RENEWABLE ENERGY PROGRAMME AND VISION IN INDIA

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ABSTRACT

In the present world, renewable sources of energy have begun to make a significant contribution to meeting heat and power needs. In India, the Government is implementing a wide ranging programmes on renewable energy technologies. Several policy and fiscal measures have contributed to the rapid expansion of the progress during the last few years. This paper presents a review of renewable energy programme and vision in India. The present situation is seen to be much more promising and favourable for renewables.

KEYWORDS

Renewable energy; national programme; future vision.

INTRODUCTION

The growth of national demand for electric power in India is likely to be around 9% per annum over the next 15 years, requiring about 10,000 MW of capacity addition every year over that period. Demand is, therefore, expected to triple by 2010 from the present installed capacity of about 84,000 MW. It has been estimated that the present energy shortage results in an annual loss of production of about 2% of the national income. Despite of large resources poured into the power sector, the shortage of electricity persist. Uptill now, nearly 90% or more investment required for the power sector came from the public sector through Five year/Annual Plans (Parikh, 1997). Restoration of the financial health of the State Electricity Boards (SEBs) and improvement of their operational performance are the most critical issues in the energy sector. Improvements in the capacity utilisation of the existing power plants and in the distribution and use of electricity are required. At about 60%, the Plant Load Factor (PLF) continues to be low and Transmission and Distribution losses at 23% are very high, compared to international averages. Negligible revenue streams from the agricultural and domestic sectors have brought the SEBs to the brink of bankruptcy. The main challenge facing for Indian energy sector is the bringing about of power sector reforms and restructuring of the SEBs, with emphasis on tariff reform, privatisation of distribution and establishment of independent regulatory mechanisms. This process, already initiated in few States, needs to be expanded rapidly.
Fossil fuels will continue to be the major energy source, and will continue to play a critical role in the economy. India will have to continue to rely in large measure on its vast coal reserves as a source of power generation. At the same time there is a need to develop programmes and policies that will reduce dependence on fossil fuels in order to achieve sustainable economic growth and environmental stability. Three-fourths of all carbon dioxide released into the atmosphere comes from the production and use of energy. For every tonne of fossil fuel burned, at least three-quarters of a tonne of carbon is released as carbon dioxide. Other environmental concerns from conventional energy use relate to deforestation and declining soil fertility (MNES, 1996). These challenges of the present energy scene offer us a window of opportunity in the form of renewable energy sources to expand and diversify energy supply and shift the development path towards greater sustainability, as well as environmental and social responsibility. The renewable energy technologies are generally environment friendly and are likely to play an increasing role in the near future because of their capabilities to aid economic growth in underdeveloped regions beyond the reach of centralised power generation and distribution system, and their ability to help combat both global warming and other environmental problems. In rural areas, energy for cooking, lighting, water pumping, agro and rural industry and other productive activities can be effectively provided through locally available renewable energy sources. In remote areas, where transmission of grid power has been found to be totally uneconomical, off-grid electrification can be undertaken through renewable energy systems such as solar photovoltaics. Where appropriate, electricity supply requirements can also be met by hybrid systems integrating two or more sources, in conjunction with storage.

Scenarios projected by reputed international organisations covering the period up to 2060 have pointed to the increasing role and growing share of renewable energy in the world's energy demand, particularly in developing countries. A UN study (Johansson et al., 1993) concluded that "given adequate support, renewable energy technologies can meet much of the growing demand at price lower than those usually forecast for conventional energy". Another report of World Energy Council (WEC, 1993) describes that 18% of total energy used in the world is derived from renewables, primarily hydro power and biomass. Given strong international support at government level, it says, this figure might reach 30% by the year 2020. Several renewable energy technologies are now showing signs of being able to stand on their own in the foreseeable future, without subsidies. The recent surge of interest in renewables is on account of these developments, as also their declining costs, while fossil fuels are showing rising cost trends. In addition, the steady growing awareness of the importance of environmental protection is a major factor favouring renewables.

NATIONAL RENEWABLE ENERGY PROGRAMME

The Government of India recognised this potential of renewable energy as far back as 1982, when India became the first country in the world to set up a separate Department of Non-Conventional Energy Sources. This was followed in 1992 by the establishment of a full-fledged Ministry of Non-conventional Energy Sources (MNES), under the overall charge of the Prime Minister himself. The ministry is thus entering its 6th year in pursuit of its mission to promote renewable energy technologies and create an environment conducive for their commercialisation through innovative policy initiatives and strategies. The range of its activities covers renewable energy resource assessment, research and development, demonstration, extension and promotion in the areas of biogas, improved chulha/cookstoves, biomass, solar thermal and solar photovoltaics, wind energy and small hydro power. The sustained efforts of the Ministry have resulted in the creation of wide-spread awareness among policy makers, administrators, investors, industry, development agencies and the public about the benefits of the use of renewable energy systems and devices. Under the administration of MNES, Indian Renewable Energy Development Agency (IREDA) was established in 1987 to promote renewable energy technologies in the country. It provides finances to manufacturers, consultancy services to entrepreneurs, and also assists in the development and upgradation of technologies. The main renewable energy programmes in India are described in the following section.
Wind Energy Programme

The Wind Energy Programme is aimed at catalysing commercialisation of wind power generation on a large scale in the country. The programme involves Wind Resource Assessment to identify the potential locations for wind power generation; demonstration of new technologies and creation of infrastructure through a limited number of demonstration projects; development of commercial wind power projects; Research and Development; institutional finance for commercial projects; performance and monitoring; wind energy estates for small investors etc. According to a first order estimate, the total potential in the country could be of the order of 20,000 MW.

India now has the third largest wind power installed capacity in the world which has reached 820 MW. A programme for demonstration wind farms was initiated in 1985 and an aggregate capacity of 50 MW has been established in 23 locations in the country. Also demonstration projects of 3 MW capacity are under installation. Another feature of the Indian programme is the interest among private investor/developers in setting up commercial wind power projects. A capacity of 775 MW of commercial projects have been established by December, 1996, and is likely to cross 1000 MW by 1997 (MNES, 1997). Wind power development in India during last 6 years has been shown in figure 1.

A wind resource assessment programme covering 213 wind monitoring stations and 530 wind mapping stations is being implemented in 25 states. 77 sites have so far been identified in 8 States which have potential of over 4000 MW. About a dozen manufactures have taken up phased local manufacturing/assembly of wind turbines mainly through joint ventures and licensed production. A wind turbine Test Station is planned for standardisation, testing and certifications. A Wind Energy Development and Test Centre is planned for Kayalpam, with financial and technical assistance from DANIDA. The Centre will be responsible for developing standards and testing and certification of wind electric generators and equipment, conduct special technical courses and co-ordinate R&D activities (MNES, 1997).

Fig. 1 Wind power development in India (MNES, 1997)

Solar Photovoltaic Programme (SPVP)

Solar photovoltaics is one of the key programmes underway, particularly for decentralised applications in rural and remote areas. Photovoltaics is a simple, reliable and environmentally benign technology which is immediately available to provide electricity to widely dispersed households and farms. Today, India is
the second largest manufacturer in the world of solar photovoltaic panels based on crystalline silicon solar cells. The technology for the manufacture of these solar cells and panels has been developed and commercialised almost entirely on the basis of domestic R & D. Industrial production has touched a level of 8 MW/year in relation to a total world production of around 85 MW/year in 1995. There are now 13 companies engaged in the production of solar cells and modules and another 60 companies designing and supplying solar PV systems. Over 3,50,000 solar PV systems aggregating to about 25 MW have been installed (MNES, 1997). They involve different types of systems for rural, remote area and industrial applications. These include stand alone village home and street lighting; water pumping for drinking and irrigation; rural telecommunication; unmanned TV transmitters in remote area; the powering of refrigerators for vaccine storage in rural health centers, to name only a few. In recent years, major market-oriented programmes have also been launched for popularisation of solar water pumps and solar lanterns. The distribution (%) of solar photovoltaic systems installed on 31.12.96 is shown in figure 2. Over thirty thousand of street lighting systems were installed in the country through State Electricity Boards and Renewable Energy Agencies. More than 1,00,000 solar lanterns have been distributed so far. During 1996-97 it is proposed to deploy 35,000 solar lanterns, 10,000 domestic lighting systems and 500 street lighting systems. A total of 1778 pumping systems have been installed so far. The typical sizes of PV power plants range from 2 kW to 10 kW. A total of 178 such power plants have been installed with an aggregate capacity of 949 kW.

CUMULATIVE CAPACITY 25 MW
(Over 3,50,000 Systems)

Fig. 2 Solar photovoltaic systems installed in India (MNES, 1997)

Solar Thermal Energy Programme (STEP)

In India, after successfully demonstrating several applications, a Solar Thermal Extension Programme (STEP) was launched in 1984. Subsidy was provided to both individual and institutional users for solar water heaters, solar cookers, solar dryers etc. Several demonstration projects were also undertaken. The objective of Solar Thermal Energy Programme is to develop reliable, efficient and cost effective products and to ensure their wide spread utilisation to meet heat energy requirements for different applications in domestic, commercial and industrial sectors. The potential estimate for solar water heaters and solar cookers is around 13 million sq.m. of collector area and 20 million nos. respectively.

Solar water heating systems installed in the country range from a capacity of 50 litres of hot water per day for domestic use to 2,40,000 litres per day for industrial use. These systems are now being increasingly used in establishments like hotels, hostels, hospitals, dairies, textile mills and individual houses. About 20 research and demonstration projects have been funded by the Ministry since 80's on various aspects of
solar passive architecture. The projects cover classification of climatic zones, publication of books on solar passive design, development of instruments, development of computer software, etc. Experimental buildings were constructed in Jodhpur, Delhi and Srinagar. Solar passive houses and 'solar huts' were also constructed in Ladakh and hill areas of Himachal Pradesh and U.P. The buildings of the Solar Energy Centre of MNES also incorporate solar passive features. The cumulative achievements by the end of 8th National Year Plan (1992-97) include installation of 3.8 lakh square metres of solar thermal collectors (IREDA, 1997).

**Biogas and Biomass Programme**

In India a national programme for promotion of bagasse based generation for surplus power generation in the sugar industry has been initiated. India has over 400 sugar mills and there is an estimated potential of generating 3500 MW of surplus power. A Pilot Programme for promotion of biomass based power projects is taken up under this programme. The programme covers cogeneration projects of almost all categories. Under demonstration scheme of the programme capital subsidy has been provided to 12 projects distributed among the major sugar producing states in the country. During the year 1995-96, first four projects have been commissioned successfully. The largest of these has a gross installed capacity of 19 MW. India has the largest improved wood stoves programme in the world and over 22.7 million improved wood stoves have been installed so far. Under the National Biogas Programme about 2.37 million family size biogas plants have been installed in the country up to the year 1995-96, thereby covering about 20% of the estimated potential. Community/sanitary linked biogas plants are also being promoted. The scheme of setting up large sized bio-gas plants linked with community toilet complexes, added in 1993-94, was given a thrust during the 1995-96. About 1750 community, institutional and night soil based bio-gas plants had been installed up to 1995-96 (MNES, 1997).

Biomass Research Centres covering 9 agro-climatic regions of the country have been supported to develop mass scale capabilities to produce improved quality planting materials - both seeds and seedlings having the potential to produce about 15-20 tonnes or more of fuelwood per hectare per year in a rotation cycle of 5-6 years. R&D on biomass gasification is in progress at 4 Action Research Centres. Gasifier systems have been designed for a variety of biomass and integrated with different application packages to match the requirements of various user groups. Wood based biomass gasifier technology has been developed for ratings up to 500 kW capacity and systems up to 100 kW capacity have been successfully commercialised. Twelve models of gasifiers of different ratings and modes have already been promoted. Gasification of agricultural residues in the form of briquettes as well as in the powdery form is at an advanced stage of development. About 1600 biomass gasifiers with an aggregate capacity of about 22 MW equivalent of different capacities ranging from 3.5 KW to 500 KW have been installed for various applications such as water pumping, thermal and electricity generation. 16 non-electrified villages have been electrified through biomass gasifiers (MNES, 1996).

**Small Hydro Power Programme (SHPP)**

The small hydro programme is aimed at catalysing speedy development of micro, mini and small hydro schemes of up to 3 MW capacity for power generation from the otherwise dissipating energy in flowing waters at canal falls/irrigation dams, run-o-rivers and natural falls in the hilly areas having significant potential. In India, the potential for small hydro power projects (up to 15 MW capacity) is estimated about 10,000 MW. About 1600 potential sites with 7000 MW of aggregate capacity have already been identified. A capacity of 113 MW has so far been installed, and a capacity over 246 MW is under installation. Proposal for 1000 small hydro power sites are being developed. As on 31.12.96, 185 projects aggregating to 134 MW have been completed and 186 projects aggregating to 247 MW were under implementation. A scheme for portable sets up to 15 KW capacity for generation and distribution by village communities in the hill area has been evolved. A US $15 million UNDP/GEF project for optimising and development of small hydel resources in the Himalayan and sub-Himalayan regions has been initiated (MNES, 1997).
Apart from this, the Government of India also promote and support studies and research in new technology areas such as ocean energy, geo-thermal energy, alternate fuels for transportation, hydrogen energy and fuel cells.

CONCLUSIONS AND FUTURE VISION

Over the last decade, in particular, Government has endeavoured to lay the foundation for a broad-based renewable energy programme. Through various initiatives, grid quality power generation from renewables has attained maturity during the 8th Plan. The cumulative achievements of renewable energy sector by the end of 8th plan include installation of 2.5 million Biogas plants. 25 million improved chulhas, 3.8 lakh square metres of Solar Thermal Collectors and 28 MW installed capacity of Solar Photovoltaic systems [7]. The quantum leap made in the renewable energy projects is evidenced by the fact that in wind energy development, India with 900 MW of installed capacity, is third in the world. So renewables have a share of 1.5% of the total installed power generation capacity 1400 MW out of a total of around 88,000 MW. There is keen private sector interest for the manufacture of renewable energy equipment, development of power projects and in the service sector. The total annual turnover in this sector has reached about Rs. 2000 crore. It is proposed to add further 3000 MW of grid capacity from renewable energy during the 9th National Year Plan (1997-2002). Out of this 2000 MW is expected to come from wind energy. The plan also envisages installation of 1.45 million biogas plants, 25 million Improved Chulhas and 1.3 million square meters of solar thermal collectors (IREDA, 1997).

Setting of broad goals in a Perspective Plan, of say, 15 years, will accelerate commercialisation and help in the development and sustained growth of a sound renewable energy sector. Government is targeting generation of an additional 3000 MW of grid power from renewables by the end of the Ninth Plan (1997-2002). If a goal of 15,000 MW of renewable electric capacity is set by the year 2010, this would amount to a share of about 6% of the total projected installed grid capacity of 240,000 MW at that time. In other words, the goal would be an addition on average of about 1000 MW or 10% of the anticipated annual conventional power increment, each year, for the next 15 years. If such an expanded programme is to be achieved, an appropriate policy, institutional, financial and technological framework has to be put in place. It is within such a perspective that Government is promoting the renewable energy programme. The strategy for achieving these enhanced goals will depend on the active participation of all players - from Government agencies to NGOs, from manufacturers to R&D institutions, from financial institutions to developers and, of course a new breed of energy entrepreneurs - in this exciting endeavour.  

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