generation of which only 17 per cent has been harnessed so far. The share of hydro power or hydro-electricity (hydel) in the country has been steadily declining from over 50 per cent in 1963 to 25 per cent in 2001-02. Based on a systematic survey carried out during the Seventh Plan, the hydro-electric potential in the country is estimated at 600 Bkwh per year as against 472.15 Bkwh per year assessed earlier. Out of the total potential available, about 30 per cent has either been developed or is being developed. Greater emphasis on hydro-electricity is important, particularly to meet the peak loads. Hydro-electricity is also a clean and renewable source of energy. The long gestation of the hydro projects due to delays in forest and environment clearances, rehabilitation of the project-affected people, inter-state disputes, construction delays in civil works etc. come in the way of accelerating hydro projects. Large hydro projects involving significant pondage have serious environmental impacts of their own that need to be evaluated and mitigated. Small hydro projects, therefore, assume importance since

they do not require large pondage and have the potential to provide energy in remote and hilly areas where extension of grid systems is either not possible or is uneconomical. Small hydro projects, especially run-of-the-river projects are economically viable, environmentally benign and have relatively short gestation periods. Hydro projects with up to 25 MW station capacity are classified as small hydro projects and are being implemented by the Ministry of Non-Conventional Energy Sources.

Wind Power

8.2.106 The harnessing of wind power for electricity generation in recent years has been quite impressive. The country has achieved an installed capacity of 1,507 MW for electricity generation through wind power. The estimated potential in the country has been revised upwards to 45,000 MW from the 20,000 MW estimated earlier in view of the technological advances and the availability of more modern equipment. Works are in progress to assess the wind resource potential at different locations and India is fifth in the world after Germany, the United States, Denmark and Spain in terms of wind power. The participation of the private sector in this area is highly encouraging. The economic viability of wind power projects depends a great deal on the capacity factor and, therefore, very careful site selection is called for. The unit size of wind turbine generators is also being enlarged. The unit size of machines has gone up from 55-100 KW in the first few projects to 750-1000 KW in recent projects. The productivity of the larger machines is higher than that of the smaller machines. The present capital cost of wind power projects ranges between about Rs. 4 crore to Rs. 5 crore per MW including local civil, electrical works and erection. This takes into consideration various central/state fiscal incentives available for wind power projects, which help to offset the low capacity utilisation. The life of a wind power project is estimated at about 20 years. Levelised costs over the life of the project compare quite favourably with those for new thermal power projects located away from coal mining areas, as there is no recurring cost on fuel. If environment and social benefits offered by the wind power projects are also considered, these projects would favourably compare with

conventional power projects.

Solar Power

8.2.107 There is abundant potential of solar radiation available during most part of the year for a tropical country like India. It has been estimated that a potential of 20 MW/sq.km is available through the Solar Photo-Voltaic (SPV) route and another 35 MW/sq.km through the Solar Thermal route. There are ongoing programmes to tap this potential both for stand-alone applications and for grid connected power systems. The stand-alone applications include the installation of solar-powered street lights, domestic lights, portable solar lanterns, solar-powered water pumps and solar power packs all based on the principle of conversion of solar energy directly into electricity through SPV cells. The cost of crystalline photo-voltaic (PV) modules at the international level is in the range of \$ 3-4 per watt. Despite extensive efforts, the cost of these cells and modules has not come down to commercially viable levels of below \$ 1 per watt. Other types of solar cells using amorphous silicon technology were developed with a view to bringing down the cost. However, the performance of amorphous silicon-based solar cells suffers over time. Elemental silicon continues to be the best material for PV and cost cutting is only possible with newer concepts and thin film materials. With the large scale production, the thin film PV technology could produce per watt cells at 5 per cent at 10 per cent efficiency. The future of PV technology for application as a decentralised energy source mainly depends upon the cost reduction of the PV modules. The utilisation of the SPV technology to meet the energy requirement of people living in far-flung areas for applications like lighting etc. is becoming attractive since extending conventional electricity grid to these areas is not cost effective.

8.2.108 The other route is to convert the heat energy contained in solar radiation to useful applications. Various types of solar thermal devices are now available in the country which include solar water heaters for industrial, commercial and domestic applications, solar cookers (both domestic and community type), solar stills, solar dryers etc. Besides, solar energy is also being used for space heating by including solar passive features in

buildings and for agriculture through solar greenhouses. Work is in progress to set up solar thermal power plants by utilising the heat from the sun to produce high temperature/pressure steam to generate electricity. An integrated solar combined cycle thermal plant is being set up in Rajasthan with a capacity of 140 MW. This type of plant would make it possible to generate electricity even during non-sunshine periods with the support of a combined cycle gas plant. However, the economic viability of such plants for commercial applications is yet to be established. It is expected that these plants may become economically viable in the future on life-cycle cost basis and also on the basis of indigenous technology development. In any case, the environment-friendly nature of solar plants and the renewable fuel source would justify the setting up of such plants in the future.

Biomass Power

8.2.109 Bio resources, such as firewood, agro-residues and animal wastes form an important component of the energy mix of a developing country like India, and account for nearly 30 per cent of the primary energy supply. These resources will continue to be used in order to meet the increasing demand for energy, though with higher end-use efficiencies. With a view to promoting efficient methods of using these energy resources the Ministry of Non-Conventional Energy Sources is implementing the National Project on Biogas Development (NPBD), National Programme on Improved Chulhas (NPIC), National Biomass Gasification Programme and Biomass Power/Co-generation Programme. It has been estimated that the country has the potential to set up 12 million biogas plants and install 120 million improved chulhas. However, only around one-fourth of the potential has been tapped so far. It has been estimated that there is a potential to install 19,500 MW capacity through biomass conversion technologies viz. combustion, gasification, incineration, pyrolysis and also bagasse-based co-generation in sugar mills. So far only around 381 MW of this potential has been tapped. There is scope for expanding the size of these programmes as they directly benefit the majority of the rural population and help them meet their

basic energy needs.

8.2.110 During the Tenth Plan, biomass production will assume an increasing and crucial role. Strategies for encouraging energy plantations on waste/degraded/marginal lands to feed biomass-based power projects need to be evolved. In addition, the technologies and projects for feed preparation relating to various agro residues also need to be encouraged.

8.2.111 Biomass offers an ideal option for rural electrification in remote areas and has been getting priority in certain areas in hilly states, islands etc. These schemes for decentralised power plants have particular relevance in the north-eastern states, Jammu and Kashmir and Sikkim. Some experiments have been carried out to install community-based biomass gasifier and biogas plants to meet the energy needs of a village. However, the replication of such programmes on a country-wide scale and their success would depend on the identification of the institutions, mobilisation of the community, method of collection of user charges etc.

Energy from waste

8.2.112. On a conservative basis, it is estimated that about 30 million tonnes of solid waste and 4,400 million cubic meters of liquid waste are generated every year in urban areas from households and commercial enterprises. In addition, the manufacturing sector also contributes a significant quantity to the country's waste. From the estimated availability of garbage, there is a potential to generate 1,700 MW of electricity — 1,000 MW from urban and municipal waste and 700 MW from industrial waste. Technologies are now available to treat the garbage to meet the required pollution control standards, besides generating power. A national programme under the Ministry of Non-Conventional Energy Sources seeks to promote such projects with suitable financial/fiscal incentives to encourage private sector participation. International financial institutions also take keen interest in these types of projects and come forward to support them. A United Nations Development Programme (UNDP)/Global Environment Facility (GEF) funded project called Development of High Rate Biomethanation Processes as a Means of

Reducing Green House Gases Emission is being implemented by the Ministry of Non-Conventional Energy Sources covering different waste sectors. It is expected that the demonstration projects taken up under this programme would provide the necessary awareness among entrepreneurs to take initiative to set up such projects.

Alternative Fuel for Surface Transportation

8.2.113. Hydrocarbons used as fuels for transportation are to be replaced by other eco-friendly fuels for surface transport vehicles. Many options such as compressed natural gas (CNG), battery-powered vehicles and fuel cells are currently available. Some of the measures to be taken up to promote such programmes include the upgradation of the existing technology, cost reduction and creation of an effective infrastructure network. A noteworthy feature of the fuel cell vehicles is that they are truly zero-emission vehicles. Hydrogen produced as a by product in chlor-alkali and fertiliser units, oil refineries and several chemical industries can be effectively used as a fuel in fuel cells. The cost of fuel cells needs to be reduced significantly in order to make them attractive for commercialisation. Efforts should be made to produce hydrogen from renewable sources such as solar energy and water in an eco-friendly manner. Hydrogen can be produced by the electrolysis of water, a well-established and environmentally benign technology. Efficient and economical storage of hydrogen is also possible. One method for storage of hydrogen is the use of rechargeable metal hydrides. Several metal alloys have been identified which are capable of storing hydrogen in a safe and environmentally clean manner. The large energy storing capacity in these metal hydrides per unit volume would make these storage devices compact in size.

Ocean Energy

8.2.114. The ocean covers 71 per cent of the earth's surface and it acts as a natural collector and store of solar energy. On an average day, 60 million sq. km. of tropical seas absorb an amount of solar radiation equivalent in heat content to about 245 billion barrels of oil. If this energy could be tapped, a large-scale renewable source would become

available especially for tropical countries. The energy available in the ocean is clean, continuous and renewable. There are various means for tapping ocean energy such as Ocean Thermal Energy Conversion (OTEC), wave energy, tidal energy, salinity gradient energy, marine currents, marine biomass conversion etc. Among these, the first three technologies are likely to be viable for the future.

8.2.115. Even though it is not possible to extract all the energy potential in the ocean, what can be extracted is still a vast source of power. Research activities are being undertaken in the areas of wave energy and OTEC. Studies are being carried out to establish tidal power plants in the Gulf of Kutch and in a creek in the Sunderbans area. Once this research establishes the commercial viability of ocean power, significant power generation capacity

based on the country's ocean energy potential can be expected.

REVIEW OF THE NINTH PLAN

8.2.116. The major thrust of the Ninth Plan programme for renewable sources of energy covered the following two areas:

- i. Restructuring of the existing programmes for non-conventional energy towards gradual commercialisation. Special initiatives were taken to exploit the large co-generation potential available in the country. A draft Renewable Energy Policy has been formulated which seeks the approval of the Government for follow-up action on this matter.
- ii. Restructuring the socially-oriented

Table 8.2.15

S.No.	Programmes	Units	Ninth Plan Target Fixed	Cumulative Likely Achiv. During Ninth Plan
1.	Biogas plants	Nos. in lakh	10	8.44
2.	Community/Institutional/Night soil based	No.	800	1,775
3.	Improved chulha	Nos. in lakh	150	102
4.	Biomass/Gasifier	MW	40	25.50
5.	Integrated Rural Energy Programme	Block Nos.	860	860
6.	Energy Parks	Nos.	200	190
7.	Solar Photovoltaic Programme (SPV)			
	SPV Home Light	Nos.	2,00,000	1,35,567
	SPV Lanterns	Nos.	3,00,000	3,04,528
	SPV Street Lighting Systems	Nos.		13,536
	SPV Power Plants	KWp	1,600	581
	SPV Pumps	Nos.	4,000	3,023
8.	Solar Thermal Energy Programme			
	Solar water heating system	m2 collector area	1,50,000	1,41,409
	Solar cooker	Nos.	1,50,000	1,02,000
9.	Wind Pumps and Hybrid System	Nos.	1,000	614
10.	Wind Power	MW	1,000	650
12.	Small Hydro (upto 25 MW)	MW	130	254
13.	Biomass Power	MW	314	295
14.	SPV Power	kW	1,500	1,475
15.	Waste to Energy Programme	MW	42	22.4

programmes in a manner that the direct capital subsidy provided by the Government is brought down. The continuation of these programmes during the Tenth Plan requires an evaluation study taking into account various incentives such as interest subsidy in place of capital subsidy and the implementation of some of the programmes as a part of the other rural development programmes. Some of the socially-oriented programmes which were continued under the central sector for a long period, i.e. more than two Five-Year Plans are being transferred to the states.

8.2.117. The physical achievements of the various renewable energy programmes are in Table 8.2.15:

TENTH PLAN

8.2.118. In the context of the Tenth Plan, an exercise for convergence, retention, retention with modifications, transfer, and weeding out of the central sector and centrally sponsored schemes under the Ministry of Non-Conventional Energy Sources was carried out jointly by the ministry and the power and energy division of the Planning Commission. Accordingly, 35 schemes implemented by the ministry have been converged under 11 major schemes. Besides, two of the three centrally-sponsored schemes under are to be transferred to the states. The two schemes relate to community-based plants and improved chulahs. It has been recommended that one scheme on animal energy be discontinued since it is not making any significant headway.

Approach for the Tenth Plan

8.2.119. There is a significant potential to meet the basic energy requirement of people (cooking, lighting and heating) in an economically efficient manner through non-conventional and renewable sources of energy. The emphasis has to be on preparing a time-bound plan for progressive electrification covering groups of users or a village as a whole. Wherever feasible, community systems have to be put up to meet

and manage the energy requirements in the villages. {{People's participation through panchayats, other local bodies, cooperatives and NGOs is to be secured in planning and implementation of such programmes. concepts as Barefoot Solar Engineers could be adopted. The approach has to be a decentralised one and based on a judicious mix of public and private investment.

8.2.120. At present, non-conventional energy sources accounts for a mere 3.4 per cent of the total installed power generating capacity. The strategy to enhance the grid supply of power from renewable sources of energy or from co-generation has to aim at improving the ability to despatch and cost-competitiveness. A suitable policy framework would need to be introduced for providing remunerative returns and encouraging private investments. Development and promotion of this sector, which is environmentally benign, should not be constrained by intrusive regulation.

THE PATH AHEAD

8.2.121. The following steps need be taken in the Tenth Plan:

- Identify remote areas where power supply from the conventional grid will be prohibitively expensive and make it a priority to provide off-grid supply from renewables for these areas. Create provisions for integrated generation and distribution of off-grid energy supply.
- Conduct a comprehensive review of programme objectives, achievements to date, and efficacious use of funds by all concerned.
- Clarify the framework for supply to main grid by providing regulatory certainty on tariff, off-take agreements, and direct/contracted sale to bulk users.
- Encourage private sector investments in renewable energy sources by promoting a bidding process for available subsidies. Award contracts to private entrepreneurs

who provide maximum benefit with the lowest amount of subsidies.

- Promote local/private sector management of both generation and distribution for off-grid supply from renewable sources.
- Integrate renewable energy technologies in all buildings.
- Optimise energy plantation by raising plants on degraded forest and community land.

generation capacity from renewables has been set for Tenth Plan, as per the following details:

Wind	1,500 MW
SHP	600 MW
Biomass power/co. generation	700 MW
Biomass gasification	50 MW
Waste to Energy	80 MW
SPV Power	5 MW
Solar Thermal Power	140 MW
Total	3075 MW

Village Electrification

8.2.122. It is proposed that around 18,000 villages located in remote and difficult areas will be electrified through decentralised and non-conventional energy sources. A time frame has been set to complete the electrification of all the remote villages by the end of the Eleventh Plan i.e. 2012. Accordingly the Tenth Plan would accord top priority to this activity.

8.2.123. A physical target of 3075 MW of power

8.2.124. It is proposed to electrify 5,000 villages through decentralised energy sources, 4,000 of them by solar and the remaining villages by biomass and small hydro and to install 10 lakh biogas plants, 2.5 lakh domestic plus 6 lakh solar lantern SPV lighting systems, 5 MW of SPV power plants, 8,000 SPV pumps and 10,000 SPV generators. In addition, solar water heating systems, solar cookers, solar air heating systems etc. are also proposed to be encouraged.

8.2.125. The schemewise break-up of the Tenth Plan outlay for Ministry of Non-Conventional Energy Sources is given in the Appendix.

**RESOLUTIONS OF THE CHIEF MINISTERS/POWER MINISTERS
CONFERENCE ON 3rd MARCH' 2001.**

The following Resolutions of the Chief Ministers/Power Ministers Conference held on 3rd March, 2001 were adopted:-

A. COMPLETING ELECTRIFICATION OF ALL VILLAGES AND HOUSEHOLDS

- i. Rural Electrification may be treated as a Basic Minimum Service under the Prime Minister's Gramodaya Yojana;
- ii. Rural Electrification may be completed by the end of the Tenth Plan i.e. by year 2007;
- iii. Full coverage of all households may be targeted for the end of the Eleventh Plan i.e. by year 2012.
- iv. For the attainment of full electrification, States may be given flexibility for using funds under Rural Development Programmes with the consent of the Village/ Block Panchayats for undertaking the task of electrification where it is required.
- v. It was agreed that electrification of remote villages in the States would need a special mode of financing including an element of grant.

B. DISTRIBUTION REFORMS

The real problem of management and the challenge of reforms lies in the distribution sector.

- i. Energy audit at all 11 KV feeders must be made effective within the next 6 months and accountability fixed at the local level.
- ii. An effective Management Information System for this purpose needs to be made operation.
- iii. On the basis of the above, an effective programme needs to be launched for identifying and eliminating power thefts in the next 2 years.
- iv. Full metering of all consumers had been targeted for completion by December 2001. Special efforts should be made to complete the programme.
- v. The quality of power supplied especially in rural areas needs to be improved through the APDP and other programmes quickly;
- vi. Commercial viability has to be achieved in distribution in 2-3 years through any or all of the following:
 - Creating Profit centres with full accountability
 - Handing over of local distribution to Panchayats/Local Bodies/Franchisees/Users Associations, wherever necessary.
 - Privatisation of distribution
 - Or any other means
- vii. Efforts by States, if necessary, at inviting private investment in the power sector need to be focused towards the distribution sector.
- viii. Current operations in distribution would need to reach break even in two years and achieve positive returns thereafter.

C. TARIFF DETERMINATION BY REGULATORY COMMISSIONS AND SUBSIDIES.

- i. State Electricity Regulatory Commissions may be made functional in the next six months and tariff filings made. Tariff orders issued by Central Electricity Regulatory Commission and

State Electricity Regulatory Commissions need to be implemented fully unless stayed or set aside by Court order.

- ii. Subsidies may be given only to the extent of State Government's capacity to pay the subsidies explicitly through budget provisions.
- iii. It is necessary to move away from the regime of providing free power. The past decision of CMs of a minimum agricultural tariff of 50 paise may be implemented immediately.

D. GENERATION

- i. Special efforts need to be made to increase the PLF of existing plants through Renovation & Modernisation.
- ii. In the short run, there is no alternative to increase in public sector investment in generation, as large-scale private investment in generation would flow only after reforms succeed in restoring financial viability. The Centre and the States need to take suitable decisions regarding increase in outlays for the Tenth Plan. Priority should be given for investments at those locations which produce the cheapest power. CEA has estimated the requirement for an additional 100,000 MW of generating capacity by 2012. Emphasis may be given for the development of hydro and other renewable sources.
- iii. Where the States and Financial Institutions are in agreement about the need for development of IPPs, they need to work together to achieve financial closure at the earliest. The Centre would facilitate the finalization of reforms based multi-partie agreements.
- iv. The evolution of a National Grid for inter-regional transfer of power needs to be taken up on priority.
- v. Some provisions of the Forest Conservation Act may require to be revised for expeditious completion of power and other projects.

E. ENERGY CONSERVATION AND DEMAND SIDE MANAGEMENT

An effective programme in the field of demand side management through

- energy efficient bulbs, tube lights and agricultural pumpsets,
- time of the day metering and differential tariff for peak and off peak hours.

needs to be implemented with suitable mass awareness and extension efforts.

F. SUPPORT FROM GOVERNMENT OF INDIA

- i. The Government of India would support the States in their reform efforts. This support would be linked to time bound power reform initiatives in the States and achievement of definite milestones towards restoration of financial viability.
- ii. Interest rates of PFC and REC should be brought down to reflect market conditions.
- iii. An Expert Group would be set up to recommend one time settlement of all power sector past dues CPSUs to State Power Utilities. This would be linked to implementation of reforms with time bound milestones. The Group will give its report within three weeks of its constitution.

G. SUPPLY FROM CENTRAL GENERATING STATIONS

Continued supply of power from Central Generating Stations would have to be linked to demonstration of capacity to make payments for current purchases and securitisation of past dues.

H. HIGH LEVEL EMPOWERED GROUP

A High Level Empowered Group comprising of Minister of Power and Chief Ministers of some States may be set up to co-ordinate, monitor and review the implementation of Reforms.

