



Renewable Energy in China

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The most prominent feature of China's energy consumption is its heavy reliance on coal. Coal—a highly polluting energy source—comprises about 75 per cent of China's total primary commercial energy use. This coal-dominant energy structure has serious environmental consequences. Locally, emissions of sulfur dioxide (SO₂) and particulates from burning coal affect air quality and increase respiratory problems; regionally, SO₂ from China is causing acid rain damage (soil degradation, deforestation and agricultural losses) in Korea and Japan; while on the global level, carbon emissions from fossil fuels are the culprit for climate change. As China's economy is expected to maintain its high growth rate, continued rapid increases in energy demand are inevitable. Therefore, the Chinese government is beginning to aggressively develop clean, renewable energy sources such as hydro, biomass, solar, and wind energies as a means to satisfy the country's development and energy needs in a sustainable manner.

I. Potential and Current Development of Renewable Energy in China

China is rich in renewable energy resources. Since the 1970s, the Chinese government has recognized the importance of developing renewable energy for off-grid rural and remote areas and supported development of small hydropower, biogas, and small wind turbines to provide energy and electricity to those isolated populations. While progress has been achieved in developing renewable energy in rural areas, the potential for expanding the use of this clean energy throughout China is great.

- China's wind capacity is officially estimated to be 253 gigawatts (GW) (Shi 1995; Gu & Liu 2000), distributed mainly along the coastline and in the northern provinces including Inner Mongolia, Xinjiang and Qinghai. However, by the end of 2000 the grid-connected wind power stands only at 345 megawatts (MW).
- Potential biomass energy resources (e.g., agricultural wastes) are estimated to be 650 million tons of standard coal equivalent (Mtce), which equals half of China's current primary energy consumption (Zhang & Shi 2000).
- In two-thirds of the Chinese territory, the solar radiation intensity exceeds 140kcal/m²/hr with duration of over 2000 hours per year. Currently, China has the world's largest and fastest-growing market for solar water heating. The photovoltaic (PV) market is small but growing rapidly. There was over 19 MW of photovoltaic equipment installed in 2000.
- There are 3200 locations with geothermal reserves in China. Low and medium-temperature reserves in over 40 geothermal farms contain approximately 3160 Mtce (Zhang & Shi 2000, Gu & Liu 2000). High-temperature geothermal reserves that can be used for power generation are equivalent 5800 MW.
- The exploitable reserve of small hydropower stands at around 75 GW. By the end of 1998, there were over 44,000 small hydropower plants with a total installed capacity of 22 GW (Gu & Liu 2000).

The Chinese government has, in recent years, increased its commitment to the development of renewable energy, as outlined in the *New and Renewable Energy Development Program 1996-2010*. Jointly developed by three key government commissions—the State Planning Commission (SPC), State Economic and Trade Commission (SETC), and State Science and Technology Commission (SSTC), this program aims to improve the efficiency of renewable energy, reduce production costs, and enlarge the share of renewable energy in the overall energy mix. The 1995 *Electricity Law* also extends support to solar, wind, geothermal and biomass energy for power. In the newly-released five-year plan for industrial development, SETC sets the target of 1.2 GW electricity production from new, renewable energy for the power industry, a nearly four-fold increase from last year's production of 330 MW.

(<http://www.setc.gov.cn/home/index.htm>)

II. Obstacles to China's Renewable Energy Development

China's abundant renewable energy resources and huge potential market, combined with the growing concern about energy-related environmental problems, have fueled the demand for more vigorous development of renewable energy. However, a series of institutional, financial, and technical barriers have to be overcome before significant progress can be made in developing such clean energy sources.

- Lack of awareness of the potential for commercial applications of renewable energy among Chinese decision-makers still constrains the policy support for renewable energy development.
- Current government renewable energy policy lacks specific, clear long-term development objectives, workable incentives, and financing mechanisms.
- Funding for research and development is inadequate.
- Insufficient market regulation and the lack of industry standards suppress demand because of widespread product quality and service problems.
- Current renewable energy applications are small and scattered and thus incapable of achieving economies of scale.
- Information exchange is inadequate among renewable energy research centers and industries because of institutional fragmentation as well as their geographical isolation. The renewable energy industry in China has a somewhat limited access to recent technological advances in other countries due to restrictions (e.g., relating to intellectual property rights).
- Commercial experience is lacking in the Chinese renewable energy community.

III. International Support for China's Renewable Energy Development

China's efforts to develop renewable energy have received strong support from the international community. International and regional development agencies (the World Bank, UNDP, Asia Development Bank) have provided financial assistance for renewable energy development in China. Some countries, including the United States, Australia, and the Netherlands also are actively involved in bilateral aid and technical assistance for renewable energy. Some examples of multilateral and bilateral renewable energy projects are summarized below:

Technology Cooperation Agreements Pilot Project (TCAPP) TCAPP is an initiative of the U.S. government that is assisting developing countries in attracting clean energy investments that will meet their development needs and reduce greenhouse gas emissions. In late 1997, TCAPP was initiated in China. In April 1999, the State Development Planning Commission of China (SDPC) and the U.S. Environmental Protection Agency signed a Statement of Intent for a three-year effort (Clean Air and Clean Energy Technology Cooperation project). The National Renewable Energy Laboratory (NREL) leads the TCAPP implementation for the U.S. government and SDPC is the lead organization for this project in China. Teams have been formed to work on the following six fields: wind resource assessment; wind turbine testing for certification; wind business partnerships; motors training; motor testing, labeling, standards, and certification; and motor financing and business partnerships. (www.nrel.gov/china)

The U.S.-China Protocol for Cooperation in the Fields of Energy Efficiency and Renewable Energy Technology Development and Utilization This Protocol was signed February 1995 by the U.S. Department of Energy and the State Science and Technology Commission and renewed for five years in April 2000. It focuses on three goals: 1) to help China diversify its energy resources and thereby reduce its future demand for oil; 2) to mitigate environmental damage associated with energy consumption through deployment of renewable energy and energy efficiency measures; and 3) to enhance U.S. industry competitiveness in China's energy market. Seven specific Annexes to the Protocol have been developed and are now operating. Five annexes pertain to renewable energy, which NREL implements in collaboration with various partners in China: rural energy, wind energy, business development, geothermal energy, and policy and planning. (www.nrel.gov/international/china/protocol.html)

World Bank/Global Environmental Facility (GEF) Renewable Energy Program: China-Renewable Energy Development Project This project aims to establish sustainable markets for wind and PV technologies so as to supply electricity in an environmentally sustainable manner and to provide modern energy to remote rural populations. The World Bank and GEF will provide \$100 million and \$35 million in funding, respectively. The project was approved in June 1999 and is now underway. (<http://www.worldbank.org.cn/english/content/702q1225506.shtml>)

UNDP/GEF Capacity Building for the Rapid Commercialization of Renewable Energy Program

Launched in April 1999, this five-year program consists of capacity building, technical assistance, and technology transfer activities that address the challenges to the commercialization of renewable energy in China. It couples capacity building activities in the fields of resource assessment, standards development, and business and finance, with work in specific market sectors (bagasse, biogas, hybrid village systems, and large-scale wind). This project led to the establishment of the Chinese Renewable Energy Industries Association (CREIA). This project is jointly financed by the Chinese, Australian and Dutch governments and GEF and implemented by UNDP in partnership with the SETC and the Chinese State Environmental Protection Administration. (<http://www.ccre.com.cn>)

World Bank Renewable Energy Scale-up Program This program will help enable commercial renewable electricity suppliers provide energy to the electricity market efficiently, cost-effectively, and on a large scale. It aims to support the implementation of a national policy framework that would require a share of electricity to utilize renewable resources—a mandated market policy. This mandated market policy is required to address the failure of the market price for thermal electricity to reflect the pollution costs that burning fossil fuels has had on society. This program will support implementation of necessary laws and/or regulations, as well as a range of other measures to strengthen commercial capacity to scale up renewable energy markets. The program will also directly support a small number of investment projects. Project preparation is under way. (www.worldbank.org.cn/english/Project/ProjectPrepare.asp)

IV. U.S. Environmental Nongovernmental Organizations in China

Over the past five years, U.S. environmental nongovernmental organizations (NGOs) and universities—often in partnership with the U.S. Department of Energy and Chinese government agencies—have become increasingly active in energy projects and research in China. The Energy Foundation, David and Lucile Packard Foundation, and the W. Alton Jones Foundation are the main grant-giving organizations supporting such NGO activities in China. The NGOs most active in this area include: Natural Resources Defense Council, Joint Institute for Energy and Environment, International Fund for China's Environment, Center for Resource Solutions, WWF-China, Solar Electric Lighting Foundation, and Greenstar. (Full updated descriptions of most of these NGO projects can be found in the Wilson Center's *China Environment Series* Issue 4 at <http://ecsp.si.edu>).

V. Useful Links for Additional Information on Renewable Energy in China

Renewable Energy Project (SETC, UNDP and GEF): <http://www.ccre.com.cn>

Embassy of the United States of America in China: <http://www.usembassy-china.org.cn/english/sandt/index.html>

National Renewable Energy Laboratory: <http://www.nrel.gov/china>

Nautilus Institute: <http://www.nautilus.org/energy>

Pacific Northwest National Laboratory: <http://www.pnl.gov/china>

World Bank (China Country Office): <http://www.worldbank.org> (<http://www.worldbank.org.cn>)

Chinese Renewable Energy Industries Association: <http://www.creia.net/home.asp>

Internationally supported renewable energy projects: <http://www.ccre.com.cn/projectdatabase/asp/Database.htm>

References and Short Bibliography:

Gu Shuhua and Liu Wenqiang. 2000. "The Role of Renewable Energy Options in China's Present and Future Energy System." Paper presented at the "Regional Collaboration for Energy Futures and Energy Security in China and Northeast Asia" Workshop, June 14-15, Tsinghua University, Beijing, China.

Jan Hamrin, 2001. "Renewable Energy Gains Currency Towards a sustainable Energy Path in China," in *Refocus Magazine*, April 2001.

Debra Lew, "Micro-hybrids in Rural China: Rural Electrification with Wind/PV Hybrids," *Renewable Energy Focus*, pp 30-33, April, 2001.

Debra Lew and Jeffrey Logan, "The Answer is Blowin' in the Wind," China Online, http://www.chinaonline.com/commentary_analysis/thiswk_comm/010312/c01030960.asp, 12 March 2001.

Martinot, Eric. 2001. "World Bank Energy Projects in China: Influences on Environmental Protection." *Energy Policy*. (29): 581-594.

Michael B. McElroy, Chris P. Nielsen, and Peter Lydon, Eds. 1998. *Emergizing China: Reconciling Environmental Protection and Economic Growth*. Harvard University Press.

National Research Council, Chinese Academy of Sciences and Chinese Academy of Engineering. 2000. *Cooperation in the Energy Futures of China and the United States*. Washington, D.C.: National Academy Press.

Shi Pengfei, 1995. "Brief Introduction to the Future Development of Wind Farms and Market Potential in China (1995-2000)." Paper presented at the special session for commercial affairs, Beijing International Wind Energy Conference, 9-13 May, Beijing.

World Bank. 1998. *China - a strategy for international assistance to accelerate renewable energy development*. [On-Line]. Available: http://www-wds.worldbank.org/pdf_content/0000092653980702115933/multi_page.pdf

Zhang Aling & Shi Ling. 2000. "Prospect for and Impact of Diversifying China's Fuel Use Away from Coal." Paper presented at the "Regional Collaboration for Energy Futures and Energy Security in China and Northeast Asia" Workshop, June 14-15, Tsinghua University, Beijing, China.