

## TECHNICAL ABSTRACT

### Energy Policy and Renewable Energy Resources in Taiwan, R.O.C.\*

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#### STATISTICAL DATA

The gross national product in Taiwan increased from US\$7.2 billion in 1961 to US\$47.0 billion in 1982, with an annual growth rate of 9.2%. Per capita income increased from US\$584 in 1961 to US\$2,334 in 1982, representing an annual growth rate in per capita income of 6.7%.

Regarding energy consumption, the increase was from 4.3 million kilolitres of oil equivalent (K.L.O.E.) in 1961 to 28.0 million K.L.O.E. in 1982, or an annual growth rate of 9.3%. In 1982, industry accounted for 15.1 million K.L.O.E., or 54% of the total energy consumption; residential, commercial and other sectors accounted for 5.6 million K.L.O.E., or 20% of the total energy consumption; transportation accounted for 3.6 million K.L.O.E., or 13% of the total energy consumption; raw materials accounted for 2.8 million K.L.O.E., or 10% of the total energy consumption; and agriculture accounted for 0.9 million K.L.O.E., or 3% of the total energy consumption.

Concerning the structure of energy supply in 1982, out of a total of 31.7 million K.L.O.E., 20.0 million K.L. (20.0 million kilolitres) was provided by oil, i.e. 63% of the total. Coal, with a total of 5.7 million K.L.O.E. (8.3 million tons) provided a further 18% of the total; nuclear power provided 3.1 million K.L.O.E. (12.5 TWh), representing 10% of the total; natural gas provided 1.6 million K.L.O.E. (0.6 billion cubic metres), which was 5% of the total; and the remaining 1.3 million K.L.O.E. (4.8 TWh), 4% of the total, was provided by hydropower.

The reserve indigenous energy resources of Taiwan consist of 1.5 kilolitres of oil, 200 million tons of coal, and 23 billion cubic metres of natural gas. Production of indigenous energy supplies in 1982 consisted of 0.1 million kilolitres of oil, 2.4 million tons of coal, and 1.4 billion cubic metres of natural gas. Hydropower resources are estimated at 5,300 MW, of which 1,387 MW have already been developed.

#### ENERGY POLICY

For reducing the impact of energy problems in Taiwan, an "Energy Policy for the Taiwan Area" has been approved and promulgated by the government. Highlights of the contents are as follows:

1. Efforts should be strengthened to explore and develop indigenous energy, and emphasis should be laid on the diversification of imported energy forms and supply sources, while incentives should be offered to encourage investments in overseas energy development.
2. The price structure of various forms of energy should be correlated to each other and reasonable enough to reflect their real costs.

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\*Adapted, with permission, from notes given in a workshop on Energy Development Policies for the Asian Countries, Asian Institute of Technology, 9 August 1983.

3. Vigorous and intensified efforts should be made to plan and develop the import energy handling harbors and the corresponding inland transportation system and storage facilities.

4. For energy utilization and conservation, priority should be given to the industrial use of coal, and certain restrictions should be imposed on the use of local natural gas as industrial fuel, while energy-related equipment and appliances should be upgraded to improve energy efficiency.

5. Efforts should be made in the research and development of non-conventional energy sources which have potential for future use.

## ASSESSMENT OF RESEARCH AND DEVELOPMENT OF RENEWABLE ENERGY

Since Taiwan has meagre indigenous energy resources, research and development of domestic renewable energy resources is a major approach to reduce the dependence on imported energy. With due consideration to the physical environment and social conditions of Taiwan, a long-range development plan covering the period from 1983 through 2000 has been primarily proposed for six types of renewable energy, namely: solar energy, biomass energy, wind energy, geothermal energy, ocean thermal energy conversion, and small hydropower.

The research and development of six types of renewable energy are described as follows:

### 1. Solar Energy

Since Taiwan is located in the subtropics with an annual average insolation of  $1,236 \times 10^6$  kcal/m<sup>2</sup>, it is very conducive to the development of solar energy. Research items include: 1) solar water heating systems; 2) solar cooling systems; and 3) photovoltaic systems.

### 2. Biomass Energy

The main biomass energy resources applicable in Taiwan are: agricultural wastes and by-products, and wood or charcoal and hog waste. R&D items cover: 1) direct combustion; 2) synfuel from biomass; 3) methane from biomass; and 4) alcohol from biomass.

### 3. Wind Energy

According to the meteorological data there is a high potential for generating wind power along the coasts, in mountainous areas and on the off-shore islands of Taiwan. R&D of wind power generating technology in such areas will be the future objectives for electric power generation, cultivation of stocks and irrigation.

### 4. Geothermal Energy

According to the exploration data in the last 15 years, geothermal potential for generating electrical power in Taiwan has been estimated to be 970 MW. R&D of electric power generation and multiple-purpose usage of geothermal energy in very high potential areas will be strengthened.

### 5. Ocean Thermal Energy Conversion (OTEC)

The average temperature of the surface ocean water near the eastern coast of Taiwan is about 27°C, but the lower temperature of 7°C prevails at a depth of 700 m. The temperature difference is approximately 20°C, which is suitable for generating electrical power. According to the preliminary estimate, the potential in a square kilometre will be 45.6 GWh per year. Collection of basic data is under way. The research in the future will emphasize the investigation of the

characteristics of the ocean. When foreign technology in this field has been developed to its fullest extent, this technology may be transferred to others in due course.

#### **6. Small Hydropower**

Small hydropower potential in Taiwan is estimated to be 300 MW. Private investment in development of hydropower plants with an installed capacity of less than 20 MW is highly encouraged by the government. A full-scale islandwide investigation of all the streams and canals will be conducted in the near future. Some of the favorable locations will be first developed, especially where power is urgently needed.