CHAPTER -IV
ENERGY

4.0 Introduction

The State of Orissa is poised for rapid industrial development and large use of electricity for industrial purpose for which the demand for electrical power is continuously increasing. The present demand for power is greatly in excess of generating capacity. The power generation scenario in the State reveals that the demand for power will continue to outstrip the available and planned generation capacity.

4.1 Driving Forces

The State is endowed with rich mineral deposits like Bauxite, Iron Ore, Chrome Ore and Nickel. It has become imperative to exploit the resources to make the State financially rich and also meet the demand of the market, both at the National and International level. It is estimated that power consumption of these mineral based industries will be around 1200 MW by 2012. Most of the demands will be met by CPPs to be set up by the industries. Only emergency supply and startup power will be availed by them from the State grid

The present per capita consumption in the State is around 350 KWH. It is endeavoured to double it by 2012.

4.1.1 Rural Electrification

Rural Electrification is a priority area for the State Government. The total number of revenue villages in the State is 51057 (1991 census); 46989 villages are inhabited and 4068 are un-inhabited. 9392 villages remain to be electrified. Government of Orissa is committed to electrify all villages by March 2007 and supply power to all the households by the end of March 2012. The programme of 100% electrification of the villages of the State is given in ***Table – 4.1***.

TABLE: 4.1
Electrification in Rural Orissa

Financial Year	2002-03	2003-04	2004-05	2005-06	2006-07	Total
No. of Villages to be electrified	2188	1801	1801	1801	1801	9392

[Source: Vision 2010 of GoO]

Off grid supply: Out of this, around 5000 nos. of villages will have to be covered under non-conventional means such as solar cells/photo voltaic (SPV), bio-mass energy, as extending transmission lines to these remote villages may not be feasible due to long length of lines, forests and undulating terrain consisting of hills and valleys. (Maintenance of assets will also pose a problem).

4.1.2 Projections of Electricity Requirement in India and Orissa

(a) According to the 16th Electrical Power Survey published by the Central Electricity Authority in September 2000, the energy requirement and peak demand of the country is projected in ***Table - 4.2***.

TABLE: 4.2
Energy Requirement & Peak Demand In India

	9th Plan End of 2001-02	10th Plan End of 2006-07	11th Plan End of 2011-12	12th plan End of 2016-17
Peak Demand (in MW)	85132	115705	157107	212725
Energy Requirement (in MKWH)	529013	719097	975222	1318644

[Source: 16th EPS published by CEA]

Fuel Map of India published by the CEA in August 1998 states that the installed capacity by end of 11th plan i.e. by 2011-12 will be about 2,40,000 MW. It means an increase of more than 1,00,000 MW from the existing installed capacity.

(b) As per the 16th Electrical Power Survey published by Central Electricity Authority (CEA), Government of India, the energy requirement and the estimated peak load of Orissa is presented in ***Table - 4.3***

TABLE: 4.3
Energy Requirement and Peak Load of Orissa

Year	Energy(MU)	Peak Load (MW)
2001-2002	14002	2317
2006-2007	17997	2977
2011-2012	23376	3867

4.1.2 Generation Expansion

The estimated addition in generation both Hydro and Thermal upto the year 2012 in Orissa is around 12778 MW comprising of 11840 MW thermal and 938 MW hydro generation, mostly to be achieved through Independent Power Producers (IPPs). This requires an estimated investment of Rs.114732 Crore upto 2012 calculated at an installed cost of Rs.4.5 Crore per M.W. and an equal amount for transmission and distribution. Export of 10000 MW of power to user States outside Orissa is envisaged in the expansion programme after meeting States internal needs. This can materialise with investment by the IPPs and development of National GRID and transmission network. The major Captive Power Plants (CPPs) like National Aluminium Company (NALCO), Rourkela Steel Plant (RSP), Indian Charge Chrome Ltd. (ICCL), Choudwar and other Captive Power Plants have installed capacity of 1351 MW.

(a) The Central Electricity Authority with the approval of Central Government have published a document viz., Fuel Map of India where the broad scenario of power generation by 2012 has been brought out which indicates the Thermal Power Stations for construction in the State of Orissa. (***Table 4.4***)

Table 4.4
New Thermal Plants in Orissa

Name of the proposed Power Stations	Installed Capacity	Year of Completion (Proposed)
Hirma Power Project developed by CEPA	6X660 MW=3960 MW(Stage-I) 6X660 MW = 3960 MW (Stage-II)	2002-2007 2007-2012
AES IB Valley Unit- 5 & 6	2X250 MW = 500 MW	2002-2007
OPGC Unit 3 & 4	2X210 MW = 420 MW	2002-2007
Duburi (KPCL)	2X250 MW = 500 MW	2002-2007
Naraj	2X250 MW = 500 MW	2002-2007
NTPC, Kaniha	2X500 MW = 1000 MW 2X500 MW = 1000 MW	2002-2007 2007-2012
TOTAL	**11,840 MW**	

[Source: Vision 2010 of GoO]

(b) New Hydel Projects (Planned through Joint Sector): The planning till 2011-12 involves installation of new Hydel Projects to meet the future demands of the State as indicated in ***Table 4.5***.

TABLE: 4.5
Proposed Hydel Projects of Orissa

1.	Balimela		150 MW
2.	Hirakud-B	(4X52 MW)	208 MW
3.	Chipilima-B	(4X50 MW)	200 MW
4.	Sindol-I	(5X20 MW)	100 MW
5.	Sindol-II	(5X20 MW)	100 MW
6.	Sindol-III	(2X60 MW)	120 MW
7.	Balimela Dam Toe	(2X30 MW) 50% Orissa Share	60 MW
TOTAL			938 MW

[Source: Vision 2010 of GoO]

The establishment of these Mega Power Stations will not only meet the requirement of the State but shall be a source of energy for the power starved states of the other regions.

The National Hydro Power Corporation (NHPC) of the Government of India have evinced interest for developing projects at Serial No.(3), (4), (5) & (6).

The State is committed to the growth of Captive Power Plants in the State to meet the requirement of Industries for generation of power at a competitive rate for marketability and to save the State Government of any investment in building additional generation and transmission capacity.

4.1.3 Transmission

The optimal and economic use of coal reserves could be achieved by generating thermal power at pit heads and transporting large blocks of power through EHV lines to load centres. The requirement of load is substantial in Northern and eastern region to which power is to be transmitted.

Orissa will exploit this situation on account of availability of power grade coal, feasibility of its transportation, availability of sources of water, green fields, power station and Township, Ash disposal space, geological suitability of site, evacuation of power to load centers due to its strategic location for inter-connection to Western, Southern and North Eastern region.

The prospective Transmission Plan, 2011 and 2012 prepared by Central Electricity Authority (CEA) for development of the national grid envisages the country as a whole to be treated as one spatial pool for planning with free flow of power across regional boundaries/State boundaries. The transmission system projected for Orissa will be a part of national grid and to be integrated with bulk power transmission system for inter-regional power transfer. The futuristic projections contemplate evacuation of power through HVDC and 765 KV A.C. transmission network.

Strengthening of 132KV, & 220KV networks for transmission within the State with funding from outside agencies will improve the load transfer capability within the State in a short time frame. System improvement works to meet the increasing load demand by installing 132/33 KV substations and also 33/11KV primary substations at the enhanced distribution level is a part of the national target of “Electricity for all” by 2012.

The World Bank has made a commitment of US $ 290 Million for long term investment in Transmission and Distribution Sector of the State.

4.1.4 Summary on the Power Scenario by 2012 and Ahead

In view of the large deficit of power requirement, Government of India through various policies decisions is trying to rope in private sector investment in power. To that extent there is a policy reversal from public sector to private sector. Interestingly prior to independence, power sector in the country was being managed through private sector initiative only.

4.2 Pressures

4.2.1 Utilisation of coal for power generation poses one of the biggest environmental problems because of the fly ash emission to the atmosphere and fly ash dumping in the land. Large areas of land are required by the thermal power plants in the neighbourhood for dumping the ash. As a thumb rule, for 1MW of installed capacity approx. 1 to 1.5 acre of land is required for a period of 20 years to dump the dry ash. For wet disposal the requirement of land may be still higher. However, now thermal power stations are opting for dry ash disposal, as the dry ash can be utilised for various purposes as narrated later.

There is a proposal of addition of about 12,000 MW of thermal power capacity in the state by 2012 in addition to the existing capacity. This will mean years consumption of coal of about 60 million tonnes generating about 30 million tones of ash. The land requirement will be around 7200 hectares. Setting up of a power plant and associated mining activity to supply required amount of coal will not only put pressure on the land mass but also on the forest cover.

Due to large emissions from the thermal power plants air pollution has become an international problem. Thermal plants use pulverised coal as fuel.

4.2.2 Hydro power stations are generally considered as non-polluting since there is no discharge of any process affluent or emission, but hydroelectric projects pose different kinds of environmental problem as detailed below.

4.2.3 Forest Loss

Large tracts of forest area are submerged in the reservoir area of the hydro project. Anthropogenic activities during construction period and thereafter create the ecological damage. It is a fact that hydro projects include irrigation through which increased area of cultivation is achieved with a direct economic gain to the people, but this does not mean any ecological advantage.

It has been established beyond doubt that massive deforestation has taken place around all dams in India including catchment areas. This has led to erosion of soil and deposition of silt in the bed of the reservoir and river, thereby reducing their water holding capacity. When a large water body is created at the cost of virgin forest, the microclimate of the area is affected. Moreover, human activities also increase at accelerated rate around the reservoir area, causing further loss of forest and adverse change in the microclimate. A study was made in and around Hirakud reservoir area and it has been found out that average annual rainfall, number of rainy days in a year, morning relative humidity in Sambalpur, Jharsuguda area have decreased. The mean and maximum temperature, relative humidity and atmospheric pressure have shown increasing trend. This indicates that the vegetation loss could not be compensated by the reservoir to provide atmospheric moisture in the night time because the total evapo-transpiring area of dense multi storied forest is much higher than the evaporating surface of an artificial lake (Mishra, A & Dash, M.C., 1984 – Environmentalists, 4:41-60).

Another public concern is the rehabilitation of the displaced person from the submerged areas.

At present, the thermal hydro mix at the national level is 75:25. There is a technical requirement to increase the hydro capacity in the system for stability purpose. Whenever there is a loss of generation due to a thermal plant tripping, then a hydro station can be brought immediately to the grid preventing collapse of the system.

Coal mining also involves significant loss of forest area as mentioned in the ***Table 4.6***. However, the loss is largely compensated through land reclamation and plantation activities undertaken by MCL in the mined areas.

TABLE: 4.6
Forest Area Due To Coal Mining

Open Cast Mines	Total forest land (ha) including reserve forest	Total forest area lost for mining activities (Ha)	Total forest area to be lost for mining (Ha)
Bolanda	1045.75	245.0 (23.42%)	315.0 (30.12%)
Lingaraj	240.804	6.71 (2.78%)	109.687 (45.55%)
Bharatpur	198.171	65.01 (32.80%)	133.161 (67.19%)
Ananta	146.0	74.0 (50.68%)	82.0 (56.16%)
Jagannath	106.16	106.16 (100.0%)	-
Kalinga	85.201	-	60.523 (71.03%)
Total	**1822.086**	**496.88 (27.26%)**	**700.371 38.43%)**

(Figures in brackets give percentage estimates of total forestland)

4.3 State

4.3.1 Most of the power generated will be wheeled through the national grid to meet the requirement of power deficit states in line with the power policy of the Government of India. It means that the State of Orissa will have to bear brunt of the pollution where as other states will be enjoying the power.

4.3.2 Thermal Power Plants and Associated Coal Mining in Orissa

(a) Thermal power plants in the State generate power for captive uses and also supplies power to a number of States. Together this is more than the power supplied to state grid, which account for 1/3rd of total purchase of power by GRIDCO. The lone plant of OPGC at Banaharpali shares only about 15% of the total thermal power generated in the State (***Table 4.7***)

TABLE: 4.7
Thermal Power Generation in Orissa
(Generation figures for 2000-01, 2001-02 & 2002-03 in MU)

Thermal Power Plant	Generation Capacity (MW)	2001-02	2001-02	2002-03	Remarks
		(Generation in MU)			
NTPC, Kaniha	2500	4,845	5,753	5,964	Besides supply to GRIDCO, surplus power is sold to eastern region grid.
NTPC, Talcher	460	2488	2465	2233	After auxiliary consumption, rest is sold to GRIDCO
ITPS, Banharpali, OPGC	420	3382	2599	2621	-do-
RSP, Rourkela, Captive	203	325	445	-	Own consumption mostly
HINDALCO, Hirakud Captive	100	524	543	-	-do-
NALCO, Angul Captive	840	4283	4419	4777	After auxiliary consumption & meeting own demand, surplus is sold to GRIDCO
ICCL, Chowdar, Captive	108	770	778	842	-do-
NAV Bharat Ferro Alloys, Captive	30	-	-	-	Own consumption mostly

IFFCO, Paradeep Captive	55	-	-	-	Own consumption mostly

4.3.3 Generation of power by thermal power plants in Orissa has increased in recent times. NTPC Kaniha's capacity has increased with addition of new units. Generation at the captive power plant of NALCO, Angul has increased with addition of new units to meeting the demand of its smelter after expansion. Captive generations of HINDALCO, Hirakud, Rourkela Steel Plant and ICCL, Chowdar have increased marginally to meet the internal demand.

Thermal power generation is going to increase further in the state with expansion of NTPC Kaniha plant from 2500 MW to ultimately 4000 MW to meet the demand of eastern region states. NALCO's capacity has already increased from 720 MW to 840 MW and would increase to 1200 MW to meet the second phase expansion of its smelter. HINDALCO, Hirakud has plans for expansion of generation capacity and new thermal power plants based on Ib valley coal is likely to come up. Captive Power generation of proposed and existing industries of mini steel plants and sponge iron plants are being planned. While, no further hydel projects are in prospect, the thermal power generation would increase in future to meet the growing demand. With the availability of plenty of coal, thermal power generation in the state is expected to double in the coming decade.

Most of the coal produced in Orissa for power generation goes to power plants outside the State. Thus, while 72% of coal produced in 2002-03 was used for power generation, more than 60% of this went to meet the external demand. About 1/3rd of the total coal produced in the State is consumed by its own power plants while less than 1/6th is used for power supplied to GRIDCO. Consumption of coal in the power plants of OPGC accounted for only 4% of the total coal mined during 2002-03.

Amongst the major thermal power plants in the States, except RSP, HINDALCO and ICCL four plants viz., NTPC, Kaniha, NTPC, TTPS, Ib TTPS and NALCO with higher generation capacity and accounting for about 90% of thermal power generated in the State are located at the pit heads. Hence the pollution load of coal mining and thermal power generation together affects the environment of the region. As such, Talcher -Angul and Ib Valley areas around Belpahar-Brajarajnagar are considered to have serious air pollution besides other environmental impacts. With the proposed expansions in both the sectors, environmental impact would increase further in future.

4.3.4 Existing Status of Generation and Transmission

The capacity of the plants dedicated to Orissa along with their firm capacity and peak capacity in 2003-04 is indicated in ***Table 4.8***.

TABLE: 4.8
Capacity of Plants in Orissa

Category	Installed Capacity (MW)	Firm Capacity (MW)	Peak Capacity (MW)
Hydro (Orissa Hydro Power Corporation)	1896	682	1470
Thermal (Orissa Power Generation Corporation & Talcher Power Station)	880	515	722
Share of Centre Generating Stations.	690	415	460
Total	**3466**	**1612**	**2652**

(Hydro potential is basically used for peak load support)
[Source: Vision 2010 published by GoO]

The position of sub-transmission and distribution system at 33KV, 11 KV and LT lines alongwith the details of EHT net-work as on March 31, 2004 is given in ***Table – 4.9***.

TABLE: 4.9
Transmission and Distribution System in Orissa

Transmission lines CKT-Km)		Distribution lines (CKT-Km)	
400 KV lines	643.5	33 KV lines	10296.15
220 KV lines	4801.9	11 KV lines	56942.49
132 KV lines	4784.8	LT lines	57393.25

[Source: OERC Review Report]

4.3.5 Reform and Restructuring

The Reform and Restructuring of the Power Sector already implemented in Orissa since 1996 is another milestone with an aim to achieve the following objectives in the long term.

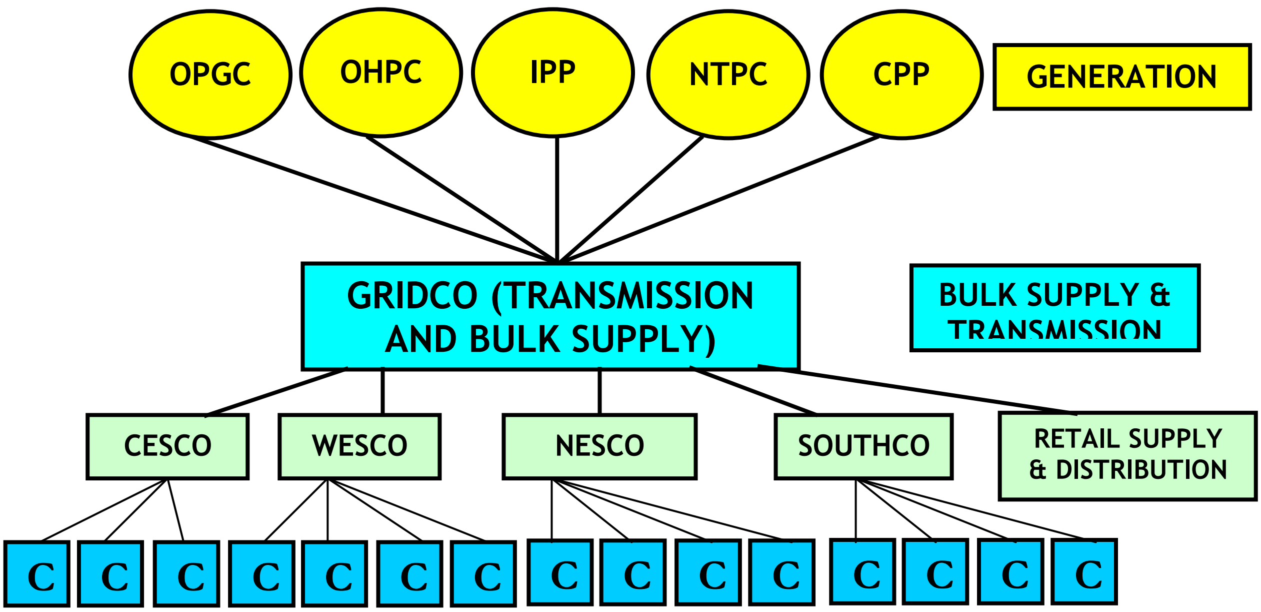
- Withdrawal of the Government from the management of the Power Sector and reduction of the need of Government spending leading to a self sustaining Power Sector.
- Make available power at affordable price.
- Improve quality of service to consumers.
- Improve operational efficiency and reduce losses.
- Attract private investment into the Distribution Business.

- Contribute to economic growth in Orissa

Reform and Restructuring in Orissa Power Sector was initiated with an initial assistance from World Bank.

The structure of electricity sector in Orissa after reforms, restructuring and privatisation can be seen from ***Figure 4.1***.

Fig.4.1
Structure of Electricity Sector in Orissa



After the reform and restructuring, the State Goverrnment was the biggest beneficiary of the entire process. From 1.4.1996 onwards Government did not pay any subsidy which it was paying earlier to the tune of Rs.300 crores per annum. By 2002-03 it is estimated that on this account Government has saved to the extent of Rs.4400 crores. Besides this the dis-investment of 49% equity share in OPGC fetched Government Rs.603 crores over Rs.220 crores. Rs.159 crores have also been paid by the private sector investors during 51% dis-investment of the four distribution companies shares.

Unfortunately the desired results as forecast in the Staff Appraisal Report of the World Bank could not be achieved due to the following major reasons:

The estimated loss of 39.5% in the beginning of year 1996-97 worked out to be more than 51% subsequently after meters were provided at different points including the consumer.

The industrial loads at Duburi and Gopalpur did not materialize. On the whole, there was a decrease in industrial consumption due to recession in the industrial sector. To make matters worse consumption in the LT sector which is substantially subsidised by the industrial loads went on increasing.

Reduction of commercial loss did not take place significantly due to bypassing/tampering of meters by the consumers, non replacement of large numbers of defective meters, and absence of law and order support from the State govt.

The Cyclone in South Orissa in early part of October 1999 and the Super Cyclone on 29th and 30th October had a devastating effect on the power sector in Orissa. GRIDCO and the distribution companies lost assets valued of Rs.372.25 crores as estimated by the World Bank. There was a meagre support from the State Govt. for replacement of the damaged assets.

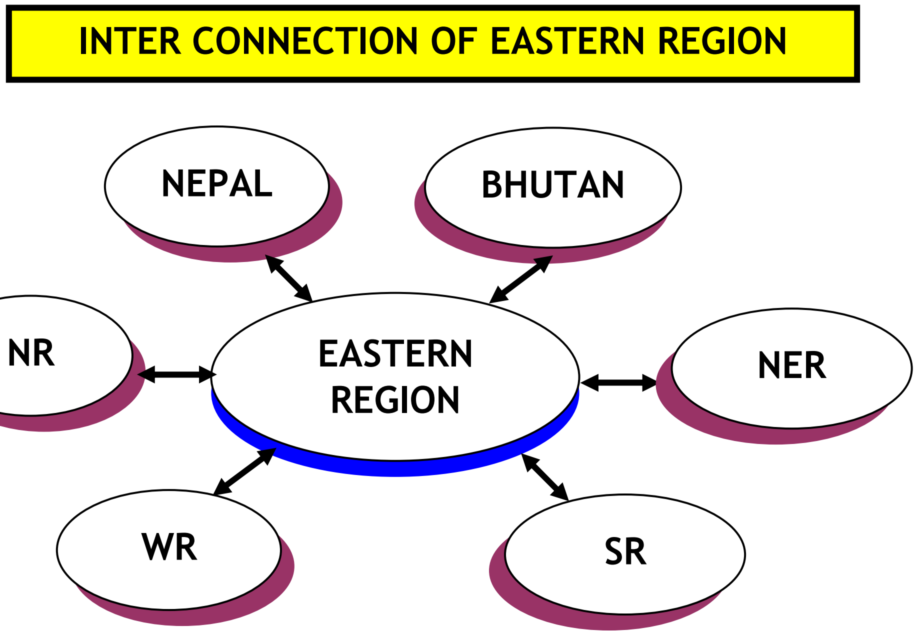
However, although slow, there is a positive indication of turn around of the sector for better days ahead. GRIDCO possibly can service smoothly its loans and liabilities which amount around Rs.5000 crores, if there is a good monsoon in the coming three years and the power trading goes forward without any interruption.

At present, there is a distribution loss of around 40% in the distribution segment of the sector. This has to be brought down to a level of 20% which will mean 15% technical loss + 5% commercial loss. In other words 20% of power which has been flowing in the system and unaccounted for, will come to billing fold. This means that generation power and purchase remaining same, more number of consumers will be served by this unaccounted power.

Orissa is going to have a number of thermal power stations due to availability of coal. These power stations will mainly supply power through the National grid feed to the other power deficit Region and States. It is estimated that by 2012 about 10000 MW of power mostly contributed by Orissa from the Eastern Region will flow to Northern, Southern and Western Regions.

The Eastern Region is the only region, which has connection with all other regions of the country along with international connection with Nepal and Bhutan. The network is diagrammatically presented in ***Figure 4.2***.

Fig. 4.2
International Connection



4.4. Impact

4.4.1 Particulate Emissions and Fly Ash

The thermal power plants, which burn conventional fuels like, coal, oil, gas etc. contribute to air pollution in a large way. The combustible components of the fuel are converted to gaseous products and the non-combustible components as ash. The common gaseous products of interest are sulphur dioxide, nitrogen oxide, carbon dioxides, carbon monoxide and particulate matters such as fly ash, carbon particles, silica, alumina and ironoxide. The heavier particles are removed as bottom ash. The lighter particles are arrested by the Electro Static precipitator (ESPs). The residual lighter particles and gaseous combustion products are discharged to the atmosphere through stack as the flue gas.

Thermal plants use pulverised coal as fuel. A 400 MW plant with poor quality of coal could emit 50 tonnes of fly ash per hour. Although coal available in Talcher and Ib Valley area in Orissa does not contain large quantities of

Sulphur which varies from 0.2% to 1.06%, but the problem becomes very acute when in one place a mega project with installed capacity of 1000 MW and more is set up. ***Table- 4.10*** below shows coal consumption of the existing plants (of more than 100 MW capacity) and generation of flyash (assuming an ash content of about 42% in the coal used). However, this figure may vary depending on the coal quantity.

TABLE: 4.10
Coal Consumption by Existing Thermal Power Plants

Power Plant	Capacity in MW	Coal Consumption TPD	Ash Generation TPD
NTPC, Kaniha	3000	36,000	15,120
TTPS, NTPC, Talcher	460	7,000	2,940
NALCO, CPP, Angul	960	14,000	5,880
ICCL, Choudwar	108	2,100	882
Ib Thermal Power Station	420	6,500	2,730
Hirakud Power, Hirakud	167	2,000	840
NSPCL CPP & Rourkela Steel Plant	195	4,000	1680
Total	**53100**	**71,600**	**30,072**

4.4.2 Greenhouse Effect

The thermal power plants emit huge quantities of carbon dioxide (CO_2) to the atmosphere. It is estimated that at present CO_2 emission into the atmosphere worldwide is 57000 million tonnes per year due to man made causes.

CO_2 is continuously increasing in the atmosphere. It was 312 ppm in 1940, 318 ppm in 1960 and is around 350 ppm by 2000. The level of CO_2 in the atmosphere is maintained in a steady state through the process of photosynthesis carried out by green plants, which reduces CO_2 and increases O_2 in the atmosphere. Therefore, to absorb the huge quantities of CO_2 generated sufficient green plant cover by way developing forestry should be in place. CO_2 has the capacity to block the long wavelength heat radiation from earth's surface. This trapping of heat contributes to global warming and known as greenhouse effect. If no greenhouse effect existed, the average temperature of earth would have been -19^0C making life incompatible. However, too much of green house effect also leads to temperature rise which affects agricultural production, reduce the rain fall and increase evaporation and sea level rise because of melting of ice caps at the polar region. Therefore it is imperative to adopt appropriate energy management strategy to protect the environment.

In Orissa, annually an estimated 40 million tons of carbon dioxide is emitted to the atmosphere at the present generation level of the coal based thermal power plants.

4.5 Response and Recommendation

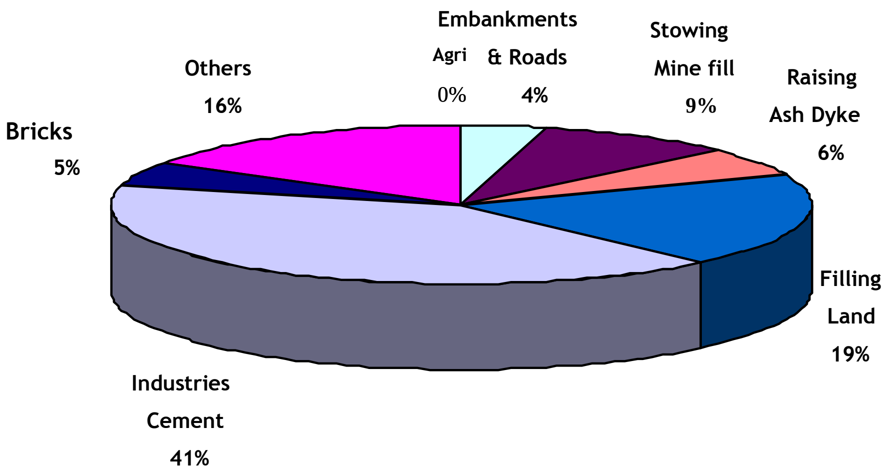
4.5.1 Fly Ash Management

(i) The addition of thermal plants will generate huge quantities of ash to the extent of 30 million tonnes per annum. In the present technology the plants will go for dry ash disposal. It is necessary to utilise the ash for the following purposes:

- Brick manufacturing
- Road construction
- Mines filling
- Raising the height of ash pond dykes
- Manufacture of cement
- Soil conditioner for agricultural purpose.

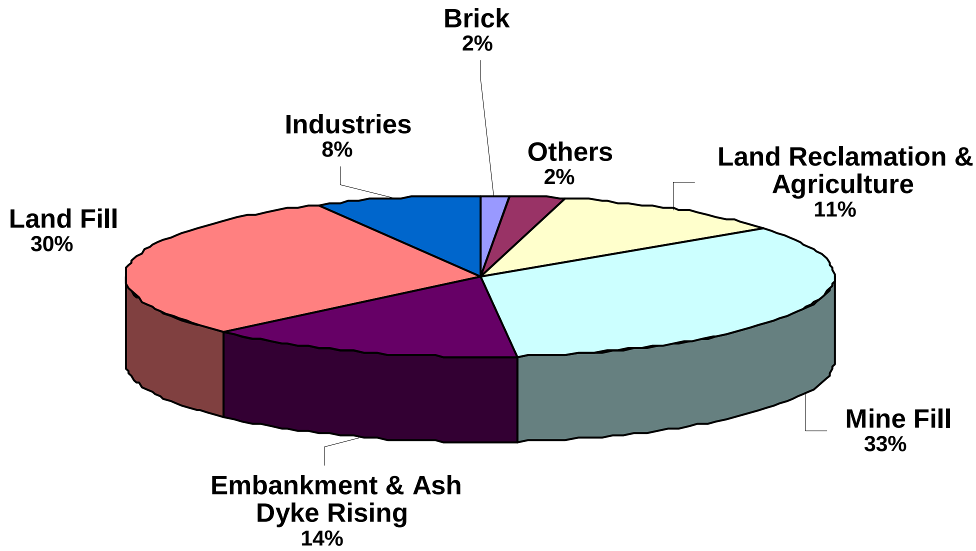
At present the utilisation of ash across the country is shown in ***Fig. 4.3(a)***. The total ash utilization in the country is, however, quite low (about 32%). In Orissa, ash utilization is quite close to the national figure (about 31%. ***Fig. 4.3(b)***). These figures are to increase significantly to mitigate environmental problems of the present mode of flyash disposal.

Fig. 4.3 (a)
Mode of Fly Ash Utilization in India (2001-02)



[Source: Annual Report of CEA 2002-03]

Fig. 4.3 (b)
Mode of Fly Ash Utilization in Orissa (2002-03)



4.5.2 (a) Following steps should be taken to reduce the impact of pollution while meeting energy demands:

(i) improve operational efficiency of the existing plants,

(ii) reduce the distribution loss in the system,

(iii) educate the general public on Demand Side Management (DSM) of the power availed by them which can contribute to 10% reduction in the demand. There are a number of Captive Power Plants (CPPs) which can optimally generate power and feed the surplus power to the state grid/loads in compliance to the provisions of Electricity Act, 2003, by going for gas fired power stations in Godavari and Mahanadi basin or alternatively gas can be marketed from Bangaladesh to meet the generation requirement by importing power from neighbouring countries like, Bangaladesh, Nepal and Bhutan. In fact, the PGCIL is planning to construct EHV lines to facilitate import of 6930 MW in X plan and 4000 MW in XI plan from these countries.

(b) Electricity Act, 2003 has delicensed setting up off thermal power stations as long as they comply to the technical standards. Therefore, there will be practically no control either at the state level or Government of India level for controlling the setting up of new thermal plants. This means that very strict control and monitoring of the discharges from the plant has to be done so that the ecology is not disturbed.

(c) It is estimated that by adopting methods of conservation about 25000 MW of power can be saved which means a saving of Rs.200,000 crores of capital investment towards both for capacity and transmission cost addition. This is one of the major driving forces which led to enactment of Energy Conservation Act, 2001. The results after enforcement of the Act have to be studied to ascertain the savings in power.

(d) The high degree of distribution loss needs to be reduced on a war-footing basis from 40% to a permissible limit of 20% so that the quantum of billable energy will increase leading to turn around of the distribution companies. Loss reduction will also ease the pressure on capacity addition in generation.

(e) A question comes to the mind as to whether power sector reform and restructuring has got any relevance with respect to the environmental issues. The Centre for Multi Disciplinary Development Research (DMDR) Group were assigned by DFID to make a study on the Socio-economic and environmental assessment of reforms in the power sector in Orissa. The report indicates that due to reforms and restructuring, there was improvement in the quality of generation. Due to construction of a number of transmission lines and expansion of distribution network, there was less tripping of feeders. This also resulted in less outage of power stations thereby decreasing the secondary fuel oil consumption and thereby less contribution to pollution. More attention is given to the optimal use of resources like coal, water etc. This is a positive aspect of the reforms and restructuring, which needs to be completed as per scheme of things to derive maximum benefits.

4.5.3 Clean Development Mechanisms (CDM) and Carbon Trading

According to "The Kyoto Protocol" adopted by the United Nations, the developed countries have to contain and limit their green house gas emissions and reduce them to an average of 5% to 8% from the 1990 emission levels. One of the mechanisms to control the green house gases emission is Clean Development Mechanism (CDM), which provides for cooperation between developed and developing countries. Under this mechanism, the developed countries would invest in projects in developing countries which are carbon efficient.

The Maharastra Electricity Regulatory Commission recently has raised the issue whether environmental consideration should be a factor in deciding the electricity tariff and who should share the high cost of environmentally benign power till the technology has fully developed. The Commission has suggested that in addition to the government, consumers should also pay higher energy charges taking into account the importance of switching over to renewable energy sources.

Recently the Govt. of India has constituted a "National Hydrogen Energy Board" for promotion of development of fuel and other high technology. Alternative sources energy will increasingly play a greater role in future years to come.

4.5.4 Alternative sources of power supply adopting renewable sources

A Vision 2012 for Renewable Energy Sources has been prepared which has the following main features.

- Setting up of 3 million family size bio gas plants;
- Development of 2 million solar home lighting systems;
- Solar water heating systems in a million homes;
- Electrification of 18,000 remote villages;
- 10% of power capacity addition through renewables by 2012;
- Creating one million jobs in manufacturing, installation and servicing of renewables.

Governments at the national and state level are committed for 100% rural electrification of villages by 2007 and power supply to all the houses by 2012. Most of the villages particularly in Orissa which need to be electrified are at places far away from the grid. It will be quite expensive to extend grid supply to these villages which will also mean felling of trees in forest area. It will be economical to electrify these villages through distributed generation which means setting up of plants near to the village and supply power. Such a distributed generation can be fed by bio-mass fuels which include fuel wood, animal and domestic wastes and agro wastes etc.

Biomass Power

(i) According to the India Vision 2020 published by Planning Commission, about 50 million hectares of degraded waste land lie outside the demarcated forest areas and 34 million hectares of protected forest areas do not have any forest cover. A massive fast growing tree plantation programme, like Bamboo, Casurina and Eucalyptus can be undertaken. The product can be utilised as fuel for the biomass power plants. Power plants ranging in sizes from 10 to 25 MW can generate large blocks of energy thereby substantially reducing dependence on imported fuel oils and fast depleting fossil fuel reserves. It is estimated that 40 million hectares of such plantation can generate 100,000 MW of power and provide employment to 30 million people round the year.

(ii) If wood is to be used as feed stock, it should come from energy plantations done on wastelands and not from existing forests. Orissa has about 51.57 lakhs hectares of wasteland (national figure 936.91 lakh hectares). As per the estimate of the DNES, about 1,000 hectares of land with energy plantation can produce 3 MW power besides fuel-wood and charcoal for 125-130 families. On the basis of this calculation, 51.57 lakh hectares of wasteland in Orissa can generate 15,470 MW of power, which is several times more than the present installed capacity of all the power stations in the State.

Power from Ocean

The Ocean Thermal Energy Conversion (OTEC) technology is based on temperature difference at surface (at about 29^0C) and at a depth of 1100 meter (at about 5^0C) to produce electricity. It has a potential to generate around 180,000 MW of power. The National Institute of Ocean Technology (NIOT) is implementing the World's first 1MW floating OTEC Technology demonstration project off the Tuticorin coast in Tamilnadu. This can help in generating clean power along the 7000 KM of coastal belt of India.

Orissa can also benefit from its 480 KM long coast line. It is estimated that along the Orissa's coast line, Ocean Power to the tune of 10000 MW can be generated based on the principles mentioned above. The technology can be obtained from the National Institute of Ocean Technology (NIOT).

4.6 Conclusion

In conclusion, it can be stated that pollution of environment, ground water and ecological disturbance can be greatly reduced as far as power sector is concerned, by taking the following measures:

(i) improving performance of all thermal and hydraulic power stations through supply side management,

(ii) adopting clean coal technology,

(iii) blending high ash content low calorific value coal with low ash content high calorific value imported coal,

(iv) 100% utilization of flyash,

(v) ensuring zero discharge from ash pond,

(vi) setting up of small, mini and micro hydro stations for which water sources are plentily available in the state,

(vii) encouraging sources of renewable energy and going for large scale distributed generation,

(viii) importing power from neighbouring countries instead of adding generation capacity in the country,

(ix) public awareness on demand side management and conservation of energy which will substantially reduce the requirement of building additional generation capacity to meet the load growth,

(x) reducing the distribution loss to an acceptable level through various measures like energy audit, strict supervision on consumption pattern and stopping illegal abstraction of power,

(xi) taking up rural electrification only through HVDS system with AB conductor and metering arrangement near the transformer and entrusting billing, collection etc., to local village Committee or a franchisee who will be responsible for making payment to the utility on readings recorded in the meter near the transformer minus 6 to7% of technical losses in LT distribution system.

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