

Renewable Energy in Hong Kong and Mainland China

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Hong Kong and Mainland China share many characteristics in social, economic, and energy development. China is a country with large population, fast economic development and large energy consumption. The existing energy structure of China is based on non-renewable fossil fuels (mainly coal), which inevitably leads to the continuing depletion of energy resources and the related environmental problems. Renewable energy, such as solar, biomass and wind energy, is important to China since it can reduce the heavy dependence on coal and help promote rural development.

Hong Kong does not have any indigenous fossil resources and depends totally on imported fuels for energy generation (mainly using coal). Diversification and cleanliness of generation technologies are important and renewable energy is an effective method to achieve this. However, the use of renewables is limited at present, as the incentives and government support to stimulate this market are lacking. It is essential for Hong Kong to develop a renewable energy market that will satisfy the local demands for green energy and enhance the renewable energy development together with her motherland.

Overview of Status and Development

With the fast expanding economy and improvement of people's living standards, energy demand in China will continue to grow in the coming decades. Table 1 shows a forecast of the primary energy demand and mix in China for the next 30 years. It can be seen that the total energy demand increases at a growth rate of about 3.2% each year. Non-fossil energy sources, including large hydro-power and renewable energy, will become more and more important in the energy mix.

Table 1 Forecast for the primary energy demand and mix in China *

| | <i>Forecast for the primary energy demand and mix in China</i> | | | |
|------------------------|--|------------------|------------------|------------------|
| | <i>Year 1990</i> | <i>Year 2000</i> | <i>Year 2010</i> | <i>Year 2020</i> |
| Total energy demand ** | 987 Mtce | 1,495 Mtce | 2001 Mtce | 2548 Mtce |
| Energy mix:- | | | | |
| • Coal | 74.25% | 71.23% | 68.63% | 63.08% |
| • Oil | 18.98% | 19.17% | 17.89% | 16.87% |
| • Natural gas | 2.01% | 2.66% | 3.99% | 6.29% |
| • Hydropower | 4.74% | 6.46% | 7.15% | 9.18% |
| • Others | 0.02% | 0.48% | 2.34% | 4.58% |

* Data Source: Zhou, Fengqi, 1996. Energy consumptions and air pollution issues in China, In *Proc. of the International Symposium on Sustainable Energy Development in Asia*, 8-10 May 1996, The Hong Kong Institution of Engineers - Electrical Division, Hong Kong, pp. 9.1-9.3.

** Mtce = million tons of coal equivalent

China has abundant sources of renewable energy and is exploiting them for meeting the needs of future energy demand and for creating a sustainable energy structure. Table 2 summarises the current status of renewable energy in China. As the bulk of the population lives in the rural areas (over 900 million people), energy development in the countryside is the most important in China. Renewable energy systems are effective for rural electrification and could ease acute energy shortage and pressure on electricity network extension.

Table 2 Current status of renewable energy in China *

| <i>Energy source</i> | <i>Item</i> | <i>Present situation</i> |
|----------------------|--|--|
| Biomass | <ul style="list-style-type: none"> • Biogas digesters for farmer • Firewood forest | <ul style="list-style-type: none"> - about 5.25 million sets, 1.2×10^9 m³/year - about 5.4 million hectares |
| Solar | <ul style="list-style-type: none"> • Hot water heater • Solar house (passive) • Greenhouse • Cookers • Drying • PV cells | <ul style="list-style-type: none"> - about 5 million m² - 2.7 million m² - 342,000 hectares - 150,000 sets - 20,000 m² - about 6 MW |
| Wind | <ul style="list-style-type: none"> • Water pumping machines • Mini-generators • Wind farms | <ul style="list-style-type: none"> - over 2,000 sets, total 2.11 MW - 150,000 sets, 15 MW - 14 farms, 30 MW |
| Small hydro | <ul style="list-style-type: none"> • Power station | <ul style="list-style-type: none"> - over 60,000 stations, about 17,000 MW and 34.3 billion kWh |
| Geothermal | <ul style="list-style-type: none"> • Power station • Direct use of heat | <ul style="list-style-type: none"> - 5 stations, 28.78 MW (excluding Taiwan) - 1.6981×10^4 TJ/year |
| Tidal | <ul style="list-style-type: none"> • Power station | <ul style="list-style-type: none"> - 8 stations, 11 MW |

* Source: Yan, Luguang and Li, Kong, 1997. The present status and the future development of renewable energy in China, *Renewable Energy*, 10 (2/3): 319-322.

Biomass

Biomass is a major source of energy in the rural areas of China. By the end of 1993, the volume of biomass resources, including crop residues, firewood, and various kinds of organic wastes, used in a year is equivalent to 260 million tons of coal equivalent (tce), which makes up to 70% of the total energy consumption in rural areas. At present, efforts are mainly focused on development of fuelwood forest, utilisation of biogas, promotion of fuel-saving stoves and study of biomass gasification technology.

Utilisation of biomass energy has a close relationship with the development in agriculture and waste disposal practice, and should be considered in context. For example, biomass energy can be used for drying and processing agricultural products; the effluent from biogas digesters is a good nutrition for fish-farming and a fertilizer for vegetable growing; the residues from digestion can be used for growing mushrooms and earthworms, as well as fertilizers for farmland. In developed urban cities like Hong Kong, the main driving forces for waste-to-energy development are likely to be waste disposal and recycling policies, although energy recovery should be given credits to.

Solar

Utilisation of solar energy in China is mainly in the form of solar water heaters, passive solar houses, solar cookers, and solar dryers. Solar water heaters have been widely used in China, either as a large-scale separate system or as an integrated collector-storage system for domestic sectors. Most of the solar water heaters in China are of thermosyphon type. At present, work is being done to develop all-glass evacuated tubular collector and heat-pipe evacuated tubular collector.

Passive solar houses are growing popular in northern and central China. Guidelines and data have been developed to help architects and engineers achieve the maximum benefits from the climatic conditions when designing them. Solar cookers are used to solve the shortage of firewood for cooking in the northern provinces of China such as Gansu, Qinghai, Hebei and Inner Mongolia. Solar dryers are used for drying agricultural products, foods, lumber, medicine herbs and industrial materials.

A new and potential area of solar energy is the solar photovoltaics (PV). Solar PV systems are now mainly used in small-scale applications in telecommunication, meteorological stations and military installations. Large-scale central power generation using PV technology is being investigated in Mainland China and building-integrated photovoltaics (BIPV) is being studied in Hong Kong. Future PV development in China will focus on efficiency improvement, cost reduction and integrated applications.

Wind

Wind energy resources in China are estimated to be around 3.2 million MW, 10% of which are available for exploitation. Areas rich in wind energy potential include the coastal provinces in southeast China, north of Inner Mongolia, Gansu province, north of Xinjiang, and the down stream of Songhua River. Wind energy has been used for water pumping for a long time in China. Some 2,000 wind pumps now operate across the country, particularly in the coastal regions.

Wind turbine for electricity generation was developing in China since 1980s. Mini- and small-size wind machines (up to 1 kW) are now mature in technology and have been commercialised and used in Inner Mongolia, Xinjiang and Qinghai. Large-size wind turbines imported from other countries were used in some pilot sites. Up to 1995, 14 wind farms have been built in China, with 106 wind turbines operating on line with the electricity grids. It is believed that wind turbines can supply electricity to remote locations and contribute to rural electrification of the country.

Small Hydro

Small hydro-power (SHP) stations also play an important role in the implementation of rural electrification in China, since the rural areas in the hilly regions of China are rich in small hydro resources. By the end of 1993, more than 60,000 SHP stations have been put into operation with total installed capacity of 17,000 MW. Most of the SHP stations in China are run-of-the-river types with a water head of as low as 3 metres. Although quite a large amount of small hydro-power installations have already been used in China, the market and potential for new installation is still great.

Other Renewables

Geothermal energy is another important heat and energy resources in China. The geothermal resources in China are mainly located in the southeast coast and the southwest plateau, such as Fujian, Guangzhou, south Tibet, west Yunnan and west Sichuan. Depending on the temperature, these steady energy sources can be used for power generation, greenhouses and pools for agriculture, heating for buildings, and hot water

supply. The famous Yangbajin geothermal power station in Tibet, with an installed capacity of 25 MW, is the largest one in China.

The long coastal line of China also provides opportunities for exploiting energy resources of the ocean. Some tidal power stations have been built along the coastal areas in Guangzhou, Fujian and Zhejiang provinces. Wave-activated generation devices have been widely used for navigation buoys and light ship to convert wave energy into electricity. Research studies are also being made on ocean thermal energy conversion (OTEC) and energy conversion from salinity difference of fluids.

Policies in China

China has shown much concern about the development and utilisation of renewable energy. Since the Sixth Five Year Plan in 1981-85, the research and development of new and renewable energy have been included in the national program. Many universities, colleges and research units have taken part in these projects and hundreds of enterprises have been engaged in the production of renewable energy products. Over ten ministries and commissions under the central government have set up agencies or appointed officials to be in charge of the development of renewable energy.

Renewable energy is also stressed in the "*China's Agenda 21 -- White Paper on China's Population, Environment, and Development in the 21st Century*". The promotion and uptaking of renewable energy technologies are put into the economic programs at national level and local government level, so as to achieve sustainability for the country. The fundamental policy in China can be summarised by the Chinese words as follows, which means "site specific measures; inter-supplemented energy sources; multi-purpose utilisation; effectiveness of development":

因地制宜，多能互補
綜合利用，講求效益

According to the Chinese Government's "*Program on New and Renewable Energy Development in China (1996 -- 2010)*", the overall objectives in China in the coming years are to raise the conversion efficiency, lower the production cost, and increase the proportion in the energy constitution. From now on to year 2000, a number of renewable energy technologies will mature from research and demonstration, and they will be commercialised by extending their usage and entering the market. The traditional low-efficient way of biomass utilisation will be gradually improved, while solar and wind energy will be developed for supplying electricity to remote areas. For the period from 2001 to 2010, new techniques of renewable energy resources will be commercialised, and industry scale and research systems for them will be established. Main technical items should reach the level of mass production at that time.

Considerations in Hong Kong

Unfortunately, no data is available to show how much renewable energy is now being utilised in Hong Kong. It is believed that only a very limited number of projects have adopted any forms of renewable energy scheme, such as solar water heating systems, and these are primarily demonstration projects. Lack of incentives and shortage of land and space remain the key limiting factors in Hong Kong.

However, it is believed that some technologies that can be integrated into the urban environment could be used in Hong Kong, such as building-integrated PV. Countrysides and new towns in Hong Kong are potential candidates for small renewable energy systems, such as solar thermal, biomass and wind. Technologies involving the conversion of waste to energy may also help alleviate the problems associated with waste treatment and disposal.

As Hong Kong has been returned to the People's Republic of China on 1 July 1997, there are more opportunities for developing renewables through partnerships between Hong Kong and Mainland China. Making use of its financial strength and communication networks, Hong Kong may profit economically by manufacturing equipment, involving in financing and research, and promoting projects in our region for renewable energy technologies. In order to seize the opportunity, the existing institutional barriers to renewables should be removed and incentives and government support are needed to stimulate the renewable energy market in Hong Kong.

Conclusion

China will be a major interest for energy development in the Asia-Pacific region and in the world, since a large part of the increment in energy use and industrial production over the next few decades is likely to be concentrated in China. Development of renewable energy is an important element in the national strategy of China and will determine how sustainable its energy structure will be in the 21st century.

This article only provides a brief overview of the development of renewable energy in Mainland China and Hong Kong. The diversity and complexity of renewable energy technologies have made a short description of them almost impossible. It is hoped that through communications and sharing of experience, a better understanding on renewables can be developed for creating a sustainable energy future.

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Photos

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| Photo01 | Biogas generator developed in Chengdu (Sichuan) |
| Photo02 | Solar water heating system in a hospital in Hong Kong |
| Photo03 | A solar cooker in Lhasa (Tibet) |
| Photo04 | Wind turbines in Nanao (Guangdong) |
| Photo05 | Yangbajin geothermal power station in Tibet |
| Photo06 | Wave-activated generation device in a navigational buoy (Guangdong) |

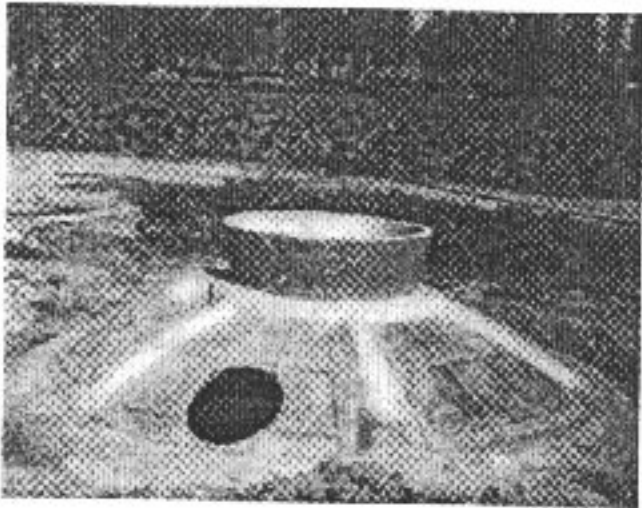


Photo01.JPG

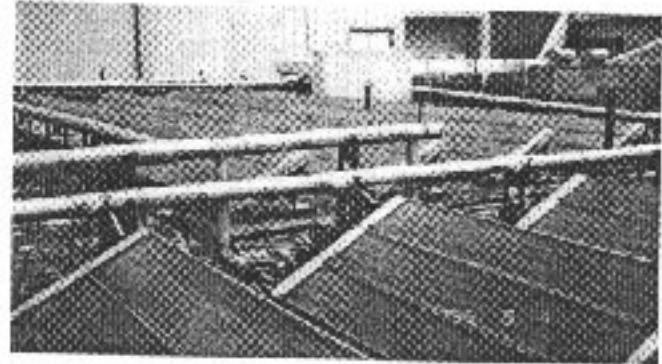


Photo02.JPG

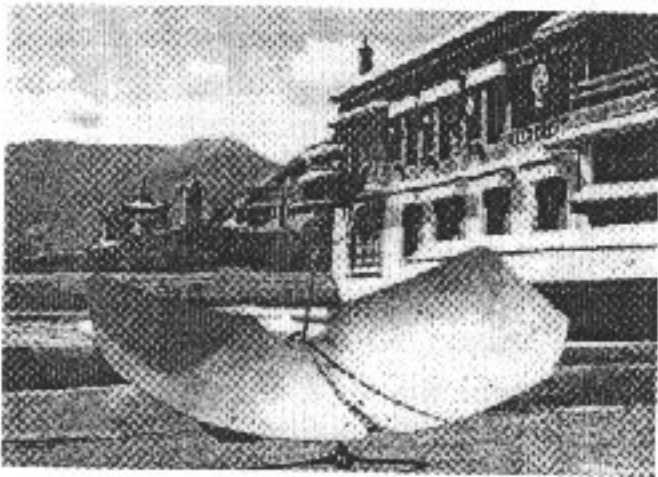


Photo03.JPG



Photo04.JPG

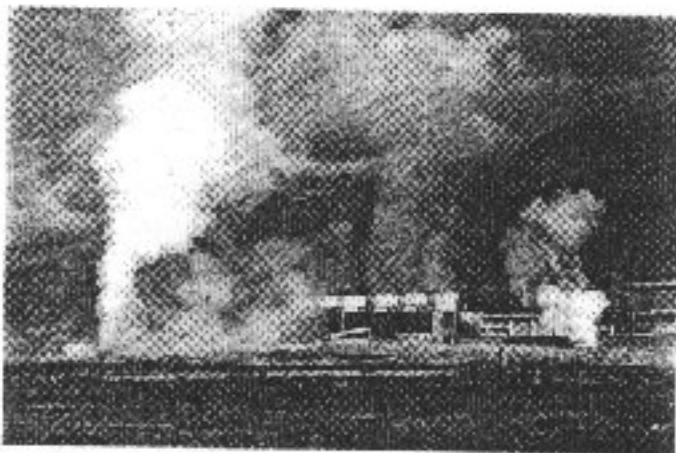


Photo05.JPG



Photo06.JPG