

PROPOSAL FOR PDF BLOCK C GRANT

Country:	People's Republic of China	
Focal Area:	Climate Change	
Project Title:	Renewable Energy Project	
Project Costs:	\$305.0 million	
Financing Plan (provisional):	GOC	\$10.0 million
	GEF	\$30.0-35.0 million
	Equity/debt finance	\$200.0-205.0 million
	IBRD	\$60.0 million
Requesting Agency:	The World Bank	
National Executing Agency:	State Economic and Trade Commission (SETC)	
Block:	C	
Amount of PDF Funding Requested:	\$590,000	
Co-funding:	GOC	\$540,000
Block B Grant:	Yes (\$140,000: 1996)	
Convention Ratification:	January 5, 1993	

SECTOR BACKGROUND

1. Energy is the largest source of greenhouse gas (GHG) emissions worldwide, and China currently accounts for 10 percent of global GHG emissions from energy use, behind the US (21 percent), countries of the former Soviet Union (18 percent), and Europe (21 percent). However, among countries and regions with the highest GHG emissions, only China is likely to maintain rapid rates of economic growth well into the next century and this will require a significant expansion in coal use, China's principal energy resource. Assuming the continuation of rapid economic growth in China, macroeconomic and energy modeling work show that an aggressive program to promote technical energy conservation and an expansion of non-carbon energy sources could limit the increase in GHG emissions between 1990 and 2020 from a three-fold increase to less than two-fold.¹

2. While improvement in energy efficiency will play a critical role in limiting future increases in GHG emissions in China, and is the objective of several ongoing GEF activities in China, over the longer term the only option for significantly reducing GHG emissions in China is an expansion of non-carbon energy sources. China has a large and expanding hydroelectric program, and has a growing nuclear power program underway in coastal provinces. To tap the potential of other renewable energy sources, China must adopt new policies and increase investment.

¹ See *China: Issues and Options in Greenhouse Gas Emissions Control, Summary Report*, joint report of the Chinese Government, UNDP, and the World Bank, December 1994, p. 33.

3. The expansion of non-carbon energy technologies is essential not only for reducing the threat of global climate change, but is a critical component of China's long-term energy supply for both environmental and poverty reduction reasons. Given China's current and expected future dependence on coal, it is critical that China develop clean energy alternatives. Chinese cities are seriously polluted, with ambient air pollution concentrations commonly exceeding World Health Organization guidelines by three to five times. Indoor air pollution, from both coal and biomass burning, is equally serious, resulting in widespread respiratory illnesses, especially in rural areas among women and children. Recent analyses estimate that the annual health and agricultural losses associated with coal-related air pollution in China may be as high as 6 percent of GDP.² In addition to environmental benefits, the GOC is committed to development of renewable energy for rural development and poverty alleviation. More than 100 million people in China currently depend on traditional biomass fuels for most of their energy needs, while more than 75 million people are without electricity.

4. **Renewable Energy Potential.** The potential for renewable energy in China is huge in absolute terms and accounts for a large share of total potential worldwide renewable energy capacity. Two of China's largest renewable energy resources are wind and solar. Exploitable wind resources in China are estimated at over 250 GW, about three times greater than China's small-scale hydroelectric resources, which are large by world standards. Solar resources are excellent in many areas, especially in the plateau areas of northern and western China, where the majority of China's 75 million people without access to electricity live in highly dispersed communities.³ If twenty percent of the households in these areas were electrified with solar photovoltaics (PV), the market would be about 150 MW, almost double current annual sales of solar PV worldwide.

5. **China's Renewable Energy Program.** The GOC has strongly supported small hydropower (<25MW), biogas, and small wind machines over the past 35 years as a means of providing energy and electricity to dispersed and isolated rural populations. In the past, however, China's program for other renewable energy technologies has suffered from the lack of an overall strategy, market orientation, and relative isolation from the international community. In 1995, the Government voiced new commitment to renewable energy development, as outlined in the *New and Renewable Energy Development Program, 1996-2010*, jointly developed by the State Planning Commission (SPC), the State Science and Technology Commission (SSTC), the State Economic and Trade Commission (SETC) as well as relevant ministries. The 1995 Electricity Law and Renewable Energy Development Program extend GOC support for renewable energy to solar, wind, geothermal and advanced biomass energy for heat and power.

² *Clear Water, Blue Skies: China's Environment in the 21st Century*, East Asia and Pacific Region, World Bank, 1997.

³ *China: Renewable Energy for Electric Power*, Report No. 15592-CHA, The World Bank, 1996.

6. Despite large resource potential and government commitment, the contribution of renewable energy to China's current energy supply is small and is likely to remain so in the absence of a stronger market-oriented approach. Past development of renewable energy relied primarily on indigenous technologies, which failed to take advantage of international technology developments. Previous development efforts were largely orchestrated by central government agencies with little attention to costs or the underlying demand for renewable energy services. Today, not only do governments at all levels in China have less money for investment and research and development, but past command-and-control measures have become ineffective in the transition economy. What is needed to spur renewable energy development in China is a new market-driven approach which: (i) focuses on promoting commercial or near-commercial renewable energy applications; (ii) combines international advances in renewable energy technology with demonstrated Chinese low-cost production capabilities; and (iii) taps the large potential demand for energy services from renewable energy technologies by lowering costs and improving products, system reliability, and consumer service.

7. Recognizing the need to provide a strategic orientation to renewable energy development, GOC, with Bank/GEF assistance, began initial analyses to identify priority areas for development. A PDF Block B was approved in September 1995, to support this analytical program effort. This culminated in the production of an overview strategy document and two detailed background papers.⁴ These studies concluded that among the high-priority areas for renewable energy development are large-scale grid-connected windfarms and solar photovoltaics (PV) for rural applications.

8. While large-scale grid-connected windfarms and solar PV are considered "near competitive," their development in China has been hampered by a variety of institutional barriers. Reduction of institutional barriers to wind and solar PV technologies in China would provide the enabling environment to develop one of the world's most important markets, because of the large energy resource and consumer demand potential for these renewable energy technologies. Wind development in China is limited by the lack of independent windfarm companies and a demonstrated institutional framework that would stimulate large-scale investment. The costs and potential risks of undertaking many of the initial enabling activities are prohibitively high for a single producer, especially in the windfarm business. While there is tremendous potential for solar PV in many parts of China, development has been limited by poor quality products, a lack of sales and service infrastructure, and inadequate credit. There are few "systems" companies that can efficiently design, assemble, and market integrated PV systems, and which can provide follow-up customer service to ensure that the systems are properly operated and maintained.

⁴ *China: A strategy for International Assistance for Accelerating Renewable Energy Development*, 1997; *China: Renewable Energy for Electric Power*, 1996; and *China: Renewable Energy Development for Thermal Applications*, 1997. All documents are available upon request.

9. International assistance is critically needed to advance China's renewable energy program. With GEF assistance, the World Bank and UNDP have developed a programmatic approach for supporting renewable energy development in China, and are currently preparing a number of complementary activities in high-priority areas. As described below, the World Bank's activities include investment in large-scale windfarms for grid-connected electric power, and the expansion of solar PV use through commercial development of solar-electric home systems. UNDP's program focuses on technical assistance and capacity building for renewable energy in general, and for four specific technologies -- solar PV hybrid systems for decentralized electric power, windfarms, medium and large-scale anaerobic digestors, and bagasse cogeneration. For solar, UNDP is supporting the demonstration of new solar PV hybrid systems, which could be disseminated under the World Bank/GEF project. For windfarms, UNDP proposes to develop a pipeline of future sites (including site selection and pre-feasibility assessments) and incorporate wind into power sector development planning.

PROJECT OBJECTIVES AND DESCRIPTION

10. The project seeks to reduce the barriers to commercial renewable energy development in China, and through competition and larger scale demonstration, bring down future supply costs for two promising technologies (grid-connected wind and solar PV), allowing further commercial development of these technologies in other parts of China. The project also aims to contribute to long-term development of wind and solar PV through capacity building and technology development, with the aim of improving product quality and lowering supply costs. Over the longer term, the project is expected to result in significant power generation from windfarms and solar PV, thereby limiting the expansion of coal-fired power plants and related greenhouse gas emissions and other local and regional environmental effects.

11. The project consists of four main components: (a) windfarm development; (b) solar PV market expansion; (c) national-level institutional capacity building; (d) applied technology development.

12. **Windfarm Development.** The market for windpower will be promoted in the project by developing and demonstrating a framework for large-scale windfarms by independent power producers (IPP). Costs for windpower are expected to decrease over time to international levels as local experience is gained, market scale increases, and the IPP development framework proven. It is envisioned that two IPP windfarm companies would install 100 MW of grid-connected windfarms in Huitingxile, Inner Mongolia, and 50-100 MW in sites yet to be determined. The equity in the IPP companies will be owned by a combination of the provincial/local power company, the provincial windfarm company, local governments, and the State Power Company. Each IPP company will obtain World Bank debt financing and mobilize the remaining debt from local and international sources, such as commercial banks. A legal "security package," including agreements on power purchase, land lease, grid-interconnection, and bidding documents will be prepared to enable the IPP companies to attract international debt and equity

financing. The security package will provide standard agreements that, once proven, will serve for future windfarm development. The GEF would be requested to support: (a) the preparation of the security package, and (b) technical assistance to the provincial windfarm companies to: (i) negotiate a follow-up IPP on each site with private equity participation; and (ii) strengthen the technical and commercial capability of the windfarm companies to sustain the continued development and financing of grid-connected windfarms.

13. **Solar PV Market Expansion.** This component will support the development of PV systems companies that will sell, install, and maintain a critical mass of solar home system units (about 200,000 SHS units with 8-12 MWp total) to provide off-grid electricity to households, commercial, and local community establishments in Inner Mongolia, Xinjiang, Qinghai, and Gansu Provinces. The PV systems companies will sell certified PV systems, offer warranties, provide maintenance and repair services, and provide credit to individual and institutional consumers. To ensure competition, all PV systems companies meeting project requirements (e.g., suppliers offering qualified products and suitable sales and service arrangements), would be eligible to receive support under the project. Support would include access to bank loans at commercial rates of interest arranged by GOC. The credit for this component will be provided by the State Economic and Trade Commission (SETC) through local commercial banks. Grant assistance from the GEF would be requested to improve products, expand sales and service networks, improve business practices, and demonstrate new financing modes such as lease-purchase contracts.

14. **National-level Institutional Capacity Building.** This component will focus on establishing critical institutional capabilities essential for the success of the wind and solar components. A *Wind System Testing and Certification Center* and a *PV System Testing and Certification Center* are needed in China to promote technology development, and would be supported under the project. A *Consumer Information Program* would be carried out under the project to provide independent information to potential consumers in target market areas about PV systems and their performance, maintenance requirements, sales and service arrangements, price ranges of systems, and the availability of financing arrangements. The initial establishment of the testing centers and information program would be supported by GEF and local counterpart funds.

15. **Applied Renewable Energy Technology Development.** This component will identify and implement priority technology development and demonstration activities to adapt international windfarm and solar PV technologies to Chinese conditions and take advantage of areas where local manufacturers have demonstrated low-cost production capabilities. Activities under this component will be closely related to project implementation and will be carried out by industry, on a cost-shared basis. The component will be prepared in close collaboration with industry, and will include activities such as: (a) demonstration of state-of-the-art applications, such as 1-1.5 MW wind turbines and grid-interactive PV for peak shaving and bulk power generation; and, (b) support for design, manufacture and performance testing of locally produced

components of advanced systems, where local manufacturers have demonstrated capability and a likely cost advantage (e.g. generators for 600-750 kW wind turbines, PV DC/AC inverters and DC lights). The GEF would be requested to support the incremental costs of these activities.

16. Implementation Arrangements. The SETC and Provincial Governments will be responsible for preparation of the proposed Renewable Energy Project, assisted by other agencies, research units, and by experts selected by the SETC to form a Project Management Office (PMO). Under the guidance of the SETC, the detailed preparation and implementation work will be undertaken by the wind and solar PV system companies in the participating provinces.

DESCRIPTION OF PROJECT PREPARATION ACTIVITIES

17. Phase I Preparation -- September 1995-August 1997. Work included: (a) a review of power and non-power renewable energy options; (b) the economic viability of renewable energy technologies in China relative to fossil-fuel alternatives; (c) a review of the policy issues and barriers to renewable energy development in China; and (d) an outline of the priorities for international assistance in the sector to China. The results of the Phase I preparation activities are summarized in the previously mentioned report, *China: Strategy for International Assistance for Accelerating Renewable Energy Development*.

18. Phase II Preparation -- October 1997-October 1998. This phase of project preparation will assist the GOC in preparing a GEF/World Bank investment project for two of the priority areas identified under Phase I: (i) grid connected windfarms, and (ii) off-grid solar photovoltaic systems. For the Windfarm Development component, preparation activities include project site characterization and feasibility studies, development of legal documentation required for IPP windfarm development, and definition of the training needs required to strengthen the capacity for independent windfarm development. Preparation activities for the Solar PV Market Expansion component include market studies, development of technical standards and specifications for solar home systems and subsequent product testing, project management, and business planning assistance to the expected participating PV companies. Other activities include preparation of the Capacity Building and Applied Technology Development components.

19. The following table shows the financing of the Phase I project preparation activities and provisional funding for Phase II.

Project Preparation Funding (US\$ '000)					
PREPARATION ACTIVITY	GEF	GOC ⁵	World Bank ⁶	Other	Total
Phase I-- July 95 to August 97			(Actual Budget)		
Strategy Development	140	90	327	99	656
Phase II-- October 97 to October 98			(Provisional Budget)		
<i>Wind Farm Development</i>	210	335	485		1030
<i>Solar PV Market Expansion</i>	260	305	315	120	1000
<i>Capacity Building</i>	60	100			160
<i>Applied Research and Development</i>	60	95	20		175
Sub-total Phase II	590	835	820	120	2,365
Total - Phases I and II	730	925	1,147	219	3,021

DESCRIPTION OF PHASE II PDF ACTIVITIES

20. The following activities would be carried out under the Phase II PDF for the China Renewable Energy Project:

- a) Preparation of the Wind Component.
 - (i) definition of training program needed to strengthen the technical, financial and managerial capabilities of participating windfarm/power companies;
 - (ii) preparation of the legal documentation for IPPs for international financing including: power-purchase agreement (PPA), other contractual documents, and bidding documents; and
 - (iii) financial and economic analysis of the costs of windpower versus alternatives, including estimation of local environmental externalities.

- b) Preparation of the Solar PV Component of the project.:
 - (i) standards and certification development;
 - (ii) testing of PV systems to pre-qualify them for sale under the project;
 - (iii) analysis of potential market size and identification of target market areas based on demand for services and willingness-to-pay analyses; and
 - (iv) a study tour for representatives of PV system companies and Chinese officials to Indonesia to observe PV business and market development activities being carried out as part of the World Bank's GEF-assisted Solar Home System Project.

⁵ Includes expected proceeds of a loan from the Bank-assisted CRISPP Project (CR. 2447-CHA).

⁶ Includes ASTAE and IENPD Trust Funds, other Trust Funds, and Japan Policy and Human Resources Development (PHRD) Funds..

- c) Design and preparation of the Institutional Capacity Building Component, including: (i) determination of requirements to establish national testing and certification centers for solar PV and wind turbine equipment, as well as balance of systems; and (ii) solar PV consumer information program including services required to design, prepare materials, and execute an information program using various media, as appropriate.
- d) Design of the applied R&D component including: (i) evaluation of existing programs; (ii) identification of priority technology areas; and, (iii) definition of a cost-effective, results oriented approach.
- e) Delineation of the incremental cost approach to be used for above components.
- f) Determination of institutional arrangements for project management and monitoring and evaluation.

ELIGIBILITY

21. China ratified the UN Framework Convention on Climate Change on January 5, 1993. The project is consistent with the GEF Operational Strategy for climate change, where one of the long-term mitigation measures under Operational Program #6 is the promotion of renewable energy. The project seeks to remove the current institutional barriers in China for wind and solar PV, and through large-scale demonstrations, lower the supply costs and allow widespread commercial dissemination of the technologies.

NATIONAL LEVEL SUPPORT

22. A Climate Change Coordination Group, an interagency committee of five leading governmental departments, was created in February 1990 and charged with overall policy formulation on the greenhouse gas issue. A GHG abatement strategy for China was completed in 1994-95 by the National Environmental Protection Agency (NEPA) of China, the State Planning Commission (SPC), the World Bank, and UNDP, with GEF pilot-phase support, and involved a comprehensive analysis of a full range of abatement options and their relative costs and benefits. Renewable energy was identified in the study as the top priority for GHG abatement in China over the longer-term, and that to realize this goal required action now. The GEF focal point in China, the Ministry of Finance, has requested GEF assistance for preparation and implementation of the China Renewable Energy Project.

JUSTIFICATION FOR PDF GRANT

23. Given the lack of familiarity and supporting framework for market-oriented renewable energy development in China, significant up-front technical assistance and preparation activities are needed for the proposed GEF/IBRD China Renewable Energy

Project. The project design and preparation activities outlined here are critical to the viability of the project, and will also speed implementation once the project is approved.

ITEMS TO BE FINANCED

24. PDF funds would finance the following inputs to Phase II project preparation:

- a) Technical assistance for preparation of the windfarm component including: (i) one international legal expert with experience in IPP projects in China; (ii) an international expert in establishment and management of windfarm development companies; (iii) local experts specialized in the legal and financial aspects of power project development in China; and (iv) local experts experienced in incorporating environmental assessment into least cost power planning.
- b) Technical assistance for preparation of the solar PV component including: (i) an international expert on PV system specifications and certification procedures; (ii) testing and certification of local PV systems in qualified laboratories; (iii) an international expert in market analysis for consumer renewable energy products; (iv) local experts in PV system design, market surveys, socio-economic surveys and analysis.
- c) Technical assistance for preparation of the institutional strengthening component, including: (i) two international experts with experience in establishment and management of solar PV and wind equipment testing centers; and (ii) local experts on information dissemination campaigns for consumer awareness.
- d) Technical assistance for the preparation of the applied technology development component including: (i) an international expert with experience in design of national renewable energy technology development programs; and (ii) local experts on the Chinese renewable energy technology development programs.
- e) Other logistics, meetings, workshops and assistance necessary for the preparation of the above components.

COST TABLES

Activity	Phase II PDF Activities (US\$)		
	GEF	GOC	TOTAL
Preparation of Windfarm Component	170,000	120,000	290,000
Preparation of PV Component	230,000	180,000	410,000
Preparation of Capacity Building Component	60,000	100,000	160,000
Preparation of Research and Development Component	100,000	95,000	195,000
Study Tour, Training and Workshops	30,000	45,000	75,000
TOTAL	590,000	540,000	1,130,000

Phase II Expense Categories

	GEF	GOC	TOTAL
International Consultants	435,000	n/a	435,000
Domestic Experts	85,000	375,000	460,000
Office Logistics	50,000	110,000	150,000
Training, material, workshops, and publications.	20,000	55,000	85,000
TOTAL	590,000	540,000	1,130,000

PDF OUTPUTS

25. Specific outputs from the Phase II PDF will include:
- a) Final Preparation of the Windfarm Component of the project;
 - b) Final preparation of the Solar PV Component of the project;
 - c) Work program and cost estimates for the National-level Institutional Capacity Building Component of the project;
 - d) Work program and cost estimates for the Applied Research and Development Component of the Project;
 - e) Estimation of the global benefits and incremental costs for the project; and
 - f) Project Brief for GEF Council endorsement and Project Document for final approval by World Bank Board.

EXPECTED DATE OF PDF COMPLETION

26. In October 1997, a major preparation mission will visit China, during which time a detailed preparation timetable will be agreed upon with SETC and the PMO. It is anticipated that PDF activities will be initiated in October 1997 and be completed 12 months later, by October 1998. It is expected that the Project Brief will be submitted to the GEF Council for review in April, 1998 and that the project will be ready for final approval by November, 1998.