



United Nations Development Programme
Global Environment Facility
United Nations Office for Project Services

Improving Kiln Efficiency for the Brick Making Industry in
Bangladesh – PDF B Phase
(BDG/04/014)

Terminal Report
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1. Introduction

1.1 Project Background

Brick kilns are a major source of greenhouse gas in Bangladesh, emitting approximately 3.1 million tons of CO₂ annually. Such high levels of emissions are a result of the use of outmoded technologies and substandard fuels such as high sulphur coal, tires and wood energy in kilns. This situation is being exacerbated by the growth of new brickfields every year. In Bangladesh, brick supply is fairly elastic because of the footloose nature of the industry. Studies in the 1990's show that out of 14.8 million households, 3.7 million or 25% used bricks as wall materials. Demand for bricks, which has been growing at about 10% over the last two decades, stems mainly from the growth of the construction industry which has been growing above GDP rates. GDP growth rates have averaged about 4% whereas the construction industry growth has been about 5.5% during this period.

Kiln technology in Bangladesh is mostly based on Bull's Trench Kiln (BTK) technology or some variation of it. This type of technology is over 150 years old and exceedingly inefficient in terms of fuel usage and being poorly constructed cause excessive leakage through the top of the "trench". Estimates indicate that in Bangladesh, 23 tons of coal are required to produce 100,000 bricks whereas in China, only 7.8 to 8 tons are required. Equally alarming is the use of wood energy in BTKs. Studies carried out in the 1980's identified brickfields as a major cause of deforestation in Bangladesh. The Bangladesh Brick Manufacturing Owners Association (BBMOA) estimates that even today, 25% of the fuel used in kilns is still from wood.

Only sporadic efforts to introduce efficient kiln technologies have been made in the past in Bangladesh using intermediate technologies. Moreover, there had been no comprehensive barrier removing effort to disseminate clean technologies. One previous study on demonstrating energy efficient technologies for brick making in Bangladesh involving the Swiss Development Corporation in 1992 did not result in any further donor involvement.

UNDP in collaboration with a consortium of proponents submitted a concept paper in December 2003 that was developed to secure GEF project preparation funds (PDF B grant) to reduce greenhouse gas emissions (GHGs) from the brick industry through the removal of barriers inhibiting adoption of cleaner kiln technologies for the brick making industry. The GEF secretariat approved a PDF B grant in December 2004 as preparatory assistance to study the technical feasibility of a project to improve efficiency of brick kilns in Bangladesh and to scope, design and prepare an implementation program for a barrier removal Operational Program 5 (OP5) project. The consortium of proponents included Clean Energy Alternatives (CEA), the Institute for Building Materials, Xian, China (XIAN), the Bangladesh University of Engineering & Technology (BUET) and the Infrastructure & Industrial Finance Company (IIDFCL) in collaboration with the BBMOA.

The duration of the PDF B Phase was planned as a one-year period with the total budget for the PDF B activities, inclusive of private sector financing totaling US\$550,840. Of this, US\$348,000 was to be from GEF, US\$27,840 from UNDP and the balance US\$175,000 from stakeholder contributions. A major part of the stakeholder contribution, US\$148,000, was to be from private commercial banks and brick-makers with the US\$27,000 balance from technology providers, monitors and project proponents. It is noteworthy that neither GEF nor any other donor provided any funds for PDF A activities, all of which were contributed by the project proponents.

1.2 Outline of Official Arrangements

At the time of award of PDF B funds in December 2004, UNDP recognized the time sensitivity of the full project. Furthermore, the key to the successful development of the project was to allow the private sector more latitude in formulating the project. UNDP arranged the management of this PDF B phase as a DEX project under a Project Preparatory Assistance Program. As a consequence of this decision, UNDP arranged the outsourcing of project management functions to UNOPS acting as the Executing Agency.

Full time staffing arrangements consisted of an International Chief Technical Advisor (CTA) (who was under contract with UNOPS), and local staff consisting of a National Technical Coordinator, an Administrator and a Capacity Building Specialist, all of whom were hired under local UNDP contracts after receiving authorizations from UNOPS. Short-term technical specialists, both international and domestic were recruited through UNOPS. This included:

- Institute of Building Materials, Xian, China for design, construction supervision and training of personnel for one demonstration kiln;
- Bangladesh University of Engineering & Technology to provide technology support services including assisting the Xian Institute in technology adaptation issues;
- Industrial & Infrastructure Development Finance Company of Bangladesh to develop financing models and providing financing for the demonstration kiln in line with the model developed; and
- The Louis Berger Group, USA, to provide a credible estimate of baseline emissions from the brick industry in Bangladesh.

Under the DEX operational modality, the CTA provided project coordination with the guidance of the Project Review Committee consisting of the UNDP and key stakeholders listed below. Supporting the activities of full time staff and short-term technical specialists, a number of activities were carried out by key stakeholders through their own co-financing. This approach facilitated acceleration of the program to the extent where a number of activities being undertaken during the PDF B phase was a part of the full project but was also included in the PDF B activities to speed the project implementation on a fast track; this included the construction and setup of a demonstration energy efficient kiln. Other project stakeholders making contributions to the project included:

- The Department of Environment, Government of Bangladesh, in assisting with the modalities of environmental clearances for the energy efficient kilns;
- The Bangladesh Brick Makers Owners Association (BBMOA), through their cooperation in facilitating their membership to disclose valuable operational information to establish the project baseline; and
- Clean Energy Alternatives (Dhaka and Washington DC), in providing technical assistance, preparing feasibility reports for implementing a clean energy technology dissemination program, and to participate in the Project Review Committee.

Project operations commenced on June 16, 2005 and were completed on March 31, 2007. Project contributions by the stakeholders are summarized in Table 1. Final project expenditures are shown on Table 2.

Table 1: Stakeholder Co-Financing

Co-financing Sources for Project Development Preparation (PDF)				
Name of Co-financier (source)	Classification	Type	Amount	
			Expected (\$)	Actual (\$)
UNDP TRAC	Exec. Agency	In cash	25,000	27,840
Government of China	National Gov't	In kind	10,000	10,000
Bangladesh University of Engineering and Technology	Research Institution	In kind	11,000	20,000
Clean Energy Alternatives	Private Sector	In kind	6,000	50,000
Private Sector Financial Institutions	Private Sector	In cash	96,000	466,500
Private Sector Brick Making Entities	Private Sector	In cash	52,000	251,200
Total co-financing			200,000	825,540

Table 2: Final Project Expenditures

Input Description*	Approved (Based on Budget 'A')			Committed		
	Staff weeks	GEF funds	Co-finance	Staff weeks	GEF funds	Co-finance
Project Personnel	31	11,413	-	58	5,137	-
Local consultants	103	71,338	11,000	152	62,588	20,000
International consultants	92	182,850	-	94	184,250	-
Training		4,900	10,000		3,819	10,000
Travel		34,960			35,582	-
Office equipment		12,275			12,275	10,000
Miscellaneous		30,264	179,000		44,349	785,540
Total	162	348,000	200,000	180	348,000	824,540

1.3 Project Objectives

The objectives of this PDF B phase were to:

- identify all key stakeholders along with their roles on the full project;
- prepare a logical framework analysis with the participation of key stakeholders, to narrow the focus of project objectives;
- collect data and information to profile the current brick industry including assessments of current technologies being employed by regional brick industry, various energy efficient brick kilns (EEKs) and their adaptability to the Bangladeshi environment, and brick molding techniques to be used for improving energy efficiency;
- design barrier removal activities and identify co-financing partners for the proposed GEF full project;
- complete a GEF Project Executive Summary and UNDP Pro-Doc for full project funding;
- construct and assemble a demonstration EEK.

2. Results and Conclusions

All objectives for this project were achieved albeit to schedules that differed from the original plans. As well, project outcomes have been successful with the high level of awareness amongst a number of brickfield entrepreneurs of the environmental and social benefits and profit potential of a shift to HHK technology. Results and conclusions of each activity are provided in this section.

Activity 1: Establishment of Implementation Arrangements and Office Operations

From the June 2005 commencement of the project, an office was provided by Clean Energy Alternatives for the PDF B team members. While the recruitment of PDF B staff was commenced upon the June 2005 fielding of the CTA, the process of recruiting local full time staff (including the NTC, administrator and a secretary) was long and cumbersome requiring a minimum of 3 months for advertising, interviews and contract signing. For a 9-month project, this recruitment period was not practical resulting in a project management decision to only recruit an NTC and an administrator. The recruitment of the secretary was cancelled.

In addition, recruitment of other local consultants was curtailed for three reasons:

- Unavailability of qualified consultants such as the economist;
- For the regulatory consulting assignment, no specialist was required as technical assistance on regulatory issues was provided by the PDF B team in partnership with the Department of Environment; and
- Consolidation of some of the positions with local service contracts such as the database consulting work being assigned additionally to BUET.

Activity 2: Logical Framework Analysis

A national participatory workshop was organized during July 2005 (month 2 of the project) to complete the LFA. The workshop was successful considering the wide range of participants and their level of interest on the project. LFA discussions were thorough in developing a project that would support demonstration EEKs, and sustain the development of a cleaner brick industry. Discussions revolved around applicable technologies, providing concrete project objectives and designing the full project complete with the identification of success indicators and risk factors. The inputs provided by the stakeholders attending the workshop were crucial to the design of the project.

The discussion on technology options, however, was initially met with resistance due to the higher costs involved for the EEK to be demonstrated (known as the Hybrid Hoffman Kiln or HHK) and the lack of confidence that the HHK would work in a Bangladeshi environment. This discussion outcome reinforced the PDF B design for sponsoring travel to Xian, China to allow stakeholders to visit and observe operational HHKs for BBMOA members (see Activity 3).

Activity 3: Data and Information Collection and Technology Assessment on EEKs

This activity was successful and provided significant contributions towards the understanding of the brick industry in Bangladesh as well as the design of the full GEF barrier removal project. The information and outcomes are summarized as follows:

- *Technology assessments of prevailing and proposed brick making technologies in Bangladesh.* The project provided a credible and well-researched paper on all available brick making technologies in Bangladesh during early 2006. The paper was prepared by BUET, a respected engineering institution in Bangladesh to

provide a comparison of existing technologies and other technologies that would reduce GHG emissions from the industry;

- *Baseline profile of the brick industry in Bangladesh.* Using BUET field survey teams, the task of locating all brickfields in Bangladesh was completed. This valuable survey overcame the paucity of data available on brick making activities in Bangladesh manifested from the fact that brick making is not considered as a formal industry. Outputs from the survey provided the PDF B team with credible estimates of the number of brick field operations and the types of kilns being used. This was used towards an improved estimation of greenhouse gas emissions from the industry, a number crucial in the GEF document for full project funding;
- *Potential for HHK market transformation.* With credible estimates of the number of energy inefficient kilns (EIKs) operating in Bangladesh and the energy consumption of both EIKs and EEKs, estimates were made as to the full potential for market transformation of the Bangladesh brick industry;
- *Setup of database.* BUET setup a database for the monitoring of all brickfield operations in Bangladesh, a tool that will be valuable for market transformation activities of the full project. While the database was populated with data from some of the kilns, the database structure was established to allow for additional data from new HHK installations and EIKs that were missed in the original baseline profile survey;
- *HHK information from XIAN.* A visit for stakeholders was organized in November 2005 to visit XIAN facilities in Xian, China and to observe operational HHKs. Stakeholders were impressed by the efficiency and the significant reduction of emissions from the Chinese HHKs. However, the key for many of the trip participants was the actual cost and performance of such a plant under Bangladeshi conditions;
- *Soft support for the setup of the demonstration HHK.* The project supported the presence of XIAN personnel in the setup of the demonstration HHK in Dhamrai, 35 km west of Dhaka. XIAN personnel were responsible for site selection, planning, design, layout and construction supervision of a private sector funded HHK. This activity, however, did delay the completion of the project from March 2006 to March 2007. After the March 31, 2007 PDF B completion, XIAN personnel remained on site to operationalize the plant. Reasons for the delay included difficulties in achieving financial closure of the demo HHK with IIDFCL and a private brick company, Universal Bricks Ltd. This was related to perceived risks incurred by any financier and brick company in the investment into a new technology; time was required for the financiers to become familiar with an HHK operation in China as well as operating conditions in Bangladesh. As a consequence, the financiers became more comfortable with risks related to the setup of the first HHK in Bangladesh. Full project designs were presented to a wide range of stakeholders during the Final Workshop held on March 28, 2007. A field trip was also organized as a part of this workshop to showcase the completed demo HHK construction. Though the HHK was not yet operational at that time, several BBMOA members and interested entrepreneurs informed the PDF B team of their plans to commence construction of these kilns as soon as they could observe the operations of the demonstration HHK.

Overall, Activity 3 was a successful departure from “traditional” PDF B activities in one significant way: It envisaged the design and construction of at least one demonstration kiln, which would normally be a full project activity. The outcome of the completion of the demonstration kiln was a heightened awareness and enthusiasm of the stakeholders (including entrepreneurs, brickfield managers, investors and banks) for HHKs as a viable investment. The momentum built from this outcome will prove to be useful in the startup of the full GEF project. Once the demonstration HHK is operational, XIAN personnel will provide operational data and HHK energy consumption to prospective HHK owners that will allow them to assess the potential for cost reductions and energy savings versus baseline technologies.

Activity 4: Project Design and Co-Financing Development

With the February 2006 completion of the assessment of the potential for HHK market transformation, project design and commitments for co-financing for the full project were completed within a 2-month period (commencing February to April 2006) to meet the GEF submission date of May 2006 date for proposals for full project funding. Assistance from the UNDP-GEF Regional Office in Bangkok was valuable in refining the project design and to meet the submission date schedule of late May 2006.

The financial arrangement for an HHK investment was studied by IIDFCL through a project consultancy. The initial consultancy required IIDFCL to provide a suite of creative financing options for brickfield operations, notably small-to-medium enterprises (SMEs). The terms of reference for the consultancy were scaled back given that IIDFCL did not have the resources to evaluate SME financing. As a result, their study was mainly related to conventional financing of HHKs.

Co-financing development for the full project was facilitated by the PDF B team and CEA through project presentations. Co-finances are reflected in the GEF Project Summary.

Activity 5: Preparation of GEF Project Summary and Draft Project Documents

These documents were completed in late April 2006 by the CTA based in Vancouver, Canada with assistance from the PDF B team in Dhaka and the UNDP-GEF Regional Coordinator for Climate Change in Bangkok. The CTA and the PDF B team also provided responses to queries during the bilateral (GEF) and STAP reviews. The outcome of this activity was successful as measured by GEF approval of these documents in August 2006, four months after submission to GEF.

In conclusion, overall implementation of this PDF B phase was successful. The main success indicators were the approval of the GEF full project funding (a main output of the project), and the completion (albeit late) of the demonstration HHK for raising awareness and knowledge of energy efficiency issues for the brick industry in Bangladesh. Appendix I contains a PDF B Activity Matrix for Monitoring Progress updated to March 31, 2007, and showing the completion of all project activities.

3. Recommendations

Recommendations contained herein are provided to guide future efforts for UNDP project preparations and to improve their efficiency as it relates to projects that have significant private sector involvement. This includes:

- DEX project implementation modality is advantageous if a project is to be mainly implemented by the private sector. The DEX modality averts lengthy government approvals and provides more freedom for UNDP personnel to collaborate with the private sector, and to more efficiently design knowledge transfer and capacity building activities;
- Provide sufficient project resources for the careful planning of a demonstration project. This would include:
 - Setting up visits to a country to observe the successful operation or use of a demonstration technology. Proponents and financiers will garner ideas of how the technology might fare in their own environment;
 - Providing exhaustive assistance in comprehending project risks and mitigation measures. This needs to be done in close collaboration with both proponents and project financiers. This will minimize delays in implementing the demonstration project; and
 - Retaining of adequate resources for the technology providers to setup, operate and maintain the demonstration project. The technology provider should also be fully engaged in knowledge transfer of the technology to the host country.

Appendix I: PDF B Activity Matrix for Monitoring Progress

Intended Outputs	Indicative Activities	Inputs	Intended Achievement / <u>Status as of March 31, 2007</u>
<p><u>Output 1:</u> <i>Establishment of Implementation Arrangements and Office Operations</i></p>	<p>1.1 Establishment of a PDF-B executing team and local project office; 1.2 Establishment of operational modalities between the Executing Agency and the MOEF; 1.3 Periodic Meetings (every 2 months or as appropriate) for monitoring and evaluating PDF-B exercise progress</p>	<ul style="list-style-type: none"> • UNDP and UNOPS management (to recruit PDF-B TA team); • Personnel of PDF-B TA team (local technical director assisted by CTA, and intermediate and junior support staff); • Airfares and per diems for int'l personnel; • Recurring expenses for office operations and international travel 	<p>i. PDF-B Team members appointed (<i>completed</i>); ii. PDF-B office with logistical support systems is operational (<i>completed</i>); iii. Operational modalities between UNDP Bangladesh and the MoEF established (<i>completed</i>); v. Periodic meetings (every two months) to monitor and evaluate PDF-B progress (<i>completed</i>).</p>
<p><u>Output 2:</u> <i>Logical Framework Analysis</i></p>	<p>2.1 Defining the full project objectives, expected results, framework design, detailed components, implementation plan; 2.2 LFA Workshop with stakeholders to identity full project success indicators, means for verification, project risks and mitigating actions.</p>	<ul style="list-style-type: none"> • PDF-B Team personnel; • Airfare for CTA; • Per diems for workshop participants and CTA • Office transport • Workshop facility rental • Admin fees for organization of workshop 	<p>i. National participatory LFA workshop (including proceedings) (<i>completed</i>); ii. Defined full project objectives, expected results, components, implementation plan, and risks assessment (<i>completed</i>); iii. Technology barriers and root-causes (<i>completed</i>); iv. Full project success indicators, means for verification and critical assumptions (<i>completed</i>); v. Potential project risks and mitigating actions to reduce the risks (<i>completed</i>); vi. Key requirements and local organizational support for full project success (<i>completed</i>);</p>

Appendix I (con'd): PDF B Activity Matrix for Monitoring Progress

Intended Outputs	Indicative Activities	Inputs	Achievement or Status
<p><i>Activity 3: Data and Information Collection and Technology Assessments on EE Kilns</i></p>	<p>3.1 Conduct desk study of technology options; 3.2 Obtain industry market profile and create database; 3.3 Obtain emissions baseline; 3.4 Design and setup demonstration kilns; 3.5 Determine suitability of EE kiln options; 3.6 Provide training support for demo kilns; 3.7 Conduct technology familiarization visits to another country; 3.8 Conduct baseline study of regulatory regime; 3.9 Study capacity building needs of BMI.</p>	<ul style="list-style-type: none"> • PDF-B Team personnel; • Airfares for CTA and kiln specialists and trainers from China; • Per diems for CTA and kiln specialists from China; • Technical evaluations and verifications; • Kiln material, construction and labor costs; and • Admin fees for organization of workshop 	<p>i. Stronger profile and understanding of the brick making industry in Bangladesh (<i>completed</i>); ii. Data and information collected that is related to technology application in Bangladesh (<i>completed</i>); iii. Baseline assessment on the brick making industry and EEK technology application and demonstration (<i>completed</i>); iv. Assessment of EEK technology market potential (<i>completed</i>); v. One demonstration EEK setup for the full project (<i>completed</i>).</p>

Appendix I (con'd): PDF B Activity Matrix for Monitoring Progress

Intended Outputs	Indicative Activities	Inputs	Achievement or Status
<p><i>Activity 4:</i> <i>Project Design and Co-Financing Development</i></p>	<p>4.1 Design the different activities in each project component;</p> <p>4.2 Finalize financing models to meet needs of financial institutions and brick entities;</p> <p>4.3 Preparation of budget for the full project;</p> <p>4.4 Confirm co-financing commitments for the full project;</p> <p>4.5 Prepare full project team structure;</p> <p>4.6 Prepare terms of reference (TOR) for the PPT for the full project.</p>	<ul style="list-style-type: none"> • PDF-B Team personnel; • Airfares for CTA and kiln specialists and trainers from China; • Per diems for CTA and kiln specialists from China; • Technical evaluations and verifications; • Kiln material, construction and labor costs 	<p>i. Activities for each component of the project completed (<i>completed</i>);</p> <p>ii. A suite of financial models to enable banks to finance brick making entities to introduce EEKs developed (<i>completed</i>);</p> <p>iii. Full project budget (<i>completed</i>);</p> <p>iv. Confirmed co-financing commitments for the full project (<i>completed</i>);</p> <p>v. Full Project team structure, identification of key candidates and lead organizations completed (<i>completed</i>);</p> <p>vi. ToRs for the Full Project Team (<i>completed</i>);</p> <p>vii. Consultations and consensus with stakeholders on project design (<i>completed</i>).</p>
<p><i>Activity 5:</i> <i>Preparation of GEF Project Brief and Draft UNDP Project Document</i></p>	<p>5.1 Preparation of the GEF Project Brief;</p> <p>5.2 Preparation of the draft UNDP Pro-Doc;</p> <p>5.3 Preparation of the final UNDP Pro-Doc.</p>	<ul style="list-style-type: none"> • CTA with guidance from UNDP Bangladesh and UNDP-GEF. 	<p>i. GEF Project Executive Summary and Project Brief (<i>completed</i>);</p> <p>ii. EEK technology baseline assessment and incremental cost analysis in the GEF Project Brief (<i>completed</i>);</p> <p>iii. Draft UNDP Project Document (<i>completed</i>);</p> <p>iv. Co-financing confirmation (<i>completed</i>).</p>

Appendix II: List of Participating Staff and Organizations

Name of Staff or Organization	Function	Start Dates	Concluding Dates
Mr. Roland Wong	Chief Technical Advisor (International)	Oct 14/05 Oct 22/05 (Xian) Jan 21/06 Mar 1/06 (Canada) May 12/06 Aug 2/06 Aug 8/06 Mar 23/07	Oct 22/05 Oct 28/05 (Xian) Feb 26/06 Mar 31/06 (Canada) May 26/06 Aug 5/06 Aug 11/06 Mar 30/07
Mr. Shofiqul Alam	National Technical Coordinator	Oct 1/06	June 30/06
Mr. Iqbal Hussain	Capacity Building Specialist	Nov 1/05	Mar 31/07
Mr. Partha Sarathi Nandi	Administrative Assistant	Feb 5/06	Mar 31/07
Louis Berger Group Inc (USA): (Ms. Donna Boysen and Mr. Paramdeep Oberoi)	Consultants for Estimation of Baseline Emissions	Feb 22/06	Feb 24/06
Xian Institute of Wall Building Materials (5 part-time engineers)	Technology Assistance for Demonstration HHK (International)	July 22/06	Mar 31/07
IIDFCL	Consultant for Financial Feasibility Studies	Dec 1/05	Mar 31/07
BUET	Technology Assessments	Aug 1/05	May 15/06
	Bengali-Chinese Translator	Jan 1/07	Feb 28/07

Appendix III: Selected Bibliography of Reports Prepared

1. BUET, Chemical Engineering Department, "Brick Kiln Database for Bangladesh", July 2006.
2. BUET, Chemical Engineering Department, "Desk Study of Brick Manufacturing in Bangladesh", July 2006.
3. BUET, Chemical Engineering Department, "Test Report on Emission Levels from the Stack of Rose Brick Field Private Limited", July 2006.
4. Industrial and Infrastructure Development Financial Company Limited (IIDFCL), "Feasibility Study for Haair Bricks Ltd.", March 2007.
5. UNDP, "Project Document for IKEBMI", April 2006, available from:
<http://gefonline.org/projectDetails.cfm?projID=1901>
6. UNDP, "Project Executive Summary", April 2006, available from:
<http://gefonline.org/projectDetails.cfm?projID=1901>