

Renewable Energy Applications for Rural Development in China

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ABSTRACT

This paper provides a description of current work to promote and support the developing market for renewable (RE) and energy efficiency (EE) technologies in China. Since the signing of the US/China Protocol for Cooperation in the Fields of Energy Efficiency and Renewable Energy Technology Development and Utilization in 1995, NREL has helped to promote RE and EE technologies, specifically rural energy, wind energy, geothermal energy, and renewable energy business development, in addition to more general policy and planning support. This paper focuses on NREL's work in support of the \$240 million Township Electrification Program, which is providing power to over 1000 rural communities using renewable based energy sources.

1. Objectives

Activities under the NREL China program support the following three main program objectives:

- Provide data and analysis on cost, performance, and reliability of fielded PV systems (MYTP Table 4.1.1-6, Tasks 7-8, Milestone 35).
- Remove barriers to the widespread deployment of solar technologies (MYTP Table 4.1.1-6, Tasks 9-10, Milestones 42, 50).
- Execute DOE commitments in international agreements and activities (MYTP Table 4.1.1-6, Task 10).

Specifically, in 2001 the Chinese Government initiated the Township Electrification Program (TEP), a national program to provide power to the primary community in remote townships, which are equivalent to counties in the United States. Due to the costs of extending power transmission to these remote areas, the government decided to rely completely on renewable technologies to meet the electricity needs of these communities. During 2002 and 2003 the Chinese Government spent \$240 million on hardware to electrify one million people in more than 1000 villages, primarily using PV and wind technologies. In the follow-on phase to the TEP, the Village Electrification Program, the government has set a goal of providing power to the remaining 22,000 unelectrified villages within these townships, again using renewable technologies. However, the initiation of the second phase is dependent on the success of the current program, making its success critical.

2. Technical Approach

Over the last year, NREL's China program has focused on the following objectives:

- Promote U.S. renewable energy industry goals in China and support business development efforts.
- Support development of sustainable renewable energy-based rural electrification infrastructure in China.
- Leverage and coordinate with Chinese government investments and donor community support for geothermal heat pump, photovoltaic, small wind, grid-connected wind, and mini-grid technologies.
- Support development of market-based wind industry in China, especially as it relates to US developers and manufacturers.

This paper concentrates on activities within rural energy.

2.1 2004 Program activities in rural energy

To help ensure the success of the Township Electrification Program, over the last two to three years NREL has provided valuable contributions to educating national and provincial decision-makers, providing input on ownership issues, developing a technician training infrastructure, successfully implementing a training certification regulation, and providing support for village power system design analysis. Activities over the last year have included:

- Training for village power systems owners, including appropriate tariff identification, village operator certification, baseline studies and monitoring, and management modeled after renewable energy service companies to help ensure that once power systems have been installed, they operate in a sustainable manner.
- Options analysis training through capacity building for system integrators in design and issues related to village power systems, specifically using the HOMER and Hybrid2 software.
- Technology transfer for village power system components to ensure installed power systems operate as expected over their design life.

3. Results and Accomplishments

NREL has made significant accomplishments in the above first and last topic areas.

3.1 Village power system sustainability

To support the development of sustainable village power projects, NREL has assisted in the activities of the United Nations Environmental Program (UNEP) by providing technical assistance with the commissioning of five power systems in a remote area of the Xinjiang Autonomous Region, the most western province in China along the famed Silk Route. The five Bulunkou power systems combined PV and wind with batteries and diesel engines to provide 24-

hour, year-round electric supply. The power systems were installed in four villages within the Bulunkou Township and one hotel as a demonstration of local economic development. A key element of the UNEP program is to develop a Rural Energy Service Organization based in the local government to operate and maintain the power systems. NREL assisted in training local staff in community survey techniques and conducting an analysis of possible productive use opportunities within the communities—both activities that will support the development of the Village Electrification Program.

3.2 Village power development and technology transfer

In support of expanding the technical expertise in renewable based village power systems, NREL has undertaken a number of activities.

Charge controllers are often the “weak link” in Chinese village power systems, causing premature failures and shortening the life of system batteries. To address this problem, NREL sponsored a workshop on improving component reliability where over 50 participants had an opportunity to discuss key village power system components such as inverters, charge controllers, and batteries. During this session, many US and Chinese-based experts made presentations focusing on the key issues associated with the design and manufacture of components for off-grid power systems, some focusing on results of the PV Gap and IEA research programs. In addition to a fruitful technical exchange, US manufacturers and Chinese system integrators developed relationships and mutual interests in quality US products.

To support the development of specific implementation and installation standards, over the last three years NREL has worked with the Institute for Sustainable Power (ISP) and the Chinese Government to develop specific training standards for rural energy systems. Of specific interest over the last year: the Chinese Government has approved a new regulation stipulating mandatory levels of technician certification. NREL, the Jikedian Renewable Energy Center, and other collaborators finalized a training and information manual for technicians responsible for operating and maintaining the renewable village power systems and trained hundreds of technicians, helping to develop the infrastructure for renewable energy technologies. NREL and partners are currently developing an English version of the manual. Finally, newly trained auditors in China are currently working with ISP and the Yunnan Normal University to accredit a training center in western China.

Additionally, to assess the performance and impact of China’s rural energy initiatives, NREL staff conducted a review of a 1996 joint US DOE/Chinese Ministry of Science & Technology rural electrification program in the Inner Mongolia Autonomous Region that installed over 400 PV/wind hybrid power systems for more remote households. The survey included a technical review of the power systems and documented the socio-economic and quality of life impacts of providing electric power to rural herdsman households. The study found that overall, stand-

alone renewable energy technologies have improved the quality of life of the traditional Inner Mongolian household in a variety of ways. In some cases 24-hour electricity has led to a higher income potential for users through direct or indirect productive use applications; in other cases electricity has allowed for higher educational achievement. The full report will be available in late 2004.

Finally, as part of NREL’s work to commission the systems installed by UNEP in the Bulunkou Township, staff worked with the implementing companies to correct installation issues, re-site equipment and fix problems that could lead to premature system failure.

Each of these tasks help to improve the use of renewable technologies, with the intention of improving product quality and usability in rural electrification projects.

4. Conclusions

NREL continues to work with many Chinese and other international bi-lateral and multi-lateral organizations in a coordinated fashion to support the development and use of renewable energy and energy efficiency technologies within China. The Chinese Township Electrification Program is the first nationally based implementation of renewable technologies to supply electric service to rural populations. Other countries, such as Brazil, Mexico and India are now initiating similar programs, which will be followed by other developing countries from Indonesia to Morocco, if the technology is demonstrated to be reliable.

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MAJOR FY 2004 PUBLICATIONS

J Ku, D. Lew and M. Shenghong, “Sending Electricity to Townships,” *Renewable Energy World*, pp 56-67, September-October 2003.

J Ku, D. Lew and M. Shenghong, “The China Township Electrification Program: One Million People Served,” *American Solar Energy Society’s Solar 2003*, Austin, Texas, 23-26 June 2003.

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