
Introduction

Energy is a basic requirement for economic growth and social development and essential for all life-sustaining activities. While energy security has always been a key concern in all countries, nations have become increasingly conscious of the challenge of ensuring the growth of the sector in an environmentally-benign manner.

Energy and sustainable development are intimately related and the sector occupied an important place at the Earth Summit. Agenda 21 urges countries to enhance the *contribution of environmentally sound and cost-effective energy systems, particularly new and renewable ones, through less polluting and more efficient energy production, transmission, distribution and use*. More specifically, the key issues highlighted in Agenda 21 and reiterated at the IX session of the Commission on Sustainable Development relate to the following.

- Improving access to energy;
- Addressing environmental and social concerns in the energy sector;
- Enhancing energy efficiency and the use of environmentally sound energy systems (including advanced fossil fuel technologies);
- Mobilizing financial resources including participation of the private sector;
- Promoting renewable sources of energy;
- Addressing issues related to energy use in transportation; and
- Fostering international and regional co-operation.

This chapter examines the developments in the energy sector in India in the light of these key Agenda 21 concerns. Following a brief overview of the sector in India and a discussion of relevant Agenda 21 issues, the chapter analyses developments in the coal, oil and gas and power sectors to highlight achievements and concerns vis-à-vis the corresponding Agenda 21 objectives. New and renewable sources of energy and the linkage between transport and energy are dealt with in separate chapters.

Overview of the energy sector

Organization

Coal sector

Under the Constitution of India, the power to regulate mines and mineral development lies both with the central and state governments. The Parliament enacted the Mines and Minerals (Regulation and Development) Act in 1957, which provided for the administration of Schedule I minerals by the central government and the other minor minerals by the states. Coal is listed in Schedule I and so the development of coal resources is controlled by the central government.

Apart from the two government owned companies – Singareni Collieries Company Limited (SCCL) and the National Coal Development Corporation, the coal industry remained largely in the private sector until 1970. Subsequently, coking coal and non-coking coal mines were nationalized in two phases – coking coal mines in 1971-72 and non-coking coal mines in 1973 – reserving coal mining for the public sector. Nationalization was a response to the urgent need to make large capital investment in the coal mines to meet the burgeoning demand; to prevent unscientific mining and to ameliorate the working conditions of labour in the industry.

In 1975, the industry was reorganized with Coal India Limited (CIL) as the holding company. At present, CIL has seven coal-producing subsidiary companies and one planning and design institute.

The Ministry of Coal is the primary agency in the Government of India for formulating and implementing policy for the exploration and development of coal and lignite resources in the country. This includes all matters regarding production, supply, distribution and pricing of coal. It is also responsible for the administration of legislation in the sector discussed later. The Ministry has under its administrative control subordinate offices such as the Coal Controllers Organization and Coalmines Provident Fund Organization. The Coal Controllers' Organization is responsible for enforcing the Colliery Control Order 2000. The Ministry also exercises control over the public sector companies, CIL and Neyveli Lignite Corporation Ltd. In addition, it has a 49% share in SCCL, a state government enterprise for development of coal resources in the state of Andhra Pradesh.

Oil and Gas Sector

The Ministry of Petroleum and Natural Gas (MoPNG) oversees the entire chain of activities in the oil industry: exploration and production of crude oil and

natural gas; refining; distribution and marketing of petroleum products and natural gas, etc. While there are no statutory regulatory bodies, the Directorate General Hydrocarbons (DGH) acts as the de facto upstream regulator. The Oil Co-ordination Committee (OCC) was overseeing downstream activities until the deregulation of the sector in 2002. Post-deregulation, the role of the government in pricing and distribution is likely to be minimal and the OCC is to be replaced by the Petroleum Planning and Analysis Cell (PPAC) whose role will be restricted to analyzing domestic and international sectoral trends, maintaining a database and communication systems to deal with emergencies and the administration of limited subsidies on LPG (liquefied petroleum gas) and SKO (superior kerosene oil) as well as the freight subsidy to far-flung areas.

Exploration and production (E&P) in the country is primarily undertaken by the Oil and Natural Gas Corporation Ltd (ONGC) and Oil India Ltd (OIL). Private parties and joint ventures account for about 10% of the total oil and gas production. Refining/marketing operations are largely in the hands of public sector companies – Indian Oil Corporation Ltd (IOCL), Hindustan Petroleum Corporation Ltd (HPCL), Bharat Petroleum Corporation Ltd (BPCL) and IBP Co Ltd. In addition there are two private/joint venture refineries: the HPCL/A V Birla Group JV at Mangalore, Karnataka and Reliance Petroleum Ltd at Jamnagar, Gujarat.

The Gas Authority of India Ltd (GAIL) is the largest organization in India to handle post-exploration activities relating to transmission, processing, distribution and marketing of natural gas, its fractions and by-products. Gas is also marketed by smaller regional companies – by Mahanagar Gas Ltd (MGL), Maharashtra; by Gujarat Gas Company in Gujarat; and by Indraprastha Gas Limited (IGL), in Delhi.

Other prominent institutions in the sector include the Oil Industry Development Board set up to provide financial and other assistance for the development of the oil industry; the Petroleum Conservation Research Association, which coordinates energy conservation efforts; and the Oil Industry Safety Directorate which develops safety standards and codes for the industry.

Power Sector

Under the Indian Constitution, electricity is a concurrent subject, i.e. the Union and State governments have concurrent authority to make laws in the area though laws made by the Parliament and the Union override those made by the state legislatures.

Box 3.1 summarizes the organizational structure of the power sector. The structure has evolved considerably after independence as private participation progressively diminished and the sector assumed its current form – that of vertically integrated state-wide public sector utilities (State Electricity Boards, or SEBs). The role of the Government of India, initially limited to national planning and policy, extended over time to generation, transmission and financing. The share of the Centre in installed capacity progressively increased from 9.7% in 1979/80 to 30% as in March 2001. Distribution has remained with the states. In the nineties, however, changes have been effected, allowing the private sector a greater role. There has been a trend towards breaking up the SEBs along functional lines (Karnataka, Andhra Pradesh, Rajasthan, Uttar Pradesh, Orissa and Haryana) and inducting the private sector in distribution (Orissa).

Box 3.1 Institutional structure of the power sector

MoP (Ministry of Power): The nodal agency for planning, policy formulation, processing investment needs of public sector projects, monitoring of implementation of power projects, training and manpower development etc. The MoP is assisted by the following agencies in the execution of policies and programmes:

CEA (Central Electricity Authority): Advises the Ministry on technical, financial and economic matters and also regulates certain aspects of the sector.

REC (Rural Electrification Corporation): Provides financial assistance for rural electrification programmes.

NHPC (National Hydro Power Corporation): Plans, promotes and integrates the development of hydroelectric power in the country.

NTPC (National Thermal Power Corporation): Premier central sector thermal power generator with a share of more than 20% in generation capacity.

PFC (Power Finance Corporation): Provides term finance for power sector projects.

NPC (Nuclear Power Corporation): Under the administrative control of the Department of Atomic Energy is responsible for nuclear power plants.

PGCIL (Power Grid Corporation of India Limited): Responsible for transmission projects in the central sector and for the formation of the National Power Grid.

CPRI (Central Power Research Institute): Undertakes applied research in electric power engineering and functions as an independent testing and certification authority for ensuring the reliability of electrical equipment.

NPTI (National Power Training Institute): Responsible for training sector personnel in India.

Other Organizations that come under the MoP include the North Eastern Power Corporation, the Nathpa Jhakri Power Corporation, the Tehri Hydro Power Corporation and two statutory bodies, the Damodar Valley Corporation and the Bhakra Beas Management Board.

SEBs (State Electricity Boards): Constituted by the state governments, are responsible for generation, transmission and distribution in the most economical and efficient manner.

CERC (Central Electricity Regulatory Commission): Independent statutory body with quasi-judicial powers; regulates tariff-related matters and inter-state bulk sale of power, aids and advises the central government on tariff policy and promotes competition and efficiency in the sector.

SERCs (State Electricity Regulatory Commissions): set up in some states; engaged in regulating purchase, distribution, supply and utilization of electricity, quality of service and tariffs, responsible for promoting competition, efficiency and economy within the sector.

Energy reserves and production

India is the fourth largest producer of coal in the world, with nearly 8% of the world's reserves. India's total coal reserves are estimated at 213,905 MT (upto a depth of 1200 metres), of which nearly 86% are non-coking coal reserves (Table 3.1). Coal is the dominant energy source in the country, accounting for 70% of the total primary energy production in 2000-01. Coal production has increased from 214 MT in 1990/91 to 309 MT in 2000/2001. Indian coal has a low calorific value and high ash content. The production from open cast mines, which contributed only about 20% in 1970/71, had increased to 81% in 2000/2001.

Table 3.1. Energy supply indicators -2000/2001

Reserves/ Production	Coal (million tonnes)	Oil (million tonnes)	Gas (billion cubic metres)	Power
Reserves/Installe d capacity	213905.5 ^a	645	647	101630 MW ^d
Production/ generation	309	31.95 ^b	28.45 ^c	499.45 billion units

^a Coal reserves upto depth of 1200 metres, 1 January, 2001

^b Figures are for 1999/2000 and include crude oil production only. Petroleum products production during the year was 79.4 million tonnes.

^c Figures are 1999/2000. Gross production including flaring

^d As on 31 March, 2001

Source. MoPNG (2000)

In the oil and gas sector, India continues to be one of the least explored regions with just 30% of its estimated reserves having been (Table 3.1) explored so far. The annual production of crude oil in the last decade hovered around 32 MT while that of gas increased from around 18 BCM in 1990/91 to 28.45 BCM in 2000-01. At current production rates, India's existing proven oil reserves would last another 18 years, while gas reserves would be depleted in the next 25 years. The production of petroleum products in the country has increased from 48.5 MT to 74.42 MT between 1990/91 and 1999/2000.

India's power sector draws upon coal and petroleum products as well as the country's resources of uranium, renewable sources and hydropower. Installed capacity has increased from 66 GW in 1990 to 101.63 GW in 2001. Thermal capacity dominates the fuel mix with a share of 71%. The share of hydro stands at 25% and nuclear 3% while wind energy constitutes 1% of the total installed capacity. Coal is the dominant fuel used in the power sector, contributing 60% of the total installed capacity. Generation of electricity has

increased from around 264 billion kWh in 1990/91 to 499 billion kWh in 2000/2001. About 86.3% of the villages in the country have access to grid electricity.

Energy movement

Coal is transported mainly by rail. The other major mode of coal movement is the MGR (merry-go-round) system, which is preferred by the pithead power stations and comprises unit trains owned and operated by power stations. The total movement of coal and coal products in 2000/2001 was about 318 MT and the share of different modes as follows: rail (56%), MGR (22%), road (17%) and others (5%). Coastal movement has emerged as an important mode of coal transport to southern India.

Bulk transportation of petroleum products is primarily by rail tank-wagons and pipelines. In 1998/99, 38% of petroleum products were moved by rail while 26% were transported by pipelines, the remaining by road and coastal tankers. The share of pipelines in product movement has increased considerably over the last five years while that of rail has declined marginally.

The development of new pipeline infrastructure for petroleum products is being primarily undertaken by PIL (Petronet India Ltd). Natural gas is transported through pipelines. The largest of these is from Hazira in Gujarat to Delhi. It is proposed to import natural gas through LNG terminals and construction on two terminals, one at Dabhol for the power plant and the other at Hazira to feed the HBJ natural gas pipeline, has begun.

In the power sector, the transmission and distribution network has been strengthened and extended significantly. The length of T&D lines has increased from 1.1 million km in 1970 to 5.5 million km in 1998. The sector is characterized by relatively high T & D losses, over 25% in some states in 2000/01, resulting in sub-optimum utilization of existing assets.

Energy consumption

India's commercial energy consumption, though only one-fourth of the world's average, has grown significantly over time. The final commercial energy consumption has grown from 125 MTOE in 1990/91 to around 202 MTOE in 1999/2000. Coal continues to be the major energy source for the country- with a share of 55% of primary energy consumption. The share of oil stood at 36% of total energy consumption in 1999/2000.

The industrial sector is the largest consumer of energy, consuming about half of the total commercial energy in 1999/2000 followed by the transport sector (Figure 3.1).

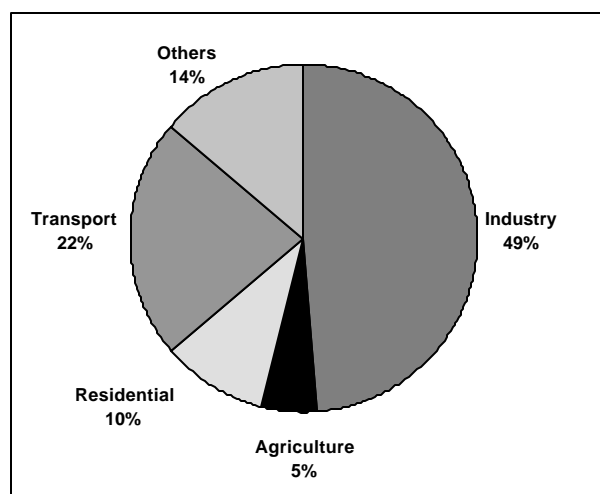


Figure 3.1 Sectoral composition of commercial energy consumption: 1999/2000

Source. TERI (2002)

The fuel composition of commercial energy varies significantly across sectors (Table 3.2). Over 70% of the industry's energy needs are met by coal. Due to the limited availability of indigenous coking coal and its deteriorating quality, low-ash coking coal is imported for blending with indigenous coal and used in integrated steel plants. Imports of coking coal have been rising continuously over the last 15 years and are about 12 million tonnes a year at present, while those of non-coking coal are around 9 million tonnes annually.

Table 3.2 Sectoral energy consumption by fuel: 1999/2000 (%)

	Coal	Natural Gas	Total Petroleum	Power	Total
Agriculture	0.00	1.27	9.51	89.22	100
Industry	73.10	2.36	13.61	10.93	100
Transport	0.00	0.00	98.49	1.48	100
Residential	0.00	1.12	71.32	27.56	100
Others	0.00	33.90	60.88	5.22	100

Source. TERI (2002)

The use of coal in the transport sector has become negligible following the substitution of steam traction with diesel and electric traction. Commercial energy consumption in the transport sector, about 98% of which is in the form of high-speed diesel and gasoline, grew at the rate of 3.1% per annum in the 1970s and at 5.6% per annum in the 1990s. The higher rates of energy consumption in the latter period are because of two structural shifts – one from the railways to roads for both passenger and freight movement, and second, a decline in the share of public transport in meeting urban travel demand.

The rising demand for petroleum products from transport and other sectors together with stagnating domestic production have led to an increased dependence on petroleum imports. Net imports of crude oil and petroleum products have more than doubled in the last nine years, from 27 MT in 1990 to 57 MT in 1999 (MoPNG, 2000).

Gas demand in the country has been increasing rapidly, with sales registering a 7% growth rate over the last decade. While there are no natural gas imports at present, long-term forecasts indicate that domestic gas production will decline, necessitating imports. In fact with demand outstripping supply, the government has had to resort to a system of gas allocations. Supplies to power and fertiliser plants have been given a priority and together these account for about 80% of the total sale.

The use of electricity in the agriculture and the domestic sectors has also increased over time. While about 86.3% of the villages in the country have been electrified, only 37% of the households actually use electricity for lighting. The result is that at least 70-80 million rural households still depend on kerosene lamps for meeting their basic lighting needs^a. The household sector continues to meet a large part of its energy requirement – as much as 40% – especially for cooking through the use of traditional fuels (NSSO, 1997 as cited in TERI, 2001). About 78% of the rural populace continues to rely on fuelwood as a primary energy source for cooking.

Energy and Agenda 21

Agenda 21 and the subsequent CSD sessions recognized the need to accelerate energy production to foster development and raise the living standards of people in developing countries. *Energy for sustainable development can be achieved by providing universal access to a cost-effective mix of energy resources compatible with different needs and requirements of various countries and regions. This should include giving a greater share of the energy mix to renewable energies, improving energy*

^a According to Draft Tenth Five Year Plan (2002-2007) of the MNES, Government of India.

efficiency and greater reliance on advanced energy technologies, including fossil fuel technologies (IX CSD Session). To implement these objectives, financial and technological assistance from developed countries and allocation of resources by national governments was emphasised. The international community should support national efforts by promoting capacity-building, technology transfer, investments and other forms of financial resources for developing countries. The specific Agenda 21 concerns for the energy sector, reiterated at the IX CSD session are elaborated below.

Improving access to energy

One of the guiding principles and priority areas of Agenda 21 is eliminating poverty and reducing disparities between and within nations with respect to the access to basic necessities. Access to energy is crucial to economic and social development and the eradication of poverty. *Improving accessibility of energy implies finding ways and means by which energy services can be delivered reliably, affordably and in an economically viable, socially acceptable and environmentally sound manner.*

Addressing environmental and social concerns in the energy sector

The underlying theme in Agenda 21 is the prevention and control of environmental degradation, and the integration of environmental concerns in the development process. Activities in the energy sector may cause severe impacts on the environment right from the mining stage through the processing stage to the final use of fuels in power generation or for transport. One of the mechanisms for integrating environmental consideration in development planning, is *to develop and implement integrated enforceable and effective laws and regulations that are based on sound social and ecological principles.* Another mechanism is the use of economic and market-based instruments that incorporate environmental costs in the decisions of producers and consumers.

An important dimension of sustainable energy systems is the direct social impact of energy development such as resettlement and rehabilitation of people displaced by clearing of land for mining or setting up large hydropower plants. Those losing land and other productive assets on which their livelihood depend, such as land owners, tenants and labourers could experience a decline in living standards and need to be adequately compensated. Addressing the social impacts of energy projects is an important component of sustainable energy development.

Mobilizing resources including participation of the private sector

The need to augment financial resources, both domestic and international, particularly for developing countries, as a means of implementing programmes for achieving sustainable development has been highlighted in Agenda 21. The financial performance of the sector is critical to its sustainability and the allocation of resources for undertaking environmental protection.

Business and industry can play an important role by providing financial resources and technological know-how. Agenda 21 underscores the need for a conducive and stable policy regime that enables the active participation of the private sector. The action plan goes on to urge the private sector to accord a high priority to environmental management.

Energy efficiency and environmentally-sound energy systems

Agenda 21 gives primacy to the role of efficiency in energy production, transmission, distribution and consumption, and on the use of environmentally-sound energy systems, such as advanced fossil fuel technologies and new and renewable sources of energy for controlling environmental damage. It advocates strengthening R&D and institutional capacities, and formulating appropriate policies and programmes towards the development and use of efficient and less polluting forms of energy. The need for favourable access to and transfer of environmentally sound technologies to developing countries has been emphasized.

International and regional cooperation

As Agenda 21 points out, *an open, equitable, secure, non-discriminatory and predictable multilateral trading system that is consistent with the goals of sustainable development and leads to the optimal distribution of global production in accordance with comparative advantage is of benefit to all trading partners.* This holds equally well in the context of energy resources. The other ways in which international cooperation, both in the private sector and through multilateral and bilateral organizations, can play an important role in the implementation of Agenda 21, is through cooperation in the development and transfer of technology and capacity-building.

In what follows, major policy and other developments in the coal, oil and gas and power sectors are discussed and analyzed to highlight achievements and concerns in the light of Agenda 21's objectives discussed above. Strategies and directions are proposed that will address the emerging concerns and go towards ensuring sustainable energy development envisioned in Agenda 21.

Review and analysis of policy and other developments in the energy sector

This section reviews legislation and policy developments in the energy sector to identify areas where energy sector policies have incorporated Agenda 21 issues and areas which remain a cause for concern.

Highlights of legislation, policy and other developments in the energy sector

Tables 3.3, 3.4 and 3.5 below provides an overview of the legislative framework and policies for the development of the energy sub-sectors in the country.

Table 3.3 Legislation and policy developments in the coal sector

Year	Law/Act/Policy	Main provisions
1952	Mines Act	Promoted the adoption of health and safety standards in coal mines.
1957	Mines and Minerals Regulation and Development Act	Vested in the Central government control over prospecting and mining of coal reserves.
1957	Coal Bearing Areas (Acquisition and Development) Act	Increased public control over coal production by empowering the Central government to acquire unworked land containing or likely to contain coal deposits.
1960	Mineral Concession Rules	Provided for procedures for the grant of prospecting licences, mining leases, payment of royalty for 'other minor minerals'.
1971	Coking Coal Mines (Emergency Provisions) Act	Provided for the take over of the management of coking coal mines and coke oven plants.
1972	Coking Coal Mines (Nationalisation Act)	Provided for nationalization of 214 coking coal mines
1973	Coal Mines (Taking over of Management) Act	Extended management control of the Central government to 738 coking and non-coking coal mines including the coking coal mines taken over earlier.
1973	Coal Mines	Nationalization of all coking and

	(Nationalisation) Act	non-coking coal mines and reserved coal mining for the public sector, with a few exceptions.
1974	Coal Mines (Conservation and Development) Act	Provided for the conservation of coal during mining operations.
1993	Coal Mines (Nationalisation) Amendment Act	Allowed private participation in captive coal mining and setting up of washeries.
1996	Committee on Integrated Coal Policy (Chari Committee)	Recommendations included deregulating prices, allocation of blocks on the basis of a competitive bidding process in which Indian companies including national coal companies could participate and establishment of a regulatory body.
2000	Colliery Control Order	Deregulated the prices of all grades of coal.

Source. TERI and IMC (2000)

Table 3.4 Highlights of policies and other initiatives in the oil and gas sector

Year	Policy/programme	Main provisions/Objectives
1975	Institution of the Oil Industry Development Board	Mobilize financial resources for the oil sector
1976	Institution of Administered Pricing Mechanism (APM)	Insulate domestic markets from volatility in international markets Assured availability of products throughout the country at uniform prices Framework to administer subsidies
1976	Establishment of Petroleum Conservation Research Association	Nodal agency to coordinate conservation efforts of the oil industry
1979	Exploration blocks put on bidding to attract private participation	Attract private sector in upstream area
1987	Allowing private participation in JV refineries	Attract private sector in refining area
1993	Allowing parallel marketing for LPG and SKO	Attract private sector in downstream area Increase availability of LPG and SKO

		Induce switch from traditional to commercial fuels
1993	Establishment of Directorate General Hydrocarbons	Attract private participation in upstream area Provide a de facto regulatory framework
1995	Introduction of unleaded petrol	Improve environmental quality
1997	Reduction in sulphur content of petrol	Improve environmental quality
1998	Initiation of phased dismantling of the Administered Pricing Mechanism (APM)	Phased reduction in tariffs Shift to market determined pricing mechanism
1998	Delicensing of refining sector	Strengthening role of private sector in refining sector
1999	Exploration blocks put on bidding under New Exploration Licensing Policy	Strengthening role of private sector in upstream sector
2000	Introduction of low benzene petrol	Improve environmental quality
2000	Introduction of low sulphur diesel	Improve environmental quality
2002	Administered Price Mechanism dismantled	Market determined pricing mechanism

Table 3.5 Highlights of major policies and other initiatives in the power sector

Year	Policy/Programme/ Act Notification etc.	Highlights
1969	The REC (Rural Electrification Corporation) set up	Set up under the Ministry of Power to fund programmes for rural electrification.
1975	The, National Thermal Power Corporation (NTPC) and the National Hydro Power Corporation (NHPC) set up.	The central sector begins to play an important role in power generation
1983	Amendment of the Electricity Supply S Act (1948)	Sought to ensure a minimum 3% return on the fixed assets of State Electricity Boards. Effected in 1985
1991	Electricity Laws (Amendment) Act	Permitted private investors to set up stand-alone generation capacities and to invest in captive and co-generation plants and renovation and modernization
1996	Common Minimum Action Plan for Power	National consensus on reforms - restructuring SEBs, rationalization of retail tariff, participation of the private sector and setting up of independent regulatory bodies at the central and state level as important to ensuring efficient growth of the sector.
1997	Notification for use of beneficiated coal	Mandated the use of beneficiated/blended coal with ash not of not more than 34% from June 2001 in power plants located beyond 1000 km from pitheads and those located in critically polluted areas, urban areas and ecologically sensitive areas.
1999	Notification for use of ash	To discourage the dumping of ash and promote its utilization. Power plants required to prepare an action plan for full utilization of fly ash, and provide ash free of cost (for at least ten years) for the purpose of manufacturing ash-based products. Brick manufacturers within a radius of 50 km from coal- or lignite-based power plants to use at least 25 per cent of ash with soil on weight-to weight-basis. Local authorities required

		to specify in their respective building bylaws and regulations the use of ash and ash-based products
1998	Electricity Regulatory Commissions Act	Enabled the setting up of independent and autonomous regulatory commissions at central and state levels. The Commissions were expected to promote competition, efficiency, and economy. Among other functions were to develop appropriate policies and procedures for environmental regulation of the power sector.
1998	Electricity Laws (Amendment) Act	1910 and 1948 Acts amended to give legal status to CTU/STU/RLDC and REB and provide for stand alone transmission companies, thus paving the way for the participation of the private sector in transmission
1998	National Hydro Policy	<p>Outlined various strategies required to exploit the vast hydro potential faster, maintain a reasonable minimum level of hydro in the power system, enable inter-state and inter-regional transfer of hydropower by suitable evacuation of power and encourage greater private investment for faster hydro development. These include measures such as:</p> <ul style="list-style-type: none"> - Survey and investigations of potential hydro sites - Basin-wise development of hydro potential - Premium on the sale rate of hydropower during peak period - Recommendations to address rehabilitation and resettlement of project affected persons
Year	Policy/Programme/ Act Notification etc.	Highlights
2000/01	Accelerated Power Development Programme (now called Accelerated Power Development and Reform Programmes)	<p>Centrally sponsored scheme initiated with the objective of providing systematic financing for:</p> <ul style="list-style-type: none"> ▪ Renovation and modernization ▪ Upgradation of sub-transmission and distribution network in the country for financial turn-around of the SEBs
2001	Energy Conservation Act	Enables the creation of the Bureau of Energy Efficiency which would recommend energy consumption norms and standards,

create awareness and disseminate information for efficient use of energy and its conservation, promote R&D in the field of energy conservation, provide financial assistance to institutions to promote energy efficiency, implement international cooperation programmes relating to energy-efficiency etc.

The following section discusses how these and other initiatives have addressed Agenda 21 concerns relevant to the sector.

Achievements

Improving access to energy

Providing energy at affordable prices has been a key component of the Indian planning process. The emphasis has been to increase production, expand the network for distribution and to ensure that the final consumer price is affordable, specially for the poorer segments of society. This is reflected in policies in the oil and gas sectors as well as the electricity sector.

Pricing policies in the oil and gas sector have aimed at ensuring affordable energy to households. The Oil Prices Committee (OPC), constituted in 1975, recommended the Administered Pricing Mechanism (APM) for the industry. At the core of the APM was the Oil Pool Account, an extra budgetary account, which reconciled the interests of the consumers and producers. The APM ensured:

- Achievement of socio-economic objectives of the government such as availability of petroleum products at subsidized prices
- Stable domestic prices insulated from volatility in international markets
- Assured availability of petroleum products throughout the country at uniform prices.

Even with the dismantling of the APM in 2002 (which is discussed in greater detail below) the government intends to continue with subsidies on LPG and kerosene to ensure that commercial fuels are affordable.

Similarly access to electricity has improved considerably since Independence (Table 3.6). Installed capacity grew from about 1,700 MW in 1950 to about 1,01,630 MW in March 2001. Commensurate with this, per capita consumption per annum increased from around 16 kWh at the time of Independence to about 360kWh at present. The pricing policies of power are also sensitive to the income levels of consumers.

Rural electrification has received a high priority in the country- about 86.3 % of the villages in the country and thirteen states in the country have been electrified. As per the latest estimates, out of the agricultural pumpset potential of 19.5 million, 12.2 million had been electrified by March 1999 (Planning Commission, 2000). The GoI has schemes to electrify the remaining villages. The 2001/02 Union Budget announced a package of initiatives for electrification of 80,000 villages that have no access to electricity over the next 6 years. Recognizing the difficulties of the SEBs in servicing debt, the 2002/03 budget introduced a new interest subsidy scheme called the Accelerated Rural Electrification Programme. The Budget also announced notable initiatives for the electrification of villages using renewable sources of energy. In particular, 500 villages situated in far-flung areas are to be electrified through small hydropower.

Table 3.6 Growth of Indian power sector

Indicator	1950	1992/93	2000/01
Installed capacity (GW)	1.70	63.6 ^a	101.63
Electricity generation	5.10	245	499.45
Per capita consumption (kWh)	15.00	283	360 ^b
Villages with access to grid	0.00	84.8 ^c	86.3

^a 1990 data

^b 1998/99 data

^c as on 31 March 1993

Source. MoP (2001), Planning Commission (2001a); TERI Energy Data Directory and Yearbook (various years)

Addressing environmental and social concerns

The energy sector seeks to achieve environmental protection by implementing provisions under environmental legislation and policy statements (Chapter 2). The aim of these has been to ensure that the environment is adequately protected through project-specific safeguards and minimum effluent/emission discharge standards. Major initiatives taken in the 90's have been the introduction of mandatory EIA's (1994); public hearings for consideration of these EIA's (1997) and certain other specific steps discussed below.

In the coal sector, the central government has taken a number of measures for the control of fire and subsidence in some coalfields and the protection of the environment in all coal mining areas. Environmental Monitoring and Subsidence Control (EMSC) schemes have been taken up in Raniganj and Jharia coalfields for controlling fires, thereby enabling coal conservation and stabilization of old abandoned workings lying under habited areas. Box 3.2

outlines the policies proposed in successive Five-Year Plans for environmental protection in mining areas.

Box 3.2 Policies proposed in successive Five-Year Plans for environmental protection in mining areas

- Environmental guidelines to be prepared for coal mining.
- Environmental impact assessments to be conducted for mining projects.
- Environmental management plans to be made an integral part of the mining feasibility project reports for new projects.
- Monitoring and implementing environmental protection measures such as land reclamation after mining to be undertaken.
- Improving environment and ecology through scientific land management.
- Preparing a comprehensive rehabilitation policy.
- Concurrent restoration of land in ongoing and new projects. Restoration of land and implementation of environmental safeguards in old worked out areas.
- Establishing an independent agency to formulate and implement environment preservation schemes for the coal (and associated) sectors.
- Integrated approach to the development of coal mining blocks with specific regard to environmental and forestry issues.
- Streamlining forestry and environmental clearance procedures.

CIL has spelt out its policy on land reclamation in mining areas. The Resettlement and Rehabilitation (R&R) policy of CIL has been designed to ensure that affected people improve or at least regain their former standard of living and earning capacity after a reasonable transition period. Coal India Limited is implementing the Environmental and Social Mitigation Project (ESMP) in 24 coal projects with World Bank funding. However, such programmes are not limited to these projects. CIL, out of its own resources is implementing this programme in almost all opencast projects.

In the oil sector the major achievements are compliance with sulphur emission norms and improvements in fuel quality.

All Indian refineries comply with the applicable minimum national standards prescribed for SO₂. Measures adopted include:

- Use of low-sulphur fuel oil
- Desulphurization of refinery fuel gas in sulphur recovery unit
- Taller stacks for better dispersion

Improvement of fuel quality to reduce vehicular air pollution has also been a priority. Unleaded petrol was introduced in phases in April 1995, and the entire country has been supplied unleaded petrol since February 2000. In addition, the sulphur content in petrol was reduced from 0.2% to 0.15% in March 1997, and further to 0.1% from April 2000. Ultra low sulphur petrol with

sulphur content of 0.05% has also been introduced in the four metropolitan cities.

The benzene content in petrol has been limited to 3% in the metros and 5% for the rest of the country w.e.f. April 2000. In addition, low benzene petrol (1% vol. max.) has been introduced in the National Capital Territory (NCT) of Delhi and Mumbai. In order to improve the quality of HSD, nine diesel hydrodesulphurization units have been commissioned in different refineries. The sulphur content in diesel was brought down to 0.25% throughout the country w.e.f. January 2000. In addition, ultra low sulphur diesel (sulphur content less than 0.05%) was introduced in selected retail outlets in the National Capital Region for newly registered vehicles in April 2000. Since March 2001, all outlets in the NCT sell diesel with less than 0.05% sulphur. Compressed natural gas (CNG) has also been introduced in Delhi and a few other states in the country urged also by the judicial system.

In the power sector, apart from prescription of emission standards for power plants, the problem of disposing large quantities of fly ash generated during power generation has received increasing attention, particularly in the Ninth Plan period. This is a problem common to the power and coal sectors. In 1997, a notification issued by the MoEF required the use of beneficiated/blended coal (with ash content not exceeding 34%) from June 2001 in power plants located beyond 1000 km. from pit heads and those located in critically polluted areas, urban areas and ecologically sensitive areas. The deadline for the use of beneficiated/blended coal with ash content not exceeding 34% has since been extended to June 2002. In addition the use of fly ash in the manufacture of bricks and roads is being promoted. To address the issue of submergence of biodiversity due to the construction of large hydropower projects, compensatory forestry has become an essential and integral part of all new water resources projects. In several large projects like Narmada Sagar and Sardar Sarovar, lands for compensatory afforestation have been allocated and related costs included as part of project costs. In addition, a lot of soil conservation, catchment area treatment and afforestation work is initiated along with such projects, which reduces the siltation rate and increase the life of the reservoirs apart from the environmental benefits.

Promoting energy efficiency and environmentally sound energy systems (including advanced fossil fuel technologies)

Efficiency enhancement and energy conservation have received considerable attention right from the first oil shock in 1973. Improving energy efficiency has

been attempted by a mix of market mechanisms as well as traditional command and control measures. The R&D efforts include international co-operation and promotion of pilot projects for new technologies. Energy efficiency standards and energy audits have also gained importance over time. The Energy Conservation Act 2001 provides for the setting up of a Bureau of Energy Efficiency to facilitate and enforce efficient use of energy – its functions include laying down standards, making energy audits mandatory, and imposition of penalties for non-compliance. The annual Union budget also makes allocations for energy conservation activities such as energy audits, demonstration projects studies, and awareness-building. Specific steps taken in the three sub-sectors are detailed as follows.

The introduction of new mining technologies to improve efficiency and productivity have been emphasized in the research and development programmes developed in the coal sector. Foreign collaboration for technological and financial assistance has been promoted through the establishment of joint working groups with France, Germany, Russia, Canada, Australia, United Kingdom, Poland and China.

Some areas of research and development that have been given priority in the coal sector are:

- Improved mining techniques
- Promoting the use of new technologies such as fluidized bed combustion
- Land reclamation systems for areas degraded by opencast mining
- Environmental protection, through improvement in ventilation and environmental conditions in underground mines
- New methods for coal beneficiation
- Clean coal technologies
- Alternative modes for coal transportation
- Environmentally friendly sources of energy such as coal bed methane (CBM)

For harnessing CBM, one pilot-scale demonstration project has been undertaken by the Ministry of Coal with funding from the GEF (Global Environment Facility) and the UNDP (United Nations Development Programme). A few blocks are also under exploration. In addition, seven blocks have been offered for development through competitive bidding by the Ministry of Petroleum and Natural Gas.

The oil industry has a strong research and development base to promote energy efficiency and technology upgradation. The IOC established a full-fledged Research & Development (R&D) centre in 1972. The centre has carried

out extensive work in upgrading and optimizing existing technologies and developing new process technologies. Likewise, the ONGC has set up seven different R&D centres to carry out research in various aspects of the upstream sector. The Centre for High Technology (CHT), a registered society under the Ministry of Petroleum & Natural Gas, acts as a focal point for co-ordinating and funding research work.

The oil industry's conservation efforts are coordinated by the Petroleum Conservation Research Association (PCRA), a society funded by the oil companies. Programmes undertaken by the PCRA include adoption of efficient engines and spreading awareness about fuel-efficient driving habits; energy audits and oil diagnostic studies in industries; standardization of fuel efficient irrigation pump sets; development of fuel-efficient domestic appliances, etc.

In the electricity sector, it is attempted to address the issue of energy conservation by reducing T & D losses, and integrated and long term planning that facilitates optimum use of the country's resources. In particular establishing pithead coal based power stations and coastal power stations would help in reducing the burden of coal transportation. The need to increase the share of hydropower and construct regional grids that will ultimately be welded into the national grid has been often felt.

The Renovation and Modernization programmes for power plants in the Seventh and Eighth Plans have been successfully implemented. Phase I of the programme covered 163 thermal units aggregating to 13570.50 MW in 34 selected power stations and achieved an additional generation of more than 10,000 MU/year against the targeted benefits of 7000 MU/year.

The Accelerated Power Development and Reform Programme is a notable initiative of the central government that promotes energy efficiency through assistance to states for renovation and modernization of old stations and upgradation of sub-transmission and distribution network in the country (Table 3.5). The APDRP is being used as a tool to engineer reforms in the distribution sector, which is central to bringing about commercial viability of the power sector, given that over 75% of the T&D losses and almost entire commercial losses take place at the distribution stage apart from maximum consumer interface. The progress of the various schemes under the programme is monitored by a committee headed by the Ministry of Power.

On the demand side the reform process is expected to improve energy efficiency through a rational tariff regime and some success has already been achieved. The states of Uttar Pradesh, Gujarat, Maharashtra and Himachal Pradesh have instituted time-of-the-day tariffs for industry and other states are

moving in this direction too. Agricultural tariffs have been increased in many states and there is a conscious move to meter energy consumption by agricultural consumers.

The rectification of pumpsets has the potential to save about 30% energy. The Ministry of Power has been sponsoring rectification of agricultural pumpsets since 1987 through programmes including subsidies.

In the area of environmentally sound energy systems, an important development is the increase in the share of natural gas – the share of gas-based power in the thermal mix increased from 2% in 1970 to 14.5% in 2001. In addition, advanced fossil fuel technologies, especially coal-based ones that will play an important role in the power scenario of the country include FBC (fluidized bed combustion), IGCC (integrated gasification combined cycle), CFBC (circulating fluidized bed combustion) are receiving attention from the government. The GOI is undertaking a project with USAID for conducting a feasibility study for a 100 MW IGCC unit. The NTPC which is the implementing arm of this project also established a Centre for Power Efficiency and Environmental Protection in 1994, with the objective of assisting utilities in reducing carbon dioxide emissions. Reforms in the power sector and market forces will also encourage the development of advanced and cleaner technologies.

Mobilizing financial resources including participation of the private sector

The mobilization of financial resources has been a major concern for the sector and has received attention with respect to the need for ensuring adequate returns on public investment and increasingly, by encouraging the participation of the private sector. When international oil prices rose in the 1970s, increasing the production of coal and substituting coal for oil became a priority. The primary objective of the energy pricing policy of the country was to minimize the cost of supplying energy, protect against fluctuations in international oil prices and encourage inter-fuel substitution. Prices of energy were closely controlled by the government, with a view to balance the interests of the consumers and the producers. The achievement has been mixed with the oil sector being the most healthy and the electricity sector the weakest. Increasingly the trend has been to use market mechanisms and the private sector to raise resources. These are discussed in detail below.

Correcting policy distortions

The coal industry was closely regulated by the government until recently. Coal prices were controlled under the provisions of the CCO (Colliery Control Order) 1945. Prices did not include a provision for depreciation and a reasonable return on investment. This resulted in substantial losses being incurred by the coal industry. Since the 1980s, the administered pricing system for coal has provided for a reasonable rate of return on capital employed in the coal industry with an additional provision for escalation linked to increase in input costs.

With the introduction of economic reforms in 1991, the problem of inadequate financial resources in the coal industry and the need to increase financial viability was given attention. This was to be achieved primarily through increases in efficiency and productivity, along with increases in prices. Accordingly, the coal industry initiated the rationalization of manpower and closure of uneconomic mines. The prices of all coking coal and superior grades of non-coking coal were decontrolled.

The Planning Commission constituted the Committee on Integrated Coal Policy in 1996, to evolve a policy for the coal sector for adoption in the Ninth and Tenth Plan periods. The main recommendations of the Committee included deregulating the prices of some grades of coal and the establishment of a regulatory body to resolve price disputes. The administered price mechanism for coal has been dismantled in phases. The prices of all grades of coal have been deregulated with effect from 1 January, 2000. It is expected that this will help in improving the financial position of the coal industry.

Funding requirements in the oil and gas sector are met through a combination of sources – the Oil Industry Development Board (OIDB), plan outlays from the Union Budget, internal accruals of companies, etc. The OIDB was constituted in 1975 to mobilize resources for the sector. The Board was set up with the objective of providing financial and other assistance for the development of the oil industry.

Though the Administered Pricing Mechanism (APM) ensured an orderly growth of the oil industry for years, it insulated oil pricing from the underlying economic realities. The prices of politically-sensitive products did not reflect their economic costs. Subsidies and cross-subsidies resulted in a wide distortion of consumer prices and led to wasteful use of energy. The APM provided little incentive for improving productivity or efficiency as returns were guaranteed on the capital employed. Competition was stifled with marketing companies acting merely as distributors.

The Ninth Five-Year Plan pegged the resource requirements for the industry during the plan period at Rs 1,240 billion. It was recognized that this

scale of investment was not possible by the government or the public sector oil companies. Participation of private capital from both domestic and international sources was considered imperative. The APM was considered inappropriate for attracting private capital. After extensive consultation the government initiated the phased dismantling of the APM in 1998, with the complete deregulation of the sector in 2002. Post-deregulation the role of the government in pricing and distribution has become minimal.

In the electricity sector a number of states in the country have initiated the process of reform. This includes transferring the powers of fixing tariff from government to an independent regulator, both at the centre and in the states that have initiated the reform process. These developments have led to a more rational tariff system, specially on the crucial issue of reducing cross subsidies. The trend is to reduce the under-recoveries for the agricultural and domestic sectors. This would help in restoring the financial health of the sector. The government also continues to give budgetary support to the sector. In the states this takes the form of subsidising losses as well to fund capital works. At the centre the funds are mainly for hydro projects.

Role of private sector

In 1993, limited private participation was permitted in the coal sector, essentially captive mining for self use. In 1996, the Chari Committee recommended a greater role for the private sector, along with its deregulation. These recommendations have been reflected in policy statements of the government. The Ninth Plan proposed reforms for deregulating the coal industry and increasing the role of the private sector. The main proposals were: restructuring the industry, greater autonomy to the subsidiaries of CIL, private sector participation in commercial coal mining through allocation of coal mining blocks and setting up coal washeries. The Approach Paper to the Tenth Five-Year Plan points out that a major policy constraint is the fact that the coal sector is the only one not open to private investment (except for captive mining). Private participation in the oil and gas sector was initiated in the upstream sector, followed by the refining sector and finally downstream marketing. Exploration bidding rounds to attract private investment in the upstream sector started as early as 1979. On the upstream front, exploration blocks were put on offer under the New Exploration Licensing Policy (NELP) in 1999, under radically different terms and conditions to attract private investment. NELP was fairly successful in attracting investments to the upstream sector – 25 blocks were awarded under the first round, while another 23 blocks were awarded

under the second. Private and joint venture companies already account for about 12% of the total domestic production of oil and gas (Table 3.7). The government plans to come out with the third round under the NELP soon.

In 1987, the Government allowed private participation in refining through joint ventures, which was eventually delicensed in 1998. The country's largest refinery, a 27 MMTPA facility at Jamnagar, Gujarat is run by a private sector company.

Parallel marketing of LPG and kerosene was permitted in 1993. Under the scheme, imports of these products were decanalized and private parties were allowed to import and market these at market-determined prices. Over the years parallel marketeers have developed facilities for imports, tankages for storage, and LPG bottling plants and have set up their own distribution and marketing networks.

Table 3.7 Oil and gas production by national oil companies (NOCs) and private and joint venture companies

Year	Oil (MMT)			Gas (BCM)		
	NOCs	Pvt/JV	Total	NOCs	Pvt/JV	Total
1995/9	34.5	0.7	35.2	22.3	0.3	22.6
1996/9	31.6	1.3	32.9	22.7	0.5	23.3
1997/9	31.3	2.5	33.9	24.7	1.7	26.4
1998/9	29.7	3.0	32.7	24.6	2.9	27.4
1999/0	27.9	4.0	31.9	25.0	3.5	28.4

Source. MoPNG (2000)

In the power sector, private sector participation and competition will improve the sector's financial viability and also serve the overall objective of sustainable development by arresting the inefficient generation and use of power, promoting technological innovations and encouraging the use of non-conventional energy by correcting the under-pricing of conventional sources of electricity. Institutional changes introduced over the past few years (Table 3.6) have removed the legal barriers to a greater role of the private sector and have also sought to create a commercial environment that would allow the private sector to effectively participate. As a result of these measures, the contribution of the private sector to installed capacity in the first four years of the Ninth Plan (97-01) was 4174 MW - 26.5% of the total as against 1262 MW (7.7%) in the eighth plan period (92-97). Simultaneously executive action has been taken to allow foreign investment into the sector - in 1998, foreign investment was made automatic upto 100% of equity in almost all activities of the power sector.

International and regional cooperation

International and regional cooperation in the energy sector has been strengthened over time to further the objectives of Agenda 21. As has been seen in the section on energy efficiency the coal sector has been co-operating with a number of countries, for technological and financial assistance.

With the large dependence on oil imports, the country has been actively pursuing options to secure acreage abroad to enhance oil security. The OVL (ONGC Videsh Limited), a wholly-owned subsidiary of the Oil and Natural Gas Corporation, is involved exclusively in foreign ventures, including acquisition of acreage and exploration and production operations. In addition to the projects in the Sakhalin area of Russia and the Caspian Basin, the company is involved in projects in Iran, Iraq, Myanmar and Vietnam.

The country has also been actively exploring the possibilities of strengthening international cooperation for the import of gas both via pipeline and in the form of liquefied natural gas (LNG). Amongst the pipeline projects, gas imports are being proposed from the South Pars field in Iran, via Pakistan. On the east coast, Unocal has proposed a pipeline from the Bibiyana gas field in Bangladesh to India. With uncertainty about assessments on reserves and future demand, Bangladesh is reluctant to commit to gas exports.

There is enormous potential for regional trade in hydropower. There is a huge untapped hydro-potential in Nepal and Bhutan – under 2% of the respective potentials of 83,000 MW and 21000 MW has been exploited in both countries. In the recent years a number of developments have taken place that will facilitate trade in hydropower in the region, notable among them being the signing of Power Trade Agreement between India and Nepal. India has been assisting Nepal in the utilization of its hydro power potential and four hydroelectric schemes, Pokhara, Trisuli, Western Gandak and Devighat have been implemented with financial and technical assistance from the government of India. Three major water resources projects in Nepal, Karnali, Pancheshwar and Saptakoshi are presently under discussion at various levels as mutual benefit projects. In Bhutan, the Chukha Project (336 MW) implemented with Indian financial and technical assistance is a shining example of cooperation between the two countries for mutual benefits. The Kurichu Project (45 MW) in Eastern Bhutan is being implemented on a turnkey basis with Indian financial and technical assistance. Another project, the Tala hydroelectric project (1020 MW) is being executed with Indian financial and technical assistance and a major portion of the power generated will be made available to India.

The Power Grid Corporation also has plans to develop a regional grid connection among Bangladesh, Bhutan, and Nepal. This will facilitate smooth electricity trade in the region.

Concerns

Environmental concerns

Although there is a comprehensive legal and regulatory framework for addressing and mitigating the environmental effects of energy production and use, its implementation and monitoring needs strengthening. Typically, environmental performance has not met prescribed norms. Enforcement mechanisms for the implementation of provisions made in the EIA report, standards, legislation etc, need to be strengthened by effective post-project monitoring and through the use of effective regulatory or economic instruments.

The use of economic instruments for the control of pollution has been negligible. Market-based instruments such as sulphur permits and pollution charges that have proved effective in other countries need to be encouraged. Within the country too, there are some examples of the use of economic instruments for pollution control, such as sales tax concessions on fly ash products such as bricks and cement in some states. Regulatory bodies will play an important role in ensuring environmentally correct decisions through the use of such economic instruments.

Financial constraints

The coal industry has been characterized by lack of financial resources, both in terms of inadequate returns and small shares of budgetary support, relative to other energy sectors. Reform measures undertaken periodically have led to some improvement in internal resource generation but delays in revision of prices have diluted the benefits of these measures. As a result of the deregulation of coal prices through the Colliery Control Order 2000, regional differentials in the price of coal have emerged and so has pricing on a cost-plus basis in some areas. However the effectiveness of this order in decontrolling prices is limited as the coal industry remains highly centralized.

Recommendations for a greater private sector role in the coal industry have not been realized, as the industry remains centralized. Private sector participation is limited to captive mining^a and contributes only about 4%-5% to

^a These are the captive mines of TISCO, IISCO, the Damodar Valley Corporation (DVC), the Bengal Emta Coal Mines Limited (BECML) and Jindal Steel and Power Limited (JSPL).

the total production. This situation will be addressed if the Coal Mines (Nationalisation) Amendment Bill, 2000, currently before Parliament, is passed. This Bill provides for private mining of coal for non-captive use.

In the oil sector, as per the estimates of the Group on India Hydrocarbon Vision 2025, investment requirements for refining and marketing alone are estimated at about Rs 3,850 billion. In addition to this, massive investments are also required for exploration and production. It is evident that such a scale of investment would require funds from both the state and the private sector. While there has been substantial progress in encouraging private investment, private players are increasingly voicing concerns about provision of a level playing field. They have expressed the need for access to existing distribution infrastructure such as pipelines, storage installations, depots, hydrant systems at airfield installations, etc.

The issue of subsidies also remains an area of concern. Over time, with political reluctance to adjust prices of sensitive fuels, huge deficits have accumulated in the oil pool account. The current deficit in the oil pool account is substantial, estimated to be at Rs 231.3 billion. However, the intended subsidies on LPG and kerosene add up to Rs 140 billion only. The remaining deficit is on account of subsidies on diesel, despite the government's decision to put diesel prices on import parity in 1997. While no official estimates are available, it is generally believed that a substantial amount of the subsidised kerosene is used for to adulterate diesel. The government has taken a number of steps, such as the introduction of tracer dyes to check adulteration.

The financial performance of the power sector is still a matter of concern, owing largely to the subsidies being accorded to agricultural and domestic consumers and the high level of T&D losses. Subsidies to the agricultural sector have also led to over consumption of electricity, specially since most of the agricultural connections are unmetered and flat rates are charged on the basis of the connected load. This over consumption of electricity in turn has meant overuse of groundwater reserves, falling water tables and also inefficient use of pumpsets. The poor financial health of the SEBs has constrained adding new capacity, improving the T&D system, carrying out renovations and modernizing and investing in new technology. This has resulted in persistent shortages of electricity – there was a peak deficit of 13% and energy deficit of 7.8% at the all India level as on March 2001 (Planning Commission, 2001b)- there are significant regional variations, with the Eastern region having surpluses. Poor performance has also affected the sectoral composition of sales,

with industry moving out of the grid (Figure 3.2). This trend needs to be corrected urgently.

The poor financial performance of the industry has also had a serious impact on private investment and introducing competition. In addition, its financial insolvency has implications for the environment because investments in cleaner technology and the import of cleaner options such as gas or hydropower are adversely affected. Minimizing subsidies and effectively targeting these would also provide a level playing ground to non-conventional energy sources. While regulatory commissions have made some progress in rationalizing the tariff structure for electricity in some states, it needs to be extended to other states.

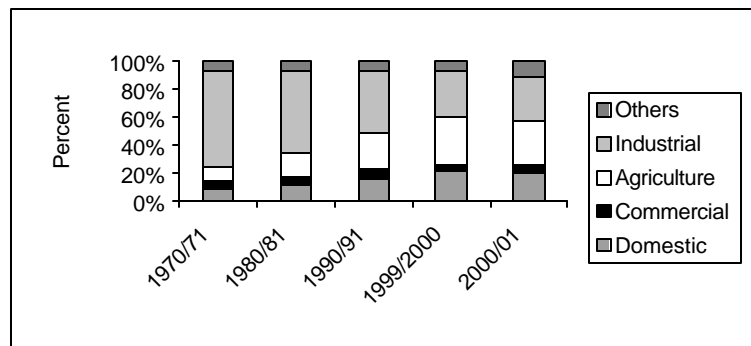


Figure 3.2 Sectoral share of electricity consumption
Source. Planning Commission (various years)

Clean energy sources

Almost all committees and plans have expressed concern over the declining share of hydro and emphasized the need to accelerate hydro development in the country. In spite of this, the share of hydropower has progressively fallen from 43% in 1970 to 34% at the end of the Sixth Plan (1980-1985), to 29% at the end of the Seventh Plan (1985-90) and further to 25% at the end of the Eighth Plan (1992-97). Not only is hydropower a cleaner source of power, it also is essential for grid stability since it provides valuable peak time support to the power system. The National Hydro Policy of 1998 has identified the hurdles to the development of hydro projects and has attempted to deal with them. CEA has completed a countrywide basin wise ranking study for hydro projects. This prioritizes the potential projects and would thus facilitate setting up of new hydro projects. Renewable sources of energy are viable options for grid and off-grid energy applications. The share of renewable energy sources needs to be augmented. This is discussed in more detail in Chapter 4.

Energy security

One of the key areas of concerns is related to security of energy supplies. With a high dependence on imports, the vulnerability to external shocks is high. The high level of imports also results in a continuous strain on the country's foreign exchange reserves. This dependence needs to be brought down by greater use of domestic resources especially non-conventional energy sources that have enormous potential. Currently, these sources contribute only about 3% to the total capacity. Strategies to augment the share of non-conventional energy sources are discussed in the chapter on 'Renewable Energy Sources'. Among other issues, it is necessary to take an integrated view of the energy problems in rural areas so that the initiatives taken by agencies in this regard can be coordinated.

Integrating Agenda 21 concerns - directions

As the energy sector grows, new challenges have emerged requiring different policies and directions. Action has been taken in many of these areas and what is required is a deepening and widening of these reforms to accelerate the process of change. The directions in which further action needs to be taken are discussed for each sub-sector below.

An analysis of policy developments in the coal industry indicates the priority areas for further action are:

- Adoption of best practices to improve coal quality, productivity and safety and to protect the environment;
- Adoption of environment-friendly technologies including coal gasification, beneficiation, and liquefaction for value addition to domestic coal;
- Environmental protection including rehabilitation of affected land and preservation of biological diversity; and
- An acceptable rehabilitation and resettlement policy for project-affected persons.

In order to achieve sustainable coal development and meet the above commitments, several initiatives will be necessary. Private sector investment needs to be promoted for the growth of the industry. The Approach Paper prepared for the Tenth Five-Year Plan has highlighted that early passage of the Coal Mines (Nationalisation) Amendment Bill 2000 is necessary for attracting private investment.

The reclamation and use of land degraded or converted to wasteland due to mining needs to be planned. Some form of reclamation trust fund or performance guarantee bond, as developed in some countries, could be established as a pre-requisite to the grant of a mining lease. Alternatively, an

effective programme to monitor compliance with land reclamation works envisaged in the Environmental Management Plans of mines needs to be formulated.

Coal gasification and liquefaction technologies have to be promoted in view of the rising prices of oil in the international market. This is essential from the point of view of adding value to domestic coal and also from considerations of energy security. Coal beneficiation has to be promoted by clearly specifying the agency that will be responsible for implementing the ash content norms.

Substantial progress has already been made in the oil and gas sector in addressing Agenda 21 issues. Subsidized prices for petroleum products have ensured affordable access to commercial energy for the economically-weak sections of society. In addition, a lot has been done to strengthen the role of the private sector in industry. Key concerns that remain are those related to energy security, mobilization of resources, and improving the subsidy mechanisms.

Enhancing energy security would require a host of measures, foremost among which is the issue of a strategic petroleum reserve for the country. This is particularly significant in the light of spiralling oil prices. In addition, strategic reserves provide a cushion against temporary disruptions. The long-term security of the country can also be enhanced by introducing specific measures to augment domestic oil and gas production. Such measures include complete analysis for sedimentary basins, institution of a regulatory framework for the upstream sector to attract investors, offering exploration bids on attractive fiscal terms, sustaining current production levels through Enhanced Oil Recovery Schemes, etc.

Over the long-term, the trend towards other sources such as coal and renewables which are domestically available, will be strengthened. Natural gas, which is also a cleaner fuel, would need to be promoted with greater vigour. With limited gas reserves, gas requirements would also have to be met by imports. However, a review of gas markets indicates that gas prices display a lesser degree of volatility compared to oil prices. In addition, gas sales are generally backed by long-term take-or-pay commitments offering greater security to both suppliers and consumers. A number of LNG projects have already been proposed along the country's coastline. Investor confidence in the sector can be further boosted by instituting a regulatory authority for the sector to address issues such as open access in transmission.

Institution of a regulatory authority for the sector would go a long way in mobilizing private capital for it. Though the sector has been deregulated, there

are still a number of issues, in particular those related to assuring a level playing field for new entrants which a regulatory framework would help resolve.

Universal subsidies, especially in the case of kerosene, have led to a large-scale diversion of subsidized kerosene for adulteration. Clearly, as long as the price difference between petroleum products is substantial, the economic incentive to divert supplies will remain. It is thus imperative that prices throughout the trade channel be uniform. Measures are required to introduce alternative mechanisms that provide subsidies directly to the intended beneficiaries.

An analysis of policy developments in the Indian power industry indicates that while the regulatory and legislative groundwork to encourage the private sector has been effected, the core problem afflicting the industry – that of financial insolvency, remains. This can be addressed by phasing in organizational changes that gradually dismantle the existing public monopoly structure and introduce competition in the generation and distribution of electricity. Market forces will also help to promote new and superior technologies and minimize inefficiency in supply as well as demand, bringing out the synergies between the reform process and sustainable development. Till markets develop, the regulatory structure would be used to reduce cross subsidy especially for agriculture. This would help in more rational use of energy and groundwater. The APDRP will be used to incentivise states and accelerate reforms.

In areas, where the public sector is bound to play a major role in the foreseeable future – such as in the case of large hydro and nuclear power – and where the interests of the weakest sections have to be ensured, the role of the government and public sector management need to be strengthened. The government also needs to proactively engage in economic diplomacy to ensure regional co-operation in energy, especially the import of hydropower and gas.

The government both at the centre and in the states has recently resolved to reform the sector – this was done in a conference of the Chief Ministers/Power Ministers in March 2001. The Approach Paper to the Tenth Five-Year Plan also recognizes the above concerns and reiterates the government's commitment to reforms in the sector, including augmenting the share of cleaner fuels such as renewable sources and hydro. It is expected that as policy reform gains momentum, the power industry will achieve not only financial sustainability but also resource efficiency, along with socially and environmentally-accountable growth.

Integrated energy policy

A comprehensive analysis of energy developments and articulation of policies for the future is critical to the pursuit of sustainable development. Typically, energy decisions are seen only in their application to the supply of specific forms of energy, but considerations of sustainability require that an integrated energy framework be woven not only into energy sector decisions, but into the structure of the economy as a whole. Energy-related decisions can be constrained if the structure of the economy is such that large quantities of energy would be required to ensure that the structure functions in keeping with the overall economic objectives. The constraint in such cases would allow very limited improvements in overall energy efficiency and only some degree of inter-fuel substitution, if at all. In other words, if the structure of an economic system is characterized by high intensity of energy use, considerations of sustainable development would be compromised by severe limitations as they would apply to the supply and consumption of energy. Perhaps the most relevant sectoral example is that of transport. In India, a continuing shift has taken place over the past five decades in the share of rail to road transport. This has led to a much higher energy intensity of transportation services with severe pollution problems and the exploitation of natural resources for expansion of roads and highways, production of construction material, and soil erosion including landslides, etc. particularly in hilly areas. Intensive use of railway facilities and a preference for rail transportation is a far more sustainable option in several areas of the country than the expansion of road transportation. Conscious policies for a greater share for rail transportation through technological improvements, appropriate pricing measures (including the internalization of environmental and social externalities) and greater investments for creating larger railway capacity are clearly preferable to the expansion of road transport.

Energy considerations should also play a part in the choice of industry and the production of all goods and services. In an era of freer international trade, it is not necessary for every country to produce the majority of goods and services that it consumes. An economic system that has abundance of energy resources, for instance, could justify large-scale production of aluminium, but this may not be desirable in a country that has no such comparative advantage. However, if choices are made to set up industrial and other activities that consume large quantities of energy then such a structure is locked into an energy-intensive path of growth which does not allow major shifts or variations. Overall energy intensity, therefore, largely determined by the choice, for

instance, between a mineral-processing or heavy-engineering oriented economic system versus one that emphasises professional services, software production and such activities with low energy intensity.

Within the energy sector an integrated policy would support sustainability objectives if environmental factors and energy security considerations determine the type and form of energy to be used. Trade-offs often become important in the choice of energy mix. Thus, for instance, coal used with traditional technologies would generally have undesirable environmental implications, but for a country such as ours, security of supply, which is as much an issue of sustainable development as any other, would favour greater use of coal. In such cases, government policy could, however, provide incentives for the development and use of clean coal technologies, which would minimize the environmental impact and promote energy security.

The choice of an appropriate mix of energy sources does not have to be the result of a planning exercise with quantities and magnitudes clearly defined. Essentially, it requires proper signals being designed and structured into a fiscal policy, so that a mix of energy sources evolves to support the objectives of sustainable development. If, for instance, the total cost of power supply from centralized sources were to be considered in supplying power to a remote rural habitation, it may emerge that some decentralized renewable technology would be far more acceptable as an option. If to this assessment of conventional costs were added the costs to the environment, the choice in favour of decentralized sources may become overwhelming. Pricing policies are therefore critical to the internalization of externalities and are perhaps the most important tool for ensuring movement towards sustainability.

Similarly, the problems of rural energy require an integrated view to be taken. Although there is an Integrated Rural Energy Programme this is essentially a programme for renewables and energy efficiency for use of traditional fuels. A policy that takes into account the possibilities of substitution between the various forms of energy will be more effective. Among other things it can make the best use of resources currently used for subsidising various forms of energy. Thus it may be more effective to divert the money used in cross-subsidising kerosene to subsidies for renewables. There is therefore need for a rural energy policy that makes the best use of the limited resources across the different energy sub-sectors.

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