

OPTIONS FOR THE DEVELOPMENT OF RENEWABLE ENERGY RESOURCES

The Department of Science and Technology is responsible for introducing new renewable energy systems and appropriate technologies in the country. The standard approach is to select suitable options from possible alternatives in order to match domestic energy requirements. The appropriate options are selected, based on such criteria as (i) investment requirements, (ii) ease in implementation and maintenance, (iii) intervention requirements, and (iv) suitability for end use requirements.

Being a landlocked and mountainous country, Bhutan faces formidable problems in terms of transportation. The lack of accessibility will continue to be a constraint in locating and constructing energy projects. Other constraints to energy development in Thimpu District relate to manpower, finance, infrastructure, technology, and information.

Use of Appropriate Technologies

The use of appropriate technologies in harnessing the renewable energy resources, mainly solar, wind, and biogas, requires further research and development in Bhutan. The availability of adequate information

on district energy needs, constraints, and options is an essential prerequisite for sound energy planning and policy-making. However, technical information regarding various energy options are not readily available in Bhutan. The following paragraphs discuss options for the development of various renewable energy resources in Bhutan in general and in Thimpu in particular.

Options

Fuelwood. The annual fuelwood production from existing forests is enough to meet the present fuelwood requirements in the district. However, the amount of timber cut for fuelwood purposes may expand and reach alarming proportions with the increasing population and expanding road system. It is now feared that indiscriminate use of this natural resource could lead to large-scale deforestation.

Traditionally, the use of firewood in Bhutan is very wasteful. However, even this wasteful use of firewood seems more economical than electricity use at current prices of these energy sources. In this situation the rural households will continue to use firewood for cooking purpose.

A considerable saving in fuelwood can be achieved by the rural households by using improved smokeless stoves. A national project on smokeless stove has been launched by the National Women's Association of Bhutan. This project envisages producing 60,000 smokeless stoves during the Sixth Five Year Plan. The dissemination of improved cooking stoves should first be done in areas where there is scarcity of fuelwood. Subsidies on these stoves should be given only for an initial period to encourage their use. As women are the main users of stoves, they should be trained on stove maintenance and emphasis should be given to appointing women as stoves promoters. This project should encourage the development of local models of stoves. This is possible if local people and masons are trained as stove-makers.

Biogas Energy. One of the potential new sources of energy is biogas. It is an environmentally clean source of energy. Organic materials, such as animal and agricultural wastes, provide gases that can be easily used for heating and lighting. Biogas plants are technically feasible in the subtropical areas of the district, but they are not feasible in the cool areas because gas production decreases drastically below 10 degrees centigrade. One biogas plant has been tried successfully in a subtropical block of the district. However, economic analysis of biogas production has not been undertaken so far. The Science and Technology Division will also try another biogas plant in Thimpu by constructing a dome type concrete plant to study the effect of temperature on daily and seasonal variations in gas production. This Division is also planning to install individual biogas plants on a trial basis in each block in the subtropical areas.

Solar Energy. No measurements of solar energy insolation are available in Thimpu except "dry shine" data recorded by the Department of Forests. However, according to a rough estimate based on a theoretical calculation the daily insolation in winter months in the wider Valley of Thimpu is in the order of 14 MJ per square meter on a horizontal surface. The solar heating system being proposed now can probably provide sufficient energy for heating water for an average Bhutanese household for bathing and for washing clothes.

The Bhutanese Government has launched a "Rural Housing Project" through the Public Works' Department. The houses built under this project will use solar energy for lighting and heating water. The initial design and planning was done by the National Urban Development Corporation. The aim of the project is to make rural houses comfortable, warm, and clean. According to the Planning Commission, Nu. 800 million has been set aside in the Sixth Plan for subsidies to be given to families to improve rural houses. The subsidies would be in the form of hardware supplies for constructing toilets, smokeless stoves, window panels, and chemicals for treating shingles in order to extend their life from the present

five years to about 20 years. Solar power for lighting is also being considered in areas that are inaccessible to hydropower supply. It may be worthwhile and feasible to make use of solar energy in inaccessible alpine areas where grid extension is not possible.

There are several advantages of solar photovoltaics, for example, no maintenance and operation costs, high reliability, long lifespan, etc. However, they also have some disadvantages. Solar panels are still very costly, although their prices are expected to fall substantially in the future. Foreign exchange is required to import these panels from abroad. Moreover, electricity generation from solar panels is very small, thus limiting its application to small individual consumers.

In Bhutan, solar photovoltaic systems have been supplied to almost all wireless stations which require a small but reliable source of electric power to run the transmission sets. Helvetas, a Swiss Agency for Technical Assistance has demonstrated the feasibility of solar generators for certain applications. The Science and Technology Division, with UNICEF participation, proposes to install and demonstrate the use of solar energy in heating, drying, fencing, and in greenhouses.

Wind Energy. Strong winds blow during the winter months in the funnel-shaped Valley of Thimpu. The narrowness of Thimpu Valley can, therefore, provide a higher than average wind condition. A systematic survey of wind patterns and distribution has not been carried out in the district. Wind energy may be useful in isolated areas for generating electricity and for pumping water for irrigation and drinking purposes.

The Science and Technology Division plans to install high-tech windmills for lift irrigation within the country. These mills would be economical because they are practically maintenance free and involve low running costs. If this system is found profitable, the Agricultural Department may find it suitable for its irrigation programme.

Hydropower. It is the government policy to plan future, major water resources' schemes taking into consideration irrigation, flood control, electricity supply for domestic and industrial use, and wildlife development. A very rough estimate shows that about 20,000 MW of hydroelectric power can be harnessed in the country.

In relatively inaccessible areas, the Government plans to carry out detailed investigations and surveys on mini hydroelectric projects. A 30 kW micro-hydel project, constructed with Japanese aid is to be evaluated for economic performance.