Energy

It is energy that drives the world and the quest for which pollutes it.
-Anonymous

ENERGY

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CURRENT STATUS

Karnataka uses three major sources of energy - firewood, electricity and petroleum products. Firewood is used by people for cooking and water heating and by tiny and small scale industries making bricks and tiles, jaggery, puffed rice, etc., for heating purposes. Electricity is used by several sectors - domestic, industries, agriculture, transport, trade, public utilities and services for several activities like motive functions, refrigeration, heating and cooling, electrolysis, etc. Petroleum products are used for transportation through vehicles, for captive power plants and for meeting the cooking needs of domestic consumers (Kerosene and LPG). Some quantity of kerosene is used for lighting especially by poor people.

Let us now see the share of different energy forms in the total energy consumption in the state for the year 2000-01. The share of electrical energy is 47.5% of the total. The share of petroleum products is around 10.5%. Energy from firewood and other traditional fuels like agricultural residues has a share of 42%, nearly equal to the share of electrical energy. Coal is used mainly for generation of electricity at the thermal power plant at Raichur.

Electricity

For a long time, Karnataka depended only on major hydel power plants to meet its electrical energy needs - from the first power project at Shivanasamudram set up in 1902 till the operation of the power house at Nagjhari on Kali river in 1979-84. This led to the construction of large reservoirs at several places mainly in Shimoga and Uttara Kannada districts leading to the loss of good forest areas. The public became concerned about the ecological consequences of these mega projects.

The State set up the Raichur Thermal Power Plant in 1984 which now generates 1470 MW. Environmentally this resulted in problems of emission and storage and disposal of flyash. A nuclear power plant at Kaiga set up by the Government of India is also operational. Location of these projects far away from the load centre is not as per accepted network balancing and optimization practices.

Initiatives of the government

Compensatory afforestation has been raised successful to the extend of 34000 hectares.

Installed capacity from wind energy systems has increased from 0.55 MW in 1994-95 to 96.7 MW in 2002-2003 with an annual generation of 135 million units. From cogeneration in sugar units, the state generates 182.7 MW of power and 91.85 million units of energy. A separate organisation called the Karnataka Renewable Energy Development Ltd is functioning from 1996 to promote use of renewable energy.

Electricity companies provide subsidy for those using solar water heaters in their monthly electricity bills.

Fly ash utilization in Raichur thermal plant is around 30% and it is expected to reach 60% in a few years. KPC has entered into agreements with cement manufacturers and small scale units in this regard.

To improve the efficiency of production and operation, separate organizations for generation (KPC), transmission (KPTCL) and distribution have been established in the state.

The state has been in the forefront in the development and use of biogas plants from 1980 onwards. This provides an alternate energy source to people, improves the sanitation of the area and increases the quality of the manure. About 30,000 biogas units are installed every year in the State. The State has setup 3.09 lakh biogas plants by 2002 out of a total potential of 6 - 8 lakhs.

Micro hydel power plants have been setup initially on experimental basis and later on for commercial production.

A private entrepreneur has ventured into the experiment of setting up of a barge mounted power plant at Tanneer Bhavi in Gurpur river near Mangalore. Its impact on the coastal environment is not clear and it needs to be studied and analysed.

The installed capacity of electricity generation in the State in the beginning of the year 2003-04 was 6539 MW including the State's share of central generating stations of 840 MW. The share of hydro, thermal and wind were 3227 MW(49.35 percent), 3215 MW (49.17 percent) and 96.7 MW (1%) respectively. The Karnataka Power Corporation Ltd (KPCL) and the Visvesvaraya Vidyuth Nigam Ltd(VVNL) both owned by the government of Karnataka operate a large number of power plants ranging in size from 0.35 MW to 1470 MW. The installed capacity of the power plants of these organizations was 4350.50 MW and 348.52 MW respectively as given in Tables 1 and 2. Installed capacity of the Independent Power

MoEF Notification on fly ash

The Ministry of Environment and Forests issued a notification on 14th September 1999 which was amended in 2003 to deal with management of fly ash. The salient features of this notification are:

- All coal or lignite based thermal power plants shall fully utilise fly ash generated within a period of nine years from the publication of this notification. 30 percent fly ash utilization shall be reached within three years from the publication of this notification with further increase in utilization by at least 10 percent points every year progressively.
- Manufacturing units located within a radius of 100 km from coal or lignite based thermal power plants cannot manufacture clay bricks or tiles without mixing at least 25 percent of ash with soil on weight to weight basis.
- Thermal power plant shall maintain month wise records of ash made available to each brick kiln.
- User agencies from the Government and private sector shall prescribe the use of ash and ash based products in their respective schedules of specifications and construction applications including appropriate standards and codes of practice.
- All local authorities shall specify in their respective building bye laws and regulations the use of fly ash and ash based products and construction techniques within a period of 4 months from the publication of this notification.

Actions initiated for the utilization of fly ash in the State

- The Public Works Department has included the items of fly ash bricks and fly ash for road embankment in the schedule of rates of Gulbarga and Bellary Circles. The said schedule of rates are being used by the Irrigation Department, Urban Development Department& Housing Department
- Nirmithi Kendras produce products utilizing fly ash.
- Fly ash building products are used in the construction of Ashraya houses and other buildings by the Rajiv Gandhi Rural Housing Corporation.

Statement showing the names of power plants, flyash generated and its utilisation in the State as on 31 March 2003

Name and address of unit	Quantity of ash generated (MT\ month)	Percentage Utilisation
Vasavadatta Cements Sedam, Gulbarga	27,699	100.00
Rajshree cements Aditya Nagar, Malkhed, Gulbarga	65,022	100.00
Tata Power Corporation, Wadi, Gulbarga	66,440	100.00
Grasim Industries Ltd, Kumarapatnam, Haveri	13,900	64.70
Jindal Thermal Power Company, Toranagallu, Bellary	25,073	50.50
Raichur Thermal Power Station, Raichur	1,755,901	29.80

Producers is given in Table 3.

Several co generation and biomass based projects and windmills have been taken up by the government and private organisations. Details are given in Tables 4 & 5. There is an estimated potential of cogeneration in the sugar industry of about 2000 MW. There is also enormous scope for generation of power from mini\micro hydel projects and windmills. Most of the decentralized renewable power comes from the private sector and this is expected to increase rapidly in the years to come. Electricity generated by different agencies under different categories is given in Table 6.

There is an estimated shortage on meeting peak power demand of about 1300 MW. The current emphasis is on setting up large thermal projects in Bellary and Dakshina Kannada districts and near Bangalore.

The major load centre is Bangalore. Several transmission voltages - 400 kv, 220 kv, 110 kv, 66 kv and 33 kv - exist in the State. In the recent past there have been addition of lines in all voltage categories.

Karnataka Electricity Board is now reconstituted as the Karnataka Power Transmission Corporation Limited in order to focus on transmission, networking and

Windmills at the Kappatagudda windfarm

despatching. Distribution is passed on to different distribution companies in Bangalore (BESCOM), Hubli (HESCOM), Gulbarga (GESCOM) and Mangalore (MESCOM). Transmission and distribution losses are high. Tariff for High Tension consumers is high and this results in cross subsidies for I.P sets. Energy consumed by different categories of consumers is given in Table 7.

Table 8 gives the decennial growth rates for different consumers of electricity. The percentage growth for 10 years is low for High Tension power (27.28%), highest for domestic consumers (159.5%) and moderate for Low Tension power (65.33%). Table 9 gives the details of domestic connections obtained districtwise. The ratio of number of consumers to the population indicates the disparities that exist in the use of electricity in households which is a key element in determining the quality of life that people lead.

Table 10 gives the details of captive generators set up in the State as on 31 March 2003. The installed capacity of the 21,631 units adds up to 4433 MVA. The power generated by these captive units during the year exceeded 2900 Million Units.

Firewood consumption

Firewood is the main source of fuel for 65 percent of the households in the state. In the rural areas, firewood is the primary source of cooking fuel in about 85 per cent of the houses. It is mainly used for cooking and water heating. Current estimates of consumption are around 0.5 tons / head / year of firewood. Large scale growth of *prosophis juliflora* in almost all districts in the northern plateau provides the needed firewood for people in villages in these districts thereby reducing pressure on forests. The people in Malnad areas (districts of Uttara Kannada , Mangalore, Udupi, Shimoga, Kodagu and Chikkamagalur) depend on firewood collected from forests. This affects the quality of forests especially in the periphery. Further the per capita consumption is higher in these districts.

With a view to meet the energy needs of the rural households in the State, the government has been playing an active role in the setting up of biogas plants. In the recent past, in excess of 20,000 units have been established every year. Details are given in Table 11. Further, improved stoves not only reduce indoor air pollution but also minimize the use of firewood, Table 12 gives the details of these stoves established in this State in the recent years.

The reserved forest area has remained nearly the same in the recent past as per the annual reports of the Forest Department. Forest degradation is not visible from this data. Firewood sale through depots of the Forest Department, the Karnataka State Forest Industries Corporation and others has come down from 2,85,479 m^3 in 1990-91 to 1,16,107 m^3 in 2001-2002 (about less than half). The number of depots has also come down from 151 (1990-91) to 44 (2001-2002). Reasons and impacts due to these reductions need to be looked into.

Petroleum products

LPG consumption has gone up from 3,10,245 MT in 1999-00 to 5,00,880 MT in 2003-2004 . Petrol consumption also has gone up from 3,81,958 MT to 5,09,918 MT in the same period. Diesel consumption was 21,55,062 MT in 1999-00 and 22,98,370 MT in 2003-2004. This is only a marginal

Sales of various petroleum products in Karnataka (in MT)

Year	LPG	Petrol	Diesel
1999-00	3,10,245	3,81,958	21,55,062
2000-01	3,65,861	4,33,252	21,55,653
2001-02	4,13,358	4,81,647	21,58,390
2002-03	4,61,441	4,98,228	22,20,671
2003-04	5,00,880	5,09,918	22,98,370

Source: State Coordinator, Indian Oil Corporation, 2004

increase and it has to account for increases in the capacity of captive DG sets also. One inference is, more dependence on privately owned vehicles.

■ ISSUES

The energy sector has close links with environment. Hence the key issues are listed under two categories - direct (energy related) and indirect (affecting the environment of the State).

Direct

- Shortage of electrical energy for the past two decades to meet the demands. [Poor reliability and availability - (< 6 hrs / day in many places)]
- Poor efficiency in energy utilisation in industries, agriculture, transport and domestic sectors as well as high distribution losses.
- Depletion of non renewable resources.
- Unequal distribution of energy (particularly electrical energy) in different districts of the State.
- Improper location of power plants.

Indirect (Environment related)

- Degradation of forests due to firewood collection.
- Loss of forests due to hydro and nuclear power projects and transmission lines.
- Soil pollution due to fly ash accumulation in thermal power plants.
- Air pollution due to thermal power plants.
- Air pollution due to captive diesel generators.
- Air pollution due to transport vehicles.

The demand for electricity is higher than the supply in the State for more than two decades. This had led to large scale introduction and growth of captive D.G sets not only in major industries but also in small scale industries, offices, hotels, health centres and many other places. The total capacity works out to about two-thirds of the generation capacity of the State. This is very high and undesirable. This means use of depletable resources, inefficiency as well as more emissions.

Low energy efficiency is a major concern in the State. Low efficiency means more energy consumption and hence more consumption of non renewable resources. Several studies conducted in the State show that the efficiencies of irrigation pumpsets are very low and that the efficiencies of normal chulas are in the range of 10-15% . Efficiency of energy consumption is measured by Specific Energy Consumption(SEC) given by the ratio of energy consumption to production (physical units or monetary units). Studies conducted on Specific Energy Consumption in several sectors like metallurgy, paper, sugar, textiles, tiles, etc., show large variations thereby indicating the fact that there is enormous potential for reducing energy consumption while maintaining the same production levels. Many industries are taking steps to improve energy efficiency.

Energy efficiencies for some common end use devices

Enduse	Place	Efficiency (%)
Irrigation centrifugal pumps	Hassan	9.2 - 69.4
Irrigation centrifugal pumps	Mandya	42.3 - 78.1
Diesel generator	Bangalore	32.2 - 41.8
Shearing machine	Bangalore	33.1 - 36.4
Press brake	Bangalore	9.0-24.0
Electric furnace (induction type)	Bangalore	10.8
Electroplating	Bangalore	13.45
Welding (mg set)	Bangalore	14 - 18
Welding (rectifier, set)	Bangalore	24 - 32

(Source : Based on studies done at I.I.Sc., and KSCST)

As regards the issue of depletion of resources, the State has increased the share of thermal power generation during the past 15 years and the demand for petroleum products is increasing due to the large number of captive DG power plants and the increasing growth of private transport vehicles. There may be a few hotspots where forest regeneration might have reduced considerably because of over exploitation due to the large scale collection and harvesting of firewood. These hotspots are to be identified by detailed studies on the quality of the forests.

Energy distribution, particularly electrical energy and petroleum fuels, has not been uniform in the state for decades. Development has been concentrated mainly in Bangalore and to some extent in Mysore, Mangalore, Hubli, Belgaum and Bhadravathi.

Solar powered lanterns

The location policy followed by the State has resulted in the clustering of several power plants in the ecology rich Uttara Kannada and Shimoga districts. Whereas it is acceptable to locate hydro projects in these areas, it is not easy to justify the location of a nuclear power plant in the forest area. Forest area is lost not only for the setting up of a power plant but also for the construction of two transmission lines.

■ CAUSES

The causes for the problems that are there in the energy sector are listed below:
Shortages arise due to poor and inadequate planning, financial constraints, poor growth of alternative renewable energy sector and high transmission and distribution losses.

Poor efficiency in the use of energy is due to inefficient devices and old technologies, poor instrumentation and energy audit, lack of norms for various components and subsystems, poor maintenance of equipment., poor quality and standard of devices, improper matching of input electrical power and output load (due to poor quality of power supply), lack of awareness about new devices and absence of research institutions in energy conservation.

Incorrect location of power plants in forest area is due to lack of awareness about ecology. Lack of proper environment friendly routing of transmission line arises as environmental and ecological aspects are not integrated in the planning and implementation stages of the projects.

Inequity is caused because of inadequate infrastructure, poor economic growth / demand in districts, target based approach in extending domestic connections and poor financial affordability of people to get low tension supply.

Soil Pollution arises due to the use of high ash content coal, and non utilisation of fly ash by industries.Poor management of the catchment area of hydel power plants is resulting in soil erosion and siltation of reservoirs.

Threat to State's white water

The State's white-water is under grave threat. White-water, that is river rapids, is a major eco-tourism resource. All existing stretches of white water in our land are in the rivers of northern India with a single, remarkable, exception: the Kali river between Ganeshgudi and Dandeli. These are the last, 14 km, free flowing, waters of the river. The river rafting on this superb stretch of the Kali is run by professionals of the ecologically sensitive Jungle Lodges and Resorts. It is so popular that from receiving 6,550 tourists in 1998-99 it welcomed 16,500 guests in 2002-03.

This growth rate is astounding, especially at a time when international tourism took a beating after 9/11. But, instead of being proud of the achievements of this green, non-polluting, job-generating "industry", a Ministry of the government is thinking of destroying it. It is planning to build a Mini Hydel Project here which will submerge 10 islands, some as large as 10 to 15 hectares and covered with enormous trees, impact on 200 hectares and cover the foaming rapids in still water. Karnataka's white water advantage will be destroyed. All for an insignificant 18 MW of power: just 1.5 times the power generated by the captive diesel generator installed in a single complex in Bangalore: the ITPL. Is the gain to the contractor, his sponsors, loggers and the State Electricity Board, worth the loss of a habitat, where the rare black panthers are found and of a free river which attracts growing number of income and employment generating eco-tourists. Surely, eco-sanity must prevail over myopic cupidity.

- Hugh and Colleen Gantzer, Deccan Herald Spectrum, April 11, 2003

Problems relating to bio fuels and resource optimisation are largely due to poor management of village wood lots (indiscriminate cutting and felling), overexploitation, poor maintenece support, use of inefficient stoves and improper management of cooking, lack of awareness, contentions on the use of forests for firewood, grazing, etc., non availability of data regarding collection by people and regeneration, no proper institutional mechanism and poor professional approach.

Shortage in electrical energy has led to the high growth of captive power plants. This adds to air pollution. In the case of transport sector, the reasons for air pollution are the use of inefficient vehicles, poor transportation planning in cities, poor handling of traffic at junctions, low level of awareness, use of improper / adulterated fuels like kerosene, etc., in I.C engines and large scale dependence on private individual owned two wheelers (poor public transportation system).

The causes for indoor air pollution include use of wrong fuels like tyre, use of inefficient stoves, poor design of the room without ventilation, non provision of chimneys, use of kerosene for lighting, etc.

IMPACTS

Shortage in electricity has lead to reduced production in industries and agriculture and hence to loss in productivity and consequent reduction in the total state domestic product. There is an addition to capital costs due to the establishment of captive power plants. Use of diesel in these plants means outgo of foreign exchange. High transmission and distribution losses mean higher costs of energy. Similarly low efficiency devices lead to higher costs of production. Leaching of fly ash may lead to reduced agricultural production in the neighbourhood.

Due to shortage and non availability of energy, the standard of living is poor in many villages. People need electricity for lighting and water supply. Use of improper cooking stoves and fuels has lead to health problems.

The large scale requirement of firewood has led to the degradation of forests in the Malnad area. Forest areas in Shimoga and Uttara Kannada districts have been lost due to submergence for creation of reservoirs for various hydro power projects. This has a consequent impact on biodiversity of these districts also. Similarly forest areas are lost for the right of way for transmission lines like Sharavathy to Shimoga and to Hubli, Kaiga to Sirsi etc. This also affects the biodiversity. There may be changes in the coastal ecosystem due to the barge mounted power plant at Taneer Bhavi, Mangalore.

Hazards arising from improper disposal of fly ash:

- Fly ash is reported to cause ailments like allergic bronchitis, silicosis and asthma.
- Fly ash can become air borne easily and contaminate surface water. It also affects the aquatic life and corrodes exposed metallic structures in its vicinity.
- Fly ash can reduce agricultural productivity in the vicinity of the generating plant by settling on the leaves and reducing photosynthesis.
- The heavy metals present in fly ash may leach into ground water resulting in contamination.

TRENDS

Since additions of large power plants to the grid have impacts on environment, it is desirable to assess the future demands of electric power carefully and scientifically such that there is no over estimation. Currently there is a shortage of electric power. Electricity planners assume an annual growth rate of 9%. Shortages cannot be predicted accurately due to the nonavailability of data on shortages and energy from other sources.

There is a shift in the pattern of industrialization in the State from high energy intensity industry to low energy intensity software, Information Technology Enabled Services(ITES) and Business Process Outsourcing(BPO) industries. Though the energy shortage may not increase in the coming years for this reason, there will be an increase in the demand for high quality power supply and this will not reduce the diesel based captive power generation.

Similarly it is difficult to predict the effect of energy efficiency increases that may happen in the next 5-10 years. A lot of measures are required to improve energy

efficiency in the system.The disparity in energy use in many districts remains the same for the past twenty years and will not improve unless affirmative actions are initiated.

There is an increasing trend discernible in the total capacity of captive DG sets. There is an increase in the use of these sets in industries, small scale units, service units like hospitals, hotels, computer centres, etc., and even in houses. This might continue unless quality of power supply improves. The situation regarding fly ash utilisation is better and it is expected to improve in the near future.

Firewood consumption from forests in Maidan areas has reduced as people use prosophis juliflora, but the degradation of forests in Malnad area has not reduced and is expected to increase at least at the same rate of increase of population in these areas. If biomass based gasifiers are installed in several places, the impact on forests will be more.

■ PRIORITIZATION

In order to find out the most important problems, marks are assigned for several parameters considered relevant from social, economic and ecological points of view to each problem / issue.

Based on the total, it is possible to identify problems needing attention. It was agreed to perform the analysis for the entire state as well as for five regions - Bangalore, Coastal, Malnad, North maidan and South maidan regions.

Policy Issues

Current practices for electricity generation depend on conventional and large projects. The growth rate of renewable energy systems in different areas is poor. Environmental issues like degradation of forests, location policies for various power plants like nuclear plants, coast based / barge mounted power plants, etc., need to be integrated into the planning processes. Private

Prioritization Matrix

Problem	Public Health	Loss of biodiversity	Impact on vulnerable groups	Productivity Loss	Critical Ecosystem	Irreversibility	Urgency	Total
Degradation of forests due to firewood extraction	3	5	5	5	3	5	5	31
Loss of forest areas due to power plants	1	5	3	3	5	5	1	23
Air pollution due to thermal plants	3	1	3	1	1	3	3	15
Air pollution due to vehicles	5	1	5	3	1	5	3	23
Air pollution due to captive power plants	3	1	5	1	1	5	3	19
Soil pollution due to thermal plants	3	1	3	1	1	3	3	15
Unequal distribution of energy	1	1	5	5	1	1	5	19
Energy shortage	3	1	5	5	1	1	5	21
Low Energy Efficiencies	5	5	5	5	1	5	5	31
Poor location strategy	1	5	3	3	3	5	3	23

Scale: 1=Low, 3= medium, 5=high

participation in decentralised energy systems needs encouragement and formal mechanisms.

A holistic view of regional level (district level or substation level) energy plan and implementation (looking at all aspects of energy) is missing. The problems of quality of energy, shortages and disparities in distribution have to be addressed.

Biofuels are finding several new applications like use of honge oil in I.C engines, use of firewood in gasifiers, production of charcoal from prosophis, use of ethanol in transport vehicles, etc. Biofuels already are used in large quantities for meeting the domestic needs like firewood for cooking and water heating and needs of tiny and small scale industries. The contentions on the use by several sectors, demands and availabilities may create additional pressures and needs to be studied. A policy has to be evolved for biofuels.

There are no studies on the amount of optimal energy to be consumed for the production of several products like sugar, textiles, steel, aluminium, oxygen, etc. It is possible that one manufacturing unit producing steel (say) may consume more energy than another for producing one unit of similar product. Since the Specific Energy Consumption varies amongst industries producing the same type of item, norms for SEC have to be established. This will improve efficiencies in production. This is particularly important for traditional units like bricks and tiles. Energy audits and technology audits need to be made mandatory to all industries.

Issues in implementation

The following issues are to be looked at in order to balance environmental aspects.

There are not enough measurements in various applications. For example, I.P sets are not metered.It is not possible to do energy analysis - the percentage of energy flow into several paths and segments from a substation. Automated reliable instrumentation and recording of energy consumption by various segments needs attention. Quality of power supply needs to be measured at different places and quality indices calculated.

There is no study or measurement of head loads of firewood collected from forests by people as well as its impact on degradation / regeneration of forests. There is a large data gap in respect of firewood supply and consumption by different categories of consumers .The quantum of firewood collected from forests and the quality and production of biomass in forests need to be assessed periodically. Popularisation of efficient and renewable energy devices is weak and needs strengthening.

Firewood is the dominant energy source for rural and urban poor households. Many energy efficient stoves both fixed and portable types have been developed in the state. Capacity and skills have been built at district levels. The potential for stoves is estimated to be 60.76 lakhs and about 15.90 lakh stoves have been constructed so far. The annual target is around 60,000 units of improved chulas and this is mostly being met.

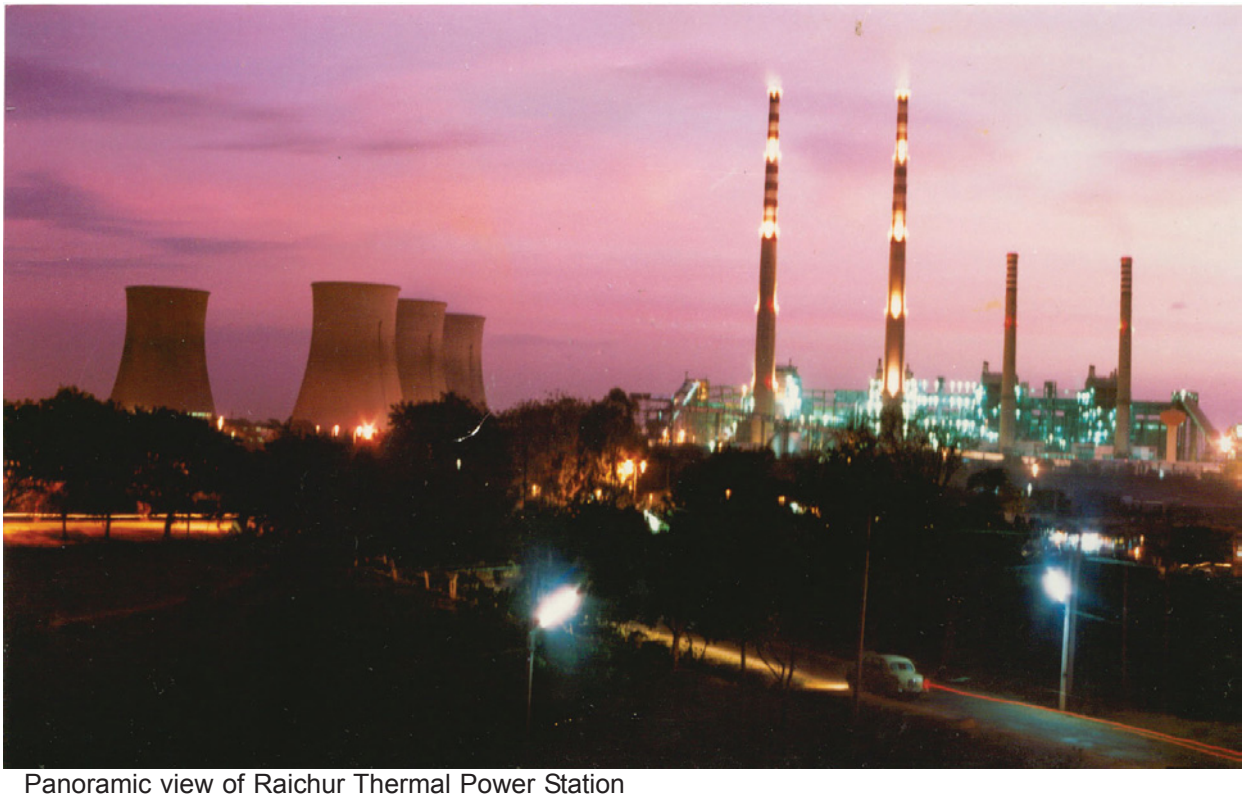
Similarly, large energy efficient stoves for canteens, hotels, hostels, jaggery making, etc., have been developed and successfully installed in several places. All these would lead to a considerable reduction in demand for firewood and consequently reduced pressure on forests.

■ ACTION PLAN

- There should be long term plans for not only generation and transmission but also distribution systems. It is desirable to conduct the planning activity in a comprehensive manner involving experts from several sectors. Planning for all energy sources should be done and load forecasting made more accurate. Rigorous mathematical techniques including location theory, network optimisation etc should be used fully.
- Environmental aspects should be integrated into the planning and design of generation, transmission and distribution systems from the beginning. Environmental costs should also be included in the costs of power plants, lines, sub stations etc. The money realised should be used by the Government for environmental upgradation in the State.

- Energy conservation should be taken up in a large scale by setting up a separate organisation to develop norms of energy use for different end use tasks like motive power, refrigeration etc, measure energy consumption and enforce the norms of specific energy use by tasks. Awareness on energy conservation should be built up and testing facilities created.
- Distribution losses should be brought down by taking up improvements which are area specific. All sub stations should be modernised, automated and instrumented to improve quality and minimise unaccounted energy. The distribution companies should install modern voltage regulation equipment at sub stations so that proper voltages are available to all consumers. There should be penalties for poor quality of electricity supplied.
- District level planning and implementation with a view to have an integrated decentralised power system should be taken up in a coordinated manner to include generation, transmission and distribution. This could be subject to State level guidelines to maintain standards and uniformity.
- Eco friendly location policies need to be followed. Eco sensitive \ eco fragile regions have to be avoided for establishment of power plants. Unique sites like the white waters, rapids, coasts etc could be avoided. Large storage based hydel power plants could also be avoided. Thermal plants should be located near load centers and forest land should not be diverted for such purposes. Further, generating stations should be distributed in the entire State and not concentrated in a few places. Transmission lines should be routed on the periphery of forests to the extend possible and not by the shortest route through thick forests. Alternative networking should be looked into. Ecological costs should be considered while determining the routing.
- Rural energy needs should be addressed through a professional body. It should look at issues like creation of awareness and proper utilisation of end use devices. IP sets should be tested for quality, endurance and efficiency. Domestic and electric connections can reach most of the population in rural areas if arrangements are made to provide loans for initial capital costs, minimal costs standard plan for house connection and reliable power. . Proper advice needs to be rendered in regard to crops and irrigation pattern to minimise energy and water wastage. A campaign should be launched to cover all feasible households with biogas plants and efficient chulas. All Below Poverty Line(BPL) families should be brought under the Bhagya Jyothi scheme in a time bound manner.
- The demand for biofuels like firewood, ethanol, honge oil, biogas, etc., is increasing and hence it is necessary to have an integrated biofuel policy dealing with production, transport, distribution, regulation, monitoring, etc. It is desirable to setup a formal organisation with professional management to look into the following aspects:
  i) Long term forecasting of demand for different biofuels,
  ii) Scientific production of biofuels in identified forest/ non forest areas.
  iii) Linking production to demand for each biofuel.
  iv) Proper market orientation.
  v) Development of energy efficient devices and popularisation.
  vi) Development of energy plantations in a large scale.
  vii) Proper use of agricultural waste.
  vii) Establishment of service and technical support centers.
- Confidence building and encouragement is a highly necessary activity to be taken up in the State. We need to generate expertise in the areas like load forecasting, system planning, integrated distribution management, etc., Designers and engineers should be sensitised to environmental and ecological concerns.
- Solar water heaters should be encouraged for all heating tasks in houses and industries through incentives and penalties. Water to households should be provided with sufficient pressure so that energy is conserved.
- The responsibility of raising and managing fuel wood plantations could be given to the user agency in case of diversion of forest land for energy related projects.
- Data on energy distribution and use is not available in several instances. Proper scientific data collection should be taken up and made mandatory.

Cooling towers, Raichur Thermal Power Station, Raichur



Panoramic view of Raichur Thermal Power Station