PEREZ-GUERRERO TRUST FUND Project

BUILDING NATIONAL CLEAN DEVELOPMENT MECHANISM (CDM) CAPACITY OF DEVELOPING COUNTRIES TO EFFECTIVLY HARNESS SMALL HYDRO POWER

INT/07/K06

FINAL REPORT

Submitted by

International Center on Small Hydro Power

136 Nanshan Road 136

Final Report

Introduction

T01. Consultation to Africa: Three pilot SHP projects will be selected for CDM case study and local SHP survey report is completed.

T01.1 Training Workshop and On-site Consultation for Zimbabwe;

T01.2 Conducting Feasibility Study and Training in Mozambique

T01.3 On-site CDM SHP project case study in Nigeria;

T02. Consultation to South America: Developing clean renewable energy through utilizing existing water projects.

T02.1 Consultation Mission to Argentina;

T02.2 Consultation Mission to Colombia;

T03. Strengthening expertise knowledge and capacity building on CDM in the SHP sector

T03.1 *Training course on CDM financing SHP for Officials of Developing Countries* held from 21st April～5th May, 2008, Hangzhou, China

T03.2 *The 4th Global Forum on "Hydropower for Today"*, May 26-29 2008, Abuja, Nigeria

T04. Research Reports are Issued

04.1 Compilation and Publication of the *Strategy Research Report for CDM and Hydropower Carbon Financing in China*

T04.2 Publication of *SHP-Small Scale CDM Project Developers Guide: Basic Requirements and Questions for CDM Project Development*;

T04.3 Dissemination of the descriptive paper "The Clean Development Mechanism and Small Hydropower Projects in China";

T04.4 Dissemination of the practically guiding paper "*The Clean Development Mechanism and Small Hydropower Projects in China* ".

This project collaborates with Argentina, China, Nigeria and Zimbabwe and leads to the increased development of SHP projects, contributing to poverty alleviation, environmental protection and sustainable development of rural areas. The successful implementation of this project will enhance the application of the Clean Development Mechanism (CDM) as an effective source of funding to develop Small Hydro Power (SHP) projects in developing countries, and build national capacity through a mixture of activities designed to identify and overcome the barriers to successful promotion of SHP through the CDM. Government officials and SHP developers of Argentina, Colombia, Mozambique, Nigeria and Zimbabwe will benefit from an increased understanding of the steps needed to successfully develop SHP and CDM projects and will be able to continue developing SHP CDM projects. As a result, these countries will be able to move away from the reliance on fossil fuels, harness their own energy resources and move away from depending on neighbouring countries, and crucially provide rural areas with much needed electricity, as well as associated social, economic and environmental benefits. By stimulating the development of SHP and CDM and providing governments with the appropriate tools, this project will ensure the benefits of SHP can be fully harnessed over the long term. By disseminating the results, this project is also expected to replicate its success in neighbouring countries, by stimulating the development of SHP and the CDM. So the Project will enhance the application of the CDM as an effective source of funding to SHP projects in developing countries worldwide.

The outputs generated by this project are described in details as below.

T01.1 Consultation Mission to Zimbabwe

Background

SHP constitutes a proven, clean and environmentally benign source of energy, suited to meeting both the electricity demands of rural un-electrified communities as well as greater national needs in a clean, renewable way. There are a number of perennial rivers in Zimbabwe, Mozambique and Nigeria, especially, in the southeastern highlands area, which can be tapped for small hydropower development. Potential also exists at many irrigation dams throughout these countries to develop small scale hydroelectric projects to partially offset the energy imports of these countries, to strengthen the local network in the area or to supply isolated parts of the provinces as an alternative to connecting to the main network. To meet the growing needs of the majority of the rural population who do not have access to electricity, there is need to expand the generation capacity. However, lack of sufficient funds means innovative solutions are required.

The Clean Development Mechanism constitutes an ideal tool to channel foreign funding (from developed countries) to enable the development of small hydro power projects in developing countries, contributing to emission reductions as well as the sustainable development of the host country. The countries involved in this project provide a spectrum of countries where CDM remains underdeveloped. Africa is the most critical region as only 4 of the total 146 UNFCCC registered CDM projects are in Africa. Many countries including Mozambique do not actually yet possess the relevant Designated National Authority to process and validate CDM projects. Nigeria and Zimbabwe do have such authorities in place but have yet to develop and successfully register or validate a CDM project. In Southern Africa to tackle the lack of SHP CDM projects, the need is first and foremost for SHP advice, as SHP development remains very limited.

Zimbabwe is a country endowed with plentiful SHP resources in some regions while a lot of people living in remote areas still suffer from no access to electricity. Totally 40% of its population is not electrified. A series of problems remain impossible to solve because of no electricity. For example, in the remote areas, the lack of facilities to freeze vaccines has prevented successful implementation of the immunization program. The rural economy development has also been hindered by poor power supply.

Invited by Ministry of Energy and Power Development and Powermate International, a team of four members from ICSHP, Prof. TONG Jiandong, DG of INSHP, Prof. LI Zhiming, Chief Engineer and Mr. Liu Deyou, Managing Director, participated in the training workshop organized by the INSHP Sub-centre (SC) in Zimbabwe and visited some proposed small hydro sites in Zimbabwe. The government of Zimbabwe in conjunction with the Zimbabwe Power Company (ZPC) carried out pre-feasibility studies on a number of sites on rivers in the Eastern Highlands of Zimbabwe.

The task of the visit is to provide consultation and other technical assistance in identifying/evaluating several SHP sites as well as carrying out the master plan of the national SHP development plan of Zimbabwe. Through the mission, it is expected that a close relation will be established between stakeholders in Zimbabwe and ICSHP, and through ICSHP, with other INSHP members. This is critical to SHP development in Zimbabwe as there is a lack of awareness, technology and expertise in SHP development in this country.

Objectives

- To promote SHP development in Zimbabwe through the Training Course, On-site Consultation and smooth commercial business.
- To provide electricity through a renewable energy resource to remote rural areas for the socio-economic development of the surrounding areas.
- To examine the reasons behind the uneven development of CDM projects and provide governments of Zimbabwe, Mozambique and Nigeria with a blueprint for enhancing CDM capacity and using it to promote national SHP development.
- To have “on-site” and “in-depth” study on China’s SHP technology.

Tasks

I. Training Workshop to address the barriers facing the private sector for small Hydropower projects in Zimbabwe.

With the establishment of the INSHP Sub-Centre in Africa (SC), several programmes for awareness building and training on renewable energy and in particular on SHP are to be conducted, to promote and accelerate sustainable development in the region. This will ultimately facilitate the design of cost effective RETs using locally manufactured equipment, materials, and labour, and organizing consultancy services on comprehensive aspects of renewable energy systems and in particular those related to small hydropower development.

One of the immediate objectives of the cooperation is to conduct seminars and workshops at the national and regional level in the area of small hydropower. As part of the project activities for 2007, it was decided that a regional seminar would be conducted by the SC at Harare in from 15-17 September 2007 with the support of the ICSHP in Hangzhou, China and the Government of Zimbabwe. 30 delegates from private sector developers from Zimbabwe, Zimbabwean governmental representatives, and representatives from other relevant development agencies attended the training workshop.

To Impart Basic technical knowledge of SHP

Activities

1. To discuss technological issues relevant to SHP development, imparting China's accumulated experience in the sector.
2. To discuss in basic terms the various stages of an SHP project, from pre-feasibility studies to project installation. Electromechanical equipment selection will be included as a topic.

Outcomes

1. That SHP developers and policy makers will benefit from China's wealth of technical experience in developing SHP.
2. That basic technical information will be imparted to participants, to set the context of the workshop and to empower policy makers.

Addressing Financial Barriers

Activities

1. To focus the workshop on the development of SHP for productive use, not just for power for cooking and lighting.
2. To emphasize the role of private sector involvement in projects. To identify the financial barriers to SHP development in Zimbabwe and to help alleviate these barriers through dissemination of information between participants as well as from experts.
3. To discuss the possibility of developing CDM projects and economic viability of SHP projects in Zimbabwe.

Addressing Policy Barriers

Activities

1. Awareness of the benefits of SHP development within in Zimbabwe for energy security, rural development, environmental sustainability and socio-economic development will be clarified and promoted.
2. To provide a platform for SHP stakeholders such as developers to negotiate with policy makers on SHP policy barriers.
3. China's successful SHP policy implementation strategy and wealth of long standing expert knowledge will be effectively transferred to the participants.

Outcomes

1. Awareness will be raised for policy makers on the significance of the utilization of SHP to promote energy security, protect the ecological environment, and to enhance socio-economic development.
2. Stakeholder and policy-makers will be empowered with the means to together discuss the policy barriers to SHP development and to

promote the prioritization of SHP as a renewable energy resource, thus ensuring that SHP is considered as a developmental priority.

3. China's SHP policy will be disseminated as a model for development with Zimbabwean policy makers.

II. On-site consultation to three SHP sites and <u>SIRAKOROBOUGOU</u> was selected for pilot SHP project for a CDM case study.

<u>FARAKO-I</u>

As measured, within a river stretch of 210.23m, the river bed descends from a height of 457.74m to 452.81m, a drop of 6.93m.

In April the discharge observed on site as $0.25m^3/s$, which is for the rainless period. There is a low water period from November to April and a high water period from June to October, a minimum discharge of $1m^3/s$ for the latter.

By design head of 6m, the firm output is calculated as N_{firm}=12kW.

Considering that firm output is produced by half of the unit, the two units have a total installed a capacity of 48kW.

<u>FARAKO-II</u>

As measured, within a 210.23m-long river stretch, the river bed descends from a height of 427.56m to 413.28m, a drop of 14.28m. By design head of 12m, the firm output is calculated as N_{firm}=24kW, two units to be installed, 20kW for each and total 100kW.

<u>SIRAKOROBOUGOU</u>

Here it is a small waterfall, 1km away from the village. The local residents are very interested in making use of the waterfall to build a small hydro power station. During the visit of the consultation team they organized a group of residents to welcome the visitors, dancing with open arms to the drumbeat. The Ministry of Mine's report ill-defines the water head as 7.19m, with an absurd and undistinguishable topographic map attached; it also defines the discharge as 0.66m^3/s, much discrepant from the measured cross discharge in section made on 9th September 2004, one is 0.578m^3/s, the other is 0.082 m^3/s. According to the on-site survey, the ICSHP experts estimated that the water head is 7m, the water discharge is 0.1m^3/s and the firm output is as N_{firm}=5.6kW, and they advise equipping a small unit of 10kW.

T01.2 Conducting Feasibility Study and Training in Mozambique

Background

Mozambique is a country in southern Africa with increasing energy demand and large SHP potential. Many rivers originating in neighbouring countries pass through Mozambique before flowing into the Indian Ocean. These rivers are rich in hydraulic resources. In the mountainous areas, many potential SHP sites remain untapped, while a handful of SHP stations are discarded due to either war damage or bad management. On the other hand, only 15 percent of the population in Mozambique has access to electricity and most of them live in cities. Almost all rural areas are non-electrified. SHP can play a key role in rural electrification in Mozambique, leading to poverty alleviation and social change.

Tasks

The main task in Mozambique was to conduct the feasibility study. The other task is to provide training to the local engineers on how to conduct the feasibility study.

I. Feasibility study conducted for two sites and Tsatsadu was ideal for such a demonstration plant for a CDM case study.

The consultation delegation consisting of three experts from the International Network on Small Hydro Power (INSHP), Prof. TONG Jiandong, DG of INSHP, Prof. LI Zhiming, Chief Engineer as well as two engineers from Powermate International, where the Sub-center of INSHP for Africa is functioning, covered two sites in Mozambique and the team was guided by Ministry of Energy and

Ministry of Industry of Mozambique.

IC-SHP was asked to:

-Analyse river measurements taken to determine potential power capacity of the river.

-Survey sites for construction, project layout and equipment designs.

-Analyse community surveys of electricity demand required for present and future use in the community.

-Analyse and measure community lay out for village reticulation designs

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Bogo/Kawa Micro-Hydro Project

This project is to install a micro-hydro project in Bogo/Kawa to provide the communities with electricity. Currently there are no reliable electricity services or supplies in the area. The main target groups are the schools, health centers, aid posts, villagers, small entrepreneurs, Women's groups and Church groups. The area has about ten villages and 8000 people. The current estimated power demand is 55.8kW. The project will be owned by local communities and it will be managed by the Government.

The benefits of the project include the direct benefits from lighting and income generating activities. It is believed that there will be an increase in the number of small entrepreneurs engaged in activities that will create employment, markets and generate income. Communities will also benefit from the health centers, government aid posts and schools who will now be able to have more reliable use of their electrical equipment.

Tsatsadu

At Tsatsadu, the experts found that, considering the flow available, it will be better to have two units of 30 kW units established and to operate only one unit during the lean season. There is a nearby community within 2 km, which can benefit by the power, community development center and the ICT facilities. Further, there exists a church, which has plans for a hospital, a technical training institute and other income generating activities for the community, making it possible for productive use of energy during the day also. Civil construction costs would be minimal for this site. The community promised physical support for the construction. The PVC pipes produced in Mozambique are of very good quality and finish and hence the penstocks can be locally sourced at cheaper price. Thus, it will be ideal for such a demonstration plant.

During the discussions,

1) From the Ministry side, it was suggested that instead of the 'stand alone' operation for Tsatsadu Falls station, it is preferred to have a grid connected set up. The leader of the ICSHP mission replied that the Chinese government would supply the pilot project with a set of hydraulic equipment under the implementation of the "Lighting up Africa" project, making it a 'no man on duty' (automatic) station, saving on operation cost. If it is to be connected to the grid, there will have to be a governor controlled set up requiring presence of operators on shift, and the associated interface equipment also will have to be purchased separately by the Ministry.
2) The Ministry wanted the alternative plans and the cost of each item of works for Tsatsadu to be communicated before the end of May 2007. The information required is a) detailed design drawings and lay out; b) generic specifications for the turbines and electromechanical equipment; c) breakdown of expected total project cost; and d) the time schedules for the implementation of the project.
3) ICSHP stated that the conclusions are based on the brief data given by the Ministry and physical observations and that the final report can only be prepared, if these data are confirmed in writing and available additional information furnished (within 10 days to keep the time targets) – on Tsatsadu by the Ministry.

4) The Ministry wanted two Mozambique engineers to be trained in China to familiarize themselves with Chinese SHP technology. ICSHP offered free training at the Center in Hangzhou.
5) The Ministry also requested establishing a Sub-Center of INSHP in Mozambique. ICSHP agreed to consider setting up a Country Focal Point, for which details can be decided through further communication.

II. Training workshops conducted during the consultation course

The training workshop was conducted for two days from 22-23 September. Workshop participants included Powermate and local engineers. The main theme for the training workshop was the design of the main works of a SHP station. Day one topics covered were the intake, weir, headrace, forebay, penstock, turbine and generator. Day two topics discussed were selection of the turbine and generator, main electrical equipment and layout of the powerhouse.

Also, during the course of the feasibility study, several local Mozambican engineers will be involved with the study to gain experience and learn from ICSHP's engineers. Hence while each of the following tasks was being conducted, there was also training for the local engineers by learning from example.

T01.3 On-site CDM SHP project case study in Nigeria;

<u>Background</u>

So far, investments in hydro power have concentrated mainly on large projects. In Nigeria, investment in hydro power has concentrated mostly on large dams involving high capital cost. This can be attributed to the reason that donor agencies prefer investing in such large projects. SHP has the potential to cater for the needs of individual households whose majority is concentrated in the rural areas. Currently hydro power contributes to about 33 percent of the national need while thermal/fossil contributes to about 77 percent. According to the Energy Commission for Nigeria, the small hydro potential in Nigeria is about 734MW which translates to about 40 percent of the present output from large Hydro.

Nigeria registered the first CDM project which is the Aba Clean Energy Carbon Project developed by Geometric Power LTD .The plant is to produce 120MW of clean energy using efficient gas fired powered with a cogeneration unit that will reduce Green Houses Gases Emissions that are responsible for climatic change. About 1.2Million CERs will be generated from the project and was bought by the Community Development Carbon Fund (CDCF).

Output of the Mission

Invited by Citizens for Environmental Safety (CES), three ICSHP experts visited the proposed pilot CDM SHP Obudu Ranch Plateau Project. Discussion was made between the experienced ICSHP engineers and local government on the feasibility study for this project and potential cooperation in implementing this SHP project with the CDM financing and technical assistance under the guide of ICSHP. After the visit, the project idea note (PIN) was compiled as follows:

A	**Title of the small-scale project activity:**	Obudu Ranch Plateau Small Hydro Project
	Description of the small-scale project activity:	The Obudu Ranch Plateau Small Hydro Project is a 1 MW run-of-river hydroelectric project located in Obudu Ranch Plateau, Obanliku LGA, and Cross River State. The 1 MW Obudu Ranch Plateau Small Hydro Project is expected to sell at least 6570 megawatt hours (MWh) of electricity per year.
	Contribution to Sustainable	New economic activities that deliver or make use of energy services are expected to emerge both in the

	Development in the Host Country	vicinity of the Cattle Ranch Resort and the local community, thereby increasing employment and income generating opportunities.
	Environmental component	It is estimated that the project would result in an annual emissions reductions of 5,256 tonnes of CO_2, and total emissions reductions of 36,792 tonnes of CO_2 equivalent for the first 7 years and 110,376 tonnes of CO_2 for the 21 years crediting period.
B	**Baseline methodology**	The baseline for the project activity in accordance with Appendix B of the simplified modalities and procedures for small-scale CDM project activities is Type 1.D, where electricity from a renewable energy source replaces a local diesel grid. Evidence to why the proposed project activity is additional is offered through an analysis of existing barriers such as (a) technological barrier, (b) prevailing practice, (c) regulatory barrier and (d) market barrier. These barriers are unique to the project, and are not relevant to the business as usual scenario (i.e. use of diesel generating sets). Default Emissions Factor for >200kW 24hr service mini-grid = 0.8 kgCO_2/kWh (Table I.D.1) Baseline emissions = 6570 MWh/yr x 0.8 kg/kWh = 5256 tonnes CO_2/yr. Date of completion of the baseline study: 30/04/2006
C	**Duration of the project activity / Crediting period**	Expected operational period of the project is 25 years. Crediting period is 7 years starting from 01/01/2009
D	**Monitoring**	The project will apply a monitoring methodology Type

	methodology and plan	1D, and as outlined in Appendix B of the simplified modalities and procedures for small-scale CDM project activities, “monitoring shall consist of metering the electricity generated by the renewable technology”.
E	**Calculation of GHG emission reductions by sources**	Baseline emissions = annual electricity production by hydro facility (kWh/yr) X emissions factor for current mini-grid system. Default Emissions Factor for >200kW 24hr service mini-grid = 0.8 $kgCO_2/kWh$ (Table I.D.1) Annual electricity production = 6570 MWh/yr Emissions factor = 0.8 kg CO_2/kWh Annual emissions = 5256 tonnes CO_2e/yr
F	**Environmental impacts**	Environmental Impact Assessment for the Obudu Cattle Ranch SHP is consistent with laws and regulations of the Federal Republic of Nigeria.
G	**Stakeholders comments**	The stakeholders are the Federal Ministry of Power and Steel, Cross River State Government Cross River State Government and Mr Omang Bassey and Obudu Cattle Ranch worker. They have been engaged in various meetings and consultations. Issues deliberated upon include: □□Technical and financial viability □□Environmental sustainability with particular focus on preserving the natural aesthetics of the plateau as well as maintaining clean air □□Management issues with the IPP and □□Concession with regulatory authorities

ICSHP experts also recommended that:

1. There should be a public (Designated National Authority), private and civil society partnership in information dissemination on CDM projects and its inherent benefits.
2. Designated National Authorities should put forth simplified documentation on CDM project development.
3. Tertiary institutions should include CDM development in their curriculum
4. Designated National Authorities should put forth an action plan for the dissemination of information on CDM project development.
5. The transaction cost of documentation on developing renewable energy CDM projects should be reduced by the CDM Authority
6. Carbon credit generated by CDM projects should be of high value so as to attract more investment in renewable energy projects.

T02.1 Consultation Mission to Argentina, 10-17 November 2008

Background

Many countries in LAC region are currently in a state of fast economy development. Energy shortage is becoming one of the main barriers of economic development. The governments of LAC countries are facing the pressure to solve various energy problems, including power demand far in excess of supply, no grid connection in the rural areas, over-dependence on the conventional sources of energy such as coal, petrol, small contribution of power from renewable sources of energy, lack of policy and institutional framework, .etc. Finding a clean and cheep source of energy is becoming the major concern for the energy sectors of LAC countries. As China provides a very good example of electrification through the way of SHP development, the governments of LAC countries see SHP development as a very good opportunity to solve their energy problems. Most of LAC countries have rich hydropower resources and they also have their own SHP industry. The only things they lack are the advanced knowledge technology and introduction of policy and framework.

ICSHP is an organization dedicated to promoting global SHP development with the aim of rural electrification and poverty alleviation. In recent years, INSHP has put great emphasis on the LAC region and has sent experts to LAC countries for consultation many times. It also received frequent invitations from various sectors of LAC countries, such as government authorities, international organizations and also companies involving SHP development. They request to cooperation with ICSHP in the hope of gaining some technical support or seeking mutual development. It is to this end that ICSHP decided to send a delegation to visit Argentina and Columbia. The objective of the mission is to promote cooperation with LAC countries in the field of SHP development as well as give consultations for some SHP projects.

The delegations of ICSHP are: Prof. TONG Jiandong, Director General of INSHP, namely, Mr. Cai Xianfang, Senior engineers from ICSHP and Mr. WEI Jianghui, translator of ICSHP.

Objectives

- To further strengthen the SHP related activities of ICSHP in South America
- To build capacity for its counterpart organization in handling SHP related activities in South America
- To create favourable conditions for TCDC in SHP sector in Argentina through smooth commercial business and strategic planning of a functional ICU, thus bringing great benefits to the two peoples and further strengthening the links between Latin America and China.

Outputs of the mission

1) The main output will be a draft plan for TCDC/ECDC in Cordoba. However, in view of the complexity, a preliminary MOU of the several programs is necessary.
2) A draft plan of building up the International Cooperation Unit (ICU) on SHP, based on findings and recommendations on the sub-region
3) 3-day training course on SHP
4) Daft detailed terms of the contracts about equipment transfer

5) A report on findings and recommendations on further trade and investment for the promotion in sub regions

<u>Tasks</u>

I. to set up the International Cooperation Unit

This is a decision of the government of Cordoba with very favourable conditions. It was discussed between the Governor or Energy Minister of Cordoba and ICSHP .

1. After acknowledging the future benefits of cooperation with INSHP, the Government decided to set up the ICU and has contributed resources towards the establishment of the ICU.

2. The two parties reached an agreement/contract to design a Master Plan/technical assistance/marketing and integration of interests in South America.

3. The following options was decided:

1) The government of Cordoba and ICSHP could be partners in a binational company "the International Cooperation Unit".
2) The Bank of Cordoba, controlled by the Government, could give loans at 0% interest to start the ICU program.
3) A grant could be given by the Government.

II. Training Course in Cordoba

In Argentina, where SHP and CDM development is more established, the project will seek to develop alternate ways to develop SHP and CDM. Existing water resource structures (dams, reservoirs) used for irrigation or flood control can readily be developed into hydro power projects. This is a cost effective solution to efficiently exploit existing resources and remains eligible for CDM funding.

To upgrade such structures to produce renewable energy, a training course on the integration of CDM and SHP projects was held in Cordoba, Argentina for 3 days, 19-21 November 2008. 20 participants from the Cordoba government and local hydropower developers participated in this course, and discussed the existing potential CDM SHP projects with ICSHP experts.
The 3-day course covered the following topics:

1) How to enable efficient and trustworthy cooperation between ICSHP and developing countries in the SHP field;
2) How to share China's unique experience in the field of SHP and to help in promoting the Technology Transfer of Small Hydropower Equipment and Know-how among developing countries,;
3) How to explore the possibility of establishing a development framework with focal points at regional and country level in the developing countries for further development of IC-SHP activities.

III. On-site consultation for Equipment Supply

After the training course, ICSHP experts visited two sites, namely JURADO (700kW) and LA CHORRERA (200kW). ICSHP was asked to supply equipment for this SHP power station, with a combination of competitive prices, collateral financing, plus splitting labor works and equipment provision will reduce costs and optimize available resources.

T02.2 Consultation Mission to Colombia, 17-25 November 2008

The ICSHP delegation arrived in Antioquia province of Colombia on 17 November 2008. Antioquia has very favorable conditions to develop SHP with many mountains and rivers.

I. the III International Symposium of Rural Electrification and Edge

Technology, Rionegro, Antioquia, from 18-21 November, 2007

The delegation was invited to attend a the III International Symposium of Rural Electrification and Edge Technology Organized by the Planning and Promotion Institute of the Off Grid Zones of Colombia (IPSE), Rionegro, Antioquia, from 18-21 November, 2007. A paper titled “SHP: China’s Features and Practice” was presented by Prof. TONG Jiandong at the conference. Prof. Tong talked about series of policies and strategies formulated by Chinese government to stimulate SHP development. Prof. Tong explained in detail some most effective policies. For example, “3-Self” policy, namely, Self-construction, Self-management and Self-consumption; preferential policies, such as Leadership by example system, Establishment of rural SHP development foundation, Electricity generates electricity; Prof. Tong also introduced some successful examples of SHP development in mountainous and backward areas benefited by the policies. The second presentation was made by Mr. Cai Xianfang, who is an expert on the SHP equipment. He emphasized the importance to reduce cost and make the technology affordable to backward areas and introduced different cost-effective types of equipment by Chinese manufacturers. After each presentation, the ICSHP delegations exchanged opinions with the participants and answered their questions.

II. Meeting held between local government officials and ICSHP delegates

During this visit, IN-SHP delegation held meetings with the Ministry of Mines and Energy on the future cooperation between the energy and SHP sector.

The provincial Antioquia government is keen to cooperate with ICSHP to develop small hydropower. The governor of the Province, Mr. Aníbal Gaviria Correa put great importance on the visit of INSHP delegation. The press conference was held on the second day of the visit, which attracted many medias such as local newspaper, TV, companies. They showed great interest in the rural electrification practice in China, SHP technology transfer, etc. The engineers from INSHP exchanged opinions with them and answered their questions.

A half-day meeting was held in the provincial office building, which focused on the establishment of ICSHP sub-center in Antioquia province. ICSHP has been thinking of establishing a sub-center in Latin America for a long time. Much work has been done and discussion on the selection of the right place is still ongoing. The provincial government was very supportive to establish the sub-center to enhance SHP development in the province and other places of the region with support of ICSHP. An initial agreement of cooperation was reached after the meeting.

III. On-site consultation for the recommendation to exploit existing structures with CDM funding

On the 22nd November, the delegation went to visit a deserted hydropower plant in the province in the hope of recommission. The site is about 20 kilometers from the capital of the province. The dam is an earth dam having a capacity of 30 million cubic meters of raw water. It was constructed for irrigation and water supply to the town. The experts first looked into the possibilities of incorporating small/micro hydro turbines for electricity generation. They found that the dam can provide a head of 10 –15m and a penstock already in place making it suitable for the purpose with very minimum investment. The only civil works required are (a) completion of spillway; (b) repair of the dam for soil erosions and construction of a powerhouse. The experts sited the powerhouse and recommended modifications for penstock to derive maximum head. They suggested that a maximum capacity of 600 kW can be generated and all the works can be completed within 6 months.

A comprehensive survey report was produced, detailing the results of their analysis and recommendations on how best to exploit existing structures and how this can be supported through CDM funding.

T03.1 *Training course on CDM financing SHP for Officials of Developing Countries* held from 21st April～5th May, 2008, Hangzhou, China

<u>Background</u>

In China, where installed SHP capacity accounts for over 50% of the world's installed SHP capacity, the project will concentrate on CDM issues. In a bid to enhance developers and local governments' knowledge of CDM and stimulate the development of SHP through CDM, a training course was organized in Hangzhou.

Training Objectives

The aim of this project is therefore to examine the reasons behind this uneven development of CDM and provide governments of these developing countries with a blueprint for enhancing CDM capacity and using it to promote national SHP development. Such barriers differ among countries but include:

a) Lack of knowledge and experience in developing new SHP projects
b) Lack of appropriate technology
c) Lack of knowledge in exploiting or upgrading existing water resource and hydro power projects
d) Absence of institutional arrangements for CDM
e) Lack of knowledge about CDM and its financing mechanism
f) Lack of experience in successfully developing SHP CDM projects

Training Content

IC-SHP arranged abundant courses and lectures for the participants, including: introduction of China's situation, the history, current status and experiences of SHP development in China, SHP project development, construction and management, local manufacture of SHP equipments, SHP development and rural community development, SHP development in the mountainous area of Rucheng and sustainable development of local economy, background of CDM, CDM application in SHP projects, introduction of SHP CDM projects in China, and strategies to develop SHP Projects under CDM, case study on Yuzikou project, etc. The participants used study tour opportunities to visit SHP stations and survey rural community development in Chenzhou City of Hunan province and Jinhua City of Zhejiang Province.

Training Methods

Lessons, internship, demonstration, lectures, visit, field trip, discussion and reports

Means of Assessment

The trainer made a comprehensive evaluation on the level of training that the students received by their grade in written examination and internship, as well as their performance during the course.

Programs

Date	Time	Activities	Speaker/Coordinator Position/Title	Organization of the Speaker/Coordinator	Venue
20 April, 2008 （Sunday）	All Day	**REGISTRATION**	Ms. WANG Kemin Deputy Chief of China Affairs Division/Engineer	IC-SHP	IC-SHP
21 April, 2008 （Monday）	9:30-10:30	**OPENING CEREMONY**	Prof. LIU Heng Director General/ Senior Engineer with Professor Rank	IC-SHP	International Conference Hall, IC-SHP
			Prof. TONG Jiandong Director General/ Senior Engineer with Professor Rank	IN-SHP	
	10:45-12:00	**WARM UP:** Education before Training	Ms. ZENG Yuehua Managing Director of IC-SHP/Senior Economist	IC-SHP	

	13:30-15:30	**WARM UP:** Introduction of China	Prof. LIU Heng Director General/ Senior Engineer with Professor Rank	IN-SHP	International Conference Hall, IC-SHP
22 April, 2008 （Tuesday）	8:30-12:00 13:30-16:30	**LECTURE:** The History, Situation and Experience of SHP Development in China	Prof. TONG Jiandong Director General/ Senior Engineer with Professor Rank	IN-SHP	International Conference Hall, IC-SHP
23 April, 2008 （Wednesday）	8:30-12:00	**SPECIAL SUBJECT:** Clean Development Mechanism (CDM) for SHP	Ms. HU Xiaobo Deputy Chief of Multi-affairs Division/Engineer	IC-SHP	International Conference Hall, IC-SHP
	14:00-16:00	**VISIT**：Leave for Chenzhou Hunan	Ms. WANG Kemin Deputy Chief of China Affairs Division/Engineer	IC-SHP	Hangzhou·Zhejiang
24 April, 2008 （Thursday）	9:30-12:00 14:00-17:30	**VISIT:** International SHP Chenzhou Base	Mr. YUAN Peisheng Director of IC-SHP Chenzhou Base /Senior Engineer	Chenzhou Base, IC-SHP	Chenzhou·Hunan
25 April, 2008 （Friday）	8:30-12:00	**SPECIAL SUBJECT:** SHP Development in Rucheng &	Mr. YUAN Peisheng Director of IC-SHP	Chenzhou Base, IC-SHP	Chenzhou·Hunan

		Sustainable Development of Local Economy	Chenzhou Base /Senior Engineer		
	14:00-17:30	**VISIT:** Demonstration Power Station and Substation in Chenzhou Base			
26 April, 2008 （Saturday）	8:30-12:00	**VISIT:** Dongjiang Hydropower Station & Rural Ecological Environment	Mr. YUAN Peisheng Director of IC-SHP Chenzhou Base /Senior Engineer	Chenzhou Base, IC-SHP	Chenzhou·Hunan
	14:00-16:00	**CONCLUSION**			
27 April, 2008 （Sunday）	8:00-12:00	**VISIT:** Return to Hangzhou	Ms. WANG Kemin Deputy Chief of China Affairs Division/Engineer	IC-SHP	Hangzhou·Zhejiang
	14:00-16:00	**VISIT:** Free & Shopping			
28 April, 2008 （Monday）	8:30-12:00	**LECTURE:** Case Study on Pilot CDM SHP projects in China	Prof. LIU Deyou Managing Director of IC-SHP/Professor	IC-SHP	International Conference Hall, IC-SHP
	13:30-16:30				
29 April, 2008 （Tuesday）	8:30-12:00	**SPECIAL SUBJECT:** Domestic Manufacturing of SHP Equipments	Mr. WANG Hangwei Director of IC-SHP Jinhua Base/Senior Engineer	Jinhua Base, IC-SHP	Jinhua·Zhejiang
	13:30-16:30	**VISIT:** IC-SHP Jinhua SHP Equipment Manufacturing Base & Local SHP Development			

30 April, 2008 （Wednesday）	8:30-12:00 13:30-16:30	**VISIT:** SHP Development in Lin'an, Hangzhou	Mr. WEI Jianghui Deputy Chief of China Affairs Division/Engineer	IC-SHP	Hangzhou·Zhejiang
1 May, 2008 （Thursday）	8:30-12:00 13:30-16:30	**CITY TOUR:** Hangzhou City	Ms. WANG Kemin Deputy Chief of China Affairs Division/Engineer	IC-SHP	Hangzhou·Zhejiang
2 May, 2008 （Friday）	8:30-12:00 13:30-16:30	**CITY TOUR:** Yiwu City	Ms. WANG Kemin Deputy Chief of China Affairs Division/Engineer	IC-SHP	Yiwu·Zhejiang
3 May, 2008 （Saturday）	8:30-12:00 13:30-16:30	**VISIT:** The Development of Rural Communities in Hangzhou—Longjing	Mr. WEI Jianghui Deputy Chief of China Affairs Division/Engineer	IC-SHP	Hangzhou·Zhejiang
4 May, 2008 （Sunday）	8:30-12:00	**LECTURE:** How to integrate CDM in projects in SHP sector	Prof. LIU Heng Director General/ Senior Engineer with Professor Rank	IC-SHP	Hangzhou·Zhejiang
	13:30-16:30	**LECTURE:** Lighting Up Africa			
5 May, 2008 （Monday）	8:30:-10:00	**DISCUSSION:** Introduction of SHP Development and CDM application in Participants' Countries	Prof. LIU Heng Director General/ Senior Engineer with Professor Rank	IC-SHP	International Conference Hall, IC-SHP
	10:30-12:00	**DISCUSSION:** between			

		Participants and Chinese Experts	Prof. TONG Jiandong Director General/ Senior Engineer with Professor Rank	IN-SHP	
	13:00-14:30	**CLOSING CEREMONY**			
6 May, 2008 （Tuesday）	All Day	**DEPATURE**	Ms. WANG Kemin Deputy Chief of China Affairs Division/Engineer	IC-SHP	

Participants List

No.	Country	Name	Position	Work Unit
1	Angola	Mr. Munzila Jackson Dodão	Head of Department	Ministry of Energy and Water
2	Angola	Ms. Gloria Gueve Marques	Specialist	Ministry of Energy and Water
3	Benin	Ms. Jocelyne Marcelle Alladaye	Division Chief	Communication Division, Ministry of Agricuture
4	Benin	Mr. Gbenagnon Calixte Desire Houssa	Division Chief	Regional Center for Agriculture Promotion, Aguegues
5	Central Africa	Mr.Nganare Aimé	Mining Production Director	Central Africa Ministry of Mining, Energy and Water Resources
6	Djibouti	Mr. Jalludin Mohamed Abdoul Kayoun	Director General	Djibouti Science & Research Center
7	Djibouti	Mr. Nabil Mohamed Ahmed	Division Chief	Djibouti Science & Research Center
8	D.R.Congo	Mr. Modeste Bampufu Itsuma	Division Chief	Energy Institution
9	D.R.Congo	Mr. Roger Limoko	Division Chief	Rural Electrification Bureau
10	Ethiopia	Mr. Michael Melaku Admassu	Expert	Tigray Electric Power Agency
11	Ethiopia	Mr. Belachew Zekarias Sintayehu	Expert	Tigray Electric Power Agency
12	Indonesia	Mr. Antonius Bintarto Ekoprasetyo	Researcher	Ministry of Energy and Mineral Resources
13	Indonesia	Mr. Zulkarnain	Researcher	R&D Center for Electrical and New and Renewable Technology
14	Lesotho	Mr. Hlopheho Moses	Project Monitoring	Monitoring Division,

		Ntlamelle	Manager	Department of Energy
15	Liberia	Mr. Browne Nyan Pouh	Division Chief	Infrastructure & Economic Development Planning Division, Ministry of Planning & Economic Affairs
16	Liberia	Mr. Romeo Coker	General Coordinator	Ministry of Land, Mines and Energy
17	Moldova	Mr. Iurcu Mihail	Main Specialist	General Department of Structural Policy，Ministry of Economy and Trade, Moldova
18	Mongolia	Mr. Tumenjargal Makhbal	Officer	Ministry of Fuel and Energy
19	Mongolia	Mr. Khas-Ochir Sambalkhundev	Officer	Ministry of Fuel and Energy
20	Morocco	Mr. Abdelali Taik	Division Chief	Secretariat of Water and Environment
21	Morocco	Mr. Abderafia Benbouziane	Division Chief	Secretariat of Water and Environment
22	Mozambique	Mr. Chicachama Antoniomr	Head of Department	Ministry of Energy, National Directory of Electircal Energy
23	Mozambique	Mr. Sitoe Inaciomr	Head of Department	Ministry of Planning and Development
24	Myanmar	Dr. Than OO	Assistant Superintending Engineer	HydroPower Generation Enterprise， Ministry of Electric Power No.(1)
25	Myanmar	Mr. Tun Kyaw Soe	Assistant Director	Irrigation Department, Ministry of Agriculture and Irrigation
26	Nepal	Mr. Rajendra Kumar Shrestha	Assistant Manager	Aepal Electricity Authority
27	Nigeria	Mr. Clement Oluremi Jawo	Division Chief	Rurual Power Bureau, Ministry of Energy, Nigeria
28	Nigeria	Mr. Simon Chukwuemeka Atigwe	General Manager	Rural Power Committee of Enugu, Nigeria

29	Pakistan	Mr. Iftikhar Ahmad Randhawa	Director Technical	Office of the Chief Engineer Power Irrigation & Power Department, Govt of Punjab
30	Pakistan	Mr. Muhammad Saddique Khan	Deputy Director	Operation & Maintenance, AJK, Muzaffarabad
31	Rwanda	Mr. Minani Theoneste	Head of Planning in Water Department	Electrogaz/Rwanda
32	Rwanda	Ms.Mujawingoma Muligo	Engineer	Electrogaz/Rwanda
33	Sierra Leone	Mr. Dennis John Scott Garvie	Vice General Manager	Sierra Leone National Power Authority
34	Sierra Leone	Mr. Michael Abu Conteh	Program Officer-Power	Ministry of Energy and Power
35	Sudan	Mrs. Suad Mahmoud Abdel Razig	Economist	Ministry of Energy and Mining
36	Sudan	Mr. Badi Osman Badi Elhassan	Electrical Engineer	Ministry of Energy and Mining
37	Sudan	Mr. Mohamed Fadlelmonla Mabyou	Semior Electrical Engineer	Ministry of Energy and Mining
38	Togo	Mr. Nadio Assakoua	Vice General Manager	Nangbéto Hydropower Station, Togo
39	Togo	Mr. Kakatsi Kossi Mawusi	Planning & Investment Manager	Energy & Electricity Company of Togo (CEET)
40	Uganda	Mr. Philip Ggayi	Senior Planning Engineer	Rural Electrification Agency
41	Uganda	Mr. Moses Murengezi	Project Monitoring Manager	Rural Electrification Board
42	Viet Nam	Mr. Nguyen Anh Tu	Specilist	Construction Management Department Ministry of Agriculture and Rural Development

43	Viet Nam	Mr. Ngo Tuan Manh	Specilist	Hydropower Center , Ministry of Agriculture and Rural Development
44	Zambia	Ms. Malenga Fanny	Officer	Ruling Party（The Movement for Multi-Party Democracy，MMD）Office
45	Zimbabwe	Mr. Kudzayi Johannes Ndoma	Energy Development Officer	Ministry of Energy and Power Development
46	Zimbabwe	Mr. Justice Chipuru	Senior Energy Development Officer	Ministry of Energy and Power Development

T03.2 *The 4th Global Forum on "Hydropower for Today"*, May 26-29 2008, Abuja, Nigeria

Background

Africa, a vast and beautiful continent, is the home of more than 900 million people. All countries over here are making efforts to probe into the development road of their own to promote the economic construction, social advancement and the people's livelihood improvement. Africa has the longest river of the world – the Nile. The Congo River with the drainage area and flow discharge is only next to Amazon River. Other numerous perennial and seasonal rivers also hold the abundant water energy resources in store for Africans. Small hydropower for its unique characteristics of the short construction period, less investment and environmental impacts and easily tailored to decentralized development is being favored by almost all governments of African countries. It is of far reaching importance to utilize the ample water energy resources to energetically develop small hydropower. This can be done on the basis of the decentralized power generation and distributed power supply to settle the problems of power shortage and to promote sustainable development in those rural areas. That is why the main subject of the Forum was focusing on "small/mini/micro hydropower project development and management”.

One of the major factors militating against development in Africa and the developing countries is lack of adequate energy supply; the growth in demand for energy far exceeds the supply of energy. It is in realization of the need for energy security in Africa that African governments have adopted the dual strategy of increasing capacity as well as diversifying the energy generation base.

The 4th International Hydro Power for today Forum: “Small/Mini/Micro Hydro Power Project Development & Management in Africa”, was jointly organized by the International Center on Small Hydro Power (ICSHP), Hangzhou China and the ICSHP Regional Center for Small Hydro Power for Africa, Abuja- Nigeria, in collaboration with other stakeholders.

This event is a unique and significant one as it brings together experts from the academic, public and the private sectors as well as decision makers from the government to discuss and share experiences on how best to integrate the abundant Small/Mini/Micro Hydro energy resources in Africa into the various nation’s energy supply mix, especially for rural electricity generation.

Chinese Delegation to the Seminar

The Chinese experts who were invited by the organizer to attend the Forum in Abuja were Mr. TIAN Zhongxing, Director, Bureau of Rural Hydropower and Electrification of Ministry of Water Resources of China, Prof. LIU Heng, Director General of ICSHP, Mr. WEI Jianghui, Chief of Chinese Affairs Division of ICSHP, Ms. HU Xiaobo, Chief of Mutli-lateral Coopreation Division of ICSHP, Mr. DONG Guofeng, Program Officer, Mr. Yuan Peisheng, Senior Engineer, and other ten delegates from Chinese Hydropower Equipment Manufacturers.

Output of the Conference

1. The participants to the *Global Forum on “Hydropower for Today”* acknowledge the efforts of Peoples Republic of China in the sustained development of hydropower including small hydropower, and appreciate

the joint initiatives in co-organizing this discussion forum by the International Center on Small Hydro Power (ICSHP), Ministry of Water Resources (MWR) of China and ICSHP Regional Center (ICSHP-RC) for Small Hydro Power for Africa, Abuja- Nigeria.

2. The Forum recognizes the need to integrate hydropower development with other demands on water resources such as drinking water supply, irrigation, flood prevention, pollution abatement, tourism, environmental protection, regional biodiversity maintenance, and other local economic development needs and requests all concerned to develop innovative methods for realizing this opportunity.
3. The Forum appreciates the need for development of hydropower potential in moderation and the need to have an effective governmental framework to achieve these objectives, as it is governments that should draw up national plans for hydro-energy generation and mandate the amount of river runoff that must be maintained free and to build capacity to manage this critical resource for the benefit of society as a whole.
4. The Forum also recognizes the roles of international agencies in promoting global hydropower development and calls for developing multilateral channel cooperation, and to optimize and ensure the maximum use of water resources for the common benefit, through new and revised policies that reflect issues of ecological balance and social equity.
5. The Forum takes note of the fact that the hydro power project inputs are based on impact of submergence and river re-direction as well as on the potential carbon dioxide emissions, and this is inadequate. The Forum recommends that all hydro projects should be covered under the CDM and reasonable mitigation impacts be built into the project budgets. However, higher compensation will upset the project viability and it is recommended that the international agencies involved in promoting hydro power agree on sustainable guidelines and come up with reasonable cost structures for evaluating the impacts and benefits of hydropower projects, so they can be constructed at reasonable cost.
6. In view of the very low percentage of electrification in Africa and the abundance of hydro resources in the African continent, the Forum considers it appropriate to focus more on environmentally-friendly and

economically-viable hydropower development in Africa during the next decade to help with global reduction of GHG emissions.

7. The Forum further calls upon all agencies related to hydropower, to support the promotion of replicable and sustainable models of small hydropower projects, backing income generating activities, non-formal education and training in skills in rural areas of developing countries, and especially in sub-Saharan Africa.

Programs

Day 1 (May 26 2008)		
Time	**Topic**	
08:00 – 09:00	Registration	
09:00 – 10:30	Opening Ceremony Speeches of representatives of NEC and MWR	ICSHP-RC
10:30 – 11:00	Tea / Coffee Break	
SESSION I		
11:00 – 11:30	Global Overview on SHP Project Development and Management	ICSHP
	Introduction of Lighting-up Rural Africa Program	
11:30 – 12:00	Energy Policy Framework and Opportunities for Decentralized Hydro Energy Systems (SHP)	Prof. V.K. Damodaran – Chairman, EMC, Kerala, India
12:00 – 12:30	Project Finance and Investment for SHP in Africa	Philippe Niyongabo – Head, Energy Division, AU Commission, Addis Ababa, Ethiopia.
12:30—13:00	Carbon Finance for Small Hydro Projects Development	ICSHP
13:00—14:00	Discussion I	

14:00 – 15:00	LUNCH	
SESSION II		
15:00—15:30	New and Advanced Technologies in the Development of SHP Projects; /Selection of Equipment -Elec/Mech.and Auxiliaries	Martin Boelli – ENTEC, Austria
15:30—16:00	Project Construction, Implementation and Management/New Technologies for Operation and Maintenance of SHP Plants	Prof. Arun Kumar – AHEC, Roorkee, India
16:00—16:30	Energy Kiosk Implementation: Case Study	
16:30 – 17:00	Tea Break	
17:00—17:30	Risk Management of Hydro Investment	Remi Olowude – Vice Chairman, IGI, Nigeria
17:30—18:00	Overview of Policy Landscape in Africa on SHP Project Development and Management	Prof. A.S. Sambo – Vice Chair, WEC Africa, Abuja, Nigeria
18:00 – 18:30	Discussion II	
18:30 – 19:30	Banquet	NASENI
Day 2 (May 27 2008) **SESSION III**		
09:00 – 09:45	Regulatory Issues in SHP: Management: Licenses, Tariffs, Feed-in-Tariff and Power Purchase Agreement	Dr. Ransome Owan, Chairman, NERC, Abuja, Nigeria
09:45 – 10:30	Role and Achievements	Engr. (Dr.) A.A Esan, Technical Director, URC, Abuja, Nigeria
10:30 – 11:00	Tea/Coffee Break	
11:00 – 11:30	Development and Management of SHP Project: An IPP Overview	Guru Prasad Neupane – Arun Valley Hydropower Ltd. Kathmandu, Nepal

11:30 – 12:00	Development and Management of Hydro Turbine Manufacture at URC – Kerala, India: An Overview	K.M. Dharesan Uunithan – Technical Director, URC, Kerala, India
12:00 – 13:00	Discussion III	
13:00—14:00	LUNCH	
14:00—16:00	COUNTRY Presentations I	
16:00—16:30	Tea Break	
16:30—18:00	COUNTRY Presentations II	
18:00—19:30	Banquet	ICSHP
Day 3 (May 28 2008)		
08:00—14:00	Field Trip I – Gurara SHP Project (FCT) LUNCH (Project Site)	FMA&WR FMA&WR
14:00 – 17:00	COUNTRY Presentations III	
17:00 – 17:30	Tea Break	
17:30 – 18:30	Project Development Roundtable: AHEC, URC, State Governments, IPP, etc.	
18:30 – 19:00	Closing Ceremony	
Day 4 (May 29 2008) - Optional		
7:00 – 12:00	Field Trip II – Travels	
12:00 – 13:00	Waya SHP Excursion	Pilot SHP Project Coordinator
13:00 – 14:00	Lunch	Upper-Benue River Basin Development Authority, Bauchi State Government
14:00 – 19:00	Return to Abuja	

Participants List

NO.	NAME	COUNTRY	DESIGNATION	ORGANIZATION
1	Engr. Dama Ndirpaya Fali	NIGERIA	Deputy Director	Directorate of Technical Cooperation in Africa (DTCA)
2	Dr. Bala E. J.	NIGERIA	Director	Energy Commission on Nigeria
3	Engr. Abdullahi Garba Abubakar	NIGERIA	Assist. Chief Progr. Officer	NEPAD, Nigeria
4	Obi Innocent Onuora	NIGERIA	Director	NCERD / UNN
5	Funso J. Makanjuola	NIGERIA	Managing Director	Makfurgo Nig. (Ltd)
6	Arc. C.C. Uche	NIGERIA	Director	Fortune Mentoring Foundation
7	Engr. Udey Simeon Ugbuji	NIGERIA	General Manager	Cross River Basin Dev. Authority
8	John Ilodu Ngbede	NIGERIA	Honourable Commissioner	Ministry of Water Resources & Environment
9	Engr. Mutiu Odesanya	NIGERIA		Ogun-Oshun RBDA
10	Engr. T. A. Adesanya	NIGERIA	Chief Engineer (Irrigation)	Ogun-Oshun RBDA
11	Engr. Otis Anyaeji	NIGERIA	Chairman / CEO	O.T. OTIS Engineering
12	Amooti Binaisa	NIGERIA	Chief Business Officer	Micheal & Cecilia Foundation
13	Okogbue J. Ngozi	NIGERIA	Director	National Directorate of Employment
14	Mr. Otoks Dan Princewill	NIGERIA	Chief Executive Officer	Imperial Properties Limited
15	Mr. Chindindu Eze Ozo, Mni	NIGERIA	Director, Policy, Analysis, Monitoring & Inspectorate	Fed. Min. of Envir. Housing & Urban Dev.
16	Yerima Peter Tanfa	NIGERIA	Chief Engr. Scientist	Fed. Min. of Envir. Housing & Urban Dev.
17	Halima Kolo	NIGERIA	Assistant Chief	Fed. Min. of Envir.

	Mohammed		Scientific Officer	Housing & Urban Dev.
18	Engr. Kayode Orekoya	NIGERIA	Director Projects	Rural Electrification Agency (REA)
19	Engr. Jawo			Rural Electrification Agency (REA)
20	Terence S. A. Modebe	NIGERIA	Vice Chairman	Aqua Energy Nig. Ltd
21	Mr. Osula A.A.	NIGERIA	Coordinator SHP/ Deputy Director	B-ORBDA
22	Mr. K. S. Fashina	NIGERIA	Deputy Director	B-ORBDA
23	Engr. B.A. Iteke	NIGERIA	Head Mech. Eng. Division ((ERDP)	PRODA
24	Engr. Fom Dalyop Chollom	NIGERIA	Principal Manager, Material Control (PHCN)	Technical Committee on Energy Plateau State
25	Arc. John Alkali	NIGERIA	Chairman, Plateau Energy Comm.	Energy Committee, Plateau State
26	Engr. Mike Nwachukwu	NIGERIA		Anambra-Imo River Basin Development Authority
27	Mr. Felix Ter Bubwer	NIGERIA		Lower-Benue River Basin Development Authority
28	Engr. Emmanuel Ajani	NIGERIA	Engr.	National Agency for Science & Engineering Infrastructure NASENI
29	Ento Edako	NIGERIA	Director Maint/Supply	Cross River Electrification Agency
30	Daniel Asuquo	NIGERIA	Director General	Cross River Electrification Agency
31	Chief Emma V. C Amafili	NIGERIA	Hon. Commissioner	Min. of Public Utility & Rural Dev.
32	M. C. Okoro	NIGERIA	Head generation	NESCO (Nig) LTD

33	Bemidele Reuben	NIGERIA	Programme Officer	
34	A. S. Gurin OON, Mai	NIGERIA	Director Programme	REA
35	Engr. Ohide Sola	NIGERIA	Director Porduction	REA
36	Prof. A. Mustapha	NIGERIA	Vice-Chancellor	Katsina State University
37	Ibrahim Haruna Soba	NIGERIA		Katsina State University
38	Ibrahim Aminu	NIGERIA	Director	Southern Energy
39	Engr. J. F. Adeyemi	NIGERIA	CEO	Jabudep & Aquawatch Nig. LTD
40	Engr. Dan J. Eneh	NIGERIA	Res. EVC	PHCN
41	Engr. R. A. Bello	NIGERIA	Director	FCT Water Board
42	Engr. O. S. Egberongbe	NIGERIA	AGM(PSPD) TCN	PHCN/TCN
43	Engr. Charles N. Asulanna	NIGERIA	Dir. Of Engineering	PRODA Enugu
44	Engr. Olugbenga Owojuyigbe	NIGERIA	Deputy General Manger (Eng. Services)	Osun State Water Corporation
45	Engr. F. O. Aeyeye	NIGERIA	Assitant Gen. Manager	
46	Ibrahim Gwadimawa	NIGERIA	National Vice President	NASSI, NW Zone
47	Sunday Oriala	NIGERIA	Director	NIGELEA
48	Engr. I. E. Ekpo	NIGERIA	Deputy Director	NICOLD
49	Engr. P.A. Ogunhindia	NIGERIA	CEO	SSC
50	Engr. Akinro I. A.	NIGERIA	Director	ODWC
51	Engr. Omodemi M. O.	NIGERIA	Director	ODWC
52	Engr. Famakin S. R.	NIGERIA	S/Engr	ODWC
53	Prof. Prasad	NIGERIA	MD/CEO	Newstal Group
54	Hon. Komolafe	NIGERIA	Commissioner	Water Resources
55	Sulaiman Ismaila	NIGERIA	S/ Engr.	Waya Dam Project
56	Engr. (Dr.) Tat Adeyemi	NIGERIA	CEO	Mathkonsult

57	Sani Aliyu	NIGERIA	Rep. of Director	SERC, Udu, Sokoto
58	Ezenna V. Okoh	NIGERIA	Rep. of Director	SERC, Udu, Sokoto
59	Dr. B. G. Danshehu	NIGERIA	Rep. of Director	SERC, Udu, Sokoto
60	Engr. Mohammed Garba	NIGERIA	Special Adviser	Ministry of Rural Dev.
61	Muhammed B. Gadau	NIGERIA	Perm. Sec.	Ministry of Rural Dev.
62	Samuel Karuri	NIGERIA	Special Adviser	Plateau Govt.
63	Chief Emma Amafili	NIGERIA	Hon. Commissioner	Ministry of Public Utilities & Rural Dev.
64	Hon. Oyong Asuquo	NIGERIA	Hon. Commissioner	Ministry of Rural Dev.
65	Engr. A. S. Idris	NIGERIA	Director General	Ministry of T & ID
66	Mohammed Abbass	NIGERIA		Katsina State University
67	Camara Mohamed Lamin	COTE D'IVOIRE	Engineer in Charge of Study	Ministry of Mines and Energy / Direction of Energy
68	Koffi Komenan	COTE D'IVOIRE	Engineer in Charge of Renewable Energy	Ministry of Mines and Energy / Direction of Energy
69	Bandzouzi Talani Alexander	CONGO	Deputy Coordinator Nationale	L'Agence National pour l'Electrification Rurale
70	Issang Lumiere Jean Felix	CONGO	Charge de Programme Energy/Environment	UNDP
71	Gabriel Takyi	GHANA	Lecturer	Kwame Nkrumah University of Science and Technology (KNUST)
72	Geoffrey M. Kihara	KENYA		
73	Mr. Augustus Goanue	LIBERIA		Ministry of Lands Mines & Energy
74	Mr. Marson Rafalarivo	MADAGA SCAR		
75	Oumar Sidibe	MALI	Ingenieur	Ministry de l'Energie

			Hydrotechnicien	des Mines et l'eau
76	Birama Diorte	MALI	Chef de Section Statisque et Suivi de Programmes	Ministry de l'Energie des Mines et l'eau
77	Bello Nassourou	NIGER	Division of Renewable Energy	Ministry des Mines et de l'Energie
78	Emmanuel Michael	TANZANIA	Project Engineer	TATEDO
79	Dilli B. Singh	NEPAL		Dept. of Electricity Dev.
80	MR. JOSSY THOMAS	VIENNA		
81	MR. JOHANNES DOBINGER	VIENNA		
82	Prof. V.K. Damodaran	INDIA	Vice Chair	Energy Management Centre
83	Prof. Arun Kumar	INDIA		Alternate Hydro Energy Centre
84	K.M. Dharesan Unnithan	INDIA	Technical Director	ICSHP-RC
85	DR. HUSSEIN ELHAG	TUNISIA	Executive Director	African Energy Commission (AFREC)
86	Prof. Abdu Salihi	NIGERIA		
87	Masayoshi Matsushita	NIGERIA		
88	Okoku Archibong Ediang	NIGERIA		Nigerian Metrorological Agency
89	Dr. Ransome Owan	NIGERIA	Chairman	NERC
90	Engr. (Dr.) A.A. Esan	NIGERIA		
91	Dabire Bayaonibe	NIGERIA	Director Energy	ECOWAS
92	Jin Jiatian	CHINA		Zhejiang Jinlun Electromechanical Co., Ltd
93	Xu Congxiao	CHINA		Zhejiang Jinlun Electromechanical Co., Ltd
94	Wang Xiaobing	CHINA		Changsha Hua'neng

				Automation Control Group Co., Ltd
95	Hu Xiangyun	CHINA		Zhejiang Yueqing Machine Co. Ltd
96	Yuan Peisheng	CHINA		Hu'nan Chendian Power International Co. Ltd
97	Tian Zhongxing	CHINA	Director, Bureau of Rural Hydropower and Electrification	Ministry of Water Resources
98	Zhang Xuejin	CHINA	Director, Bureau of Rural Hydropower and Electrification	Ministry of Water Resources
99	Jin Hai	CHINA	Division Head, Department of International Cooperation, Science and Technology	Ministry of Water Resources
100	Liu Heng	CHINA	Director General	ICSHP
101	Liu Yihou	CHINA		

04.1 Compilation and Publication of the *Strategy Research Report for CDM and Hydropower Carbon Financing in China*

Contents

4) Dissemination and Supervision

Research Persons
Mr. TONG Jiandong,
Ms. HU Xiaobo,
Mr. WEI Jianghui,
Mr. WANG Yansong,
Mr. A. Ogilvie,
Mr. Consul.Fulvio

T04.2 Publication of *SHP-Small Scale CDM Project Developers Guide: Basic Requirements and Questions for CDM Project Development*

To Project Developers:
This short package is aimed to give an understanding for basic requirements when designing a small-scaled Clean Development Mechanism (CDM) project based on SHP's understanding. Aside from a shortlist of questions that verifies eligibility to be considered for CDM funding, there is also lists of detailed questions to which developers can provide answers to, prior to contacting intermediaries and IC-SHP for assistance.

CDM, in short, is one of the three *Kyoto Mechanisms* (See next page) designed for the purpose of global Greenhouse Gas (GHG) emissions reduction. It is a system by which Annex I (i.e. industrialized states) countries and their companies can form a partnership with renewable energy or emissions displacing project developers in developing states.
As the main goal of this mechanism is to reduce global emissions of GHG gases, projects must prove to effectively displace emission factors. In the case of SHP, the added capacity should effectively displace or lessen the emissions from other GHG sources such as diesel or coal-fired thermal plants.

Annex I entities will then provide financial support (up to 10% of project funds) after assessing the theoretical reduction of GHG by the proposed project –

prices will be calculated in terms of USD/Euros per metric ton of carbon. It must be noted that the overall process is not a simple one and projects can be turned down during the many authorization processes that it must go through.

Along with the feasibility report, going over this packet and providing verifiable answers will greatly fasten the process and increase the chance of being awarded CDM funds, which is overall a very competitive and complicated procedure. We hope that this packet will help guide developers when designing future CDM projects.

A brief history and explanation of the Kyoto Protocol and its Mechanisms

The history of the Kyoto Protocol can be traced back to 1972 when the first *Earth Summit* was held in Stockholm, Sweden with the intent of meeting every ten years thereafter to determine the health of the planet. 16 years later, in an effort to approach the question of climate change in a more scientific manner, the United Nations created the *International Panel on Climate Change* (IPCC).

Composed of specialists from around the world, the IPCC released its first report in 1990. It was a significant step forward from previous discussions: The authors claimed that the planet was warming and more importantly, that this warming process was being triggered by human activity.

Two years later in Rio de Janeiro, Brazil, the *Second Earth Summit* became the largest gathering of world leaders ever and resulted in the creation of the *United Nations Framework Convention on Climate Change* (UNFCCC – also known as the Rio Convention), which called on worldwide stabilization of greenhouse gas (GHG) emissions by 2000.

Since 1995, countries that ratified the *Rio Convention* have convened the *Conference of Parties* (COP) every year. In the 1997 COP which was held in Kyoto, the original goals of the Rio Convention were modified to accommodate a more realistic and concrete set of goals. At this time, the goal was set to cut GHG emissions (at 1990 level) by at least 5% between 2008 and 2012. Different industrialized countries set higher goals, such as the EU target of 8% reduction, Germany 25%, UK 15%, etc.

At the 1998 COP IV in Buenos Aires, Argentina, the Kyoto Mechanisms were formulated to aid the implementation of the Kyoto Protocol. The Kyoto Mechanism consists of three pillars:

Clean Development Mechanism, in which industrialized (Annex I) countries gain credits through various measures to displace GHG emissions (including renewable energy and afforestation programmes) in developing nations;
Joint Implementation, in which Annex I countries receive credits for cutting emissions in another Annex I country; and
Emissions Trading, in which Annex I countries trade emissions credits amongst each other.

Subsequent COP meetings saw further adjustments and agreements among participating parties but it was not until November 18, 2004 when Russia ratified the Kyoto Protocol that it became legally feasible to be put in effect. This was because the Protocol had to be first ratified by countries who together were responsible for at least 55% of 1990 global GHG emissions. 90 days following Russia's ratification, the Kyoto Protocol officially entered into force on February 16, 2005.

In order for countries to reach the 2012 target and beyond, the CDM is one of the most important mechanisms to effectively achieve reductions in GHG emissions while at the same time guiding sustainable development and providing benefits for developing countries.

■Small-Scaled CDM Projects – Basic Requirements

In order to save time and costs of assessing CDM eligibility of small hydropower projects, the following basic points should be checked.

1. "Small-Scale" is defined to be under 15MW net installed capacity;
2. The SHP should not already be built or under construction and should be accompanied with an official feasibility and environmental assessment study;
3. There must be proof that without CDM funds, the SHP project will not be

financially feasible, and therefore the project cannot be part of a government project in which its construction is guaranteed regardless of CDM funds or emission reduction goals;

4. "Additionality": The proposed SHP must replace emissions arising from thermal plants or household use of fossil fuel within the grid that it supplies electricity to, therefore the grid that the proposed SHP will be connected to cannot consist only of hydropower or emissions neutral renewable plants;

5. The proposed SHP must not cause adverse affects to its environs including sizeable relocation of people or submerging of land;

6. Basic information about the grid (which the proposed SHP will be connected to) that will help speed up the compilation of the project PIN include:

a. Energy generation data (in kWh) for all generating sources serving the target grid and their average heat rate or plant efficiency by fuel type,

b. Most recent capacity additions to the grid, defined to be the greater (in MWh) of most recent 20% of existing plants, or the 5 most recently built plants.

Basic Questions for CDM Project Design

1. What are the main objectives of the project?
2. Description of the project:

- Where the project is situated
- Some detail of the geology of the area
- The hydropower potential in the area and how much has been tapped
- The generation capacity and output of the station
- Technical details of the project (components, head, flow rate, turbine, etc)
- Where the electricity will be delivered to and how
- Estimated time of construction of the project
- Information regarding the type of grid it's connected to and its energy mix
- If possible, identify other most recently built power plants in the area
- Has the project been approved environmentally by any source?

■ **Energy Mix and Grid Information**

If your project is selling electricity to a grid please answer these questions:

1. To what grid(s) will the proposed SHP sell its electricity, and what proportion

of its total generation?

2. What is the total energy generation (GWh) in the grid? Please give the name, capacity (MW), generation (GWh), average plant efficiency or heat rate, and fuel type of current power plants operating in this grid.

3. What will be the energy mix after the project is completed?

4. Please give the name, capacity (MW), generation (GWh), average plant efficiency and fuel type of the 6 most recently built plants within the grid.

If your project is not connecting to an existing grid please answer the following question:

What capacity factor do you expect your project to be running when completed?

Site Information:

1. Who are the project developers? Please give all their contact details.

- Company name
- Contact person
- Type of organisation: state owned / private company
- Summary of the experience of the project developer
- Address
- Telephone / fax number, email, and website address if any

2. Please give the developer's budget for the most recent fiscal year.

3. Identify construction period and expected date of completion.

Investment Structure:

1. How will this project be funded? How much funding has already been secured and from what sources?

2. Identify the amount of loans, its source, and payback period.

3. Are grants and loans available, if so please give details?

4. How long has the project been seeking funding?

5. How much is electricity sold for in the area currently (also for non-SHP electricity sources)?

6. How much will the electricity from this project be sold for?

■ **Community Benefit Questions**

Developmental issues:

1. Has any local authorities (of where the proposed project is located) implemented, in the process of implementing, or planning to implement any environmental programmes? If so, what are they? Please give the name, the main objectives and the amount of committed funds.

2. Please, identify and describe the communities that will benefit from this project, with details of their

a. Location

b. Population

c. Social composition

d. Economic activities

e. Major problems

3. Please list and describe any specific community benefits that will result from the project e.g. describe the economic, social or environmental benefits such as training, impact on industry, etc.

4. Please describe how these communities will be involved in planning, implementing, and managing these benefits and project execution.

5. Please describe any underprivileged or minority groups in the community and indicate how they
will participate in and will benefit from the project

6. Please list government and/or any other organizations and institutions (local, regional, national) that will participate in the project and describe their roles.

7. Please describe how the community benefits could be measured and verified.

8. Please describe how the community benefits will be maintained and sustained after the project is completed. Who will be responsible for this?

9. Please describe any negative environmental, social or economic consequences that could arise from project implementation (i.e. submerging of land) and identify any strategies to mitigate this trade-off, such as compensation schemes and replanting of submerged vegetation.

10. Please identify community partners and minority shareholders who will act as points of contact during project implementation and local electrification schemes if there are any.

■ **Other Questions:**

1. Have any other CDM projects been attempted in the county?
2. How many PPAs (Public Private Agreements) have been signed in the County? Please give details.

T04.3 Dissemination of the paper "The Clean Development Mechanism and Small Hydropower Projects in China";

The Clean Development Mechanism and Small Hydropower Projects in China

Professor Tong Jiandong, Hu Xiaobo

Director General, International Center on Small Hydropower,

2004.

Introduction

Since signing the United Nations Framework Convention on Climate Change (UNFCCC) in 1992, China has increased its efforts to address the issues of global climate change. As the world's second largest emitter of greenhouse gases (GHG) and the world's largest consumer of coal, China's involvement in the climate change mitigation process is vital.

China's national greenhouse gas inventory was developed as part of a 1998 Asian Development Bank-Global Environment Facility-United Nations Development Program study entitled *Asia's Least-Cost Greenhouse Gas Abatement Strategy: People's Republic of China*. This will lay the foundations for China's first National Communication, expected to be released this year. According to this inventory, China's total net emissions in 1990 were in the range of 1816-1864 Tera grams of CO_2 and between 25-32 Tg of CH_4. Agriculture and coal mining were the major sources of $CH_{4.}$ CO_2 emissions made up 73-78% of total GHG emissions, and energy consumption and industrial processes accounted for 92% of total CO2 emissions.

China is generally regarded as the country with the largest Clean Development

Mechanism (CDM) potential. A joint World Bank study, for example, estimates China's CER potential as 0-211 $MtCO_2$, and projects China will capture around 11% of the global carbon market. As another study notes, not only does China have a large quantity of potential GHG emissions, it also has a relatively flat marginal abatement cost (MAC) curve. China's MAC for GHG emissions are particularly in the industry/power sector.

However, CDM is still a new process for China and its institutional capacities are young. Despite several investigative and capacity building projects, CDM processes in China still face a number of important challenges. This paper will examine the barriers and issues for China's successful implementation of the CDM, and the specific dimensions relevant to small hydropower (SHP) projects under the CDM. It will also provide information about the CDM experiences of International Center on Small Hydropower (IC-SHP), and potential projects.

Issues for the CDM in China

Despite China's potential to become the world's top host country for CDM projects, its CDM process has begun slowly. China is among a number of Asian countries that have approached the CDM with caution, concerned for its quality and the integrity of the Kyoto Protocol5. China's National Designated Authority (DNA) and related regulations for the implementation of CDM projects were only released in late June 2004. Despite increased clarification for project developers and investors, the effective implementation of CDM projects in China still faces a number of challenges. These include:

● A key barrier for implementing CDM projects in China is a lack of local knowledge and skills. Although there are increased efforts to build CDM capacity outside of government circles, local ability to identify CDM projects and develop project design documents is still limited. For example, China lacks any approved designated operational entities (DOE), and few organizations have CDM project development experience. A lack of CDM capacity intensifies difficulties in realizing projects, especially for smaller organizations. It also increases transaction costs, as developers need to devote more resources to training, accessing information, and using foreign DOEs.

● There is still a lack of easily accessible information. For example, China's DNA has yet to develop strong information dissemination resources, and project developers will need concrete guidelines on China's national sustainable development criteria for CDM projects. Technical information, particularly in poorer and more isolated regions, can also be difficult to obtain. Unfamiliarity with China's institutions, regulations and local conditions compounds concerns for developers and investors.

● There are also concerns about potential restrictions on certain kinds of CDM projects. For example, China's DNA has stated that only Chinese enterprises and companies held by Chinese partners can apply to develop CDM projects. The Chinese government has also indicated that technology transfer will also play an important part in the approval of CDM projects. In addition, there is some concern that a China may use measures to filter projects that are deemed less compatible with China's development priorities7. These issues will hopefully be clarified as the DNA begins implementation of CDM approval processes.

● In addition, CDM projects in China face the general challenges associated with CDM and the emerging carbon market. The project cycle requires significant financial, human, and temporal resources, and access to detailed technical information. Transactions costs for developing CDM projects are still high, and can reach up to $US 250 000 per project. The low price for CERs, hovering around the US$ 3-6/tCO_2 mark, makes it difficult to include CDM financing as a significant revenue stream. This situation also favors large-scale energy efficiency and sinks projects, which generate larger amounts of CERs, and which are more capable of meeting the costs of project development. Further, the risk that the Kyoto Protocol will not enter into force, or will be enter into force too late for the first commitment period, contributes to investor uncertainty. These market issues compound the perceived difficulties and transaction costs of developing CDM projects in China. These issues will need speedy resolution, if projects are to be competitive for the first commitment period of the Kyoto Protocol.

Developing SHP projects under the CDM

China's SHP potential, existing capabilities, and government support for SHP initiatives enhance the attractiveness of SHP for CDM projects. China can claim 17% of the world's hydropower resources, and its developable SHP potential amounts to 100GW, in over 1500 out of nearly 2300 counties in the country. China's SHP development has focused on rural electrification, and has seen installed capacity additions of more than 2000 MW annually. China's SHP management system stresses a decentralized approach, and is integrated with rural electrification and development schemes. This approach encourages the utilization of indigenous technology and manufactures, and the development of local grids. SHP development remains a priority within the context of government programs, such as 'Replacing Firewood with Electricity' and 'Sending Electricity to Villages'.

SHP can also take advantage of the GHG abatement opportunities projected for China's energy sector. Emissions from fossil fuel combustion, mainly coal, account for 80% of China's total emissions, and power generation and consumption continues to rise. Energy consumption has already doubled between 1980 and 2000. China's GHG emissions from the energy sector are predicted to increase from 3080 $MtCO_2$ in 2000 to around 4000 $MtCO_2$ in 2010, with coal contributing the major share. Further, China's industry/power generation sector has a relatively flat MAC curve in comparison with other sectors, and the power generation sector could account for 50% of China's CDM potential. To supply these CERs, China would need a significant number of new power initiatives to be registered as CDM projects, and up to 100 RE power projects to be in operation by 2006-2007.

According to a 2002 study by the Global Climate Change Institute of Tsinghua University, hydropower in China has an abatement potential of 54.3 Mt CO_2e.13 Utilizing CDM for SHP projects in China has both advantages and disadvantages. Some of these issues are specific to SHP, while others may be applied to renewable energy projects in general:

- SHP projects are capable of demonstrating environmental and sustainable development benefits, such as watershed management, and income generation. They can also be effectively tied to schemes for rural electrification or community development. In this regard, SHP has an advantage over large hydropower projects, which have been criticized by groups such as the International Rivers Network and CDM Watch for undermining the Kyoto Protocol.

● As SHP projects are by nature small, they can take advantage of small-scale project status under the CDM. If the maximum output capacity equivalent is less than 15MW, these projects are eligible to use streamlined procedures and modalities, and for bundling. This can reduce transaction costs and increase the economic viability of a project. For example, small-scale projects may use the same DOE for both validation and verification of CERs, and must wait only four weeks, instead of eight, for registration with the CDM Executive Board.

●The small-scale and community-focused nature of many SHP projects can also result in greater local participation. Indeed, local participation and acceptance of an SGP project is vital to its success. This is an advantage in generating 'high quality' CERs, and for applying to funds, such as the Community Development Carbon Fund (CDCF), that require demonstrated local involvement.

● However, this also entails a certain dependency on local context and capacities. Local developmental priorities and policies are important, as are local technical and 'soft' capacities. For example, these may affect the maintenance of equipment, the monitoring process, and local acceptance of new energy technology or schemes. The structure of local GHG emissions and fuel use also affects the amount of emissions reductions. In addition, project development may depend on the availability of local or provincial information, as national or sector baselines are rarely appropriate in China's case.

● Additionality is another issue for SHP projects in China. The Chinese government programs and incentives for the development of SHP create an environment more conducive for SHP projects. However, even with this support, local participants must still raise funds, and work is often delayed or suspended. Small-scale projects can also attempt to demonstrate additionality based on barrier tests, such as technology barriers, investment barriers, or prevailing practice barriers.

● The technology transfer objective of the CDM, which is a stated high priority for China, is relevant for SHP projects. China has a strong SHP capability and manufacturing industry, and may prefer SHP/CDM projects to utilize advanced technologies that are less prevalent in China, such as new automated systems.

IC-SHP's role in the implementation of the CDM

IC-SHP is well placed to act as an agency for the development of CDM projects and to help overcome some of the local capacity barriers for implementing the CDM in China. This section will discuss IC-SHP's previous experience with the CDM. It will also examine some options for potential SHP/CDM projects in China.

● Heihe SHP Project, Gansu Province

IC-SHP developed project documents for this SHP project located in Gansu Province, in the west of China. This project was submitted it for pre-qualification to Senter, an agency seeking CERs through the CERUPT program on behalf of the Netherlands government, in early 2002. This was also the first project to apply for CDM Host Country endorsement in China.

A small-scale project, it consists of three SHP power plants located on branches of the Heihe River:

- Hongwan (1 MW installed capacity);
- Xishuigou (1.8 MW installed capacity), and;
- Yueyaya (3.75 MW installed capacity).

The plants will be constructed and operated by the privately owned Gansu Heihe Hydropower Development Corporation. A local energy-intensive producer of ferroalloy will consume part of the projected 33.34GWh of annual production, and part will go into the grid. The plants will meet increased demand from the ferroalloy industry, as well as supply a larger proportion of electricity in dry seasons from hydropower.

CERs over the first crediting period of seven years. For the project lifetime, reductions could amount to more than 250 000 t/CO_2e. The expected first year of delivery was 2004, with the final of the three plants coming online in 2005. Feasibility studies were conducted for all three sites, and the Provincial Planning Commission has already approved construction. China's central government has also provided a letter of endorsement for CDM component of the project. IC-SHP has continued its work on developing a CDM project in this area.

● **Dagangou/Dingjiaxia Hydropower Stations Project, Gansu Province**

This small-scale project involved the construction of two run-of-river power stations on the Dongda and Jinchuan rivers, in Yongchang County, Gansu Province. Dingjiaxia station (3.0 MW installed capacity) and Dagangou station (8.4MW installed capacity) will form part of a cascade development that was initiated in 1958.

The project will displace the use of coal and firewood for cooking and heating, as well as electricity generated from coal-fired thermal plants for lighting, electrical appliances and cottage industries. It was expected to begin delivery of CERs in 2005, with an estimated annual reduction of 57 543 tCO_2e, and to provide a reduction of 805 602 tCO_2e over a 14 year period.

This project idea was first submitted to the World Bank's Prototype Carbon Fund (PCF) in 2003. In August 2003, IC-SHP was advised to submit it the Community Development Carbon Fund (CDCF), which was done in October 2003. For this project, IC-SHP sought US$2.417 million from the CDCF, based on $US3 per ton for 805 602 tCO_2e .

Due to the CDCF's suggestions about the additionality of the project, IC-SHP has continued to work on developing a project design document in this area.

● **Study on the CDM and SHP in China, 2004**

IC-SHP is also conducting a study on the CDM in China. The objective of this study is to build the CDM capacity of the Center and to inform potential CDM project development.

This study will provide the Center with an information resource on the CDM, and address the barriers and issues relevant to developing replicable SHP projects under the CDM in China.

Potential SHP/CDM projects

- **Dagangou Hydropower Station Project, Gansu Province**

IC-SHP is currently developing a project design document for this project. It involves the construction of a run-of-river, diversion type station on the Dongda River in Yongchang County. Yongchang County is a Yugu nationality Autonomous County, located in Gansu Province. Dagangou station will be connected to the Yongchang County grid, and will operate as the main source of electricity for the county. Around 10 000 households will be served by the project.

The station will have an installed capacity of 8.4 MW, and an annual output of 37.968GWh. It can therefore be classified as a small-scale project. The feasibility study for Dagangou has been completed and approved by the Ministry for Water Resources.

By replacing the use of firewood and coal for household cooking and heating, this project is estimated to supply an annual reduction of 92 503tCO_2e, and 1 942 563 tCO_2e over a 21 year crediting period. The project's earliest start date is September 2004.

This project will also result in significant national and local environmental benefits, by reducing emissions of CO_2 and other air pollutants, reducing local deforestation, and providing power for the development of the local economy.

- **Quhe Hydropower Station, Sichuan Province**

Qingchuang County, in the north of Sichuan, has a theoretical hydropower potential of 485.5 MW, of which 260 MW is exploitable. Of this, 160MW of exploitable potential is available on the Qingshui River, which has ten hydropower plants planned for it.

Quhe is the fourth-stage station of the Qingshui River cascade development, and is intended for power generation. A dam, situated at Jinggongtang, near Quhe Village, collects part of the water head, while a diversion tunnel collects the rest. The installed capacity will be 7500kW, with a guaranteed output of 1001.22kW.

Qingchuan County's economy is lagging, and its power potential remains almost untapped. This project will boost the development of local agriculture and industry. It will provide 15.21 million kWh of power annually for 8 781 households, and a population of 31028, and guarantee electricity supply in the project area. The low tariff rate will also save farmers in the area 4.58 million yuan each year, and save around 100 000 hours of labor previously taken by fuel wood gathering.

The station is expected to begin operation before the end of 2004. The project is small-scale, and the major work involves the dam construction.
An environmental assessment of the project has been submitted to the Environmental Protection Bureau of Guangyuan City, and does not foresee negative environmental impacts. This project may also involve rebuilding two small hydropower stations further downstream, with the potential to increase the installed capacity by 1000kW, and 4 million kWh each year.

● **Qinjiamo Hydropower Project, Shanxi Province**
Located in the southeast of Shanxi Province, Lingchuan County, the Haihe River Basin has relatively high rainfall, good forest cover, and a hydropower potential 1.68 MW. Nine hydropower stations have been established so far, with a total installed capacity of 5260 kW. The Wujiawan River, a tributary of the Haihe River, has continuous flow and abundant hydropower potential. A project to develop this potential, proposed by the Power Bureau of Southeast Shanxi in 1978, was abandoned due to the complexity of the task. With further social development and mechanization, this project has returned to the agenda.

The construction of Qinjiamo cascade power plants would serve as a key power project to achieve rural electrification in Lingchuan County. The County government has stressed the need for rural electrification to develop the local economy and alleviate poverty. The County planning report decided to construct a double arch dam near Qinjiamo Village to serve as the regulation reservoir, and to divide the cascade stations into four stages:

- Plant I: installed capacity of 3 x 1250kW;
- Plant II: 3 x 320 kW;
- Plant III: 3 x 500 kW, and;
- Plant IV: 3 x 320 kW.

The total installed capacity will be 7170 kW, and total energy output will be 32 330 000kWh. Construction is expected to be completed within three years.

Conclusion

This paper has discussed a number of dimensions of the progress of CDM in China that are relevant to IC-SHP's future role in this area:

● There is potentially a wide scope for the development of CDM projects in China. The country's future GHG emissions are projected to be high, while its marginal abatement costs remain relatively low.

● SHP has the strong potential to contribute to GHG abatement in China, as a renewable energy source with the support of the Chinese government.

● A lack of local capacity in China still poses a barrier to the effective implementation of CDM projects.

IC-SHP is well placed to help overcome these concrete barriers to developing SHP/CDM projects in China. The Center has a growing understanding of the specific issues and barriers that apply to SHP projects under the CDM, and its experiences have suggested several priority issues must have priority in developing SHP/CDM projects.

First, careful attention must be given to demonstrating a project's claim of additionality, particularly for SHP projects in China. Second, attention must also be given to identifying the buyer for CERs and understanding their interests and priorities. For example, are they looking for cheap CERs or are they concerned with quality? Third, effort must be put into developing a detailed and credible baseline and project document: a quality product and learning-by-doing will be more valuable in replicating CDM projects. Fourth, the project development process should consider other avenues for financing, the reduction of transaction costs, and maximizing CERs, such as bundling, or outreach programs that increase the acceptance of new power technology and schemes in a community.

By addressing these issues, IC-SHP can effectively assist in the identification of appropriate sites and projects, in drafting project design documents, and in linking Chinese CDM projects with interested parties and buyers. As the CDM forms a significant component of the financing mechanisms explored by the SYNERGY Programme, IC-SHP hopes that the Programme will expand access to information, investors, and interested parties in Europe. This experience will further enhance its capacity to effectively design and replicate SHP/CDM projects in China.

T04.4 Dissemination of the paper "*The Clean Development Mechanism and Small Hydropower Projects in China* ".

Developing Small Hydropower Projects Under the CDM

Seminar for Renewable Energy Policies and CDM Approaches in China

Supported by the Synergy Programme: Building up the structures for the commercialization of renewable energy in China.

September 13-15, 2004, Beijing.

1. Introduction

As a relatively mature technology with demonstrable environmental and socio-economic benefits, SHP projects are able to meet many of the requirements of the CDM. Of the more than 160 CDM projects identified by a recent OECD/IEA study, 2/3 involved electricity generation from renewable energy. Hydropower is the most popular project type so far, accounting for 39 projects. However, renewable energy projects only account for 38% of the expected emission reductions generated under the CDM.1. Although the trend is towards high yield energy efficiency and HFC reduction projects, hydropower still made up 11% of all emission reductions contracted in the first half of 2004.

SHP projects applying for CDM financing possess both advantages and disadvantages compared to other types of technologies. In terms of the objectives of the Kyoto Protocol and the CDM, SHP meets important requirements: it is a renewable energy, with minimal environmental impact, and contributes to sustainable development. The CDM also offers SHP project developers an opportunity to gain crucial financing for projects that may be too small or focused on rural development to attract sufficient private sector investment. However, SHP projects face barriers specific to this technology. For example, project developers may face challenges in proving additionality3 and in demonstrating technology transfer. This paper will outline the advantages and disadvantages specific to SHP projects under the CDM, and the major strategies SHP developers may use to gain CDM approval. It also includes an examination of issues for SHP/CDM projects in China. For example, see: The International Rivers Network, and CDM Watch. 2003.

2. Advantages Specific to SHP Projects

● SHP projects are capable of demonstrating environmental and sustainable development benefits, such as reduced pollution, watershed management, and income generation. They can also be effectively tied to wider schemes for rural electrification or community development. In this regard, SHP has an advantage over large hydropower projects, which have been criticized by groups such as the International Rivers Network and CDM Watch for undermining the Kyoto Protocol4. For example, large hydropower projects are more likely to result in the displacement of communities, and the fragmentation of rivers, detracting form the sustainable development aims of the CDM. Although the CDM is at its core a market-based mechanism, SHP projects have an advantage in attracting investors who are concerned with the environmental and developmental credentials of a project and in gaining host country approval.

● As SHP projects are by nature small, they can take advantage of small-scale project status under the CDM. If the maximum output capacity equivalent is less than 15MW, these projects are eligible to use streamlined procedures and modalities, and for bundling. This can reduce transaction costs and increase the economic viability of a project. The streamlined procedures for small-scale projects will be further examined below.

● The small-scale and community-focused nature of many SHP projects can also result in greater local participation. Indeed, local participation and acceptance of an SHP project is vital, as it will depend on the uptake of new technology and energy practices by the local population. This is an advantage in generating ‘high quality’ CERs, and for applying to funds, such as the Community Development Carbon Fund (CDCF), that require demonstrated local involvement. As discussed below, however, local context can also generate challenges for the project developer.

3. Challenges Specific to SHP Projects

● SHP projects, like other small-scale, decentralized renewable energy projects, often have a greater dependency on local context and capacities. This can create issues such as:

- Local developmental priorities and policies are important, as are local technical and ‘soft’ capacities. This issue is relevant for any project involving the transfer of new technology and practices. For example, these may affect the maintenance of equipment, the monitoring process, and local acceptance of new energy technology or systems.
- The structure of local GHG emissions and fuel use also affects the amount of emission reductions. Areas with lower GHG emissions, such as those with little industry or coal-fired electricity, naturally generate fewer emission reductions.
- In addition, project development may depend on the availability of local or provincial information. The required information may be particularly

difficult to gather in remote, rural regions.

- The use of simplified baselines for small-scale projects may require using standard, averaged figures or coefficients for making certain calculations. If a project is in an area where the development (consumption of all energy sources) over the lifetime of the project is slow compared to the national average, then the emission reductions are actually greater than the national averages given in the fixed emission coefficients. However, if a CDM project is in an area where the future development will be faster then the national average, the emission reductions are not as great as the coefficient indicates.

● Additionality is another issue for SHP projects, particularly in countries with a favorable policy or commercial environment for SHP development. For example, the SHP industry is well established in China and in a number of countries in Central America. Given existing levels of government support, subsidies, and commercial viability in such countries, it can be difficult to claim that SHP projects face a prevailing practice barrier.

However, government support or a large number of already functioning SHP projects does not necessarily mean a project in this area will fail to gain CDM validation. Instead, this situation demands that more attention be paid to demonstrating additionality and justifying the need for CDM financing. In some cases, government support may indicate an inability to secure private financing or compete in the marketplace. Further, some CDM projects are proposed and carried out by governments and public utilities, such as landfill projects, which necessarily involve city councils.

As yet, there is no pattern to the validation of CDM projects in areas with favorable government or prevailing practice environments. Projects that have drawn criticism as business-as-usual outcomes have still achieved validation. However, critiques and tests of additionality are increasingly detailed. For example, comments on La Esperanza Hydroelectric Project in Honduras included information taken form previous press releases and presentation about the project to determine whether the CDM was long considered as a source of financing5. In environments where SHP can be viewed as business-as-usual, project developers will need to go to greater efforts to justify government support and investment, the project construction date, and whether CDM has long played a part in mobilizing the project. The existence of one barrier is enough for a project to become CDM-eligible. However, if the developer can demonstrate the existence of more barriers, then the project will stand a better chance of validation.

● The technology transfer objective of the CDM, which is a stated high priority for developing countries, is also highly relevant for SHP projects. SHP technology has a strong manufacturing base and is widely used in some countries. This creates two challenges for project developers. First, it may be more difficult to prove a technology barrier that hinders carrying out the project. Second, host countries with strong SHP industries may prefer CDM projects to utilize new or advanced technologies that are less prevalent, such as new automated systems. The technology transfer factor may thus affect a project's chance of both validation and approval by the host country.

● As SHP projects have a small production scale, they are at a disadvantage compared to projects that can yield large amounts of CERs. According to an OECD/IEA study, even the lowest estimates of transaction costs still require a CDM project to generate at least 10 000 CERs over its crediting lifetime just to break even. This study predicts a further shift away from renewable energy and electricity generation projects toward more cost- effective, higher-yield projects, such as methane and F-gas reduction projects6. It is therefore important for SHP/CDM project developers to investigate ways of reducing transaction costs and increasing efficiency to maximize the benefits of the CERS they produce.

4. Strategies for Developing SHP Projects under the CDM

There are a number of possible strategies for marketing SHP projects, of which the CDM is but one component. The CDM is designed to make marginal projects more competitive in the market, where the technology concerned is not the least-cost option. At heart, the CDM is a market-based mechanism, although there is a number of ways aof approaching CDM buyers. Due to specific features of small hydropower technology and scale, SHP projects have certain strategies open to them in utilizing the CDM. These include using small-scale project status, bundling a series of small projects, and taking advantage of the environmental and developmental aspects of SHP.

Small- scale projects

Under the Marrakech Accords, small-scale projects are subject to much simpler requirements for CDM approval. Projects falling into the small-scale category therefore gain advantages, such as reduced transaction costs and a shortened project cycle. Small-scale projects are defined7 as:

- Renewable energy projects with a maximum capacity equivalent of less than 15 MW;
- Energy efficiency projects which reduce energy consumption by the equivalent of up to 15 gigawatt hours per year;
- Projects that reduce anthropogenic emissions and directly emit less than 15 kilotons of CO_2e per year.

Project that fall into one of these categories can then take advantage of simplified modalities and procedures for validation, registration, and monitoring. These projects use a simplified PDD format with fewer requirements, and can use simplified baseline methodologies and monitoring plans. Small-scale projects may also use the same DOE for validation, verification and certification.

In addition, these projects are eligible for bundling, although the total size of the bundle must not exceed the small-scale eligibility limits. Small-scale projects can also claim a reduced registration fee and a shorter registration period. Other requirements, such as conducting an environmental impact assessment, gathering stakeholder comments, and allowing for a 30-day public comment period, remain the same as for a standard project.

Many SHP projects fall within the small-scale project category. Project developers can reduce transaction costs through these streamlined procedures, and thus increase the financial attractiveness of their projects. The benefits of small-scale status may also have an influence on geographical the distribution of CDM projects. Small-scale power generation, for example, is more prevalent in certain Asian and African countries, where the CDM has so far made little progress8

Bundling

Bundling is an activity open to small-scale projects, and is another way to reduce the costs of developing a CDM project. According to the UNFCCC, a series of small projects may be bundled together at the following stages of the project cycle: in the PDD; validation; registration; monitoring; verification; and certification. The total size of the bundled project must not exceed the limits set for small-scale projects9.

For example, a number of small run-of-river SHP stations could be developed and presented for validation in the same package, using the same baseline methodology and monitoring plan. The projects in the bundle do not need to share the same technology or location, but some similarities are necessary to gain the full advantage of bundling and using a single baseline10. According to a study by IT Power, bundling can raise internal rates of return, making marginal CDM projects more financially attractive.

The environmental, social, and economic development benefits of SHP projects make them more eligible for consideration in sustainable development focused programs. SHP projects are generally small-scale, community-focused, and have relatively few negative social and environmental impacts, especially compared to large hydropower installations. The negative impacts of large reservoirs, such as the displacement of communities, fragmentation of rivers, and contribution to methane emissions are contradictory to the sustainable development aims of the CDM.

SHP projects thus lend themselves to an environmental and sustainable development 'marketing strategy', and are more likely to be considered by buyers such as the CDCF, or companies interested in developing a 'green' image. The CDCF, for example, aims to link small-scale emissions reduction projects with governments, companies and organizations seeking to improve livelihoods and gain CERs.

This strategy is particularly suited to those projects that are too small or remote to gain adequate financing in the private sector, or to attract major CER buyers. Small projects in areas with less fossil fuel consumption and emissions generate fewer CERs and are therefore less competitive in the carbon market.

5. Developing SHP/CDM Projects in China

Since signing the United Nations Framework Convention on Climate Change (UNFCCC) in 1992, China has increased its efforts to address the issues of global climate change. As the world's second largest emitter of greenhouse gases (GHG) and the world's largest consumer of coal, China's involvement in the climate change mitigation process is vital.

China's national greenhouse gas inventory was developed as part of a 1998 Asian Development Bank-Global Environment Facility-United Nations Development Program study entitled *Asia's Least-Cost Greenhouse Gas Abatement Strategy: People's Republic of China*. This will lay the foundations for China's first National Communication. According to this inventory, China's total net emissions in 1990 were in the range of 1816-1864 Tera grams of CO_2 and between 25-32 Tg of CH_4.

Agriculture and coal mining were the major sources of $CH_{4.}$ CO_2 emissions made up 73-78% of total GHG emissions, and energy consumption and industrial processes accounted for 92% of total CO_2 emissions13. Please see Figure 5.1 for details on China's GHG emissions by sector.

China is generally regarded as the country with the largest CDM potential. A joint World Bank study, for example, estimates China's CER potential as 0-211 $MtCO_2$, and projects China will capture around 11% of the global carbon market15. As another study notes, not only does China have a large quantity of potential GHG emissions, it also has a relatively flat marginal abatement cost (MAC) curve, meaning that emissions reductions will be relatively cheap to achieve16. China's MAC for GHG emissions is particularly flat in the industry/power sector 17. The direction and development of China's CDM potential depends on a number of factors, including its attitude toward the CDM, institutional and industry capacity, and general developments in the CDM market.

China's attitude toward the CDM

China's relatively slow start in the carbon market is partly due to its cautious approach to the CDM, and its desire to build a certain level of domestic CDM capacity. A senior official in the climate change process has noted "that Asian countries have not rushed into the CDM process, as they are concerned about the quality of the CDM and the integrity of the Kyoto Protocol"18. China has maintained a conservative position in international climate change negotiations, and made efforts to represent 'developing country issues'. Efforts to mitigate climate change and reduce GHG emissions must also allow for economic development and poverty alleviation. As Buen notes, China has consistently stressed 'common, but differentiated responsibilities', and contrasted the 'survival' emissions of developing countries with the 'luxury' emissions of developed countries19.

China's cautious initiation of official CDM processes, however, has not limited its interest in CDM capacity building activities. Prior to the announcement of its Designated National Authority (DNA), China has cooperated with a number of foreign donors through various CDM capacity building projects. By coordinating these projects, China was able to ensure each had a different focus and thus made a useful contribution to its CDM capacity and knowledge20. These include:

▪ The China CDM Study, funded by the World Bank, the Swiss Government, and the German Agency for Technical Cooperation (GTZ), which addressed methodological and technical issues, developed six CDM project case studies, and released a final report in June 2004.

▪ Canada-China Cooperation in Climate Change (C5), funded by the Canadian

International Development Agency (CIDA), which focused on developing a CDM operational model, case studies in urban transportation, and research on carbon sinks. It also finished in June 2004/

▪ Opportunities for the CDM in the Energy Sector, an ADB project, financed by the Canadian Cooperation Fund for Climate Change, examined abatement opportunities in the energy sector, and developed PDD's for four small-scale projects. Finished August 2003.

▪ Building Capacity for the CDM in China, was a UNDP project, funded by the UN Foundation, the Italian Ministry for the Environment, and the Norwegian Agency for Development Cooperation (NORAD), and focuses on capacity building for government and stakeholders, prefeasibility studies, the implementation of three CDM pilot projects, and the establishment of a CDM website for information dissemination. It is due to finish in 2006.

China also maintains that the CDM must be implemented with full consideration of its stated intentions to provide technology transfer and sustainable development options to developing countries. Chinese negotiators have repeatedly stated their concern for the technology transfer component of the CDM, even calling for a separate technology transfer mechanism to be established under the Kyoto Protocol22. This is further reflected in China's regulations on the implementation of CDM projects, which do not allow either unilateral Chinese or foreign CDM projects.

There is still some uncertainty as to how China will manage projects that do not meet its technology transfer or environmental priorities. The projects that may be most attractive to CDM investors, such as low-cost, high-yield HCF reduction projects, offer few social and environmental benefits to host countries such as China. Energy efficiency and renewable energy projects will provide greater sustainable development benefits, such as the reduction of local pollutants23. China's recent CDM regulations state that these project types will be given priority.

Issues for the CDM in China

Despite China's potential to become the world's top host country for CDM projects, its CDM process has begun slowly. China's DNA and related regulations for the implementation of CDM projects were announced in late June 2004. Although this provides increased clarification for project developers and investors, the effective implementation of CDM projects in China still faces a number of challenges. These include:

▪ A key barrier for implementing CDM projects in China is a lack of local knowledge and skills. Although there are increased efforts to build CDM capacity outside of government circles, local ability to identify CDM projects and develop project design documents is still limited. For example, China lacks any approved designated operational entities (DOE), and few organizations have CDM project development experience. A lack of CDM capacity intensifies difficulties in realizing projects, especially for smaller organizations. It also increases transaction costs, as developers need to devote more resources to training, accessing information, and using foreign DOEs.

▪ There is still a lack of easily accessible information. For example, technical information, particularly in poorer and more isolated regions, can also be difficult to obtain. Project developers may also need concrete guidelines on China's national sustainable development criteria for CDM projects. Unfamiliarity with China's institutions, regulations and local conditions compounds concerns for developers and investors.

▪ There are also concerns about potential restrictions on certain kinds of CDM projects. For example, only Chinese enterprises and companies held by Chinese partners can apply to develop CDM projects24. The Chinese government has also indicated that technology transfer will also play an important part in the approval of CDM projects. In addition, there is some concern that a China may use measures to filter projects that are deemed less compatible with China's development priorities25. These issues should become clear as the DNA further implements the CDM approval processes.

▪ In addition, CDM projects in China face the general challenges associated with CDM and the emerging carbon market. The project cycle requires significant financial, human, and temporal resources, and access to detailed technical information. Transactions costs for developing CDM projects are still high, and can reach up to $US 250 000 per project. The low price for CERs, hovering around the US$ 3-6/tCO_2 mark, can also make it difficult to include CDM financing as a significant revenue stream. This situation favors

large-scale energy efficiency and sinks projects, which generate larger amounts of CERs, and which are more capable of meeting the costs of project development. Further, the risk that the Kyoto Protocol will not enter into force, or will be enter into force too late for the first commitment period, contributes to investor uncertainty. These market issues compound the perceived difficulties and transaction costs of developing CDM projects in China. These issues will need speedy resolution, if projects are to be competitive for the first commitment period of the Kyoto Protocol.

SHP and the CDM in China

China's SHP potential, existing capabilities, and government support for SHP initiatives enhance the opportunities for developing SHP projects under the CDM. China can claim 17% of the world's hydropower resources, and its developable SHP potential amounts to approximately 100GW spread over 1500 out of nearly 2300 counties in the country. China's SHP development has seen installed capacity additions of more than 2000 MW annually26. SHP management systems stress a decentralized approach, encouraging the utilization of indigenous technology and manufactures, and the development of local grids. Projects are often integrated with rural electrification and development schemes, and SHP development remains a priority within government programs, such as 'Replacing Fuelwood with Electricity' and 'Sending Electricity to the Villages'.

SHP can also take advantage of the GHG abatement opportunities projected for China's energy sector. China's GHG emissions from the energy sector are predicted to increase from 3080 $MtCO_2$ in 2000 to around 4000 $MtCO_2$ in 2010, with coal contributing the major share27. Further, a flat MAC curve means that China's industry/power generation sector could account for 50% of China's CDM potential28. According to a 2002 study by the Global Climate Change Institute of Tsinghua University, hydropower in China has an abatement potential of 54.3 Mt CO_2e.29 To realize its CER potential, China would need a significant number of new power initiatives to be registered as CDM projects, and up to 100 RE power projects to be in operation by 2006-2007.

Utilizing CDM for SHP projects in China also faces a number of challenges. These challenges are both general to SHP projects under the CDM and specific to SHP projects in China. The challenge of demonstrating additionality for SHP projects in conducive policy and commercial environments is particularly evident in China. The Chinese government programs and incentives for the development of SHP include preferential policies, soft loans and subsidies. However, the ration of government to private finance in SHP activities is approximately 1:24, indicating that significant funding must still be sought from private investors and commercial loans.

Further, SHP technology and knowledge is well-established in China. There is a strong manufacturing industry, extensive SHP experience, and a base of SHP experts. As technology transfer is a stated high priority for China, the government may prefer SHP/CDM projects to utilize advanced technologies that are less prevalent, such as automated systems. Further, this situation makes it more difficult for CDM project developers to demonstrate technology or prevailing practice barriers.

Small-scale renewable energy projects, such as SHP, are also relatively dependent on local context and capacities. The availability and quality of information about local energy use and emissions is vital to the development of a CDM project baseline and the number of CERS a project may claim. Developmental and energy use figures vary widely between Chinese regions and provinces, particularly between the east coast and the western parts of the country. Although national or sector-wide baselines may be inaccurate reflections of local energy development, the basic assumption that development increases emissions is still applicable to many Chinese regions.