

10

Energy

ENERGY SECTOR

ISSUES AND CHALLENGES

10.1 Availability and access to energy are considered as catalysts for economic growth. The envisaged growth of the economy at 9% in the Eleventh Plan cannot be achieved without a commensurate increase in the availability of energy. Over half of the country's population does not have access to electricity or any other form of commercial energy. Meeting the energy access challenges and ensuring lifeline supply of clean energy to all is essential for empowering individuals, especially women and girls, who have the task of collecting and using non-commercial fuels such as fire wood, crop residues, and dung cakes that remain the primary energy source for cooking in over two-thirds of the households. Provision of clean fuels or at least wood plantation within one km of habitation and dissemination of technology for use of clean fuels is vital for good health. This is essential if growth is to be inclusive.

10.2 India is both a major energy producer and a consumer. India currently ranks as the world's seventh largest energy producer, accounting for about 2.49% of the world's total annual energy production. It is also the world's fifth largest energy consumer, accounting for about 3.45% of the world's total annual energy consumption in 2004. Since independence, the country has seen significant expansion in the total energy use in the country with a shift from non-commercial to

commercial sources. The share of commercial energy in total primary energy consumption rose from 59.7% in 1980–81 to 72.6% in 2006–07. It must be noted, however, that India's per capita energy consumption is one of the lowest in the world. India consumed 455 kilogram of oil equivalent (kgoe) per person of primary energy in 2004, which is around 26% of world average of 1750 kgoe in that year. As compared to this, per capita energy consumption in China and Brazil was 1147 kgoe and 1232 kgoe, respectively.

10.3 The main challenge before the energy sector for fuelling the proposed growth in the Eleventh Plan is to enhance energy supply in cost-effective ways. The persistent shortages of electricity both for peak power and energy indicate the magnitude of the problem. Average peak shortages are estimated to be 12% in 2006–07 which is an underestimate as scheduled load shedding is not included in it. The very high load factor of 76.8% for the system indicates that the system is operating under strain or has limited reserve. At the same time, for want of natural gas, some gas-based power plants are kept idle. Nuclear plants are also operated at lower load factors for want of adequate uranium. Power shortages are an indication of insufficient generating capacity and inadequate transmission and distribution (T&D) networks. To a great extent this is the outcome of poor financial health of the State Electricity Utilities having high levels of Aggregate Technical and Commercial (AT&C) losses.

10.4 The task of meeting the energy needs of development has become more complex in recent times due to the imminent threat of global warming. This poses a challenge to the world as a whole including India and points to the need for an acceptable international approach to deal with the problem. India's energy strategy has, therefore, to bear in mind the need for action as part of a reasonable international agreement which is consistent with India's development objectives.

LONG-TERM REQUIREMENT

10.5 Since energy sector involves large gestation lags, we also need to look at the long-term requirement. The rate of growth and, therefore, the energy intensity are the key factors which impact the projections of future energy demand. The Expert Committee (EC) on Integrated Energy Policy, Planning Commission (Box 10.1) has projected primary energy demand for 2031–32 for India. Table 10.1 summarizes the range of projected

requirement and supply. The projected requirement of coal has been estimated assuming its calorie content to be 4000 kcal per kg and 2865 kcal per kg for lignite.

AVAILABILITY OF ENERGY RESOURCE

10.6 India is not endowed with large primary energy reserves in keeping with her vast geographical area, growing population, and increasing final energy needs. The distribution of primary commercial energy resources in the country is quite skewed. Whereas coal is abundant and is mostly concentrated in the eastern region, which accounts for nearly 70% of the total coal reserves, the western region has over 70% of the hydrocarbons reserves in the country. Similarly, more than 70% of the total hydro potential in the country is located in the northern and the north eastern regions. The southern region, which has only 6% of the coal reserves and 10% of the total hydro potential, has most of the lignite deposits occurring in the country.

Box 10.1 Integrated Energy Policy

The Planning Commission had set up an expert group to recommend integrated energy policy. Its report submitted in 2006 (http://planningcommission.nic.in/reports/genrep/rep_intengy.pdf) deals with various sources and forms of energy (electricity, coal, oil, gas, nuclear, hydel energy, renewables including wind energy, solar energy, biofuels, wood plantations), the country's projected requirement and availability of resources, energy security, energy efficiency as well as R&D priorities.

The report lays strong emphasis on making the energy sector efficient and competitive. It argues for relative prices and taxes that reflect the true social cost of different fuels and forms of energy as the best way to encourage right choice of fuels and techniques; for competitive markets wherever possible; transparent and target subsidies when needed; policies that rely on incentives and disincentives; and policies that are implementable. The recommendations are being discussed with various ministries for implementation. Many of the policies recommended for the coal sector have already been implemented. Progress has also been made in policies concerning energy efficiency and renewable energy. Progress in the power sector has yet to show results. The oil and gas sector continues with an unsustainable pricing policy.

TABLE 10.1
Projected Primary Energy Requirement for India, 2030

(All in Mtoe)

Fuel	Range of Requirements	Assumed Domestic Production	Range of Imports [#]	Import (%)
Coal including lignite	632–1022	560	72–462	11–45
Oil	350–486	35	315–451	90–93
Natural gas including coal bed methane (CBM)	100–197	100	0–97	0–49
Total commercial primary energy	1351–1702	–	387–1010	29–59

Note: # Range of imports is calculated across all scenarios by taking the minimum requirement and maximum domestic production as the lower bound and maximum requirement and minimum domestic production as the upper bound.

Source: Integrated Energy Policy Report (IEPR), 2006.

COAL AND LIGNITE

10.7 Coal continues to be the major energy resource of the country. As on January 2007, the coal reserves were 253.3 billion tonnes (bt), out of which 97.92 bt are in the 'proved' category. The lignite reserves as on April 2006 were estimated at 38.27 bt, out of which 4.5 bt is in the proved category. If all the inferred reserves materialize, these reserves can sustain current level of production for 140 years.

PETROLEUM AND NATURAL GAS

10.8 The balance of recoverable oil reserves as on 1 April 2006 is around 1653 mt (Directorate General of Hydrocarbon, DGH 2005–06 report), which can sustain the current level of production for the next 35 years. The current level of production barely caters to 26% of the petroleum products demand and the balance oil requirements are met by importing the crude. The current level of natural gas production in the country is inadequate to meet the industrial demand, particularly of the power and fertilizer industries. LNG imports since 2004–05 have been able to bridge the gap partially. The situation is likely to improve once production starts from Krishna–Godavari (K–G) basin reserves in a couple of years.

10.9 Besides natural gas, the country has significant CBM and underground coal gasification (UCG) resources. Coal India Limited (CIL) and ONGC are already implementing two CBM projects. Blocks have also been allocated through competitive bidding process to private companies for exploration and exploitation of CBM. Production of 3.78 bcm from CBM and 2.99 bcm from UCG are included in the Eleventh Plan targets.

NUCLEAR ENERGY

10.10 At present, nuclear energy installed capacity is 3900 MW_e which is 3.1% of total installed power generation capacity and the Plant Load Factor (PLF) of Nuclear Power stations is 57%. India's long-term nuclear power programme is based on utilizing the vast indigenous resources of thorium for electricity generation. The three-stage nuclear power development programme in India is aimed at converting thorium to fissile material. India is poorly endowed with uranium and available uranium resources can support

10000 MW_e electricity generation programme based on pressurized heavy water reactors (PHWRs) using natural uranium as fuel and heavy water as moderator and coolant. The energy potential of natural uranium can be increased to about 300000 MW_e in the second stage through fast breeder reactors (FBRs) which utilize plutonium obtained from the recycled spent fuel of the first stage along with thorium as blanket to produce U₂₃₃. With the deployment of thorium in the third stage using U₂₃₃ as fuel, the energy potential for electricity generation is large and substantial.

RENEWABLE SOURCES OF ENERGY

10.11 Projections made in the IEPR reveal that to achieve its development goals, India would need to rely increasingly on imported oil, gas, and coal in the medium term (2032). Against this backdrop, the role of new and renewable energy assumes added significance, irrespective of whether it replaces coal or oil. In this regard, IEPR recognizes 'the need to maximally develop domestic supply options as well as the need to diversify energy sources...'; although renewables are likely to account for only around 5%–6% of the primary commercial energy-mix by 2032. Given the growing concerns for climate change and energy security, it is imperative that this energy in the longer term will substantially increase its share in the fuel-mix. Continuing to support the growth of new and renewable energy is in the country's long-term interest, even though in the medium term this option might appear somewhat costlier. Thus, a balanced approach for new and renewable energy that factors in the need to develop domestic and renewable sources of energy has to be adopted.

TRENDS IN PRIMARY ENERGY DEMAND AND SUPPLY

10.12 The demand for energy, particularly for commercial energy, has been growing rapidly with the growth of the economy, changes in the demographic structure, rising urbanization, socio-economic development, and the desire for attaining and sustaining self-reliance in some sectors of the economy. Table 10.2 gives the trend of primary commercial energy demand and supply between 1960–61 and 2006–07 and projected requirement for 2011–12.

Box 10.2 Energy Equivalence

The energy labeled as 'final energy' such as electricity, petrol, gas, coal, firewood, etc. is obtained from the sources available in nature, labeled as 'primary energy', and includes hydrocarbons (coal, oil, and natural gas), fissile or fertile elements primarily uranium, the kinetic energy of natural elements (wind, water, etc.), and the electromagnetic rays of the sun and the natural heat of the Earth (geothermal energy). As per convention, final energy consumption is generally expressed as weights of fuels burnt, or from kWh consumed if it is electricity. Each fuel, while burning, produces certain amount of energy in the form of heat that can be measured in standard units such as kilocalories or Joules. Fuels are compared using their calorie content with that of oil in tonnes or million tonnes of oil equivalent (mtoe). One tonne of oil is worth 42 billion Joules or 10 billion calories whereas one million tonne of Indian coal has 4.1 billion calories. Thus 1 mt of coal is 4.1/10 mtoe or 0.41 mtoe. Electrical energy measured in kWh is also converted into the thermal energy kcal or kJ using the definition and finally expressed as mtoe (1 billion kWh = 0.86 billion calorie). Taking the thermal efficiency of the power plant and other losses in the system, the equivalence between electricity and fossil fuels would be 1 billion kWh = 0.28 mtoe (in case of coal-fired boilers) and 0.261 mtoe (in case of nuclear electricity). 1 billion kWh generated from hydroelectricity or wind power, however, are considered as equivalent to 0.086 mtoe since there is no intermediate stage of heat production while using these primary energies. It is possible to argue that the efficiency of thermal power plant should be used to convert hydroelectricity and wind power also. In this case, 1 billion kWh of hydroelectricity would be equivalent to 0.28 mtoe. This has an important bearing when one considers how much renewable energy is renewable. Thus in 2006–07 renewable energy was 2.8% or 8.3% of India's total primary commercial energy depending on the conversion factor used.

TABLE 10.2
Trends in Demand and Supply of Primary Energy

(All in Mtoe#)

	1960–61	1970–71	1980–81	1990–91	2000–01	2006–07	2011–12*
Domestic production of commercial energy	36.78	47.67	75.19	150.01	207.08	259.56	435
Net imports	6.04	12.66	24.63	31.07	89.03	131.97	111
Total commercial energy	42.82	60.33	99.82	181.08	296.11	391.53	546
Non-commercial energy	74.38	86.72	108.48	122.07	136.64	147.56	169
Total primary energy demand	117.20	147.05	208.30	303.15	432.75	539.09	715

Note: # Mtoe = million tonne of oil equivalent. For details see Annexure 10.3.

* Projected requirement at the end of the Eleventh Plan is as per the Report of the EC on Integrated Energy Policy and projection of domestic supply is as per the Working Group Reports. Import requirement is the difference between projected requirement and domestic supply projections.

(i) Domestic production of commercial energy includes coal, lignite, oil, natural gas, hydro power, nuclear power, and wind power.

(ii) Net imports include coal, oil, and LNG imports.

Source: IEPR.

10.13 While total primary energy requirement registered an average annual growth rate of 3.67% between 1990–91 and 2006–07, the primary commercial energy requirement registered an average annual growth rate of 4.93% during the same period. The Tenth Plan had envisaged a declining primary commercial energy intensity of GDP reflected in growth of 6.64% in primary commercial energy supply by the end of 2006–07 over the 2001–02 level while GDP grew at 8% implying an energy elasticity of 0.83. However, the primary commercial energy consumption actually registered a growth rate of 5.51% over the consumption level in

2001–02, whereas the economy registered an average growth rate of 7.8% during the Tenth Plan period yielding an elasticity of primary commercial energy consumption with respect to the GDP of only about 0.71%.

10.14 Non-commercial energy resources include the traditional fuels such as wood, cow dung, crop residue, and biogas and constitute a significant percentage of total primary energy consumption in the country. A larger share of these fuels is used by the households, particularly in rural areas, for meeting

their cooking and heating needs. The consumption of 147.56 mtoe of traditional fuels in 2006–07 includes consumption of 238 mt of fuel wood, 98 mt of dung, and 38 mt of agricultural waste. Around 80% of the fuel wood is used for household consumption and the balance is used by the cottage industry, hotels, etc.

10.15 The total energy needs are met by different energy sources. Table 10.3 gives the source-wise breakup of the energy demand and Table 10.4 gives the percentages of these met from domestic production, the rest coming from imports.

10.16 Though the share of oil and gas has been progressively increasing over the years, coal continues to be the dominant fuel in the total energy use in the country. Imports constituted about 33.70% of the total primary commercial energy consumption in 2006–07.

10.17 While production of coal in 2006–07 has increased about three times the level of production

in 1980–81, the share of coal and lignite in total primary commercial energy supply has been declining progressively over the years. On the other hand, share of oil and natural gas in the total primary commercial energy supply has been rising progressively. While the share of oil and natural gas rose from 37.89% in 1980–81 to 42.93% in 2006–07, the share of coal and lignite declined from 56.83% in 1980–81 to 53.11% in 2006–07.

10.18 Our dependence on imports is growing. Table 10.4 shows that we imported 13.4% of our coal requirement, 73.4% of oil and product needs, and 1.6% of gas requirement. Net imports of 131.97 mtoe in 2006–07 covers import of 95.43 mt of crude oil and petroleum products, 44.29 mt of coal, and 5 mt of LNG.

10.19 India needs to eliminate shortage of energy supply and enhance the availability of commercial energy resources if it has to sustain the projected 9% economic growth in the Eleventh Plan period. Table 10.5 shows projected commercial energy requirement of all the

TABLE 10.3
Source-wise Energy Demand

	1960–61	1970–71	1980–81	1990–91	2000–01	2006–07	2011–12 [#]
Coal	35.64	36.48	56.96	94.15	131.52	200.02	270
Lignite	0.01	0.81	1.23	3.58	6.43	8.72	13
Oil	8.29	19.14	32.26	57.75	106.97	132.75	186
Natural gas	–	0.60	1.41	11.49	25.07	34.60	48
Hydro power	0.67	2.17	4.00	6.16	6.40	9.75	12
Nuclear power	–	0.63	0.78	1.60	4.41	4.86	17
Wind power	–	–	–	–	0.13	0.83	<1
Total	44.61	59.83	96.73	174.73	280.93	391.53	546

Note: [#] Projected requirement at the end of the Eleventh Plan as per the IEPC report.

Source: Planning Commission.

TABLE 10.4
Percentage Demand met from Domestic Sources

	1960–61	1970–71	1980–81	1990–91	2000–01	2006–07	2011–12 [#]
Coal	100	100	99.7	97.8	96.1	90.33	93.02
Lignite	100	100	100	100	100	100	100
Oil	5.4	35.6	32.6	42.8	30.3	26.6	27.59
Natural gas/LNG	–	100	100	100	100	82.08	69.30
Hydro power	100	100	100	99.93	99.96	99.74	95.94

Note: [#] Projections from various Working Group Reports.

Source: Planning Commission.

TABLE 10.5
Projected Commercial Energy Requirement for
2011–12 at the Rate of 9% Growth

Primary Fuel	Unit	Quantity
Coal	mt	731
Lignite	mt	55.59
Oil	mt	145
Natural gas	bcm	106
Hydro power	BkWh	165
Nuclear power	BkWh	44.64
Wind power	BkWh	7

Source: Working Group Reports of various sectors.

available resources in the terminal year of the Eleventh Plan period in physical units. Coal demand of 731 mt covers 51 mt of imports. 74% of this is expected to be consumed by the power sector including captive plants. Out of the oil demand of 145 mt, domestic production will be around 40 mt and the balance would be imported. Domestic availability of natural gas in the terminal year of the Eleventh Plan is expected to be about 47 bcm. An import of 23.75 mt of LNG would augment the supplies to meet the demand shortfall. There will be a gap of around 32 bcm between availability and demand if no addition by the private sector is achieved. The shortfall in availability will adversely affect the power sector and fertilizer industry, which consume around 70% of the current gas demand.

10.20 Availability of hydro, wind, and nuclear energy is estimated assuming a capacity factor of 37% for hydro, 20% for wind, and 70% for nuclear for taking into account the likely capacity additions during the Plan period.

10.21 Table 10.6 shows the realized growth rates of domestic supply of different fuels in the past as also those projected for the Eleventh Plan.

SUPPLY OPTIONS

10.22 Coal production in the terminal year of the Eleventh Plan period is projected to increase more than one and half times the production level in 2006–07. In spite of the significant increase in domestic coal production, around 51 mt coal is required to be imported to meet the gap between demand and supply. Domestic production is likely to reach 680 mt level in the terminal year of the Eleventh Plan registering an average annual growth rate of 9.37% as compared to a growth rate of 5.8% achieved during the Tenth Plan period. Power sector alone will consume more than 70% of the projected demand.

10.23 Domestic production of crude is likely to increase to around 40 mt in the terminal year of the Eleventh Plan representing a modest increase from the current level of about 34 mt. By the end of the Eleventh Plan, the domestic production will cater to only around 28% of the projected petroleum products demand of 145 mt.

10.24 Domestic production of natural gas in the terminal year of the Eleventh Plan is likely to be 63.23 bcm, which will be around 100% higher than the current level of production. This increase in gas production will be mainly from K–G basin production of 40 million standard cubic metres per day (MMSCMD). The level of production may go further up if the Gujarat State Petroleum Corporation Limited is able to develop its resources in K–G basin in the Eleventh Plan period itself.

TABLE 10.6
Growth Rates of Domestic Supply

(All in %)

	1960–70	1970–80	1980–90	1990–2000	2002–07 [#]	2007–12 [*]
Coal	2.74	4.57	6.39	3.87	5.80	9.37
Lignite	–	4.18	10.42	5.24	4.64	11.72
Oil	31.23	4.42	12.1	–0.18	0.56	3.31
Natural gas	–	5.50	22.32	5.06	0.09	18.53
Hydro power	12.61	7.03	3.17	2.66	9.02	7.87
Nuclear power	–	7.95	4.86	11.10	(–) 9.18	19.13

Note: [#] The Tenth Plan period; ^{*} projected for the Eleventh Plan as per various Working Group Reports.

Source: Planning Commission.

10.25 Ministry of Power's (MoP) proposal of 78577 MW during the Eleventh Plan includes addition of 16553 MW of hydro capacity and 3380 MW from nuclear reactors. Taking into account this capacity addition, projected energy generation from both hydro and nuclear plants will be 165 Trillion Watt hour (TWh) and 44.6 TWh, respectively.

ENERGY IMPORTS

10.26 Traditionally, India has remained supply constrained in energy and the country is forced to resort to imports to bridge the gap between demand and supply. With the rising demand of natural gas in the power and fertilizer sectors, LNG imports were started in 2004–05. Though LNG imports have augmented the demand to some extent, still there is a considerable shortfall. Oil imports also continue to grow every year to meet the petroleum products demand. Of late, import of non-coking coal by the power utilities and cement industry also started increasing besides the coking coal imports by steel industry to meet the growing demand. As a result of this, the share of imports in the total primary energy supply is progressively rising. The GoI is making efforts to import nuclear fuel from the US which is expected to improve the supply of nuclear fuel for nuclear power plants.

THE WAY FORWARD

10.27 It is evident from the discussions above that India is short of all energy resources and that coal will dominate India's energy basket. We need to expand resources through exploration, energy efficiency, renewables, and R&D. The environmental impact of various energy options is of growing concern owing to widespread use of energy. It is necessary that the demand of energy in the country is met in an environment-friendly and sustainable manner.

10.28 Available fossil energy resources must be optimally exploited using enhanced recovery techniques. Additional sources of energy such as CBM must be fully exploited and fossil fuel reserves advanced through more intensive exploration. Though the renewable energy sources such as wind energy, biomass, and biofuels account for a small percentage in the total energy, their contribution must increase by 2%–3% in the Eleventh Plan. Accordingly, a roadmap with

detailed policy initiatives is necessary in all the sub-sectors of the energy sector for achieving the desired growth. While the Central and State sectors will continue to dominate the energy sector in the Eleventh Plan, energy policy should not be determined sector by sector where the dominant public sector players often have significant vested interests. We need to move towards a more transparent policy framework that treats different sources of energy in a similar fashion. Such a framework must be able to meet the energy requirements cost effectively by introducing competition for minimizing distortions across sectors and maximizing efficiency gains. Further, availability of clean, modern fuel to all households should be our guiding concern. This would require removal of barriers to entry at all stages and an optimal pricing and tax strategy so that resource allocation takes place based on market forces operating under a credible regulatory regime that also ensures a level playing field to public and private players.

10.29 Institutions for promoting and forcing the pace of energy conservation and improvement in energy efficiency need strengthening. Restructuring incentives and support by shifting from supply driven programmes to demand driven programmes and technologies would assist development and use of new and renewable energy sources. The subsidies and support need to be linked to the outcomes in terms of renewable energy generated rather than to capital investments. There is need for meeting social objectives as far as possible through direct and tradable entitlements offered to those in genuine need. The renewables may be given appropriate incentives for the environmental externalities.

10.30 It is also necessary to set up a robust energy R&D system for developing relevant technology and energy sources that enhance energy security and lead to energy independence in a cost-effective way in the long run. A number of technology missions covering areas such as in situ gasification, integrated gasification combined cycle (IGCC), solar energy, energy storage, etc. are proposed to be launched. The scope for bio-fuels including extraction of ethanol from agricultural waste using reported advances in technology needs to be pursued.

10.31 Sector-wise programmes and financial requirement for the Eleventh Plan are given in the following section.

POWER SECTOR

ISSUES AND CHALLENGES

10.32 Rapid growth of the economy will place a heavy demand on electric power. Reforms in this sector, for making the power sector efficient and more competitive, have been under way for several years and while there has been some progress, shortage of power and lack of access continues to be a major constraint on the economic growth. The greatest weakness is on the distribution front which is entirely the domain of the States. AT&C losses of most of the State Power Utilities (SPUs) remain as high as 40% and this has made them financially sick and unable to invest adequately in additional generating capacity. For the same reason, these utilities have had only limited success in attracting private investors to set up power plants.

10.33 The Eleventh Plan must ensure substantial expansion in order to move to a comfortable situation consistent with a growth rate between 9% and 10% per annum. Policies must be evolved that would ensure completion of on-going projects quickly and add new capacity in an efficient, least cost manner, while emphasizing exploitation of India's hydro potential and nuclear capabilities especially in the field of FBRs. Renewables such as wind power, which can be set up in a short time, play a useful role. One of the main challenges is a major step-up in investment in distribution infrastructure and a restructuring of the Accelerated Power Development and Reforms Programme (APDRP), using technological and managerial tools such as smart metering and GIS mapping for real time, monitoring and accountability at each distribution transformer with a goal set for the State Governments to bring down AT&C losses from the current level of around 40% to at least 15% by the end of the Eleventh Plan. Given the high level of such losses at present, it may be difficult for some States to attain these targets. Another challenge is to provide electricity access to all households and actually connect all BPL households under the RGGVY.

10.34 Establishment of new generation capacity and reducing cost of power will require action on many fronts:

- Availability of fuel such as coal or natural gas for new power plants must be assured.
- Long-term finance should be made available to lower the capital charge.
- The presently provided guaranteed rate of post tax returns for CPSUs, the rate of return to the utilities, needs to be realigned by Central Electricity Regulatory Commission (CERC) keeping in view the assessments of overall risks and prevalent cost of capital.
- Inter-state and intra-state transmission system of adequate capacity needs to be built that is capable of transferring power efficiently from one region to another.
- Distribution system must be made efficient which alone can ensure financially viable expansion.
- Thermal stations should be rehabilitated through Renovation and Modernization (R&M) to augment generating capacity and improve PLF.
- Hydro stations should be rehabilitated to yield additional peaking capacity.
- Supply side and demand side efficiencies should be improved to effectively lower primary energy demand by 5%–7% during the Eleventh Plan period.
- Use of washed coal should be ensured for power generation.
- Captive capacity should be harnessed to meet the power deficit.

REVIEW OF THE TENTH PLAN

Power Sector Reforms

10.35 Power sector reforms have been underway for over a decade. Enactment of 'Electricity Act 2003' during the Tenth Plan was an important step towards reforms in the power sector. The objectives of the Act are 'to consolidate the laws relating to generation, transmission, distribution, trading and use of electricity and taking measures conducive for the development of electrical industry, protecting interests of consumers and supply of electricity to all areas, rationalization of electricity tariffs, ensuring transparent policies

regarding subsidies, promotion of efficient and environmentally benign policies, constitution of Regulatory Commissions and establishment of Appellate Tribunal for matters connected therewith or incidental thereto’.

10.36 The following milestones were achieved in the power sector during the Tenth Plan:

- As many as 14 States have restructured or corporatized their power sector and unbundled their boards into separate entities for transmission, distribution, and generation.
- Distribution has been privatized in Orissa and Delhi.
- Setting up of State Electricity Regulatory Commissions (SERCs) has become mandatory. A total of 25 States have either constituted or notified the constitution of SERC and 21 SERCs have issued tariff orders.
- A total of 26 States have notified rural areas under Section 14 of the Act, permits have been taken of composite schemes of generation and distribution without any license.
- In compliance with Section 3 of the Electricity Act 2003, the Central Government notified the National Electricity Policy in 2005. Similarly, National Tariff Policy was also notified in 2006. Further, in compliance with Sections 4 and 5 of the Electricity Act 2003, the Central Government notified the Rural Electrification Policy on 28 August 2006.
- The Central Government constituted the Appellate Tribunal for Electricity and the same became operational in July 2005. The Tribunal has started hearing appeals against orders of the Regulatory Commissions/Adjudicating Officers.
- Open access has been technically allowed and also made functional for inter-state transmission; however it has, in fact, been hindered by the high cross-subsidy surcharge set by many SERCs.
- Finally, under APDRP, nine States have shown a cash loss reduction of Rs 5254.60 crore over their loss levels of 2001–02. However, the progress is small and AT&C losses continue to remain high in most States.

OTHER NEW MAJOR INITIATIVES IN THE TENTH PLAN

Guidelines Formulated for Merchant Plants/Coal Linkages

10.37 Guidelines were formulated on Merchant Power Plants with an aim to restructure the electricity industry on 3 November 2006. Under this policy, coal blocks/coal linkage will be provided to the successful bidders in setting up thermal power stations.

Guidelines for Procurement of Electricity

10.38 In compliance with Section 63 of the Electricity Act 2003, the Central Government has notified guidelines for procurement of power by Distribution Licensees through competitive bidding. Further, the Central Government has also issued the standard bid documents for long-term procurement of power from projects having specified site and location.

Launch of Ultra-mega Power Projects (UMPPs)

10.39 The Electricity Act 2003 requires competitive tariff-based bidding from independent power producers. To initiate the process and to realize the benefits of international competitive bidding and economies of scale, a scheme was launched for development of coal-based UMPPs with a capacity of 4000 MW or above through tariff-based competitive bidding. The projects will include development of power projects as well as associated coal mines in respect of pithead sites and imported coal sourcing in respect of coastal sites. These projects will be awarded to developers on BOO basis. The bidding process has been completed in respect of two projects, that is, Sasan in Madhya Pradesh and Mundra in Gujarat and the projects allotted to Reliance Energy and Tata Power, respectively. The process is underway in respect of Krishnapattanam in Andhra Pradesh.

Guidelines Issued for Encouraging Competition in Development of Transmission Projects

10.40 The Central Government has also notified guidelines for encouraging competition in development of transmission projects through tariff-based bidding.

Capacity Addition

10.41 The all-India installed generating capacity of utilities at the beginning of the Tenth Plan was 104917.50 MW. This included 26261.22 MW of hydro, 74428.82 MW of thermal, 2720.00 MW of nuclear power, and 1507.50 MW of wind energy.

10.42 The capacity addition target for the Tenth Plan was 41109.84 MW. Against this, a capacity addition of 21080.24 MW was actually achieved during the Plan period. The sector-wise, mode-wise summaries of the Tenth Plan capacity addition target and achievement are given in Table 10.7.

10.43 It may be noted that the above capacity includes 1210.6 MW thermal-based capacity (Central: 500 MW, State: 538 MW, and private: 172.60 MW) which was not included in the original Plan target. Despite these additional projects, the Tenth Plan performance has been disappointing.

10.44 The cumulative capacity at the end of the Tenth Plan was 132329.21 MW, including 7760.60 MW renewable sources of energy, the details of which are given in Table 10.8.

Transmission and Distribution (T&D) Facilities

10.45 The major portion of the HVDC, 765 kV and 400 kV transmission network planned to be set up during the Tenth Plan, was in the Central sector, while that of the 220 kV network was in the State sector. Most of the targeted addition achieved was inadequate as neither the targeted generation nor the projected demand was realized. A summary of the Tenth Plan transmission achievement up to 31 March 2007 is given in Table 10.9.

Transmission and Distribution (T&D) Losses/AT&C Losses

10.46 T&D losses in India continue to be among the highest in the world and are the main concern in the development of power sector. The reported all-India average T&D losses increased from 19.8% in 1992–93 to 33.98% at the beginning of the Tenth Plan. There is a wide variation in the losses reported by different States. T&D losses for the country as a whole are estimated to be in the range of 35%–45%.

10.47 As T&D losses figures did not capture the gap between the billing and the collection, the concept of AT&C loss was introduced in 2001–02 to capture the

TABLE 10.7
Installed Capacity Addition during the Tenth Plan

Type	Target				Achievement			
	Central Sector	State Sector	Private Sector	Total	Central Sector	State Sector	Private Sector	Total
Hydro	7842.00	5381.20	1170.00	14393.20	4495.00	2691.00	700.00	7886.00
Thermal	12790.00	6675.64	5951.00	25416.64	6590.00	3553.64	1970.60	12114.24
Nuclear	1300.00	0.00	0.00	1300.00	1080.00	0.00	0.00	1080.00
Total	21932.00	12056.84	7121.00	41109.84	12165.00	6244.64	2670.60	21080.24

Source: Central Electricity Authority (CEA).

TABLE 10.8
All-India Cumulative Generating Capacity

	Hydro	Thermal	Nuclear	Total (MW)
Centre	7562.00	33658.99	3900.00	45120.99
State/UTs	25785.62	43334.33	0.00	69119.95
Private	1306.15	9021.52	0.00	10327.67
Total	34653.77	86014.84	3900.00	124568.61 [#]

Note: [#] excludes the capacity of 7760.60 MW from renewable energy sources (State: 975.65 MW and private: 6784.95 MW).

Source: CEA.

TABLE 10.9
Cumulative Achievements of Transmission Lines at the End of the Tenth Plan

Transmission System Type/Voltage Class	Unit	At the End of Ninth Plan (March 2002)	Addition during Tenth Plan	At the End of Tenth Plan (March 2007)
Transmission Lines				
(i) 765 kV	ckm	971	733	1704
(ii) HVDC + 500kV Bi-pole	ckm	3138	2734	5872
(iii) 400 kV	ckm	49378	26344	75722
(iv) 230/220kV	ckm	96993	117636	114629
(v) HVDC 200 kV Mono-pole	ckm	162	0	162
Total of (i), (ii), (iii), (iv), and (v)	ckm	150642	47447	198089
Sub-stations				
(i) 765 kV	MVA	0	2000	2000
(ii) 400 kV	MVA	60380	32562	92942
(iii) 230/220 kV	MVA	116363	40134	156497
Total of (i), (ii), and (iii)	MVA	176743	74696	251439
HVDC				
(i) Bi-pole link capacity	MW	3000	2000	5000
(ii) Back-to-back capacity	MW	2000	1000	3000
(iii) Mono-pole link capacity	MW	200	0	200
Total of (i), (ii), and (iii)	MW	5200	3000	8200

Source: CEA.

total performance of the utility. The AT&C losses are presently in the range of 18% to 62% in various States. The average AT&C loss in the country is about 40%. There is wide variation of losses among the States and variation among the distribution companies within the States. The major portion of losses is due to theft and pilferage, which is estimated at about Rs 20000 crore annually as per the *Economic Survey 2006–07*. More than 75%–80% of the total technical loss and almost the entire commercial loss occur at the distribution stage.

Programme for Central Assistance under APDRP
 10.48 To encourage distribution reforms, the

APDRP was launched in March 2003 consisting of an investment financing component and an incentive component for improved performance. Under the investment component, projects worth Rs 17033.58 crore had been sanctioned. All of these projects were designed to reduce the AT&C losses through strengthening of the sub-transmission and distribution system. While the total investment needs for projects in special category States were to be met by the GoI, the non-special category States were required to fund 75% of the approved project outlay through counterpart funding arranged by the State Governments. A broad summary of the investment component is given in Table 10.10.

TABLE 10.10
Summary of Investment Component of APDRP (as on 31 August 2007) (at Current Price)

S. No.	Category of States	Project Outlay	Revised APDRP Component to be Funded by GoI	Amount Actually Released by GoI	Counterpart Funds Provided by States	Total Utilization (Actual Investment)
1.	Non-special	13668.28	5567.26	5094.32	4750.97	9232.01
2.	Special	3365.30	3152.81	2292.49	62.95	1830.41
Grand Total		17033.58	8720.07	7386.83	4813.92	11062.42

Source: MoP.

10.49 APDRP was promoted with the promise of bringing down AT&C losses to 15% over five years. Actual performance has not come anywhere close to the targeted level. Table 10.11 summarizes the performance of SEBs. The scope for further tariff increase is limited since tariffs for paying customers are already among the highest in the world and it may make sense for them to opt out for captive generation.

significant worsening between 2001–02 and 2005–06. However, Gujarat has shown improvement in 2006–07. Given absence of a baseline, lack of consistency in reporting and fluctuating performances, it may be difficult to state whether the improvement, if any, is of a permanent in nature.

10.52 Evaluation studies have shown what is wrong with APDRP:

TABLE 10.11
Viability of State Utilities not Improving

	2001–02 (Actual)	2002–03 (Actual)	2003–04 (Actual)	2004–05 (Actual)	2005–06 (Provi.)
Energy sold/energy available (%)	66.02	67.46	67.47	68.75	69.58
Revenue from sale of electricity (Rs crore)	68135	76640	85942	91738	100000
Cost of electricity sold (Rs crore)	98541	102247	110553	118975	128853
Loss on sale of electricity (Rs crore)	30407	25607	24611	27237	28853
Average cost of supply (paise/kWh)	374.57	351.72	353.80	357.35	366.96
		(–6.10%)	(–5.54%)	(–4.60%)	(–2.03%)
Average tariff (paise/kWh)	258.99	263.63	275.04	275.55	284.79
		(1.79%)	(6.20%)	(6.39%)	(9.96%)
Gap between the cost of supply and tariff (paise)	115.58	88.09	78.76	81.80	82.17

Note: 1. Financial Performance of 20 major States excluding Delhi and Orissa—as reported.

2. Figure in brackets are growth rates over 2001–02.

3. Approved tariffs hikes exceed average tariff increases estimated above.

Source: Power utilities of various States.

10.50 The reported AT&C loss of Rs 28853 crore for 20 major States is an underestimate. SEB accounts conceal more than they reveal—because of unaccounted ghost billing, manipulated consumer mix, and recording of sales and expenditure on accrual and cash basis, respectively. Further, audit comments have also not been incorporated. As per the Auditor’s comments, Gujarat SEB’s losses for 2002–03 have increased from Rs 476 crore to Rs 985 crore. Similar results for Uttar Pradesh could not be confirmed as for Uttar Pradesh State Electricity Board even cash balances remain un-reconciled. Actual AT&C losses are estimated to exceed Rs 40000 crore.

10.51 The performance varies across States. Haryana and Andhra Pradesh have shown considerable improvement in this regard. However, Haryana started with a very low ratio (energy billed/energy available) in 2001–02, but later its performance deteriorated considerably in 2006–07. Some States such as Rajasthan, Uttar Pradesh, Bihar, Gujarat, and Kerala have shown

- It was an investment driven programme without any outcome accountability.
- The project reports were ill-prepared. They replicated the same type of investments without a full buy-in by the host utility.
- There was no baseline data established on the distribution losses or on billing/collection efficiency. This makes it difficult to determine what has been achieved.
- Unrealistic targets were set and the scheme did not provide incentive for SEB staff to co-operate.

10.53 The APDRP needs to be restructured in order to obtain better results.

Plan Expenditure during the Tenth Plan

10.54 The Plan expenditure for Centre, State, and union territories on the basis of actual for 2002–03, 2003–04, 2004–05, revised estimates (RE) for 2005–06, and approved outlay for 2006–07 (Table 10.12) reveal the following.

TABLE 10.12
Outlay/Expenditure—Centre, State and UTs

Sector	Tenth Plan Approved Outlay	(Rs Crore)					Tenth Plan Likely Expenditure	% Utilization
		2002–03 (Actual)	2003–04 (Actual)	2004–05 (Actual)	2005–06 (Actual)	2006–07 (RE)		
States and UTs	93225.71 (93225.71)	17102.58 (16462.20)	17836.89 (16541.68)	17035.28 (15137.09)	17330.07 (14742.72)	19371.57 (15580.77)	88676.39 (78464.46)	95.12 (84.17)
Central Sector	177050.64 (177050.64)	10993.42 (10581.79)	14327.50 (13287.12)	17039.96 (15141.25)	21045.93 (17903.81)	27271.04 (21934.40)	90677.85 (78848.37)	51.22 (44.53)
All	270276.35 (270276.35)	28096.00 (27043.99)	32164.39 (29828.80)	34075.24 (30278.34)	38376.00 (32646.53)	46642.61 (37515.17)	179354.24 (157312.82)	66.36 (58.20)

Note: Figures in the bracket are at 2001–02 price.

Source: Planning Commission.

10.55 The shortfall in fund utilization in the Central sector is on account of the following:

- During the first two years, there was a delay in according investment approval for various projects such as Teesta Low Dam-III and IV, Sewa-II, Omkareshwar, Subansari Lower, Parbati-III, Purulia PSP (Pump Storage Project), Chamera HEP-III (Hydro Electric Project), Uri-II, Kishanganga, Tipaimukh, Tural HEP, Tuivai HEP, Lower Kopali HEP, Ranganadi Stage II, Kameng, Tripura Gas, etc.
- In case of NTPC, an outlay of about Rs 3000 crore was included as GBS to be utilized if need be. However, it was decided to fund the projects from its internal resources and in addition gas projects such as Kawas and Gandhar could not take off.

10.56 In the State sector the major shortfalls were in the States of Gujarat, Himachal Pradesh, Maharashtra, Orissa, Punjab, Tamil Nadu, Uttar Pradesh, and Uttarakhand.

ELEVENTH PLAN PROGRAMMES

GENERATION

Capacity Additions

10.57 The gross electricity requirement by the end of the Eleventh Plan projected by the Working Group on power is 1038 Billion Unit (BU) and peak demand estimation is 151000 MW whereas the EC on Integrated Energy Policy has projected the gross electricity requirement of 1097 BU and peak demand of 158000 MW. To fulfil the estimated electricity demand requirement, the Working Group recommended the capacity addition programme initially of 78530 MW and updated at 78577 MW during the Eleventh Plan (Table 10.13). The mode-wise capacity addition is depicted in Table 10.14.

10.58 The public sector will continue to play a dominant role during the Eleventh Plan while progress along the reform path helps to clear the roadblock for greater private participation in the medium to long term.

TABLE 10.13
Status of Capacity Addition during the Eleventh Plan

		(in MW)			
		Central	State	Private	Total
1.	Projects commissioned (as on 18 October 2007)	1360	1350	250	2960
2.	Projects under construction	28765	16342	7378	52485
3.	New Projects	9740	10260	3132	23132
	Total	39865	27952	10760	78577

Note: At the time of going to press on 8 May 2008, 9573 MW were commissioned, 62717 MW are under construction and 6410 MW are likely to come up.

Source: CEA/Planning Commission.

TABLE 10.14
Sector-wise, Mode-wise Capacity Addition
during the Eleventh Plan

		(in MW)			
Source	Central	State	Private	Total	
1. Hydro	9685	3605	3263	16553	
2. Thermal	26800	24347	7497	58644	
3. Nuclear	3380	0	0	3380	
Total	39865	27952	10760	78577	

Note: At the time of going to press on 8 May 2008, the mix of thermal/hydro has undergone some changes.

Source: CEA/Planning Commission.

10.59 The proposed capacity addition is three and a half times of that achieved in the Tenth Plan and in that sense is very ambitious. Effective implementation is also 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, and investment clearance. On the basis of this, the cumulative generation capacity in the country by the end of 2011–12 will be as given in Table 10.15.

Hydro Power Development

10.60 The share of hydro capacity in the total generating capacity of the country has declined from 34% at the end of the Sixth Plan to 25% at the end of the Ninth Plan. The present share of hydro capacity of 26% is envisaged to be about 23% by the end of the Eleventh Plan if the targeted Eleventh Plan capacity addition programme is achieved.

10.61 A 50000 MW hydro initiative was launched in 2003 for accelerated development of hydro in the country and Preliminary Feasibility Reports of 162

projects totaling to 48000 MW were prepared. Out of this, 77 projects with total capacity of about 37000 MW, for which first-year tariff is expected to be less than Rs 2.50 per unit, were selected for execution. In the Eleventh Plan, a capacity addition of about 16553 MW has been earmarked keeping in view the present preparedness of these projects. Projects totaling to a capacity of 30000 MW have been identified for the Twelfth Plan on which necessary preparations have to be made from now onwards to ensure their commissioning during the Twelfth Plan. Thus, the effect of 50000 MW initiatives would be visible in the Twelfth Plan period.

10.62 Geological uncertainty, contract management, resettlement and rehabilitation, delay in land acquisition and infrastructure development have been the main reasons for time and cost over-runs 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:

- Bankable DPR, based on a detailed survey, should be prepared to avoid geological uncertainty.
- Contract monitoring, as distinct from project monitoring, should be emphasized.
- Land acquisition and infrastructure development should be settled and completed before the start of the project.

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

- Preparation of a DPR based on economic viability to be expedited.
- Streamline clearances for pursuing priority projects.
- Simplify approval procedures.
- Facilitate the early financial closure of projects.

TABLE 10.15
Generating Capacity Anticipated at the End of the Eleventh Plan

	Hydro	Thermal	Nuclear	Wind and Renewables	Total
Installed capacity as on 31 March 2007	34653.77	86014.84	3900.00	7760.60	132329.21
Addition during Eleventh Plan	16553.00	58644.00	3380.00	14000.00	92577.00
Total capacity anticipated as on 31 March 2012	51206.77	144658.84	7280.00	21760.60	224906.21

Source: Planning Commission.

- Priority to be given to projects for which concurrence has already been issued by the CEA.
- High priority to be accorded to smaller capacity Run of the River-type hydro projects having gestation period less than five years.
- Basin-wise optimization studies for all the major river basins should be carried out.
- Competitive bidding other than tariff-based competitive bidding could also be considered for hydro projects since there are formidable construction risks in hydro power construction due to geological uncertainties and other factors.

Nuclear Power

10.64 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 installed capacity is 3900 MW_e which is 3.1% of total installed capacity. The PLF of Nuclear Power Corporation of India Limited (NPCIL) stations increased from 60% in 1995–96 to 82% in 2000–01 but it has decreased to 57% in 2006–07. Constraint in nuclear fuel availability is the main reason for lower PLF. NPCIL made major strides in cutting costs and construction periods for nuclear power projects in the Tenth Plan. The lower construction period and improved contracting and contract management have resulted in reduction in the capital cost per MW_e.

10.65 The Kudankulam project (2 × 1000 MW_e) is being set up, based on light water reactor technology, and NPCIL has initiated pre-project activities for its expansion with another two units of 1000 MW_e. Further, the design of 700 MW_e indigenous PHWRs has been undertaken by NPCIL to enhance the pace of first stage capacity addition programme. Pre-project activities of four such units have been initiated.

10.66 Having successfully completed the R&D phase of the FBR technology, the DAE has engaged the Indira Gandhi Centre for Atomic Research (IGCAR) for the design, development, construction, and operation of the country's first 500 MW_e liquid-sodium-cooled FBR. The government has set up a new company, Bharatiya Nabhikiya Vidyut Nigam Limited, in September 2003

to implement the first project based on the FBR technology. The first 500 MW_e prototype FBR is likely to be commissioned in the Eleventh Plan. The FBR technology is critical for developing the second stage of India's nuclear power programmes. Without developing the wide-scale use of FBR technology, India would find it difficult to go beyond 10000 MW_e nuclear capacity based on known indigenous uranium resources. About 20000 MW_e nuclear power programme is critical to developing the thorium-based third stage of India's nuclear power programme. Use of FBR technology would enable indigenous uranium resources to support it. The BARC is also engaged in R&D activities to develop advanced heavy water reactors of 300 MW_e capacity that would provide an alternative route to the thorium-based third stage of India's nuclear power programme.

10.67 The Eleventh Plan power programme includes 3380 MW_e of nuclear power plants. The GoI is making efforts to import nuclear fuel from abroad which is expected to improve the supply of nuclear fuel for nuclear power plants. It is also expected that the execution of nuclear projects will also be opened up to enable participation by other PSUs and private sector. The effect of this is likely to be visible in the Twelfth Plan period. NPCIL has indicated a capacity addition of about 11000 MW during the Twelfth Plan.

Merchant Power Plants

10.68 A merchant power plant does not have long-term Power Purchase Agreement for sale of its power and is generally developed on the balance sheet of developers. The GoI has reserved coal block with reserves of 3.2 billion tonnes of coal for allotment by Screening Committee of Ministry of Coal (MoC) for merchant and captive plants. About 10000 MW capacity is expected to be developed through this initiative. This capacity has not been taken into account while working out the capacity requirement over the Eleventh Plan period as it is not likely to materialize before the Twelfth Plan.

Captive Power Generation

10.69 Large number of captive plants including co-generation power plants of varied type and sizes exist

in the country which are either utilized in process industry or used for in-house power consumption. A number of industries have set up their own captive plants so as to get reliable and quality power. The installed capacity of captive power plants has increased from 588 MW in 1950 to 24680 MW in March 2007. The annual generation from captive power plants at the end of the Tenth Plan is likely to be about 78 billion units. Captive plants including co-generation power plants could, therefore, play a supplementary role in meeting the country's power demand. It is envisaged that during the Eleventh Plan period about 12000 MW capacity power plants would be added to the system which will take care of the demand of the industry and also supply surplus power to the grid.

Private Sector Participation (Box 10.3)

10.70 New initiatives in power sector development such as UMPPs, Merchant Power Plants, and Captive Power Plants are expected to trigger the capacity addition in private sector during ensuring Five Year Plans.

Box 10.3 Private Sector Participation

The policy of inducting private investment into the power sector, initiated in 1991, was expected to result in the addition of 17588 MW of power capacity in the Ninth Plan. The actual achievement was 5061 MW, a mere 29% of the target. Further, during the Tenth Plan capacity addition target in private sector was 7121 MW against which actual capacity addition was 2670.60 MW which is merely 37.50%, while the achievement ratio for Central and State sectors were higher at 55.47% and 51.79%, 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, slow growth in demand for future power below the expected levels, etc.
- The absence of enabling regulatory, legislative, and market environment.
- 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.

Fuel Requirements

10.71 The requirement of various fuels for the thermal plants by the terminal year of the Eleventh Plan (2011–12) considering a capacity addition of about 58644 MW, based on normative generation parameters such as PLF and specific fuel consumption, is summarized in the Table 10.16.

TABLE 10.16
Fuel Requirement during 2011–12

Fuel	Requirement	Availability
Coal	545 mt	482 mt
Lignite	33 mt	33 mt
Gas/LNG	89 MMSCMD	36 MMSCMD

Source: Working Group Report on Power.

10.72 However, total coal availability for power sector from domestic sources is expected to be 482 million tonnes per annum by 2011–12. There is need for augmenting availability of domestic coal for the power sector or import coal to bridge the gap between requirement and domestic supply. Further, 89 MMSCMD (million standard cubic metres per day) of gas requirement has been projected in 2011–12. At present, the availability of gas is of the order of 40 MMSCMD which is not sufficient to meet the requirement of even existing plants. Additional gas supply is expected from the K–G basin finds during the Eleventh Plan.

TRANSMISSION

Perspective Transmission System

10.73 The transmission system facilities had earlier been planned on regional basis with provision of inter-regional link to transfer regional surplus power arising out of diversity in demand. The generation resources in the country are unevenly located, the hydro in the northern and North Eastern States and coal being mainly in the eastern part of the country. Development of strong national grid has become a necessity to ensure reliable supply of power to all. A national grid can exploit the diversity of peak demand across regions, reduce it to the required peak capacity as well as facilitate better use of national hydro power capacity. The planning and operation of the transmission system has thus shifted from the regional level to the national level.

Transmission Capacity Requirement

10.74 The focus of transmission system development programme for the Eleventh Plan is to provide adequate inter-regional and intra-regional transmission capacity so as to consolidate and strengthen the national grid network towards a strong all-India grid. The inter-regional power exchange requirement has been assessed from possible scenarios of regional surpluses and deficits for the peak and off-peak conditions of winter, summer, and monsoon months. The projections are based on programme of generation and anticipated demand aim at estimating the transmission requirement at the inter-regional level. Grid expansion plan based on this projection would be able to cater to the needs of various feasible operating scenarios and also provide required margins to support market-oriented power exchanges.

Development of National Grid

10.75 It is envisaged to add new inter-regional capacities of 20700 MW at 220 kV and above during the Eleventh Plan period. This would increase the total inter-regional transmission capacity of national power grid at 220 kV and above from 14100 MW (by the end of the Tenth Plan) to 37750 MW by 2011–12. The plan for national power grid and the schemes have been identified. NER, Sikkim, and Bhutan have vast untapped hydro potential which is planned for development during the Eleventh Plan and beyond. The requirement of transmission system for evacuation of the NER hydro power has been estimated corresponding to the capacity of hydro projects which may be feasible to develop in the next 20 years. This generation is estimated to be about 35000 MW in the NER, about 8000 MW in Sikkim, and about 15000 MW in Bhutan. Taking local development at accelerated pace resulting in demand within the NER, Sikkim, and Bhutan to be in the range of 10000–12000 MW (presently it is about 1500 MW), the transmission requirement through the chicken neck works out to be of the order of 45000 MW. The total requirement including additional circuits for meeting the contingencies and reliability needs would work out to seven or eight HVDC bi-pole lines of 800 kV and four or five double-circuit lines of 400 kV—a total of 12 high-capacity transmission corridors passing through the chicken neck. For this, Right of Width

requirement would be about 1.5 km in width considering the minimum distance between adjacent towers to be such that fall of any tower does not affect the adjoining line. The first 800 kV HVDC bi-pole line has been planned from a pooling sub-station at Biswanath Chariyali in the NER upto Agra in the northern region. This is being programmed for commissioning matching with Subansiri Lower HEP in 2011–12.

Transmission Capacity for Trading/Margins

10.76 The method adopted for evolving the national transmission system expansion plan provides sufficient transmission capacities which would have inherent margins for trading transactions. Transmission system implemented on the basis of the expansion plan evolved in this manner would enable trading across the regional boundaries towards optimal utilization of generation resources in the country for ultimate benefit of the consumer.

Distribution

10.77 Distribution is the key segment of the electricity supply chain. The distribution sector caters to the rural and urban areas. Rural distribution segment is characterized by wide dispersal of network over large areas with long lines, low demand density, high cost of supply, low paying capacity of the people, large number of subsidized customers, unmetered flat rate supply to farmers, non-metering due to high cost and practical difficulties, low load and low rate of load growth. Urban distribution is characterized by high consumer density and higher rate of growth of load. Both segments are distinct with different problems and issues. The biggest challenge of the power sector is the high T&D losses. A combination of technical and non-technical factors is contributing to high T&D losses. Lack of consumer awareness, political interference, and inefficient use of electricity is further aggravating the problem. In urban areas too, the distribution system suffers from a large number of unauthorized connections and power theft.

10.78 The sub-transmission and distribution system were the thrust areas during the Tenth Plan. The performance of APDRP scheme has not been up to the mark in the Tenth Plan period and needs to be

restructured in the Eleventh Plan period as distribution is the key element for improving the overall performance of the power sector. For APDRP restructuring, following actions are suggested to be taken during the Eleventh Plan:

- All distribution companies should target a reduction of 3% per annum of their AT&C losses in next five years. High loss making feeders need to be franchised by distribution companies.
- Setting up of peaking power plants should be encouraged to overcome peaking shortages as the additional power cost of supply from such a plant could then be passed on to the consumer who opt for uninterruptible/reliable supply.
- Introducing bifurcation of feeders for agricultural users with unmetered power supply, automated metering of all distribution transformers, and GIS mapping of all consumers.
- Preparation of baseline data in respect of energy flow for each distribution transformer within three months of completing the above.
- Incentive for staff linked to specific measures of improvement.
- Web-based transparency of performance of each distribution transformer level including names of the staff responsible.
- Independent external audit to track and monitor outliers.
- Funds initially to be given as loan which may be converted to grant based on achievement of specific milestones on outcomes of investments.

10.79 The Working Group of the Eleventh Plan has assessed a total investment requirement of this sector as more than Rs 2 lakh crore. A major investment of this size is beyond the capacity of State utilities. It is therefore planned to set up a National Electricity Fund (NEF) to cater to the requirement of these companies. State utilities could prepare their distribution investment plans along with supportive measures including appointment of franchises, high voltage distribution supply, fast track courts to punish persons guilty of theft of electricity, use of covered cables in areas prone to theft of electricity, installation of metres, and a monitoring system with complete audit of electricity generated and received by the company.

The APDRP funds could be used to provide grant (25%) for utilities, the balance being the loan from the NEF and for North Eastern States this could be (90%) grant.

RAJIV GANDHI GRAMEEN VIDYUTIKARAN YOJANA (RGGVY)

10.80 The GoI launched RGGVY in April 2005 to provide electricity access to all rural households and extend free connections to all BPL households (estimated at 2.3 crore) by 2009. RGGVY subsidizes the capital cost by 90% through GoI grants. The approved capital cost estimate for RGGVY is Rs 16000 crore with a subsidy component of Rs 14750 crore. The physical targets included electrification of 125000 un-electrified villages by creating rural electricity distribution backbone and village electrification infrastructure and last mile service connectivity to 10% households in the village at a rate of Rs 6.50 lakh per village. The target to give free connections to 2.34 crore BPL households was also included in the above estimates. Further, the estimates covered intensification works in already electrified villages at a rate of Rs one lakh per village for 4.62 lakh villages.

10.81 While approval was accorded to Phase-I of the scheme of Rural Electricity Infrastructure and Household Electrification, which was later renamed as RGGVY by CCEA in December 2004, it was decided that implementation of Phase-I of the scheme in the Tenth Plan will have a provision of Rs 5000 crore as subsidy under the Plan Budget of the MoP for the remaining two years of the Tenth Plan, namely, 2005–06 and 2006–07. It was also decided that prior commitment of the States will be obtained, before grant of subsidy, for (i) deployment of franchisees for the management of rural distribution in projects financed under the scheme and (ii) the provision of the requisite revenue subsidies to the State utilities by the State Government as required under the Electricity Act 2003. CCEA also decided that the scheme is to be subject to concurrent evaluation and a view on modifications required for implementation during the Eleventh Plan may be taken after a comprehensive review towards the end of the Tenth Plan.

10.82 The target set by the MoP was electrification of 10000 villages in 2005–06 and the achievement reported was 9819 villages during the same period. In addition, intensification works were carried out in 350 already electrified villages. Against the total subsidy amount of Rs 1100 crore provided for 2005–06, an amount of Rs 1031.067 crore was released to the States. The total amount of funds released for RGGVY in 2005–06 was Rs 1616.24 crore which includes loans provided by Rural Electrification Corporation Ltd (REC) to meet the capital cost over and above the subsidy amount released for the scheme. The MoP had also reported that a total of 34003 households (including 16815 BPL households) were provided electricity access. The implementation of RGGVY in 2005–06 was mainly in the States of Bihar, Karnataka, Rajasthan, Uttar Pradesh, Uttarakhand, and West Bengal. However, the achievement of villages electrified in accordance with the revised definition of village electrification (requiring a mandatory coverage of at least 10% of the households to be electrified in a village declared as electrified) is yet to be verified and reported by the MoP.

10.83 The MoP set a target to electrify 40000 un-electrified villages under RGGVY in 2006–07. An amount of Rs 3000 crore was provided in the budget of the MoP to meet the subsidy requirements of RGGVY during the year. As on 31 March 2007, the MoP had reported a cumulative achievement of electrification of 50402 villages during 2005–06 and 2006–07, which includes 11177 electrified villages where intensive electrification had been carried out. In other words, the number of un-electrified villages electrified during 2006–07 is limited to 28706 only, that is 72.64% of the set target of 40000 villages. The intensification works had been carried out in 11177 villages. In respect of electricity access provided to households, the cumulative achievement was 731527 households (including 672588 BPL households). During 2006–07, a total of 697524 households (including 655773 BPL households) were provided with electricity access. The total funds released for RGGVY during the Tenth Plan were Rs 5475.15 crore which includes 10% of the loan component over and above the Central subsidy provided at 90%.

RGGVY IN THE ELEVENTH PLAN

10.84 An amount of Rs 3983 crore has been provided in the MoP budget for 2007–08 to meet capital subsidy under RGGVY. The MoP has set a target to electrify 40000 un-electrified villages during 2007–08. Meanwhile RGGVY for the Eleventh Plan has been approved by the Cabinet at the cost of Rs 28000 crore. A GoM has been appointed to look into enhancing the effectiveness of the scheme implementation.

10.85 The Rural Electrification component under the Bharat Nirman Programme envisages electrification of all 125000 un-electrified villages and 2.3 crore households (out of total 7.8 crore un-electrified households in the country) by 2009. Thus the Rural Electrification component under Bharat Nirman Programme is the sub-set of RGGVY. The time frame for these two programmes coincides.

R&D IN POWER SECTOR

10.86 With the twin cries of depletion of energy resources and environmental pollution, it has become more crucial to develop efficient and clean power plants and their delivery system. These plants should be capable of effective utilization of resources such as coal, NG, and other sources of energy. Thus, in order to meet India-centric requirements, various sectors related to the field of energy have been identified for segregating different research avenues. The depletion of fuel resources has resulted into the need of exploring renewable power generation. Similarly, the application of distributed power generation may be useful for electrification of remotely located un-electrified villages. Apart from this, application of new technologies in the field of generation, transmission, and distribution also needs to be given utmost emphasis.

Policy Issues

The following are the policy issues:

- Technology advancements and R&D have so far not been properly addressed. Major organizations such as NTPC, NHPC, Power Grid Corporation of India Ltd (POWERGRID) on the generation side and Bharat Heavy Electricals Ltd (BHEL), Asea Brown Boveri Ltd (ABB), and Siemens on the

manufacturing side must enhance substantially their budget allocations for R&D. The utilities should aim at least about 1% of their profit to be utilized for R&D activities and the manufacturing organizations should consider 3%–4% to be provided for technology development.

- Ultra Super Critical boiler technology, IGCC technology, and oxy-fuel technology are well researched abroad but have to be developed for Indian coal. NTPC, the major Indian Central Sector utility should have its R&D centre strengthened to expedite the work started during the Tenth Plan on IGCC. This project may be given top priority.
- There is a need to work with specialized S&T laboratories under CSIR and other space and nuclear establishments to develop material technology for advanced boilers, fuel cells, solar power, battery, and super conducting material application in power sector.
- The projects of national interest have to be taken upon collaborative research route. In future capital fund support for R&D should be reduced and utilities and industries should collaborate to fund R&D projects.
- R&D import should be exempted from custom duty to encourage indigenous R&D.
- A High Power Committee in R&D should monitor R&D projects and regulate funds. This will avoid duplication and ensure competitive R&D.

Human Resource Development and Capacity Building

10.87 Human resource development and capacity building in the present power scenario demands a very comprehensive and pragmatic approach to attract, utilize, develop, and conserve valuable human resources. Training, re-training, and career prospects are some of the important elements of human resource development. The reforms in the power sector have led to change in the role of senior engineers from a purely government-controlled technical management to business management in a corporatized framework.

10.88 Technically trained manpower comprising skilled engineers, supervisors, artisans, and managers is required in every sphere of the power supply

industry. Due to the introduction of more sophisticated technology and automation, the Man/MW ratio is declining over the years. The overall Man/MW ratio in power sector which was 9.42 at the end of the Ninth Plan is expected to go down to 7.00 at the end of the Tenth Plan and it is expected to be 5.82 at the end of the Eleventh Plan. This indicates the increasing importance of each individual, the man behind the machine. Therefore, the human resource development/training needs of technical, non-technical, and supporting staff should be given importance keeping in view the National Training Policy for the power sector.

10.89 It is estimated that during the Eleventh Plan, the availability of infrastructure for training is about 0.77 lakh man-months per year against the requirement of 3.40 lakh man-months per year. This shows that there is a deficit of about 77%. In spite of such a situation of lack of availability of required infrastructure, quite often a number of training institutes remain under-utilized. Therefore, there is need to network various training and academic institutions such as National Power Training Institute, Indian Institute of Management (IIMs), Administrative Staff College of India and other reputed institutions for providing training to power sector personnel.

LEGISLATIVE AND POLICY ISSUES

10.90 The Electricity Act 2003 has put in place a liberal and progressive framework for the development of electricity sector in the country. Its main objectives are promoting competition, protecting interest of consumers, supply of electricity to all areas, rationalization of electricity tariff, and ensuring transparent policies regarding subsidies.

10.91 The National Electricity Policy and the Tariff Policy have been notified under the provisions of the Act. The National Electricity Policy aims at providing access to electricity to all in the next five years by overcoming energy and peaking shortages and having adequate spinning reserves by the year 2012 for fully meeting the demand and supply of reliable and quality power of specific standards in an efficient manner and at reasonable rates. The Tariff Policy aims at ensuring financial viability of the sector and promoting transparency, consistency, and predictability in

regulatory approaches. It also aims at promoting competition and efficiency in operation and meeting quality of supply. Further, the Integrated Energy Policy aimed at promoting overall development of the sector has been announced. The Electricity Tariff Policy based bidding is mandatory for all plants from January 2006 excepting for public sector plants which are required to do so by 2011.

10.92 The legal provisions of the Electricity Act 2003, National Electricity Policy, Tariff Policy, and the Integrated Energy Policy provide an appropriate legislative and policy framework for the development of the power sector. The provisions of these policies must be implemented within the stipulated time in order to make power available at affordable cost to all by 2012. The major issues to be addressed in this regard during the Eleventh Plan are as follows.

Issues Related to Capacity Building

The issues related to capacity building are the following:

- There is a need to streamline and standardize the procedure to shorten the time cycle for obtaining environmental/forest clearance for power projects.
- The captive coal blocks development should be done in advance to match with commissioning schedule of power projects.
- The number of agencies having authorization to undertake exploration of coal blocks also needs to be increased.
- State governments should take suitable policy measures to make captive generation more attractive.
- To encourage R&M of old power plants, CERC should set up benchmarks for capital expenditure on R&M.

Issues Related to Promotion of Open Access and Trading

The following are the issues related to promotion of open access and trading:

- There is a requirement of having an enabling policy framework for merchant power plants which could be in the size of up to 1000 MW so that adequate power is available for open access.

- To provide transmission corridors for merchant power plants, adequate redundancy should be built at the stage of transmission planning.
- A rational transmission tariff framework is essential for facilitating optimum network use, promoting power trade, and facilitating open access.

Issues Related to Control Cost of Bulk Power

The issues related to control cost of bulk power are the following:

- Coal blocks should be offered on the basis of competitive tariff-based bidding as part of the integrated coal mine cum power project to reduce the fuel cost as major part of the cost of bulk power is fuel cost.
- The price of domestic natural gas and its allocation should be independently regulated on a cost plus basis including reasonable return till the time domestic supply exceeds demand by fertilizer and stranded power plants after which it should be market determined. An exception needs to be made for hydro plants that involve significant geological uncertainties.
- Various taxes and initiatives on generation, transmission, and distribution projects should be identical to remove distortions.
- Taxes on fuels should not distort economic fuel choices.

Issues Related to Improvement in Distribution Segment

The issues related to improvement in distribution segment are as follows:

- An National Electricity Fund be set up and supportive measures taken to bring major improvement in the distribution system.
- There is a need to restructure the APDRP to make it sustainable for better results.
- To reduce distribution losses and improve quality of supply to the consumers. The larger investments would be required for upgradation of distribution networks and a special drive would be necessary for identifying high loss areas and controlling commercial losses in such areas.
- AT&C loss reduction of 3% every year in next five years should be targeted by all States.

- Setting up of peaking power stations should be encouraged by time of day tariff for both producers and consumers to overcome peaking shortages as the additional power cost of supply from such a station could then be passed on to the consumers who opt for uninterrupted/reliable supply.

PLAN OUTLAYS

10.93 A public sector tentative outlay for the Eleventh Plan is Rs 554766 crore at constant price. This consists of Rs 343387 crore for the Central sector and Rs 211379 crore for the State sector. The proposed outlay for Central sector includes Rs 313722 crore IEBR requirement of PSUs (Rs 278781 crore for PSUs under the MoP, Rs 12218 crore for Power projects of Neyveli Lignite Corporation (NLC), and Rs 22723 crore for power projects of Atomic Energy). It also includes Rs 29665 crore budgetary support (Rs 26924 crore for programmes of the MoP and Rs 2741 crore for power related programmes of DAE). The State sector investments include borrowing amount of Rs 25000 crore for the APDRP scheme initially as loan to the SPUs by Central PSUs of the MoP. In addition, investment would have to be made to meet the gap, particularly in the T&D systems for which a group of ministers has been set up.

PETROLEUM AND NATURAL GAS SECTOR

ISSUES AND CHALLENGES

10.94 Currently, India's per capita consumption of petroleum products is about one-fifth of world's average per capita consumption. The share of hydrocarbons in the commercial energy is about 45% out of which the share of oil is 36% and that of natural gas is around 9%. In India, the indigenous production of crude oil has not been increasing in tandem with the consumption/demand of petroleum products. Considering the global trend of shift in energy mix from oil to gas, the share of gas in consumption pattern is also likely to increase gradually. India's current import of crude oil is more than 70% of its total requirements and the share is expected to increase in the near future. The impact of high oil prices in the international market and stagnant domestic oil supply has led to accelerated efforts on domestic exploration, venturing into overseas equity oil and gas and LNG imports as measures for

ensuring energy security. The hydrocarbon industry has been passing through very turbulent and challenging phases for the last few years.

10.95 The challenges before the country are:

- Maximizing supply of crude oil and gas at the least possible cost as part of energy security by getting as much as possible from known reserves, encouraging exploration for new finds, and getting equity oil abroad.
- Developing suitable gas market through exploration for finding new gas fields, rapid development of existing fields, creating a pipeline network for distribution and competitiveness.
- Creating conditions for competitive markets of petroleum products and regulating it to ensure that fair competition protects interests of all stakeholders.
- Rationalizing subsidies for kerosene and domestic LPG whose burden has increased dramatically. Effective delivery and targeting of subsidies are critical to reduce the burden.
- Ensuring large investment for creating marketing and associated infrastructure such as ports, storage, pipelines, etc.

10.96 Various policies and programmes have been pursued in the past for the petroleum and natural gas sector. A brief review of these is given below.

REVIEW OF THE TENTH PLAN

10.97 A brief review of the thrust areas identified during the Tenth Plan is given below.

Oil Security

- Under six rounds of NELP, 162 blocks have been awarded. A total of 37 discoveries have been made so far and development plans for their exploitation are under progress. In addition, 26 blocks have been awarded for exploitation of CBM and 6 TCF (trillion cubic feet) of gas reserves have been established so far.
- A number of Improved Oil Recovery (IOR) and Enhanced Oil Recovery (EOR) schemes were implemented to enhance the indigenous production of crude oil.

- Oil and gas PSUs were encouraged to pursue equity oil and gas opportunities overseas. OVL (ONGC Videsh Ltd), OIL, IOC (Indian Oil Corporation), and GAIL are actively involved in acquiring overseas exploration and production assets. Against the acquisition target of 10.14 million tonnes of oil and oil equivalent of gas (O&OEG) during the Tenth Plan period, OVL achievement was 22.24 million tonnes of O&OEG from its overseas activities.
- About 5 million tonnes strategic crude oil storage is under construction at three locations.
- Biofuels Policy initiatives for blending of petrol with ethanol and biodiesel with diesel were taken up.

Infrastructure Development

- Refining capacity at the beginning of the Tenth Plan was 118.37 million tonnes per annum which increased to 148.97 million tonnes per annum in the terminal year of the Tenth Plan.
- Private sector was allowed to market transportation fuels, namely, motor spirit, high-speed diesel, and ATF. However, the desired competition could not be achieved due to unprecedented increase in crude oil prices in the international market which led to the government intervention for moderating the prices of petroleum products.

Efficiency Improvement

- A number of energy efficiency projects were implemented to reduce energy consumption in various refineries.
- Petroleum Conservation and Research Association and other organizations have taken up a number of programmes on conservation of petroleum products in transport, industry, agriculture, and household sectors. However, the savings of petroleum products due to conservation and efficiency improvement measures have yet to be quantified.

Environment and Quality Improvement

- Road map was prepared for achieving product quality norms based on the Auto Fuel Policy Report. Diesel Hydro Desulphurization projects were implemented in the refineries.
- Introduction of Bharat Stage II petrol throughout the country was achieved by 1 April 2005. Introduction of Bharat Stage II diesel in a phased

manner was completed in various States. EURO III petrol and diesel were introduced in 11 major cities.

Reforms

- Petroleum and Natural Gas Regulatory Board Bill was passed and the Board has now been constituted.
- Dismantling of administered price mechanism (APM) regime was initiated w.e.f. 1 April 2002. However, the envisaged competition in the marketing of petroleum products could not be achieved. The GoI currently exercises control by declaring price caps. As a practical matter, full competition at refinery gate and retail level within the declared price caps should be allowed. Such competition will lead to lower prices and, over a period, lead to limiting/eliminating the government support on automotive fuels. If such price caps entail any compensation to National Oil Companies (NOCs) through pricing of crude oil or otherwise then such benefit should be made available evenly to both public and private sector players. The ultimate objective should be to remove government intervention in pricing of all petroleum products and provide targeted subsidies directly to the intended beneficiaries. Such subsidies should be funded through the National Budget. Full competition at the refinery gate and retail level would lead to trade parity prices.
- The phasing out of subsidies on domestic LPG and PDS kerosene envisaged during the Tenth Plan was not achieved.

10.98 The physical and financial performances of the petroleum and natural gas are given in Tables 10.17 and 10.18.

Exploration and Development

10.99 Under NELP, so far 162 exploration blocks have been awarded, covering an area of less than 40% of the Indian sedimentary basins. Out of the above 162 blocks, 115 blocks were awarded during the Tenth Plan.

10.100 Under the CBM policy, contracts with PSUs/private companies for 23 blocks in three rounds of bidding were signed. In addition, three blocks—two blocks to ONGC–CIL consortium and one block to

TABLE 10.17
Physical Programmes—Petroleum and Natural Gas

Programme	Ninth Plan	Tenth Plan	2002–03	2003–04	2004–05	2005–06	2006–07 (Prov.)	Achievement 2002–07	% of Target
	Actual	Target	Actual	Actual	Actual	Actual	Actual		
Demand/consumption (million tonnes)	100.43 [#]	120.4 [#]	104.2	107.75	111.63	111.92	119.85	119.85 [#]	99.5
Reserve accretion (Mtoe)	795.13	785–914	329.47	348.32	337.15	222.95	387.53	1652.92	178–207
Crude oil production (million tonnes)	162.99	169.38	33.04	33.37	33.98	32.19	33.98	166.56	98.3
Natural gas production (bcm)	140.92	177.48	31.39	31.96	31.76	32.20	31.55	158.86	89.5
Net Import									
Crude oil	–	–	81.99	90.43	95.86	99.41	111.50	–	–
Petroleum products	–	–	–13.06	–6.72	–9.38	–9.38	–15.77	–	–
Refining capacity (million tonnes) as on 1 April	118.37	138–155 [#]	118.37	127.37	127.37	132.47	148.97	148.97 [#]	–

Note: [#] Figures for the terminal year of the Tenth Plan.

Source: Ministry of Petroleum and Natural Gas.

TABLE 10.18
Outlays/Expenditure—Petroleum and Natural Gas

							(Rs Crore)	
Tenth Plan Approved Outlay	2002–03 (Actual)	2003–04 (Actual)	2004–05 (Actual)	2005–06 (Actual)	2006–07 (Actual) (Prov.)	Likely Achievement 2002–07	% Utilization	
96041.19 (119409.99)	15805.67 (18915.35)	16625.99 (19169.83)	20981.19 (23178.51)	251414.57 (26879.50)	29175.23 (29175.23)	108002.65 (117318.43)	112.45 (98.25)	

Note: Figures in the bracket are at 2006–07 price.

Source: Planning Commission

Great Eastern Energy Corporation Ltd—were awarded on nomination basis.

Financial Performance

10.101 An outlay of Rs 96041.19 crore was approved for the Tenth Plan for oil and gas PSUs against which the actual expenditure was Rs 108002.65 crore at current price. At constant 2006–07 price the expenditure was 98.25% of the approved outlay.

THRUST AREAS IN THE ELEVENTH PLAN

10.102 The policy issues that need to be addressed in the petroleum and natural gas sector relate to oil and gas security, pricing of petroleum products, pricing of domestically produced natural gas and its allocation to the power and fertilizer industry, ensuring competition and open access in the pipeline transportation and distribution grid, and conservation of petroleum products and natural gas.

OIL AND GAS SECURITY

Enhanced Exploration and Development

10.103 The Eleventh Plan envisages bringing more and more acreage under exploration especially those in the frontier areas/basins, adoption of state-of-the-art Exploration and Production (E&P) technology, faster development of discovered reserves, development of marginal fields, and continuation of IOR/EOR schemes. These efforts would lead to a projected total crude oil production of 206.76 million tonnes against the actual production of 166.56 million tonnes during the Tenth Plan. Similarly, the projected gas production will be 255.76 bcm against the Tenth Plan production of 159.06 bcm. In addition, CBM blocks would be awarded during the Eleventh Plan in Madhya Pradesh, Jharkhand, Gujarat, Tamil Nadu, and Arunachal Pradesh. During the Eleventh Plan, the CBM production is projected to be around 3.78 bcm.

Acquisition of Equity Oil and Gas Abroad

10.104 Considering the continuing gap between the demand and indigenous production of crude oil and natural gas and low crude oil reserves replenishment, NOCs and private companies are being encouraged to venture abroad. The various strategic options in this regard are: focus on ventures with producing property in the short term; purchase of equity share of companies as a part of reserves portfolio management; focus on exploration acreages in short to medium term, and promoting upstream sector services.

Strategic Crude Oil Storage

10.105 The government has taken in principle decision to construct 15 million tonnes of strategic storage in various phases. In the first phase, a project for creating a strategic storage of 5.0 million tonnes for crude oil is under implementation at three locations, viz., 1 million tonne at Visakhapatnam, 1.5 million tonnes at Mangalore, and 2.5 million tonnes at Padur, a site near Mangalore. This storage will be over and above the existing storage capacity for crude oil and petroleum products at the various refineries and would act as emergency response in case of short-term supply disruption. The project is anticipated to be completed during the Eleventh Plan.

DEVELOPMENT OF ALTERNATE FUELS

Coal Bed Methane

10.106 A total of 26 CBM blocks have already been offered in the three rounds of bidding. These fields are under development stage and production of CBM is expected in the Eleventh Plan. The bidding rounds will be continued in the Eleventh Plan and it is planned to offer CBM blocks in Assam, Arunachal Pradesh, Orissa, Jharkhand, Madhya Pradesh, Gujarat, and Tamil Nadu.

Gas Hydrates

10.107 National Gas Hydrates Programme was started in 1997. Till now, a large number of seismic surveys have been conducted. K–G basin, Mahanadi basin, and Konkan and Kerala basins have been identified as potential areas. The production of gas from the gas hydrates is one of the biggest challenges facing the energy

sector and technology is still to be established in this area. Pilot test production is planned to be carried out in India by 2009–10.

Underground Coal Gasification (UCG)

10.108 ONGC and GAIL have been exploring the possibilities of exploiting the gas through UCG process. The techno-economic feasibility and commercial exploitation is proposed to be carried out during the Eleventh Plan. ONGC has planned to produce 2.7 MMSCMD of gas through UCG process and envisages producing 2.99 bcm of UCG gas during the Eleventh Plan.

Coal to Liquid

10.109 OIL has carried out pre-feasibility studies on Catalytic Two-Stage Liquefaction Technology and Direct Liquefaction Technologies in order to select the best suitable technology for the North East coal for liquification. The feasibility study on the selected technology will be carried out during the Eleventh Plan. A joint task force between OIL and CIL has been constructed by MOP&NG to confirm availability and assured supply of coal in Assam, Arunachal Pradesh, and Meghalaya for a commercial plant.

Biofuels

10.110 After stabilization of 5% ethanol blending petrol sales, the content of ethanol in petrol would be considered for increasing up to 10% by the middle of the Eleventh Plan, subject to ethanol availability and commercial viability of blending. Depending upon the bio-diesel production and availability, the entire country may be progressively covered with sale of 5% bio-diesel blended diesel by the end of the Eleventh Plan.

Oil Shale

10.111 In India, shale formation is exposed to the surface in the region of Belt of Schuppen falling in Assam, Arunachal Pradesh, and Nagaland. The oil shale reserves are estimated at about 100 billion barrels. However, the production of shale oil requires large amount of energy and water. Environment and monetary cost have so far made production of oil from oil shale uneconomical.

REFORMS

Petroleum Product Pricing

10.112 With the dismantling of APM for petroleum products w.e.f. 1 April 2002, it was envisaged that the price of petroleum products would be moved from APM to market-determined pricing mechanism. An import parity pricing mechanism was followed by the oil industry which was subsequently modified to a trade parity pricing as an approximation to competitive market prices. Full price competition at the refinery gate and retail level needs to be adopted to enhance competition in the sector.

Phasing Out Subsidies on PDS Kerosene and Domestic LPG

10.113 For kerosene, it is proposed to provide direct subsidies to the consumers, particularly those below the poverty line. A system of smart card for supply of kerosene to BPL families would be introduced. With the smart card, kerosene may be bought from any shop at market price. In case of domestic cooking gas also, it is proposed to phase out subsidy gradually with the introduction of smart cards for domestic LPG which would help in preventing diversion of domestic LPG to the commercial sector.

Unified State Taxes and Removal of Tax Anomalies

10.114 There is a need to amalgamate the individual State markets into one nation-wide market with unified State taxes. Therefore, there is need to remove State tax anomaly, provide level playing field to domestic production vis-à-vis direct import, and introduce a uniform VAT which provides full set-off for local levies such as octroi and entry-tax at the State level.

ENVIRONMENTAL AND QUALITY MANAGEMENT

10.115 Efforts would be made to improve the Health Safety and Environment (HSE) management so as to provide occupationally healthier work force, reduced accident rates, cleaner and greener product with reduced emissions and effluents. The following measures would be implemented in the exploration and production sector during the Eleventh Plan period:

- Establishing environment management system for all oil and gas field installations and drilling rigs based on international standards to ensure improvements towards reducing discharges and emissions to internationally acceptable levels.
- Eco-rating of major installations and compulsory environmental audits.
- Pro-active measures to prevent marine pollution and to effectively combat oil spills.
- Benchmarking at par with international oil majors with respect to environmental practices.

10.116 On the basis of the assessment of the impact of Bharat Stage-II norms in the entire country and EURO III equivalent norms in identified cities, EURO IV equivalent norms in identified cities and EURO III equivalent norms in the entire country would be introduced w.e.f. 1 April 2010.

INFRASTRUCTURE DEVELOPMENT

Marketing Infrastructure

10.117 In view of the proposed increase in refining capacity during the Eleventh Plan, a large investment would be required for creating marketing and associated infrastructure such as ports, storage, pipelines, and terminals.

Manpower Planning

10.118 The rapid development of the oil and gas sector in the last few years has led to acute shortage of skilled manpower. Therefore, high degree of collaboration between the industry and academia, expanding training programmes to address emerging skill shortages, would be a major thrust area for planning sustained availability of knowledge workers in the petroleum and natural gas sector.

Servicing of E&P Activities in India

10.119 E&P service providers play a key role in enabling success for E&P operators. The accelerated growth of E&P activities has led to multifold growth in demand of technology and oilfield services worldwide. Therefore, availability of services in India is becoming constrained and expensive. Hence, there is a need to facilitate the growth of E&P service industry.

PHYSICAL PROGRAMMES

DEMAND/CONSUMPTION OF PETROLEUM PRODUCTS

10.120 The demand of petroleum products in the terminal year of the Eleventh Plan (2011–12) is projected at 131.77 million tonnes to 141.79 million tonnes against the anticipated consumption of 119.85 million tonnes in 2006–07, indicating a CAGR of 1.91% to 3.42% during the Eleventh Plan. The actual growth may be lower if the prevailing high oil prices continue during the Eleventh Plan resulting in policies encouraging energy efficiencies.

DEMAND OF NATURAL GAS

10.121 About 70% of the natural gas is currently being consumed in the fertilizer and power sectors. As per the Working Group on Petroleum and Natural Gas, the demand for natural gas in the terminal year of the Eleventh Plan is expected to increase up to 279.43 MMSCMD out of which 126.57 MMSCMD has been assumed for power sector and 76.26 MMSCMD for fertilizer sector. However, as per the MoP projections, the demand of natural gas for power sector would be only 89 MMSCMD. The lower projected demand of natural gas by the MoP is taking into account the prevailing market price and

availability of APM gas. Taking into account the lower demand for natural gas by the MoP, the total demand of natural gas in the terminal year of the Plan would be 241.86 MMSCMD. However, materialization of this demand would depend upon the price of natural gas.

HYDROCARBON RESERVE ACCRETION

10.122 The anticipated reserve accretion during the Tenth Plan was 1652.92 million tonnes, excluding Pvt/Joint Venture Company (JVC) share, against the target of 785–914 million tonnes. The projected indicative hydrocarbon in-place reserves during the Eleventh Plan are of 2129.44 million tonnes.

CRUDE OIL AND NATURAL GAS PRODUCTION

10.123 The targets for production of crude oil and natural gas are given Tables 10.19 and 10.20, respectively.

10.124 It may be seen from above that against the projected demand of 241.86 MMSCMD in the terminal year of the Eleventh Plan, the production will be only 173.23 MMSCMD. The additional requirement would have to be met through the import of natural gas.

TABLE 10.19
Crude Oil Production

Organization						(Million Tonnes)	
	2007–08	2008–09	2009–10	2010–11	2011–12	Total	
ONGC	27.16	28.00	29.00	28.53	27.37	140.06	
OIL	3.50	3.55	3.73	3.91	4.30	18.99	
Pvt/JVC	10.57	10.78	9.76	8.75	7.85	47.71	
Total	41.23	42.33	42.49	41.19	39.51	206.76	

Source: Working Group Report on Petroleum and Natural Gas.

TABLE 10.20
Natural Gas Production

Organization						(bcm)	
	2007–08	2008–09	2009–10	2010–11	2011–12	Total	
ONGC	22.10	22.53	22.77	22.99	22.00	112.39	
OIL	3.13	3.21	3.25	3.28	3.56	16.43	
Pvt/JVC	8.55	22.55	29.41	28.77	37.61	126.45	
Total	33.78	48.29	55.43	55.03	63.23	255.76	
Total (MMSCMD)	92.20	132.30	151.86	150.79	173.23	700.38	

Source: Working Group Report on Petroleum and Natural Gas.

LNG SUPPLY DURING THE ELEVENTH PLAN

10.125 Currently 5 million tonnes per annum of LNG is being imported at Dahej terminal. The Hazira terminal of Shell with capacity of 2.5 million tonnes per annum is operational but is yet to stabilize its operation. LNG supply is projected to reach a level of 23.75 million tonnes per annum by the year 2011–12. A detailed break-up of LNG supply during the Eleventh Plan is given in Table 10.21.

10.126 The projected crude oil and gas production from the NOCs overseas ventures is given in Tables 10.19, 10.20, and 10.22 .

REFINING CAPACITY

10.127 The refining capacity is projected to go up to 240.96 million tonnes per annum in the terminal year of the Eleventh Plan as against 148.97 million tonnes per annum in the beginning of the Plan. This addition to the refining capacity during the Eleventh Plan period would be 91.99 million tonnes per annum. This addition includes 38.5 million tonnes per annum

(Essar—3.5 million tonnes per annum; Reliance—29 million tonnes per annum; and Nagarjun—6 million tonnes per annum) from the private sector. Against the 240.96 million tonnes per annum of the projected refining capacity, the demand for products would be ranging between 132 million tonnes during the terminal year of the Eleventh Plan. Thus, the country would be in surplus of the refining capacity by almost 108 million tonnes. In view of the above, the setting of new capacity needs to be reviewed.

RESEARCH AND DEVELOPMENT (R&D)

10.128 India is spending around Rs 200–250 crore per annum on R&D efforts in the hydrocarbon sector having an annual turnover only of oil PSUs of around Rs 4 lakh crore. This is substantially lower compared to the research expenditure in developed countries that spend about 1% of the turnover towards R&D. A mission-oriented approach on co-operative basis needs to be adopted for developing technologies pertaining to exploration and exploitation of gas hydrates, UCG, conversion of coal to liquid (CTL), development of

TABLE 10.21
LNG Supply Projections during the Eleventh Plan

LNG Supply Source	2007–08	2008–09	2009–10	2010–11	2011–12
Dahej	5.00	5.00	7.5	10.00	10.00
Hazira	2.50	2.50	2.50	2.50	2.50
Dabhol	1.20	2.10	5.00	5.00	5.00
Kochi	–	–	–	2.50	5.00
Mangalore	–	–	–	–	1.25
Total LNG Supply (million tonnes per annum)	8.70	9.60	15.00	20.00	23.75
Total LNG Supply (MMSCMD)	30.45	33.60	52.50	70.00	83.12

Assumptions:

1. Hazira expansion to 5.0 million tonnes per annum is not considered in the Eleventh Plan.
2. Mangalore terminal is expected to be partially commissioned in 2011–12.

Source: Working Group Report on Petroleum and Natural Gas.

TABLE 10.22
Projected Crude Oil and Natural Gas Production from Overseas

		2007–08	2008–09	2009–10	2010–11	2011–12	Total
Crude oil production (million tonnes)	OIL	0.25	0.5	1.0	1.53	1.6	4.88
	OVL	7.02	6.53	5.97	5.76	5.35	30.63
	Total	7.27	7.03	6.97	7.29	6.95	35.51
Natural gas production (bcm)	OVL	1.75	1.82	1.93	1.97	2.2	9.67

Source: Working Group Report on Petroleum and Natural Gas.

shale oil, biofuels and hydrogen, etc. Presently, most of the funding comes from the government or the public sector. Under the present scenario the private sector is playing a significant role in the growth of the petroleum industry. Therefore, funding of R&D programmes from the private sector should also be encouraged.

PLAN OUTLAYS

10.129 A public sector tentative outlay for the Eleventh Plan is Rs 213514.59 crore at current price. This consists of Rs 150932.49 crore for exploration and production and Rs 62582.10 crore for refining and marketing sector. The PSU-wise outlays are given in Table 10.23.

10.130 In addition, during the Eleventh Plan, the government has decided to set up Rajiv Gandhi Institute of Petroleum Technology, an institute to cater to the education and training requirements of all segments of petroleum and natural gas industry. The total estimated cost of the institute is estimated to be Rs 695.58 crore, out of which Rs 285 crore is proposed to be met through the budgetary support.

TABLE 10.23
Public Sector Outlays for the Eleventh Plan
(Rs Crore)

PSUs	Eleventh Plan Outlay
A. Exploration and Production	
ONGC-OVL	45332.87
ONGC	75983.77
OIL	13439.02
GAIL	10326.83
IOC	2982.00
HPCL	2000.00
BPCL	868.00
Subtotal (A)	150932.49
B. Refining and Marketing	
HPCL	8714.00
BPCL, incl. KRL	11344.80
CPCL	3275.00
BRPL	1444.53
IOC	28567.75
IBP	0.00
NRL	593.00
MRPL	8643.02
Subtotal (B)	62582.10
Total petroleum and natural gas sector	213514.59

Source: Ministry of Petroleum and Natural Gas.

COAL SECTOR

ISSUES AND CHALLENGES

10.131 Coal provides 25.1% of global primary energy needs against 34.3% from oil, 20.9% from gas, 6.5% from nuclear, 2.2% from hydro, and 11% from renewable. The contribution of coal in the world's electricity generation is around 40%. Coal accounts for over 50% of India's commercial energy consumption and about 78% of domestic coal production is dedicated to power generation. The global hard coal consumption in 2005 was 4990 million tonnes. China is the largest producer of coal (2226 million tonnes) followed by the US (951 million tonnes) and India (398 million tonnes). The major coal exporters are Australia (231 million tonnes), Indonesia (108 million tonnes), Russia (76 million tonnes), South Africa (73 million tonnes), and China (72 million tonnes). The major coal importing countries are Japan (178 million tonnes), Republic of Korea (77 million tonnes), Chinese Taipei (61 million tonnes), UK (44 million tonnes), and Germany (38 million tonnes).

10.132 The growth in demand of coal in the Eleventh Plan is pegged at more than 9% per annum for enabling the power sector to attain the anticipated growth. The coal producing companies may not be able to jump from the present growth rate of less than 6% to more than 9% within a year, but there is need for aligning strategies so that the projected coal production from coal PSUs as well as captive coal mines materializes by the end of the Eleventh Plan. Under the Coal Mines (Nationalization) Act 1973, coal can be mined by public sector companies as well as designated captive users, which are steel, cement, and power at present, for their own use. An increase in the number of producers can help reach the targeted production. At the same time we will need to import more coal, which needs to be facilitated. Further, it is necessary to take required steps for addressing the need for matching the growth of infrastructure with the proposed growth in coal production. The desired expansion of the rail network and rolling stock for moving the projected quantities of coal from mines to load centres would need large investments. Coal movement should also be economical; therefore the railway freight rate for movement of coal needs to be rationalized.

A high freight rate increases coal price at a distance and distorts choice of fuels, reduces competitiveness, and results in mislocation of industries.

10.133 A competitive coal market is required for economic efficiency. Since for power plants, the major users of coal, coal cost is a pass through cost, price discovery mechanism is a challenge. We need to streamline the process of e-auction of non-coking coal and sell at least 20% of the non-coking coal production through this process for effective discovery of market price of coal.

10.134 An independent coal regulator is required to oversee the price discovery mechanism, regulate upstream allotment, and exploit available coal blocks to yield coal, coal bed methane, mine mouth methane, CTL, and for in situ coal gasification so that India, with the third largest reserves of coal in the world, becomes a long-term player in the highly liquid international market for coal. In order to deliver, coal companies must ensure that productivity of men and machines is at par with international standards. The cost of coal movement can also be reduced by washing and beneficiating coal as Indian coal has a high ash content. A change in the coal pricing system, where price of coal is fully variable based on its gross calorific value (GCV) rather than the current practice of grading coal by using wide ranges of useful heat values (UHV), is also called for.

10.135 The extractable coal reserves in the country will run out in about 45 years if domestic coal production continues to grow at 5% per year. However only about 45% of the potential coal bearing area has currently been covered by regional exploration and detailed drilling. Rapid increase of coal production requires accelerated exploration, augmentation of drilling capacity and capacity to assess coal reserves, and preparing geological reports.

REVIEW OF THE TENTH PLAN

Coal Demand and Production

10.136 Demand for coal in the terminal year of the Tenth Plan was projected at 460.50 million tonnes comprising 37.21 million tonnes of coking coal and 423.29 million tonnes of non-coking or thermal coal.

Demand from the power sector (utilities) touched 297.37 million tonnes. The CAGR of the demand was 5.66% against 5.74% envisaged at the time of formulation of the Plan and 3% actually achieved during the Ninth Plan.

10.137 To meet the surge in the demand of coal, Emergency Coal Production Plan of CIL was approved to raise the production by advancing the production schedule in 12 existing mines/ongoing projects and by taking up four new projects with a likely capital investment of Rs 2085.05 crore. Outsourcing of coal and overburden removal activities in these projects was proposed. Though the earmarked projects did not yield additional production during the Tenth Plan, they set the pace of implementation of new projects.

10.138 Production of coal in 2006–07 touched 430.54 million tonnes against the target of 430.10 million tonnes. While there were delays in taking up new projects during the Tenth Plan, augmentation of coal production was made possible by increasing the production from existing mines and acceleration in activities to reduce production build up period of ongoing projects. CAGR of production during the Tenth Plan period was 5.6% against 4.46% envisaged at the time of formulation of the Plan and 2.5% actually achieved in the Ninth Plan. Growth in CIL's production during the Tenth Plan was 5.28%. The output of captive mines increased at a higher rate.

Demand Supply Management

10.139 It is pointed out that the demand and production numbers are not weighted for quality of coal and differences in coal quality can also impact the demand realized. Finally, use of washed coal in power generation or the use of Corex technology in the steel sector is also not well accounted in establishing the demand numbers. The physical gap of 45 million tonnes between the demand and supply in the terminal year (2006–07) of the Tenth Five Year Plan was met through import of 45 million tonnes of coal (coking coal, 22 million tonnes; thermal coal, 23 million tonnes) as envisaged. Though the import of thermal coal by the power sector helped its planned generation programme, it resulted in reduced domestic off-take, resulting in additional stock build-up at pit heads.

Lignite Consumption and Production

10.140 Demand of lignite in the terminal year (2006–07) of the Tenth Plan was projected as 57.79 million tonnes (Tamil Nadu, 35.86 million tonnes; Gujarat, 16.27 million tonnes; Rajasthan, 5.65 million tonnes) but the materialization was about 30.63 million tonnes (Tamil Nadu, 20.51 million tonnes; Gujarat, 9.65 million tonnes; Rajasthan, 0.47 million tonnes) showing a CAGR of 4.93%. Linked to 16.36 BU of Gross Power Generation, the demand for NLC in 2006–07 was projected as 21.50 million tonnes. Consequent upon the downward revision of Gross Power Generation target to 15.71 BU, the demand for lignite was lowered by 1.09 million tonnes and kept at 20.41 million tonnes. NLC produced 19.38 million tonnes of lignite and generated 14.85 BU of gross power.

Coal and Lignite Inventories (Reserves)

10.141 As on 1 January 2007, the national coal inventory stood at 255 billion tonnes, out of which 97.92 billion tonnes are in the proved category. The inventory of lignite resources stood at 38.27 billion tonnes, as on 1 April 2006, with 4.5 billion tonnes in the proved category. Table 10.24 gives accretion of coal reserves over the years.

Central Sector Plan Schemes

PROMOTIONAL EXPLORATION

10.142 An outlay of Rs 275.80 crore was provided during the Tenth Plan for plan scheme of 'Regional/Promotional Drilling' for drilling 6 lakh metres, comprising 3.3 lakh metres for coal covering 43 blocks and 2.7 lakh metres for lignite covering 13 blocks; and for

other exploratory services including creation of coal/lignite database and CBM studies. Project-based approach was adopted for this plan scheme and 121 projects were sanctioned for implementation. Against the projection, 6.288 lakh metres (91%) of drilling was achieved during the Tenth Plan establishing 19.78 billion tonnes of coal resource and 17.53 billion tonnes of lignite resource.

DETAILED DRILLING IN NON-CIL BLOCKS

10.143 The blocks outside the purview of CIL were proposed to be explored in detail for reducing the time lag between offering the blocks to potential entrepreneurs and start of mining operations by them through the scheme of 'Detailed Drilling in Non-CIL Blocks' with budgetary support. The cost of exploration was to be recovered from the recipients of these blocks. This scheme continued from the Ninth Plan and an outlay of Rs 70.66 crore (Rs 57.86 crore for drilling and Rs 12.80 crore for other exploratory services) was provided during the Tenth Plan for drilling 2.13 lakh metre to bring 3.65 billion tonnes of resources under the proved category. Revised cost estimate of this Plan Scheme was approved in March 2006 where physical target was revised to 2.83 lakh metre of drilling with an outlay of Rs 93.84 crore. Against the projections, drilling of 2.84 lakh metre was achieved during the Tenth Plan, establishing 7.06 billion tonnes of coal resource as proved.

SCIENCE AND TECHNOLOGY (R&D)

10.144 Despite the thrust laid on coal science and technology (S&T) programme, the continuing scheme since 1975, the progress has not been satisfactory both

Table 10.24
Accretion of Coal Reserves over the Years

(In Million Tonnes)

Coal Reserves as on	Proved Category	Accretion in Proved Category	Inferred Category	Indicated Category	Total Reserve	Reserve Accretion
1 January 2002	87320	–	109377	37417	234114	–
1 January 2003	90085	2765	112613	38050	240748	6634
1 January 2004	91631	1546	116174	37888	245693	4945
1 January 2005	92960	1329	117090	37797	247847	2154
1 January 2006	95866	2906	119769	37666	253301	5454
1 January 2007	97920	2054	118992	38260	255172	1871

Source: Coal Directory of India.

in terms of taking up of new projects and utilizing the outlays provided to various ongoing projects. The cumulative expenditure during the Tenth Plan under this scheme was Rs 50.94 crore.

ENVIRONMENTAL MEASURES AND SUBSIDENCE CONTROL (EMSC)

10.145 The Ninth Plan scheme, namely, 'Rehabilitation, Control of Fire, and Subsidence in Jharia and Raniganj Coalfields' was merged in this Tenth Plan scheme. The purpose of the scheme is to improve the environmental conditions in old mined out areas, particularly, Jharia and Raniganj coalfields, through implementation of a number of projects for mitigating the damages that occurred due to unscientific mining carried out prior to nationalization of coal mines. Against an outlay of Rs 163.00 crore provided under this scheme, the cumulative expenditure in the Tenth Plan is Rs 52.57 crore. The progress of implementation has not been satisfactory due to constraints of land acquisition, agitation/frequent interruption by local people, non-finalization of site of rehabilitation by local authorities, some technical problems, etc.

INFORMATION TECHNOLOGY

10.146 The government had mandated all the ministries to formulate a plan scheme with an outlay of about 2% of the total Plan outlay in the field of information technology in order to give a boost to e-governance. Accordingly, the MoC spent Rs 4.21 crore in the Tenth Plan for improving infrastructure needed for e-governance.

COAL CONTROLLER ORGANIZATION (CCO)

10.147 CCO under Collection of Statistics Act 1953 and Rules 1959 undertakes the activity of collection of coal and lignite related data and publishes 'coal statistics' annually using an outlay of Rs 0.22 crore. The Tenth Plan expenditure under this scheme was Rs 0.93 crore.

CONSERVATION AND SAFETY IN COAL MINES AND DEVELOPMENT OF TRANSPORT AND INFRASTRUCTURE IN COAL MINES

10.148 On the directions of the Ministry of Finance, MoC in the year 2005–06 had proposed two plan schemes with an outlay of Rs 117 crore and Rs 135.79

crore, respectively. Activities under these schemes are funded as reimbursement of a portion of the stowing excise duty, which is statutorily levied as per the Coal Mines (Conservation and Development) Act 1974 and deposited in the government treasury account. Prior to 2005–06, the expenditure incurred in these schemes was shown under the non-Plan head. In spite of the fact that the Planning Commission insisted on treating activities under these schemes as non-Plan activities, matter could not be resolved with the Ministry of Finance. A token provision of Rs 0.01 crore in each of these schemes was provided in last two years of the Tenth Plan period.

Productivity of Coal and Lignite PSUs

EQUIPMENT PRODUCTIVITY

10.149 The Heavy Earth Moving Machinery (HEMM) productivity has improved significantly in the Tenth Plan. In Coal India Ltd (CIL), the increase in productivity of shovels was by 124%, dumpers by 15%, drills by 25%, and dozers by 14% over the achievements of the Ninth Plan whereas the productivity of draglines remained constant. In the case of Singareni Collieries Company Ltd (SCCL), the improvements in the productivity are to the tune of 18% in draglines, 21% in shovels, 50% in dumpers, and 6% in the performance of dozers. System capacity utilization in most of the coal companies is consistently indicated as more than 100%. However, the percentage utilization of machinery (except dragline machine) in open-cast mines remained below the standard norms of Central Mine Planning and Design Institute.

MANPOWER PRODUCTIVITY

10.150 The overall productivity in terms of the output per man-shift (OMS) has increased from 2.45 tonnes in the beginning of the Tenth Plan to 3.54 tonnes in 2006–07 in CIL and from 1.88 tonnes to 2.32 tonnes in SCCL. In NLC, the OMS has increased from 8.84 tonnes in the beginning of the Plan to 10.16 tonnes in 2006–07. Many activities have been outsourced by different coal companies during the Tenth Plan but its effect on manpower productivity has not been captured while assessing manpower productivity of respective coal companies.

Coal Movement

10.151 The Tenth Plan identified certain critical rail links in potential coalfields and the railways have taken up most of these for implementation. It was also envisaged to strengthen the infrastructure such as port capacity and backward rail linkages for higher coal imports. The movement of raw coal and coal products by rail from CIL and SCCL increased from 199.74 million tonnes (63.7% of the total coal off-take) in 2001–02 to 217.20 million tonnes (53.4% of the total coal off-take) in 2006–07. The component of merry go round movement has increased from 74.62 million tonnes (23.8% of the total coal off-take) in the beginning of the Tenth Plan to 96.35 million tonnes (23.9% of the total off-take) in the terminal year. The movement of coal by road in the beginning of the Plan was 51.35 million tonnes (16.4% of the total coal off-take) and has increased to 94.32 million tonnes (22.5% of the total coal off-take) in 2006–07. Coastal shipment (inland) of coal increased from 16.10 million tonnes in 2001–02 to 17.47 million tonnes in 2006–07.

Initiatives on Clean Coal Technologies

10.152 Higher thermal efficiency and better environmental performance are apparent benefits of Circulatory Fluidized Bed Combustion, Integrated Gas Combined Cycle (IGCC), and super-critical boiler. High ash Indian coal and high sulphur lignite have been found to be good for these technologies. Initiatives were taken in the Tenth Plan for improving efficiency of energy conversion of Pulverized Coal Combustion (PCC) boilers by giving thrust on adoption of super critical and ultra super critical technologies.

10.153 Coal India Ltd, SCCL, and NLC entered into MoU with ONGC for developing UCG technology. ONGC, in turn, tied up with Skochinsky Institute of Technology, Moscow for technical assistance. NLC took up an R&D project for gasification of lignite seams in Rajasthan but the project remained non-starter as technical consultant or adviser could not be found even after two rounds of global bid. Finally, NLC chose to enter into MoU with ONGC for consultancy in the project. A joint venture between GAIL and CIL proposed for surface gasification of coal is under active consideration.

10.154 Interaction between CIL and OIL has taken place on the business initiatives of Coal Liquefaction project by way of creating a 'Joint Task Force'. The project for converting coal from North Eastern Coalfields (NEC) to liquid would cost Rs 12600 crore including Rs 3500 crore for producing 3.5 million tonnes of coal.

10.155 A demonstration Coal Bed Methane project is under implementation with financial support from the Global Environment Facility and UNDP. Several CBM blocks have also been awarded to private companies for exploration and production during three rounds of bidding. Apart from this, exploration works on two blocks were awarded to two PSUs on nomination basis. Commercial production of CBM is expected in the beginning of the Eleventh Plan.

Safety and Welfare

10.156 Implementation of safe practices in all operations by the coal companies lowered number of serious and fatal accidents in mines. However, the number of casualty was inflated during the Plan period due to five disasters involving more than 10 deaths. The practice of monitoring mine safety through Worker's Participation in Safety in association with Internal Safety Organization of coal companies, risk assessment techniques, and safety audits was strengthened.

10.157 The wages of workmen in the CIL and SCCL were revised in 2005. In addition to enhancement in the quantum of fringe benefits and allowances, the minimum wage was increased to Rs 238.63 per day. There were substantial improvements in respect of welfare amenities such as housing satisfaction, water supply, education facilities, health care, etc.

10.158 The coal companies are committed to bear the social responsibilities in medical services, education, water supply, housing, co-operatives and banking, ecology and environment, and community development for their employees. In addition to this, community development activities were also undertaken by different coal companies of Coal India Ltd. During the Tenth Plan, CIL spent an amount of about Rs 85 crore on various community development projects.

Revival of Loss Making Companies

10.159 Three subsidiary companies of CIL, namely Eastern Coalfields Limited (ECL), Bharat Coking Coal Limited (BCCL), and Central Coalfields Limited (CCL), were loss making at the terminal year of the Ninth Plan period (2001–02). During the Ninth Plan period, efforts were made with little success to turn these companies around. Eventually, during the Tenth Plan these companies were referred to BIFR for devising strategy/measures for their revival/rehabilitation. One of the companies, CCL managed to come out of BIFR in the year 2005–06. Increased production and higher revenue earned by sale of coal through e-auction made it possible for BCCL to show profits for the first time since nationalization. CCEA approved the BIFR sanctioned rehabilitation scheme for ECL for making the net worth of the company positive by 2009–10.

Expenditure Pattern

10.160 The cumulative expenditure in the Tenth Plan in form of investment by PSUs (funded through IEBR)

was Rs 9574.49 crore (at 2001–02 price) against a provision of Rs 30556.48 crore which is 31.33% of the total outlay provided. Investments in CIL, SCCL, and NLC are 44%, 60%, and 33% of the outlay proposed during the Tenth Plan, respectively (see Table 10.25). Poor performance has been attributed to the late start of projects. Outsourcing of mining activities in many projects also brought down the requirement of capital investment as envisaged earlier.

Policy Reforms

- Pending the passage of the Coal Mines Nationalization (Amendment) Bill 2000, many policy initiatives such as permitting captive block holders to sell incidental coal surpluses during development and operation of the block to CIL or directly to currently linked end users, allowing group-captive mines, etc. were taken to increase the number of players in coal mining by making more coal available for allocation to different private and public companies for captive consumption and the State Governments for commercial mining. Initiative was taken to amend

TABLE 10.25
Company-wise/Scheme-wise Expenditure during the Tenth Plan

(Rs Crore)

Company/Scheme	2002–03	2003–04	2004–05	2005–06	2006–07	Tenth Plan	
	Actual	Actual	Actual	Actual	Actual	Original	Achieved [#]
(A) PSUs under MoC (IEBR)							
CIL	1147.54	1072.82	1055.90	1370.68	1674.10	14310.00	6321.04
SCCL	134.27	151.55	244.24	360.85	371.82	2113.00	1262.74
NLC	418.55	146.56	194.61	322.99	908.00	14133.48	1990.71
Total IEBR	1700.36	1370.94	1494.75	2054.52	2953.92	30556.48	9574.49
(B) Central Sector Plan Schemes (GBS)							
R&D (S&T)	6.74	9.11	11.32	12.54	4.85	100.00	44.55
Regional exploration	16.84	33.57	38.21	41.23	32.32	275.80	162.17
Detailed drilling–Non-CIL block	12.06	13.97	19.99	19.36	16.95	70.66	82.34
Environmental measures and subsidence control	12.63	0.00	4.31	21.46	6.46	163.00	44.87
Conservation and safety in coal mines	0	0	0	56.24	145.45	0	201.69
Development of transportation infrastructure in coalfield areas	0	0	0	42.54	11.16	0	53.69
Others (including VRS* and North East component)	115.39	16.80	94.05	1.01	24.79	425.06	252.05
Total GBS	163.66	73.45	167.88	194.38	242.00	1034.52	841.36
Total MoC	1864.02	1444.38	1662.63	2248.90	3195.92	31591.00	10415.85

Note: [#] At constant price (2001–02); * GBS was provided for implementing Voluntary Retirement Scheme (VRS) in the Tenth Plan but expenditure under this scheme occurred only in 2002–03 and 2004–05.

Source: MoC.

existing provisions of Mines and Minerals (Development and Regulation) Act (MMDR Act) 1957 to facilitate offering of coal blocks to potential entrepreneurs through competitive bidding.

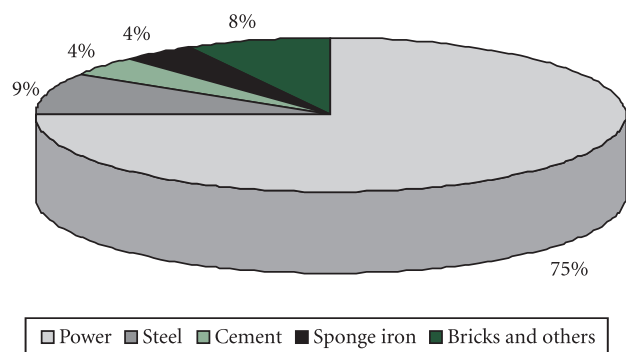
- Coal has been removed from the list of essential commodities under the Essential Commodities Act 1956.
- System of e-auctioning of coal open to both consumers and traders was introduced.
- Existing system of calculation of the royalty on coal and lignite on the tonnage basis was revised to hybrid formula-based system comprising fixed part (tonnage basis) and variable part (ad valorem basis).
- Coal gasification and coal liquefaction has been notified as end-use under the Coal Mines (Nationalization) Act 1973 for the purpose of allocation of captive coal blocks.

THE ELEVENTH PLAN

COAL DEMAND AND PRODUCTION

10.161 Coal demand is projected to reach 731.10 million tonnes by the end of the Eleventh Plan. Cumulative Annual Growth Rate in coal demand during the Eleventh Plan is projected at 9.7%. The sector-wise break up of the requirement is shown in Figure 10.1 and Annexure 10.1.

10.162 Coal production is envisaged to reach 680 million tonnes in the terminal year of the Eleventh Plan. The incremental production is envisaged to be 247.50 million tonnes as against 104.71 million tonnes



Source: Working Group Report on Coal and Lignite.

FIGURE 10.1: Estimated Sector-wise Demand for Coal in 2011-12

added in the Tenth Plan. CIL is expected to add 156.70 million tonnes, SCCL 3.30 million tonnes, and captive blocks 86.53 million tonnes. CIL envisages taking up 114 projects with an ultimate capacity of 230 million tonnes (to contribute 70 million tonnes in 2011-12) and SCCL 38 projects with an ultimate capacity of 55.40 million tonnes (to contribute about 8 million tonnes in 2011-12). Cumulative Annual Growth Rate in coal production during the Eleventh Plan is projected at 9.47% (Annexure 10.2).

DEMAND SUPPLY MANAGEMENT

10.163 In overall terms, the physical gap between the projected demand of 731.10 million tonnes and the projected domestic availability of 680 million tonnes works out to 51.10 million tonnes in 2011-12. This comprises 40.85 million tonnes of coking coal and 10.25 million tonnes of thermal coal. This requirement would need to be met from imports. In case production from captive blocks does not come as envisaged, the quantity of imports would be higher.

10.164 Given the fact that captive mines will take seven or eight years to ramp to full production, the end-use projects would either have to be delayed or some interim supply arrangements would have to be made. Since coal import for inland sites is not a viable option, coal PSUs would need to provide coal to those power plants that have been allotted captive mines till their captive mines achieve full production.

10.165 Coking coal production during the Eleventh Plan is projected to grow by 9.1% from the current level hovering between 17-18 million tonnes to 27.65 million tonnes in spite of the fact that no new resource of coking coal has been found.

LIGNITE DEMAND AND PRODUCTION

10.166 The Eleventh Plan envisages a lignite demand of 55.59 million tonnes (Tamil Nadu, 23.59 million tonnes; Gujarat, 23.73 million tonnes; Rajasthan, 8.27 million tonnes) in 2011-12. The additional lignite-based power-generation capacity in the Eleventh Plan is envisaged as 2225 MW. Lignite demand from NLC in 2011-12 has been projected to be 27.04 million tonnes implying CAGR of 6.89%. Lignite-based power generation by NLC during the Eleventh Plan is expected

to reach 26077 Million Unit (MU) implying CAGR of 11.91%. The lignite production is projected to reach 54.96 million tonnes (Tamil Nadu, 24.23 million tonnes; Gujarat, 22.26 million tonnes, Rajasthan, 8.47 million tonnes). NLC is expected to meet this level of demand growth.

CENTRAL SECTOR PLAN SCHEMES

10.167 Exploration activities undertaken under two plans schemes of the Tenth Plan namely regional/promotional exploration and detailed drilling in non-CIL blocks need to be carried forward in the Eleventh Plan for enhancing the pace of exploration in coal and lignite. Jharia–Raniganj Action Plan has been proposed in the Eleventh Plan to recover remaining coal before it gets burnt or become uneconomic due to sterilization. Existing EMSC scheme is proposed to continue with the objective of implementing the action plan. Existing S&T scheme is also proposed to continue in the Eleventh Plan.

Regional/Promotional Exploration

10.168 An outlay of Rs 383.50 crore has been proposed by the MoC for undertaking exploration activities under this scheme. A projection of 4.0 lakh metre of drilling in coal and 3.5 lakh metre in lignite has been envisaged to establish about 20 billion tonnes of coal and 4.06 billion tonnes of lignite resources. This excludes the programme for regional exploration by GSI where 1.94 lakh metre of drilling in coal and 0.10 lakh metre of drilling in lignite has been projected.

Detailed Exploration in Non-CIL Blocks

10.169 About 10 lakh metre of drilling has been proposed to be undertaken in 32 non-CIL blocks during the Eleventh Plan targeting 10.75 billion tonnes of resources to be brought under proved category. Major part of the exploration activity would be outsourced by CMPDI. The total fund requirement for detailed exploration in non-CIL blocks scheme during the Eleventh Plan has been estimated at Rs 893.89 crore.

Environmental Measures and Subsidence Control

10.170 The issue of land subsidence and fire in old mined out areas of Raniganj coalfields of West Bengal and Jharia coalfields of Jharkhand has been under

consideration of the government for quite some time. A scheme was formulated for mitigating adverse impacts of fire and subsidence problems caused due to unscientific mining activities by erstwhile owners before nationalization. However, the scheme did not yield desired results during previous Plan periods.

10.171 The Jharia–Raniganj Action Plan would be taken up for implementation during the Eleventh Plan under this scheme. The Action Plan proposes to deal with fires, rehabilitation of the uncontrollable subsidence prone inhabited areas, and diversion of railway lines/roads within the command area of BCCL and ECL. Total outlay proposed for the Action Plan is Rs 8638.87 crore spread over a 10-year period. The annual outgo for implementing the proposal would be of the order of Rs 860 crore as per the tentative cost estimates furnished above. It is proposed to fund Rs 350 crore per annum through accrual of cess by additional cess of Rs 6.50 per tonne under Coal Conservation and Development Act (CCDA) already being charged on all type of coal produced in the country, Rs 200 crore per annum through internal resources of CIL, and the remaining Rs 310 crore per annum through budgetary support. As accruals from cess are considered revenue to the government, the net budgetary support needed for the scheme would be Rs 660 crore per annum starting from the second year of the Eleventh Plan.

Science and Technology (S&T)

10.172 The main thrust areas in this scheme are promotion of clean coal technologies including coal beneficiation, in situ coal gasification, carbon capture and sequestration, coal bed methane/coal mine methane/abandoned mine methane, coal gasification, coal to oil, etc. Research efforts for industry-oriented projects would be promoted. Areas such as extraction of steep and thick coal seams, open-cast bench slope stability, strata control, etc. would be given special attention. An outlay of Rs 100 crore has been proposed for the implementation of this scheme.

Conservation and Safety in Coal Mines and Development of Transport Infrastructure in Coalfield Areas

10.173 Line entries were maintained under these schemes till the matter of treating them as non-Plan

schemes are settled with the Ministry of Finance. Planning Commission had not agreed with the proposal of the MoC for treating these schemes as Plan schemes as activities under these schemes are funded as reimbursement of a portion of the stowing excise duty, which is statutorily levied as per the CCDA and deposited in the government treasury account. The Ministry of Finance, now, is of the view that these schemes should be treated as Plan schemes for better monitoring. As the source of funding of these schemes is through the dedicated Subsidence Excise Duty collected under CCDA, funding would not be a problem.

INITIATIVES IN INFORMATION AND COMMUNICATION TECHNOLOGY

10.174 In order to improve efficacy of the project monitoring system and e-governance, the thrust areas that have been identified for introduction of ICT in the Eleventh Five Year Plan are computerization of various business functions up to project level; coal and lignite resource information system; resource depletion information system; Integrated CoalNet Application Software; GPS-based truck despatch system; GIS for mapping, spatial concepts, and time/space operations technology; integrated safety, production and environment monitoring and control in underground mines; centralized mail/messaging system; employee welfare. The estimated expenditure in this scheme is Rs 10 crore in the Eleventh Plan.

BENCHMARKING OF PRODUCTIVITY

10.175 The Eleventh Plan envisages achieving a productivity level of 5.54 tonnes per person shift in CIL and 2.67 tonnes in SCCL in the terminal year of the Plan. Thrust would be given on improvement of operational efficiency of the coal mining companies by establishing benchmarks for different mining operations/equipments and manpower productivity comparable with international standards and measures. The productivity norms of different HEMM benchmarked earlier for both availability and utilization in different coal companies would be revisited so that these are comparable with the international standards.

STRATEGIES FOR COAL MOVEMENT

10.176 In the terminal year of the Eleventh Plan (2011–12) it is proposed to move 348 million tonnes of raw

coal and products from CIL using railway network which is about 50% more than the rail movement in 2006–07. As against a Four Wheeler Wagon (FWW) requirement of 25300 per day by the end of the Tenth Plan, the Eleventh Plan envisages 36728 FWW per day in 2011–12 which is about 45% increase from the current level. It is proposed to augment rail movement of coal through independent freight corridors, matching wagon volume and matching unloading facilities at power stations, etc. Power stations will have to equip themselves for handling multiple types of wagons.

10.177 The port infrastructure needs to be strengthened in order to facilitate rise in imports as well as coastal shipment. About 110 million tonnes of coal is required to be handled at the end of the Eleventh Plan including coastal shipment implying a port capacity of about 120–130 million tonnes by 2011–12.

10.178 To ease out the load on rail infrastructure, it is equally important to develop alternative modes of transportation of coal through inland waterways and coastal movement.

INITIATIVES ON CLEAN COAL TECHNOLOGIES

10.179 Coal fired power generation would continue to occupy center-stage of India's energy scenario. Hence, it is desirable to have continuing improvements in its environmental performance, thermal efficiency, and thereby economics. Diffusion of new high-efficiency technologies in the field of energy conversion can lead to reduction in energy intensity of the economy. The process of producing energy has a significant impact on the environment, hence pollution abatement processes also form an important part of the development in this regard. A number of technologies have emerged for improving thermal efficiency and environmental performance. Different initiatives in this field are termed as clean coal technology, which include pre-combustion processes, combustion processes, and alternative use such as gasification of coal, coal bed methane, in situ coal gasification, etc. Different clean coal technologies do not compete with each other and have distinctive advantages.

10.180 Coal beneficiation is one of the prime clean coal technologies. The effect of coal washing and

thereby ensuring a more consistent fuel supply to conventional PCC boilers may improve their efficiency by around 1%.

10.181 High ash Indian coal needs clean coal technology for improving thermal efficiency of energy conversion processes and finally environmental performances. Use of washed coal ensures consistency of coal qualities and results in boiler performance improvement by allowing the unit and auxiliaries to operate near the design (optimum efficiency) points. The projected capacity increase in the country warrants introduction of higher capacity units (in the range of 800–1000 MW) where it is desirable to use washed coal for limiting the size/number of unit and auxiliaries within the conventionally available sizes.

10.182 The use of washed thermal coal has been on the rise during the Tenth Five Year Plan from 17.12 million tonnes in 2002–03 to 55.24 million tonnes in 2006–07. It is estimated that 243 million tonnes per annum of thermal coal is required to be washed by the end of the Eleventh Plan and accordingly about 140 million tonnes of additional thermal coal washing capacity would be created. The perfect growth in coal washing may be realized if the Planning Commission's suggestion to price coal on a fully variable GCV is implemented. Such a pricing methodology will provide the right incentive to both the producer and the consumer of coal to improve quality. However, enhancing washing capacity would increase demand for raw coal, unless the fines are used productively.

10.183 First 100 MW IGCC demonstration project will be taken up by a consortium of NTPC and BHEL with part funding from the GoI.

10.184 Underground coal and lignite gasification technology utilize fuel in different form and can be beneficial when used for inaccessible resources. CBM extraction enhances energy security by tapping an additional source of fuel which would otherwise have gone waste. CBM in association with CO₂ sequestration enhances methane recovery while reducing green house gas. Coal liquefaction involved conversion of coal into oil through gasification requiring surface

gasifier. CIL and NLC in association with ONGC would work towards making the technology successful.

10.185 CBM and CTL have been covered under petroleum and natural gas sector.

MINING TECHNOLOGY, SAFETY, AND WELFARE

10.186 Safety in coal mines is governed by the Mines Act 1952 and the rules and regulations framed hereunder. The Directorate General of Mines Safety (DGMS), under the Ministry of Labour and Employment has been empowered to enforce the statutes relating to mine safety. There is a Standing Committee on Safety in Coal Mines which is chaired by Minister in Charge of Coal. The strategies for action includes introduction of the concept of self-regulation, development of legislation, planning and technology, emergency response and disaster management, human resource development, and R&D effort including identification of areas of application of information technology in safety.

R&D IN COAL SECTOR

10.187 R&D in coal sector is carried out under four broad areas, namely, production, productivity, and safety; coal beneficiation; coal utilization; and environment and ecology. In addition to initiatives in clean coal technologies, efforts should be made to undertake industry-oriented R&D projects which may include areas such as extraction of steep and thick coal seams, open-cast bench slope stability, strata control, etc.

INVESTMENT NEEDS AND FINANCING PATTERN

10.188 The proposed public sector investment for the Eleventh Plan for supporting their production plans is Rs 35774 crore (CIL, Rs 17390 crore; SCCL, Rs 3340 crore; NLC, Rs 15044 crore including Rs 176.00 crore for the ongoing projects – NLC Mines Rs 2993 crore; NLC Power Rs 12051 crore). The outlay proposed for coal PSUs for the Eleventh Plan is about 117% more than the Tenth Plan outlay of Rs 30556.48 crore.

10.189 Against the estimated IEBR availability of Rs 69926.77 crore (CIL, Rs 51542.55 crore; SCCL, Rs 3340.30 crore; NLC, Rs 15043.92 crore), the

proposed plan outlay of PSUs is Rs 35774 crore (at constant price). While the resource position of SCCL and NLC is just sufficient to meet the plan outlay, there is a huge surplus in the resource position of Coal India Ltd and CIL has to consider productive investment of the surplus resources through feasible diversification plans.

10.190 The proposed outlay for departmental schemes to be supported through domestic budgetary support including North East component is Rs 6667.76 crore (at constant price) comprising promotional exploration, Rs 383.50 crore; detailed drilling in non-CIL blocks, Rs 893.39 crore; R&D, Rs 100.00 crore; EMSC/Jharia Action Plan, Rs 3614.07 crore; schemes under CCDA, Rs 1665.60 crore (Rs 692.95 crore for stowing and protective works and Rs. 972.65 crore for road and rail infrastructure); publication of coal statistics Rs 1.2 crore; and Rs 10 crore for e-governance. The Jharia–Raniganj Action Plan under EMSC scheme is proposed to be financed partly through the IEBR of Coal India Ltd (Rs 800 crore) and the rest Rs 1400 crore through the CCDA fund and Rs 1200 crore through budgetary support. Accordingly, the MoC would need Rs 5867.76 crore of domestic budgetary support for implementing above Plan schemes. This includes Rs 3065.72 crore coming from the accrued fund of Subsidence Excised Duty being collected under the CCDA at the rate of Rs 10 per tonne of all types of coal sold.

10.191 Thus the total plan outlay proposed for MoC for the Eleventh Five Year Plan is Rs 42442 crore (at constant price) which is 134% more than the Tenth Plan outlay of Rs 31591 crore.

POLICY REFORMS

10.192 Policy interventions required in the Eleventh Plan for:

- Restructuring CIL for optimizing their operations.
- Improvement in productivity of the sector by establishing benchmarks for different operations equipments comparable with international standards.
- Ensuring sale of at least 20% of coal production through e-auctions open to both consumers and traders.
- Promoting additional thermal coal imports under long-term supply contracts. Such coal imports could feed coastal power plants.
- Changing grading and pricing of non-coking coal from the existing UHV to the international practice of pricing coal based on GCV.
- Replacing coal linkages with fuel supply agreements.
- Promoting in situ coal gasification and tapping of coal bed methane/coal mine methane.
- Rationalization of rail freight rates for coal transport.
- Extending infrastructure status to the coal industry. Lower duties on capital goods imported for coal mines.
- Instituting an independent regulatory mechanism for the coal sector.
- Amending the provisions of Contract Labour (Regulation and Abolition) Act 1970 which prohibit employment of contract labour in mining activities. This will facilitate offloading of certain activities in coal mining for improved economics of operations.
- Promoting underground mining operations for extraction of deep seated deposits.
- Augmenting domestic coking coal supplies by opening up new mines and coal washeries.
- Augmenting port infrastructure capacity to facilitate envisaged rise in import.
- Exploration for CBM and detailed drilling in non-NLC lignite blocks should be included in existing Plan schemes.
- Institutional framework for maintenance of database on coal and lignite resource (net of depletion) is required which will have access to the geological data in respect of all coal/lignite blocks (whether held by public or private).
- Identifying forest areas as ‘Yes’ and ‘No’ zones for exploration, for saving energy in exploration in the area which can never be mined.
- Involving reputed domestic and international agencies in coal/lignite exploration.
- Concerted efforts for addressing the issues related to decommissioning of mines/mine closure after exhaustion of reserves are required to be made.
- Need for developing mechanism for management of occupational safety and health of coal miners and persons living in the vicinity of coal mining areas.

- Need for evolving appropriate corporate social responsibility for fulfilling the aspirations of population living in and around coalfield areas and to promote environmentally sustainable mining practices.
- Recruitment and skill upgradation of mining engineers and other professionals required for operation and statutory purposes in the coal/lignite mines need to be stressed upon. It is necessary to strengthen internal safety organization of respective coal producing companies and introduce safety audit of mines by independent auditors. Infrastructure including human resource for rescue and emergency response systems also needs reinforcement.
- Coal mining should be opened to private players without the restriction of captive use which requires passage of the Coal Mines (Nationalization) Bill 2000.
- Introduction of competitive bidding process in allocation of coal blocks by making suitable amendments in the MMDR Act. This would not only ensure optimal allocation of precious resources, but would also attract more serious players into coal sector.
- Need for a suitable Resettlement and Rehabilitation Policy which is acceptable to all concerned that is, State Governments, project-affected people (PAP), and coal and lignite producing companies.
- In order to gain confidence of the PAP, coal and lignite producing companies should return the restored/reclaimed land to PAP for appropriate use after mining operations have ceased in the area.
- Establishing standards for undertaking Energy Efficient and Conservation Programmes in all critical operations in the value chain starting from exploration to utilization and mechanisms for independent monitoring and verification of achieved energy savings and cost effectiveness of such programmes.

ENERGY EFFICIENCY AND DEMAND SIDE MANAGEMENT (DSM) PROGRAMMES

10.193 Energy conservation is a multi-faceted approach with the involvement of supply side, demand side, and also T&D system. The success of the energy conservation programme depends upon the aspects such as pricing of different fuels and electricity for

different categories of consumers, awareness among the users to appreciate the necessity of energy conservation, an effective institutional arrangement to co-ordinate energy conservation programmes, and other aspects that include mobilizing financial resources to fund energy conservation programmes. It is worthwhile to give necessary importance for energy conservation programmes in view of the fact that it is economical and wise to invest in energy conservation adequately in order to avoid creation of equivalent new capacities for generation with significant level of investment.

10.194 In India, DSM measures have a key role in eliminating power shortages to a considerable extent. The demand for electricity fluctuates within a 24-hour cycle as well as between seasons. This has important implication in 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, supply side is limited by insufficiency of investible resources and the demand side by lack of purchasing power. In such a situation, it is clear that a capacity to provide additional energy is always likely to lag behind the rising demand, unless consumption of energy is also economized.

10.195 The basic problem in power generation and supply is the maintenance of the frequency of the grid and the power factor of the loads at stipulated levels. The low-frequency conditions lead to instability of the interconnected grid and thereby causing frequent tripping. Sometimes this results in cascade tripping leading to total black out. It is essential that frequency is maintained between 49.8–50.2 Hz for effective grid management as well as maximization of useful life of thermal/nuclear generating plants. At present, the situation is managed by resorting to emergency manual load shedding by switching off various feeders. However, these are only temporary measures adopted to meet exigencies, arising from time to time, without attempting any strategy to influence the basic pattern of load curves.

BARRIERS IN IMPLEMENTING DSM

10.196 One of the basic reasons for energy inefficiency in India is energy pricing. Electricity rates, kept

deliberately low for a large block of consumption, do not send correct signals to consumers to alter their consumption behaviour. A typical case relates to the low agricultural tariffs (subsidies are as high as 80%–90% in most States) that have resulted in gross misuse of both electricity and groundwater. Low tariffs for domestic consumers also do not offer any incentive to encourage efficient use of energy. There is therefore an urgent need to look into the issue of pricing and efficient operation and management of the SEBs. Other 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 initiated by the utilities on an experimental basis.

10.197 The other important constraint in the implementation of Demand side Management (DSM) programme is the information gap. Indian consumers are not fully aware of the opportunities available for improving energy efficiency.

ENERGY-EFFICIENCY PROGRAMMES IN THE ELEVENTH PLAN

10.198 In the Eleventh Five Year Plan, Bureau of Energy Efficiency (BEE) will be strengthened as a nodal organization at the national level and will be empowered to provide direction to the energy conservation programmes in the States. An 'Energy Conservation Information Centre' will be set up within BEE to collate energy use data and analyse energy consumption trends and monitor energy conservation achievements in the country. Supporting organizational set-up will also be strengthened in the State designated agencies (SDAs) in various States and UTs. For this, a matching grant support from Central Government restricted to the contribution made by the respective States/UTs governments is proposed to establish State Energy Conservation Fund as mandated under EC Act. In the Eleventh Five Year Plan, BEE will focus energy conservation programmes in the following targeted sectors.

TARGETED SECTORS

Industrial Sector (Energy Intensive Industries)

10.199 BEE will develop 15 industry-specific energy efficiency manuals/guides for the following sectors:

aluminium, fertilizers, iron and steel, cement, pulp and paper, chlor alkali, sugar, textile, chemicals, railways, port trust, transport sector (industries and services), petrochemical and petroleum refineries, thermal power stations and hydel power stations, electricity transmission companies and distribution companies. The manuals will cover specific energy consumption norms as required to be established under the EC Act, energy efficient processes and technologies, best practices, case studies, etc. Follow up activities will be undertaken in the States by SDAs and manuals will be disseminated to all the concerned units in the industries.

Small and Medium Enterprises (SMEs)

10.200 SDAs in consultation with BEE will initiate diagnostic studies in 25 SME clusters in the country, including four to five priority clusters in the NER, and develop cluster-specific energy-efficiency manuals/booklets and other documents to enhance energy conservation in SMEs.

Commercial Buildings and Establishments

10.201 BEE will prepare building specific energy-efficiency manuals covering specific energy consumption norms, energy-efficient technologies, best practices, etc. As a follow up, SDAs would initiate energy audits and their implementation in 10 government buildings in each State and one or two buildings at UT level. BEE will also assist SDAs in the establishment and promulgation of energy conservation building codes (ECBC) in the States, and facilitate SDAs to adapt ECBC.

Residential/Domestic Sector

10.202 BEE will enhance its ongoing energy labeling programme to include 10 other appliances, –namely, air conditioners, ceiling fans, agricultural pump-sets, electric motors (general purpose), Compact Fluorescent Lamps, Fluorescent Tube Light (FTL)–61 cm, television sets, microwave ovens, set top boxes, DVD players, and desktop monitors. To facilitate this consumer awareness will also be enhanced nation wide.

Street Lighting and Municipal Water Pumping

10.203 To promote energy efficiency in municipal areas in various States, SDAs in association with State

utilities will initiate pilot energy conservation projects in selected municipal water pumping systems and street lighting to provide basis for designing State-level programmes.

Agriculture Sector

10.204 In the Eleventh Plan, SDAs will disseminate information on successful projects implemented in some States, launch awareness campaigns in all regional languages in print and electronic media, and initiate development of State-level programmes along with utilities.

Transport Sector

10.205 SDAs with assistance of concerned institutions/agencies will conduct diagnostic studies to establish the status of energy consumption and conservation in the sector. BEE will also set up labeling and/or norms for specific fuel consumption for a few automobile and transport categories (services/public transport). BEE in association with SDAs will facilitate State utilities to pursue DSM options by focusing on orientation workshops for awareness building, setting up of DSM cells in utilities to conceive and implement DSM programs, support load research and studies to rationalize the tariff structures, and initiation of DSM programmes, especially in the residential, agricultural pumping and municipal water works, and street lighting sectors.

10.206 Policy research on legislative amendments, policy interventions including fiscal and non-fiscal measures are planned to be undertaken in the Eleventh Plan.

PROPOSED TARGET OF ENERGY SAVINGS BY THE END OF THE ELEVENTH PLAN

10.207 It is proposed to set a target of 5% of the anticipated energy consumption level in the beginning of the Eleventh Plan as energy savings to be achieved at the end of the Eleventh Plan. Financial provision for the same has been made in the outlay of power sector.

CONSERVATION AND EFFICIENCY IMPROVEMENT

Demand Side Management

10.208 Road transportation consumes about one-third of the total consumption of the petroleum products in India. There is a need to reduce this consumption

by shifting goods and passenger traffic from roads to rails, improving the road infrastructure, streamlining of traffic signals, mandating fuel efficiency levels in transport vehicles, and developing hybrid electric vehicles (EVs).

Conservation of Petroleum Products

10.209 The major focus would be towards efficient use of petroleum products, minimizing the waste of energy sources, development of efficient equipments and their commercialization, educating and motivating the people towards conservation techniques and practices. There is a need to establish a system approach to quantify the conservation potential.

Benchmarking of Hydrocarbon Sector

10.210 To make the hydrocarbon sector globally competitive, the oil and gas industry needs to benchmark their operations against the best in the world and should upgrade their technology for improving the efficiency.

NEW AND RENEWABLE ENERGY SECTOR

ISSUES AND CHALLENGES

10.211 From a longer term perspective of the growing threat of climate change and keeping in mind the need to maximally develop domestic supply options as well as the need to diversify energy sources, renewables remain important to India's energy sector. Solar power could be important for attaining energy independence as well as a green house gas-free energy system in the long run. However, based on present technology with a concerted push and a 40-fold increase in their contribution to primary energy, renewables excluding hydroelectricity may account for only 5%–6% of India's energy mix by 2031–32. While this figure appears small, the distributed nature of renewables can provide many socio-economic benefits.

10.212 While there were renewable energy programmes taken up in the past to address the above challenges, the impact of these programmes were rather marginal. The lack of institutional support at the grassroots, poor focus on training and maintenance aspects, lack of awareness among rural community, subsidies acting as barrier in cost reduction, etc., were

found to be the bottlenecks for the programmes not achieving desired results. The actual benefit of the subsidies did not reach the beneficiaries but only acted as barriers in attempts for cost reduction and efficiency improvement of the renewable energy devices and gadgets.

10.213 A renewable energy source may be environment-friendly. It may be locally available thereby making it possible to supply energy earlier than in a centralized system. Grid-connected renewables could improve the quality of supply and provide system benefits by generating energy at the ends of the grid where otherwise supply would have been lax. Further, renewables may provide employment and livelihood to the poor. Hence, subsidies to renewables may be justifiable; however, they should be linked to outcomes and given for a well-defined period.

10.214 A majority of India's people especially in rural areas use traditional fuels such as dung, agricultural wastes, and firewood for cooking food. These fuels cause indoor pollution. The 1999–2000 NSS 55th Round revealed that for 86% of rural households the primary source of cooking energy was firewood and chips or dung cake. In urban areas too more than 20% households relied mainly on firewood and chips. Only 5% of the households in rural areas and 44% households in urban areas used LPG. Kerosene is used by 22% of urban households and only 2.7% of rural households for cooking. Other primary source of cooking energy used by urban and rural household covers coke and charcoal, biogas, electricity, and other fuels. The situation in rural areas calls for provision of

sustainable and clean energy supplies. In this context the role of renewable energy sources such as biogas, improved cook stoves, solar energy, and biomass based systems to meet the basic needs of cooking, lighting, and water heating is important.

10.215 The total quantities of traditional fuels used to meet the basic energy needs are substantial. Table 10.26 gives the data on household energy use. The biomass-based fuels dominate particularly in rural areas.

10.216 Use of traditional fuels for cooking with the attendant pollution and the cost of gathering them impose a heavy burden on people particularly women and girls. The need to gather fuels may deprive the girl child from schooling. Use of such fuels, overtime, increases the risks of eye infections and respiratory diseases. Lack of access to clean and convenient energy impacts the health of women and the girl child more adversely as they spend more time indoors and are primarily responsible for cooking. Women's micro-enterprises (an important factor in household income, as well as in women's welfare and empowerment) are heat-intensive (food processing), labour-intensive, and/or light-intensive (home industries with work in evenings). The lack of adequate energy supplies—and other co-ordinated support—affects women's ability to use these micro-enterprises profitably and safely. Furthermore, women often face additional barriers in making best use of available opportunities and obtaining improved energy services. There are social and practical constraints related to ownership and control over productive resources—women are typically excluded/marginalized from decision-making and

TABLE 10.26
Household Energy Consumption in India (July 1999–June 2000)

Fuel Type	Physical Units			Mtoe		
	Rural	Urban	Total	Rural	Urban	Total
Fire wood and chips (million tonnes)	158.87	18.08	176.95	71.49	8.13	79.62
Electricity (BkWh)	40.76	57.26	98.02	3.51	4.92	8.43
Dung cake (million tonnes)	132.95	8.03	140.98	27.92	1.69	29.61
Kerosene (million litre)	7.38	4.51	11.89	6.25	3.82	10.07
Coal (million tonnes)	1.20	1.54	2.74	0.49	0.63	1.12
LPG (million tonnes)	1.25	4.43	5.68	1.41	5.00	6.41

Source: Derived from NSS 55th Round (July 1999–June 2000) data, NSSO, Ministry of Statistics and Programme Implementation, GoI.

suffer barriers related to illiteracy, lack of exposure to information and training. It is estimated that in rural north India 30 billion hours are spent annually in gathering fuel-wood and other traditional fuels. The economic burden of traditional biomass-based fuels, time to gather fuels, time lost in sickness, and cost of medicines is estimated to be some Rs 300 billion. An energy policy responsive to social welfare must address this fact.

10.217 National surveys have indicated that for 86% of rural households, the primary source of cooking energy was firewood and chips or dung cake. The efficiency of fuel use is of vital importance for the users of these traditional fuels. The inefficient methods of using such fuels result in low thermal efficiency and high emission products. The traditional cooking methods produce very high concentration of air pollutants such as total suspended particulates, carbon monoxide, formaldehyde, etc. This is the major cause of indoor air pollution in the rural areas. Indoor air pollution makes the women and children who spend sufficiently long time in kitchens suffer from bronchial asthma, bronchitis, TB, and chest infection. Risk from all respiratory diseases and eye diseases increases with length of use of traditional fuels. The collection of traditional fuels results in drudgery of women and children since they have to walk long distances to collect such fuels. Moreover, the time spent for this purpose is significantly long, depriving them of their additional income which they would have earned during that time. Further, deforestation and environmental degradation also results in the long run. Collection of traditional fuels is at zero private cost but at tremendous social cost. Supply of clean cooking fuels for rural households would go a long way in addressing the social aspects associated with use of traditional fuels discussed above.

10.218 The Ministry of New and Renewable Energy (MNRE) is responsible for programmes covering renewable energy sources. The mission of the MNRE is as follows:

- Reduce dependence on oil imports through development and deployment of alternate fuels (hydrogen, biofuels, and synthetic fuels) and their

applications to contribute towards bridging the gap between domestic oil supply and demand and thereby improve energy security.

- Increase the share of clean power by promoting renewable electricity to supplement fossil fuel based electricity generation.
- Enlarge energy availability and improve access to meet needs for clean energy for cooking, heating, motive power and captive generation in rural, urban, industrial, and commercial sectors.
- Encourage convenient, safe, and reliable new and renewable energy supply options to be cost-competitive.

10.219 MNRE programmes include (i) grid connected and stand-alone power generation from small hydro, wind, solar, biomass, and industrial/urban wastes; (ii) rural energy programmes such as electrification of remote villages, biogas, and improved chulhas for cooking; (iii) solar energy applications such as thermal water heaters, solar photovoltaic applications for lighting and water pumping; and (iv) integrated rural energy programme (IREP). Research, development, and demonstration programmes in new technologies such as geo-thermal, hydrogen energy, fuel cells, alternative fuels for surface transport, etc., are also undertaken by MNRE. Indian Renewable Energy Development Agency (IREDA), a financial institution under the administrative control of MNRE, supports the renewable energy programmes by providing concessional funds. By the end of the Tenth Plan (as on 31 March 2007) the contribution of power generation from renewables had reached 10406.69 MW representing about 8.1% of total installed generating capacity. Of this, wind power accounted for 7092 MW followed by small hydro at 1975.60 MW and biomass (including co-generation) at 1158.63 MW. The estimated medium-term potential and achievement as on 31 March 2007 have been given in Table 10.27.

10.220 The progress in grid interactive renewable power at a glance is given in Table 10.28.

10.221 Table 10.29 gives the typical capital cost per megawatt and cost of electricity generated per kWh through different renewable energy sources.

TABLE 10.27
Estimated Medium-term (2032) Potential and Cumulative Achievements as on 31 March 2007

S. No.	Sources/Systems	Estimated Potential	Units	Cumulative Achievements
I.	Power from Renewables			
	A. Grid interactive renewable power			
	1. Bio power (agro residues and plantations)	16881*	MW	524.80
	2. Wind power	45195**	MW	7092.00
	3. Small hydro power (up to 25 MW)	15000	MW	1975.60
	4. Co-generation (bagasse)	5000	MW	615.83
	5. Waste to energy	7000	MW	43.45
	Subtotal (in MW)	133000	MW	10251.68
	B. CHP/distributed renewable power			
	6. Solar power	50000***	MW	2.92
	7. Biomass/co-generation (non-bagasse)		MW	45.80
	8. Biomass gasifier	–	MW	86.53#
	9. Energy recovery from waste	–	MW	19.76 MW
	Subtotal	50000	MW	155.01
	Total (A+B)	183000	MW	10406.69
	10. Remote village electrification	–	Nos	2821/830 (villages/hamlets)
II.	Decentralized Energy Systems			
	11. Family type biogas plants	120	Lakh Nos	38.90
	12. Solar photovoltaic programme	20	MW/sq km	
	(i) Solar street lighting system	–	Nos	61321
	(ii) Home lighting system	–	Nos	313859
	(iii) Solar lantern	–	Nos	565658
	(iv) Solar power plants	–	kWp	1870.00
	13. Solar thermal programme	–		
	(i) Solar water heating systems	140	Million sq m collector area	1.90
	(ii) Solar cookers	–	Lakh Nos	6.03
	14. Wind pumps	–	Nos	1180
	15. Aero-generator/hybrid systems	–	kW	608.27
	16. Solar photovoltaic pumps	–	Nos	7068

Note: # Progress upto 15 March 2007.

* Although potential is based on surplus agro-residues, in practice biomass power generation units prefer to use fuel-wood for techno-economic reasons. A potential of 45000 MW from around 20 MH of wastelands assumed to be yielding 10MT/ha/annum of woody biomass having 4000 k-cal/kg with system efficiency of 30% and 75% PLF has not been taken into account. In order to realize this potential a major inter-Ministerial initiative involving, among others, Environment and Forests, Agriculture, Rural Development, and Panchayat Raj would be required. Further, a Biomass atlas is under preparation which is expected to more accurately assess State-wise renewable energy potential from agro-residues.

** Potential based on areas having wind power density (wpd) greater than 200 W/m² assuming land availability in potential areas @ 1% and requirement of wind farms @ 12 ha/MW, all of which may not be technically feasible or economically viable for grid interactive wind power. This economically viable potential could get enhanced with higher level of land availability than what has been assumed. Areas having lower wpds might be suitable for off-grid applications. Further, preliminary surveys do not at this juncture suggest a sizeable grid interactive off-shore wind power potential.

*** Potential for solar power is dependent on future developments that might make solar technology cost-competitive for grid interactive power generation applications. However, insolation in the country varies between 4–7 kWh/m²/day.

MW = megawatt; kW = kilowatt; kWp = kilowatt peak; sq m = square metre; sq km = square kilometre; CHP = combined heat and power.

Source: MNRE, GoI.

TABLE 10.28
Progress in Grid Interactive Renewable Power

Resource	(In MW)			
	By the End of the Ninth Plan	Tenth Plan Addition	Eleventh Plan [#]	By the End of Eleventh Plan
Wind power	1667	5415	10500	17582
Small hydro	1438	520	1400	3358
Bio-power	368	750	2100	3218
Solar power	2	1	50*	53
Total	3475	6686	14050	24211

Note: [#] Anticipated in the Eleventh Plan.

* Dependent on future developments to make solar technology cost competitive for grid interactive power generation.

Source: MNRE.

TABLE 10.29
Capital Costs and the Typical Cost of Generated Electricity from the Renewable Options

S. No.	Source	Capital Cost (Crore of Rs per MW)	Estimated Cost of Generation per Unit (Rs per kWh)
1.	Small hydro-power [#]	5.00–6.00	1.50–2.50
2.	Wind power	4.00–5.00	2.00–3.00
3.	Biomass power	4.00	2.50–3.50
4.	Bagasse co-generation	3.5	2.50–3.00
5.	Biomass gasifier	1.94	2.50–3.50
6.	Solar photovoltaic	26.5	15.00–20.00
7.	Energy from waste	2.50–10.0	2.50–7.50

Note: [#] Up to 25 MW station capacity is covered under small hydro power.

Source: IEPR, 2006.

REVIEW OF THE TENTH PLAN

10.222 The approved outlay for the Tenth Plan for New and Renewable Energy Programmes was Rs 7167 crore comprising Rs 4000 crore as GBS and Rs 3167 crore of IEBR. The likely expenditure at the end of the Tenth Plan is Rs 4000 crore.

10.223 While the overall target has been achieved there are shortfalls in some programmes especially in solar thermal power. During the Tenth Plan wind power capacity of 5415 MW has been created achieving 3.61 times of the set target (Table 10.30).

10.224 In addition to the programmes of power generation other programmes relating to rural energy, urban applications, and R&D programmes have been implemented during the Tenth Plan. Around 5000 remote villages/hamlets have been provided with

TABLE 10.30
Power Generation through Grid Interactive Renewable Power

Source	Tenth Plan	
	Target (MW)	Actual (MW)
Wind	1500	5415
Small hydro	600	520
Biomass power and biomass gasification	700	750
Waste to energy	80	25
Solar photovoltaic	5	1
Solar thermal power	140	0
Total	3075	6711

Source: MNRE.

electricity from renewable energy sources mainly through solar energy. Village Energy Security Projects are under implementation in 100 villages. Around 5

lakh biogas plants have been installed. In the programmes catering to the requirement of urban areas under the solar water heaters programmes 12.5 lakh sq m collector areas of water heating systems have been installed. R&D activities have been carried out especially in the area of alternative fuel for transport including hydrogen energy.

ELEVENTH PLAN PROGRAMME

10.225 The various programmes of the MNRE for the Eleventh Plan have been drawn up in the light of recommendations made by Planning Commission and those made in IEPR. The five programmes proposed are:

- Grid Interactive and Distributed Renewable Power.
- Renewable Energy for Rural Applications.
- Renewable Energy for Urban, Industrial, and Commercial Applications.
- Research, Design, and Development for New and Renewable Energy.
- Information, publicity and extension, international relations, HRD and training, equity support to IREDA and spill-over liabilities.

10.226 Proposed outlay of Rs 10460 crore (at constant price) includes GBS of Rs 3537 crore. The physical targets and the financial outlays proposed by MNRE for the above programmes are given in Table 10.31 and 10.32.

TABLE 10.31
Financial Outlays Proposed for the Eleventh Plan
(Rs Crore)

Grid Interactive and Distributed Renewable Power	3925.00
Grid interactive renewable power	1800.00
Off-grid/distributed renewable power	2100.00
Performance testing	25.00
Renewable energy for rural applications	2250.00
Renewable energy for urban, industrial, and commercial applications	685.00
Research, design, and development	1500.00
Programmes to support information, publicity and extension, international relations, HRD and training, equity for IREDA, and spill-over liabilities	2100.00
Plan Outlay	10460.00

Source: Working Group on New and Renewable Energy.

TABLE 10.32
Physical Targets Proposed for the Eleventh Plan

Programme Component	Physical Target for Eleventh Plan (in MW)
Wind power	10500
Small hydro power	1400
Biomass power	1200
Co-generation	500
Urban waste to energy	200
Industrial waste to energy	200
Total	14000
Off-grid renewable power	
Wind/hybrid power	950
Small hydro power	
Bio power	
Solar power (grid/off-grid)	50
Total	1000
For remote villages/hamlets	
Remote village lighting	9000 villages/hamlets
Village energy security test projects	1000 villages
Common component for cooking/supplementary motive power	10000 villages/hamlets
For all villages	
Solar thermal systems—flat plate—concentrating	15 lakh sq m 1 lakh sq m
Family type biogas plants	20 lakh plants
Total	
Solar thermal systems/devices	
Water heating @Rs 1550/m ²	9.50 million sq m
Drying @Rs 1250/m ²	0.25 million sq m
Other (steam generation) @Rs 2500/m ²	0.25 million sq m
Instl./prog. support @Rs 200/m ²)	—
Municipal corporations—incentive	10 nos
Energy-efficient buildings	50 lakh sq m floor area
Akshay Urja Shops	2000 nos
Cities with RPOs	100 nos
Total	

Note: RPOs = Regional Project Offices.

Source: Working Group on New and Renewable Energy.

POLICY APPROACH

10.227 Capital subsidies that encourage investment without ensuring outcomes would be phased out. Incentives provided for grid connected power from renewable sources would be linked to generation and not to power capacities created. Thus power regulators will be asked to create alternative incentive structures such

as mandated feed-in laws or differential tariffs for grid interactive power.

10.228 Alternatively grid interactive renewable power will be promoted by mandating a renewable portfolio standard for all power distribution companies and providing a subsidy for each unit of renewable electricity purchased. The utilities would be free to meet their requirement by purchasing certificates from other utilities that may have a surplus of renewable electricity in their portfolios. Many State Electricity Regulators have stipulated RPS as required by the Electricity Act 2003.

10.229 To eliminate subsidy for other renewable system for rural, urban, industrial, and commercial applications, instead a large prize may be offered to one who sells a lakh or a million units first (for outputs sold directly to households), for example, solar water heaters, biogas plants, solar lighting systems, etc. This will promote competition, innovation, and consumer requirement oriented development.

10.230 To facilitate biofuels that require action by many different actors such as producer, processor, distributor, and consumers, a well-defined policy that provides incentives and leads to a competitive industry is needed. Also the policy has to be incentive compatible for all actors in the chain. With these in mind, the national biofuel policy has to be finalized.

10.231 To increase availability of finance for new and renewable energy, IREDA is to be restructured by broad basing its equity structure. IREDA needs low cost funds. It should be permitted to issue Capital Gains Bonds similar to those issued by REC and NHAI to the tune of Rs 300–400 crore per year during the Eleventh Plan. IREDA's role in financing renewable energy program-mes is to be enhanced.

R&D IN THE ENERGY SECTOR

10.232 R&D in energy sector is critical to augment our resources, meet our long-term needs, promote efficiency, attain energy independence, enhance our energy security, and ensure harmony with the environment. Energy R&D has not kept pace with the development of the energy sector in the country. There is a

need to substantially augment the resources for energy R&D and to allocate these resources strategically.

10.233 The report of the EC on Integrated Energy Policy has recommended setting up of a National Energy Fund (NEF [R&D]) for supporting studies on a regular basis in a number of institutions. The studies should be commissioned by NEF (R&D) from experienced and qualified individuals. The important areas are research and analysis for energy policy leading to outlining of technology road maps; energy policy modelling; launching of technology missions for developing near-commercial technologies and rolling out new technologies in a time bound manner; co-ordinated R&D in all stages of the innovation chain, etc. It is further recommended that each company in the field of energy should be mandated to spend at least 0.4% of its turnover on R&D.

10.234 Keeping the need in mind, a separate working group on R&D for the energy sector was set up for the formulation of the Eleventh Five Year Plan which supported the creation of NEF (R&D). In addition to the projected needs of Atomic Energy Commission and some R&D activities already being undertaken by individual energy ministries, the Working Group has identified areas which need support through NEF (R&D) in the Eleventh Plan (Table 10.33). The NEF (R&D) would be governed by an independent board with representatives from Department of Science and Technology, Planning Commission, and energy ministries. The government would finance the fund directly and through fiscal incentives. The fund would be used for supporting inter-institutional and inter-ministerial/inter-departmental research and for setting-up of Centres of Excellence in Universities/National Laboratories/Mission-oriented Agencies in the areas of identified energy technology.

10.235 Technology missions are the most appropriate mechanism, particularly when it requires co-ordinated action in a number of different areas, involving different ministries/departments, industry, academia, India's R&D infrastructure of laboratories and research institutions, and the private sector. The following National Technology Missions may be taken up in the Eleventh Plan. The list however excludes the

TABLE 10.33
Proposed R&D Initiatives in the Eleventh Plan

		(in Rs Crore)
S. No.	Items	Amount Projected
1.	Development and production of new material	400.00
2.	R&D in biofuels	200.00
3.	Combustion research initiative	200.00
4.	Energy R&D in Indian railways	45.00
5.	Hydrogen as a source of clean energy	350.00
6.	Advanced coal technologies	
	(i) Setting up of first 100 MWe IGCC demonstration plant	350.00
	(ii) In situ coal gasification of coal and lignite	30.00
	(iii) Coal to oil conversion	200.00
	(iv) Coal bed methane	35.00
	(v) Carbon capture and storage (incl. climate change issues)	125.00
7.	Ultra super critical technologies	30.00
8.	Energy storage systems	400.00
9.	Futuristic energy sources	
	(i) Gas hydrates	350.00
	(ii) Oil shale	15.00
10.	Energy efficiency	205.00
11.	Technologically important crystals—facility to manufacture polysilicon for production of single crystals of silicon	1200.00
12.	Light-emitting diodes (LEDs)—a viable alternative to fluorescent lighting	1000
13.	EVs and hybrid electric vehicles—viable alternate propulsion systems	175
	Grand Total	5310.00

Source: Working Group on Energy R&D.

initiative likely to be taken up by the Atomic Energy Commission.

- In situ coal gasification.
- IGCC.
- Carbon capture and sequestration.
- Bio-energy.
- Solar energy/technologically important crystals.
- Increased/enhanced oil and gas recovery and recovery of hydrocarbons from abandoned and isolated fields.
- Fuel-efficient vehicles. The automotive industry should be asked to achieve higher fuel efficiency standards.
- Combustion research initiatives.
- Development and production of new materials.

ANNEXURE 10.1
Coal Demand/Supply—Sector-wise Break-up

Sector	2001-02 (Actual)	2002-03 (Actual)	2003-04 (Actual)	2004-05 (Actual)	2005-06 (Actual)	2006-07 (Prov.)	2007-08 (BE)	2011-12 (Proj.)
(Million Tonnes)								
I. Coking Coal								
1. Steel and cokeries (indigenous)	18.73	17.66	16.68	17.51	16.99	17.51	18.00	27.65
2. Coking coal import	11.11	12.95	12.99	16.93	17.11	22.00	20.00	40.85
Subtotal	29.84	30.61	29.67	34.43	34.10	39.51	38.00	68.50
II. Non Coking Coal								
3. Power (utilities)	249.23	255.47	268.21	285.55	299.76	307.03	330.00	483.00
	(1.86)	(1.71)	(1.44)	(1.48)	(1.48)			
4. Power (captive)	19.22	19.55	18.19	27.10	26.58	24.65	33.60	57.06
	(1.36)	(1.53)	(1.74)	(1.71)	(1.71)			
5. Cement (incl. CPPs)	15.22	16.37	16.64	18.33	18.71	18.92	26.80	31.90
6. Sponge iron/CDI	4.40	6.17	7.59	10.99	14.73	13.07	15.10	28.96
7. BRK/others/export/SSF/	33.58	35.19	40.62	32.39	39.64	60.33	49.00	61.58
	(0.28)	(0.01)	(0.00)	(0.00)	(0.00)			
NLW coke/loco/colly,cons	321.65	332.74	351.24	374.35	399.41	424.00	454.50	662.50
Subtotal	(3.50)	(3.25)	(3.18)	(3.19)	(3.19)			
Total raw coal	351.49	363.35	380.91	408.79	433.51	463.51	492.50	731.00
Middling	(3.50)	(3.25)	(3.18)	(3.19)	(3.19)			

Note: colly,cons = Colliery consumption.

Source: Coal Directory of India/Planning Commission.

ANNEXURE 10.2
Company-wise Coal Production Programme

Company	(Million Tonnes)															
	Ninth Plan	2001-02 (Actual)	2002-03 (Actual)	2003-04 (Actual)	Tenth Plan	2004-05 (Actual)	2005-06 (Actual) (Prov.)	2006-07 (Actual)	2007-08 (Target/BE)	2008-09 (Proj.)	Eleventh Plan	2009-10 (Proj.)	2010-11 (Proj.)	2011-12 (Proj.)	Twelfth Plan	2016-17 (Proj.)
ECL	28.55	27.18	28.00	27.25	31.11	30.47	33.41	39.76	43.74	45.08	46.00	48.00				
BCCL	25.25	24.15	22.68	22.31	23.31	24.20	25.20	26.50	27.50	28.50	30.00	35.00				
CCL	33.81	36.98	37.33	37.39	40.51	41.35	44.00	47.00	55.00	65.00	78.00	115.00				
NCL	42.46	45.10	47.03	49.95	51.52	52.16	58.00	60.50	65.00	68.00	70.00	80.50				
WCL	37.01	37.82	39.53	41.41	43.20	43.21	42.40	42.95	43.65	44.50	45.00	45.00				
SECL	64.12	66.60	71.01	78.55	83.02	88.50	91.50	93.65	101.10	106.30	111.00	140.00				
MCL	47.81	52.23	60.05	66.08	69.60	80.00	88.00	99.00	111.00	122.00	137.00	197.00				
NEC	0.64	0.63	0.73	0.63	1.10	1.05	2.00	2.00	2.50	3.00	3.50	3.50				
CIL—Total	279.65	290.69	306.36	323.58	343.39	360.93	384.51	411.36	449.49	482.38	520.50	664.00				
SCCL	30.81	33.16	33.85	35.30	36.14	37.71	38.04	38.30	39.00	40.00	40.80	45.00				
Other Public Sector#	2.07	1.54	1.64	1.90	1.81	1.77	1.92	2.02	2.32	2.52	2.52	2.52				
Private—TISCO	5.64	5.92	6.14	6.37	6.52	7.00	6.50	6.50	6.50	6.50	6.50	6.50				
Captive Mining*	4.46	5.51	7.61	10.11	13.59	17.54	23.93	36.22	47.09	73.00	104.08	331.38				
Meghalaya	5.02	4.41	5.44	5.35	5.57	5.57	5.60	5.60	5.60	5.60	5.60	5.60				
All-India	327.64	341.23	361.04	382.62	407.01	430.52	460.50	500.00	550.00	610.00	680.00	1055.00				

Note: # includes ISCO, DVC, JSMDCL, and JKML; * includes Bengal Emta, JSPL, Hindalco, Monnet, ICML, Castron, and BLA Industries.

Source: Coal Directory of India/Working Group Report on Coal and Lignite.

ANNEXURE 10.3
Calorific Values, Units and Conversion Factors

Calorific Value of Various Fuels

S. No.	Name of Fuel	Unit	Calorific Value (kilocalories)
1.	Biogas	m ³	4713
2.	Kerosene	kg	10638
3.	Firewood	kg	4500
4.	Cowdung cakes	kg	2100
5.	Coal	kg	4000
6.	Lignite	kg	2865
7.	Charcoal	kg	6930
8.	Soft coke	kg	6292
9.	Oil	kg	10000
10.	LPG	kg	11300
11.	Furnace oil	kg	9041
12.	Coal gas	m ³	4004
13.	Natural gas	m ³	9000
14.	Electricity	kWh	860

Conversion Factors

1 kilocalorie	3.96832 btu, 4186.8 joules
1 kilowatt hour	3412.14 btu, 3.6 × 10 ⁶ joules
1 btu	0.252 kilo cal, 1.055 kilo joules
1 US Gallon	0.833 Imperial Gallon, 0.134 cft, 0.00378 cum
1 Imperial Gallon	1.2009 US Gallon, 0.1605 cft, 0.0045 cum
1 Cubic Metres	264.172 US Gallons, 219.969 Imperial Gallons, 35.3147 cft,
1 Cubic Feet	7.4805 US Gallons, 6.2288 Imperial Gallons, 0.0283 cum
1 BkWh hydro or wind electricity	0.086 Mtoe [#]
1 BkWh nuclear electricity	0.261 Mtoe
1 million tonne of coal	0.41 Mtoe
1 million tonne of lignite	0.2865 Mtoe
1 billion cubic meter of gas	0.9 Mtoe
1 million tonne of LNG	1.23 Mtoe
1 million tonne of fuel wood	0.45 Mtoe
1 million tonne of dung cake	0.21 Mtoe

Note: # Mtoe conversion factors are as per International Energy Agency (IEA) Practice.

Abbreviations

Unit	Name	Unit	Name
bcm	Billion Cubic Metre	MMBtu	Million British Thermal Unit
BkWh	Billion Kilowatt Hours	MMSCMD	Million Standard Cubic Meters per Day
Bt	Billion Tonne	Mt	Million Tonnes
btu	British Thermal Unit		
GW _e	Gigawatt Electrical	Mtoe	Million Tonne of Oil Equivalent
GW-Yr	Gigawatt Year	MVA	Million Volt Amperes
kcal	Kilocalorie	MW	Megawatt
kWh	Kilowatt Hour	MW _e	Megawatt Electrical
TCF	Trillion Cubic Feet		