

11.2 NON-CONVENTIONAL SOURCES OF ENERGY

Introduction

The Industrial Revolution of the 19th century ushered in new technologies. The spurt in inventions in that century was unprecedented in many ways. Some of these inventions involved use of natural resources like coal and oil. The thought of exhaustible nature of these resources and the environmental damage from the use of these resources never occurred either to the inventors or the subsequent generations. In the quest to sustain galloping economic activity, the dependence on coal and oil has soared at a phenomenal rate over the years. The burnt fuels result in the release of carbon dioxide and other gases into the atmosphere causing environmental damage. It has become imperative to look at energy technology with a new perspective. There are abundant renewable sources of energy such as wind, sun, water, sea, biomass apart from even daily wastes. These sources are pollution free and hence clean energy apart from being unlimited/inexhaustible.

Power generation in India has grown in size to around 1 lakh MW and in Tamil Nadu it has increased to 7924 MW which is distributed through a vast network of transmission, sub-transmission and distribution lines that reach all villages even in remote areas. The demand for power is growing rapidly. The problem will be compounded due to fast depletion of fossil fuel deposits, quality of fuels, heavy price to be paid for basic materials plus their transportation cost and above all the environmental degradation caused by the use of conventional energy sources. Under such conditions, environment-friendly and pollution-free, non-conventional and renewable energy sources known as 'clean and green energy' have emerged as an important alternatives to conventional energy sources. The renewable energy sources are clean and inexhaustible as they rely on sun, wind, biomass, etc., as primary sources of energy. It is estimated that, about 2000 MW can be generated from wind potential available in Tamil Nadu. As against this potential, 19 MW of power in the State Sector mostly through demonstration wind farms and 838 MW in the private sector have been harnessed as on 31.3.02. Under Biomass, the estimated potential is about 500 MW and 154 MW capacity has been expected using biomass/bagasse.

The country is endowed with large amount of sustainable resource base and non-conventional energy technologies which are well-suited for grid connected power generation, energy supplies in remote areas which are not/could not be connected to the grid and for captive consumption. Non-conventional energy sources like wind energy, solar energy through thermal as well as photovoltaic system, biomass and hybrid sources will help to a great extent in enhancing power generation capacity. Hence appropriate policies and programmes that optimise the use of available energy resources with new technologies have to be propagated, promoted and adopted, if necessary, by budgetary support.

Tamil Nadu has done very well in promoting and harnessing renewable sources of energy particularly wind and bagasse based power generation. With a view to develop and propagate the non-conventional sources of

energy, the Tamilnadu Energy Development Agency (TEDA) was formed in 1985. Apart from serving as a coordinating agency to promote the use of non conventional energy sources, TEDA acts as nodal agency to the Ministry of Non-conventional Energy Sources (MNES), Government of India to implement Centrally funded and sponsored schemes in the State. During the past 17 years, TEDA has conducted sustained campaigns to promote harnessing of renewable energy with active support from the Central and the State Governments. The total installed capacity in Tamilnadu under Non-conventional Energy Sources is 1000 MW as on 31.3.2002 which is about 13% of total TNEB grid capacity, while at the All-India level, it is only 3%. The major share of this comes from Wind Energy followed by bagasse based co-generation plants in sugar industries. This has largely come through private investments encouraged by policy initiatives of the Central and the State Governments.

Non - Conventional or Renewable Energy Sources

1. Wind Energy

The evolution of windmills into wind turbines did not happen overnight and attempts to produce electricity with windmills date back to the beginning of the century. It was Denmark which erected the first batch of steel windmills specially built for generation of electricity. After World War II, the development of wind turbines was totally hampered due to the installation of massive conventional power stations using fossil fuels available at low cost. But the oil crisis of 1973 heralded a definite break through in harnessing wind energy. Many European countries started pursuing the development of wind turbine technology seriously and their development efforts are continuing even today. The technology involves generation of electricity using turbines, which converts mechanical energy created by the rotation of blades into electrical energy, some times the mechanical energy from the mills is directly used for pumping water from well also. The wind power programme in India was started during 1983-84 with the efforts of the Ministry of Non-Conventional Energy Sources. In India the total installed capacity from wind mills is 1612 MW, of which, Tamilnadu has an installed capacity of 858 MW as on 31.03.2002.

Tamil Nadu is endowed with lengthy mountain ranges on its Western side with three prominent passes in its length. These are with wind-potentials: (1) Palghat Pass in Coimbatore District-1200 MW, (2) Shengottah Pass in Tirunelveli District-500MW and (3) Aralvoymozhi Pass in Kanniyakumari District- 300 MW (Total potential-2000 MW). The mountainous areas close to Cumbum Valley are observed to be having high potential and, though coastal areas, central plains and hilly areas have been observed unsuitable for wind power projects, Rameshwaram is found suitable.

2. Bio Energy

Biomass is yet another important source of energy with potential to generate power to the extent of more than 50% of the country's requirements. India is predominantly an agricultural economy, with huge quantity of biomass available in the form of husk, straw, shells of coconuts wild bushes etc. With

an estimated production of 350 million tons of agricultural waste every year, biomass is capable of supplementing coal to the tune of about 200 million tonnes producing 17,000 MW of power and resulting in a saving of about Rs.20,000 crores every year. Biomass available in India comprises of rice husk, rice straw, bagasse, coconut shell, jute, cotton, husk etc. Biomass can be obtained by raising energy farms or may be obtained from organic waste. The biomass resources including large quantities of cattle dung can be used in bio-energy technologies viz., biogas, gasifier, biomass combustion, co-generation etc., to produce energy-thermal or electricity. Biomass can be used in three ways – one in the form of gas through gasifiers for thermal applications, second in the form of methane gas to run gas engines and produce power and the third through combustion to produce steam and thereby power.

3. *Solar Energy*

Solar Power was once considered, like nuclear power, 'too cheap to meter' but this proved illusory because of the high cost of photovoltaic cells and due to limited demand. Experts however believe that with mass production and improvement in technology, the unit price would drop and this would make it attractive for the consumers in relation to thermal or hydel power. The Solar Photo Voltaic (SPV) technology which enables the direct conversion of sun light into electricity can be used to run pumps, lights, refrigerators, TV sets, etc., and it has several distinct advantages, since it does not have moving parts, produces no noise or pollution, requires very little maintenance and can be installed anywhere. These advantages make them an ideal power source for use especially in remote and isolated areas which are not served by conventional electricity making use of ample sunshine available in India, for nearly 300 days in a year.

A Solar Thermal Device, on the other hand captures and transfers the heat energy available in solar radiation. The energy generated can be used for thermal applications in different temperature ranges. The heat can be used directly or further converted into mechanical or electrical energy.

4. *Other Sources*

The other sources of renewable energy are geothermal, ocean, hydrogen and fuel cells. These have immense energy potential, though tapping this potential for power generation and other applications calls for development of suitable technologies.

(i) Geo-Thermal Energy

Geo-Thermal energy is a renewable heat energy from underneath the earth. Heat is brought to near surface by thermal conduction and by intrusion into the earth's crust. It can be utilised for power generation and direct heat applications. Potential sites for geo-thermal power generation have been identified mainly in central and northern regions of the country. Suitable technologies are under development to make its exploitation viable.

(ii) Ocean thermal and Tidal energy

The vast potential of energy of the seas and oceans which cover about three fourth of our planet, can make a significant contribution to meet the energy needs. Ocean contains energy in the form of temperature gradients, waves and tides and ocean current, which can be used to generate electricity in an environment-friendly manner. Technologies to harness tidal power, wave power and ocean thermal energy are being developed, to make it commercially viable.

(iii) Hydrogen and Fuel Cells

In both Hydrogen and Fuel Cells electricity is produced through an electro-chemical reaction between hydrogen and oxygen gases. The fuel cells are efficient, compact and reliable for automotive applications. Hydrogen gas is the primary fuel for fuel cells also. Hydrogen can be produced from the electrolysis of water using solar energy. It can also be extracted from sewage gas, natural gas, naphtha or biogas. Fuel cells can be very widely used once they become commercially viable.

(iv) Bio fuels

In view of worldwide demand for energy and concern for environmental safety there is need to search for alternatives to petrol and diesel for use in automobiles. The Government of India has now permitted the use of 5% ethanol blended petrol. Tamilnadu is one of the nine States in the country where this programme will commence from January 2003. Ethanol produced from molasses/ cane juice, when used as fuel will reduce the dependence on crude oil and help contain pollution. Further, technology is also being developed to convert different vegetable oils especially non-edible oils as bio-diesel for use in the transport sector. They are however, in R & D stage only.

5. Potential and Exploitation of Renewable Energy Sources

India ranks fifth in the world in Wind power with installed capacity of 1612 MW out of an estimated potential of 45,000 MW. Tamilnadu ranks first in the country in Wind power with a capacity of 858 MW out of an estimated potential of 3050 MW. In biomass power the country has an installed capacity of 381 MW out of total potential of 19500 MW. In Tamilnadu the installed capacity is 142 MW against the potential of 1000 MW. The potential available under solar photovoltaic energy is 20 MW per Sq.Km. But in view of high cost and heavy investment involved the progress is rather slow.

In Solar thermal energy (Solar Water Heater system) 15 lakh M² collector area has been installed in the country against a potential of 1400 lakh M². In Tamilnadu, 20084 M² area has been installed. There is considerable scope for expanding this activity with suitable incentives.

The most note-worthy achievement of Tamilnadu has been in creating an installed capacity of about 1000 MW from the non-conventional energy sources alone in the State, i.e., 13% of the total TNEB grid capacity against 3.2% only for the country. The major component of this has come from Wind Energy (858 MW) followed by co-generation in sugar industries (142 MW). Further, this has largely come about through private investment due to

attractive policy initiatives of the State and Central Governments. It may be worthwhile to offer various incentives to enhance its share further in view of the vast potential available.

Ninth Five Year Plan Performance

An outlay of Rs.19.95 crores was approved for Non- Conventional Energy sector for the Ninth Plan. But, the actual allocation by the State Government was Rs.8.73 crores which is 44% of the outlay, of which Rs.8.57 crores was spent. The over all financial and physical performance is shown below:

<i>Financial Performance</i>						
Sl. No.	Scheme	Rs. in lakhs			Rs. in lakhs	
		Ninth Plan outlay 1997-2002	Ninth Plan actual funds allocated by State Govt.	% of funds allotted to total outlay	Total 9th Plan performance	% Performance to total funds allotted
1.	Wind Energy	374.40	15.22	4.1%	14.42	94.7%
2.	Solar Energy	283.60	210.42	74.2%	208.92	99.3%
3.	Bio Energy	531.40	43.45	8.2%	36.49	84.0%
4.	IREP	459.00	300.87	65.5%	298.42	96.0%
5.	Others	346.70	302.88	87.4%	298.87	98.5%
	Total	1995.10	872.84	43.8%	857.12	98.2%

<i>Physical Performance</i>				
Sl. No.	Scheme	Unit	9th Five Year Plan	
			Target	Achievement
1.	Windmill for Water Pump	Nos.	22	18
2.	Wind Resource Monitoring Station	Nos.	11	11
3.	Wind Energy Project	MW		
	Public		-	-
	Private		-	181
4.	Biogas plant	Nos.	14	6
5.	Gasifier	Nos.	13	16
6.	Taluka Level Biomass Assessment Study	Nos.	4	4
7.	Assessment Study on Municipal Waste	Nos.	5	5
8.	Biomass Based Power Project	MW	-	-
9.	Co-generation in sugar mill	MW	-	69(private)
10.	Solar Thermal	Nos.	1250	1370
	Domestic	Sq.m	1240	1280
	Industrial	Nos.	12	12
	Government Institutions			
11.	Solar Still	Sq.M	400	-
12.	Solar Photovoltaic			
	Street Light	Nos.	60	60
	Pump	Nos.	95	95
	Lantern	Nos.	1000	1000
	Roof Top Power Plant	KW	11	9*

*Includes 4 KW installed in TEDA office at Chennai.

1. *Wind Energy*

The total wind potential in the State is around 2000 MW of which about 40% only has been tapped so far. The installation of 119 Wind electric generators for a total capacity of 19 MW as part of demonstration programmes has motivated and encouraged private sector to install 3003 Wind electric generators for a total capacity of 838 MW. The Wind Mills have a total capacity of 857 MW, of which, 181 MW capacity was added during the Ninth Plan and have generated and fed into the grid (6816.379 Mu.)

Installation of windmill for water pumping was taken up by providing subsidy ranging from Rs.20,000 to Rs.32,000 from State Government besides MNES subsidy of Rs.30,000 to Rs.45,000 against the total cost of Rs.80,000 for gear type and Rs.1,45,000 for AV55 type Wind Mills. During Ninth plan period, 18 gear type Wind Mills were installed from 1997 to 2000 and another 4 mills were also installed by the end of 2002. Wind monitoring stations were set up in 11 centres in Coimbatore, Erode, Kanyakumari and Tuticorin to conduct Wind Resource Assessment study which helps to identify potential locations for wind mills.

2. *Bio-Energy*

It is technically possible and economically feasible to generate biogas from cattle dung and certain agro and industrial waste. During Ninth Plan, 12 Biogas plants were installed in livestock farms, educational institutions, agricultural farms, central prisons and sugar mills. 24 Gasifier systems i.e., 23 thermal gasifiers and one electrical gasifier were also installed during Ninth Plan with financial assistance from the Ministry of Non-conventional Energy Sources.

Resource Assessment studies were carried out in 35 Taluks under MNES Programme and 4 Taluks under State programme during Ninth Plan. This will be useful for private entrepreneurs to evolve suitable power projects.

The sugar mills go in for co-generation projects by upgrading their boilers and other accessories suitably so as to supply excess electricity to Tamilnadu Electricity Board. Government of India extends financial assistance up to Rs.45 lakh per MW of surplus power to Co-operative sugar mills and interest subsidy to the Private Sugarmills. At present, the installed capacity through co-generation in sugarmills is 142 MW. Other potential sectors for co-generation are cement, paper, caustic soda, textiles, iron and steel etc., with a total potential of 5600 MW in the country.

The Ministry of Non-conventional Energy Sources sanctioned a scheme for establishing a 1.2 MW Power plant at Sarkar Uduppam Village in Namakkal District under private sector for energy recovery from poultry wastes as a demonstration project with an assistance of Rs.3.5 crores which will be commissioned during the year 2002. Another demonstration High Biomethnation Project has also been sanctioned under MNES for setting up of a sub-project under UNDP/GEF assisted project for processing of tapioca wastes water for generation of power (500 Kw) and manure in Pappireddipatti of Dharmapuri district under private sector. The project cost is Rs.3.59 crores which will be shared equally by MNES and the beneficiary and the project will be commissioned during the year 2002.

3. Solar Energy

(a) Solar Water Heating System

Several designs and capacities of Solar Water Heating System (SWHS) are available to suit the users' needs. The Government of Tamilnadu provided a subsidy of Rs.2000/- to Rs.3000/- for domestic Water Heating System from 1993 to 1998. The Government also sanctioned the full cost of SWHS in 12 Government buildings, mostly hostels and hospitals, in addition to which during the Ninth Plan, 1370 domestic and 58 Industrial Water Heaters were installed in Tamil Nadu.

(b) Solar Air Heating Systems

Tamilnadu has taken a lead role in the country to promote the use of Solar Air Heating technology for Tea/ Fruit processing and Grain drying. 14 systems were installed in Tamil Nadu with MNES subsidy. This process of pre-heating using solar energy saves nearly 25% of fossil fuels or firewood. The concept of solar air heating was evolved only in Tamilnadu for the first time in the country. The air gets heated when passed through the solar air heating system, which is used for bringing down the moisture content in the materials to be dried. In the process, it provides substantial fuel savings to the Industries. During Ninth Plan, 14 solar air heating Systems were installed in Tamilnadu with the research experience of Planters Energy Network, an associate of the Madurai Kamaraj University.

(c) Solar Photovoltaic Systems

Solar Photovoltaic pump is a system which produces electricity from sunlight and operates the pump to lift water from wells. A 900 watts pump can deliver about 50,000 litres of water per day over a total head of 30 feet. It can irrigate one to two acres. Under these conditions, the SPV pumps offer a reliable alternative for small farmers. The cost of a 900 watts pump is Rs.2.24 lakhs. IREDA, Government of India and GOTN provide a subsidy of Rs.1,12,500/- at Rs.125/- per watt and Rs.59,000/- per pump respectively and the remaining is the farmer's contribution. During Ninth Plan period, 95 numbers of SPV pumps were installed.

SPV lantern is a portable lighting device which provides light equivalent to a 60 watt bulb for about 4 hours per day. This is very useful in remote areas where there is no electricity or where there is frequent failure of electricity. MNES, Government of India provides subsidy of Rs.1500 per lantern. During the Ninth Plan period, 1000 SPV lanterns were distributed.

SPV Street light is a stand-alone street light system with a 11 W CFL Lamp. It provides lighting for 12 hours. The cost of each light is around Rs.30,000/-. Tamilnadu Government provided a subsidy of Rs.12000/- per light. During the Ninth Plan period 60 SPV Street Lights were installed.

4. Integrated Rural Energy Planning (IREP)

The Objectives of the IREP Programme are:

- (i) To provide for minimum domestic energy needs for cooking, heating and lighting purposes to rural people.

- (ii) To provide the most cost effective mix of various energy sources and options for meeting the requirements of sustainable agriculture and rural development with due environmental considerations.
- (iii) To ensure people's participation in planning and implementation.
- (iv) To develop and strengthen mechanisms and co-ordination arrangements for linking micro level planning for rural energy with national and State level planning and programmes.

The IREP Programme is being implemented by the Tamilnadu Energy Development Agency in 21 selected blocks all over Tamilnadu. Under this programme, the optimum mix of all types of energy locally available is provided to the rural public for meeting their lighting, cooking and heating needs. The programme is funded by Government of India which meets the staff cost and the State Government bears the scheme cost. The programmes implemented in the Ninth Plan period with subsidies ranging from 25% to 100% are:

- 1) Improved Chulah (100% subsidy)
- 2) Frictionless footvalves (75% subsidy)
- 3) Solar Cookers (25%) subsidy.
- 4) Windmills for pumping water for community use (100% subsidy)
- 5) Other energy saving devices (25% subsidy)

5. Energy Conservation and Audit

Energy Audit is a systematic approach for effecting energy conservation in an industry. Energy audit helps in identifying and assessing potential areas where energy could be conserved.

TEDA is co-ordinating with TNEB for implementation of Energy Audit in power intensive industries in Tamil Nadu.

The Government has made Energy Audit mandatory for the industrial sector and commercial sector with high tension power consumption with maximum demand exceeding 200 kVA under Phase I and between 1000 kVA to 2000 kVA under Phase II. (The new HT services covered under mandatory Energy Audit programmes are exempted from conducting energy audit for a period of 3 years from the date of service connection).

TNEB received Energy Audit Reports on 181 HT industries (having a demand of more than 2000 kVA) covered under Phase I from the registered Energy Auditors. Out of these, implementation schedule for 102 Nos. has been received. Savings in energy achieved so far is 1494 lakh units / annum. The total projected saving is 2198 units, i.e. a capacity equivalent of 25 MW of Rs.125 crores.

6. Publicity

Tamilnadu Energy Development Agency conducts seminars, exhibitions, business meets etc. using press and media and also participates in the seminars, meets, exhibitions sponsored by various Agencies in order to

propagate the usefulness of the Non conventional Sources of Energy. It is very essential to create awareness of the benefits derived by the use of NCS to reach the urban public and also to be taken to the root level in rural areas by organising energy fairs and exhibitions. One Mobile Exhibition Van is available in Tamilnadu Energy Development Agency, which is sent to exhibitions, Government functions like inaugural functions, festivals and meetings for publicity purposes throughout State.

7. Evaluation Studies

To evaluate the working of these systems and to bring forth the bottlenecks and to find out remedy to make the systems work successfully, periodical evaluation studies were conducted by TEDA to prove the success or failure of the programme so as to decide the continuance or discontinuance of the programme. During the Ninth Plan period the following Evaluation Studies were conducted by TEDA:

- (i) Biogas Plants 117 Nos.
- (ii) SPV Pumps 100 Nos.
- (iii) Wind mill for Water Pumping 108 Nos.
- (iv) Wind Electric Generators – 2599 Nos.(711 MW)
- (v) SPV Street Lights – 108 Nos. Solar Water Heating Systems: Domestic –100 Nos.; Industrial – 10 Nos.; and Government Buildings – 14 Nos.

Bottlenecks and Constraints

While the performance under the renewable energy sources programmes upto Eighth Five Year Plan was relatively good, the pace of implementation suffered during the Ninth Plan period due to various constraints, some of which are as follows:

- (i) Renewable Energy Technologies are capital intensive and require high initial investment which investors could not mobilize in the absence of financial support including capital subsidy from the Central Government/ State Government.
- (ii) The power purchase policy has not been encouraging for private entrepreneurs and suitable policy initiatives in the form of wheeling, and banking facilities, evacuation, arrangements, land allotment etc., need to be considered to boost investment.
- (iii) Technologies for several renewable energy sources have not fully stabilized which has hampered the development and hence more intensive R&D efforts are called for with special focus on partnership with industry.
- (iv) Since the cost of renewable energy gadgets/ devices such as solar cooker, biogas, solar geysers, solar lanterns etc., is high, it is not possible to generate sufficient demand for these items though the people are aware of the advantages. Hence, the cost needs to be reduced through suitable support to manufacturers.

- (v) Fiscal incentives namely 100% depreciation attracted several private investors. But it has been diluted to a considerable extent by the imposition of Minimum Alternative Tax.
- (vi) Adequate number of professionally skilled manpower has not been developed in the renewable energy sector and hence training programmes may be organized to develop required manpower.

Tenth Five Year Plan

Vision

- Provide and promote “clean and green energy” on much wider scale covering villages and towns to meet the decentralized energy requirements in agriculture, small scale industries, commercial establishments and households with priority for remote habitations which do not enjoy grid power.
- Enhance the generation of grid quality power through private investment for harnessing various renewable energy sources.
- Encourage energy efficient buildings which will conserve energy to meet energy requirements from naturally available resources.
- Promote energy efficiency and energy conservation in industries domestic use etc.

Goals and Objectives

The national goal of meeting 10% of grid capacity from renewable sources by 2010 has been achieved by Tamil Nadu (12.5%) even as on 31.3.02. Under the Tenth Plan, the goal is to consolidate and stabilize the share of grid connected power with addition of 550 MW and also achieve decentralized power generation to meet the local energy needs in agriculture, agro- processing, households etc., especially in remote areas and expand the use of renewable energy sources and promote energy efficiency and thereby energy saving.

Strategies

- i. Encourage and promote private investments in renewable energy through suitable policy initiatives at State level.
- ii. Involve local bodies in developing decentralized power and its use in agriculture, household sectors etc.
- iii. Establish field units to promote renewable energy at local levels by integrating existing programme staff.
- iv. Enable suitable revision of power purchase rate for grid connected power to make it attractive for the investors.
- v. Encourage research and development to improve efficiency of the devices and bring down the cost.
- vi. Undertake awareness campaigns in Districts through seminars, exhibition, etc.

New initiatives

The following new initiatives are proposed during the Tenth Plan:

- i) Undertake further studies for micrositing for setting up of Wind Mills by identifying proper and suitable locations
- ii) Undertake Biomass potential assessment studies at Taluk level and make data on Biomass potential available for prospective investors
- iii) Merge the staff under Centrally sponsored schemes like IREP and National Biogas Development programme and create field outfits to provide guidance and support to local bodies in tapping renewable energy.
- iv) Popularise and propagate renewable energy use among industries and households in rural and urban areas
- v) Secure proper and reasonable price for grid connected power through State Electricity Regulatory Commission
- vi) Arrange for suitable adjustments in wheeling and banking facilities, and third party sale to attract further investment in renewable energy sector and
- vii) Designate TEDA as single window agency to facilitate smooth clearance for projects upto certain capacity say 25 MW.

Programmes for Tenth Five Year Plan (2002-07)***A. Wind Energy***

- i. Wind Power Generation - It is proposed to add 250 MW wind power generation through private sector during Tenth Plan period, if policy measures, especially power purchase price, are taken in accordance with the guidelines of the Ministry of Non-conventional Energy Sources (MNES).
- ii. Micro-Level Study- To provide accurate data to the entrepreneurs, it is proposed to conduct micro-level study through C-WET in some of the unexplored regions in the State particularly in hilly terrains. An outlay of Rs.10 lakhs is proposed for the Tenth Plan at Rs. 2 lakhs each for 5 locations.
- iii. Maintenance of Wind Monitoring Stations - An amount of Rs.32,000/- per annum is proposed for the maintenance of 3 existing permanent wind monitoring stations in Tamil Nadu by Tamil Nadu Energy Development Agency (TEDA). An outlay of Rs.1.60 lakhs is proposed for the above purpose for five years.
- iv. Wind mills for Water Pumping - It is proposed to provide Rs.20,000/- per windmill as additional subsidy over and above the Central Subsidy for installing 20 Nos. of Wind Mill for water pumps in the State during Tenth Plan. An outlay of Rs. 4 lakhs is proposed this scheme.
- v. Wind – Solar Hybrid Systems - In order to promote the new concept of wind – solar hybrid system in the case of private investors, it is proposed to give an additional subsidy of Rs.50,000/- per KW over

and above Central Subsidy for a total of 40 KW in multiples of 1 KW. during the Tenth Plan. An outlay of Rs.20 lakhs is proposed for this scheme.

During Tenth Plan, a total outlay of Rs.35.60 lakhs has been proposed for Wind Power generation programmes.

B. Bio-Energy

i. Bio-Gas Plant - The Bio-Gas development is being undertaken as a State Level Programme for community and institutional set up. It is proposed to instal 10 numbers of Bio-Gas Plants in Sugar Mills using pressmud with 60 cum capacity. A provision of Rs. 11.50 lakhs has been proposed as State Subsidy Component during the Tenth Five Year Plan.

ii. Community Bio-gas Plants (CBP)- TEDA has installed 9 Community Biogas Plants under State Funding. It is proposed to maintain these plants at an annual cost of Rs.12,000/- per year per plant through Non-Governmental organizations such as Rotary Club, etc. An outlay of Rs.5.40 lakhs is proposed for this scheme. A total outlay of Rs.16.90 lakhs has been proposed for the Bio-Gas Plants Programme during Tenth Plan.

iii. Gasifier - It is proposed to install 50 Nos. of Gasifiers of 100 Kwe capacity with a State subsidy at 20% of the cost of Rs. 5 lakhs each. The Gasifiers are proposed to be installed in Educational Institutions for cooling applications. An outlay of Rs. 50 lakhs is proposed for this scheme during the Tenth Plan.

iv. Energy Park - The establishment of Energy Parks in various institutions will be continued under MNES programme. It is proposed to establish a State Level Energy Park at Chennai with financial assistance upto Rs. 1 Crore from Ministry of Non-conventional Energy Sources and the State Government's share of Rs. 60 lakhs towards the cost of civil works in buildings etc., and a minimum of 3 to 5 acres of land in TEDA's name, having easy access to Public. Further seminar halls etc. can also be built in these in order to generate sufficient revenue component for maintaining the energy park as self supporting. The objectives of the Energy Park will include generating awareness amongst common people about renewable and non-conventional resources of energy, energy conservation practices and to attract entrepreneurs towards renewable energy based projects.

A total outlay of Rs.126.90 lakhs has been proposed for the Bio-Energy Programmes during the Tenth Plan period.

C.1. Solar Energy

(i) Solar Photovoltaic Lantern - During Tenth Plan, it is proposed to distribute 1,000 lanterns per year to the poor people like fishermen. The above SPV Lanterns will emit light covering 360 degrees and will be capable of lighting for 3 hours for a CFL 7 watts lantern or 4 hours for a CFL 5 watts lantern with an average daily solar radiation of 5 kwhr / sq.mt. of horizontal surface. The cost of a lantern is Rs.4,000/- which includes the cost of module, electronics and lamp accessories. It is proposed to provide 100% State subsidy for this scheme. The total cost will be Rs. 40 lakhs / annum.

The number of beneficiaries during Tenth Plan will be 5,000. An outlay of Rs. 200 lakhs is proposed for this scheme during the Tenth Plan.

(ii) Solar Photovoltaic Pump - Against a back log of 4,70,000 applications for service connection for agricultural pump-sets with TNEB, only 40,000 could be covered per year. The Board is also suffering commercial losses due to free supply of power to them apart from the line losses of around 20%. Hence SPV pump is the most reliable and cost effective alternative option. It has no battery and easy to maintain and the life of solar module which converts solar energy directly into electricity is more than 10 years. A 900 watt pump cost Rs.2.24 lakhs, of which Rs.50,000/- will be borne by the beneficiary, Rs.99,000/- (at Rs.110/- per watt) by MNES and Rs.75,000/- is proposed as State subsidy. It is proposed to instal 70 SPV pumps every year with a total outlay of Rs.53.20 lakh/ year including Rs.1000/- per pump as service charges to TEDA. The total outlay for Tenth Plan is Rs.266 lakhs.

(iii) SPV Street Lights - Like other SPV programmes, it is proposed to install 100 SPV Street Lights per year in selected areas in consultation with District Collectors in the industrial premises, parks, gardens, educational, charitable institutions etc. The cost of each Street Light is Rs.30,000. The subsidy component is Rs.11,000/- per light and Rs.500 will be charged by TEDA as service charge. The balance cost will be met by the beneficiary organization. During the Tenth Plan, it is proposed to instal 500 SPV Street Lights. An outlay of Rs.57.50 lakhs is proposed for this scheme.

(iv) SPV Home Lighting - It is proposed to instal SPV Home Lights in selected buildings in consultation with District Collectors in industrial premises, tourist places etc. During Tenth Plan, it is proposed to instal 200 Home lights per year with a subsidy of Rs.5500/- per system and Rs.200/- each as service charges to TEDA. The balance cost will be met by the beneficiary organization. This scheme provides easy and quick method for electrification of households in remote and difficult villages and hamlets in the State. During Tenth Plan it is proposed to instal 1000 numbers of SPV Home Lighting Systems. An outlay of Rs.57 lakhs is proposed for this programme during Tenth Plan.

(v) Repayment of IREDA Loan - During 1993-94, the Government of Tamilnadu sanctioned installation of 50 SPV pumps, for which Government has undertaken to repay the IREDA loan of Rs.40 lakhs at the rate of Rs.80,000/- per pump and interest at 2.5% thereon over a period of ten years. All the 50 SPV pumps have been installed. Up to Ninth Plan, eight instalments have been paid and the remaining 2 instalments will have to be paid during Tenth Plan, which works out to Rs.8.28 lakhs. An evaluation study of the above 100 SPV pumps conducted by Anna University during 1998-99 showed that 73% of the pumps are working satisfactorily and the rest were having minor problems due to non-maintenance of the pumps. A provision of Rs.8.28 lakhs is proposed for this scheme as loan component.

(vi) Electrification for remote habitations (matching grant by State Govt.) - TNEB has identified 122 Nos. of remote hamlets spread over 11 districts in Tamilnadu, which could not be electrified by conventional grid supply. Electrification of the above hamlets is proposed during the Tenth Five

year Plan. The cost of electrification of each hamlet by providing Solar lighting devices is estimated at Rs.10 lakhs. MNES was requested to provide 90% cost with a matching grant proposed at 10% by State Government. However, MNES has indicated that their funding may only be up to 50% cost. Hence the State Government will have to meet the balance 50% cost. As a provision of only Rs.122 lakhs is proposed for the State Government during 10th Five Year Plan, the number of hamlets to be electrified will be correspondingly restricted.

An total outlay of Rs.710.78 lakhs has been proposed for Solar Photovoltaic Energy during Tenth Plan.

C.2. Solar Thermal Energy

i. Solar Water Heating System (SWHS) - During the Tenth Five Year Plan, it is proposed to instal 700 Domestic SWHS and 35 Nos. industrial system of capacity 1000 LPD systems per year with a subsidy of Rs.3000 per unit and Rs.300 as service charges to TEDA, at a total cost of Rs.23.10 lakh every year is proposed. The number of beneficiaries during Tenth Plan will be 3500 nos. An outlay of Rs.115.50 lakhs is proposed for the scheme for Tenth Plan. Similarly, for 35 nos. of Industrial SWHS, a State subsidy of Rs.20000 per unit besides service charges of Rs.2000 to TEDA with a total cost of Rs.7.70 lakhs per year is proposed. The target fixed for this scheme is 175 numbers. An outlay of Rs.38.50 lakhs is proposed for the scheme during Tenth Plan.

ii. SWHS in Government buildings - It is proposed to instal Solar Water Heating Systems (SWHS) of 2000 LPD 80°C at a cost of Rs.4.00 lakhs per unit in Government hospitals / hostels/ institutions with 100% fund assistance. The total cost the programme works out to Rs.200 lakhs. During Tenth Plan period, 50 numbers are proposed to be installed. An outlay of Rs.200 lakhs is proposed for this scheme.

iii. Solar Stills - Solar stills can produce potable water to cater to the drinking water and cooking water needs of fishermen families by making use of the freely available solar energy. To popularise the use of this device, it is proposed to instal 12.5 sq. metre area of solar stills each year for producing the potable/ distilled water. The number of units could be decided based on its area during implementation. This scheme will cater to the needs of State Transport Corporations, fishermen colonies and rural people for producing potable drinking water and distilled water from brackish water. It is estimated that, one sq.metre area of Solar stills can produce to 4 litres of potable / distilled water per day. Tentatively, system cost is fixed at Rs.2000/- per LPD and 50LPD is proposed to be installed. The subsidy component for this scheme works out to Rs. 25000/- and service charge to TEDA will be Rs.5000/-. It is proposed to instal 250 LPD during the Tenth Plan. An outlay of Rs.1.50 lakhs is proposed for this scheme during the Tenth Plan.

iv. Solar Passive buildings -The working and living spaces in idential and non residential buildings can save millions of Kw hrs. of electrical energy by keeping buildings cold during summer and warm during winter by incorporating various available energy saving features and concepts in the

design and construction of buildings at the conceptual stage. For creating an awareness about the concept, MNES is at present offering incentives for preparation of Detailed Project Report (DPR) to a maximum of Rs.50,000 or 1.5% of the estimated cost for the Architecture design with Solar Passive Concept with the incentive for construction of Buildings limited to 10% of the cost of the buildings or maximum of Rs.10 lakhs for each project. Likewise, the State Government can extend support to promote the solar passive concept. Hence, for the introduction of solar passive concept, State Government needs to provide incentives for the construction of Government, Semi Government buildings from 2002-2007 onwards. It is proposed to provide Rs 25,000/- per DPR to prepare DPRs for 25 projects and Rs. 5 lakhs per building covering 10 buildings for construction of a Solar Passive Architecture System with service charges of Rs.1 lakh per year to TEDA during the Tenth Plan. An outlay of Rs.61.25 lakhs has been proposed for this programme during Tenth Plan.

v. Solar Air Heating Systems (SAHS) - In Tamilnadu 'Solar Air Heating Systems' are introduced as an alternate to "Open drying" due to the limited fossil fuel reserves and its ever increasing demand. The Solar Air Heating System consists of an array of solar collectors generally installed over the roof of buildings which converts ambient air into very hot air with an increase of 30-40°C temperature. The above pre-heated air is used in tea drying/ fruit process/ grain drying industries and this process fetches 25-30% fuel saving. It is proposed to offer a subsidy for installation of SAHS to a total area of 1000 sq.m at Rs.1000/sq.m annually. The proposed target during the Tenth Five Year Plan is 5000 Sq.m. An outlay of Rs.52.50 lakhs is proposed for this scheme for Tenth Plan.

vi. Solar Cooker -To encourage the use of environment friendly Solar Cooker, a subsidy of 20% of the cost of the cooker plus a Service charge of Rs.100 per cooker to TEDA is proposed under this scheme. The target fixed during 10th Plan is 3000 nos. of Solar Cookers. An outlay of Rs.20.50 lakhs is proposed for this scheme during Tenth Plan.

A total outlay of Rs.489.75 lakhs has been proposed for Solar Thermal Energy Programmes during 10th Plan period.

D. Waste to Energy Programme

MNES, Government of India has sanctioned the setting up of a 0.5 MW power project from waste water from Varalakshimi Starch Industries Limited at Pappireddipatty under UNDP/ GEP assisted project and is providing financial support up to 50% of the cost of the project of Rs. 359 lakh for installation and execution through TEDA. The civil work has been completed and the project was expected to be commissioned by end of 2002.

MNES/ Government of India have also sanctioned another proposal for setting up 1.2 MW power project from poultry waste at Sarkar Uduppam village in Namakkal district by M/s.G.K.Bio Energy Private Ltd., Chennai at a cost of Rs.1402 lakhs and is providing financial assistance of Rs. 351 lakh, and IREDA sanctioned a loan of Rs. 641 lakh. 70% of Civil works were completed and the project is expected to be completed by December 2002.

E. Integrated Rural Energy Programme (IREP)

This on-going Programme will be continued in the existing 21 blocks in 18 districts during the Tenth Plan. The various energy saving devices such as chullah, cookers, lighting systems etc. are to be distributed to the rural people at subsidy ranging from 25 to 100%. The scheme cost has been proposed at Rs.5 lakh per block as indicated by MNES. An outlay of Rs.525 lakhs for scheme cost and Rs.152.90 lakhs for staff cost has been proposed for this scheme under Tenth Plan. An additional amount of Rs.250 lakhs has also been provided under rural energy programme for implementing schemes under international funding assistance. The total outlay will be Rs. 927.90 lakhs in the Tenth Plan.

F. Publicity

TEDA has been conducting Seminars, Workshops and Exhibitions mainly through sponsorships offered by the Ministry of Non-conventional Energy Sources, Government of India. It is essential that the publicity is confined not only to the urban public but it should be taken to the grass root level in rural areas.

During Tenth Plan, an outlay of Rs.50 lakhs has been proposed for carrying out the following activities by the TEDA:

- (i) Publicity through various media-postal, AIR and TV.
- (ii) Exhibitions, Seminars, Workshops, Business meets, training programmes etc.
- (iii) Publication of books, periodicals manuals etc. on renewable energy gadgets, success stories.
- (iv) Opening authorised Service Centres in each district for Renewable energy devices
- (v) Supporting Energy conservation measures in various colleges/schools and conduct of regular interactive meetings
- (vi) Efforts to include in the curricula subjects/chapters on Renewable Energy in Schools and Colleges
- (vii) Setting up a Renewable Energy Fair in a reputed Education Institute,
- (viii) Conducting three months' short time certificate programme on Maintenance and upkeep of Renewable Energy Gadgets, and
- (ix) Adopting a model village where all renewable energy gadgets are put to use.

An outlay of Rs. 50 lakhs has been proposed during the Tenth Plan period for the above purpose.

G. Evaluation Studies

TEDA does periodical evaluation of the programmes implemented in the State during Plan periods. It is proposed to conduct various evaluation studies relating to Non-conventional Energy Sources during the Tenth Plan.

An outlay of Rs. 24 lakhs has been proposed for this programme during Tenth Plan.

H. Research & Development

The main objective of the Research and Development Programme in TEDA will be to conduct and promote R & D in the fields of renewable energy sources. During Tenth Plan it is proposed to start R & D programmes in coordination with institutions like Anna University, M.K. University, Regional Engineering College, Trichy, PSG College of Technology, Coimbatore, and continue the same with increased activities in the subsequent years. R & D will also envisage generation of funding assistance from Ministry of Non – conventional Energy Sources and departments like National Research Development Programme and venture to generate earnings in future through commercialization to ensure self-support. In addition to the R & D efforts proposed, Department officials will be permitted to participate in International Seminars / Training Programmes / Study tours in order to develop their technical knowledge. An outlay of Rs.100 lakhs has been proposed in the Tenth Plan for R & D Programmes.

I. Establishment Cost

The establishment cost includes salary component, T.A and other charges for TEDA. It is proposed to strengthen the organisation with permanent technical staff to take up consultancy services to generate regular revenue to TEDA and thereby lessen the burden of the State Government. An outlay of Rs. 500 lakhs is proposed towards establishment charges for TEDA during the Tenth Plan.

In all, a total outlay of Rs.2965.00 lakhs is proposed for implementing the programmes pertaining to Non-conventional Energy Sources during the Tenth Plan period.

Recommendations/ Suggestions

- a) A consistent and long term policy may be formulated and adopted to promote harnessing of renewable energy sources in the State.
- b) A Single Window Agency may be established under TEDA to act as a forum for speedy clearance of projects.
- c) Tariff may be restructured and power purchase policy revised suitably to make investment in renewable energy attractive for investors taking into account not just the economic cost but also the social/ environmental costs associated with conventional power sources.
- d) The grant of suitable fiscal and financial incentives may be considered for investment in renewable sources of energy taking into account the clean and green nature of the energy source such as exemption from sales tax or sales tax deferral for investment in renewable energy projects
- e) Merger of NBDP and IREP schemes along with staff may be undertaken so as to create field outfits to promote renewable energy projects/ schemes

- f) Publicity and propaganda may be expected to create better awareness about advantages of renewable energy sources.
- g) R & D may be encouraged and supported so that the efficiency of devices could be improved and cost brought down.
- h) Energy efficiency and conservation may be given high priority - TEDA can play an important role if it is notified as the Designated Agency under the Energy Conservation Act.
- i) Electrification of remote habitations without grid power may be undertaken using renewable sources.
- j) Private investment may be explored in new sources of renewable energy such as micro hydel projects.

Annexure – I						
Yearwise Tenth Plan (2002-07) -Financial Outlay						
(Rs in lakhs)						
Scheme	2002-03	2003-04	2004-05	2005-06	2006-07	Outlay
I.WIND ENERGY						
Micro Study of remaining Windy Station and further Wind Monitoring Stations through C-WET	2.00	2.00	2.00	2.00	2.00	10.00
2. Maintenance of 3 permanent Wind Monitoring Stations	0.32	0.32	0.32	0.32	0.32	1.60
3. Installation of Wind Mills for water pumping		1.00	1.00	1.00	1.00	4.00
4. Wind Solar Hybrid System		5.00	5.00	5.00	5.00	20.00
Total –I Wind Energy	2.32	8.32	8.32	8.32	8.32	35.60
II. SOLAR ENERGY						
1. SPV Lanterns	40.00	40.00	40.00	40.00	40.00	200.00
2. SPV Pumps	53.20	53.20	53.20	53.20	53.20	266.00
3. SPV Street Lights	11.50	11.50	11.50	11.50	11.50	57.50
4. Repayment of IREDA loan	4.19	4.09	--	--	--	8.28
5. SPV Home Light Systems	11.40	11.40	11.40	11.40	11.40	57.00
6. Electrification of hamlets	--	61.00	61.00	--	-	122.00
Total –II –Solar Energy	120.29	181.19	177.10	116.10	116.10	710.78

Scheme	2002-03	2003-04	2004-05	2005-06	2006-07	Outlay
III. SOLAR THERMAL ENERGY						
1. Domestic Solar Water Heating Systems	23.10	23.10	23.10	23.10	23.10	115.50
2. Industrial Solar Water Heating Systems	7.70	7.70	7.70	7.70	7.70	38.50
3. Installation of Solar Water Heating Systems in Government Hospitals/Institutions	40.00	40.00	40.00	40.00	40.00	200.00
4. Installation of solar stills	0.30	0.30	0.30	0.30	0.30	1.50
5. Solar Passive Architecture System	12.25	12.25	12.25	12.25	12.25	61.25
6. Solar Air Heating Systems	10.50	10.50	10.50	10.50	10.50	52.50
7. Solar Cooker *	4.10	4.10	4.10	4.10	4.10	20.50
III.Total - Solar Thermal Energy	97.95	97.95	97.95	97.95	97.95	489.75
IV. BIO - ENERGY -						
1. Biogas Industries Sugar Mills	2.30	2.30	2.30	2.30	2.30	11.50
Maintenance of 9 CBPs	1.08	1.08	1.08	1.08	1.08	5.40
2. Gassifier Cooking application for Education Institutions	10.00	10.00	10.00	10.00	10.00	50.00
3. State Level Energy Park	0.00	0.00	60.00	0.00	0.00	60.00
Total – IV- Bio-Energy	13.38	13.38	73.38	13.38	13.38	126.90

Scheme	2002-03	2003-04	2004-05	2005-06	2006-07	Outlay
V. INTEGRATED RURAL ENERGY PROGRAMME	105.00	105.00	105.00	105.00	105.00	525.00
1. Continuance of IREP in 21 blocks – for devices - for staff	30.58	30.58	30.58	30.58	30.58	152.90 *
Sub - Total	135.58	135.58	135.58	135.58	135.58	677.90
2. Matching grant (10%) for IREP under International funding Assistance	50.00	50.00	50.00	50.00	50.00	250.00
Total – V – IREP	185.38	185.38	185.38	185.38	185.38	927.90
VI. Publicity	10.00	10.00	10.00	10.00	10.00	50.00
VII. Evaluation studies	0.00	6.00	6.00	6.00	6.00	24.00
VIII. Research and Devp	20.00	20.00	20.00	20.00	20.00	100.00
IX. Establishment cost	70.00	80.00	100.00	120.00	130.00	500.00
GRAND TOTAL	499.52	607.42	683.33	582.33	592.33	2964.93 or 2965.00
* Funded by Government of India						

Annexure - II
Year Wise Tenth Plan (2002-2007) Physical Targets

Schemes	Unit	2002-03	2003-04	2004-05	2005-06	2006-07	TOTAL X Plan Target
A. Wind Energy	MW	-	-	-	-	-	300
B. Co-generation, Bagasse and Biomass based power generation	MW	-	-	-	-	-	300
I. WIND ENERGY							
1. Micro Study of remaining Windy Station and further Wind Monitoring Stations through C-WET	Nos.	1	1	1	1	1	5

Schemes	Unit	2002-03	2003-04	2004-05	2005-06	2006-07	TOTAL X Plan Target
2. Installation of Wind Mills for water pumping	Nos.	-	5	5	5	5	20
3. Wind Solar Hybrid System	KW.	-	10	10	10	10	40
II. SOLAR ENERGY							
1. SPV Lanterns	Nos.	1000	1000	1000	1000	1000	5000
2. SPV Pumps	Nos.	70	70	70	70	70	350
3. SPV Street Lights	Nos.	100	100	100	100	100	500
4. SPV Home Light Systems	Nos.	200	200	200	200	200	1000
5. Electrification of hamlets	Nos.	-	61	61	-	-	122
III. SOLAR THERMAL							
1. Domestic Solar Water Heating Systems	Nos.	700	700	700	700	700	3500
2. Industrial Solar Water Heating Systems	Nos.	35	35	35	35	35	175
3. Installation of Solar Water Heating Systems in Government Hospitals/Institutions	Nos.	10	10	10	10	10	50
4. Installation of solar stills	LPD	50	50	50	50	50	250
5. Solar Passive Architecture System	DPR Buildings	5 2	5 2	5 2	5 2	5 2	25 10
6. Solar Air Heating Systems	Sq.M.	1000	1000	1000	1000	1000	5000
7. Solar Cooker *	Nos.	600	600	600	600	600	3000
IV BIOENERGY:							
1. Bio gas Industries Sugar Mills	Nos.	2	2	2	2	2	10
2. GASIFIER Cooking application for Education Institutions	Nos.	10	10	10	10	10	50
3. State Level Energy Park	Nos.	-	-	1	-	-	1
V. IREP Continuance of IREP in 21 blocks	No. of Blocks	21	-	-	-	-	21

Annexure – III
Specific Monitorable Targets

The following specific targets are envisaged for the tenth plan for propagating non-conventional renewal sources of energy.

Sl. No	Scheme	Units	Targets
1.	Micro Study of Remaining Wind Stations	Nos.	24
2.	Wind Mill Water Pumps	Nos.	20
3.	Wind Solar Hybrid System	KW	40
4.	SPV Lantern	Nos.	5000
5.	SPV Pumps	Nos.	350
6.	SPV Street Lights	Nos.	500
7.	SPV Home Lights	Nos.	1000
8.	Electrification of Remote Areas	Habitates in Numbers	122
9.	Domestic Solar Water Heaters	Nos.	3500
10.	Industrial Solar Water Heaters	Nos.	175
11.	Solar Water Heating System (Govt. Buildings)	Nos.	50
12.	Solar Stills	LPD	25
13.	Solar Passive Architecture System	DRPs Buildings	25 10
14.	Solar Air Heating Systems	Sq.M	5000
15.	Solar Cooker (Box Type)	Nos.	500
	(Dish Type)	Nos.	100
16.	Bio Gas Plant	Nos.	10
17.	Gasifiers (100 KW)	Nos.	50
18.	State Level Energy Park	Nos.	1
19.	IREP – Continuance of IREP in 21 Blocks: Rural Energy Programme with International Funding Assistance.	Nos.	21