RENEWABLE ENERGY DEVELOPMENT IN ANDHRA PRADESH USING GIS SOFTWARE

A DISSERTATION

Submitted in partial fulfilment of the
requirements for the award of the degree
of
MASTER OF TECHNOLOGY
in
ALTERNATE HYDRO ENERGY SYSTEMS

By

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CANDIDATE'S DECLARATION

I here by certify that the work which is being presented in this dissertation entitled, **"RENEWABLE ENERGY DEVELOPMENT IN ANDHRA PRADESH USING GIS SOFTWARE"** in partial fulfillment of the requirement for the award of the degree of **Master of Technology in Alternate Hydro Energy Systems**, submitted in Alternate Hydro Energy Centre, Indian Institute of Technology, Roorkee, is an authentic record of my own work carried out during the period from July 2005 to June 2006, under the Supervision of **Shri Arun Kumar,** Chief Scientific Officer and Head of the department, **Shri M. K. Singhal,** Senior Scientific Officer of Alternate Hydro Energy Centre, I.I.T. Roorkee.

The matter embodied in the project has not been submitted by me for award of any other degree of diploma elsewhere.

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ABSTRACT

Andhra Pradesh state, being one of the largest industrialized state in India, installation of requires electricity generation stations including Small Hydro, Wind, Biomass/Biogasse cogeneration. As per available data, there are 177 ongoing Small Hydro Power Projects (up to 25 MW) having aggregate install capacity of 523 MW. There are 377 identified/investigated SHP sites with installed capacity of 250 MW. These sites are basically on the irrigation Dam Toe, Canal fall as well as on natural river. The wind installed capacity is 124.97 MW and there are 31 sites are identified for future wind power installations in Andhra Pradesh. Biomass based generation installed capacity in Andhra Pradesh is 204.750 MW and future Biomass based installed capacity is around 72 MW. And the Biogasse- cogeneration installed capacity is 140.250 MW and future installed capacity is around 99 MW.

For the effective and efficient planning a Geographical Information Systems (GIS) based database of all Renewable Energy sites, that includes SHP, Wind, Biomass/Biogasse cogeneration has been attempted. The data has been collected from different sources including the NEDCAP (Non Conventional Energy Development Corporation of Andhra Pradesh), APGENCO (Andhra Pradesh Generatoin Corporation), APTRANSO (Andhra Pradehs Transmission Corporation), MNES(Ministry of Non-conventional Energy Sources) etc.

In the present study focus on the date for Andhra Pradesh Renewable Energy development has been made by using GIS(Geographical Information Systems) Arc View

Software. In this study the project cost details, policies, bottlenecks for the project development and the area which is mostly suitable for the different renewable energy have been brought on GIS software. The database of all renewable energy, sources is shown in the table and maps. By analyzing the data decisions on the type of renewable energy developments may be taken quickly.

- The proposed study resulted in user-friendly database for Renewable Energy site/stations i.e. under construction.
- Identified Renewable Energy sites in Andhra Pradesh state.
- Renewable Energy policies
- Capital Subsidies on the projects , suitable site selection for sustainable developments. This projects database shall be helpful for the developers of renewable energy.

The proposed study resulted in user-friendly database for all kind of Renewable Energy site/stations i.e. under construction and identified Renewable Energy sites in Andhra Pradeh state. And the renewable energy policies, capital subsidies on the projects, suitable site selection for sustainable developments. This projects database shall be helpful for the developers of renewable energy.

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INTRODUCTION TO THE STUDY

1.0 OBJECTIVE OF THE STUDY

The present study gives an over view of renewable energy potential, stage of implementation and possible strategies for speedy development in the State of Andhra Pradesh on GIS (Geographical Information System) platform. GIS is an modern technique for data management, retrieval, analysis. Such data base may be used by potential renewable energy technology. Popular Arc View GIS software has been used for this study. Project cost details, policies, bottlenecks for the project development and the area suitable for the type of renewable energy have been also studied and included in the database. The database of all renewable energies and the resources, maps which are available on land. By analyzing the data one can take the quick decisions on the type of renewable energy development in the State.

1.1 SCOPE OF THE STUDY

Power supply in the Andhra Pradesh State is in deficit, which may further aggravate in coming years, due to fast growing demand on account of industrialization. Harnessing the renewable energy Projects can contribute some power specifically to small entrepreneurs, industry in captive or other wise mode. Since, renewable energy development cases the indigenous source and can be implemented quickly, this may be is the best option to fulfill growing the energy demand in the Andhra Pradesh. Renewable energy sources Viz Small Hydro, Wind, Solar, Biomass/Biogass are available in plenty in the State. Further new electricity act 2003, and present government policies encourages the renewable energy through fiscal incentives for as

several first generation entrepreneurs and leading industrialists are taking keen interest in such development. The selection of the location that is most suitable for various sources is one of the gap in such development.

Software based solution may identifies the suitable site in minimum time for the optimum renewable energy technology. GIS plays a leading role to make the comprehensive database of renewable energy resources for the state. To prepare GIS database for existing potential sites of SHP, Wind, Biomass/Biogas etc., it is essential to collect geographical data, hydrological data and topographical data pertaining to these sites. In the present study, the database of potential renewable energy sites has been developed, which can be used for planning and decision making for speedy development. The detailed information of each station\sites can be retrieved in a user-friendly manner with data management queries. From such GIS database, renewable energy project sites may be developed in phase wise quickly.

Other useful information such as irrigation dam\canal network, their releases at different location, river system, transmission lines and network system, demography details, land uses, soil, meteorological data can be easily added to such database. The developer may find it as useful in planning, short listing and promoting of the above sites for the state.

1.2 RENEWABLE ENERGY

1.2.1 Small Hydro Power

Hydro Power represents non-consumptive, non-radioactive, and non-polluting use of water resources towards inflation-free energy development with most mature technology characterized by highest prime moving efficiency and spectacular operational flexibility. It contributes 18% of world electricity supply today. Small

hydro stands in first place in the generation of electricity from renewable sources throughout the world. The world installed capacity of Small hydropower today is about 47000 MW against an estimated potential of 180000 MW.

India has 4278 small hydropower projects up to 25 MW station capacities with an aggregate capacity of over 10265.45 MW. An estimated potential of about 15,000 MW of small hydropower projects exists in India. Ministry of Non-conventional Energy Sources Government of India (MNES) created a database of potential sites of small hydro and 4096 potential sites with an aggregate capacity of 10,071 MW for projects up to 25 MW capacities have been identified [1].

1.2.2 Biomass\Biogass

Biomass is a renewable energy resource derived from the carbonaceous waste of various human and natural activities. It is derived from numerous sources, including the by-products from the timber industry, agricultural crops, raw material from the forest, major parts of household waste and wood.

Biomass does not add carbon dioxide to the atmosphere as it absorbs the same amount of carbon in growing as it releases when consumed as a fuel. Its advantage is that it can be used to generate electricity with the same equipment or power plants that are now burning fossil fuels. Biomass is an important source of energy and the most important fuel worldwide after coal, oil and natural gas.

Traditional use of biomass is more than its use in modern application. In the developed world biomass is again becoming important for applications such as combined heat and power generation. In addition, biomass energy is gaining significance as a source of clean heat for domestic heating and community heating

applications. In fact in countries like Finland, USA and Sweden the per capita biomass energy used is higher than it is in India, China or in Asia.

Half a kilo of dry plant tissue can produce as much as 1890 K.Cal. of heat which is equivalent to the heat available from a quarter of kilogram of coal. Biomass fuels used in India account for about one third of the total fuel used in the country, being the most important fuel used in over 90% of the rural households and about 15% of the urban households.

Instead of burning the loose biomass fuel directly, it is more practical to compress it into briquettes (compressing them through a process to form blocks of different shapes) and thereby improve its utility and convenience of use. Such biomass in the dense briquetted form can either be used directly as fuel instead of coal in the traditional chulhas and furnaces or in the gasifier. Gasifier converts solid fuel into a more convenient-to-use gaseous form of fuel called producer gas.

At present, biogas technology provides an alternative source of energy in rural India for cooking. It is particularly useful for village households that have their own cattle. Through a simple process, cattle dung is used to produce a gas, which serves as fuel for cooking. The residual dung is used as manure.

Biogas plants have been set up in many areas and are becoming very popular. Using local resources, namely cattle waste and other organic wastes, energy and manure are derived. A mini biogas digester has recently been designed and developed, and is being in-field tested for domestic lighting [2].

Indian sugar mills are rapidly turning to bagasse, the leftover of cane after it is crushed and its juice extracted, to generate electricity. This is mainly being done to

clean up the environment, cut down power costs and earn additional revenue. According to current estimates, about 3500 MW of power can be generated from bagasse in the existing 430 sugar mills in the country. About 270 MW of power has already been commissioned and more is under construction.

1.2.3 Solar Energy

Solar energy is the most readily available source of energy. It is also the most important of the non-conventional sources of energy because it is non-polluting and, therefore, helps in lessening the greenhouse effect.

India receives solar energy equivalent to over 5000 trillion kWh/year, which is far more than the total energy consumption of the country. In the next few years it is expected that millions of households in the world will be using solar energy as the trends in USA and Japan show. In India too, the Indian Renewable Energy Development Agency and the Ministry of Non-Conventional Energy Sources are formulating a programme to have solar energy in more than a million households in the next few years. However, the people's initiative is essential if the programme is to be successful.

India is one of the few countries with long days and plenty of sunshine, especially in the Thar desert region. This zone, having abundant solar energy available, is suitable for harnessing solar energy for a number of applications. In areas with similar intensity of solar radiation, solar energy could be easily harnessed. Solar thermal energy is being used in India for heating water for both industrial and domestic purposes. A 140 MW integrated solar power plant is to be set up in Jodhpur but the initial expense incurred is still very high.

Solar energy can also be used to meet our electricity requirements. Through Solar Photovoltaic (SPV) cells, solar radiation gets converted into DC electricity directly. This electricity can either be used as it is or can be stored in the battery. This stored electrical energy then can be used at night. SPV can be used for a number of applications [2]., such as:

a. Domestic lighting
b. Street lighting
c. Village electrification
d. Water pumping
e. Desalination of salty water
f. Powering of remote telecommunication repeater stations
g. Railway signals.

1.2.4 Wind Energy

Wind energy is the kinetic energy associated with the movement of atmospheric air. It has been used for hundreds of years for sailing, grinding grain and for irrigation etc. Wind energy systems convert this kinetic energy to more useful forms of power. Wind energy systems for irrigation and milling have been in use since ancient times and since the beginning of the 20^{th} century, it is being used to generate electric power. Windmills for water pumping have been installed in many countries particularly in the rural areas.

Wind turbines transform the energy available in the wind into mechanical power, which can then be used directly for grinding etc. or further converting to electric power to generate electricity. Wind turbines can be used singly or in clusters called

wind farms. Small wind turbines called aero-generators can be used to charge large batteries.

Five nations – Germany, USA, Denmark, Spain and India – account for 80% of the world's installed wind energy capacity. Wind energy continues to be the fastest growing renewable energy source with worldwide wind power installed capacity reaching 14,000 MW. The wind power installed capacity of the country is 992 MW, Out of which, about 940 MW is accounted for by commercial installations [2].

1.2.4 Co-Generation

Co-generation is the concept of producing two forms of energy from one fuel. One form of energy must always be heat and the other may be electricity or mechanical energy. In a conventional power plant, fuel is burnt in a boiler to generate high-pressure steam. This steam is used to drive a turbine, which in turn drives an alternator to produce electric power. The exhaust steam is generally condensed to water which goes back to the boiler.

As the low-pressure steam has a large quantum of heat which is lost in the process of condensing, the efficiency of conventional power plants is only around 35%. In a cogeneration plant, very high efficiency levels, in the range of 75%–90%, can be reached. This is so, because the low-pressure exhaust steam coming out of the turbine is not condensed, but used for heating purposes in factories or houses.

Since co-generation can meet both power and heat needs, it has other advantages as well in the form of significant cost savings for the plant and reduction in emissions of pollutants due to reduced fuel consumption.

Even at conservative estimates, the potential of power generation from co-generation in India is more than 20,000 MW. Since India is the largest producer of sugar in the world, bagasse-based cogeneration is being promoted. The potential for cogeneration thus lies in facilities with joint requirement of heat and electricity, primarily sugar and rice mills, distilleries, petrochemical sector and industries such as fertilizers, steel, chemical, cement, pulp and paper, and aluminum etc [2].

1.3 GEOGRAPHICAL INFORMATION SYSTEMS

"**GIS** is a computer based tool for digitizing and analyzing the geo-refferenced data." Computerization has opened a vast new potential in the way we communicate, analyze our surroundings, and make decisions. Data representing the real world can be stored and processed so that they can be presented later in simplified forms to suit specific needs. Many of our decisions depend on the details of our immediate surroundings and require information about specific places on the Earth's surface. Such information is called geographical because it helps us to distinguish one place from another and to make decisions for one place that are appropriate for that location. Geographical information allows us to apply general principles to the specific conditions of each location, allows us to track what is happening at any place, and helps us to understand how one place differs from another. Geographical information, then, is essential for effective planning and decision making in the modern society [3].

1.4 LITERATURE REVIEW

There is lot of literatures available on GIS as well as renewable energy development. For preparation of the report and for development of the work many books and papers have been proved beneficial, some of the literatures which has been

adopted in preparation of this report along with the features incorporated is discussed ad below.

The details of the books, papers and Journals are referred for GIS applications on renewable energy are:

D. Voivontas et al. [21] has made a study- A GIS Decision Support System has been developed for the evaluation of Renewable Energy Sources potential and the financial analysis of RE investments. A GIS database with data on wind, topography, urban areas, and special activities has been developed and used for the evaluation of theoretical potential through the spatially continuous mapping of Renewable Energy Resources. The available and technological potential are evaluated by the application of availability and technological restrictions. The evaluation of economical potential is performed by a precise estimation of the expected energy output and installation cost. The financial analysis based on the Internal Rate of Return, identifies the financial viability of alternative investments. The evaluation of wind energy potential for the island of Crete, Greece and the financial analysis of a wind park installation are presented as a case study.

V. Ramachandra et al. [22] has investigated-an energy resource that is renewed by nature and whose supply is not affected by the rate of consumption is often termed as renewable energy. The need to search for renewable alternate and non-polluting sources of energy assumes top priority for self-reliance in the regional energy supply. This demands an estimation of available energy resources spatially to evolve better management strategies for ensuring sustainability of resources. The spatial mapping of availability and demand of energy resources would help in the integrated regional energy planning through an appropriate energy supply–demand matching. This

paper discusses the application of Geographical Information System to map the renewable energy potential taluk wise in Karnataka State, India. Taluk is an administrative division in the federal set-up in India to implement developmental programmes like dissemination of biogas, improved stoves, etc. Hence, this paper focuses talukwise mapping of renewable energy (solar, wind, bio energy and small hydro energy) potential for Karnataka using GIS. GIS helps in spatial and temporal analyses of the resources and demand and also aids as Decision Support System while implementing location-specific renewable technologies.

Regions suitable for tapping solar energy are mapped based on global solar radiation data, which provides a picture of the potential. Coastal taluks in Uttara Kannada have higher global solar radiation during summer (6.31 kWh/m^2), monsoon (4.16 kWh/m^2) and winter (5.48 kWh/m^2). Mapping of regions suitable for tapping wind energy has been done based on wind velocity data, and it shows that Chikkodi taluk, Belgaum district, has higher potential during summer (6.06 m/s), monsoon (8.27 m/s) and winter (5.19 m/s). Mysore district has the maximum number of small hydropower plants with a capacity of 36 MW. Talukwise computation of bioenergy availability from agricultural residue, forest, horticulture, plantation and livestock indicates that Channagiri taluk in Shimoga district yields maximum bioenergy. The bioenergy status analysis shows that Siddapur taluk in Uttara Kannada district has the highest bioenergy status of 2.004 (ratio of bioresource availability and demand).

M. Muselli et al.[23] has made a study on-The main objective of this project is to realize an integration plan for various renewable-energy systems in remote areas using a geographical-information system (GIS) in order to determine the optimal management and use of energy in these locations. The area studied is Corsica, an island

located in the south-east of France. For the remote site considered, four systems supplying electricity are compared: a stand-alone photovoltaic (PV)/batteries system, a hybrid PV/batteries/back-up generator system, an engine generator and an extension of the existing electrical network. The most economic configuration was chosen as the best solution to electrify the remote site. Physical and technical-economical processes are integrated in the GIS. This GIS is used to determine the profitability boundaries for PV systems compared to a grid extension and under four different load profiles, and has led to the elaboration of an integration plan of renewable energies in south Corsica. The study has shown that for 60–90% of remote sites, a PV decentralized electricity system is the most economical means of electrification.

Elizabeth Kaijuka et al. [24] have made a study on "GIS and Rural Electricity Planning in Uganda". Sustainable development is literally fuelled by the energy sector. In Uganda, the electricity sector has experienced dramatic market liberation in recent years. This reform was centered around the unbundling of the main government utility, Uganda Electricity Board (UEB), a monopoly divided into three companies created to introduce competition into the market. Market reform has also led to the creation of a regulatory body and a rural electrification fund with the aim of subsidizing rural electricity investments. Through a multi-sectoral programme financed by the World Bank and the Global Environment Facility (GEF), the Ministry of energy is developing a Rural Electrification Master Plan to provide a more systematic tool for rural electricity investments. Unlike previous approaches, this plan is demand driven. This paper discusses the use of Geographic Information Systems in the planning process for rural electrification. The aim is to identify patterns of demand and priority areas for investment. By creating a demand-side scenario, electricity can then be supplied to targeted areas. A cross-sectoral view is taken to examine the energy demand patterns

using physical data and available country statistics, incorporated into a GIS master database. Based on geo-referenced data of population and existing infrastructure, the initial priority demand-side sectors targeted are education and health. An energy benefit point system is then applied to each sector based on local conditions and needs assessments. Their aggregated points then provide an indicator of energy demand distribution for electricity planning at district level. As a result of this preliminary work, specific areas could then be targeted for investment and optimized supply systems could be designed, which include off-grid renewable energy plants such as small-scale hydropower schemes.

J.Amador et al. [25] made the study on "Application of geographical information systems to rural electrification with renewable energy. This study approaches one of the main problems of rural electrification: the choice of the most appropriate technology for each case. The main objective of this project is to apply Geographical Information Systems (GIS) to divide the research zone into areas in that are more appropriate for either conventional or renewable technologies. The approaches for choosing among the different technologies are usually technical and economic; these may be jointly considered by the *leveling electric cost* (LEC). Determination of the LEC is a complex task that requires knowledge of the capacity factor. This paper shows the conclusions of the technical and economic parameter analysis involved in the determination of the LEC for each technology. This analysis has allowed us to carry out proposals of improvement in the methodology of the GIS of rural electrification. The resulting **GIS** has been verified in the municipality of Lorca (Murcia, Spain).

Bent Srensen et al. [26] made the study on "GIS tools for renewable energy modeling". In contrast to conventional energy modeling made on a national basis, we

consider energy use and supply per unit of land area. This is particularly suited for dealing with dispersed energy resources such as renewable energy, and by making the match of demand with supply on this basis in a geographical information system (GIS), we are able to directly identify any mismatch entailing needs for energy trade and establishment of energy exchange facilities (power grids, gas distribution lines, etc.). The model is being applied to several global energy scenarios and constitutes a quite general tool for system modeling, assessment and planning.

Debyani Ghosh et al. [27] made the study on "Renewable energy technologies for the Indian power sector: mitigation potential and operational strategies", at Centre de Sciences Huaines (CSH), New Delhi, India.

The future economic development trajectory for India is likely to result in rapid and accelerated growth in energy demand, with attendant shortages and problems. Due to the predominance of fossil fuels in the generation mix, there are large negative environmental externalities caused by electricity generation. The power sector alone has a 40 percent contribution to the total carbon emissions. In this context, it is imperative to develop and promote alternative energy sources that can lead to sustainability of the energy environment system. There are opportunities for renewable energy technologies under the new climate change regime as they meet the two basic conditions to be eligible for assistance under UNFCCC mechanisms: they contribute to global sustainability through GHG mitigation; and, they conform to national priorities by leading to the development of local capacities and infrastructure. This increases the importance of electricity generation from renewables. Considerable experience and capabilities exist in the country on renewable electricity technologies. But a number of techno–economic, market-related, and institutional barriers impede technology development and penetration. Although at present the contribution of renewable

electricity is small, the capabilities promise the flexibility for responding to emerging economic, socio–environmental and sustainable development needs. This paper discusses the renewable and carbon market linkages and assesses mitigation potential of power sector renewable energy technologies under global environmental intervention scenarios for GHG emissions reduction. An overall energy system framework is used for assessing the future role of renewable energy in the power sector under baseline and different mitigation scenarios over a time frame of 35 years, between 2000 to 2035. The methodology uses an integrated bottom-up modelling framework. Looking into past performance trends and likely future developments, analysis results are compared with officially set targets for renewable energy. The paper also assesses the CDM investment potential for power sector renewables. It outlines specific policy interventions for overcoming the barriers and enhancing deployment of renewable for the future.

Agarwal et al [28] has been done the study in the area of "Use of GIS in Siting Small hydro power stations". In this study tells about the identification of suitable locations for the small hydro stations using the GIS, by using the GIS tool the siting of small hydro power stations were easily identifies, taking the quick decessions and saving the time and money.

Sami et al [29] has been done the study in the area of an "Geomorphological analysis of an alluvial river using GIS". In this study tells about the complete analysis of alluvial river has been done by using the GIS tool. The usage of GIS tool in this study was, they can easily analysed the things which are shown the river allignment and the nature of the soil in the computer screen so it is easy to made the analysis.

Sridhar et al. [30] has been done the study on the "Environmental impact assessment of hydro power station using GIS". In the present study tells about the

environmental problems and impacts of development of hydro power station using GIS. They efficiently utilized the GIS tool for the impact assessment.

Lee et al. has been done the study in the area of the "Statistical analysis with Arc View GIS". In the present study tells about the data analysis and preparing the crystal reports by using the Arc View GIS software.

Hitesh Kumar et al. [32] has been done the study in the area of the " GIS application to rural planning in tehri garhawal district". In this study focus on to the rural development issues like roads, electricity supply developments by using GIS software tool.

Verbyal et al. [33] has been done the study in the area of the "Practial GIS analysis". In this study shows the analysis of the collected data on the crystal reports with efficient way of usage of GIS software tool.

Goel et al. [34] has been done the study in the area of the "GIS based power outage analysis and management". In this study focus on the power outage areas analysis like reason for the power outage and the finding out the different kind of the solutions

Chapter-2

INTRODUCTION TO ANDHRA PRADESH STATE

2.0 INTRODUCTION OF AP STATE

Andhra Prādesh, is a state which is located in India . It lies between 12°41' and 22°N latitude and 77° and 84°40'E longitude, and is bordered by Maharashtra, Chhattisgarh and Orissa in the north, the Bay of Bengal in the East, Tamil Nadu to the south and Karnataka to the west. Andhra Pradesh is the fifth largest state in India and it forms the major link between the north and the south of India. It is the biggest and most populous state in that area of India. It is also considered the rice bowl of India. The state is crossed by two major rivers, the Godavari and Krishna. Andhra Pradesh can be broadly divided into three regions, namely Konaseema (Coastal Andhra), Telangana and Rayalaseema north and

the Rayalseema area of the Southwest. The northern part of Telengana is mountainous receiving an annual rainfall of the order of 102 cm. In the south, the terrain is undulating with isolated hills and an average precipitation of only 50 cm a year. The State is a hot, semi-arid dry land, except the coastal districts, which are very fertile and have a highly productive agriculture [4].

2.1 HYDROLOGY IN ANDHRA PRADESH

Andhra Pradesh is drained, by three large rivers (catchment< 20 000 km^2), including the Godavari and Krishna, which have an annual discharge of 105000 and 67675 million m^3 respectively. Pennar, the third major river carries 3238 million m^3 annually. The medium rivers (catchment 2001 – 20 000 km^2) comprising Nagavali, Sarda, Eluru, Gumdlakamma, Musi, Paleru, Muneru and Kunleru have an annual discharge of 6 430 million m^3. More than 33 minor rivers (catchment > 2000 Km^2) of the State are small coastal streams flowing into the Bay of Bengal, carrying a total of 6 764 million m^3 of water. All the rivers in the State are east-flowing and are harnessed for irrigation and power generation [5].

The three large rivers including the Godavari and Krishna which have an annual discharge of nearly 1,05,000 million cubic metres and 67,675 cubic metres respectively. Pennar, the third major river carries 3238 million cubic metres annually. The other rivers comprising of the Nagavali, Sarda, Yeleru, Gundlakamma, Musi, Paleru, Munnneru and Kunleru have an annual discharge of 6430 million cubic metres. More than 33 minor rivers of the state are small costal streams flowing into the Bay of Bengal carrying nearly 6764 million cubic metres of water [5].

Andhra Pradesh has a long tradition of constructing big dams and reservoirs. Some of the oldest man-made lakes in the country are situated in the State. Hussainsagar in the heart of Hyderabad city is 500 years old, followed by Saroornagar and Mir Alam, which had been in existence for the last 275 and 170 years respectively. Banjara, Osmansagar and Himayatsagar are the other old reservoirs, created between 50 to 65 years ago. A list of 137 reservoirs has been prepared. More than 46 reservoirs in Andhra Pradesh are said to be under dispute [5].

Andhra Pradesh has 98 small reservoirs, 2800 tanks, 32 medium reservoir and 7 large reservoirs with a total surface water area of 458507 ha. Vishakhapatnam district has the maximum number of reservoirs 20, followed by Rangareddy, Prakasam, Nellore and Karimnagar districts with 10 reservoirs each. While Vizianagaram and the two Godavari east and west districts have only small reservoirs, Ranga Reddy, Nellore, Nalgonda, Karimnagar and Chitoor have large concentration of small reservoirs. Medium reservoirs are well-dispersed among the districts and the seven large reservoirs are distributed among Guntur, Karimnagar, Kurnool, Nellore and Nizamabad districts Table 1.3). Majority of the reservoirs in the State are small 98, followed by those in the medium 32 and large 7 categories. The seven large reserviors have a total surface area of 190151 ha, while the medium and small reserviors cover 66429 ha and 24178 ha respectively. Taking the irrigation tanks into the account the total number and area is much higher. The total number of reservoirs are and their statistics given in the table 2.1 [5].

Table 2.1: Reservoirs of Andhra Pradesh by Category Wise

S.No.	Type of Reservior	Number	Area (at FRL) ha.
1	Small reservoirs	98	24178
2	Tanks	2800	177749
3	Small reservoirs and tanks (<1000 ha)	2898	201927
4	Medium reservoirs (1000–5 000 ha)	32	66429
5	Large reservoirs (>5 000 ha)	7	190151
	TOTAL	**2937**	**458507**

2.2 GEOGRAPHICAL AND FOREST INFORMATION OF A.P.

Geographical and forest information are useful for the biomass power generation in Anhdra Pradesh state these are shown in Tables 2.2, 2.3, 2.4.

Table 2.2: Geographical and Forest area [6]

Sl_No	Particulars	Unit	Area
1.	Total Geographical Area	SQ. Kms	2,75,068
2.	Total Forest Area	SQ. Kms	63,814
3.	Forest Area as Percentage to Geographical Area	%	23.20

Table 2.3: Classification of Forest Area [6]

Sl_No	Particulars	Forest Area In Sq. kms	Percentage
1.	Legal Status		
a)	Reserved	50478	79.10
b)	Protected	12365	19.38
c)	Un-classes	969	1.52
	Total	63813	100%
2.	Ownership (Forest Department)	63	100%
3.	Composition:		
	Non-Coniferous (Broad – Leaved)		
a)	Sal	47	0.07
b)	Teak	9,145	14
c)	Others	54,621	85
	Total	63813	100%
4.	Functional		
a)	Protected Forests	38,449	60
b)	Production Forests	25,364	39
Total		63813	100%

Table 2.4: Distribution of Forest area by Forest Types [6]

Sl_No	Forest Type		Area Sq. kms	Percentage to Total Forest Area
1.	6A/C1	Southern Tropical	16,110	25
2.	3B/C2	Southern Tropical Moist Deciduous Forests	16,100	25
3.	5A/C1	Southern Tropical Dry Deciduous Forests	28,368	44
4.	4A/L1	Littoral Forests	2,826	4
5.	4B/Ts2	Tidal Swamp Mangrove Forests	386	0
Total			63,814	100

2.3 POWER GENERATION IN ANDHRA PRADESH

Andhra Pradesh has the third largest installed power capacity in the country. Power generated from different sources is in the order of 7330 MW and power generation & consumption status are also table 2.5, 2.6, 2.7 and Figure 2.1 [7].

Table 2.5: Power Generation and Consumption in Andhra Pradesh [7]

Sl_No	Energy	units	2004-2005
1.	Installed Capacity	(Mega Watts)	11105.71
2.	Electricity Generated • Thermal • Hydel • Others	 (Million Units) (Million Units) (Million Units)	 21145.07 5264.95 24712.79
3.	Electricity Consumption • Domestic • Commercial • Industrial • Agriculture • Others	 (Million Units) (Million Units) (Million Units) (Million Units) (Million Units)	 7.789 1832 2120 13394 1305
4.	Total Low Tension	(Million Units)	26440
5.	Total High Tension	(Million Units)	11178
6.	Per Capita consumption	(No of Units)	575
7.	Agriculture Pump sets energized	(No.)	2374365

Table 2.6: Power Statistics of Andhra Pradesh [7]

Installed capacity (MW)	10,696
Units generated (MKWH)	47,776.30
Length of transmission lines (Kms)	6,70,800
No. of Substations	2,162
Average plant load power factor	85.20%
Per Capita Consumption	510 KWh
Capacity Addition	4110 MW

Table 2.7: Installed Capacity in Andhra Pradesh [7]

S.No	Item	Installed Capacity (MW)
1	Thermal	2953
2	Gas	696
3	Hydro	2683
4	Wind	57
5	Cogeneration	44
6	Total Generation	6433
7	Share from Central Generating Stations	897
	Total	7330

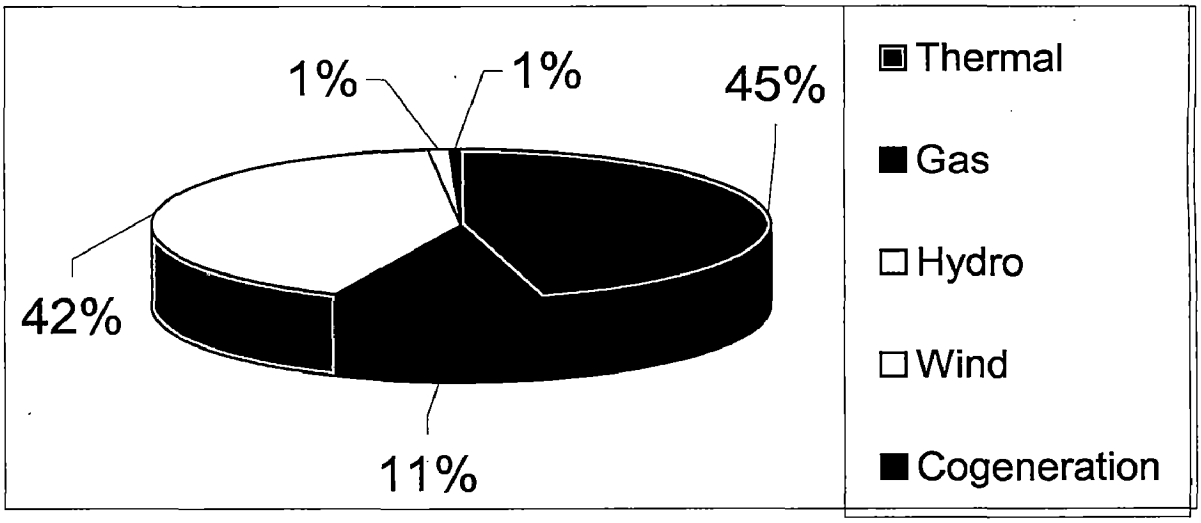

Fig 2.1: Power Generation from different sources in Andhra Pradesh

Table 2.8: A.P Power Grid System Particulars [7]

S. No.	System Particulars	2005	04/2006	% Increase
1	Morning Peak (MW)	6947	7551	8
2	Evening Peak(MW)	6723	7074	5
3	Grid Consumption (MU)	148	169	14
4	Districts' Consumption (MU)	142	164	15

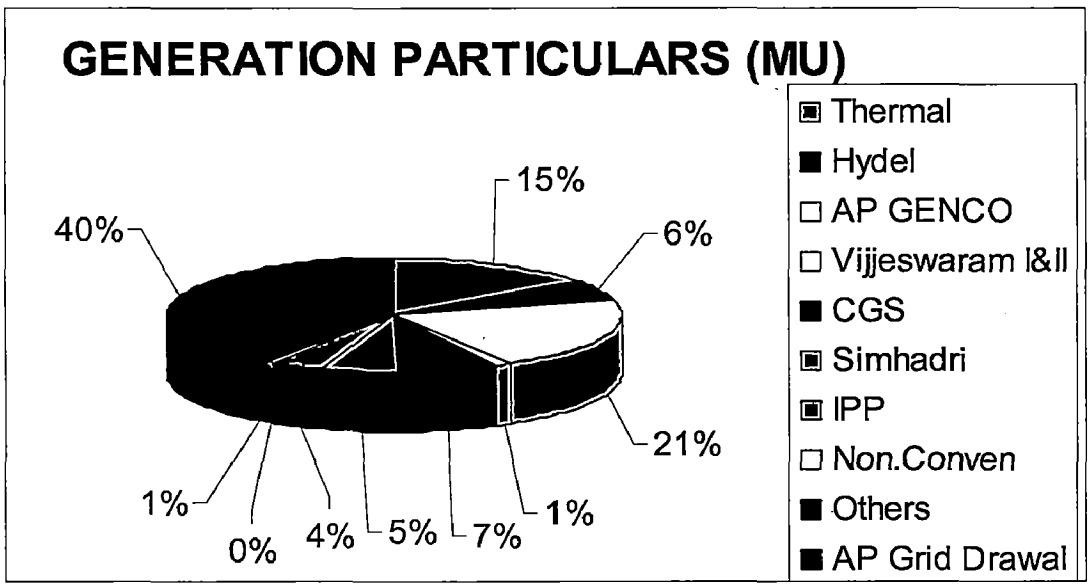

Fig 2.2: Power Generation Particulars of Andhra Pradesh State

2.4 A.P. TRANSMISSION SYSTEM [7]

The transmission lines of Andhra Pradesh owned by APTRANSCO (Andhra Pradesh Transmission Corporation) and they are developed many more projects regarding the transmission lines and substations of various ranges. The Table 2.9 shows the length of various transmission line in Andhra Pradesh.

Table 2.9: Length of Transmission Lines in A.P. State [7]

S.NO	NAME OF THE LINE	Ckm.
1	78/66 kV	0
2	33 kV	32732
3	15/11 kV	186988
4	400 kV	2033
5	220 kV	11060
6	132 kV	13050

The State power supply network which consists of 25,719 Ckm of EHT lines, 207432 Ckm of HT lines, 437610 Ckm of transmission lines and 2645 substations is one of the largest networks in the country supplying power to nearly 15 million consumers. The installed capacity of the state is 10,818 MW. The power generation available for use is 11,729.04 million units and the Per Capita Consumption is 560 KWh. The number of distribution transformers in the state is 3,23,033. Special Industrial Express Feeders to ensure uninterrupted supply to industries have also been laid.

2.5 GROWTH IN TRANSMISSION SYSTEM

Lengths of the lines are increasing regularly to meet the growing demand of the consumer which is an indication that pace of development is very fast in the state. The details of year wise length of lines given in the Table 2.10

Table 2.10: Length of the Lined Year Wise [7]

S.No	Name of the Line(Ckm)	2002	2003	2004	2005	03-2006
1	400 kV	1301.00	2033.00	2033.00	653.00	2686.00
2	220 kV	10341.35	10940.15	11462.13	75.03	11537.16
3	132 kV	12412.77	12792.57	13350.74	548.54	13899.28
	DISCOM's Lines					
4	33 kV	30552.88	32305.00	33580.31	1275.98	34856.29
5	11 kV	172881.89	178321.00	202546.82	12461.41	215008.24
6	L.T	438160.37	467312.65	486190.82	18629.54	504820.36
	Total	665650.26	703704.37	749163.82	33643.51	782807.33

The table 2.11 shows the Andhra Pradesh Power grid System particulars like different peak hours at different energy withdrawals.

In Andhra Pradesh the power distribution to the different districts are having the different distribution companies like Eastern power Distribution Company of AP Ltd, Southern Power Distribution Company of AP Ltd, Central Power Distribution Company of AP Ltd and Northern Power Distribution Company of AP Ltd. The table 2.12 shows the district wise Energy drawals from different power distribution companies

Table 2.11: District Wise Energy Drawals [7]

S. No.	District	Consumption (MU)			
		Jun-05	Quota as per RR	Jun-06	% Variat (w.r. Quot
EASTERN POWER DISTRIBUTION COMPANY OF A P LTD					
1	Srikakulam	1.89	2.17	2.19	0.55
2	Vizianagaram	2.74	2.61	3.05	16.7
3	Visakhapatnam	6.99	7.95	6.93	-12.7
4	East Godavari	5.48	6.60	6.49	-1.66
5	West Godavari	6.88	7.59	7.52	-0.99
	TOTAL	23.98	26.93	26.18	-2.78
SOUTHERN POWER DISTRIBUTION COMPANY OF A P LTD					
6	Krishna	5.46	5.79	6.22	7.50
7	Guntur	5.11	5.94	5.68	-4.46
8	Prakasam	3.31	3.43	3.47	1.13
9	Nellore	5.62	5.70	5.33	-6.50
10	Chittoor	6.85	7.26	7.44	2.61
11	Cuddapah	4.89	4.47	4.97	11.19
	TOTAL	31.24	32.59	33.12	1.61
CENTRAL POWER DISTRIBUTION COMPANY OF A P LTD					
12	Ananthapur	5.02	6.18	6.88	11.29
13	Kurnool	3.73	5.22	3.97	-23.88
14	Mahaboobnagar	4.93	6.04	6.73	11.47
15	Nalgonda	8.85	9.25	9.30	0.57
16	Medak	8.20	9.43	10.29	9.17
17	Ranga Reddy	12.63	14.65	14.35	-2.04
18	Hyderabad	14.47	15.89	15.12	-4.80
	TOTAL	57.83	66.65	66.65	0.00
NORTHERN POWER DISTRIBUTION COMPANY OF A P LTD					
19	Khammam	2.73	4.23	2.84	-32.91
20	Warangal	3.64	2.94	4.39	49.36
21	Karimnagar	4.27	4.65	4.99	7.36
22	Nizamabad	4.13	4.13	4.73	14.58
23	Adilabad	2.79	2.92	2.98	2.16
	TOTAL	**17.56**	**18.87**	**19.93**	**5.65**
	STATE TOTAL	**130.61**	**145.05**	**145.89**	**0.58**

2.6 SUBSTATIONS IN ANDHRA PRADESH

The requirement of steady and healthy power supply is very vital in present scenario. The sufficient substations needed for the purpose, have been installed as shown in Table 2.13

Table 2.12: Substations in Andhra Pradesh [7]

S.No	SUBSTATIONS (in Number)	2002	2003	2004	2005	2006
1	400 KV	3	3	3	4	7
2	220 KV	68	73	76	100	120
3	132 KV	186	191	210	231	243
	Discom's					
4	33 KV	1941	2123	2329	2519	2642
	Total	2199	2390	2618	2831	2971

Table : 2.13 Total Electrification Data of A.P.

S. No	No. Of Towns/Villages	Existing	Percentage Wise			
			2000	2001	2002	2003
1	Towns existing	264	100	100	100	100
2	Villages existing	26586	100	100	100	100
3	Hamlets existing	31664	95	95	96	98
4	Tribal Hamlets/Habitations	9893	–	–	–	–
5	Dalitwadas existing	53195	56	48	74	91
6	Weaker Section Colonies	27277	94	83	90	93

Chapter-3

RENEWABLE ENERGY IN ANDHRA PRADESH

3.0 INTRODUCTION TO R.E

In the past century, it has been seen that the consumption of non-renewable sources of energy has caused more environmental damage than any other human activity. Electricity generated from fossil fuels such as coal and crude oil has led to high concentrations of harmful gases in the atmosphere. This has in turn led to many problems being faced today such as ozone depletion and global warming. Vehicular pollution has also been a major problem.

Therefore, alternative sources of energy have become very important and relevant to today's world. These sources, such as the sun and wind, can never be exhausted and therefore are called renewable. They cause less emissions and are available locally forever. Their use can, to a large extent, reduce chemical, radioactive, and thermal pollution. They stand out as a viable source of clean and limitless energy. These are also known as non-conventional sources of energy. Most of the renewable sources of energy are fairly non-polluting and considered clean though biomass, a renewable source, is a major polluter indoors.

Under the category of renewable energy or non-conventional energy are such sources as the sun, wind, water, agricultural residue, firewood, and animal dung. The non-renewable sources are the fossil fuels such as coal, crude oil, and natural gas. Energy generated from the sun is known as solar energy. Hydel is the energy derived from water. Biomass –firewood, animal dung, biodegradable waste from cities and crop residues is a source of energy when it is burnt. Geothermal energy is derived from hot

dry rocks, magma, hot water springs, natural geysers, etc. Ocean thermal is energy derived from waves and also from tidal waves.

Through the method of co-generation a cleaner and less polluting form of energy is being generated. Fuel cells are also being used as cleaner energy source. In India a number of initiatives have been taken.

3.1 RENEWABLE ENERGY IN INDIA

The demand for energy is rising faster due to increasing industrial and agricultural activities. The installed capacity of Renewable Energy in India stands at 1,20,000 MW. The average gap between the demand and supply was 5.5% and is bound to rise further. According to estimates, we would require 83000 MW of power by year 2008. It is in this scenario, the New and Renewable sources of energy are poised to play an important role in the coming years [2].

India has a vast potential of renewable energy sources and a number of technologies have been developed to harness them. A sizeable industrial base has been created in the country in the various renewable energy technologies such as solar thermal, photovoltaics, wind, small hydro etc. An aggregate capacity of about 1400 MW has been installed, based on these technologies.

India has a large potential for renewable energy (RE), an estimated aggregate of over 10,000 MW. In addition, the scope for generating power and thermal applications using solar energy in huge. However, only a fraction of the aggregate potential in renewables, and particularly solar energy has been utilized so far. In India has 6,400 MW small hydropower of renewable power generation capacity has been set up.

3.1.1 Small Hydro Power

Hydro Power represents non-consumptive, non-radioactive, non-polluting use of water resources towards inflation-free energy development with most mature technology characterized by highest prime moving efficiency and spectacular operational flexibility. It contributes 18 percent of world electricity supply today. Small hydro stands in first place in the generation of electricity from renewable sources throughout the world. The world-installed capacity of Small hydropower today is around 47000 MW against an estimated potential of 180000 MW. The Andhra Pradesh installed capacity of small hydro power today is around 523 MW. [2].

3.1.2 Wind Power

Air moves around the earth because of the differences in temperature and atmospheric pressure. Wind turbines harness the movement of air to produce energy. The wind turns the blades, which turn a rotor shaft. This produces mechanical power used to drive an electric generator. World-wide installed capacity of wind power is 59206 MW and INDIA has a fourth position in the Wind Energy. The installed capacity of wind power in India is likely to cross 5200 MW by the end of 2006. This means a capacity addition of more than 1600 MW during the year 2006. The wind installed capacity of Andhra Pradesh is 124.97 MW. [2, 8].

3.1.3 Biomass/Biogass

Biomass potential in India is around 16,000 MW excluding co-generation and the Installed capacity in India is around 630 MW. The projects under implementations are 630 MW. In Andhra Pradesh, Biomass Installed capacity is 203 and Biogas Cogeneration is about 150.25 MW. [9].

Table 3.0: A.P. Renewable Energy Installed Capacity

S.NO	ENERGY SOURNCE	INSTALLED CAPACITY MW
1	Small Hydro	523.32
2	Biomass	203
3	Wind	124.97
4	Biogass cogeneration	150.25
	TOTAL	**1001.22**

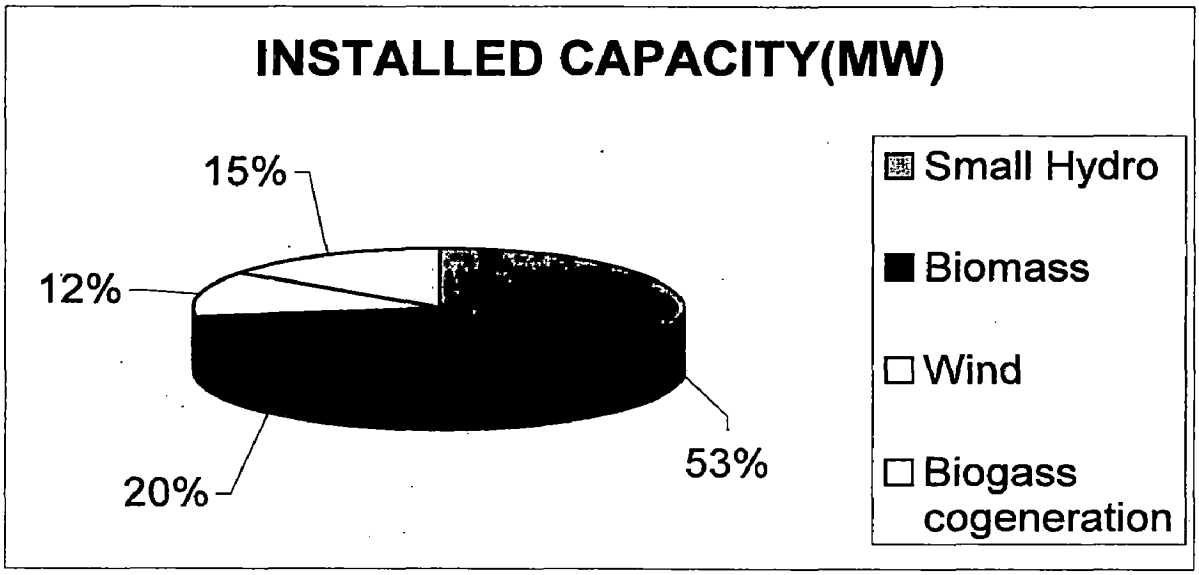

Fig 3.0: Installed Capacity of Andhra Pradesh

3.1.4 Solar Energy

Solar Energy is limited to the decentralized energy option in Andhra Pradesh i.e. not connected to the grid, the available solar energy is used in the way of cooking, lighting, water pumping etc.

Chapter-4

INTRODUCTION TO GIS

4.0 GENERAL

Computerization has opened a vast new potential in the way we communicate, analyze our surroundings, and make decisions. Data representing the real world can be stored and processed so that they can be presented later in simplified forms to suit specific need. Many of our decisions depend on the details of our immediate surroundings and require information about specific places on the Earth's surface. Such information is called geographical because it helps us to distinguish one place from another and to make decisions for one place that are appropriate for that location. Geographical information allows us to apply general principles to the specific conditions of each location, allows us to track what is happening at any place, and helps us to understand how one place differs from another. Geographical information, then, is essential for effective planning and decision making in the modern society as shown in Figure 4.0. [1, 10].

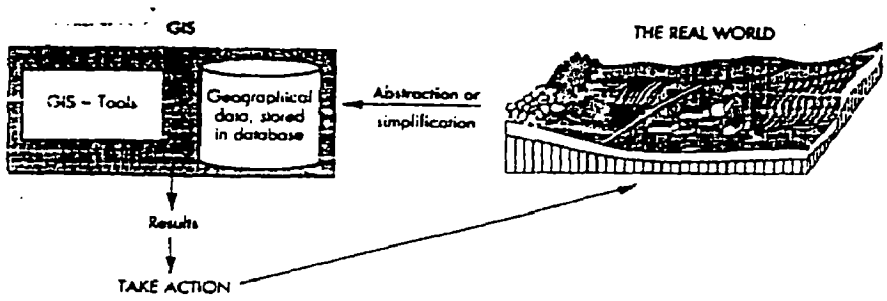

Fig 4.0: Representation of the real world in GIS environment

We are used to think about geographical information in the form of maps, photographs taken from aircraft, and images taken from satellites, so it may be difficult at first to understand how such information can be represented in digital form as strings

of zeros and ones. If we can express the contents of a map or images in digital form, the power of the computer opens as enormous range of possibilities for communication, analysis, modeling, and accurate decision making (figure 2.2). At the same time, we must constantly be aware of the fact that the digital representation of geography is not equal to the geography itself as any digital representation involves some degrees of approximation. [10].

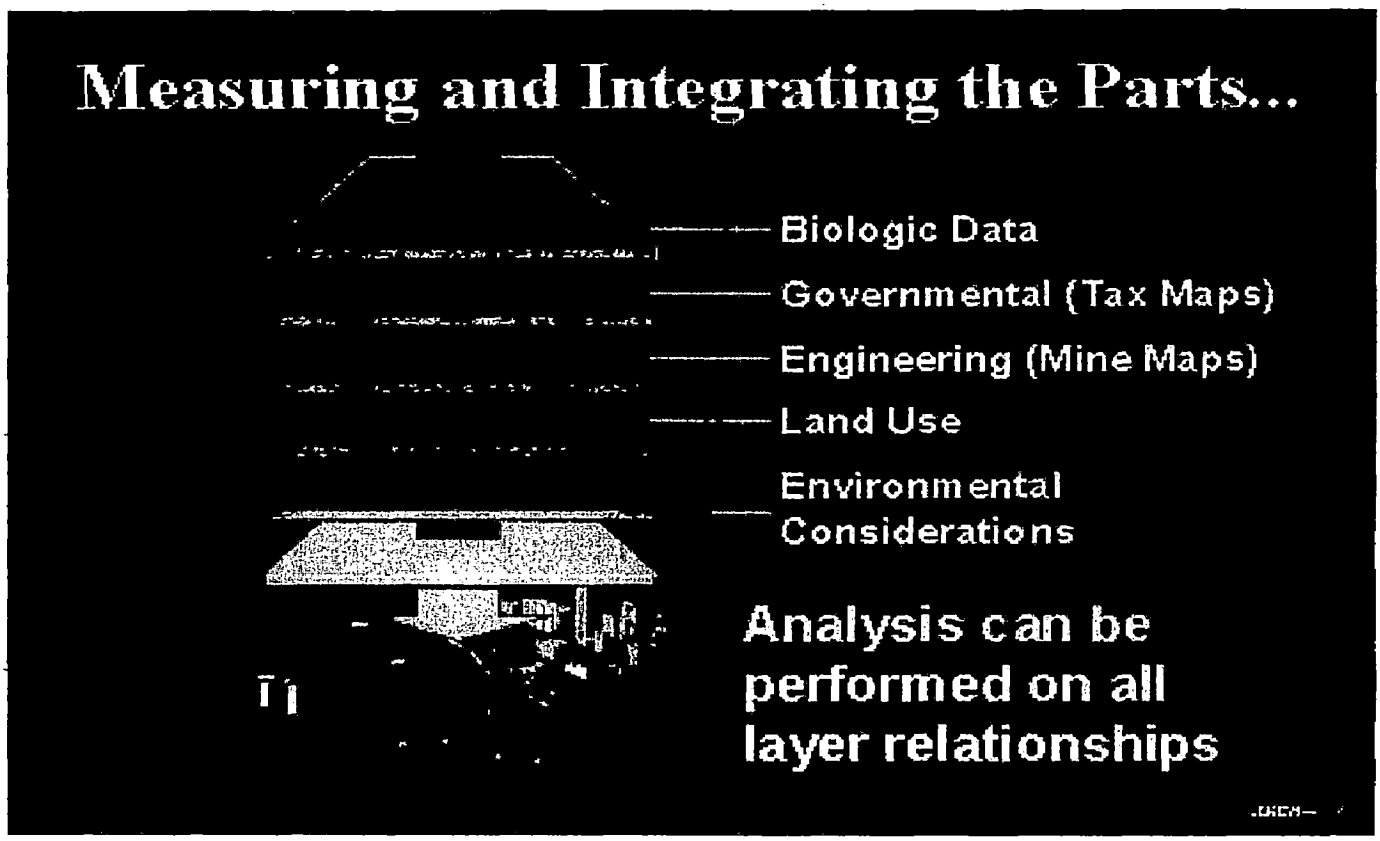

Fig. 4.1: GIS analysis and simplification of data

Since the mid-1970s, specialized computer systems have been developed to process geographical information in various ways. Which include the following:

- Techniques to input geographical information, converting the information to digital form.
- Techniques for storing information in compact format on computer disks (CDs), and other digital storage media.

- Methods for automated analysis of geographical data, to search for patterns, combine different kinds of data, make measurements, find optimum sites or routes, and a host of other tasks
- Methods to predict the outcome of various scenarios, such as the effects of climate change on vegetation.
- Techniques for display of data in the form of maps, images, and other formats
- Capabilities for output of results in the form of numbers and tables

The collective name for such systems is **Geographical Information systems (GIS)** [10].

4.1 GIS DEFINED

- A GIS is a computer-based tool for mapping and analyzing geo-referenced data
- GIS technology integrates common database operations such as query and statistical analysis with the unique visualization and geographic analysis benefits offered by maps
- These abilities distinguish GIS from other information systems and make it valuable to a wide range of public and private enterprises for explaining events, predicting outcomes, and planning strategies
- A particular form of Information System applied to geographical data
- A System is a group of connected entities and activities which interact for a common purpose
- An Information System is a set of processes, executed on raw data, to produce information which will be useful in decision-making

- A chain of steps leads from observation and collection of data through analysis
- An information system must have a full range of functions to achieve its purpose, including observation, measurement, description, explanation, forecasting, decision-making

❖ A Geographic Information System uses geographically referenced data as well as non-spatial data and includes operations which support spatial analysis

- In GIS, the common purpose is decision-making, for managing use of land, resources, transportation, retailing, oceans or any spatially distributed entities
- The connection between the elements of the system is geography, e.g. location, proximity, spatial distribution

❖ In this context GIS can be seen as a system of hardware, software and procedures designed to support the capture,

- Although many other computer programs can use spatial data (e.g. AutoCAD and statistics packages), GISs include the additional ability to perform spatial operations [10].

4.2 IMPORTANCE OF GIS

"GIS technology is to geographical analysis what the microscope, the telescope, and computers have been to other sciences. It could therefore be the catalyst needed to dissolve the regional-systematic and human physical dichotomies that have long plagued geography" and other disciplines which use spatial information.

❖ GIS integrates spatial and other kinds of information within a single system - it offers a consistent framework for analyzing geographical data

- By putting maps and other kinds of spatial information into digital form, GIS allows us to manipulate and display geographical knowledge in new and exciting ways
- GIS makes connections between activities based on geographic proximity
  - looking at data geographically can often suggest new insights, explanations
  - these connections are often unrecognized without GIS, but can be vital to understanding and managing activities and resources
  - e.g. we can link toxic waste records with school locations through geographic proximity
- GIS allows access to administrative records - property ownership, tax files, utility cables and pipes - via their geographical positions [10].

4.3 GIS APPLICATION NEED

- There is a increasing interest in geography and geographic education
- GIS is an important tool in understanding and managing the environment
- High level of interest in new developments in computing
- GIS gives a "high tech" feel to geographic information
- Maps are fascinating and so are maps in computers [10,11].

4.4 CONTRIBUTING DISCIPLINES AND TECHNOLOGIES

- GIS is a convergence of technological fields and traditional disciplines
- GIS has been called an "enabling technology" because of the potential it offers for the wide variety of disciplines which must deal with spatial data
- Each related field provides some of the techniques which make up GIS
  - many of these related fields emphasize data collection - GIS brings them together by emphasizing integration, modeling and analysis

❖ As the integrating field, GIS often claims to be the science of spatial information [11].

4.4.1 Geography

- broadly concerned with understanding the world and man's place in it
- long tradition in spatial analysis
- provides techniques for conducting spatial analysis and a spatial perspective on research

4.4.2 Cartography

- concerned with the display of spatial information
- currently the main source of input data for GIS is maps
- provides long tradition in the design of maps which is an important form of output from GIS
- computer cartography (also called "digital cartography", "automated cartography") provides methods for digital
- representation and manipulation of cartographic features and methods of visualization.

4.4.3 Remote Sensing

- Images from space and the air are major source of geographical data
- Remote sensing includes techniques for data acquisition and processing anywhere on the globe at low cost, consistent update potential
- Many image analysis systems contain sophisticated analytical functions
- Interpreted data from a remote sensing system can be merged with other data layers in a GIS

4.4.4 Photogrammetry

Using aerial photographs and techniques for making accurate measurements from them, photogrammetry is the source of most data on topography (ground surface elevations) used for input to GIS

4.4.5 Surveying

- Provides high quality data on positions of land boundaries, buildings, etc.

4.4.6 Statistics

- Many models built using GIS are statistical in nature, many statistical techniques used for analysis
- Statistics is important in understanding issues of error and uncertainty in GIS data

4.4.7 Operation Research

- Many applications of GIS require use of optimizing techniques for decision-making

4.4.8 Computer Science

- Computer-aided design (CAD) provides software, techniques for data input, display and visualization, representation, particularly in 3 dimensions
- Advances in computer graphics provide hardware, software for handling and displaying graphic objects, techniques of visualization
- Database management systems (DBMS) contribute methods for representing data in digital form, procedures for system design and handling large volumes of data, particularly access and update

- Artificial intelligence (AI) uses the computer to make choices based on available data in a way that is seen to emulate human intelligence and decision-making - computer can act as an "expert" in such functions as designing maps, generalizing map features
- Although GIS has yet to take full advantage of AI, AI already provides methods and techniques for system design

4.4.9 Mathematics

Several branches of mathematics, especially geometry and graph theory, are used in GIS system design and analysis of spatial data [11].

4.5 RENEWABLE ENERGY APPLICATIONS USING GIS

- Location analysis, site selection
- Land Acquisition
- Planning layouts
- Finding out the catchments area
- Management of wild and scenic rivers, recreation resources, floodplains
- Management of wind density areas, solar intensity levels of the particular area, monitoring of biomass per energy capita.
- Penstock alignment
- Finding out route for electrical transmission lines
- Environmental impacts of site
- Zoning, subdivision of plan preview
- Locating underground pipes like penstock system
- Locating underground cables like electrical cables

- Balancing loads in electrical networks grid connected as well as isolated small hydro power projects
- Planning facility maintenance and remote monitoring
- Tracking energy use
- Identification of unelectrified rural villages
- Develop the isolated Small Hydro Power projects
- Monitoring of transmission and distribution system of electric wires

4.6 GIS AS A SET OF INTERRELATED SUBSYSTEMS

4.6.1 Data Processing Subsystem

- Data acquisition - from maps, images or field surveys
- Data input - data must be input from source material to the digital database
- Data storage – data storing in primary/seconday storage devices with security support.

4.6.2 Data Analysis Subsystem and User Subsystem

- Retrieval and analysis - may be simple responses to queries, or complex statistical analyses of large sets of data
- Information output - how to display the results? as maps or tables? Or will the information be fed into some other digital system [10].

4.7 DIGITAL MAPPING OF DATA

Normally, the aim of information management is to ensure that the recipient picks up the message quickly and with as little uncertainty as possible. This objective is mainly achieved in GIS by simplifying the real world through a systematic

selection of information to be entered into the system. This is known as conceptual generalization or data structuring. When presenting he information, an exaggeration technique (broad lines, large symbols, etc.) is used in the map image. This technique is known as cartographic generalization as in Figure 4.2

In conceptual generalization, it is important to differentiate between the objective reality and the significance that reality has for the task to be performed. The only information to be registered is that which is relevant to carrying out the task.

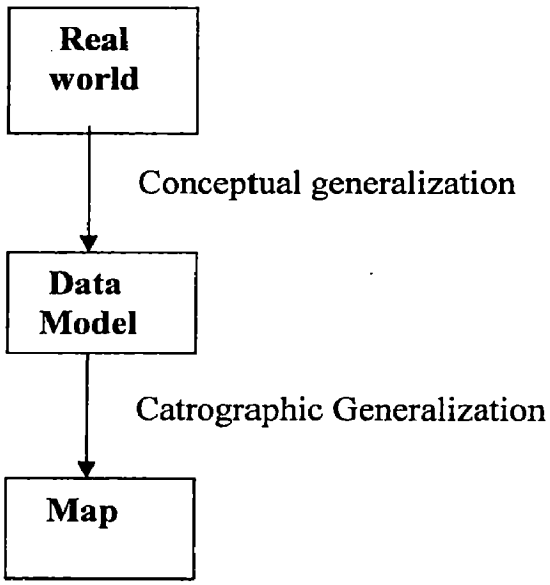

Fig 4.2: Cartographic generalization

When establishing the data model, information is divided into two main groups: interesting and uninteresting information/object types. Only interesting object types

will be put into the model; all other object types found in the real world are uninteresting and are ignored.

The need to divide objects into classes also results in generalizations. For example, an area of forest that is mainly coniferous, but with some deciduous trees, will often be generalized and classified as coniferous, not as a combination. Thus, conceptual generalization is also a method for handling uncertain elements, whereby one can ignore some uncertainty or variation.

When points, lines, and polygons are selected as the geometric representation of objects, this very often results in a generalization of the real world; a town can be represented by a point rather than a polygon, and a road is frequently represented by a center line rather than two curbs. This kind of generalization lies on the borderline between conceptual generalization and cartographic generalization, and the map scale that the data show will, to a large extent, determine what one chooses.

It will always be necessary to make choices about such generalizations in relation to the real world when making data models. This may be seen as a problem, but generalization is also a technique that makes it possible to obtain an overview of our complex reality [10].

4.8 G.I.S APPLICATION SOFTWARE

GIS is a application software, the database management systems, and the operating systems represent the foundation stones of GIS Figure 5.0.

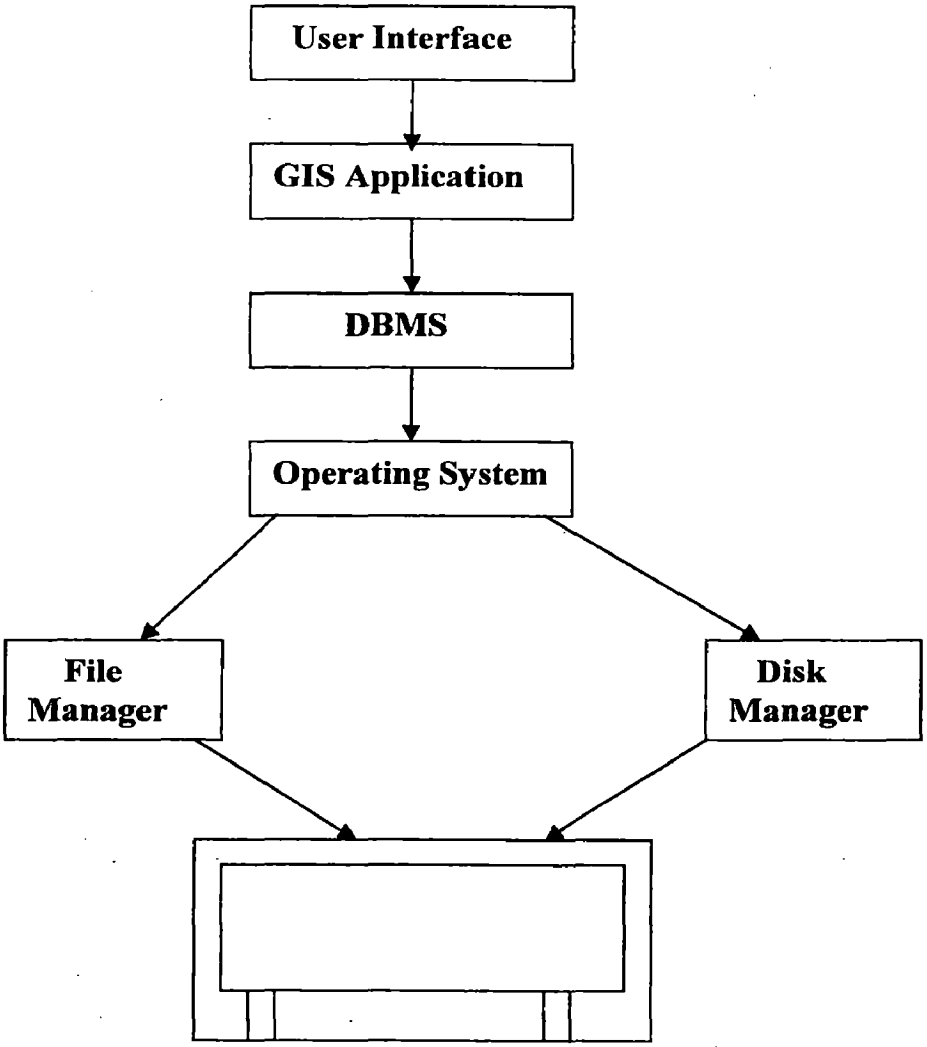

Fig 4.3: GIS Relation with Database [11]

GIS related software such as the human machine interface, ACD, ARC-View, Multi Media, Geo Media etc.

4.9 THE BASIC COMPONENTS OF GIS

- Introduction and background to GIS
- Summary of existing operations
- Summary of existing needs and problems
- General description of a GIS
- GIS hardware and software
- GIS Database

- GIS data maintenance
- Data communication

4.10 FUNCTIONS

4.10.1 Data Input

Data input requirements may include the following.

- Manual digitizing
- Scanning
- Keyed bulk data entry
- Automatic checking and corrections for digitizing errors
- Acceptance of existing raster and vector data

4.10.2 Data Manipulation

Data manipulation requirements may include the following.

- Data revisions
- Thinning and weeding digital line work
- Sliver polygon removal
- Transformation between map projections
- Edge matching of adjoining map files
- Transformation of data to fit specified control points (i.e., rubber sheeting)
- Merging data from a variety of digital and hard-copy sources into a common digital database
- Raster to vector conversion
- Merging polygons with common attributes
- Computing distance buffers

- Aggregating data within specified parameters

4.10.3Data Analysis

Data analysis functions may include the following.

- Point, line, and polygon overlay analysis
- Geometric measurements and calculations
- Analysis of proximity and contiguity
- Spatial data queries
- Attribute data queries
- Coordinate geometry calculations
- Digital terrain modeling and analysis
- Network analysis

4.10.4 Data Presentation

Data presentation requirements may include the following.

- Display and plot of raster and/or vector data
- Display and plot of data at user-defined scales
- Display and plot of digital terrain models
- Automatic plot of attribute data as map text
- Automatic generation of map symbols based on attribute data
- Automatic dimensioning
- Specific printer and plotter capabilities
- Specific report and map output formats [10,15]

Chapter-5

RENEWABLE ENERGY POLICIES AND COST DETAILS

5.0 RENEWABLE ENERGY POLICY

The spread of various renewable energy technologies have been aided by a variety of policy and support measures by Government. Major policy initiatives taken to encourage private/foreign direct investment to tap energy from renewable energy sources, include provision of fiscal and financial incentives under a wide range of programmes being implemented by the Ministry and simplification of procedures for private investment, including foreign direct investment in renewable energy projects.

The policy is clearly directed towards a greater thrust on over all development and promotion of renewable energy technologies and applications. The recent policy measures provide opportunities for increased investment in this sector, technology up-gradation, induction of new technologies, market-development and export promotion [17].

5.1 POLICY MEASURES

A host of fiscal incentives and facilities are available to both manufacturers and users of renewable energy systems, which include:

- 100% accelerated depreciation for tax purposes in the first year of the installation of projects/systems.
- No excise duty on manufacture of most of the finished products.
- Low import tariffs for capital equipment and most of the materials and components.

- Soft loans to manufacturers and users for commercial and near commecial technologies.
- Five year tax holiday for power generation projects. •Remunerative price under alternate power purchase policy by State Goverement for the power generated through renewable energy systems, fed to the grid by private sector.
- Facility for Banking and wheeling of power.
- Facility for Third party sale of renewable energy power.
- Financial Incentives/Subsidies for devices with high initial cost.
- Involvement of women not only as beneficiaries but also for their active contribution in implementation of renewable energy programmes. Encouragement to NGOs and small entrepreneurs.
- Special thrust for renewable energy in North-Eastern region of the country. 10% of Plan funds earmarked for North-East towards enhanced and special subsidies. Allotment of land on long term basis at token lease rent and supply of garbage free of cost at project site by State Governments, in respect of projects on energy recovery from municipal waste [17].

5.2 FISCAL & FINANCIAL INCENTIVES

- The Ministry of Non-Conventional Energy Sources provides as financial incentives, such interest subsidy and capital subsidy. In addition, soft loans are provided through the Indian Renewable Energy Development Agency (IREDA), a public sector company of the Ministry and also through some of the nationalized Banks and other financial Institutions for identified technologies/systems.

- The Government also provides various types of fiscal incentives for renewable energy sector, which include direct taxes -100% depreciation in the first year of the installation of the project, exemption/reduction in excise duty, exemption from central sales tax, and customs duty concessions on the import of material, components and equipment used in renewable energy projects.
- For creation of attractive environment for evacuation and purchase, wheeling and banking of electrical energy generated from renewable energy sources, the Ministry has issued a set of guidelines to all the States. It has suggested that States should announce general policies for purchase, wheeling and banking of electrical energy generated from all renewable energy sources. Twelve states have so far announced such policies in respect of various renewable energy sources [17].

5.3 RENEWABLE ENERGY POLICY NEED

In brief we need a policy framework to keep going with the industrial growth without damaging the environment and also not compromising economy. The applicable measures should provide energy security, allocative efficiency, equity, increase productivity and protect the environment, contribute to minimize emissions. With stock of fossil fuels being geographical concentrated along with series of environmental implications the current view is that fossil fuels (coal, oil & gas) cannot form the basis for a sustainable energy policy for the future, however a complete immediate closure of the existing fossil fuel based systems is very much unlikely with regard to no compromise on living standards and economic development. Whereas efficiency in fuel utilization and reduction of pollution are feasible measures to combat growing energy needs till a substantial contribution from sustainable sources is established. With business as usual approach, in no way will the expected renewable

energy deployment targets be achieved nor will there be other conventional resources to meet the future energy needs as they will be almost exhausted over 100 years at maximum. And most probably disruption of peace and strife between nations in energy trade, political unrest are other consequences that might arise.

So for a sustainable society, energy needs must be met locally. And renewable sources most probably are free of cost, and no geographical boundaries can restrict availability, but involves industrial manufactured equipment to get useful energy. As of now the renewable sources can in no way compete with conventional energy systems. Though the consumer, the general publics are very much anxious and enthusiastic towards greening the environment and feeling secured of energy availability [17].

5.4 INDUSTRIAL POLICY FOR RENEWABLE ENERGY DEVELOPMENT IN INDIA

Ministry of Non-Conventional Energy Sources is promoting medium, small, mini and micro enterprises for manufacturing and servicing of various types of renewable energy systems and devices. Industrial policy measures include:

- Industrial clearance is not required for setting-up of renewable energy industry
- No clearance is required from Central Electricity Authority for power generation projects upto Rs. 100 crores (Rs. 1000 million)
- A five-year Tax holiday allowed for renewable energy power generation projects
- Soft loan is being made available through IREDA for renewable energy equipment manufacturing [1,17]
- Facilities for promotion of export-oriented units are available for renewable energy industry also

- Financial support is available to renewable energy industries for taking up R&D projects in association with technology institutions
- Power project import allowed
- Private Sector Companies can set up enterprises to operate as licensee or generating companies
- Customs duty concession is available for renewable energy parts/equipment, including for machinery required for renovation and modernization of power Plants
- Excise duty on a number of capital goods and instruments in the renewable energy sector has been reduced/exempted [1,17].

5.5 FOREIGN INVESTMENT POLICY

- Foreign Investors can enter into a joint venture with an Indian partner for financial and/or technical collaboration and also for setting up of renewable energy based Power Generation Projects
- Liberalized foreign investment approval regime to facilitate foreign investment and transfer of technology through joint ventures
- The proposals for up to 74% foreign equity participation in a joint venture qualifies for automatic approval
- 100% foreign investment as equity is permissible with the approval of Foreign Investment Promotion Board (FIPB)
- Various Chambers of Commerce and Industry Associations in India can be approached for providing guidance to the Investors in finding appropriate partners
- Foreign Investors can also set up a liaison office in India

- Government of India is also encouraging foreign Investors to set up renewable energy based power generation projects on Built- Own and Operate basis

5.6 COST ECONOMICS

5.6.1 Small hydro Power

Table: 5.0 Incentives Under Small Hydro Power Programmed

Schemes	Areas	Below 500 KW	500 KW up to 1 MW	Above 1 MW & upto 5 MW	Above 5 MW & upto 15 MW
Capital Subsidy For Govt. Sector Projects	N E Region, Sikkim,	90% cost of the project up to Rs. 75000/- KW	90% cost of the project up to Rs. 60000/- KW	75% cost of the project up to Rs. 45000/- KW	Epuipment Cost+ 25% of Civil Cost limited to Rs. 22.50 crores/ project
	Middle Himalayas, Ladakh, A&N	Epuipment Cost+ 50% of Civil Cost upto Rs. 45,000/KW		Epuipment Cost+ 25% of Civil Cost upto Rs. 3.00 crores/MW	Epuipment Cost+ 25% of Civil Cost limited to Rs. 15 crores/ project
	Other Areas *(only notified hilly regions)*	Epuipment Cost+ 50% of Civil Cost upto Rs. 30,000/KW		Epuipment Cost+ 25% of Civil Cost upto Rs. 1.5 crores per MW	Epuipment Cost+ 25% of Civil Cost limited to Rs. 7.5 crores/ project
Renovation & Modernisation Of Old Projects		Upto Rs. 2 crores/MW			Limited to Rs. 10 crores /project

5.6.2 Wind Power

- Capital cost of wind power projects ranges from Rs 4.5-5.5 crore per MW
- Cost of generation is estimated to be Rs 2.25-2.75 per kWh (depending upon the site)
- These costs compare favourably with new conventional power projects
- There is the added advantage of short gestation, and modularity of systems

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- The costs are expected to decline and profitability increase with technology improvements, and increase in size of turbines, and optimal planning and site selection
- A cost ceiling of Rs 3.5 crore/MW has been fixed for the determination of MNES support to state government projects [1,8].

5.6.3 Biogasse cogeneration

For projects by cooperative / public sector / joint sector sugar mills in the first category, the floor rate of interest shall not be lower than 6%. For projects under the other two categories, a floor rate interest of 8% shall apply. The maximum amount of capitalized interest subsidy to a bagasse cogeneration project shall be limited to Rs. 400 crore. All the financial assistance for Biomass Power are given in the table 5.1.

5.6.4 Biomass Power

An additional interest subsidy @ 2% will be provided with floor rate of interest not lower than 6% for Biomass Power / Cogeneration Projects in all Special Category States, and Islands. The floor rate of interest for other categories of projects shall not be lower than 8%. The maximum amount of capitalized interest subsidy for any biomass power project shall be limited to Rs. 2.00 crore. A total capacity not exceeding 100 MW shall be supported in any State during the 10th Plan. The capital subsidy to projects based on MW scale 100% producer gas engines shall not exceed Rs. 2.00 crore per project, and to advanced biomass gasification projects shall not exceed Rs. 8.00 crore per project. And all the financial assistance for biogases power are given in the table 5.2.

Table 5.1: Central Financial Assistance in the form of interest subsidy [1]

Bagasse Co-generation	Pressure Configuration	Interest Subsidy
Projects by Cooperative / Public / Joint Sector Sugar Mills	40 bar & above	3%
	60 bar & above	4%
	80 bar & above	5%
	100 bar & above	6%
Projects in IPP mode in Cooperative / Public / Joint Sector Sugar Mills	60 bar & above	2%
	80 bar & above	3%
	100 bar & above	4%
Projects by Private Sector Sugar Mills	60 bar & above	1%
	80 bar & above	2%
	100 bar & above	3%

Table 5.2: Central Financial Assistance in the form of interest subsidy [1]

Biomass Power	Pressure Configuration	Interest Subsidy
Direct combustion, cogeneration, including captive power projects	60 bar & above	2%
	80 bar & above	3%
Atmospheric gasification, including captive power	Projects	3%
Projects with MW scale 100% Producer Gas Engines	Capital subsidy of Rs. 1.00 crore / MW	
Advanced biomass gasification projects	Capital subsidy of Rs. 1.00 crore / MW	

An additional interest subsidy @ 2% will be provided with floor rate of interest not lower than 6% for Biomass Power / Cogeneration Projects in all Special Category States, and Islands. The floor rate of interest for other categories of projects shall not be lower than 8%. The maximum amount of capitalized interest subsidy for any biomass power project shall be limited to Rs. 2.00 crore. A total capacity not exceeding 100 MW shall be supported in any State during the 10th Plan. The capital subsidy to projects based on MW scale 100% producer gas engines shall not exceed Rs. 2.00 crore per project, and to advanced biomass gasification projects shall not exceed Rs. 8.00 crore per project. Capital cost of the Renewable Energy is shown in the Table 5.3

Table 5.3: Renewable Energy Sources Cost of Generation [8]

S. No.	SOURCE	CAPITAL COST in Rs. Cr./MW	GENERATION COST in Rs.
1	Small Hydro	3.5-6.00	1.50-3.00
2	Wind	3.5	2.25
3	Biomass Gassifier	2.4	1.10
4	Biogass Cogeneration	2.00-2.5	2.00-2.5
5	Solar Photovoltaic System	9.0	5.80

5.7 POLICY FRAMEWORK AND PROMOTIONAL MEASURES FOR RENEWABLE ENERGY SOURCES

Since inception, Renewable Energy Programme in India has been driven by policy and promotional measures initially framed by the MNES, and subsequently by the respective State Governments. The existing policy framework for the non-conventional energy sector can be clubbed under the two broad heads.

- **Policy measures with regard to wheeling, banking, third party sale etc.**

❖ **Promotional policies in the nature of financial and fiscal incentives extended by the Government [1,17].**

5.7.1 At the Central Government Level

With a view of promoting extensive use of non-conventional energy sources, MNES has issued Guidelines and has worked closely with State Governments and utilities to provide remunerative power purchase agreements and arrangements for Wheeling, Banking, Third Party sale and Buy-back of power, with annual escalation. GOI circulated the "Guidelines for Promotional and Fiscal incentives by State Governments".

5.7.2 The salient features of the Guidelines are as follows

- Grid interfacing to be taken either by the project promoter or SEB and cost to be borne by the project promoter.
- SEB to undertake the augmentation of the sub-station capacity, based on the project generation capacity.
- SEB to allow captive use and third party sale
- SEB to charge a uniform 2% wheeling charges irrespective of the distance from the generating station.
- SEB to permit banking of power up to one year.
- SEB to purchase power at a minimum rate of Rs. 2.25/per unit with no restriction on time and quantum of electricity supplied. This rate to be reviewed annually and linked to some standard criteria such as wholesale price index.
- Transaction between SEB and project promoter to be settled on monthly basis.
- SEB to provide exemption from demand cut to the extent of 30% of the installed capacity of the project promoter.

- Infrastructural facilities to be provided for RE projects on the lines of industrial states. [17]

5.7.3 At the State Level

Pursuant to the guidelines issued by MNES, several States announced their individual policies pertaining to power from different forms of non-conventional energy. These policies cover aspects such as wheeling, banking, buy-back rate and third party sale.

5.7.3.1 Wheeling

- **Wind:** 2-5% of energy in most states (20% in case of Karnataka and 28.4%+ Rs 0.5/kwh in case of **Andhra pradesh)**
- **Boimass/Co-gen:** 2-5% of energy in most states (20% in case of Karnataka, 28.4%+ Rs 0.5/kwh in **AP** and 12.5% in UP)
- **Small Hydro:** 2-5% of energy in most states (20% in Karnataka, 28.4%+Rs 0.5/kwh in **AP** and in Maharashtra wheeling permitted at concessional rate as declared time to time)
- **Waste:** 2-5% of energy in most states (20% in Karnataka, 28.4%+Rs 0.5/kwh in **AP**)

5.7.3.2 Banking

- **Wind:** Allowed for 6-12 months in most states
- **Biomass/Co-gen:** Allowed for 8-12 months in most states (4 months in Kerala and 24 months in Uttar Pradesh)
- **Small Hydro:** Allowed for 8-12 months in most states (not allowed in Tamil Nadu and 1 month in case of Uttar Pradesh)
- **Waste:** Allowed for 8-12 months in most states.

5.7.3.3 Buy-back rate

- **Wind:** Rs. 2.25/kwh (1994-95) 5% escalation per year in most states (Rs. 2.89/kwh (1999-00) 5% escalation in rajasthan, Rs. 2.70/kwh with no escalation in Tamil Nadu)
- **Biomass/ Co-gen:** 2.25/kwh (1994-95) 5% escalation per year in most states (Rs 2.80/kwh (2000-01) 5% escalation for five years in Kerala, Rs 3.01/kwh with 2% escalation for five years in punjab, Rs 2.73/kwh (2000- 01) escalation 5% for 9 years in Tamil Nadu
- **Small Hydro:** 2.25/kwh (1994-95) 5% escalation per year in most states (Rs 2.75/kwh with 5% escalation per year for 10 years in Rajasthan, Rs 2.50/kwh with 5% annual escalation in Kerala)
- **Waste:** 2.25/kwh (1994-95) 5% escalation per year in most states (Rs 2.75/kwh with 5% escalation per year for 10 years in Rajasthan and Rs 2.80/kwh (2000-01) 5% escalation per year for 5 years in case of Kerala)

5.7.3.4 Third Party Sale

- **Wind:** Allowed in some states (Not allowed in **Andhra Pradesh**, West Bengal, Madhya Pradesh, Tamil Nadu, Gujarat and Kerala)
- **Biomass/Co-gen:** Allowed in most states (Not allowed in **Andhra Pradesh**, Kerala and Tamil Nadu)
- **Small Hydro:** Allowed in some states (Not allowed in **Andhra Pradesh**, Gujarat, Tamil Nadu and Kerala)
- **Waste:** Not allowed in **Andhra Pradesh** and Kerala.

5.8 FISCAL/PROMOTIONAL MEASURES FOR R.E. BASED PROJECTS

The promotional measures available for renewable energy projects comprise of wide range of fiscal and financial incentives like soft loans, concessional rates of custom duty, exemption from excise duty, tax holidays and accelerated depreciation benefits. Both Central Government and State Governments have been providing financial and fiscal support to RE projects.

5.8.1 From Central Government

5.8.1.1 Accelerated Depreciation

80 %-accelerated depreciation is allowed with respect to total capital cost of wind projects and capital cost of select equipments in biogas/co-generation plants. The provision can be used to offset against other corporate tax liabilities.

5.8.1.2 Concession/exemption from custom duty

Custom duty concessions or full exemption is available on certain components of wind turbines imported into the country. In case of biomass projects, maximum 20% ad valoram duty is leviable on projects less than 50 MW.

5.8.1.3 Income Tax holiday:

Income tax holiday is available for wind and biomass projects.

5.8.1.4 Soft Loans

Indian Renewable Energy Development Agency (IREDA) provides soft loans for renewable energy based power projects covering project financing, equipment financing, equipment manufacturing, market development etc.

5.8.1.5 Capital Subsidy

Capital subsidy for co-generation project in joint venture/IPP model is available to cooperative/public sector sugar mills; upto Rs 45 lakhs/MW (maximum Rs 8.10 crore per project)

5.8.1.6 Renewable Portfolio Standard

According to recently enacted Electricity Act, 2003, State Electricity Regulatory Commission (SERC) shall promote cogeneration and generation of electricity from renewable sources of energy by specifying a minimum percentage of electricity to be purchased from renewables. Distribution Licensees will be obilised to buy electricity from renewable sources at a minimum of specified percentage.

5.8.2 State Government Measures

5.8.2.1 Capital Subsidy

- **Wind Projects:** 15-30% of the capital cost in most states (maximum of Rs 25 lakh in AP, Rs 20 lakh in Maharashtra and Rs 5 lakh in Kerala)
- **Small Hydro Projects:** 15-20% of capital cost in most states.
- **Biomass/Co-gen projects:** 15-20% of capital cost in most states
- **Waste based projects:** 15-20% of the capital cost in most states.

5.8.2.2 Exemption from Electricity Duty

Electricity duty is exempted in most of the states with respect to wind, small hydro, biomass and waste based projects.

5.8.2.3 Exemption from Demand cut

Madhya Pradesh and Gujarat provide limited exemption from demand cut of electricity to the customers, which have installed RE projects.

5.8.2.4 Sales tax Benefits

Sales tax benmefits are available for small-hydro projects in states like Gujarat, Rajasthan and Madhya Pradesh.

5.8.2.5 Concession on entry tax and octroi

In Kerala equipment and materials related to RE projects are exempted from entry tax/ octroi. [17

5.9 R. E. DEVICES AND SYSTEMS EXEMPTED FROM EXCISE DUTY

1. Flat plate solar collectors
2. Black, continuously-plated solar selective coating sheets (in cut lengths or in coils and fins and tubes)
3. Concentrating and pipe type solar collectors
4. Solar cookers
5. Solar water heaters and systems
6. Solar air heating systems
7. Solar low pressure steam systems
8. Solar stills and desalination systems
9. Solar pumps based on solar thermal and SPV conversion
10. Solar power generating systems
11. SPV modules and panels for water pumping and other applications
12. Solar crop driers and systems
13. Wind operated electricity generators, their components and parts thereof
14. Water pumping windmills, and aero-generators and battery chargers
15. Biogas plants and biogas engines
16. Agricultural, forestry, agro-industrial, industrial, municipal and urban waste

conversion devices producing energy

17 Equipment for utilizing ocean waves energy

18 Solar lantern

19 Ocean thermal energy conversion systems

20 Parts consumed within the factory of production of such parts for the manufacture of goods

21 Solar PV cells. [17]

The table 5.4 shows the Andhra Pradesh Renewable Energy Policies like Banking period, Buy Bach per kilo-watt., Annual Escalation.

Table 5.4: A.P. Renewable Energy Policies Scenario [1,17]

Sl. No.	Programme	Wheeling	Banking(12m)	Buy Back per kwh	Annual Escalation5%
1	Wind	2%	2%, 8-12 M	Rs. 2.25	1997-98
2	Biomass	2%	2%, 8-12 M	Rs. 2.25	1997-98
3	SHP	2%	2%, 8-12 M	Rs. 2.25	1997-98
4	Biogass,cogen	2%	2%, 8-12 M	Rs. 2.25	1997-98

***Third Party sale is not applicable**

Chapter-6

GIS APPLICATON ON RENEWABLE ENERGY

6.0 GENERAL

The use of GIS can make consideration of renewable energy options a relatively simple process. A Geographic Information System is a computer program which can store, retrieve, analyze and display cartographic data. Satellite images and digitized maps are fed into the computer where separate layers can show individual themes. For instance, a land use study can be done using GIS to show individual themes like slope, orientation, vegetation and shading. When combined in an overlay the best solar building sites can be determined. GIS can also show features like highways, urban boundaries, lakes, rivers and floodplains.

6.1 WIND ENERGY APPLICATIONS

Wind speed data is usually recorded at airports, but that data is very unreliable since the wind's energy potential is site specific and dependent on geography. The application of GIS to analyze the relationship between geography and average wind speed would allow more accurate predictions about the wind power potential of a specific site. An average wind speed of 12 miles/hr. (19 km/hr.) is necessary to justify the expense of a wind energy system. Wind energy compliments solar energy well in most areas because high winds usually coincide with storms.

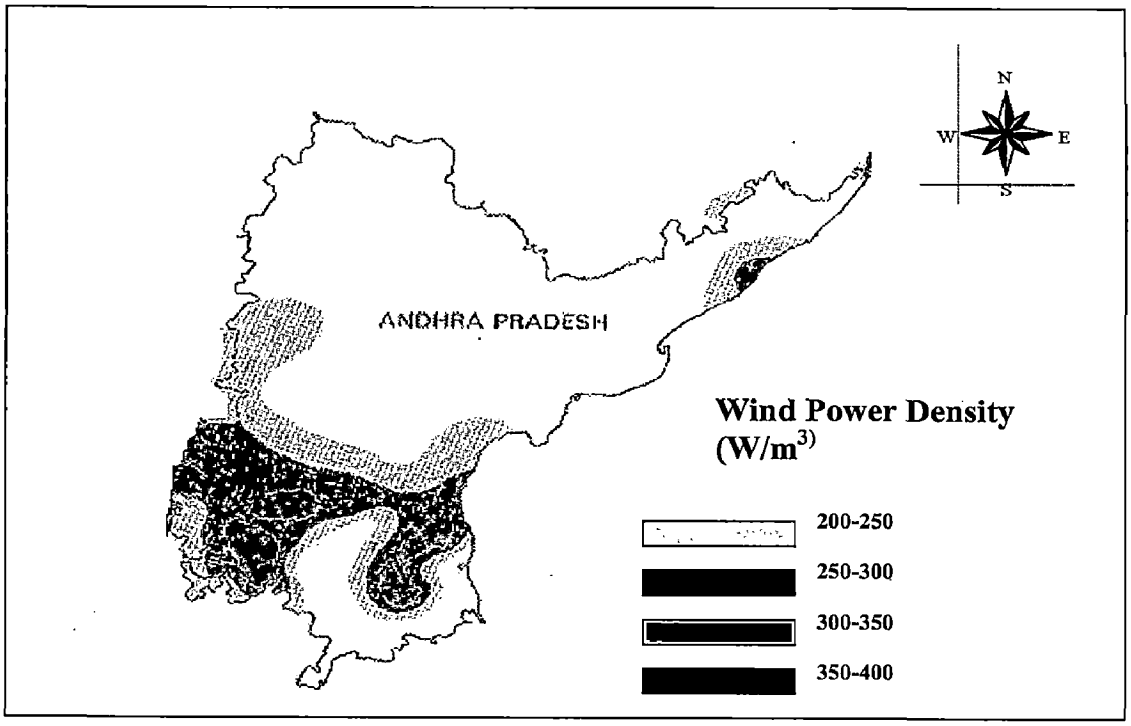


Fig 6.0: Wind Power Density Map of Andhra Pradesh

By seeing the Wind map which is shown on figure 7.0. available on GIS platform the developer/user can quickly realize that which portion of the state is highly suitable for the wind energy development based the wind intensity levels and the wind potential database. After that by using Grid over layer map one can take a decision that whether the grid available for the plant or not. [18]

6.2 SMALL HYDRO APPLICATION

Small Hydro power generation is an inexpensive compliment to solar energy. The overall size and cost of solar electric installations can be reduced when hydro electricity is available for use during overcast and rainy periods. Hydro potential is directly related to the geography of an area and the amount of precipitation and soil saturation. GIS can be used to evaluate specific watersheds for runoff and the difference in elevation from where water can be collected and where a turbine can be located. The amount of hydro energy available is a function of the change in elevation, called head, and the gallons per minute available at the turbine. Approximately 1 kWh/day is available when the product

of the head in feet and gallons per minute equals 200 (head in meters x liters/meters = 250). For instance, 10 gallons/min. (38 liters/min.) falling 20 feet (6.5 meters) for 24 hrs. /day will produce approximately 1 kWh of electricity. Mountainous areas with high rainfall should be analyzed by GIS to determine hydro power potential.

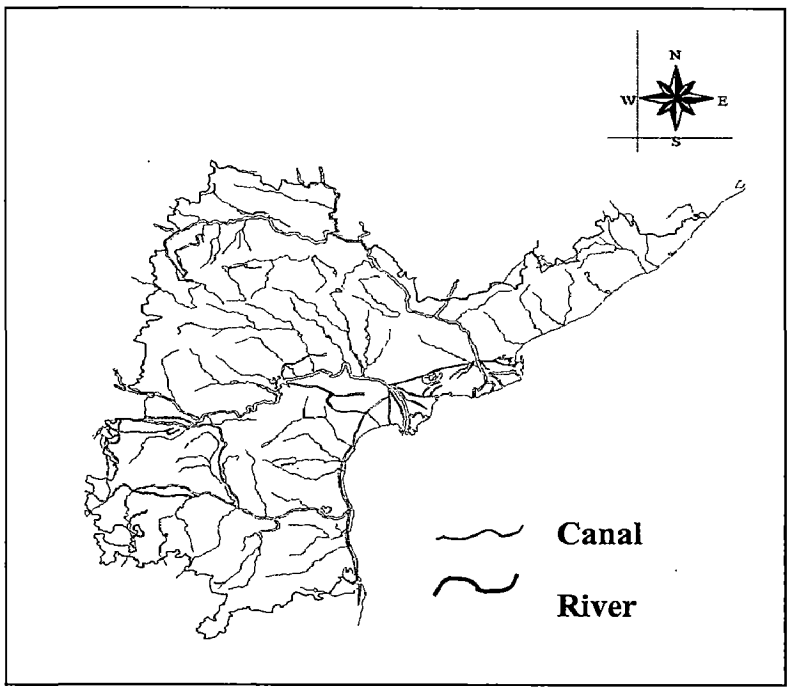


Fig 6.1: Canals/Rivers Map of Andhra Pradesh

A hidden benefit of Small Hydro is that water, which would otherwise cause soil loss on steep slopes, is directed through pipes and its force is used to produce energy rather than cause erosion. By using the water availability, the slope of the land and the energy demand the developer can develop a Small Hydro site by considering the potential sites database, water availability (rivers-canals near by which is shown in figure 6.1) and grid availability, all the data is available on this GIS software, so developer can take a quick decision that which is the suitable and beneficial to the developer as well as community [18].

6.3 BIOMASS/BIOGASSE

The main resources of Biomass/Biogasse are agro forestry, cattle dung, Municipal solid wastes, agricultural wastes etc. For finding of these resources we need the forest map and agricultural map. By this we can easily find out the place which suitable for the Biomass/Biogass power production, which shown in Figure 6.2.

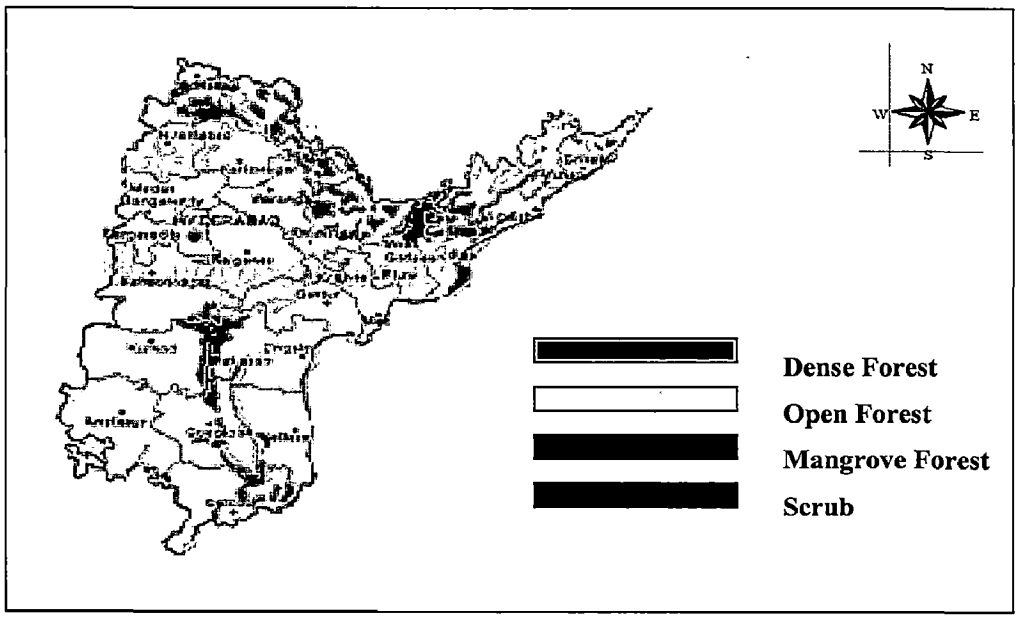


Fig 6.2: Forest Map of Andhra Pradesh

Andhra Pradesh State has been divided in to three regions according to the Renewable Energy availability which shows that the region named as Telangana, has the good potential of Biomass followed by SHP. The Second region named as Kostha has the significant potential of SHP followed by Biomass then Wind Energy. The Third region named as Rayalaseema has much potential in Wind Energy followed by Biomass then SHP and shown in figure 6.3.

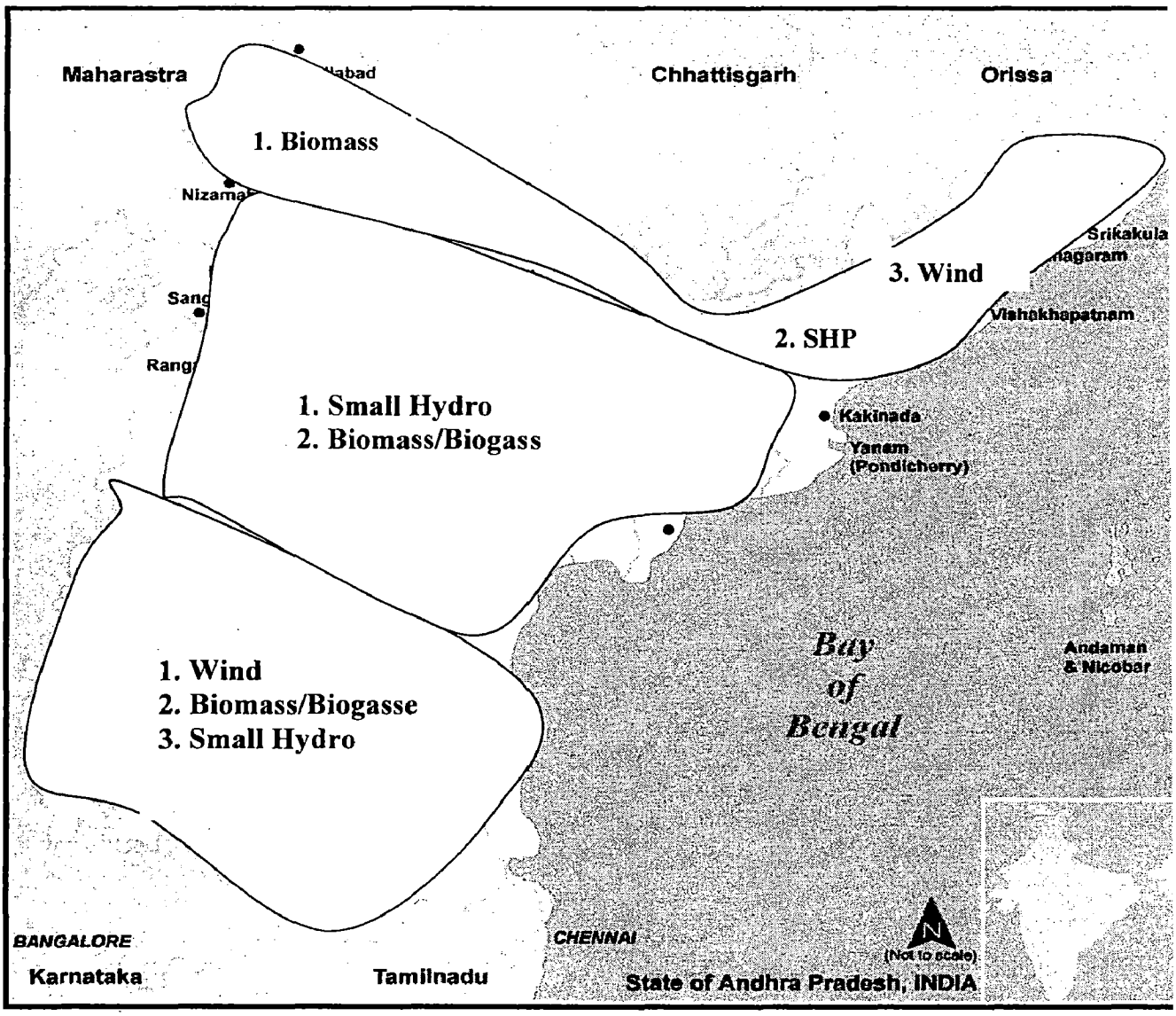


Fig 6.3: Priority Wise Availability of R.E Sources in A.P.

6.4 GEOGRAPHICAL ANALYSIS OF ENERGY SYSTEMS AND RESOURCES

Methods of analyzing the geographical constraints and distributions of renewable energy resources and the energy system infrastructure using geographical information systems (GIS). Located in between systems analysis, resource assessment and planning, this report has resulted in the development and application of GIS-based models in several fields:

- Energy demand and production in relation to the national electricity transmission grid. Geographical and temporal analysis.
- Balanced cost calculation of wind power generation using geographically determined costs and revenues.
- GIS-based models of transport costs and environmental effects of biomass logistics from forest to energy plant.
- Cost-supply and allocation studies carried out for wood chip and waste wood resources.
- Visibility and visual impact of regional wind power development. Temporal studies using visibility thresholds and population overlay in a GIS

6.5 GIS USES AND UTILIZATIONS IN RENEWABLE ENERGY

(1) Identify hydel sites for electricity generation in a decentralized way,

(2) Assessment of potentials of wind, solar resources

(3) Agro-ecological zonation helps in demarking degraded land, which helps planners to take up energy plantation to meet the fuel and fodder requirement of the region,

(4) Spatial mapping renewable energy sources and sector-wise energy demand,

(5) Resource - demand balancing (modelling)

Energy resources database (renewable and non renewable), energy demand database (sector wise), environmental database, data aggregation, data analysis (energy scenarios, techno economic analysis) and integrated plan are the various modules being incorporated in the Integrated Regional Energy Plan. The energy scenarios module along with energy demand, transformation, techno-economic and environment module are used (in integrated module) to perform an integrated energy-environment planning

exercise for a region (village / blocks/ taluk /district/state). Environmental database is used automatically calculate environmental impacts of energy scenarios.

Scenario analyses aids in creating a picture of the current energy situation and estimated future changes based on expected or likely plans and growth patterns. Base case or business-as-usual is based on present population growth, industrialization, agricultural energy requirement.

Chapter-7

DATA COLLECTION AND DATABASE DEVELOPMENT OF RENEWABLE ENERGIES

7.0 PREMBLE

The Installed capacity of Renewable Energy plants in the Andhra Pradesh state is in the order of 1001 MW. under the administrative centre of Andhra Pradesh Generation Corporation (APGENCO) by the State Government and Non Conventional Energy Development of Andhra Pradesh Corporation (NEDCAP) for private sector projects.

7.1 DEVELOPMENT STEPS

7.1.1 Database Development

The data has been collected from the NEDCAP Andhra Pradesh), APGENCO APTRANSCO (Andhra Pradesh Transmission Corporation) and MNES Non etc. the datas available in analog form and head been converted in to digital form.

7.1.2 Determination of Latitude and Longitude

The latitude and Longitude of all renewable energy sites that includes Small Hydro Power sites, Biomass/Biogasse, Co-Generation, Wind power sites of all commissioned and identified sites have been taken from the basis of survey of India map of Andhra Pradesh in the scale of 1:1000000.

Database Preparation

The raw data has been taken from the organization and that has to be converted in to digital form after that the cost of the each project has been calculated by using the cost details given by the MNES of different category of sites.

Database of A.P. contains the following information

- Name of the project
- Latitude and Longitude of the project sites
- Capacity details
- Cost of the Project details

The command line which has been used in the database is:

"IF(E4>15000,30000*E4,IF(E4>5000,37500*E4,IF(E4>1000,45000*E4,IF(E4>500,60000*E4,75000*E4))))" for the Small Hydro Power sites and others are given in the table 7.0 and 7.7

7.1.4 Digitization of Database Layers

All the maps includes, Andhra Pradesh state boundary, district boundaries, power network map, forest map, wind intensity map, canals-rivers maps are digitized in Auto cad software.

7.1.5 Application of GIS software in the project

Andhra Pradesh Renewable Energy database that includes SHP, Wind, Biomass/Biogasse Power projects has been developed using the GIS Arc View 3.2 software and shown in figures 7.1 to 7.3

7.1.6 Layers of GIS Arc View Database

Various themes used in Arc View Software

- State Boundray
- District Boundary
- SHP Commissioned/Investigated

- Biomass/Biogasse Commissioned/Investigated
- Wind Commissioned/Investigated
- Rives-Canals Map
- Wind Density Map

7.1.6.1 Point Layer

In the point layer the points are generated by appropriate latitude and longitude values which are already in the form of database (.dbx) file.Following point layer themes have been included in the Database

- SHP Commissioned/Investigated
- Biomass/Biogasse Commissioned/Investigated
- Wind Commissioned/Investigated

7.1.6.2 Boundary Layer

In the boundary layer there are two types of boundaries are available, which are shaped by using the Auto Cad software and this can be helpful to the divide the state boundary and districts boundaries.

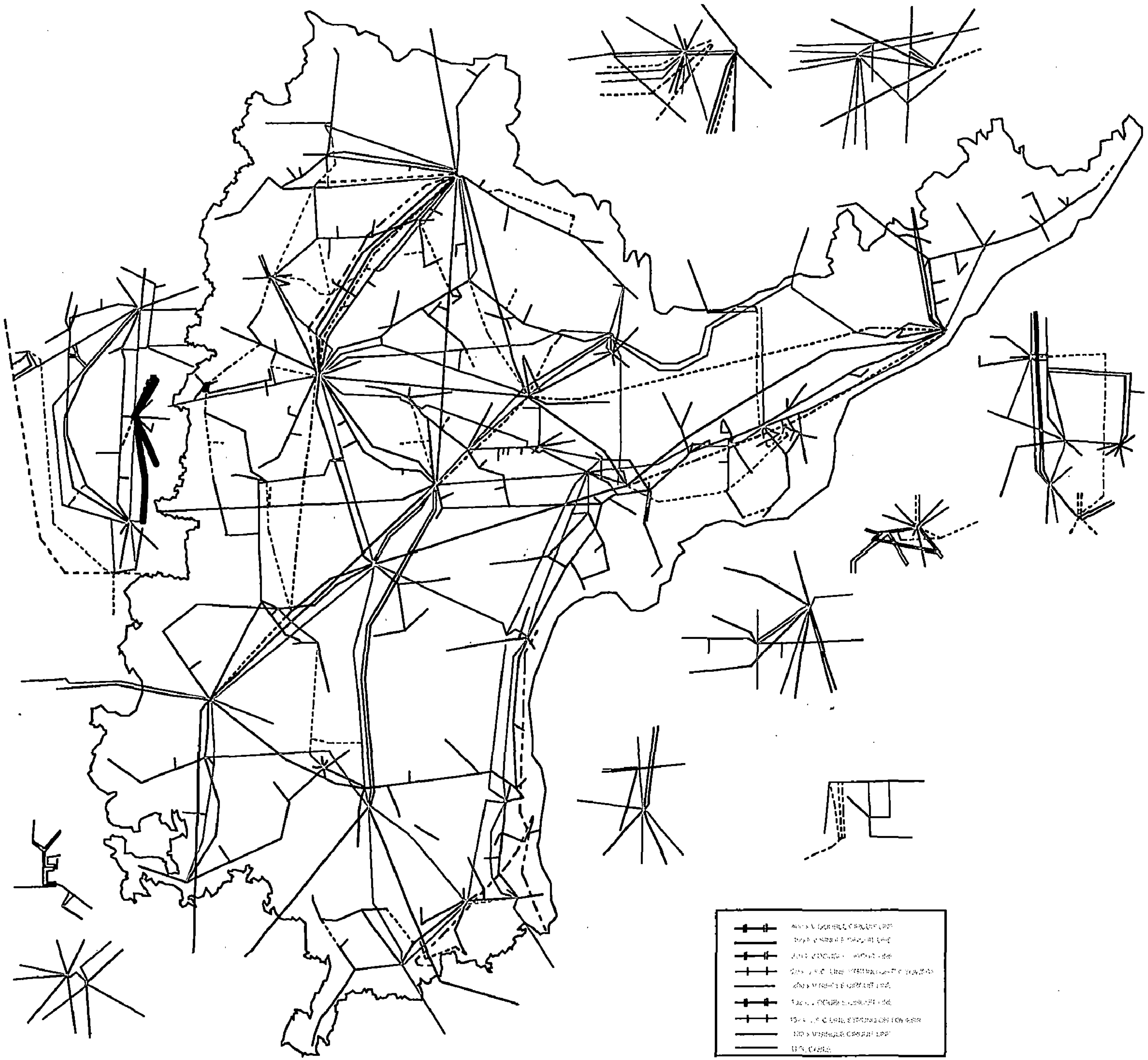
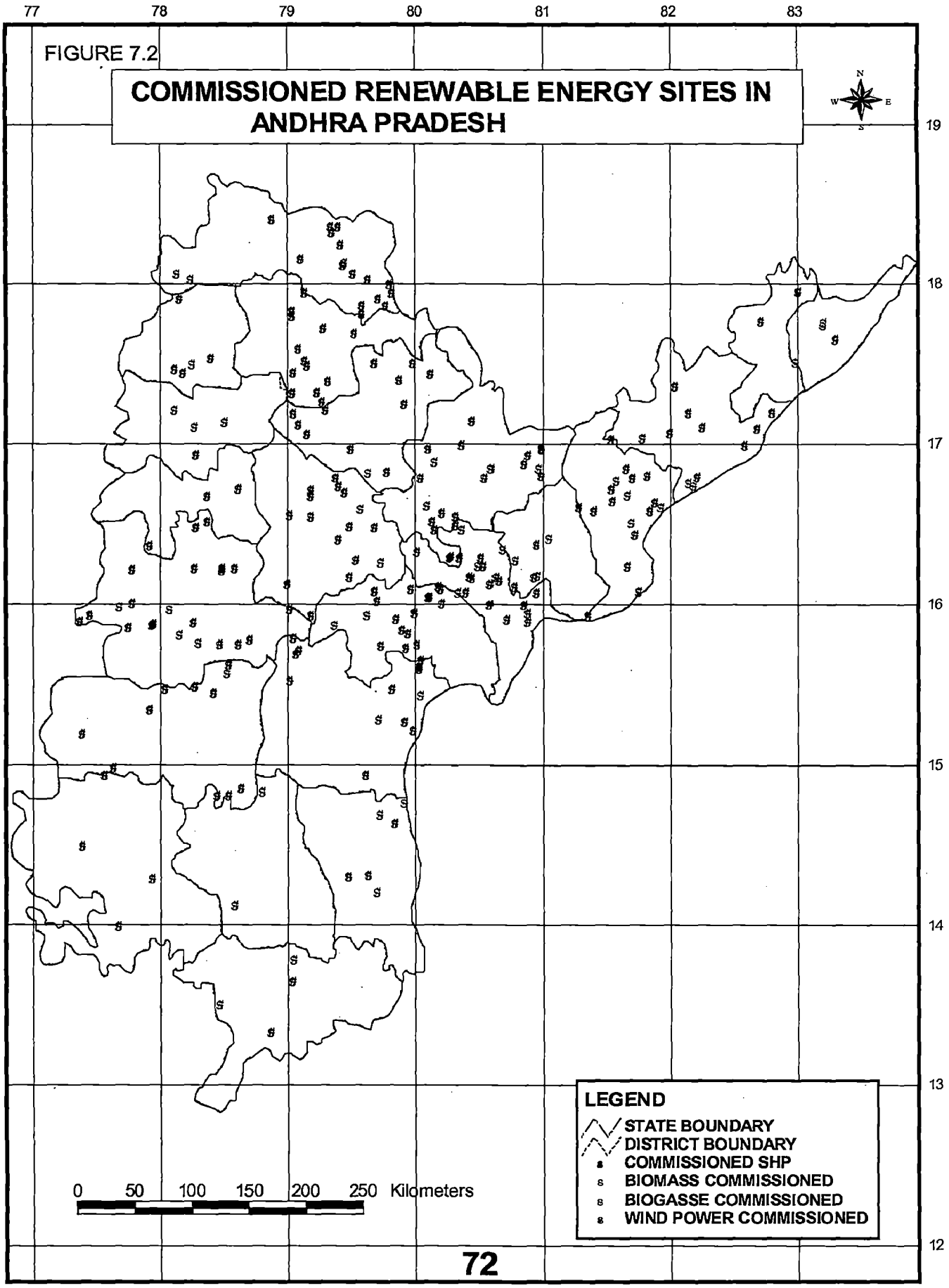


FIGURE 7.2


COMMISSIONED RENEWABLE ENERGY SITES IN ANDHRA PRADESH
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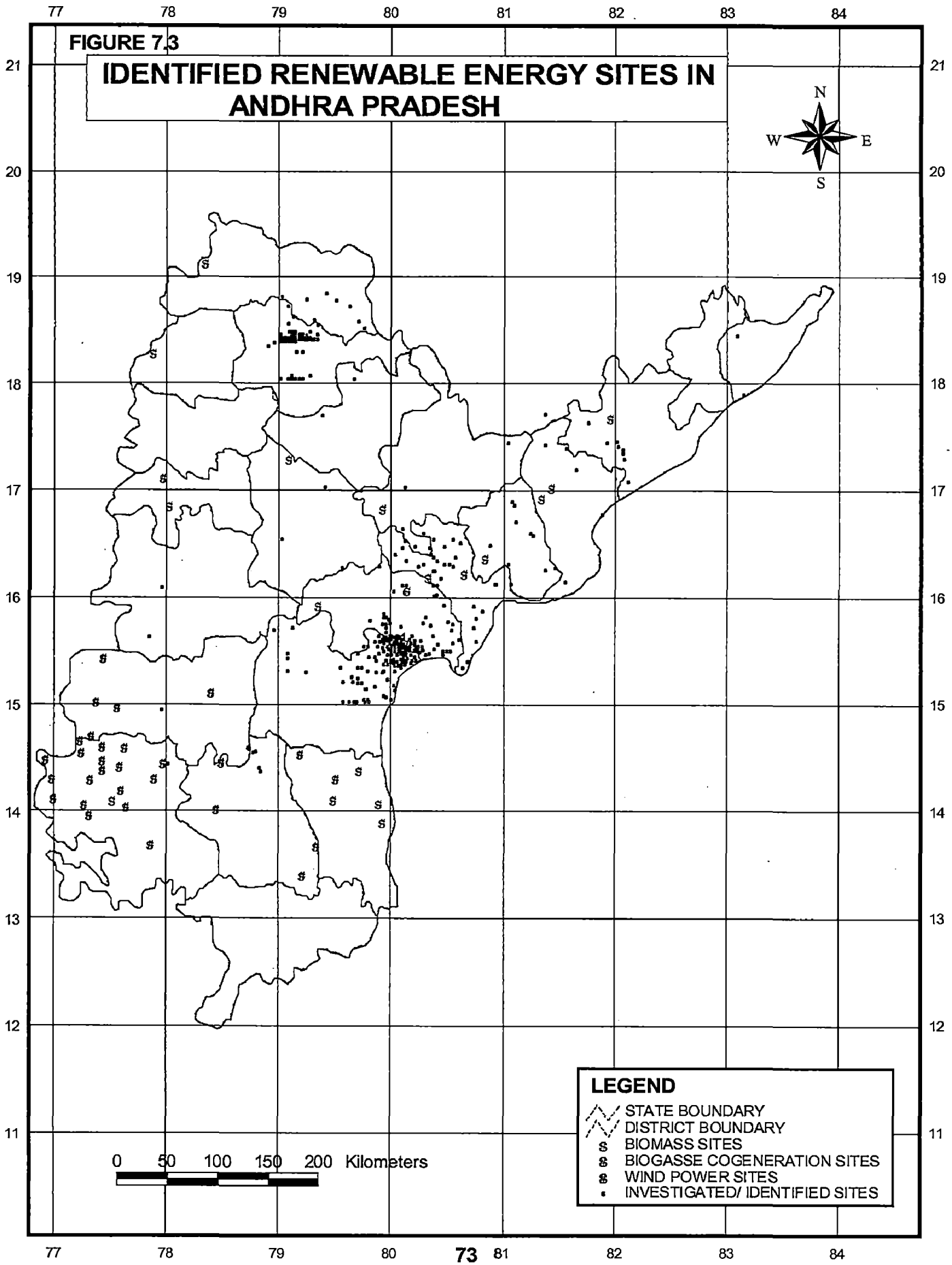
13
12
LEGEND
STATE BOUNDARY
DISTRICT BOUNDARY
COMMISSIONED SHP
BIOMASS COMMISSIONED
BIOGASSE COMMISSIONED
WIND POWER COMMISSIONED
0 50 100 150 200 250 Kilometers

FIGURE 7.3


IDENTIFIED RENEWABLE ENERGY SITES IN ANDHRA PRADESH
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0 50 100 150 200 Kilometers
LEGEND
STATE BOUNDARY
DISTRICT BOUNDARY
BIOMASS SITES
BIOGASSE COGENERATION SITES
WIND POWER SITES
INVESTIGATED/ IDENTIFIED SITES

TABLE 7.0: Andhra Pradesh Commissioned SHP Sites

S. No.	Name of the Developer	Longitude	Lattitude	category	Capacity(KW	Cost of the Project in Crores
1	M/s Deccan Cement Limited Naigonda District	80.45	16.3	Canal	3750	16.88
2	M/s Dhanalakhmi Cotton & Rice Mills Limited, Guntur	79.95	15.85	Canal	2000	9.00
3	M/s Sagar Power Ltd. .Hyderabad	80.517	16.467	Canal	4300	19.35
4	M/s KCP Limited, Vuyyur, Krishna District	80.4	16.183	Canal	1500	6.75
5	M/s Rayalaseema Power Projects Limited	80.583	16.25	Canal	3000	13.50
6	M/s SKJ Power Limited, Hyderabad	80.033	15.567	Canal	1500	6.75
7	M/s Sagar Power Limited.Hyderabad	77.933	15.917	Canal	4000	18.00
8	M/s Trident Power Corporation, Hyderabad	79.85	15.967	Canal	4000	18.00
9	M/s Trident Power Corporation, Hyderabad	79.917	15.133	Canal	3000	13.50
10	M/s Dhansiakshmi Cotton & Rice Mills	79.9	15.883	Canal	4198	18.89
11	M/s KCP Limited M/s Bhavani Hydro Power projects, Hyd	80.433	16.317	Canal	6750	25.31
12	M/s KCP Limited M/s Bhavani Hydro Power projects, Hyd	80.433	16.327	Canal	550	3.30
13	M/s Active Power (P) Limited utilising VTPS Back wate	80.883	16.017	Canal	1400	6.30
14	M/s Thirumala Hydro Power (P) Limited, Chilakalurip	80.117	16.15	Canal	2400	10.80
15	M/s Espar Pak LimitedO-3-550, 22-2-220. Scheme 2: Bel	80.35	16.467	Canal	1300	5.85
16	M/s Shivani Power Spinners Chilakaluripet	80.183	16.233	Canal	750	4.50
17	M/s Jayalakshmi Power Corporation Limited	79.933	15.733	Canal	4000	18.00
18	M/s NCL Energy Limited District Scheme 1	77.95	15.933	Canal	7500	28.13
19	M/s Manihasma Power Projects (P) Limited	81.65	17.2	Reservoir	3000	13.50
20	M/s Srinivasa Power (P) Limited from NMSLC at km 38.0	79.8	18.7	Canal	3550	15.98
21	M/s Akshay Profiles	80.217	16.1	Canal	1000	6.00
22	M/s PMC Power Pvt. Ltd.	80.267	16.467	Canal	650	3.90
23	M/s Janapadu Power & Industries Limited	80.633	16.317	Canal	1000	6.00
24	M/s NATL Power Limited, Hyderabad	79.983	15.067	Reservoir	4005	18.02
25	M/s Saraswati Power &lndustries Limited, Hyderabad	79.433	18.85	Canal	2000	9.00
26	M/s KM (P) Limited, Hyderabad Kurnool District km 7.9	78.617	15.767	Canal	4000	18.00
27	M/s Kallarn Spinning Mills Limited	80.133	16.767	Canal	2400	10.80
28	M/s KM (P) Lid., Hyderabad	75.05	17.85	Canal	3000	13.50
29	M/s Kallam Spinning Mills Limited	80.15	16.7	Canai	4000	18.00
30	M/s Suryachandra Sunergetics India (P) Limited, Guntu	80.033	15.567	Canal	1700	7.65
31	M/s AP Power Projects (P) Limited	77.633	14.767	Canal	2000	9.00
32	M/s Baiaji Energy (P) Limited, Hyderaba	79.617	14.7	Reservoir	10000	37.50
33	M/s Mahitha Power Projects (P) Ltd., Miryalguda,	79.683	16.717	Canal	400	3.00

34	M/s KM Power (P) Ltd.	77.367	15.95	Canal	3300	14.85
35	M/s Saraswati Power & industries Ltd., Hyderabad	77.383	19.317	Canal	1000	6.00
36	M/s PMC Energy Pvt. Ltd., Saincher Palace,0-3.152/B-2	80.033	15.583	[Canal	1200	5.40
37	M/s PMC Energy Pvt. Ltd., Saincher Pa!ace,0-3.152/B-2	80.073	15.583	Canal	750	4.50
38	M/s Shivanj Powera Spinners C.D. No. 1-301/1, 9thln	80.1	16.15	Canal	550	3.30
39	M/s Shivani Power Spinners, 6-3-347/1715, Dwara	80.95	16.183	Canal	500	3.75
40	M/s Vidyullatha Hydel Limited, 4/4, Vidyanagar, Guntu	80.05	15.633	Canal	1000	6.00
41	M/s Vidyullatha Hydel Limited, 4/4, Vidyanagar, Guntu	80.06	15.643	Canal	500	3.75
42	M/s Krishna Teja Aqua Farma (P) Limited, 106, Vijay	80.201	16.213	Canal	250	1.88
43	M/s Krishna Teja Aqua Farma (P) Limited, 106, Vijay	80.19	16.267	Canal	250	1.88
44	M/s Krishna Teja Aqua Farma (P) Limited, 106, Vijay	80.211	16.214	Canal	400	3.00
45	M/s Krishna Teja Aqua Farma (P) Limited, 106, Vijay	80.211	16.217	Canal	400	3.00
46	M/s PMC Power (P) Ltd. 7-1-220-146, Prasant colony, H	77.567	14.701	Canal	2250	10.13
47	M/s PMC Power (P) Ltd. 7-1-220-146, Prasant colony, H	77.567	14.702	Canal	2250	10.13
48	M/s PMC Power (P) Ltd. 7-1-220-146, Prasant colony, H	77.58	14.703	Canal	500	3.75
49	M/s PMC Power (P) Ltd. 7-1-220-146, Prasant colony, H	77.569	14.704	Canal	500	3.75
50	M/s Coromandel Cements Limited, Hyderabad	80.033	15.567	Canal	500	3.75
51	M/s Corornande! Cements Limited, Hyderabad	80.036	15.571	Canal	650	3.90
52	M/s NCL Energy Limited, Hyderabad	81.533	17.433	Canal	1300	5.85
53	M/s Rank Crance Private Limited, 102, AnupamaTowers B	81.817	17.133	Canal	550	3.30
54	M/s Nagambica Power & Industriee Pvt. Limited, 45-182	79.067	15.683	Canal	650	3.90
55	M/s Nagambica Power & Industries Pvt. Ltd., 45-182,	80.2	16.217	Canal	325	2.44
56	M/s Kalyan Chakravarthy Solvents Pvt. Limited, Pendan	80.633	16.317	Canal	250	1.88
57	M/s Kalyan Chakravarthy Solvents Pvt. Limited, Pendan	80.634	16.319	Canal	500	3.75
58	M/s Kalyan Chakravarthy Solvents Pvt. Limited, Pendan	80.636	16.321	Canal	500	3.75
59	M/s RankCrances Private Limited, 102, AnupamaTowers,	78.467	15.767	Canal	2500	11.25
60	M/s Jurala Power (P) Ltd., 8-2-120/186, A 11, Nand	78.283	16.717	Reservoir	2500	11.25
61	IWsNagaram Power aystems, Plot No. 78, Keshavnagar, N	78.533	15.6	Reservoir	1500	6.75
62	M/s Gadwal Power Projects Private Limited, 3-6-	77.917	16.567	Reservoir	1300	5.85
63	\/l/s Raji power Limited, Hyderabad	78.533	14.533	Canal	2000	9.00
64	A/s Sri Bhagavan Power Systems Private Limited, 24/10	79.917	19.033	Canal	500	3.75
65	M/s Sri Bhagavan Power Systems Private Limited, 24/10	79.917	19.04	Canal	850	5.10
66	Ws Kalpataruvu Hydro Private Limited, D. No. 11 -2-22	80.767	16.233	Canal	500	3.75
67	Vi/s Sri Rayalaseem Power Corporation ltd., Hyderabad	80	16.017	Reservoir	6000	22.50
68	,/1/s Akshaya Protiles (P) Limited, 1-320, 9th Lane.C	79.733	15.75	Canal	400	3.00
69	Ws Victory power systems Private Limited, 8-2-1 20/	78.483	16.383	Reservoir	6000	22.50
70	Ms Suji Power Limited, 3-5-797, flat No. 310, Block Rekhasakti Apts.,	80.55	17.117	Stream	1250	5.63
71	M/'s Biologicai E Limited, 8/143, Azambaci, Hyderabad	81.683	19.1	Canal	1700	7.65
72	M/'s Kaipataruvu Hydro Private Limited, D.No.	80.983	17.35	Canal	5000	22.50

73	M/s Alamur Hydel Power Prjvate Limited, Flat No. 3, M	82.067	16.883	Canal	6500	24.38
74	M/s Medapadu HydelPower Private Limited, Flat No. 3,	81.983	19.35	Canal	6700	25.13
75	M/s Raji power Limited, Hyderabad	78.45	14.533	Canal	2000	9.00
76	M/s Sri Bhagavan Power Systems Private Limited, 24/10	79.85	19.033	Canal	500	3.75
77	M/s Sri Bhagavan Power Systems Private Limited, 24/10	79.86	19.033	Canal	850	5.10
78	M/s Kaipataruvu Hydro Private Limited, D.No. 11-2-22,	80.883	15.95	Canal	500	3.75
79	M/s Sri Rayalaseem Power Corporation ltd., Hyderabad	77.45	16	Reservoir	6000	22.50
80	M/s Akshaya Profiles (P) Limited, 1-320, 9th Lane, Ch	79.083	15.717	Canal	400	3.00
81	M/s Victory power systems Private Limited, 8-2-1 20/1	78.583	16.383	Reservoir	6000	22.50
82	M/s Suji Power Limited, 3-5-797, flat No. 310, 'B' Bl	80.55	17.117	Stream	1250	5.63
83	M/s Biologicai E Limited, 18/143, Azambad, Hyderabad	81.683	19.1	Canal	1700	7.65
84	M/s Kaipataruvu Hydro Private Limited, D.No. 11-2-22,	80.983	17.35	Canal	500	3.75
85	M/s Alamur Hydel Power Prjvate Limited, Flat No. 3, M	82.067	16.883	Canal	650	3.90
86	M/s Medapadu Hydel Power Private Limited, Flat No. 3,	82.36	18.35	Canal	670	4.02
87	M/s CSR Power Gen. Pvt. Limited, Hyderabad	83	16.05	Canal	3500	15.75
88	M/s Himagiri Power Projects Pvt. Ltd., Narasaraopte,	80.85	16.083	Canal	250	1.88
89	M/s Himagiri Power Projects Pvt. Ltd.,Narasaraopte, G	80.983	17.367	Canal	350	2.63
90	M/s Himagiri Power Projects Pvt. Ltd., Narasaraopte,	80.984	17.368	Canal	600	3.60
91	M/s Savitri Power Projects Private Limited, Hyderabad	80.017	15.767	Reservoir	250	1.88
92	M/s Savitri Power Projects Private Limited, Hyderabad	78.033	15.4	Canal	2400	10.80
93	M/s Savitri Power Projects Private Limited, Hyderabad	78.034	15.401	Canal	2400	10.80
94	M/s Savitri Power Projects Private Limited, Hyderabad	78.035	15.402	Canal	2400	10.80
95	M/s Nawabharath Hydro Power Projects (P) Ltd., Vijaya	78.617	17.033	River	1500	6.75
96	Ws Himagiri Power Projects Pvt. Ltd., Narasaraopte, G	80.05	17.117	Canal	1250	5.63
97	M/S Srinivasa Power (P) Ltd., D.No. 1 8-21/1 9/B, Ash	79.133	18.067	Reservoir	2000	9.00
98	M/s Krishna Priya Power(P) Limited, 7-1-58, Block N	82.1	18.3	Canal	5250	19.69
99	M/s Krishna Priya Power (P) Limited, 7-1-58, Block	82.033	17.867	Canal	3280	14.76
100	M/s PSM Spinning Mille Limited, 208 & 408, Nilgiri	80.983	17.133	Canal	10000	37.50
101	M/s Sri Chakra Power Gen. Limited, 6-3-597/12, Venk	81.9	14.017	Canal	270	2.03
102	M/s Himagiri Power Projects (P) Limited, Paiapadu: 52	79.817	15.4	Canal	1000	6.00
103	M/s Srivitri Power Projects (P) Limited, 7-1-397/12	80.1	18.583	Reservoi	375	2.81
104	M/s NCL Energy Limited, Raghava Ratna Towers, 7t	79.05	15.817	Canal	3000	13.50
105	M/s Nallamalia Hydro Power Projects (P) Ltd., K	80.717	15.967	Canal	1800	8.10
106	M/s Shabari Power Gen. Private Limited, Hyderabad	77.25	18.867	Reservoir	3000	13.50
108	M/s Sardar Power pojects Private Limited, Hyderabad	83.25	16.2	River	3000	13.50
109	M/s Vinay Power Gen. Limited, Hyderabad.	79.483	16.317	Reservoir	22500	67.50
110	M/s Deccan CemantsLimited, Hyderabad	77.233	15.95	River	10000	37.50
111	M/s Seema Power Gen. Private Limited, Hyderabad	77.75	15.9	Reservoir	3000	13.50
112	M/s vidya Bharathi Power Systems (P) Limited, Hyderab	77.35	16.233	River	2000	9.00
113	M/s Sulakshana Developers (P) Limited, deccan Chamber	81.35	16	Canal	500	3.75

114	M/s Sailakshmi PowerProjects Private Limited, Velpur	79.033	18.433	Stream	700	4.20
115	M/s Pusala PowerProjects Private Limited D.No. 1-4-70	79.817	18.633	Stream	4050	18.23
116	M/s Akshay Profiles Private Limited.Chilkaluripet, Gu	79.183	16.967	Canal	2160	9.72
117	M/s Sri Gopi Hydel Projects Private Limited, H. No. 1	79.183	17.017	Stream	1850	8.33
118	M/s KCR Power (P) Ltd., 8-2-120/120, Nandinagar Road,	79.183	16	Stream	2000	9.00
119	M/s Shiva Sai Hydel Power Projects Limited, OPP : LIC	79.017	16.817	Stream	1500	6.75
120	M/s KCR Power (P) Ltd., 8-2-120/120, Nandinagar Road,	80.317	16.8	Stream	1700	7.65
121	M/s Indo dutch Power Private Limited, Road no. 14, Ba	80.317	16.733	Stream	1000	6.00
122	M/s Indo dutch Power Private Limited, Road no. 14, Ba	79.183	16.8	Stream	1850	8.33
123	M/s KCR Power (P) Ltd., 8-2-120/120, Nandinagar Road,	79.317	17.9	Stream	2000	9.00
124	M/s Tungapadu Power Private Limited, C-3, Anandsheel	78.283	17.3	Stream	2500	11.25
125	M/s Tungapadu Power Private Limited. C-3, Anandshee!	79.967	16.217	Stream	1250	5.63
126	M/s Indo dutch Power Private Limited, Road no. 14, Ba	79.867	18.983	Stream	1100	4.95
127	M/s Nagavali Power Pvt. Ltd., 111, My HomeApts:, Navo	83.617	18	Canal	2500	11.25
128	M/s Thungapadu Power Pvt. Ltd., C3 Anandasheel Enclav	79.3	17.667	Stream	1900	8.55
129	M/s Sindhu Power Systems Pvt. Ltd., 201 , Niharika Ap	79.5	17.35	Stream	3300	14.85
130	M/s MRS Hydel Power Pvt. Ltd., 18-10116/16/1, Ashokna	79	16.25	Stream	1250	5.63
131	M/s SV Hydel Power Pvt. Ltd., 101, West Kavuri Hills,	79.4	16.617	Stream	2400	10.80
132	M/s Sai Lakshmi Power Projects Pvt. Ltd. Vinukonda, V	80.267	19.167	Stream	2000	9.00
133	M/s Sai Rama Power (P)Ltd., 24-2-15, Venamadurru 534	82.733	16.5	Stream	2000	9.00
134	M/s Saiteja Energies (P)Ltd., P. No. 14, Sai Enclave,	79.1	18.9	Stream	1500	6.75
135	M/s Arka Power Infotech Ltd., 101, Jaya castle, New N	79.083	17.55	Canal	1000	6.00
136	M/s Jaladhara Power Projects Ltd., P. No. 3, vianohar	79.083	18.167	Canal	801	4.81
137	M/s Sneha Renewable Energies Ltd., 1-8-702/ 32/46, Pa	79.7	16.117	Stream	1000	6.00
138	M/s Sneha Renewable Energies Ltd., 1-8-702/32/46, Pa	80.283	16.483	Stream	1400	6.30
139	M/s SLS Power Ltd. 3/336, Laxmipuram, Nellore 524 002	81.283	16.883	Stream	5400	20.25
140	M/s Virinchi Renewable Energy (P) Ltd., P. No. 14Kris	81.75	16.2	Canal	300	2.25
141	M/s Konaseema Hydel Power (P) Ltd., Plot No. 56, Sarv	80.95	16.583	Canal	300	2.25
142	M/s Konaseema Hydel Power (P) Ltd., Plot No. 56, Sarv	80.017	16.517	Canal	400	3.00
143	M/s Konaseema Hydel Power (P Ltd., Plot No. 56, Sarva	81.883	16.917	Canal	400	3.00
146	M/s Veda Renewable Energy (P) Ltd., PNo. 5,Prarnitha	80.933	16.317	Canal	400	3.00
147	M/s Veda Renewable Energy (P) Ltd., P. No. 5,Prarnith	82.883	16.583	Canal	300	2.25
148	M/s Virinchi renewable Energy (P) Ltd., Plot No. 14,	80.85	17.233	Canal	300	2.25
149	M/sSLS Power Ltd. ,3/336, Laximipuram,Nellore 524 002	79.017	16.05	Stream	4800	21.60
150	M/s Kinetic Genco Limited,2-1 5/A, Kakatiya Nagar, St	79.983	18.05	River	3000	13.50
151	M/s Vummadi Hydro Power Plat (P) Ltd., 304, Surya Tow	79.267	17.733	Stream	2000	9.00
152	M/s Vummadi Hydro Power Plat (P) Ltd., 304, Surya Tow	78.267	16.383	River	2000	9.00
153	M/s Pusala Power Projects Pvt. Ltd., 1-4-908/C, Bakar	79.683	16.2	Stream	4050	18.23
154	M/s Sneha Renewable Energy Ltd., 1-8-702/32/46, Padma	80.65	16.283	River	3000	13.50

155	M/s Sri Sridevi Power Pvt. Ltd., 3/339, Laxmipuram Ne	80.533	16.4	Stream	5100	19.13
156	M/s Sri Sai Krupa Power Pvt. Ltd., Plot No. 24-1 1-37	79.883	17.917	Stream	3600	16.20
157	M/s TMs Power Pvt. Ltd., Plot No. 9, Road No. 5 Banja	79.583	18.517	Canal	1300	5.85
158	M/s Deccan Cements Ltd., 6-3-666/B, Deccan Chambers,	82.25	18.467	Reservoir	3250	14.63
159	M/s Yuvaraj Power Projects Pvt. Ltd., 77-88-4, RTC C	78.417	15.367	Stream	3000	13.50
160	M/s Pusala Power Projects Pvt. Ltd., 1-4-908/C, Bak	79.017	15.467	Stream	2000	9.00
161	M/s Akshay Profile Pvt. Ltd., 9th Lane,Pandaripuram,	78.7	15.8	Canal	1000	6.00
162	M/s Dhenu Energies Pvt. Ltd., 203, Uday Kiran Apart	78.267	15.417	Canal	3800	17.10
163	M/s Kurnool Energy (P) Ltd., Flat No. 203, Uday Kiran	78.633	14.6	River	3400	15.30
164	M/s Mitra Energy pvt. Ltd., Ground Floor, Prasanthi	78.5	20	River	2600	11.70
165	M/s MBMR Energies (P)ltd., 8-2-277/A/1, Road No. 2, B	79.533	16.45	River	3200	14.40
166	M/s Pusala Power Projects Pvt. Ltd., 1-4-908/C, Bakar	78.367	16.967	Stream	2500	11.25
167	M/s Pusala Power Projects Pvt. Ltd., 1-4-908/C, Bakar	78.367	16.767	Stream	2200	9.90
168	M/s Raji Power (P) Ltd., 1 06, Durga Apartments, Chik	81.3	18.067	Reservoir	1200	5.40
169	M/s Krishna Teja Aqua Forms (P) Ltd., Flat No. 401, K	80.583	16.083	Canal	450	3.38
170	vl/s Akshaya Hydro Power Limited, 1-320, 9th Line, Pa	80.7	18.417	weir	1000	6.00
171	M/s Sri Sridevi Power Pvt. Ltd., 3/339, Laxmipuram Ne	79.233	17.817	Stream	4800	21.60
172	M/s Kinetic Genco Ltd., 2-1 5/A, Kakatiya Nagar, Stre	79.933	18.883	Stream	1200	5.40
173	M/s Bennuri Power Projects Pvt. Ltd., 1-4-908/C, Baka	78.483	16.367	River	3200	14.40
174	M/s Elgen (India) Ltd., Prathima House, 6-3-252/2, Na	82.867	16.683	Weir	1740	7.83
175	M/s Sri Raj Power (P) Ltd. m 606, Brindavan Apts,	82.8	17.65	Waterfall	1500	6.75
177	M/s Sri Raj Power (P) Ltd. m 606, Brindavan Apts,	83	17.517	River	920	5.52
178	M/s Mohanaroopa Power Projects (P) Ltd., 74-1 3-8, Sr	81.217	17.867	River	9000	33.75
179	M/s Sri Sai Rama Power Pvt. Ltd., 24-2-15, Yenamadurr	80.217	16.833	River	3000	13.50
180	M/s Unnatha Sai Power (P) Ltd., 11-15-11 Ramireddipet	79.783	17.167	Waterfall	650	3.90
181	M/s Saiteja Energies Pvt. Ltd., Plot No. 14, Sai Encl	82.267	14.45	River	1300	5.85
182	M/s Yuvraj Power Projects Pvt. Ltd., D.No. 77-8-4,	82.583	17.383	Stream	3000	13.50
183	M/s Someswara Power Co. Ltd.,	79.033	17.8	River	2000	9.00
184	M/s Pusala Power Projects Pvt. Ltd., 1-4-908/C, Ba	79.05	17.967	Stream	2500	11.25
185	M/s Tungapadu Power Pvt. Ltd., C3, Anand Steel Encl	80.883	17.3	Stream	3580	16.11
186	M/s Sri Shiva Sai Hydel Power Projects (P) Ltd., Han	78.183	17.967	River	3975	17.89
187	M/s Paleru Power Projects ltd., 204, Archana Arcade,	79.15	17.467	River	1500	6.75
188	M/s Elgen (India)Ltd., Prathima House, 6-3- 252/216,	79.283	18.333	Stream	1600	7.20
189	M/sTurboveni hdustries(P) Ltd., 301, 3rd Floor,Manjee	79.45	17	Canal	800	4.80
190	M/s Varnsi Genco Pvt. Ltd., 8-2-704/B/15, Plot No. 14	79.4	17.05	Stream	3000	13.50
191	M/s Varnsi Genco Pvt. Ltd., 8-2-704/B/15, Plot No. 14	79.383	17.117	Stream	3000	13.50
192	M/s Gayatri Power (P) Ltd., Flat No. 101, Gharonda Sr	79.05	17.633	Stream	1700	7.65
193	9th Mile kakatiya cana!	79.433	18.85	cana!	1000	6.00
194	10th Mile	79.517	18.783	canal	6600	24.75
195	14th Mile	79.633	18.733	canal	1000	6.00

196	16th Mile	79.767	18.517	canal	1000	6.00
197	18th Mile	79.717	18.583	canal	660	3.96
198	19th Mile	79.683	18.05	canal	660	3.96
199	Palair, Khammam dist	80.1	17.35	canal	2000	9.00
200	Chettipeta, WG Dist	81.7	17.117	cana!	1000	6.00
201	Nizamsagar	76.1	18.767	cana!	10000	37.50
202	Singur	78.117	18	cana!	14000	52.50
203	PABR	0	0	canal	2000	9.00
204	Donkaraye	81.533	17.433	canal	25000	75.00
205	Pochampad	78.15	18.583	canal	18000	54.00
206	6-2-00 Mile D-83 Kakatiya Canal	79.583	18.45	canal	1200	5.40
207	7-1 -220 Mile Kakatiya Canal	79.033	18.467	canal	1000	6.00
208	12-3-334 Mile Kakatiya Cana!	79.15	18.033	cana!	1000	6.00
209	18-2-373 Mile Kakatiya Canal	79.133	18.633	canal	650	3.90
	TOTAL in KW				**523219**	

Sl no.	Project Name	Dist.Name	DD_Lat	DD_Long	Annual Rainfall (mm)	canal\river	Discharge (m^3/sec)	Head (m)	Capacity (kw)	Cost of the Project in Crore
1	Addaanki C M 18-0-550		15.850	79.950		Addaanki BC		2	600	36.00
2	Addaanki C M 18-2-110		15.083	79.950		Addaanki BC		2	600	36.00
3	Addaanki C M 18-3-440		15.817	79.950		Addaanki BC		2	1000	60.00
4	Addaanki C M 18-6-550		15.817	79.967		Addaanki BC		2	1000	60.00
5	Addanki BC M 4-6-440,7		15.800	79.967		Addanki BC			6000	225.00
6	Addanki-1		15.783	79.967		Addaanki BC		6	2000	90.00
7	Addanki-2		15.767	79.967		Addaanki BC		5	1500	67.50
8	Addanki-3		15.750	79.967		Addaanki BC		7	2500	112.50
9	Addanki-4		15.750	79.967		Addaanki BC		5	1500	67.50
10	Addanki-5		15.733	79.967		Addaanki BC		5	1500	67.50
11	Addanki-6		15.717	79.967		Addaanki BC		5	2000	90.00
12	Addanki-7		15.700	79.967		Addaanki BC		8	2000	90.00
13	Addanki-8		15.683	79.967		Addaanki BC		4	1500	67.50
14	Addanki-9		15.067	79.967		Addaanki BC		8	1500	67.50
15	Alamuru 22.86Km	Godavari E	16.783	81.883	1159	Godavari	18	3	500	37.50
16	C(D-53) Ch.1005.00	Karimganaga	18.400	79.067	954	Canal(D-53)	10	2	100	7.50
17	C(D-53) Ch.105.60	Karimganaga	21.733	79.083	954	Canal(D-53)	21	1	200	15.00
18	C(D-53) Ch.1056.00	Karimganaga	18.400	79.100	954	Canal(D-53)	10	1	100	7.50
19	C(D-53) Ch.1105.50	Karimganaga	18.400	79.117	954	Canal(D-53)	10	2	130	9.75
20	C(D-53) Ch.1116.50	Karimganaga	18.400	79.133	954	Canal(D-53)	10	3	250	18.75
21	C(D-53) Ch.1133.00	Karimganaga	18.400	79.150	954	Canal(D-53)	10	2	100	7.50
22	C(D-53) Ch.1138.00	Karimganaga	18.417	79.050	954	Canal(D-53)	10	1	100	7.50
23	C(D-53) Ch.1142.90	Karimganaga	18.417	79.067	954	Canal(D-53)	10	1	100	7.50
24	C(D-53) Ch.1145.50	Karimganaga	18.417	79.083	954	Canal(D-53)	10	1	100	7.50
25	C(D-53) Ch.1166.00	Karimganaga	18.417	79.083	954	Canal(D-53)	10	1	100	7.50
26	C(D-53) Ch.1182.50	Karimganaga	18.417	79.100	954	Canal(D-53)	10	2	150	11.25
27	C(D-53) Ch.1192.40	Karimganaga	18.417	79.117	954	Canal(D-53)	10	2	150	11.25
28	C(D-53) Ch.1196.80	Karimganaga	18.417	79.133	954	Canal(D-53)	10	2	150	11.25
29	C(D-53) Ch.1200.50	Karimganaga	18.417	79.150	954	Canal(D-53)	10	2	150	11.25
30	C(D-53) Ch.122.10	Karimganaga	18.417	79.017	954	Canal(D-53)	21	1	150	11.25
31	C(D-53) Ch.1224.50	Karimganaga	18.417	79.183	954	Canal(D-53)	10	2	150	11.25
32	C(D-53) Ch.1269.90	Karimganaga	18.417	79.200	954	Canal(D-53)	10	2	150	11.25

			DD_Lat	DD_Long	Annual Rainfall (mm)	canal\river	Discharge (m^3/sec)	Head (m)	Capacity (kw)	Cost of the Project in Crore
33	C(D-53) Ch.1301.10	Karimganaga	18.417	79.217		Canal(D-53)	9	1	50	3.75
34	C(D-53) Ch.1375.00	Karimganaga	18.417	79.233	954	Canal(D-53)	8	2	100	7.50
35	C(D-53) Ch.1408.00	Karimganaga	18.417	79.250		Canal(D-53)	3	1	50	3.75
36	C(D-53) Ch.1421.20	Karimganaga	18.417	79.267	954	Canal(D-53)	3	2	50	3.75
37	C(D-53) Ch.1444.30	Karimganaga	18.417	79.283	954	Canal(D-53)	3	2	50	3.75
38	C(D-53) Ch.1477.30	Karimganaga	18.417	79.300		Canal(D-53)	3	1	50	3.75
39	C(D-53) Ch.1484.63	Karimganaga	18.417	79.317	954	Canal(D-53)	3	2	100	7.50
40	C(D-53) Ch.1490.13	Karimganaga	18.417	79.033	954	Canal(D-53)	2	3	100	7.50
41	C(D-53) Ch.1495.63	Karimganaga	18.417	79.350	954	Canal(D-53)	2	2	50	3.75
42	C(D-53) Ch.1500.03	Karimganaga	18.433	79.033		Canal(D-53)	2	2	50	3.75
43	C(D-53) Ch.1542.20	Karimganaga	18.433	79.033		Canal(D-53)	2	2	50	3.75
44	C(D-53) Ch.1555.40	Karimganaga	18.433	79.050		Canal(D-53)	2	1	50	3.75
45	C(D-53) Ch.1585.10	Karimganaga	18.433	79.067		Canal(D-53)	1	2	50	3.75
46	C(D-53) Ch.1593.90	Karimganaga	18.433	79.083		Canal(D-53)	1	2	50	3.75
47	C(D-53) Ch.1604.90	Karimganaga	18.433	79.100		Canal(D-53)	1	2	50	3.75
48	C(D-53) Ch.1609.30	Karimganaga	18.433	79.117		Canal(D-53)	1	2	50	3.75
49	C(D-53) Ch.1623.40	Karimganaga	18.433	79.133		Canal(D-53)	1	2	20	1.50
50	C(D-53) Ch.1632.40	Karimganaga	18.433	79.150		Canal(D-53)	1	1	10	0.75
51	C(D-53) Ch.1640.00	Karimganaga	18.433	79.017		Canal(D-53)	1	2	20	1.50
52	C(D-53) Ch.1685.20	Karimganaga	18.433	79.183		Canal(D-53)	1	2	20	1.50
53	C(D-53) Ch.1699.60	Karimganaga	18.433	79.200		Canal(D-53)	0	2	5	0.38
54	C(D-53) Ch.1705.00	Karimganaga	18.433	79.217		Canal(D-53)	0	2	5	0.38
55	C(D-53) Ch.1715.00	Karimganaga	18.433	79.233		Canal(D-53)	0	2	5	0.38
56	C(D-53) Ch.1726.48	Karimganaga	18.433	79.250		Canal(D-53)	0	1	5	0.38
57	C(D-53) Ch.1729.10	Karimganaga	18.433	79.267		Canal(D-53)	0	1	5	0.38
58	C(D-53) Ch.175.20	Karimganaga	18.433	79.283	954	Canal(D-53)	21	1	150	11.25
59	C(D-53) Ch.178.30	Karimganaga	18.450	79.200		Canal(D-53)	21	1	150	11.25
60	C(D-53) Ch.190.30	Karimganaga	18.450	79.183	954	Canal(D-53)	21	2	200	15.00
61	C(D-53) Ch.198.00	Karimganaga	18.450	79.217	954	Canal(D-53)	21	1	150	11.25
62	C(D-53) Ch.232.10	Karimganaga	18.467	79.217	954	Canal(D-53)	21	2	300	22.50
63	C(D-53) Ch.49.50	Karimganaga	18.467	79.200	954	Canal(D-53)	23	2	300	22.50
64	C(D-53) Ch.55.00	Karimganaga	18.467	79.183	954	Canal(D-53)	23	2	300	22.50
65	C(D-53) Ch.551.10	Karimganaga	18.467	79.017	954	Canal(D-53)	12	4	300	22.50
66	C(D-53) Ch.602.20	Karimganaga	18.467	79.150		Canal(D-53)	12	4	600	36.00

					Annual Rainfall (mm)	Canal\river	Discharge (m^3/sec)	Head (m)	Capacity (kw)	Cost of the Project in Crore
67	C(D-53) Ch.608.00	Karimganaga	18.467	79.133		Canal(D-53)	12	4	600	36.00
68	C(D-53) Ch.623.20	Karimganaga	18.467	79.117	954	Canal(D-53)	12	2	150	11.25
69	C(D-53) Ch.650.15	Karimganaga	18.483	79.150	954	Canal(D-53)	12	4	300	22.50
70	C(D-53) Ch.66.00	Karimganaga	18.483	79.133	954	Canal(D-53)	23	2	300	22.50
71	C(D-53) Ch.761.70	Karimganaga	18.483	79.117	954	Canal(D-53)	11	2	200	15.00
72	C(D-53) Ch.776.70	Karimganaga	18.483	79.100		Canal(D-53)	11	1	100	7.50
73	C(D-53) Ch.79.20	Karimganaga	18.050	79.217	954	Canal(D-53)	23	2	300	22.50
74	C(D-53) Ch.809.00	Karimganaga	18.050	79.200	954	Canal(D-53)	11	3	200	15.00
75	C(D-53) Ch.826.00	Karimganaga	18.050	79.183	954	Canal(D-53)	11	2	200	15.00
76	C(D-53) Ch.944.50	Karimganaga	18.050	79.017	954	Canal(D-53)	10	2	200	15.00
77	C(D-53) Ch.96.80	Karimganaga	18.050	79.150	954	Canal(D-53)	21	2	300	22.50
78	C(D-53) Ch.970.70	Karimganaga	18.050	79.133	954	Canal(D-53)	10	2	200	15.00
79	C(D-53) Ch.982.30	Karimganaga	18.050	79.117	954	Canal(D-53)	10	2	150	11.25
80	C(D-53) Ch.990.00	Karimganaga	18.050	79.100	954	Canal(D-53)	10	1	100	7.50
81	C(D-53) Ch.999.30	Karimganaga	18.050	79.083	954	Canal(D-53)	10	2	170	12.75
82	C(D-83) M 10-1-110	Prakasham	15.400	80.117		Canal(D-83)	60	2	1000	60.00
83	C(D-83) M 13-7-146	Prakasham	15.400	80.067		Canal(D-83)	56	2	800	48.00
84	C(D-83) M 13-7-550	Prakasham	15.400	80.050		Canal(D-83)	56	2	800	48.00
85	C(D-83) M 14-3-34	Prakasham	15.400	80.150		Canal(D-83)	56	2	1000	60.00
86	C(D-83) M 14-7-563	Prakasham	15.400	80.133		Canal(D-83)	54	3	1300	58.50
87	C(D-83) M 16-3-121	Prakasham	15.400	80.033		Canal(D-83)	51	2	800	48.00
88	C(D-83) M 16-3-350	Prakasham	15.400	80.017		Canal(D-83)	51	2	800	48.00
89	C(D-83) M 16-6-275	Prakasham	15.417	80.117		Canal(D-83)	51	3	1000	60.00
90	C(D-83) M 17-4-478	Prakasham	15.417	80.133	751	Canal(D-83)	51	1	600	36.00
91	C(D-83) M 18-5-530	Prakasham	15.417	80.150		Canal(D-83)	49	3	1000	60.00
92	C(D-83) M 20-1-440	Prakasham	15.417	80.017		Canal(D-83)	44	2	1000	60.00
93	C(D-83) M 20-5-445	Prakasham	15.417	80.183		Canal(D-83)	44	2	1000	60.00
94	C(D-83) M 20-7-0	Prakasham	15.417	80.200		Canal(D-83)	44	2	1000	60.00
95	C(D-83) M 22-1-550	Prakasham	15.417	80.217	751	Canal(D-83)	40	4	900	54.00
96	C(D-83) M 23-0-220	Prakasham	15.417	80.233	751	Canal(D-83)	40	2	300	22.50
97	C(D-83) M 23-1-550	Prakasham	15.417	80.133		Canal(D-83)	22	4	500	37.50
98	C(D-83) M 24-6-440	Prakashan	15.433	80.150	751	Canal(D-83)	40	2	500	37.50
99	C(D-83) M 25-4-550	Prakasham	15.450	80.150		Canal(D-83)	19	3	500	37.50
100	C(D-83) M 25-6-0	Prakasham	15.467	80.133		Canal(D-83)	19	4	500	37.50

					Rainfall (mm)	Canal\River	Discharge (m^3/sec)	Head (m)	Capacity (kw)	Cost of the Project in Crore
101	C(D-83) M 4-4-0	Prakashan	15.467	80.150	1083	Canal(D-83)	64	1	500	37.50
102	C(D-83) M 5-1-330	Prakasham	15.467	80.017	751	Canal(D-83)	64	1	500	37.50
103	C(D-83) M 5-4-330	Prakasham	15.483	80.183		Canal(D-83)	64	2	1000	60.00
104	C(D-83) M 5-7-110	Prakasham	15.483	80.017		Canal(D-83)	64	3	1500	67.50
105	C(D-83) M 7-7-330	Prakasham	15.483	80.133		Canal(D-83)	64	4	2000	90.00
106	C(D-83B) M 0-2-033	Prakasham	15.483	80.150	751	Canal(D-83B)	5	2	100	7.50
107	C(D-83B) M 0-4-220	Prakasham	15.050	80.233	751	Canal(D-83B)	5	2	50	3.75
108	C(D-83B) M 0-6-220	Prakasham	15.050	80.217	751	Canal(D-83B)	5	3	100	7.50
109	C(D-83B) M 0-7-080	Prakasham	15.050	80.200	751	Canal(D-83B)	5	3	100	7.50
110	C(D-83B) M 10-2-220	Prakasham	15.050	80.183	751	Canal(D-83B)	3	1	50	3.75
111	C(D-83B) M 1-0-440	Prakasham	15.050	80.017	751	Canal(D-83B)	5	4	150	11.25
112	C(D-83B) M 10-7-330	Prakasham	15.050	80.150	751	Canal(D-83B)	3	4	100	7.50
113	C(D-83B) M 11-0-330	Prakasham	15.517	80.100	751	Canal(D-83B)	3	1	50	3.75
114	C(D-83B) M 1-1-110	Prakasham	15.517	80.117	751	Canal(D-83B)	5	2	100	7.50
115	C(D-83B) M 11-7-000	Prakasham	15.517	80.133	751	Canal(D-83B)	3	1	50	3.75
116	C(D-83B) M 12-1-440	Prakasham	15.517	80.150	751	Canal(D-83B)	3	2	50	3.75
117	C(D-83B) M 12-3-330	Prakasham	15.517	80.017	751	Canal(D-83B)	3	2	50	3.75
118	C(D-83B) M 1-2-550	Prakasham	15.517	80.183	751	Canal(D-83B)	5	2	50	3.75
119	C(D-83B) M 13-0-000	Prakasham	15.517	80.200	751	Canal(D-83B)	3	2	50	3.75
120	C(D-83B) M 13-0-550	Prakasham	15.517	80.217	751	Canal(D-83B)	3	2	50	3.75
121	C(D-83B) M 13-2-000	Prakasham	15.517	80.233	751	Canal(D-83B)	3	1	50	3.75
122	C(D-83B) M 13-3-330	Prakasham	15.517	80.250	751	Canal(D-83B)	3	1	50	3.75
123	C(D-83B) M 13-4-330	Prakasham	15.517	80.283	751	Canal(D-83B)	3	3	50	3.75
124	C(D-83B) M 13-7-330	Prakasham	15.517	80.300	751	Canal(D-83B)	3	2	50	3.75
125	C(D-83B) M 14-1-20	Prakasham	15.533	80.050	751	Canal(D-83B)	3	2	50	3.75
126	C(D-83B) M 14-1-220	Prakasham	15.533	80.067	751	Canal(D-83B)	3	2	50	3.75
127	C(D-83B) M 14-3-440	Prakasham	15.533	80.083	751	Canal(D-83B)	3	2	50	3.75
128	C(D-83B) M 14-5-000	Prakasham	15.533	80.100	751	Canal(D-83B)	3	2	50	3.75
129	C(D-83B) M 14-6-110	Prakasham	15.533	80.117	751	Canal(D-83B)	3	2	50	3.75
130	C(D-83B) M 1-7-000	Prakasham	15.533	80.017	751	Canal(D-83B)	5	1	50	3.75
131	C(D-83B) M 2-3-550	Prakasham	15.533	80.183	751	Canal(D-83B)	5	1	50	3.75
132	C(D-83B) M 2-5-000	Prakasham	15.533	80.200	751	Canal(D-83B)	5	2	50	3.75
133	C(D-83B) M 2-6-550	Prakasham	15.533	80.217	751	Canal(D-83B)	5	2	50	3.75
134	C(D-83B) M 3-0-275	Prakasham	15.533	80.233	751	Canal(D-83B)	5	2	50	3.75

					Annual Rainfall (mm)	canal\river	Discharge (m^3/sec)	Head (m)	Capacity (kw)	Cost of the Project in Crore
135	C(D-83B) M 3-7-275	Prakasham	15.550	80.050	751	Canal(D-83B)	4	2	50	3.75
136	C(D-83B) M 4-4-330	Prakasham	15.550	80.067	751	Canal(D-83B)	4	1	50	3.75
137	C(D-83B) M 4-5-220	Prakasham	15.550	80.083	751	Canal(D-83B)	4	2	50	3.75
138	C(D-83B) M 4-7-220	Prakasham	15.550	80.100	751	Canal(D-83B)	4	1	50	3.75
139	C(D-83B) M 5-1-000	Prakasham	15.550	80.117	751	Canal(D-83B)	4	3	100	7.50
140	C(D-83B) M 5-1-440	Prakasham	15.550	80.133	751	Canal(D-83B)	4	1	50	3.75
141	C(D-83B) M 5-3-550	Prakasham	15.550	80.150	751	Canal(D-83B)	4	1	50	3.75
142	C(D-83B) M 5-4-220	Prakasham	15.550	80.017	751	Canal(D-83B)	4	3	100	7.50
143	C(D-83B) M 5-4-540	Prakasham	15.550	80.183	751	Canal(D-83B)	4	3	100	7.50
144	C(D-83B) M 5-5-440	Prakasham	15.550	80.200	751	Canal(D-83B)	4	1	50	3.75
145	C(D-83B) M 5-6-275	Prakasham	15.550	80.233	751	Canal(D-83B)	4	3	100	7.50
146	C(D-83B) M 5-7-055	Prakasham	15.550	80.250	751	Canal(D-83B)	4	1	50	3.75
147	C(D-83B) M 5-7-440	Prakasham	15.550	80.283	751	Canal(D-83B)	4	3	100	7.50
148	C(D-83B) M 6-0-110	Prakasham	15.567	80.083	751	Canal(D-83B)	4	1	50	3.75
149	C(D-83B) M 6-2-385	Prakasham	15.567	80.050	751	Canal(D-83B)	4	2	50	3.75
150	C(D-83B) M 6-5-000	Prakasham	15.567	80.033	751	Canal(D-83B)	4	2	50	3.75
151	C(D-83B) M 6-5-220	Prakasham	15.583	80.033	751	Canal(D-83B)	4	1	50	3.75
152	C(D-83B) M 7-0-000	Prakasham	15.583	80.050	751	Canal(D-83B)	4	1	50	3.75
153	C(D-83B) M 7-1-100	Prakasham	15.583	80.067	751	Canal(D-83B)	3	2	50	3.75
154	C(D-83B) M 7-5-330	Prakasham	15.600	80.067	751	Canal(D-83B)	3	1	50	3.75
155	C(D-83B) M 7-6-000	Prakasham	15.617	80.017	751	Canal(D-83B)	3	1	50	3.75
156	C(D-83B) M 7-6-440	Prakasham	15.617	80.017	751	Canal(D-83B)	3	2	50	3.75
157	C(D-83B) M 8-1-220	Prakasham	15.617	80.000	751	Canal(D-83B)	3	1	50	3.75
158	C(D-83B) M 8-2-220	Prakasham	15.617	80.033	751	Canal(D-83B)	3	2	50	3.75
159	C(D-83B) M 8-3-220	Prakasham	15.617	79.983	751	Canal(D-83B)	3	1	50	3.75
160	C(D-83B) M 8-4-500	Prakasham	15.617	79.967	751	Canal(D-83B)	3	1	50	3.75
161	C(D-83B) M 8-5-330	Prakasham	15.617	79.933	751	Canal(D-83B)	3	1	50	3.75
162	C(D-83B) M 8-6-000	Prakasham	15.633	80.067	751	Canal(D-83B)	3	1	50	3.75
163	C(D-83B) M 8-7-320	Prakasham	15.133	80.050	751	Canal(D-83B)	3	2	50	3.75
164	C(D-83B) M 9-0-110	Prakasham	15.633	80.033	751	Canal(D-83B)	3	2	50	3.75
165	C(D-83B) M 9-0-453	Prakasham	15.633	80.017	751	Canal(D-83B)	3	2	50	3.75
166	C(D-83B) M 9-2-220	Prakasham	15.633	79.967	751	Canal(D-83B)	3	2	50	3.75
167	C(Ith.M) M 0-1-000	Prakasham	15.633	79.950	751	Canal(Ith.M.)	10	2	150	11.25
168	C(Ith.M) M 0-2-550	Prakasham	15.650	79.900	751	Canal(Ith.M.)	10	2	150	11.25

Sl no.	Project Name	Dist.Name	DD_Lat	DD_Long	Annual Rainfall (mm)	canal\river	Discharge (m^3/sec)	Head (m)	Capacity (kw)	Cost of the Project in Crores
169	C(Ith.M) M 10-0-440	Prakasham	15.617	79.950	751	Canal(Ith.M.)	2	1	25	1.88
170	C(Ith.M) M 10-0-440	Prakasham	15.617	80.000		Canal(Ith.M.)	2	1	50	3.75
171	C(Ith.M) M 6-0-550	Prakasham	15.567	80.033	751	Canal(Ith.M.)	5	2	50	3.75
172	C(Ith.M) M 6-2-220	Prakasham	15.533	80.083	751	Canal(Ith.M.)	5	2	50	3.75
173	C(Ith.M) M 6-3-220	Prakasham	15.417	79.967	751	Canal(Ith.M.)	4	2	50	3.75
174	C(Ith.M) M 6-4-440	Prakasham	15.383	79.950	751	Canal(Ith.M.)	4	1	50	3.75
175	C(Ith.M) M 6-6-440	Prakasham	15.383	79.983	751	Canal(Ith.M.)	4	1	50	3.75
176	C(Ith.M) M 7-0-550	Prakasham	15.383	80.383	751	Canal(Ith.M.)	4	1	50	3.75
177	C(Ith.M) M 7-1-330	Prakasham	15.367	80.050	751	Canal(Ith.M.)	4	1	50	3.75
178	C(Ith.M) M 7-2-330	Prakasham	15.517	80.133	751	Canal(Ith.M.)	4	1	50	3.75
179	C(Ith.M) M 8-1-110	Prakasham	15.600	80.083	751	Canal(Ith.M.)	4	1	50	3.75
180	C(Ith.M) M 9-1-000	Prakasham	15.583	80.100	751	Canal(Ith.M.)	3	1	50	3.75
181	C(Ith.M) M 9-2-330	Prakasham	15.567	80.117	751	Canal(Ith.M.)	3	1	50	3.75
182	C(Ith.M) M 9-4-110	Prakasham	15.550	80.167	751	Canal(Ith.M.)	3	1	50	3.75
183	C(Ith.M) M 9-5-550	Prakasham	15.550	80.183	751	Canal(Ith.M.)	3	1	50	3.75
184	C(Ith.M) M 9-7-000	Prakasham	15.483	80.183	751	Canal(Ith.M.)	3	1	50	3.75
185	C(KC) K.Cud-1	Prakasham	14.600	78.733		KC Canal		3	600	36.00
186	C(KC) K.Cud-2	Prakasham	14.567	78.800		KC Canal		3	300	22.50
187	C(KC) K.Cud-3	Prakasham	14.550	78.783		KC Canal		3	300	22.50
188	C(KC) K.Cud-4	Prakasham	14.450	78.017		KC Canal		5	500	37.50
189	C(KC) K.Cud-5	Prakasham	14.567	78.800		KC Canal		5	700	42.00
190	C(KC) K.Cud-6	Prakasham	14.583	78.750		KC Canal		8	1000	60.00
191	C(KC) K.Cud-7	Prakasham	14.383	78.850		KC Canal		5	500	37.50
192	C(KC) K.Cud-8	Prakasham	14.417	78.833		KC Canal		7	500	37.50
193	C(KC) Km 117/49	Prakasham	18.350	78.917		KC Canal	29	9	800	48.00
194	C(KC) Km 119/1	Prakasham	18.383	78.967		KC Canal	18	8	300	22.50
195	C(KC) Km 119/16	Prakasham	18.400	79.033		KC Canal	16	10	600	36.00
196	C(KC) Km 122/02	Prakasham	18.400	79.033		KC Canal	16	10	300	22.50
197	C(KC) Km 122/76	Prakasham	18.400	79.133		KC Canal	15	10	300	22.50
198	C(KC) Km 124/09	Prakasham	18.433	79.200		KC Canal	15	10	300	22.50
199	C(KC) Km 124/71	Prakasham	18.467	79.183		KC Canal	11	9	300	22.50
200	C(KC) Km 125/72	Prakasham	18.483	79.283		KC Canal	11	11	300	22.50
201	C(KC) Km 127/4	Prakasham	18.300	79.167		KC Canal	10	16	500	37.50
202	C(KC) Km 128/38	Prakasham	18.467	79.350		KC Canal	9	9	300	22.50

Sl no.	Project Name	Dist.Name	DD_Lat	DD_Long	Annual Rainfall (mm)	canal\river	Discharge (m^3/sec)	Head (m)	Capacity (kw)	Cost of the Project in Cror
203	C(KC) M13-0-110,7-550	Prakasham	15.050	79.767		KC Canal	26	4	650	39.00
204	C(KC) M20-1-440,5-	Prakasham	15.483	79.717	751	KC Canal	26	7	1000	60.00
205	C(KC) M5-1-330,4-330,7		15.050	79.767		KC Canal	26	4	650	39.00
206	C(M.M) M 15-5-330	Prakasham	15.450	79.817	751	Canal(M.M.)	9	1	100	7.50
207	C(M.M) M 16-6-110	Prakasham	15.433	79.083	751	Canal(M.M.)	7	2	1000	60.00
208	C(M.M) M 17-7-220	Prakasham	15.417	79.883	751	Canal(M.M.)	5	1	50	3.75
209	C(M.M) M 19-6-220	Prakasham	15.550	79.800	751	Canal(M.M.)	4	1	50	3.75
210	C(M.M) M 19-7-440	Prakasham	15.050	79.800	751	Canal(M.M.)	4	1	50	3.75
211	C(M.M) M 20-6-000	Prakasham	15.483	79.083	751	Canal(M.M.)	4	2	50	3.75
212	C(M.M) M 20-7-000	Prakasham	15.450	79.867	751	Canal(M.M.)	4	2	50	3.75
213	C(M.M) M 21-6-110	Prakasham	15.033	79.583	751	Canal(M.M.)	4	2	50	3.75
214	C(M.M) M 21-6-550	Prakasham	15.033	79.633	751	Canal(M.M.)	4	2	50	3.75
215	C(M.M) M 21-7-440	Prakasham	15.033	79.683	751	Canal(M.M.)	4	2	50	3.75
216	C(M.M) M 22-0-440	Prakasham	15.033	79.700	751	Canal(M.M.)	4	2	50	3.75
217	C(T.M.) M 0-7-296	Prakasham	15.350	79.717	751	Canal(T.M.)	8	2	100	7.50
218	C(T.M.) M 1-2-000	Prakasham	15.350	79.750	751	Canal(T.M.)	8	1	100	7.50
219	C(T.M.) M 1-3-440	Prakasham	15.033	79.783	751	Canal(T.M.)	8	1	100	7.50
220	C(T.M.) M 2-3-330	Prakasham	15.317	79.800	751	Canal(T.M.)	8	1	100	7.50
221	C(T.M.) M 2-5-330	Prakasham	15.033	79.817	751	Canal(T.M.)	8	1	100	7.50
222	C(T.M.) M 2-6-550	Prakasham	15.317	79.083	751	Canal(T.M.)	8	1	100	7.50
223	C(T.M.) M 2-7-550	Prakasham	15.300	79.250	751	Canal(T.M.)	7	1	100	7.50
224	C(T.M.) M 3-0-550	Prakasham	15.300	79.883	751	Canal(T.M.)	7	1	100	7.50
225	C(T.M.) M 4-0-440	Prakasham	15.300	79.933	751	Canal(T.M.)	7	1	100	7.50
226	C(T.M.) M 4-1-440	Prakasham	15.233	79.983	751	Canal(T.M.)	6	1	50	3.75
227	C(T.M.) M 4-2-440	Prakasham	15.650	80.000	751	Canal(T.M.)	6	1	50	3.75
228	C(T.M.) M 4-3-330	Prakasham	15.633	80.033	751	Canal(T.M.)	6	1	100	7.50
229	C(T.M.) M 4-5-110	Prakasham	15.650	80.067	751	Canal(T.M.)	6	1	50	3.75
230	C(T.M.) M 4-7-330	Prakasham	15.617	80.067	751	Canal(T.M.)	6	1	50	3.75
231	C(T.M.) M 5-0-550	Prakasham	15.600	80.100	751	Canal(T.M.)	6	2	50	3.75
232	C(T.M.) M 5-2-055	Prakasham	15.583	80.100	751	Canal(T.M.)	6	2	100	7.50
233	C(T.M.) M 5-3-440	Prakasham	15.550	80.150	751	Canal(T.M.)	6	2	50	3.75
234	C(T.M.) M 6-0-000	Prakasham	15.567	80.183	751	Canal(T.M.)	6	1	50	3.75
235	C(T.M.) M 6-1-000	Prakasham	15.550	80.200	751	Canal(T.M.)	6	1	50	3.75
236	C(T.M.) M 6-2-000	Prakasham	15.517	80.200	751	Canal(T.M.)	6	2	100	7.50

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237	C(T.M.) M 6-3-330	Prakasham	15.050	80.183	751	Canal(T.M.)	6	2	50	3.75
238	C(T.M.) M 6-4-330	Prakasham	15.467	80.150	751	Canal(T.M.)	6	1	50	3.75
239	C(T.M.) M 9-6-359	Prakasham	15.433	80.150	751	Canal(T.M.)	4	1	50	3.75
240	Chopella 14.36Km	Godavari E	15.417	80.117	1159	Godavari	37	2	400	30.00
241	D-83 602-80 & 608-30	Prakasham	15.383	80.100	751	Canal(D-83B)	4	7	200	15.00
242	Dowlaiswaram regulator	Godavari E	15.317	79.950	1159	Godavari	93	2	1000	60.00
243	Guntur Br.C M 13-4-		16.050	80.133		Guntur Br.	15	4	1000	60.00
244	Guntur C M 0-0-400		16.317	80.533		Guntur BC	0	3	3000	135.00
245	Guntur C M 0-0-550		16.483	80.483		Guntur BC	23	7	3750	168.75
246	Guntur C M 13-3-550		16.383	80.383		Guntur BC	0	2	1000	60.00
247	Guntur C M 13-6-505,145-110		16.033	80.417		Guntur Br.			4000	180.00
248	Guntur C M 13-6-505,14		16.317	80.483		Guntur BC	0	2	1500	67.50
249	Guntur C M 2-3-220		16.250	80.383		Guntur BC	0	2	1500	67.50
250	Guntur C M 2-4-370		16.117	80.417		Guntur BC	0	2	1500	67.50
251	Guntur C M 2-5-550		16.067	80.033		Guntur BC	0	2	1500	67.50
252	Guntur C M 2-7-220		16.017	80.400		Guntur BC	0	1	1000	60.00
253	Guntur C M 3-4-330,4-2550		16.250	80.400		Guntur Br.			1600	72.00
254	Guntur C M 6-5-0,6-7-330		16.350	80.150		Guntur Br.			1400	63.00
255	Guntur-6		16.350	80.417		Guntur BC		5	3000	135.00
256	Guntur-7		16.400	80.050		Guntur BC		4	1000	60.00
257	Guntur-8		16.317	80.533		Guntur BC		6	1500	67.50
258	Ithamukkala-1		15.433	81.333		Ithamukkala		3	200	15.00
259	Ithamukkala-2		15.400	80.700		Ithamukkala		3	100	7.50
260	Ithamukkala-3		15.317	80.050		Ithamukkala		8	200	15.00
261	Ithamukkala-4		15.367	80.083		Ithamukkala		6	150	11.25
262	Kakatiya infall		18.483	79.100		Kakatiya		7	3000	135.00
263	Kandaleru		17.717	81.383		Kandaleru(river		24	6000	225.00
264	Kty(D53)-1		18.850	79.433		Canal (D-53)		7	1050	47.25
265	Kty(D53)-10		18.783	79.517		Canal (D-53)		14	100	7.50
266	Kty(D53)-11		18.733	79.633		Canal (D-53)		5	10	0.75
267	Kty(D53)-2		18.517	79.767		Canal (D-53)		10	1500	67.50

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268	Kty(D53)-3		18.583	79.717		Canal (D-53)		15	1400	63.00
269	Kty(D53)-4		18.050	79.683		Canal (D-53)		8	600	36.00
270	Kty(D53)-5		18.083	79.283		Canal (D-53)		14	1000	60.00
271	Kty(D53)-6		18.817	79.033		Canal (D-53)		3	300	22.50
272	Kty(D53)-7		18.800	79.250		Canal (D-53)		16	1050	47.25
273	Kty(D53)-8		18.083	79.117		Canal (D-53)		7	150	11.25
274	Kty(D53)-9		18.633	79.133		Canal (D-53)		10	100	7.50
275	Kty(D83 B)-1		18.600	79.317		Canal (D-83B)		22	1000	60.00
276	Kty(D83 B)-2		18.567	79.083		Canal (D-83B)		9	300	22.50
277	Kty(D83 B)-3		18.483	79.150		Canal (D-83B)		21	600	36.00
278	Kty(D83 B)-4		18.550	79.350		Canal (D-83B)		25	600	36.00
279	Kty(D83 B)-5		18.483	79.100		Canal (D-83B)		24	600	36.00
280	Kulla 33.87Km	Godavari E	17.450	81.933	1159	Godavari	13	2	200	15.00
281	Kuntala		17.633	81.767		Godavari/Kaddar		120	15000	562.50
282	Link Canal Scheme		16.150	82.350		Link canal(Yel		22	2000	90.00
283	Lower Manrai		16.133	81.067					3000	135.00
284	Lower Newar		16.267	81.383					3000	135.00
285	M 13-6-505,4-080,3-550	Visakhapatn	16.317	80.300	1083	Guntur Br.	15	4	1000	60.00
286	Medapadu Ch.15.1Km	Godavari E	17.083	82.117	1159	Godavari	26	3	500	37.50
287	MHS on Yeleru Res.		17.200	81.650					2250	101.25
288	Mamidipalli		18.617	83.183		Modipalli		10	300	22.50
289	Mondepulanka Ch.44.8Km	Godavari E	16.717	81.117	1159	Godavari	19	2	200	15.00
290	Mukkamala Ch.41.86Km	Godavari E	16.600	82.300	1159	Godavari	17	2	200	15.00
291	Nadipudi Ch.47.49Km	Godavari E	16.900	81.083	1159	Godavari	17	2	200	15.00
292	NS Right Canal		16.867	81.100		Bellamkonda		5	1100	49.50
293	Ongole C M 0-0, 0-3		15.350	80.100		Ongole BC			1000	60.00
294	Ongole C M 10-3-440,10 4-220		15.550	79.767		Ongole BC			500	37.50
295	Ongole C M 14-5-300		16.117	80.117		Ongole BC			1000	60.00
296	Ongole C M 10-1-000		15.550	80.017		Ongole BC	44	2	600	36.00
297	Ongole C M 10-1-440		15.717	79.133		Ongole BC	44	2	600	36.00
298	Ongole C M 13-7-110		15.483	79.900		Ongole BC	44	1	500	37.50
299	Ongole C M 14-5-211		15.183	80.033		Ongole BC	44	3	900	54.00
300	Ongole C M 1-4-550		15.083	80.717		Ongole BC	51	2	800	48.00

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301	Ongole C M 15-0-000		16.533	80.133		Ongole BC	34	2	500	37.50
302	Ongole C M 1-5-080		16.650	80.117		Ongole BC	51	2	800	48.00
303	Ongole C M 15-4-220		16.383	80.583		Ongole BC	34	1	300	22.50
304	Ongole C M 16-0-00		15.283	80.483		Ongole BC	34	2	500	37.50
305	Ongole C M 2-0-080		15.150	81.133		Ongole BC	51	2	800	48.00
306	Ongole C M 20-3-550		16.150	81.550		Ongole BC	34	1	300	22.50
307	Ongole C M 20-4-000		16.183	80.450		Ongole BC	34	1	300	22.50
308	Ongole C M 23-1-196		15.200	79.750		Ongole BC	28	2	500	37.50
309	Ongole C M 2-3-199		15.383	80.450		Ongole BC	51	7	2000	90.00
310	Ongole C M 23-4-091		16.117	80.150		Ongole BC	28	2	500	37.50
311	Ongole C M 23-5-416		16.283	81.467		Ongole BC	28	2	500	37.50
312	Ongole C M 23-7-416		15.650	80.200		Ongole BC	28	3	500	37.50
313	Ongole C M 24-0-196		16.517	80.633		Ongole BC	28	1	600	36.00
314	Ongole C M 2-4-190		16.467	80.117		Ongole BC	51	2	800	48.00
315	Ongole C M 2-4-630		15.767	81.300		Ongole BC	51	2	800	48.00
316	Ongole C M 25-2-482		15.933	81.483		Ongole BC	28	2	500	37.50
317	Ongole C M 25-4-306		15.750	79.933		Ongole BC	28	1	300	22.50
318	Ongole C M 2-6-190		15.750	80.567		Ongole BC	51	2	800	48.00
319	Ongole C M 26-2-306		15.383	80.417		Ongole BC	28	1	300	22.50
320	Ongole C M 26-4-196		16.283	79.567		Ongole BC	28	2	300	22.50
321	Ongole C M 26-6-636		16.133	80.933		Ongole BC	28	2	500	37.50
322	Ongole C M 28-3-636		16.400	80.367		Ongole BC	28	1	300	22.50
323	Ongole C M 28-4-447		16.550	80.567		Ongole BC	28	2	500	37.50
324	Ongole C M 28-6-086		15.917	80.750		Ongole BC	28	2	300	22.50
325	Ongole C M 31-4-446		15.200	79.717		Ongole BC	16	1	300	22.50
326	Ongole C M 31-5-226		15.250	79.717		Ongole BC	16	1	300	22.50
327	Ongole C M 31-6-060		16.550	79.033		Ongole BC	16	1	300	22.50
328	Ongole C M 31-6-236		16.300	79.900		Ongole BC	16	1	300	22.50
329	Ongole C M 31-7-226		15.150	80.217		Ongole BC	16	1	300	22.50
330	Ongole C M 3-2-604		16.483	80.217		Ongole BC	51	1	500	37.50
331	Ongole C M 3-4-130		15.067	80.317		Ongole BC	51	1	500	37.50
332	Ongole C M 4-5-630		15.050	80.567		Ongole BC	51	1	500	37.50
333	Ongole C M 4-6-410		15.133	80.517		Ongole BC	51	1	500	37.50

Sl no.	Project Name	Dist.Name	DD_Lat	DD_Long	Annual Rainfall (mm)	canal\river	Discharge (m^3/sec)	Head (m)	Capacity (kw)	Cost of the Project in Crore
334	Ongole C M1-0-180,4-550,5-00	Prakasham	15.650	81.383	751	Ongole BC			1000	60.00
335	Ongole C M13-3-330	Visakhapatn	16.550	80.383	1083	Ongole	44	2	800	48.00
336	Ongole C M15-7-438,0-0,6-603,16-2-330	Visakhapatn	15.350	80.533	1083	Ongole	12	3	250	18.75
337	Ongole C M23-0-386,0-191,3-146,4-471	Visakhapatn	16.467	80.350	1083	Ongole	6	5	250	18.75
338	Ongole C M24-4-110,3-550,6-000	Visakhapatn	15.350	80.650	1083	Ongole	11	2	200	15.00
339	Ongole C M25-3-015,2-482,3-427	Visakhapatn	15.600	80.217	1083	Ongole	6	3	125	9.38
340	Ongole C M26-2-042,1-520,2-310,3-310	Visakhapatn	15.717	80.750	1083	Ongole	5	4	150	11.25
341	Ongole C M28-3-519,3-337,4-447,5-447	Visakhapatn	16.300	80.567	1083	Ongole	5	4	150	11.25
342	Ongole C M31-2-066,3-508,4-288,4-615,5-395,6-175,7-065	Visakhapatn	16.117	80.383	1083	Ongole	4	7	200	15.00
343	Ongole C M3-3-176,3-004,4-140	Visakhapatn	15.583	80.567	1083	Ongole	12	2	400	30.00
344	Ongole C M4-6-169,6-030,6-580	Visakhapatn	16.300	80.250	1083	Ongole	12	2	400	30.00
345	Ongole-1		15.383	80.750		Ongole Br		11	4000	180.00
346	Ongole-10		15.050	80.867		Ongole Br		7	200	15.00
347	Ongole-2		15.700	80.550		Ongole Br		5	2000	90.00
348	Ongole-3		15.417	80.133		Ongole Br		4	500	37.50
349	Ongole-4		15.417	81.350		Ongole Br		4	1000	60.00
350	Ongole-5		15.650	80.017		Ongole Br		3	250	18.75
351	Ongole-6		15.350	80.383		Ongole Br		6	250	18.75
352	Ongole-7		15.550	80.100		Ongole Br		4	150	11.25
353	Ongole-8		15.617	80.617		Ongole Br		3	700	42.00
354	Ongole-9		15.600	80.100		Ongole Br		5	150	11.25
355	Paleru Res.		17.033	25.417		Nagarjun S.L.C.		4.5-7.	5000	225.00
356	Peddagdda Stream		18.450	83.100					200	15.00

l no.	Project Name	Dist.Name	DD_Lat	DD_Long	Annual Rainfall (mm)	canal\river	Discharge (m^3/sec)	Head (m)	Capacity (kw)	Cost of the Project in Crores
357	Pedderu Reservoir	Visakhapatn	17.900	83.150	1083	K Canal	2	9	150	11.25
358	Polvaram(L)		17.400	81.567		Godavari		5	9000	337.50
359	Polvaram(R)		17.450	81.050		Godavari		5	10500	393.75
360	Ramgundam-NTPC		17.433	81.383					500	37.50
361	SRBC		16.100	77.967		Srisailam RBC	63	11	6000	225.00
362	Sri Pothuluri		14.950	77.967		Pennar/Jamniva nka		21	9000	337.50
363	SRSP Kakatiya		18.417	79.100		Canal (D-83)		4	700	42.00
364	SRSP Kakatiya		18.400	79.017		Canal (D-83)		7	1000	60.00
365	SRSP Kakatiya		18.417	79.150		Canal (D-83)		3	690	41.40
366	SRSP Kakatiya		18.450	79.250		Canal (D-83)		6	1500	67.50
367	SRSP Kakatiya		18.467	79.183		Canal (D-83)		5	1500	67.50
368	SRSP Kakatiya		18.483	79.100		Canal (D-83)		4	1300	58.50
369	SRSP Kakatiya		18.300	79.217		Canal (D-83)		3	1500	67.50
370	Sunkesala		15.633	77.850		K Canal	46	4	1500	67.50
371	Telegu Ganga		17.700	18.400		Kandaleru		12	6000	225.00
372	Throvagonta-1		17.467	82.017		Throvangonta		9	500	37.50
373	Throvagonta-2		17.417	82.033		Throvangonta		17	700	42.00
374	Tossipudi Ch.25.15Km	Godavari E	17.383	82.067	1159	Godavari	14	2	200	15.00
375	Tungbhadra Barrage		17.350	82.067		KC Canal		4	1500	67.50
376	Vella Ch.41.47Km	Godavari E	17.300	82.083	1159	Godavari	9	2	200	15.00
377	Western Delta Ch.D-83	Godavari W	17.033	80.133	1076	Godavari	164	2	2000	90.00
									250495	

Table 7.2 Commissioned Biomass Plants in Andhra Pradesh State

Sl.No.	Name Of the Developer	Latt	Long	Capacity (MW)	Cost of the Project in Cr.
1	Gowthami Solvent Oil Ltd, P.B.No. 1, Pydiparru, Tanuku -534211, West Godavari	16.752	81.694	2.750	11.000
2	Vamshi Industries Ltd, Plot No. 226, Road No. 78, Phase, III. Jubilee Hills,	16.880	81.934	4.000	16.000
3	Sudha Agro Oil & Chemical Industries ltd, P.B.No.9, Samalkot-533440, East	17.055	82.184	4.000	16.000
4	Perpetual Energy Systems Ltd, 3-5-821, Flat No. 104, 1st floor, Doshi ford	17.199	80.966	6.000	24.000
5	Jocil Limited, P.B.No 2 16, Arundalpet, Guntur- 522002 Ph:0863-2290191/192	15.769	78.299	6.000	24.000
6	, RayaJaseema Green Energy Ltd, Street No.3, Ashok Nagar, Hyderabad-500020	15.846	78.152	5.500	22.000
7	Harsha Power Projects (P) Ltd, 1-9-52/E/8, Ramnagar, Hyderabad- 48. Ph:	18.043	78.254	1.000	4.000
8	, Gayatri Agro Industrial power Ltd, 8-2-348/1, Ground floor, Flora	17.161	79.631	6.000	24.000
9	Ind - Barath Energies Ltd, PlotNo.30 A, 1st floor, Road No. 1, Filmnagar,	16.860	79.571	6.000	24.000
10	Jyothi Bio Energy Ltd, 307, Liberty Plaza, Basheerbagh, Hyderabad -64 Ph: 040	79.710	15.160	10.500	42.000
11	HCL Agro power Ltd, Amrutha Ville, Plat No. 117, left wing, 6-3-1091/13 to 15	16.889	80.096	6.000	24.000
12	Roshni Power Tech Ltd, E-506/507, Keerthi Apts, Ameerpet, Hyderabad-73 , Ph:	16.699	80.368	6.000	24.000
13	SLS Power Ltd, 3/336, Laxmipuram, Nellore - 524002, Ph: 0861-2313596/2314922	14.482	79.918	6.000	24.000
14	Gowthami Bio Energies Ltd, Gopalapuram (V), Khammam-507002, Ph: 08742-2347	17.102	81.576	6.000	24.000
15	Matrix Power (P) Ltd, PoltNo.33,No.257, Road No. 2, Banjara Hills, Hyderabad-	16.428	79.730	4.500	18.000
16	Varam Power Projects (P) Ltd, D.No, 8-4- 120/3; Raja complex, G.T.Road,	18.292	83.902	4.000	16.000
17	Satyakala power projects (P) Ltd, Ganguru (V), Penamaluru (M), Krishna dist -	18.756	81.024	4.000	16.000
18	My Hoinc power Ltd,Floor, My Home Jupally, ameerpet, Hyderabad -16, Ph: 040-	17.530	78.272	8.000	32.000
19	Vijay Agro products (P) Ltd, Enikepadu, Vijayawada, Krishna district Ph: 0866-	16.541	80.679	4.000	16.000
20	K.M. S. Power (P)Ltd, 247,2nd floor, Dwarakapuri Colony, Panjagutta, Hyd-82.	16.400	80.500	6.000	24.000
21	Rithwik Energy Systems Ltd, "LANCO HOUSE" avenue 8, L.V.Prasad Marg, Banjara	13.754	79.701	6.000	24.000
22	Shalivahana Projects Ltd Minerva House -94, Secunderabad - 5000003 Ph: 040-	18.872	79.450	6.000	24.000
23	Rithwik Power Projects Ltd, Plot No. 91/B, Sagar Society, Road No. 2, Banjara	17.245	80.152	6.000	24.000
24	Veeraiah, Non- Conventional Power Projects Ltd, Kuramaddali-521301, Pamarru	16.325	80.961	4.000	16.000
25	Sri Kalyani Agro Products & Industries Ltd,. Prathipadu (V), Pentapadu (M),	16.186	80.338	4.000	16.000
26	Suchand Power gen (p) Ltd, C/o Turbo Machinery, Chandanagar, Hyd 50, Ph:	15.531	78.521	6.000	24.000
27	Indur Green Power (P) Ltd, 3-5-821, 1st floor, Doshi Ford Building, Hyderguda,	18.790	78.130	6.000	24.000
28	Shree Papers Ltd, 76-1-17 A3&4, Akhil Apartments, Danavaipet Rajhamundry -533	17.080	82.145	4.000	16.000
29	Saro Power & Infrastructures Ltd, Magnuru (V), Mahabubnagar Dt.	78.070	16.050	6.000	24.000
30	Sree Rayalaseema Hi-Strength Hypo Ltd, H.No. 6-2-1012, 2Ilcf floor,	16.071	77.684	6.000	24.000
31	B.Seenaiah & Company (projects) Ltd, Progressive Towers, 5th floor, 6-2-	14.377	79.721	6.000	24.000
32	Agri Gold Projects Ltd. 40-1-21/21,4* floor, catholic Complex, M.G. Road,	15.917	79.365	4.000	16.000
33	Balaji Agro Oils Ltd, D. No 74-2-19, Old Check Post Centre (Near), Krishnagar,	16.453	80.786	4.500	18.000
34	Clarion Power Corpn. Ltd, "LANCO HOUSE" 141, Avenue - 8, Road No. 2, Banjara	15 351	80 048	12.000	48.000
35	m Shakti Renergies Ltd, 16-1 1-20/F, Post office lane, malakpet, Hyderabad -	12 836	78 466	6.000	24.000
36	Sri Balaji Biomass Projects (P) Ltd, H.No, 1-8-50/2/4/1, plot No. 32,	14 565	78 801	6.000	24.000
37	Satyamaharshi Power Corpn. Ltd, H.No. 3-6-6 12, 3rd floor, Himayat Nagar,	16.000	79.620	6.000	24.000

TABLE 7.3: Biomass Future Sites in Andhra Pradesh State

S.NO	Name Of the Developer	Latt	Long	Capacity (MW)	Cost of the Project in Cores
1	Mata Energy Ltd, Flat -503, Topaz building, Amrutha Hil	16.819	79.932	6.00	24.00
2	Pinakini Power Projects (P) Ltd, 206, Indralok Complex,	14.070	79.905	6.00	24.00
3	Singaraya Hills Green Power Genco(P)Ltd., 49-292, PlotN	15.917	79.366	6.00	24.00
4	R.R. Bio Energy Ltd.; Plot No, 39, Ianc-1, Street No. 3	16.918	81.350	12.00	48.00
5	Budda Deva Power Ltd, 1-2-80/1/A, Street No. 1, kakatiya	17.284	79.100	6.00	24.00
6	Lepakshi Power Projects Ltd. 305, Badam Sohara apts, Ra	13.717	77.383	6.00	24.00
7	Sainath Power Concepts (P) Lid, Plol No, 5, Progressive	19.106	78.350	6.00	24.00
8	Venkatraya Fibers (P) Ltd, 210, Ti aim al a Apartmetns,	16.843	78.027	6.000	24.00
9	Sri Anantha Laxmi Biomass Power projects (P) Ltd, 4/82	16.062	80.157	6.000	24.00
10	Vani power Projects (P) Ltd, Plot No. 16, phase I Kamala	16.223	80.664	4.500	18.00
11	Velagapudi Power Generation (P Ltd, H.No. 74-2- 12a, Ash	16.184	80.338	4.000	16.00
12	Coastal Agro Industries Ltd, P.B. No. 27, Tanuku-534221	17.023	81.431	4.000	16.00
	Total in MW.			**72.50**	

TABLE 7.4: Biogasse Cogeneration Commissioned Sites in Andhra Pradesh					
SI.No.	Name Of the Developer	Latt	Long	Capacity(MW)	Cost of the Project in Cr.
1	Sudalagunta Sugars Ltd, 209, T.P.Area, Tirupathi-517501.	13.753	79.704	8.000	32.000
2	Nava Baharath Ferro Alloys Ltd, Nava Baharat Chambers, 63- 1109/1,2ad tloor	17.055	82.182	5.000	20.000
3	Gayatri Sugars Ltd, 6-3-663/E, Diamond House,Behlnd Topaz Building, Hydera	18.741	78.240	9.000	36.000
4	GMR Industries Ltd, 6-3-866/868, Green lands, tBegumpet, Hyd-16. Ph: 23410	18.413	83.907	16.000	64.000
5	Andhra Sugars Etd, Venkatrayapurarn, Tanuku-534215, West Godavari district	16.751	81.694	7.000	28.000
6	The Etikoppaka Co-op, Agrl, & Industrial Society Ltd, etikoppaka-531082, v	18.057	82.984	4.500	18.000
7	Ganapati Sugars Industries Ltd, 8-2-438/3, Road No.-4, Banjara -Hills, Hyd	17.665	78.112	15.000	60.000
8	Kakatiya Cement Sugars & Industries Ltd, H-No. 1-10-140/1, "GURUKRIIPA" As	17.201	80.598	17.000	68.000
9	Sagar Sugars & Allied Products Ltd, Rayala TowersJInd tloor781, Anna Salai	13.207	79.044	20.000	80.000
10	The Chodavararn Co-Op. Sugars Ltd, Govada-531023 Vishakapatnam district	17.441	81.780	14.000	56.000
11	Shree vani sugars & Industries Ltd. Mudipapanapalli(V), sugalimetta (post)	13.388	78.581	6.000	24.000
12	Gayatri Sugars complec Ltd, Prabhagiripatnam (V), Podalkur (M), Nellore Dt	14.378	79.721	6.000	24.000
13	Jeypore Sugars Company Ltd, Chagallu_534342, West Godavari Dt, Ph:08813-71	16.985	81.667	12.000	48.000
14	M/S Anand Khandasari Sugars Mills, 15-9-358/9 Muthyargunj, Hyderabad-50001	19.099	78.168	0.750	3.000
				140.250	

TABLE 7.5: Future Biogasse Cogereneration Sites					
SI.No.	Name Of the Developer	Latt	Long	Capacity in MW	Cost of the Project in Cr.
1	Ernpee Power Company (India) Ltd, 693, Mount Road, Chennai-600006.	13.899	79.931	20.00	80.000
2	Sri Sarvaraya Sugars Ltd, Chelluru- 533261, East Godavarı Dıstrıct, Ph; 08857-4	17.673	81.96	14.000	56.000
3	Gayatri Sugars Complex Ltd, Prabhagıripatnarn (V), Podalkur (M) Nellore distrıc	14.377	79.721	22.000	88.000
4	K.C.P. Sugars & Industrıes Corpn. Ltd, Rama Krıshna Buildıngs, P.B. No. 727, No	16.363	80.852	20.000	80.000
5	Nizam Deccan Sugar Ltd 6-3-570/1, 201,Dıomond block, Rookdale Compound, Somajig	18.642	77.886	20.000	80.000
6	The Kovur Co-Op, Sugar Factory Ltd, Kovur, Nellore Dıstıict, Ph:08622-71 129,71	14.334	79.775	3.000	12.000
	Total in MW			99.00	

TABLE 7.6: Wind Commissioned Sites in Andhra Pradesh

SI No	Location Of the plant	Name of District	Long.	Latt.	Capacity (MW)	Cost of the Project in Crores in Crores
1	Ramgiri	Anantapur	77.39	14.13	49.47	17.50
2	Thallimadugula	Anantapur	77.94	13.86	5.00	141.26
3	Kodavakallu	Anantapur	77.67	13.48	40.36	8.75
4	Narasimhakonda	Nellore	79.63	13.89	2.50	74.03
5	Kondameena Palli	Kurnool	77.39	15.04	21.15	21.00
6	Kakulakonda	Chittor	79.04	13.03	6.00	1.12
7	Thrimula	Chittor	78.87	12.62	0.32	436.80
		TOTAL CAPACITY IN MW			124.80	

TABLE 7.7: Wind Identified Sites in Andhra Pradesh State

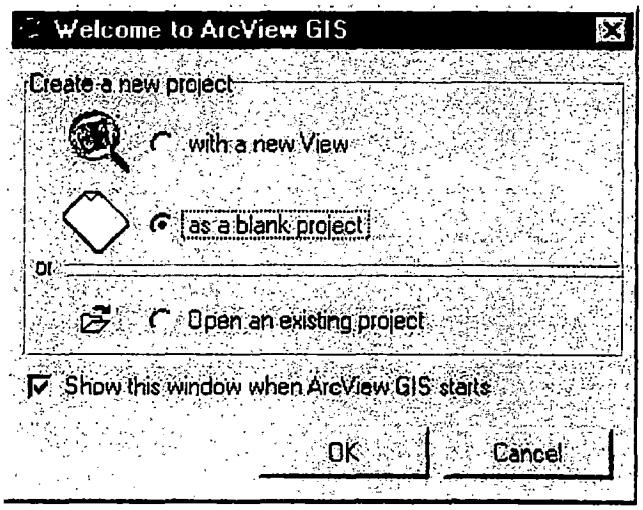
Sl. No.	Station	District	LATT	LONG	WPD at 50 m at Mast Location (W/m^2)	Estimated Potential (MW)	Cost of the Project in Crores in Crores
1	Bhimunipatnam	Vishokapatnam	17.420	82.310	282	18.7	74.800
2	Jamalamadugu	Cuddapah	14.49	78.23	265	38.4	153.600
3	Kadavakallu	Ananthapur	14.583	77.633	325	30.2	120.800
4	Kondamithipalle	Kurnool	15.060	77.950	349	52.7	210.800
5	M.P.R. Dam	Ananthapur	14.54	77.25	269	20.7	82.800
6	Nollakonda	Ananthapur	14.7	77.34	324	29.9	119.600
7	Nazirabad	Rangareddy	16.45	79.140	232	1.9	7.600
8	Pampanoorthanda	Ananthapur	13.980	77.120	232	4.4	17.600
9	Ramagiri	Ananthapur	14.22	77.32	308	31.9	127.600
10	Thirumalaypalli	Cuddapah	13.4	79.22	285	34.9	139.600
11	Vajrakarur	Ananthapur	14.24	77.33	243	678.7	2714.800
					Total	942.4	

Chapter-8

USER MANNUAL

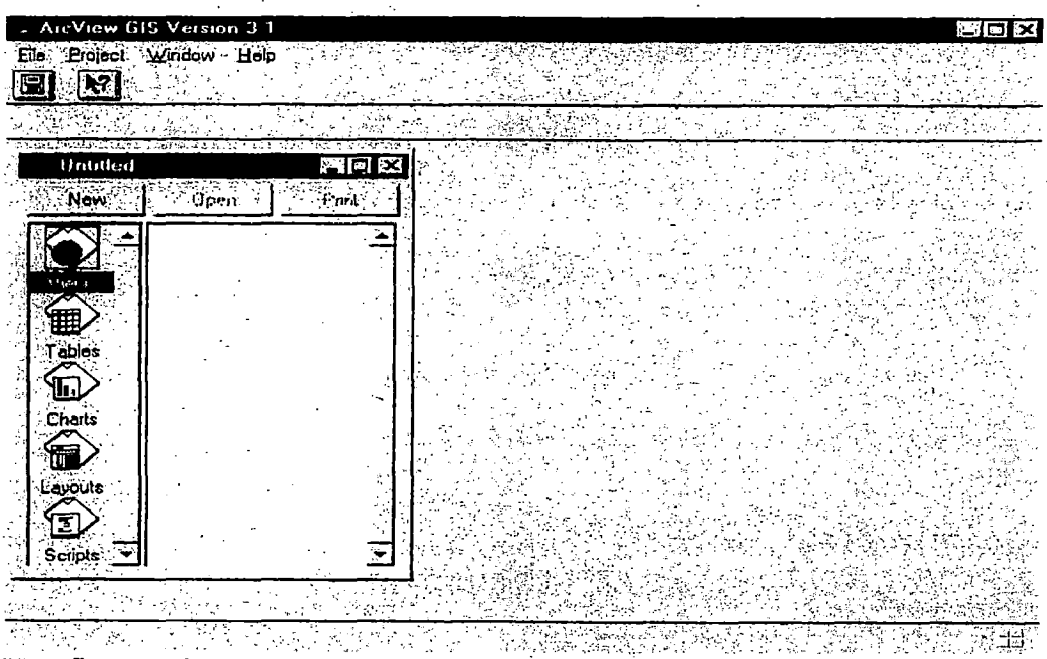
8.0 OPENING ARC VIEW AND ADDING THEMES

Start ArcView from the Start - Programs menu (look under ESRI or ArcView 3.2 or ArcView 3.1).



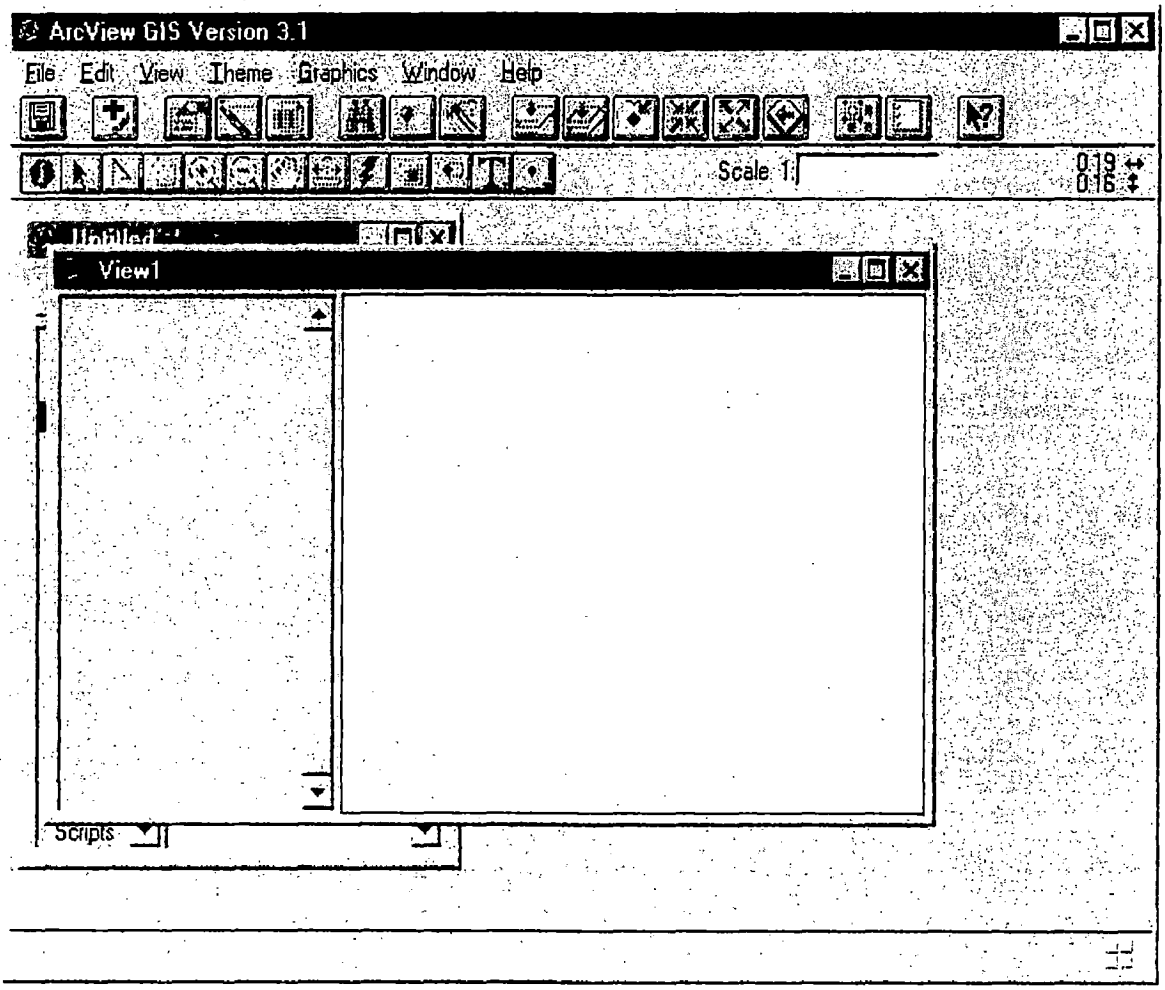
If asked, choose the option: Create a New Project - as a Blank Project

You should now see the blank project screen with the project menu across the top:

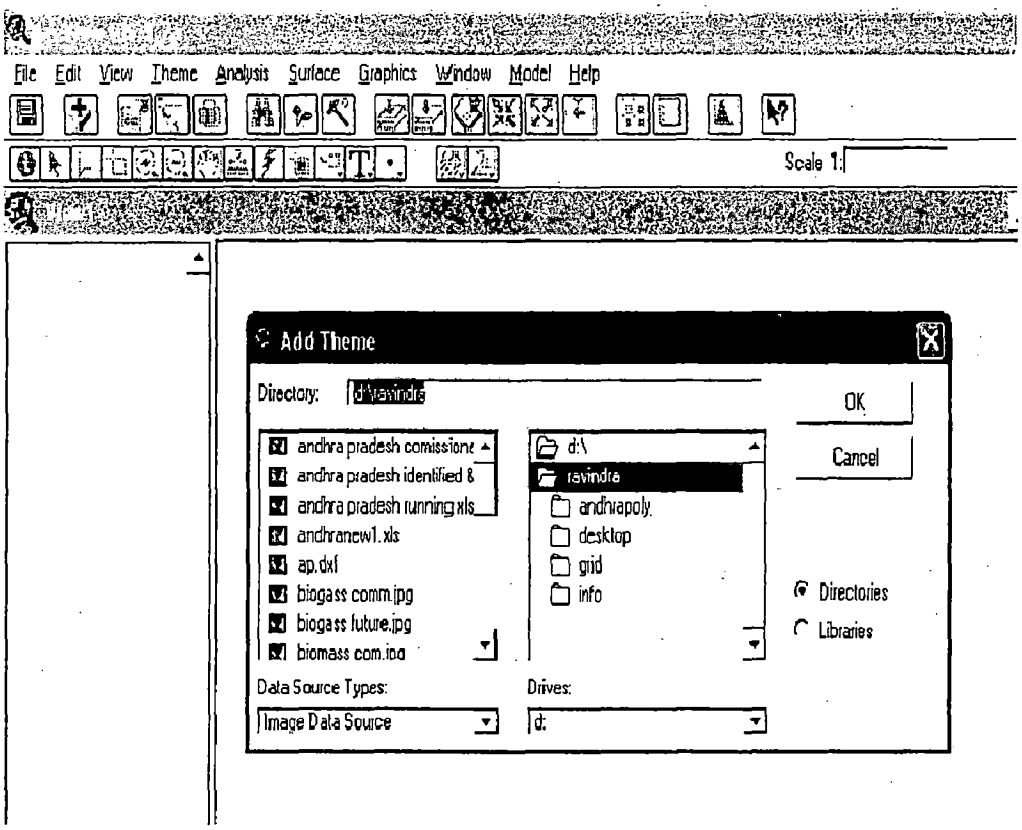


You first need to create a **View**, then **add GIS themes** to this view.

Click on the View icon and choose New - a View 1 window (called a View document) will appear together with a new menu interface across the top - this is the View document menu.



Choose **View**, then **Add Theme** (or click on Add Theme icon:( ) Navigate to where you copied the ravindra folder and double-click on it. You should see a list of files ending in .shp on the left side of the directory navigation box. These are called "shape" files and are all of the Data Source Type: Feature Data Source (see bottom left of navigation box)



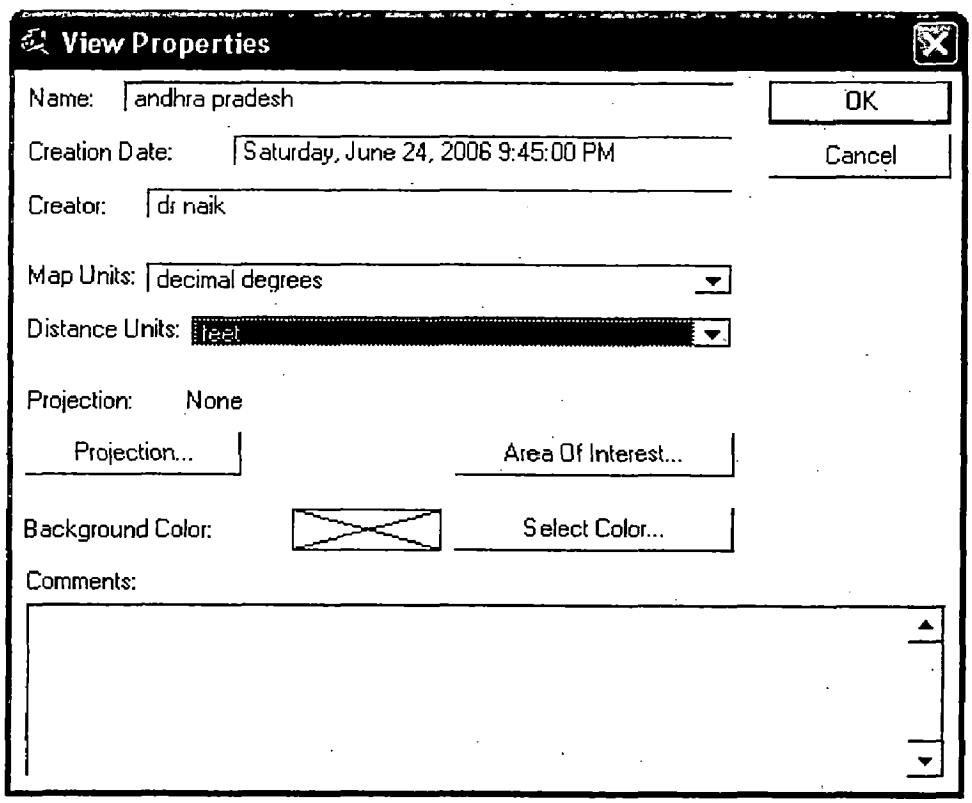
Scroll down the list of shape files to see what is there. You can select one file by clicking on it and pressing OK, or select multiple files by holding down the shift key and clicking on several files. Press **OK** when you have made your selection (for this ravindra, choose at Andhra Pradesh commissioned.dbf, Andhra Pradesh identified.dbf, ap.dxf). These files (called themes in ArcView) will appear in your view's legend but nothing will appear on the screen until you click on the box by each theme. Do this now. If you like, maximize both the ArcView program window and the View window to get a better look at these themes.

To load an image file (e.g., an aerial ortho-photo) click the Add Theme icon ( ) but this time make the Data Source Type (bottom left) an Image Data Source. Click on the Andhra running.shp from your ravindra folder and press OK. To make the orthophoto show up below the other themes, click on its name in the Legend and drag it to the bottom of the list. (Note: if your orthophoto shows up as strange colors and does not look like an aerial photo, double-click on the orthophoto's name in the legend. This

brings up the **Image Legend Editor**. Click on the **Colormap** button. On the next dialog box, click on the **Gray** button, then press **Apply**. Sometimes the black and white orthophotos try to display as color photos, and this process tells them to go back to gray scale. The orthophoto should appear as a legible photo now.) Before you go on, set the View properties. This is very important for correct measuring and scaling.

8.1 SETTING THE VIEW PROPERTIES

1. Choose View-Properties from the View menu
2. In the Name: box, type in a name for this View (e.g., Andhra com)
3. You can put in your name as Creator and add comments if you like
4. Set "Map Units" to the units of the map source's projection
5. Set "Distance Units" to whatever unit you would like to use as a measuring or scale unit (e.g., feet or miles) (later you can use the measuring tool and see the results in the "Distance Units" you specified. )
6. Do not tamper with the Projection button or parameters. Use this button only if your data is in decimal degrees (i.e., not projected) - the Andhra Pradesh image (ap.dxf) data is already projected into coordinates based on feet north and east of an origin point.
7. If you want to have a different background color, choose a color under the Select Color option.
8. Choose OK



Look at the View menu bar:

The scale on the right side now reads the scale of your display as a "unitless scale", e.g., 1:436,974. That means any one unit (e.g., one inch) on the screen, equals 436,974 of those same units (e.g., inches) in the real world. Standard topographic map scales are 1:24,000 and 1:100,000. Try typing 24000 into the scale, and then press Enter. Try typing 100000 into the scale and press Enter. This is one way to control the scale of your display.

The two numbers on the far right side of the menu bar are the coordinates of the cursor. The top number is the "easting" and the bottom number is the "northing". The easting coordinate is measuring the number of feet east of a zero origin and the northing coordinate is measuring the number of feet north of the zero origin. This zero origin is somewhere way off the map to the bottom left. Many city maps and all topographic

maps will show you easting and northing coordinates. If you ever add a theme that should come up right on top of these themes but nothing appears, that means the theme is probably in a different coordinate system. (See Using the Projector Extension in ArcView to Project Coverages to a Different Projection).

Click on the Zoom to Full Extent icon to go back to the full view. You can also change the scale using the Zoom in icon. After selecting this icon, click and hold the mouse key upper right corner of the area on which you want to focus, then drag the mouse down to the lower left corner to define a "zoom-in" box. To zoom out, choose the Zoom Out icon and define another box - the display currently on view will be squeezed into the box you have defined.

- The Pan icon () allows you to pan the view in any direction - just click and hold the mouse key as you drag it across the screen.
- The Zoom to Previous Extent icon () will take you back up through the previous few views you had.

You can use the measuring tool () to measure distance along a line that you draw on the screen. The resulting measurement of each segment you draw and the total measurement of all the segments are displayed in the bottom left corner of the View window, in the units you specified as "distance units" under View properties. If you want to get attribute information about a particular feature (e.g., land use), click on the theme's name in the legend to make it the active theme, then click on the Get Information icon  then click on a particular feature in the view. A small dialog box with the attribute items for that feature should appear (it may take a few seconds). To see the entire database table for a theme, click on the theme's name in the legend to

make it the active theme, then click on the Table icon (). Close the table when finished.

8.2 CREATING A LAYOUT IN ARC VIEW

In Arc View, layouts are maps you create for printing (or other media like slides, digital graphics, etc.). Here is a simple example. A layout will contain not only your map view, but also title, legend, north arrow, other text information, and even other graphics like charts or photos. Using a layout, you can produce some very high quality and impressive presentation graphics.

For detailed directions regarding how to create layouts, the best source is ArcView's online help (go to the **Help** menu and choose **Help Topics**, click on the **Contents** tab, then go to

8.2.1 Laying Out and Printing Maps

Before you begin a layout, make sure your View has all the themes you want to map and in the colors you want to use. You can change these later as needed, but it's easier to have them more or less as you want them before you begin a layout. Also make sure your View Properties are set, especially the View's name, the Map Units (set to feet) and Distance Units (whatever unit you want to use in measuring, probably feet or miles). A layout is attached to a particular view. If you are going to be creating multiple layouts (e.g., one for streets and the ortho-photo, another for land use, another for zoning, etc.), it is wise to also create multiple views, with each view only displaying the themes you want to show in a particular layout. To do this, you can simply go back to the Project Window (the main ArcView Window - picture of project window) and double-click on the View icon to create a new view. Then you can add themes to this view, or if you already have the themes displayed the way you like them in your

original view, you can select them in the original view (click on their names in the View Legend, holding the shift key down to select multiple themes), then choose Edit - Copy. Go to the new view and choose Edit - Paste. Remember to set your View Properties for the new view, including map units (feet), distance units (your choice), and a name.

To start a new layout from scratch, go to your Project window (picture of project window) . Your Project window is the main ArcView window that first comes up when you start ArcView. To return to it, close, minimize or move your View window and any other windows you have open. Your project window has icons for all the various documents you can create with ArcView, including Views, Tables, Charts, Layouts and Scripts.

Double-click on the layout icon to create a new layout window. A picture of a blank page appears. Maximize this layout window so you have plenty of space.

8.2.2 Page Size Settings

That will determine how you fit the other things onto your layout (map, title, etc.). If you wait to set page size until after you have put a lot of things on the layout, you will end up having to readjust things and possibly re-add them. To set up the page size, choose **Layout** from the menu, then **Page Set Up**. Choose a **Paper Size** and **Orientation**. If you are printing aerial photos, set the Resolution to High Quality (for best output of photos, you may want to use photo quality paper as well). You can fill in other options as well here but these are the essentials. Press OK when finished.

If you are going to export the layout to display on a web page or other digital graphic (e.g., for a PowerPoint presentation) make your "page" size small, no more

than 8x6, and probably smaller. Otherwise, an online viewer will have to scroll up and down and across to see the whole layout.

To see the full page in its new dimensions, choose **Layout - Zoom to Page**. You can give your layout a name by choosing **Layout - Properties**. This is especially useful if you are going to be creating more than one map, since the default names of Layout1, Layout2, Layout3, etc. can get confusing.

8.3 CREATING A SUBSET THEME OF A LARGER THEME IN ARC VIEW

Our local data sets are large files and can take more time to display than you care to wait. You can create separate subsets of a theme and save it to your own directory, so that you not only save time but have copies of your own to modify and use (I don't want you editing the original data sets).

There are two methods you can use. One is to select a portion of an existing shape file and convert that to a new shape file. The other is to clip an existing shape file by using another polygon shape file (like using a cookie cutter) to create a new shape file. If you use the selection method, you will come out with entire features, e.g., entire parcels, or entire road segments, so some of these may extend beyond the area you want. If you use the clip method, all features are clipped at the border of the cookie cutter. This has the advantage of not including anything outside your area of interest but the disadvantage of chopping some features up which perhaps should not be chopped (e.g., parcels).

8.4 TO CREATE SMALLER SUBSET THEMES OF LARGE THEMES

Subset theme by selection one theme at a time, so you will have to go through these steps for each theme. To create a subset of a theme:

1. In the view legend, click on the theme that you want to have in your subset file - this makes this the active theme, so that all other actions (selecting, displaying, etc.) relate to that particular theme.
2. Select the features of that theme that you want to have in your subset file. You can use any of ArcView's selecting tools - to learn about these go to the Help menu in ArcView, choose Help Topics, click on the Index tab and type in "selecting" and in the resulting list choose "selecting features on a view". (The easiest way to select features is to use the "selecting box" - fourth icon from the right on the bottom row of view menu icons)
3. With only the features you want selected, go to the Theme menu and choose Convert to Shape File
4. When prompted with the file management dialog box, navigate to the drive and directory where you want to save this data, and give it a name.
5. You will be asked if you want to add this new shape file to a view - answer yes.
6. You can now delete the larger shape file from your view and work with the subset.

8.5 WORKING WITH TABLES IN AND OUT OF ARCVIEW

- Overview
- Exporting data from ArcView to a spreadsheet or database program
- Using data from a spreadsheet or database in ArcView
- Manipulating fields so that they will join in ArcView
- How to determine field types and other properties in ArcView

8.5.1 Overview

Attributes for ArcView data sets depend on what type of geographic data set you are using:

Geographic Data Set	Attributes are stored in:
Arc\Info coverage	info directory
ArcView shape file	dBase (.dbf) file

8.5.2 To export data from ArcView to a spreadsheet

If your attribute data is already in dBase format (e.g., for building attributes, you have a building.dbf file), you can bring that file directly up in most spreadsheet and database programs. A theme based on a shape file (.shp) stores its attributes in a dBase file (.dbf)

Attributes stored in an INFO directory cannot be brought up directly in a spreadsheet or database. You must export this data to dBase first. If your attribute data is in INFO format (e.g., for buildings, you have a Arc/Info-style coverage in which there is a buildings directory with an accompanying INFO directory), you can export the attribute data into dBase by:

1. Adding the theme to a view and making it the active theme (e.g., buildings)
2. Opening the theme attribute table (e.g., attributes of buildings)
3. Select FILE-EXPORT from the Table menu and choose dBase format
4. Choose a location and name for the new file (e.g., buildings.dbf in your personal directory)

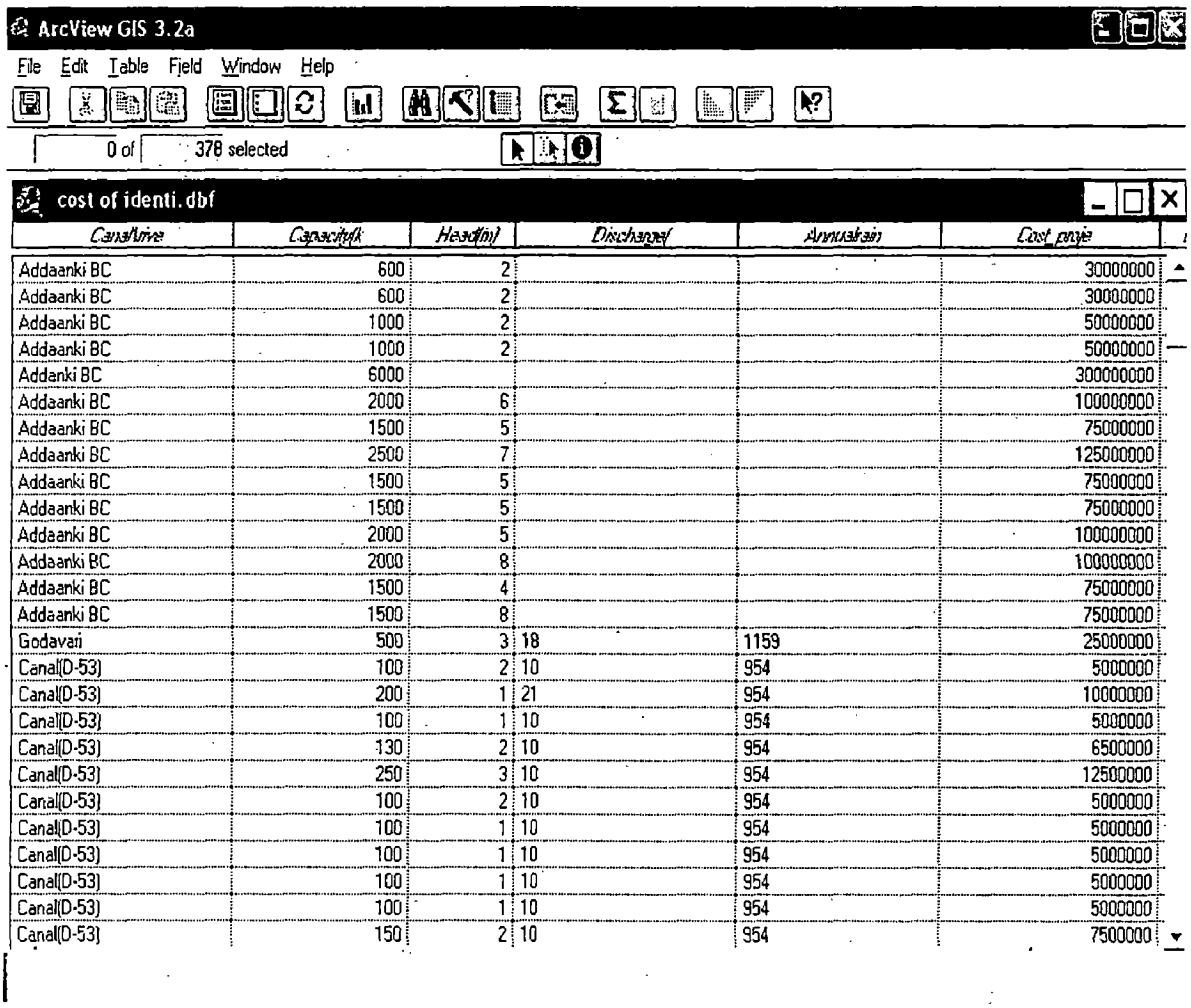
8.5.3 Using data from a spreadsheet or database in ArcView

rcView uses dBase files directly without any special import. Most spreadsheet and database programs can save files in dBase format (usually you choose File-Save, then choose dBase (.dbf) as the format. If given a choice, choose dBaseIV. Before doing this, make sure your field names are dBase compliant: 10 characters maximum in length, no spaces.

See Saving Excel files in dBase format for specific information about doing this in Excel.

8.5.4 Manipulating fields so that they will join in Arc View

To join two tables in ArcView, you must have one field shared in common. The field name can be different in each table, but the field type must be the same and the field values must match. For example, to join a table with STF3 census data at the block group level to our 1990Census blockgroup theme attribute table, you must find a field they share in common. In the example below, the STF3 table is on the right (320newb.dbf). The field most closely shared in common is the Name field in the "Attributes of Blkgrp" table and the Id field in the "320newb.dbf" table. However the later has a "BG" in front of the block-group ID. Before you can join, you must get rid of this so that the fields match up exactly. At this point we are also unsure if the field type is the same (to do this, see How to determine field types and other properties in ArcView).



Canal_line	Capacity(c	Head(m)	Discharge	Annualrain	Cost_proje
Addaanki BC	600	2			30000000
Addaanki BC	600	2			30000000
Addaanki BC	1000	2			50000000
Addaanki BC	1000	2			50000000
Addanki BC	6000				300000000
Addaanki BC	2000	6			100000000
Addaanki BC	1500	5			75000000
Addaanki BC	2500	7			125000000
Addaanki BC	1500	5			75000000
Addaanki BC	1500	5			75000000
Addaanki BC	2000	5			100000000
Addaanki BC	2000	8			100000000
Addaanki BC	1500	4			75000000
Addaanki BC	1500	8			75000000
Godavari	500	3	18	1159	25000000
Canal(D-53)	100	2	10	954	5000000
Canal(D-53)	200	1	21	954	10000000
Canal(D-53)	100	1	10	954	5000000
Canal(D-53)	130	2	10	954	6500000
Canal(D-53)	250	3	10	954	12500000
Canal(D-53)	100	2	10	954	5000000
Canal(D-53)	100	1	10	954	5000000
Canal(D-53)	100	1	10	954	5000000
Canal(D-53)	100	1	10	954	5000000
Canal(D-53)	100	1	10	954	5000000
Canal(D-53)	150	2	10	954	7500000

To manipulate the field values in ArcView, you can do the following, using the "investigated/identified.dbf" example above:

1. Open the the " investigated/identified.dbf " table and make it the active table
2. Choose Table-Start Editing from the Table Menu
3. Add a new field (Edit-Add Field). Call it Name, make it a string type field and make it 13 characters in width (so that it will include all 13 characters, including the decimal point after we have lopped off the "BG")
4. Select all the records in " investigated/identified.dbf " (Edit-Select All)
5. Make the new Name field the active field by clicking on Name
6. Press the calculate icon from the Table Menu (or Field-Calculate).

7. Choose [Id] from the Fields list, string from the Type list, and Right from the Requests list
8. Because you want the rightmost 13 characters, type 13 between the parentheses after Right [i.e., Right(13)]
9. Press OK - this will fill in all the records with the truncated name

8.5.5 Changing an Attribute Field from String to Number

If you have an attribute field that is string type and it needs to be numeric (e.g., parcel land values are numbers but in string format, and you want them to be true numbers) you can do the following:

1. Open the attribute table and start editing - choose **Table-Start Editing**
2. Create a new attribute field (**Edit - Add Field**) that is numeric in type. Make sure that it is wide enough to include your largest value, and that it has decimal points if needed. Click OK.
3. The new field name should be highlighted in the table (if not make sure to highlight it). Choose **Field-Calculate** or press the calculator icon ().
4. For the expression, double-click on the original field you want to change so that it shows up in the expression (e.g., [district_name]), then type the following: .AsNumber
5. Your entire expression should look like this:
   [district_name].AsNumber
6. Assuming this works and your new field is filled, stop editing and save your edits.

To go from a numeric value to a string value, you would follow the same procedure but use the expression .AsString

Note: The X-Tools extension has a function under the Table X-Tools menu called Table Structure - this will show you the structure of all the attribute fields in a table, including what type they are.

8.5.6 Calculating Area, Perimeter and Length of Shape Features

Load the great **X-Tools** extension. To load it, start ArcView, then choose **File-Extensions**. Scroll down towards the end and you will see the X-Tools extension. Check mark it and choose **OK**. Then when you have a View on display, you will see the X-Tools menu item, which includes a number of extremely useful capabilities including "Update Perimeter, Area and Length". The results give you area, perimeter and length in feet, plus area in acres (for polygons). If you need to add additional fields for different units (e.g., hectares, square miles), see the instructions below. **Important Note:** You must have write-access to the shape files to use this portion of the extension because it is editing the shape file's attribute table. The data on the box-gis server under the parmenter directory is read only, so you will have to copy the shape file(s) out to your own directory first. Also, this extension won't work if your original map units are not feet.

8.5.7 Adding additional fields for different measurement units

Once you have these native map unit geometry values calculated (e.g., feet), you can use the following method to create additional geometry fields in different units (e.g., miles):

1. Make the relevant theme active

2. Open the theme's table
3. Choose **Table-Start Editing**
4. Choose **Edit-Add Field** - add a new field which will hold the area calculation (e.g., "length-miles") and have enough characters to contain the resulting calculation
5. Choose the Calculator tool (or **Field-Calculate**) 
6. As the expression to calculate, type the expression to convert the Area, Perimeter or Length field to the new unit (e.g., if your original length was in feet and you want to convert it to miles, type **[Length] / 5280**)
7. The new calculation for each feature will be placed in this field. To save the results, choose **Table-Save Edits**
8. Choose **Table-Stop Editing**

8.5.8 Measure Distance Onscreen With The Measuring Tool In Arcview:

1. With at least one of the themes open, choose View-Properties from the View menu
2. Set "Map Units" to the units of the map source's projection (for andhra data, this is feet - for other themes you must know what projection that was used the projection parameters will specify the unit)
3. Set "Distance Units" to whatever unit you would like to use as a measuring unit (e.g., feet or miles)
4. You can use the measuring tool and see the results in the "Distance Units" you specified. 

RESULTS AND DICUSSIONS

In order to meet the power demand in the Andhra Pradesh, then modern and efficient strategies are necessary, for that,trying to fulfillment of the energy demand by using in this study **"Renewable Energy Development of Andhra Pradesh State Using GIS Software".** In this study the collection of all the data which is mainly useful for the design/development of Renewable energy that includes, small hydro power potential, wind potential, Biomass/Biogasse potential and all the rivers-canals, forest, power network maps projected in the GIS software that will give the complete look on the Renewable energy potential and the availability resources.

By using GIS software we can conclude that, which portion of Andhra Pradesh mostly recommended for the particular kind of Renewable energy development that may be small hydro, wind or Biomass/Biogass. This can only predict by the all land resources and the renewable resources which are available on the GIS map. The recommendation of renewable energy on particular area due to the water(river-canal) availability for hydro power development, wind potential-for wind energy development forest or agro-waste availability for biomass/biogass energy development that will not only depend upon the availability of resources and also depend upon the grid availability, design policies, cost economics for development of the plant, which are all discussed in my current study. By using all the data and the availability resources the energy demand or shortage of power in rural/urban areas only fulfillment by using this kind studies, and this will also help full for the private developers and the government to develop the pants phase wise. And one can take the quick decisions on the project developments.

CONCLUSIONS AND RECOMMENDATIONS

Power supply in the Andhra Pradesh state has deficit, which may further aggravate in coming years, due to fast industrial growth. Harnessing the Renewable Energy can contribute power availability to some extent specifically to the small entrepreneurs and rural sectors.

For the proposed study "**Renewable Energy Development of Andhra Pradesh Using GIS Software",** it is essential to collect geographical data, hydrological data and topographical data of renewable energy sites.

In the Present study, a database of Renewable Energy projects and availability, particularly renewable energy resources has been developed. These sources include SHP, Wind, Biomass/Biogasse, river/canals, wind intensity, power network maps the map based database. This can be used for planning and decision for renewable energy development.

The detailed information of each station/sites can be retrieved in a user friendly manner with data management queries for taking quick decisions to choose the potential site based on availability of resources.

The large potential of renewable energy could be realized quickly by facilitating the decision taken as if GIS was used as a proactive planning tool. Planning agencies identifies may create database of renewable energy sites using GIS software and make that information available to prospective developers.

The use of GIS is constantly becoming popular and is increasing its presence by a various of professional use. While use of GIS has become a common tool in disciplines like forestry, catchment management, geology and mining, road and demography but it is not widely being used by energy developers

Based on the information created in the database Renewable energy projects development can be seen easily in phases. Other useful information such as dam/canal, forest, power network, their releases, river system and transmission lines data can be easily retrieved. If attached in the database , such useful information can be easily added, updated to the database. The developer may find useful this database in planning, designing, short listing and promoting the Renewable Energy in the Andhra Pradesh state.

LIMITATIONS TO THE DATABASE

- The data related to project cost prevailing of as in the year 2006., this cost is to be updated on the regular basis
- After commissioning of the identified sites, it would be added in to the Database
- Database should follow the ACID properties (Atomicity, Consistency. Integrity, Durability.

FUTURE SCOPE

In the Database, priorities of sites for developments may be assigned on the basis of various parameters such as,

- Accessibility of the site

PUBLICATION

1. D. Ravindra Naik, Arun Kumar, and M. K. Singhal "*Paper Presented entitled as "Design Strategies of Renewable Energy Development Using GIS Software"* in National Conference on Energy Alternative for Rural Sector at IDC Foundation, New Delhi. PP 148-155, 27-28, April-2006.

2. Work Shop on "*Decentralized Energy Options in Eastern Ghats of Anhdra Pradesh State"* in Vishakaptanam, Andhra Pradesh, 22-26, November-2005

REFFERENCES

[1] http://www.mnes.nic.in/ (Ministry of Non conventional Energy Sources)

[2] http://www.edugreen.teri.res.in/

[3] Korte, B. G., "The GIS Book", 5th Edition, 2004

[4] www. wikipedia.org/wini/andhrapradesh

[5] www.aponline.gov.in

[6] www.forest..ap.nic.in

[7] APTRANSCO (Andhra Pradesh Transmission Corporation), www.aptransco.com

[8] www.windpowerindia.com

[9] www.greenbusinesscentre.com

[10] Cleng, K. T., "Geographical Information Systems", 2004

[11] Bylinsky, Gene, "Managing With Electronic Maps," 1989

[12] Dueker, K.J., "Geographic information systems and computer-aided mapping," 53:383-90, 1987.

[13] Rhind, D., "Why GIS?," Arc News, Summer , Vol 11(3), 1989.

[14] Parent, P. and R. Church,. "Evolution of Geographical Information Systems as Decision Making Tools," 1987.

[14] www.geog.umd.edu, www. Geography.uoregin.edu

[15] www.gis.com , www.gistutorials.com,

[16] www.data.geocomm.com

[17] www.ciionline.org (Confederation of Indian Industry)

[18] www.renewables.com

[19] NECAP (Non Conventional Energy Corporation of Andhra Pradesh)

[20] APGENCO (Andhra Pradesh Genertion Corporation)

[21] D. Voivontas et al, "Evaluation of Renewable Energy Potential using a GIS decision support system", National Technical University of Athens.

[22] V. Ramachandra "Spatial mapping of renewable energy potential", Centre of Sustainable Technologies, Indian Institute of Science, Bangalore.

[23] Muselli et al, "Computer-aided analysis of the integration of renewable energy systems in remote areas using a geographical information systems", Centre de Recherches, Energie et Systemes, Universite de Corse, France

[24] Elizabeth Kaijuka, "GIS and Rural Electricity Planning in Uganda", IT Power (UK) Uganda Office.

[25] J.Amador et "Application of geographical information systems to rural electrification with renewable energy sources", Department of Electric Engineering, EUTI, UPM, Spain.

[26] Bent Srensen et al "GIS tools for renewable energy modeling", Roskilde University, Institute of Energy and Environment Group, Denmark.

[27] Debyani Ghosh et "Renewable energy technologies for the Indian power sector: mitigation potential and operational strategies", Centre de Sciences Huaines(CSH), New Delhi, India.

[28] Agarwal et al, "Use of GIS in Siting Small hydro power stations", Civil Department, IIT Roorkee.

[29] Sami et al, "Geomorphological analysis of an alluvial river using GIS", Civil Department, IIT Roorkee.

[30] Sridhar et al, "Environmental impact assessment of hydro power station using GIS", Civil Department, IIT Roorkee.

[31] Lee et all has been done the study in the area of the "Statistical analysis with Arc View GIS". IIT Roorkee.

[32] Hitesh Kumar et al, "GIS application to rural planning in tehri garhawal district". Civil Department, IIT Roorkee.

[33] Verbyal et al, "Practial GIS analysis", IIT Roorkee.

[34] Goel et al "GIS based power outage analysis and management", IIT Roorkee.

[35] www.iredaltd.com