ISEAS INSTITUTE OF SOUTHEAST ASIAN STUDIES

Renewable Energy Resources in ASEAN

Jürgen Steiger

ASEAN Economic Research Unit
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I INTRODUCTION

After the oil crisis in 1973/74 and especially after the rise of oil prices in 1979, a wave of adjustment policies and restructuring measures was adopted in the world energy economy. This process is also called the energy transition. Besides supply-oriented approaches, which encourage the identification and exploration of domestic energy resources, a wide range of actions for energy demand management has become necessary in oil importing industrialized and developing countries.

The various measures of demand management are often classified into three categories:

1. Energy conservation, defined as the reduction in energy consumption with the same level of benefits achieved without the reduction. This includes increases in the thermal efficiency of energy use.

2. Interfuel substitution, in which the emphasis is on substituting (imported) expensive or scarce forms of energy (mainly oil) through cheaper energy forms,

locally available, if possible. This measure may also entail energy import substitution.

3. Strengthening institutional and management capabilities in the energy sector.

It is obvious that a comprehensive strategy of demand management should involve all the elements mentioned above and would thus require policy instruments consisting of both pricing and non-price policies.

However, the choice of an energy strategy or a strategy mix of a country depends on a variety of factors, among which (relative) energy price, costs and the availability of energy resources are the major constraints.

Whereas the industrialized countries are generally able to finance the capital requirements for energy development and, at the same time, expecting lower growth rates of energy consumption, both absolutely and relative to the income growth, the developing countries are generally in a much worse position with regard to the adjustment to higher costs of energy. The main reasons are:

1) the lack of capital;
2) the higher energy coefficients, as energy consumption grows faster than national income (GSP), because of the rapid progress of industrialization and urbanization;
3) the low efficiency of the energy transformation technologies (power plants, equipments, vehicles, etc.) coupled with high energy losses;
4) the lower level of diversification of energy resources, and oil products compared to traditional

forms of energy;

5) the re-substitution of firewood and other traditional energies, mainly in the rural areas, causing environmental problems.

According to the World Bank, an annual investment of about US$130 billion (in 1982 dollars) will be required by the developing countries to finance energy development programmes, including a doubling of commercial energy production.[1] Calculations of UNIDO (United Nations Industrial Development Organization) show that in order to achieve the so-called Lima-target (an increase in the share of the developing countries of the world's industrial output to 25 per cent in the year 2000) a capital demand of US$5000-6000 billion would be necessary.[2]

Consequently, developing countries have emphasized the utilization of local energy resources, which could be harnessed without capital-intensive exploration and exploitation and which could be transformed into fuel by means of low-cost, appropriate technology. Among the possible alternative forms of energy, the development of renewable energy resources (RER) has been favoured in and for developing countries, because of their availability and potential. One can say that enthusiasm to use renewable energy (RE) technologies has arisen especially among the various donor countries which regard RER as a panacea to solve energy problems in the Third World.

Needless to say, the ongoing energy programmes in the field of conventional energy forms (electrification programmes and so forth) should not be neglected.

II RENEWABLE ENERGY RESOURCES

Definition

In order to characterize energy or energy forms, many terms and dichotomies may be distinguished. Energy in its natural form, that has not been transformed for use, is normally termed primary energy. Fuel or energy forms such as electricity, generated after the conversion of primary energy sources, are called secondary forms of energy. The classical distinction is between commercial, conventional or modern and non-commercial, non-conventional or traditional energy resources. The first-named includes coal, petroleum products, gas and electricity generated by burning one or another of these fuels. Wood, animal waste and agricultural residues are fuels of the second category and are generally used in the traditional (rural) sector. These forms of energy are largely synonymous with biomass fuels.

Renewable energy refers to fuel, the supply of which is partly or totally regenerated over time. It can also be grouped into a number of categories:

1) solar, wind and hydropower, where solar and wind energy can be understood as common (public) goods, and hydropower, which can be both a public and a

private good;

2) biomass;

3) fuelwood as a part of biomass. However, in many developing countries, such as in the central-zone of Africa, the Himalayas, the Andean Plateau of Latin America, and the arid areas of the Pacific coast in South America, firewood should no longer be regarded as a renewable source of energy;

4) geothermal energy, which is also regarded as a renewable form of energy;

5) other possible RER such as ocean thermal energy conversion (OTEC). Ocean energy and tidal energy are in the first stage of development in only a few countries and not relevant to the countries of the Association of Southeast Asian Nations (ASEAN) at present.

Although hydropower is generally a renewable source of energy, the conversion into electricity in large-scale hydroelectric power plants is not included in the RE technologies. Only the mini and micro-hydropower devices are included. All these RER are called "New and Renewable Energy Resources" for better distinction. This study deals only with these new energies.

As mentioned above, in order to convert raw materials or sources of energy into fuels, technologies such as solar water-heaters, windmills, micro hydro stations, distilleries or biogas plants and so forth, are needed.

The technologies are not necessarily "intermediate", "appropriate" or low-cost. Biogas, for example, can be generated in a high-cost reactor on a highly sophisticated

TABLE 1

Renewable Energy Resources:
Derived Energy Products and Conversion Technologies

Resource	Technology	Fuel Product	Application
BIOMASS			
1. Wood	Pyrolysis (Carbonization)	Charcoal	Domestic & Industrial fuel
	Gasification	Producer gas	Transport fuel
	Gasification/ liquefaction	Methanol	Power generation
	Enzymatic digestion and fermentation	Ethanol	
2. Agricultural Residues	Fermentation	Ethanol	
a) starch & sugar containing			several applications
b) other agri-waste	Gasification liquefaction	Methanol/ Ethanol	
	Anaerobic digestion	Methane (Biogas)	Cooking, lighting dual fuel, industrial fuel, electricity
3. Aquatic weeds	Anaerobic digestion	Biogas	
	Gasification and fermentation	Methanol/Ethanol	
4. Animal wastes	Anaerobic digestion	Biogas	several applications

TABLE 1 (Continued)

Resource	Technology	Fuel Product	Application
5. Urban Wastes* and Municipal sewage Industrial wastes	Anaerobic digestion	Biogas * direct conversion to electricity	
6. Examples for direct conversion of biomass into electricity: Wood, coconut oil, rice husk; all the fuels produced from biomass can also be converted into electricity.			
SOLAR ENERGY	Solar thermal a) conversion (solar collection) b) photovoltaic conversion (solar cells)		a) Drying Space-heating Water heating Cooking Space cooling Water pumping Water distillation b) Refrigeration Air-conditioning Water pumping Production of electrical energy
WIND ENERGY	Windmills Wind turbines		Water pumping Electricity generation
HYDROPOWER (Mini and Micro)	Water mills Water turbines Heat generator	a) Mechanical energy b) Electrical energy c) Heat	a) Small-scale industry, agricultural sector b) Decentralized rural electricity c) Drying
Geothermal Energy (Hydrothermal)	a) Direct use	Heat, water heating, process heat	Domestic, agricultural & industrial heating purposes
	b) Power generation	Power	Electrification

technical level as well as in a small family plant which should not cost more than S$1,000. Certain applications, such as the production of solar electricity or ethanol and methanol can only be undertaken by matured, highly sophisticated technology. It seems that government officials and energy experts in the Third World, as well as in ASEAN favour high conversion technologies and leave the utilization of small low-cost energy technologies to non-governmental organizations (NGOs) or self-help groups working with the rural poor. However, the choice of the energy technology should be determined by the national goals, target groups and, naturally, the forms of energy which are to be substituted or the energy demand which is to be met by renewable energy devices. Such considerations could be:

- to substitute firewood for cooking by low income families - that is, a basic-needs oriented approach;
- to substitute firewood and commercial energies used for the production of mass consumer goods, especially within the small-scale industrial sector;
- to substitute oil products used in the urban-industrial area (industrial sector and transport sector) and by high income families with other forms of energy.

The Significance of RE

The initial optimism regarding the application of RE technologies has been dampened after the first phase of innovation mainly because the capital cost proved to be higher than alternative conventional systems and because of limitations in the socio-cultural field. The solar cooker, for

example, which was introduced to reduce firewood consumption for cooking, has not been accepted by the majority of the rural population because of the role of fire and/or the importance of cooking over fire and the religious symbolic significance of the kitchen in Hindu society.

Another example of social constraints is in the use of biogas. While pig waste as a raw material is impure and therefore unacceptable in a Muslim society, human excrement and sometimes even dairy wastes cannot be used as a substrate for biogas generation in a Hindu community. Only cow-dung, as one of the five holy products of the cow, can be utilized without problems. These constraints, and there are many other examples, are normally not of interest to an economist and even less for economic calculations. But, as it turns out, many RE projects have failed in the past as a result of the non-consideration of such social factors.

According to the World Bank, the anticipation that developing countries would be able to harness the enormous potential resources of renewable energy has not yet been fulfilled for two principal reasons. Firstly, the development, adaptation and application of certain technologies have proved more difficult than anticipated, and their costs have not come down as quickly as was initially forecast (for example, solar cells). Secondly, the institutional and policy framework for the assessment and commercial exploitation of suitable technologies has been weak. The contribution of RE technologies to the total energy supply in developing countries has been estimated to be no more than 5 per cent by the year 2000.

In many countries, especially in the private sector, the motivation and willingness to develop alternative

energies has decreased since the oil price reduction in 1982/83. However, oil prices are likely to rise again in real terms during this decade, so that continued attention should be paid to reduce dependence on imported oil and to utilize local renewable energy resources. Moreover, the high demand of firewood in the rural areas of Indonesia, the Philippines and Thailand, which causes a high deforestation rate, justifies the utilization of (firewood substituting) RE technologies.

III THE ENERGY SITUATION IN ASEAN

ASEAN is well endowed with oil and gas reserves. Five ASEAN members are oil and gas producers, while Singapore is an important refinery centre of the region. Indonesia, as an OPEC (Organization of Petroleum Exporting Countries) member, and Malaysia and Brunei are net oil exporters whereas Thailand has gas reserves and the Philippines, some oil seepages.[3]

The high rates of economic growth in the ASEAN region are reflected in the rapid growth of energy demand at a rate of 14 per cent a year. The major part of the total energy requirements in ASEAN are met by oil and gas, and the degree of dependence on oil in relation to the total commercial energy consumption still lies in the range of 100 per cent for Singapore, over 90 per cent for Brunei, Malaysia, the Philippines and Thailand and about 82 per cent for Indonesia (because of the relatively high contribution of natural gas).[4]

The share of the other conventional energy resources, coal and hydroelectricity, still play a minor role, although a greater utilization of these forms of energy has been planned in the countries with an adequate potential.