The of energy, namely sun, wind, tide, biomass

The oil crisis was the sudden increase in oil prices by the petroleum-exporting countries of the Middle East which led to world-wide inflation. This caused a panic situation since petroleum had to be purchased at any price to keep the wheels of transport and industries moving. Concern over disruption has continued to be a major focus of energy policy in the industrialized countries. The energy crisis along with the realisation that petroleum is an exhaustible and non-renewable resource forced us to assess the situation and focus our efforts on the development of alternative sources of power that could provide sustainable energy development.

India has today among the world’s largest programmes for renewable energy. The spectrum of renewable and non-conventional energy sources today covers solar energy, wind energy, biomass tidal (ocean) energy and geo-thermal energy. A high-powered Commission for Additional Sources of Energy (CASE) was set up in 1981 and the Department of Non-conventional Energy Sources was formed in 1982.

In 1992 this department became a full-fledged Ministry of Non-conventional Energy Sources (MNES). With increasing demand for energy the non-conventional sources of energy, namely sun, wind, tide, biomass and energy from waste material; have gained importance in recent years. The non-conventional sources are abundant, renewable, pollution-free and eco-friendly. Therefore, this energy has a bright future. According to energy experts, the non-conventional energy potential of India is estimated at about 95, 000 MW.

(i) Biogas:

Biomass resources are a abduntly available in the entire country studies sponsored by the ministry has estimated that about 18000 MW of power can be generated from agro residue, covering agricultural and forestry residues excluding energy plantation in waste land and bagasse available in sugar mills. Biogasalso known as Gobar Gas or Garbage: Biogas is the energy' obtained from organic waste which is converted into energy by direct combustion or by the conversion of such wastes into alcohol, methane or other storage fuels.

Decomposition of organic matter yields gas, which has higher thermal efficiency in comparison to Kerosene, dung cake and charcoal. Livestock manure and crop residues are a huge source of self replenishing energy. Farm waste can be converted into methane gas (energy) and the residual waste can be used as fertilizer.

The energy is being used in villages for cooking, for lighting homes and roads and for irrigation. The National Project on Biogas Development was initiated in 1981-82 for the promotion of family type biogas plants which aim at providing clean and cheap source of energy in rural areas, producing enriched organic manure for supplementing the use of chemical fertilizers, improving sanitation and hygiene and removing the drudgery of women. Three types of designs of biogas plants namely, the floating drum type KVIC design, fixed dome type and bag type portable digester made of rubberised nylon fabric are being agated. Up to the ended the Ninth Plan a total of 35. 20 lakh biogas plants have been installed which are estimated to generate fuel gas equivalent to the saving of about 16 million tonnes tonnes of fuel

wood per year. Besides these plants are generating about 9. 4 MT of enriched organic manure per annum for supplementing chemical fertilizers and improving soil fertility.

National Programme on Improved Chulhas: The National Programme on Improved Chulhas (NPIC) launched with the objectives of fuel conservation, removal/reduction of smoke from kitchens, check on deforestration and environmental degradation, reduction in drudgery for women and employment generation rural areas. As a result of continuing R&D efforts, different types of improved chulhas of fixed and portable have been developed. While the traditional chulhas have a thermal efficiency of 8-10 per cent, the ‘ roved chulhas have a minimum thermal efficiency of 20-25 per cent. In order to ensure quality and ‘ rability, the Bureau of Indian Standards has already introduced an ISI marking scheme for portable chulhas.

(ii) Solar Energy:

The Sun is a vast inexhaustible source of energy. Solar energy is transmitted from the Sun in the form of electro-magnetic radiation.

Although the Earth intercepts only a very small part of this radiation, this tiny fraction is equivalent to 754 million kilowatts hours per year; photovoltaic technology converts sunlight directly into electricity. India receives about 20 MW/sq. km per year which is far more than the total energy consumption of the country. Solar energy can be converted into thermal energy with the help of solar collectors and receivers. Solar thermal devices can be used for water heating, space heating, cooking, drying, water desalination, industrial

process heating, steam generation for industrial and power [generation application, operation of refrigeration system etc.

Solar energy can directly be available in different ways: 1. In the form of heat. 2. In the form of organic chemical energy through photosynthesis. 3. In the form of photovoltaic power (generating electricity by means of solar cells). Thar Desert can become the biggest solar power house of India. Solar power plants have been installed at several places in the country.

The largest solar plant of India is located at Madhapur, near Bhuj, to sterilise milk cans. In many areas, solar domestic lights, solar lanterns and solar streetlights have been installed. Solar energy can be used to keep the building warm in cold seasons in cold areas. Solar Thermal Energy Programme: It is possible to generate 20 MW/sq km solar power. Presently, solar energy is being utilised through two different routes, namely, solar thermal (ST) and solar photovoltaic (SPV). The technology for the manufacture of the SPV cells and nodules has been developed and commercialised almost entirely on the basis of domestic R&D. About 23 MW of module production has been achieved, which accounts for 5 percent of the global production. More than 50 companies are involved in the production of SPV cells, modules and system and over 100 companies are involved in the local manufacture of ST systems and devices such as solar cookers and solar water heaters.

The Solar-thermal devices are being utilised for water heating, space heating, cooking, drying, water desalination, industrial process heat, steam generation for industrial and power generation applications, operation of

refrigeration systems etc. These devices have been placed under three categories, viz., low grade heating devices on temperatures up to 100 degree centigrade, medium grade solar thermal devices of temperatures between 100 degree C and 300 degree C and high temperature solar thermal devices of temperatures above 300 degree C. By making use of solar concentrators, steam at temperatures up to 1000 degree C can be generated. Low-grade solar thermal devices like solar water heaters, air heaters, solar cookers, solar dryers, etc. have already been developed and deployed in the country.

Solar water heaters of capacity ranging from 50 litre per day to 2, 10, 000 liter per day for domestic, commercial and industrial applications have been installed in the country. Over 7, 50, 000 sq mt of collector area has so far been installed ranging, from domestic water heaters of 50-100 litre capacity in over one lakh homes to industrial and commercial systems of up to 2, 40, 000 litres of hot water per day. The manufacturing base of solar water heaters is now well established in the country with 72 BIS approved manufacturers.

S. No. States/UTTotal Installed Capacity (MW) 20111.

Andhra Pradesh14. 02. Chhattisgarh4. 03.

Gujarat185. 04. Haryana2. 85. Karnataka6. 06. Maharashtra18. 07.

Odisha4. 08. Punjab4. 09. Rajusthan120.

510. Tamil Nadu7. 011. West Bengal1.

012. Delhi2. 1Total368. 4Around half a million box type solar cookers are also in use. The world’s largest solar steam cooked system for cooking food for 15, 000 people has been installed in October 2002 at Tirumala, Tirupati Devasthanam in Andhra Pradesh and is functioning well. Efforts are also on to make use of solar passive architecture principles to reduce energy consumption and improve the comfort conditions in buildings. Green House Technology for growing vegetables, flowers, etc, in cold climatic regions has also been successfully developed and introduced in the market. Marketing outlets, namely, “ Aditya solar shops” are being set-up in major cities and towns with a view to promote spot sale of NRSE systems and devices servicing and repair of such systems and devices and dissemination of information.

Jawaharlal Nehru National Solar Mission: During the year Jawaharlal Nehru National solar Mission (JNNSM) continued under implementation. Overall objectives for 2022, of this three phased Mission, include: (i) Deployment of 20, 000 MW of grid connected solar power; (ii) 2000 MW of off-grid solar applications including 20 million solar lights, (iii) 20 million sq. m. solar thermal collector area; (iv) to reate Favorable conditions for developing solar manufacturing capability in the country; and (v) support R&D and capacity building activities to achieve grid party. The, first phase aims at setting up of 1100 MW grid connected solar plants, 200 MW capacity equivalent off- grid solar applications and 7 million square meter solar thermal collector area till March, 2013.

During xne year 2011-12 under JNNSM 153 MW grid solar power projects have been commissioned by 31 January, 2012 the total installed capacity,

including the achievements under states initaative as on 31 January 2012 are given below. The grid connected solar under phase 1 of NNSM has two dub-components: 1, 000 MW of large capacity grid solar plants connected to 33 KV. Both the components have rooftop and small solar plants, connected to grids below 33 KV. Both the components have distinct objectives. Solar Photovoltaic Programme: The solar photovoltaic (SPV) systems have emerged as a useful power source in remote areas not only for applications such as lighting, water pumping and telecommunications but also as power plants for meeting the electricity needs of villages, schools and public health centres. Over 3, 00, 000 SPV systems aggregating about 160 MW have already been deployed. These involve around 40 different types of systems for rural, remote area and commercial applications, including home and street lighting/ water pumping and rural telecommunication systems. Solar lighting/ water pumping systems are now being used in more than 7, 70, 000 homes.

About 2, 20, 000 rural radiotelephones are also being powered by solar energy Under the SPV programme, about 5, 60, 000 solar lanterns; 3. 42 solar home lighting systems; 54000 solar street lighting systems; 7002 solar water pumping systems and non-grid power plants of 2. 9 MWp aggregate capacity have been installed till March 2006. In addition, SPV products of 54. 5 MWp capacity have been exported. The Ministry has also undertaken a programme for the electrification of remote villages through solar photovoltaic systems and devices and other renewable energy systems.

Till March 2006, 2483 remote viilages and 594 hamlets have also been electrified.

(iii) Wind Energy:

Wind energy is the fastest growing renewable energy for generation grid power amongst various renewable energy sources. A total capacity of 16179 MW has been established up to January 2012 in the country. Wind mills have been used since early times to provide power for grinding grains. Wind mills can also be used to generate electricity. The rotation of the wind mill caused by the force of the winds, causes the turbines to turn, thus creating electricity.

This electricity can be used for pumping water from wells, for lighting houses and for use in small industries. This technology has been especially developed in Netherlands, which is known as the “ land of wind mills”. Generally, winds are unpredictable and power production is not possible from winds of low velocity. The regions which experience strong and steady winds almost continually are best suited for the generation of power from wind mills.

The potential for wind power generation for grid interaction has been estimated at about 48500 MW taking site having wind power density greater than 200w/sq m at 50m hub-height with 1% land availability in potential areas for setting wind farm @12 ha/MW. Wind Power Potential: While the gross wind power potential is estimated at around 8, 500 MW, a total capacity of 17352 MW has been established up to February 2011 mainly in Tamil Nadu, Gujarat, and Maharashtra. Andhra pradesh, Karnatka and Rajasthan wind electric generators of nits size between 225 KW and 2. 1 MW have been deployed across the country.

(iv) Biomass Power:

The National Programme on Biomass Power/Coger. Ration aims at utilisation of a variety of biomass materials, namely, forestry-based and agro-based industrial residues and dedicated energy plantations besides forestry and agro residues for power generation through the adoption of conversion technologies. These technologies include combustion/incineration, pyrolysis, gasification, etc.

, using gas/steam turbine, dual fuel engine/gas engine or a combination thereof, either for generation of power alone or for cogeneration of a minimum of 1 MW capacity grid interfaced. The potential of Biomass power in the country has been estimated at about 19, 500 MW including surplus power generation potential of around 3, 500 MW from bagasse based cogeneration from existing sugar mills in the country. So far, a total capacity of 1101. 83 MW biomass based power generating systems has been installed in the country. Projects of a capacity of 564 MW are under installation. 14 states have announced their policies covering buy-back, wheeling and banking of generated electricity by the State Electricity Boards. Biomass Gasifier Programme: Gasifiers using biomass and wood chips have been developed for generating thermal energy for industrial applications, water pumping and power generation up to one MW capacity.

Biomass gasifiers aggregating to 55. 105 MW capacity have so far been installed in the country.

(v) Tidal or Ocean Energy:

The alternate rise and fall of the ocean waters twice in 24 hours are known as tides. In narrow estuaries, the sea-water rushes up with great force during high tides and such water runs down during low tides. These movements of water are harnessed to generate power, especially when the range of the tide is great. This energy is known as tidal energy. Normally, the tidal range is quite small and so tidal energy can be developed only in a few places. In India, the Gulf of Kachchh provides ideal conditions for utilizing tidal energy.

A 900 MW tidal energy power plant is proposed to be set up here by the National Hydro-power Corporation during the Ninth and Tenth Five Year plans. The various forms of ocean energy are waves, ocean thermal energy conversion, currents and tides. Of these, tidal energy has the potential for being harnessed in the medium term. The West Bengal Renewable Energy Development Agency, Kolkata has prepared a report for a tidal power project of three MW capacity at Durgaduani Creeks in Sundarbans area of West Bengal. The energy in the sea’s tide, which rise and fall every day, can be converted to hydro-electric power.

When the tide comes in, the water is stored behind a dam. When the tide goes out, the water flows from the dam through a turbine and produces electricity. The Central Electricity Authority, the Gujarat Electricity Authority and the Gujarat Electricity Board have carried out site studies for establishing tidal plants in the Gulf of Kachchh. India has excellent ocean thermal energy conversion (OTEC) potential and some of the world’s best sites are known to be located off the mainland of India and near the islands of Lakshadweep and Andaman and Nicobar Islands.

(vi) Geothermal Energy:

Geothermal Energy is the energy derived from the use of the heat in the interior of the Earth. When water seeps down deep cracks on the surface of the Earth, it turns into steam due to the heat of the Earth’s interior.

The steam rises to the surface with great force. This force turns turbines to generate electricity. A ten-year study conducted by the Geological Survey of India (GSI) showed that India has a tremendous potential of producing geothermal energy. Of the several hundred hot springs, reliable data was obtained on 113 springs. If all the 113 springs were developed, they could produce nearly 10, 600 MW of electricity. Two experimental projects launched to harness geothermal energy have been set up in India.

One site is located in the Parvati Valley in Himachal Pradesh and the other is located in the Puga Valley in Ladakh. Other suitable potential sites in India are located in Tapoban in the Uttar Pradesh hills and the Sarguja district in Madhya Pradesh. Geothermal Sites Tattapani Geothermal Fields, Chhattisgarh and Puga geothermal Fields, Jammu and Kashmir are the two geothermal sites which have the potential for development of power generation. Development of geothermal sites is still in a preliminary stage on account of uncertainties associated with its cost economics.