PROJECT DOCUMENT

UNDAF Outcome(s)/Indicator(s):	UNDAF: Survival and Development rights of Vulnerable Groups are ensured within an Environmentally Sustainable Framework.
Expected Outcome(s)/Indicator (s): *(CPAP outcomes linked to the MYFF goal and service line)*	MYFF 3.1: Framework and Strategies for Sustainable Development.
Expected Output(s)/Annual Targets: *(CPAP outputs linked to the above CPAP outcome)*	CP Outcome 2.1: Enhanced carrying capacity of the environment and natural resource base and increased access to sustainable energy services resulting human and income poverty reduction.
GEF Implementing partner:	UNDP Bangladesh
Responsible parties:	Clean Energy Alternatives (CEA), Inc. Xian Institute of Wall & Roof Building Materials (XIAN)

Narrative

This project is designed to remove barriers to the widespread adoption of energy efficient kilns and energy efficiency practices for the brick making industry in Bangladesh. Brick making is one of the largest sources of greenhouse gas emissions in Bangladesh estimated to be on the order of 6.4 million tonnes of CO_2 annually. Brick making operations in Bangladesh are mostly within the informal SME sector, and do not have financial or strong regulatory incentives to become more energy efficient. Growth of the brick industry has been estimated at 5.3% growth over the last decade; this growth trend is likely to continue over the next decade. The project will take operational experience from the PDF B Phase (during which a demonstration energy efficient kiln was set up) and use these results to implement another 15 demonstration projects over a 5-year project period. The project will achieve its objectives by supporting an integrated set of seven component programs comprising: re-confirmation of all technology options; establishing demonstration projects; technical and managerial capacity development; communications and awareness; financing support; policy and institutional support development; and project management unit support. Successful implementation of the demonstration energy efficient kilns will result in the direct cumulative energy savings of 15,415 TJ or 526 ktonnes coal by end of project and 1,319 ktonnes CO_2 cumulative direct emission reductions during the 15 year expected service life of the energy efficient kilns.

Programme Period: 2009-2014
Programme Component: Energy and environment for sustainable development
Project Title: Improving Kiln Efficiency in the Brick Making Industry (IKEBMI)
Award ID : 00045472
Project ID: 00053721
Project Duration: 5 years (2009-2014)
Management Arrangement: Direct Execution/ Implementation

Total Budget	
GEF	US$ 3,000,000
Parallel Financing:	US$ 11,120,000
• IIDFC (cash)*	US$ 10,850,000
• CEA (kind)	US$ 80,000
• Xian (kind)	US$ 50,000
• Others (kind)	US$ 140,000

* Credit to private entrepreneurs

Agreed on behalf of	Signature & Date	Name & Designation
GOVERNMENT **Ministry of Finance/ERD**	04/4/2010	M Musharraf Hossain Bhuiyan Secretary Economic Relations Division Ministry of Finance Government of the People's Republic of Bangladesh
COOPERATING AGENCY **Ministry of Environment & Forests**	4/4/2010	ড. মোহাম্মদ নাসির উদ্দীন যুগ্ম-সচিব (উন্নয়ন) পরিবেশ ও বন মন্ত্রণালয় গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
EXECUTING/ IMPLEMENTING AGENCY		Stefan Priesner Country Director UNDP-Bangladesh

UNDP Project Document

Government of Bangladesh

United Nations Development Programme

Improving Kiln Efficiency in the Brick Making Industry
(PIMS#2837)

Brief Description: This project is designed to remove barriers to the widespread adoption of energy efficient kilns and energy efficiency practices for the brick making industry in Bangladesh. Brick making is one of the largest sources of greenhouse gas emissions in Bangladesh estimated to be on the order of 6.0 million tonnes of CO_2 annually. Brick making operations in Bangladesh are mostly within the informal SME sector, and do not have financial or strong regulatory incentives to become more energy efficient. Growth of the brick industry has been estimated at 5.3% growth over the last decade; this growth trend is likely to continue over the next decade. The project will take operational experience from the PDF B Phase (during which a demonstration energy efficient kiln was set up) and use these results to implement another 15 demonstration projects over a 5-year project period. The project will achieve its objectives by supporting an integrated set of seven component programs comprising: re-confirmation of all technology options; establishing demonstration projects; technical and managerial capacity development; communications and awareness; financing support; policy and institutional support development; and project management unit support. Successful implementation of the demonstration energy efficient kilns will result in the direct cumulative energy savings of 15,415 TJ or 526 ktonnes coal by end of project and 1,319 ktonnes CO_2 cumulative direct emission reductions during the expected 15-year service life of the energy efficient kilns.

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Acronyms

Acronym	Meaning
ADB	Asian Development Bank
BBMOA	Bangladesh Brick Manufacturing Owners Association
BELA	Bangladesh Environmental Lawyers Association
BMI	Brick making industry
BTK	Bull trench kiln
BUET	Bangladesh University of Engineering and Technology
CDM	Clean Development Mechanism
CERs	Certified Emissions Reductions
CSR	Corporate social responsibility
DoE	Department of Environment (Government of Bangladesh)
DSM	Demand Side Management
EE	Energy Efficiency
EEKs	Energy Efficient Kilns
EIAs	Environmental Impact Assessments
EIKs	Energy Inefficient Kilns
EMPs	Environmental Management Plans
FCKs	Fixed Chimney Kilns
FDTK	Forced Draft Tunnel Kiln
HHK	Hybrid-Hoffman Kiln
GEF	Global Environment Facility
GHG	Greenhouse Gases
GoB	Government of Bangladesh
IFC	International Finance Corporation (of the World Bank Group)
LGF	Loan Guarantee Fund
LPG	Liquefied Petroleum Gas
MDG	Millennium Development Goals
MoEF	Ministry of Environment and Forest
MoPEMR	Ministry of Power Energy and Mineral Resources
MoI	Ministry of Industry
NGOs	Non Government Organizations
PDF-B	Project Development Fund – Block B
PDD	Project design document
PFD	Project Framework Design
PMO	Project Management Office
Pro-Doc	UNDP Project Document
SEDA	Sustainable Energy Development Authority
SEF	Small enterprise fund
SMEs	Small and Medium Enterprises
SRO	Standing Regulatory Order
TJ	Tera joules
TOR	Terms of Reference
UNDP	United Nations Development Programme
VSBK	Vertical Shaft Brick Kiln
WB	World Bank

SECTION I: Elaboration of the Narrative

PART I: Situation Analysis

Context and Global Significance

1. In aggregate starved Bangladesh, fired clay bricks form a significant portion of the materials used in the construction industry. They are literally, the major "building-blocks" for all infrastructure projects such as roads, bridges and buildings. Studies conducted in the 1990's show that out of 14.8 million households, 3.7 million or 25% used bricks as wall materials. Until recently, demand for bricks were mainly urban based, but increasingly its use has spread to rural areas as incomes have risen there. High prices and/or scarcity of alternate building material such as, stones, iron sheets, wood, bamboo, and straw are driving the demand for bricks.

2. Trend data of the last decade show demand for bricks rising steadily at about 5.28% annually. The main driver of this growth has been the construction industry, which has been growing above GDP rates. In the 1980's and 1990's while GDP grew at about 4%, the construction industry grew at 5.5%. Annual growth rate of the construction sector in Bangladesh has ranged from 8.1% to 8.9% in the last decade and this is expected to continue into the foreseeable future. Total brick production in Bangladesh is estimated to be over 8.66 billion bricks annually with an estimated sale value of around US$450 million, almost 1% of Bangladesh's GDP.

3. The brick making industry (BMI) in Bangladesh is best described as a "footloose" industry. Production is seasonal, confined to the five to six dry months of the year; technology is outdated; labor productivity low; capitalization non-existent, mostly operating on equity capital; and management informal. Small and medium enterprises (SMEs) dominate the ownership pattern with little or no cooperative or large-scale operations. Most brickfields are on leased land with no permanent sites and fixtures. This along with the seasonal nature of production contributes to the footloose nature of the industry. The average brickfield employs about 123 skilled and unskilled workers. Apart from 6 to 10 permanent employees, most are employed for only six months during the production season. These seasonal employees, mostly migrant workers from northern Bangladesh, are compelled to seek employment elsewhere during the 'off-season', in agriculture and in other casual work. This contributes, on the one hand, to a precarious employment situation for the worker and, on the other, to the existing low labor productivity.

4. Brick making in Bangladesh is a highly energy intensive and carbon emitting activity. Prior to 2004, most kilns in Bangladesh, about 95%, were based on the 150 year old Bull's Trench kiln (BTK) technology. As its name implies, the kiln is essentially a trench dug into the ground with a crude structure built over it that serves as an enclosure in which the bricks are burnt. As is to be expected, heat loss to the surrounding air through the kiln walls is excessive and the uncontrolled burning of coal in the kiln creates extreme local and global emissions. In 2004, following a government order to raise smokestacks to 120 feet, BTK's were modified to accommodate taller chimneys and underground piping necessary to divert the flue gas to the fixed chimney. This required extending the width of the base. The taller chimney creates a stronger draft, which improves combustion to some extent and enables flue gas to be released at 120 feet, dispersing the pollution over a wider area. This 'new' kiln called the Fixed Chimney Kiln (FCK) is essentially the same Bull's Trench Kiln with a chimney

superimposed on it and slightly improved energy efficiency. Surveys conducted during the PDF B Exercise indicated that coal consumption is reduced by about 10%. Local and global emissions though are almost the same in both types of kilns.

5. The excessive use of energy has had a regressive impact on incomes of brick enterprises in Bangladesh. This has resulted in continuous effort by brick enterprises to substitute other lower cost sources of energy such as sub-standard coal, tires, fuel wood and biomass. Some estimates indicate that about 33% of the fuel used in brick kilns comes from wood fuel. In some areas such as Cox's Bazaar in the far south of the country wood fuel accounts for almost 100% of the energy used in kilns, denuding "protected" woodlands and forest areas. The brick industry is also exerting unsustainable pressure on farmlands because of the extensive use of topsoil in making 'green' bricks.

6. Other than the modifications done in the FCK, kiln technology in Bangladesh has not changed in any significant way in the last 150 years; neither regulatory requirements nor market imperatives have made change a necessity. Consequently, age-old practices and doing things the old way have been the hallmark of the brick industry. The recent addition of the 120-foot chimney was readily adapted because it retained the essence of the earlier BTK technology allowing brick owners to continue with their business as usual practices. Other attempts to introduce modern kiln technologies have also been sporadic and based mainly on intermediate technologies such as the Zigzag and VSBK Kilns from India where the industry is still in a transitional state. An attempt was made in the mid 1990's to introduce a less polluting and more energy efficient technology, known as the vertical shaft brick kiln (VSBK) that was popular in China until recently. However, a Swiss Development Agency study concluded that the effort was a sole source effort lacking the multi-dimensional and holistic methodology that is necessary to transform entrenched ways of doing business.

7. Brick manufacturing is a significant contributor to GHGs on the Indian sub-continent, and more broadly, in Asia. This situation will only exacerbate as the pace of urbanization increases and rural incomes rise creating a growing demand for bricks. In some countries, such as China, energy conservation was the driving force behind government interventions to improve kiln technology. This became increasingly critical as brick production expanded which led to significant investments in research and development in kiln technologies to reduce energy usage.

8. The brick industry contributes in three major ways to the problems identified in the Bangladesh Common Country Assessment (CCA) as matters of serious environmental concern: (i) it is a major source of urban and now increasingly rural air pollution; (ii) it contributes to land degradation; and (iii) it is a significant cause of deforestation. The project will mitigate these negative impacts and contribute to attaining MDG goals and further the efforts to integrate environmental conservation and poverty alleviation strategies contained in the 2003 I-PRSP, the Dhaka Declaration and the Declaration of the World Summit on Sustainable Development 2002. It also assists in achieving UNDAF outcomes, specifically UNDAF 4.1 and 4.2. The project is also a strategic focus of the CPAP formulated recently.

9. In July 2005, the GEF funded PDF B Exercise was initiated. The PDF B Exercise provided the contextual background for the Project by (a) identifying clean technology options; (b) conducting a rapid assessment of the possible impact of introducing a mitigating technology; (c) identifying potential stakeholders and sensitizing them to the potentials inherent in the proposed mitigating technology; (d) developing modalities for training and retraining workers and entrepreneurs to enhance their productive efficiency; (e) gauging attitudes of government, financial intermediaries, civil society and brick manufacturers to a transformation program (f)

developing baseline estimates of emissions from existing brickfields and (g) identifying potential savings in GHG emissions. The findings of the PDF B Exercise are incorporated into this Project Document.

Barriers to Energy Efficiency in the BMI

10. The barriers that have contributed to the current state of the BMI and its inability to bring about changes, particularly in the way energy is utilized in brick making operations includes:

- Lack of supporting regulations, fiscal incentives and standards to encourage more energy-efficient practices and technologies. Except for some sporadic efforts to regulate the industry, government has made little effort to establish effective boundary limit emission standards;
- Little or no governmental activity to assist the brick industry to undertake comprehensive programs to transform the industry and make it less polluting and more profitable. Brick makers have been left to bring in changes on their own which they have failed to do since they are locked into a vicious cycle of a low efficiency/low income trap. A few initiatives that have taken place in the past have come from new entrants and not from traditional brick makers;
- Lack of knowledge and access to energy efficient technologies that can also lower production costs at the same time. Comprehensive technology dissemination programs that demonstrate the potential economic benefits of energy-efficient technologies have yet to be carried out;
- Lack of access to liquidity to finance modernization of brick making operations. The BMI are considered high-risk due to the seasonal, itinerant nature of their operations and their lack of collateral;
- Lack of capacity in terms of technical and business skills at the enterprise level to bring in even small changes that could have made production more efficient and less polluting;
- Limited experience of commercial lending institutions with SMEs and in particular, brick SMEs. They lack interaction with and understanding of the brick industry;

Institutional, Sectoral and Policy Context

11. Prior to 1989, brick making was an unregulated industry in Bangladesh. Since then the government has introduced some measure of control by legislating the "Brick Burning (Control) Act 1989 (Act #8 of 1989). The main goal of the Act was to eliminate the unrestricted, rampant use of wood fuel in brick kilns. As a first step, it was necessary to bring brick kilns within the purview of the law and greater scrutiny. This was done by introducing registration and permitting requirements. The Act was amended in 1992 and again in 2001. Each amendment sought to tighten the regulations and introduce a greater measure of emissions restrictions. The Act forbade establishing a kiln within 3 km from an upazila (smallest administrative unit) boundary limit or clusters of homesteads numbering more than 50 homes. It also introduced clauses making the use of firewood in kilns illegal. Enforcement, however, has been lax due to limited numbers of enforcement staff.

12. Brickfields are also regulated through the Environmental Conservation Rules (1997) which require an Initial Environmental Evaluation (IEE) and an Environmental Monitoring Plan (EMP) be carried prior to issue of an environmental clearance from the DoE.

13. The National Environment Management Action Plan (NEMAP) of the early 1990s led to the Environmental Conservation Act 1995 and Rules 1997 that included legislation to control

brick kiln emissions. NEMAP identified brick kilns as the largest source of stationary pollution in the country and sought to regulate them.

14. The Rice Policy, which has been recently drafted and is under final approval by the government, seeks to control land degradation by recommending re-location of brickfields to non-productive or low-productive land.

Stakeholders in the BMI

15. The key stakeholders in the BMI that are also involved in the IKEBMI project includes:

- *Clean Energy Alternatives (CEA):* CEA is a Dhaka-based company formed to promote and facilitate widespread use of clean energy and energy efficient alternatives in Bangladesh. CEA has experience in market transformation projects including CNG as alternative transportation fuel under an UNDP project whose outcome was the mainstreaming of CNG in Dhaka City in a commercial way. CEA is the project proponent of brick kiln project and fostered cooperation between a number of technology groups to set-up of the demonstration EEK during PDF-B phase. CEA developed the concepts; sourced and identified the technologies; contracted the technology provider and the technology champion as well as potential commercial financiers and brick entrepreneurs in Bangladesh. CEA contributed in identifying XIAN as a technology provider and BUET as technology arbiters and as such, has fostered cooperation between technology groups to setup the demonstration an energy efficient kiln during the PDF B Phase. CEA was also responsible for the development and application of appropriate baseline methodologies, and developing monitoring plans and capacity to screen and select plants for project selection. CEA will be a Responsible Party in the Full Scale Project.
- *Xian Institute of Wall Building Materials (XIAN):* The XIAN is a China government institute that is responsible for both research and development of wall materials as well as setting national quality standards. This state-owned research and development institute in China that has developed the Hybrid-Hoffman Kiln (HHK) for use throughout most of China's brick industry. Moreover, XIAN is a part of a larger R&D organization, the China Building Materials Academy (CBMA) dedicated to advancing the quality of building materials and improving the efficiency of their related industrial facilities. Xian provided the technical back stopping support for the first demonstration project in Bangladesh. Their engineering staffs were responsible for the first constructed and operational HHK in Bangladesh in 2006-7 during the PDF B Phase of the project. XIAN institution has previous working experience with UNDP and GEF funds. Xian Institute will be another Responsible Party in the Full Scale Project.
- *Industrial and Infrastructure Development Finance Company Limited (IIDFCL):* IIDFCL is a consortium of 12 commercial banks and lending institutions in Bangladesh. IIDFCL will be the lead leading agency to the private entrepreneurs for energy efficient brick making industries. IIDFCL has agreed to provide credit to the Brick Owners for adoption of this new technology of an amount of US$ 10.85 million.
- *Bangladesh Brick Manufacturers Owners Association (BBMOA):* They represent the interests of brick manufacturing owners throughout Bangladesh. They have approximately 4,000 members representing about 4,000 operations, roughly 90% of all of these brickfields in Bangladesh.
- *Bangladesh University of Engineering and Technology (BUET):* They are premier technology learning institution of Bangladesh and viewed as the most respected arbiter of new technology evaluations by the Government of Bangladesh.

- *Department of Environment (DoE):* DoE is the government agency tasked with ensuring a safe, high quality environment for all Bangladeshis through the prevention and control of pollution and through strategic environmental management for ecosystem protection;
- *Ministry of Environment and Forest (MoEF):* The MoEF is the parent agency of the DoE with the mandate to formulate policy over matters in the areas of prevention and control of pollution as well as the sustainable use of natural resources;
- *Sustainable Energy Development Authority (SEDA):* SEDA has recently been approved by the Government to be established as a nodal agency dedicated to the objective of creating an enabling environment for the development of sustainable energy initiatives in Bangladesh. This includes renewable energy, energy conservation, energy efficiency and an energy fund. The existing Sustainable Energy Unit (SEU) will be transformed to the SEDA and it is expected that SEDA will promote the energy efficiency in brick making industries in the project in future.
- *Ministry of Power, Energy and Mineral Resources (MoPEMR):* MoPEMR set policies towards the use of energy resources throughout Bangladesh. Their policies towards discouraging the use of natural gas for brick making were aimed at encouraging the use of coal for the BMI.
- *Private Sector:* Private sector stakeholders include a number of well-managed private sector firms, all of whom represent a new wave of emerging young entrepreneurial professionals keen to re-invest in environmentally-friendly projects.

Baseline Scenario (Baseline Report Contained in Section IV, Part V)

16. In the business-as-usual scenario, new technology disseminations will follow the same paths as before, fragmented, inadequately funded and a lack of coordination led by individual private sector companies who lack the capacity to mount a thorough market transformation effort. Past attempts to bring about changes have been based mostly on Indian technologies and models which even in India have had limited success. The FCK, even with improvements has poor energy efficiencies as compared to the zigzag kiln, which is only marginally more efficient. The Hoffman kilns using gas hold the most promise from the point of view of emissions; however, erratic pipeline pressures, lack of adequate pipeline coverage and the high cost of natural gas have all acted regressively on the spread of this technology.

17. The business-as-usual scenario also features the barriers presently inhibiting the industry will continue unabated. Capital is available to enterprises to improve the performance of the BMI; however, there is low awareness of energy efficient technologies and practices; poor managerial abilities to manage the entry of a new brick making technology; lack of technical and vocational capacity to operate an energy efficient brick making operation; limited local capacity to monitor energy consumption and environmental impacts of the brick industry; reluctance of the financial sector to provide funds to SMEs and lack of awareness of policymakers on the need for a favorable regulatory regime for energy efficiency in the BMI.

18. There are 3,935 FCK and BTK kilns in Bangladesh which together account for about 95% of operating kilns. These kilns are the most polluting and therefore targeted for replacement by the new technology. Estimates obtained from surveys and on-site investigations during the PDF B Exercise showed that BTKs and FCKs consume an average of 240 tonnes of coal to produce one million bricks. Almost all the coal being used is imported from the Indian State of Meghalaya. This type of coal has a measured calorific value of 6,400 kcal/kg and it produces 25.8 tonnes of carbon, which is equivalent to 94.6 tonnes of CO_2 per TJ (IPCC default value for bituminous coal). Each kiln therefore produces 1,518 tonnes of CO_2 per year. Total annual CO_2 emissions are, therefore, 6.0 million tonnes annually from FCKs and BTKs in Bangladesh.

19. In the baseline scenario, CO_2 emissions are expected to grow by over 35% to 8.7 million tonnes by 2014. This is because the brick industry has been growing at about 5.28% over the last decade with this trend leveling after 2014. It should be noted though that the rate of growth of the brick industry may pick up pace as the economy grows at a faster rate in the coming decade. Annual GDP growth in the past decade has averaged slightly over 5% in Bangladesh, a noticeable increase from the 3.4% average rates of the 1970s and 80s. Higher growth in the 1990s has been attributed mostly to good macroeconomic management, declining inflation rates, reduction in fiscal deficits and economic liberalization. This management regime is continuing. The forecast trends of CO_2 emissions from the BMI considering the annual growth of brick output is in Fig. 1.

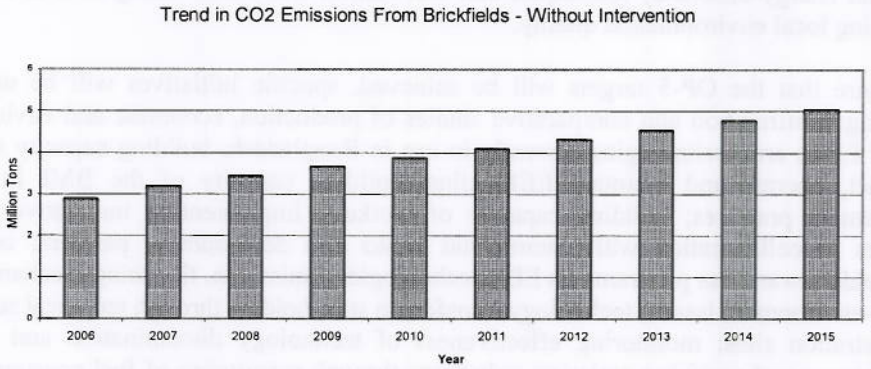


Figure 1: Trend in CO_2 Emissions from Brickfields –without Intervention

PART II: Strategy (Expanded Details Contained in Section IV, Part VI)

Project Rationale and Policy Conformity

20. The baseline analysis indicates that GHG emissions from the brick industry are already at a high level and are expected to increase by at least 5.28% every year for the foreseeable future. This means that direct carbon emissions from kilns alone will rise to 8.7 million tonnes annually by 2014 or earlier depending on the growth rate of the industry. In addition, the brick industry is contributing in various ways to growing carbon emissions from other sources. Most notable, is the impact of brick making on land degradation and deforestation. In a country where the pressure of population growth on a relatively small land mass is significant, farmland depletion can have alarming prospects for food security. Total farmland in Bangladesh is about 14 million hectares and this is depleting by about 80,000 hectares every year, a 0.05% depletion rate. Moreover, wood fuel is used as a secondary fuel for brick making accelerating the depletion of scarce carbon sinks in Bangladesh.

21. A continuation of the "business-as-usual" growth of the BMI without interventions would be counter to the major concerns of Bangladesh such as air pollution in urban centers, degradation of farmlands and deforestation. The BMI has contributed significantly to the cause of these various challenges to Bangladesh's Millennium Development Goals (MDGs) of "ensuring environmental sustainability". This can be seen in the widespread use of old technologies, poor management practices, lack of skills in efficient operation of energy consuming equipment, and inadequate investment in modern equipment. Moreover,

inappropriate policies, lack of effective regulation and the marginalization of vulnerable populations have added to the state of degradation of natural resources.

22. The proposed project would achieve the objectives set out in GEF Operational Program 5 to reduce net GHGs from anthropogenic sources and by protecting removal of such gases by sustaining available carbon sinks. The project would directly and indirectly attain the OP-5 target outputs by reducing energy use in kilns; reducing GHG emissions; introducing molding and other energy-efficiency techniques that will restrict wood from being used as a fuel; and improving local environmental quality.

23. To ensure that the OP-5 targets will be achieved, specific initiatives will be undertaken including confirmation and comparative studies of production, economic and environmental data of EEKs and technologies currently in use in Bangladesh; building capacity to design, construct, operate and maintain EEK kilns; building capacity of the BMI in business management practices; building capacity of workers; implementing innovative financing schemes in collaboration with commercial banks and development partners; conducting stakeholder awareness programs on EEK technologies, emissions, financing mechanisms, and energy-environment issues; technology transfers to stakeholders through technical seminars at demonstration sites; monitoring effectiveness of technology dissemination and financing mechanisms; and verifying emission reductions through monitoring of fuel consumption and smokestack emissions.

24. The proposed GEF-supported alternative to the baseline scenario is intended to reduce energy usage in the brick making industry and thereby contribute to the realization of Bangladesh's sustainable development objectives and its goal to reduce GHG emissions from the sector. The proposed alternative will focus on a broad range of activities to remove barriers and improve management and operational practices, supply of relevant technical and financial support services, access to EEKs, all of which will contribute to the transformation of the industry.

25. The main drivers of the market transformation to EEKs are the:

- Demand from brick manufacturers for the mitigating technology since it will lead to significant reduction in production costs and improvement in product quality;
- Pressure from civil society and government to reduce smokestack emissions; and,
- Benefits for consumers from lower production costs and better quality bricks.

26. Other expected drivers of market transformation to EEKs are:

- Market imperatives, since lower product costs and improved quality will drive producers to the new technologies. In the very short run, prices may not decline as producers strive to recover the higher capital cost of the new technology; but in the intermediate phase, other things remaining the same, prices will decline or at the least hold steady so that real prices will decline thus stimulating demand for the new product. In the long run, aggregate demand will increase because of demand increases from the construction and building industries;
- Regulatory reform actions and enforcement policies of the government that set stringent boundary emission standards and send important signals to producers to meet levels of emissions reductions;
- Project activities to increase availability of investment funds to finance the new technologies, support from technology "champions", training of workers, and better

business practices, all of which will combine to make the new energy efficient technologies attractive alternatives;

- The proposed kiln technology and the fuel injection technique that will result in significantly increased enterprise level profitability; and
- Increasing aggregate demand as urban population and incomes rise over the coming years. Urban population growth rate has been phenomenal in Bangladesh, rising from 2.6 million in 1961 to 22.5 million in 1991. Incomes too have shown a steady growth pattern. The cumulative impact of declining real prices, rising urban demand will increase and spreading rural demand will ensure the commercialization of the technologies and help sustain them even after the project has ended.

Project Goal, Objective, Outcomes and Outputs/Activities

27. The goal of the project is the reduction of GHG emissions from the BMI in Bangladesh. It is expected that as the new technology replaces the one presently in use, the potential vector of GHG emissions will also decline leading to an overall decline in GHG emissions. In addition, because the proposed technology drastically reduces emission of smoke and that of other harmful particulates, there will be improvements in local air quality as well.

28. The project objective is the removal of barriers that have so far inhibited adoption of cleaner and more efficient kiln technologies and molding techniques by brick makers in Bangladesh. Their removal through a concerted dissemination program is an essential "*sine qua non*" if there is to be any meaningful reduction in GHG emissions and in air pollution.

29. A number of outcomes resulting from full project activities are expected to remove the barriers to the dissemination and adaptation of a clean technology including:

    - Thorough understanding and appreciation of technology options and their environmental impacts by brick makers, government and other stakeholders
    - Establishment of a critical mass of demonstration projects that will provide detailed information of EEK operations, energy savings and environmental impacts to interested brick makers
    - Improved local vocational, technical; and managerial capacity to manage and sustain operations of EEKs and EE practices in Bangladesh
    - Enhanced awareness of the public and other stakeholders on EEKs, EE brick making methodologies/practices and energy efficient bricks production
    - Availability of financial and institutional support to encourage SME adoption of EEKs
    - Promulgation of, and compliance to, favorable policies and regulations that encourage adoption of EEKs and energy efficient brick making practices and methodologies

30. The proposed project focuses on EEK technology promotion to transform the brick production market. The transformation is manifested in the shift to EEKs (in this case HHKs) in the brick manufacturing industry in Bangladesh. The transformation indicator is the number of EEKs installed after the project vis-à-vis the total number of brick kilns installed in the country. Note that the product being promoted is EEK technology and not the bricks that will be produced by the technology. The end result is expected to be a market transformation of brick production in Bangladesh.

31. In regards the technology transfer strategy, this will be implemented in two clearly identified and distinct ways:

- Through capacity building for local manufacturers and engineering firms on the design, engineering, construction and commissioning of EEKs and new brick manufacturing plants equipped with EEKs; and,
- By "training of trainers" who will train enterprise level staff and workers in the use of the EEK technology.

32. The project design took into consideration one of the proven ways to ensure success in technology dissemination, which is the development of the capacity of workers and staff within the BMI to use the EEK technology productively and the training of local professionals to design, build, and commission new brick plants. The approach is to facilitate capacity creation at both these levels. An integrated, comprehensive capacity building strategy that builds capacity at two distinct levels is applied, which involve sequencing technical capacity building independently of, but parallel to, firm-level capacity enhancement.

33. Part of the technology transfer strategy is enabling the Bangladesh Brick Makers Owners Association (BBMOA) to become a service provider to the industry. Activities will be carried out to enable this association to become a virtual Center of Excellence within the industry association. After the GEF Project, this virtual center is expected to evolve into real operations, financed and nurtured by the association. Initially, it will focus on service provision in three areas: (1) skills development; (2) market access and industry information; and (3) compliance assistance and monitoring. Over time, they could branch out to services in other areas, such as R&D, product diversification, supply chain creation, and market diversification. This way capacity built during the project will be retained and spread.

34. The proposed project is comprised of 6 major components consisting of complementary activities designed to remove barriers to achieve the project objectives. There are 2 separate components on monitoring & evaluation and adaptive management.

- Component 1: EEK Technology Support Program
- Component 2: EEK Demonstration Program
- Component 3: EEK Technical and Management Capacity Development Program
- Component 4: Communications and Awareness Program
- Component 5: EEK Financing Support Program
- Component 6: Policy Development and Institutional Support Program

35. **Component 1: EEK Technology Support Program** - This component is comprised of activities that will address the technical barriers in the BMI that hinders the widespread applications of EEK technologies. The main outcome of these activities is the thorough understanding and appreciation of technology options and their environmental impacts by brick makers, government and other stakeholders.

- Activity 1.1: Assessment of Other EC&EE and EEK Technology Options for the BMI - This activity will involve a more detailed techno-economic evaluation, and all the necessary technical requirements for the successful and effective implementation, of an appropriate EEK and brick making technologies. The project will take initiative to monitor the emissions from the first demo project of HHKs before construction of other plants. A core Technical Group will be formed involving the Department of Environment, Energy Audit Cell, Sustainable Energy Development Agency, Bangladesh University of Engineering and Technology, Brick Owners Association, Clean Energy Alternatives, Xian Institution and Project Management to study the emission data and to suggest any

modification in the technology to adopt the Bangladesh situation. *GEF support is required for the technical assistance (TA) on the technology evaluations.*

- Activity 1.2: Clay Resources Assessment – This activity will involve the review of any available assessments of the country's clay resources. A limited scale survey of potential clay deposits will be carried out to supplement/update existing information. A framework plan for the sustainable utilization of the clay resource will be developed. Existing mapping of clay resources in the country will be updated to reflect new information. This activity will be carried out to address loss of arable lands and hilltops where clay used in the country to make bricks is usually sourced. *GEF support is required for the TA on the resource assessment.*

- Activity 1.3: Evaluation of the Operating Performance of BMI Companies – This activity is designed to evaluate the present performance of all brick makers in the country. This will provide useful inputs in the design of new brick making facilities or modifications in existing facilities, as well as identify potential improvements in the operation of these facilities. *GEF support is required for the TA on the performance assessments.*

- Activity 1.4: Identification of Potential Improvements in the Energy Performance of the BMI – This will be carried out in conjunction with Activity 1.3. Performance evaluation reports highlighting detailed findings and improvement recommendations will be prepared. The amount of coal use reduction in HHKs will be assessed in the first demonstration kiln and the result will be published for the stakeholders. *GEF support is required for the necessary TA on the performance assessments.*

- Activity 1.5: BMI Energy Reporting and Monitoring (BERM) Program – This will involve the monitoring of the energy performance of the BMI. Brick makers will be required to submit periodic reports (e.g., quarterly) of, among others, their energy consumption and production volumes. The periodic reports will be submitted to the BBMOA and SEDA, which will monitor and evaluate the energy performance of each brick maker. Information collected from this BMI energy reporting and monitoring (BERM) program will be stored in the BMI Database of the BMI Information Center. The BMI Database will include, among others, a special module for the energy consumption data of each brick makers. The relevant staff members of the BBMOA and SEDA and the engineering/utilities departments of the brick makers will be trained to carry out the energy consumption monitoring (in some cases systematic calculation or estimation). The training will also include energy consumption reporting and ways and means to improve the energy utilization efficiency in brick making. The BERM program will be designed to become a regular activity of the BBMOA. The program will track the achievement of the target indicators to determine project impacts. *GEF support is required for the necessary TA in the design of the program and initial logistical support.*

- Activity 1.6: Development of a Local BMI Engineering and Consultancy Service Industry - This activity will address the need for an enhanced local expertise in the area of brick making technology that will support the BMI in Bangladesh. It will also include capacity building for local engineering consultants in providing services on EC&EE and EEK technology for the BMI. This industry (i.e., BMI support industry) is expected to develop and provide the technical services associated with the design, installation, and maintenance and troubleshooting of EEKs and brick making equipment and/or components. *GEF support is required for the necessary TA on capacity building.*

36. **Component 2: EEK Demonstration Program** - This component will address the barrier concerning the need to showcase the major aspects of the application of EEKs and energy efficient brick making practices, and the limited EEK demonstrations in the BMI of Bangladesh. The main outcome of this project component is the establishment of a critical mass of demonstration projects that will provide detailed information of EEK operations, energy savings and environmental impacts to interested brick makers.

- Activity 2.1: Promotion of EEK Technology and EC&EE Demonstration Projects – This activity will involve the conduct of a seminar-workshop to promote the demonstration projects, for purposes of identifying the brick makers who are interested in hosting the demonstrations. *GEF support is required for the necessary TA and logistics in the conduct of the workshop.*

- Activity 2.2: Conduct of Detailed Feasibility Analyses of Selected Demonstration Sites – The feasibility analyses that were conducted during the PDF-B phase of the project will be reviewed to determine and verify project implementation requirements. If required, further feasibility assessments will be carried out by the demonstration hosts. This will involve carrying the existing EEK project studies for the demonstration projects forward to detailed technical design and engineering, cost calculation, design of ownership and management models, cost-benefit analysis, design of operation and maintenance concept, and assessment of financing aspects. *GEF support is required for the necessary TA in the feasibility analyses.*

- Activity 2.3: Specific Demonstration Project Implementation Requirements – This will involve the performance of activities to meet certain requirements required to facilitate the smooth and effective implementation of the demonstration projects. Among these are: (1) Verification and confirmation of the availability and quantity of clay resources; (2) Availability of materials needed and manpower for the construction of the EEKs; and, (3) Financing assistance mechanism for the financing of some of the demo projects. In addition, technical assistance will be provided in the setting up of administration, as well as operation and maintenance systems at the demonstration sites (designation of administrator, operators; establishing of guidelines and procedures, etc.). *GEF support is required for the necessary TA services.*

- Activity 2.4: Establishment of Baseline Data for the Demonstration Project Sites – This activity will involve the conduct of energy consumption and production surveys, as well as socio-economic conditions at the project sites and baseline performance data. Operating performance targets for each demonstration projects will also be established. This activity could be carried out in conjunction with the review/conduct of the feasibility analyses (Activity 2.2). The baseline will be established by the end of the first year of project implementation. *GEF support is required for the necessary TA services.*

- Activity 2.5: Finalized Design of Demonstration Projects – This activity will involve the provision of technical assistance in the preparation of the EEK project, or EC&EE project basic engineering designs, particularly to sites where no previous designs have been proposed. It will also involve provision of technical advice in the comprehensive technical and economic feasibility evaluations, as well as in the detailed engineering designs. *GEF support is required for the necessary TA services.*

- Activity 2.6: Technical Assistance for the Financing of Demonstration Projects – The provision of assistance in the processing of applications for the financing of the operation and maintenance of each demonstration site will form bulk of the work under this

activity. Host brick makers that are availing of the financing from banks/financial institutions (B/FIs) will be assisted (if needed) in securing their financing. *GEF support is required for the necessary TA services.*

- Activity 2.7: Installation and Operation of each Demonstration Project - The main tasks under this major activity for each demonstration project will be similar to that in full project implementations, starting from the conceptual design, to feasibility study, engineering design, installation, operation, monitoring and evaluation. Technical assistance will also be provided in the installation work. *GEF support is required for the necessary TA services.*

- Activity 2.8 Demonstration Program Results Evaluation and Dissemination - This will activity will entail the conduct of an overall performance evaluation of the demonstration program, including the dissemination of program results and recommendations through a national workshop. *GEF support is required for the necessary TA and logistics in the conduct of the workshop.*

37. **Component 3: EEK Managerial and Technical Capacity Development Program** - This component has been primarily designed to address the barrier of inadequate technical capacity to support the installation and operation of EEKs and different energy efficient brick making practices that can also lower production costs and emissions. The expected main outcome of this component is improved local vocational, technical; and managerial capacity to manage and sustain operations of EEKs and EE practices in Bangladesh.

- Activity 3.1: Technical Capacity Building for BMI Production Personnel – This activity will involve the conduct of comprehensive training courses on EC&EE, EEKs and EE brick making practices and methodologies, development of a certification program for EEK operators. It will be part of a certification process for operators to operate and maintain EEK system equipment and components. These training and certification program are expected to continue even after the completion of the project. This activity will also involve capacity building for the BBMOA to enable it to become a service provider to the industry. *GEF support is required for the necessary TA for the capacity building.*

- Activity 3.2: Assessment of Capabilities of Existing BMI Maintenance Service Providers - This activity will involve the evaluation of the capabilities of the local engineering firms in performing technical and maintenance services to brick makers. Assessment reports highlighting findings and recommendations will be prepared and submitted to BBMOA, SEDA and DOE. *GEF support is required for the necessary TA and logistics in the conduct of the workshop.*

- Activity 3.3: Assessment of the Viability of Local Manufacturing of EEKs and Associated Equipment and/or Components - This activity will involve the evaluation of the feasibility of, and requirements for developing an industry/business for the local manufacture of EEKs and associated equipment and components. Assessment reports highlighting findings and recommendations for local manufacturing of brick making equipment for domestic use (and possibly for the export market) will be prepared and submitted to BBMOA, SEDA and DOE. *GEF support is required for the necessary TA and logistics in the conduct of the workshop.*

- Activity 3.4: Feasibility Study on the Standardization of Brick Making Kilns & Associated Equipment and/or Components - This activity will involve the evaluation of the feasibility of, and requirements for, standardizing the procurement/supply/manufacturing of brick making equipment and components. Assessment reports highlighting findings and recommendations for possible mass procurement of brick making equipment and components will be prepared and submitted to BBMOA, SEDA and DOE. *GEF support is required for the necessary TA in the feasibility evaluations.*

- Activity 3.5: Training Course on the Design, Feasibility Evaluation, Construction, Operation and Maintenance of EEKs – This capacity building activity will involve the provision of comprehensive training courses on the design, construction, economic feasibility evaluation, operation and maintenance of EEKs for local engineering firms and equipment manufacturers, repair and maintenance service providers and BMI personnel. The training courses form part of the required capacity building for BBMOA to enable it to become a service provider to the BMI. *GEF support is required for the necessary TA.*

- Activity 3.6: EC&EE in the BMI Technology Education Program – This will involve the conduct of a training course on EC&EE in the BMI for BBMOA staff, comprehensive training course on modern brick making technology for local engineering firms. The training courses form part of the required capacity building for BBMOA to enable it to become a credible service provider to the BMI. These training courses are expected to be continuously conducted by the BBMOA after the completion of the project. *GEF support is required for the necessary TA.*

- Activity 3.7: Technical Assistance in Planning BMI EC&EE Projects – This activity will involve provision of assistance to the BBMOA and the brick makers in efforts towards widespread adoption of EC&EE in the BMI beyond the IKEBMI. Project proposals will be prepared for new projects covering project set-up, cost-benefit analysis (e.g., energy saving potentials and GHG emissions reduction) and financial plan. These proposals will be presented to the GoB, interested investors (local and foreign) and international donors. The TA on project proposal preparation and evaluation also forms part of the BBMOA's technical capacity building to enable it to become a credible service provider to the BMI. *GEF support is required for the necessary TA in promoting the project proposals.*

38. **Component 4: Communications and Awareness Program** - This component is intended for addressing the barriers related to low awareness of government, public, and SMEs of technical alternatives to energy efficient brick making methodologies and practices, as well as the lack of access to information on EEKs and EC&EE in brick making. The primary outcome of the activities that will be carried out under this component is the enhanced awareness of the public and other stakeholders on EEKs, EE brick making methodologies/practices and energy efficient bricks production.

    - Activity 4.1: Establishment of a BMI Information Center – This will involve the establishment of an Information Center in the BBMOA to cater for the information needs of the BMI SMEs on Energy Conservation & Energy Efficiency (EC&EE), in general, and in energy efficient brick making methodologies/practices, EEKs, and manufacturing of energy efficient bricks, in particular. It will also involve the development and maintenance of a BMI Database, which will contain information about the profiles of the different brick making companies (brick makers) in the country. The Project will also facilitate formation of a core support group of stakeholders, especially developers to support and propagate the use of energy efficient and environmentally friendly

technology in brick making and allied fields. *GEF support is required for the necessary TA and some logistical support in the creation of the Information Center.*

- Activity 4.2: EC&EE in the BMI Promotion & Advocacy Program – In line with the information dissemination and awareness raising objectives of the project, this activity is aimed at raising the general awareness of BMI energy performance issues with policy makers, the BMI in Bangladesh and the general public. This outreach and promotion activity will make use of appropriate communication mechanisms that will be designed based on the stakeholder analysis during the PDF-B exercise, and can include consultations, seminars, meetings, publications, case history documentation, video, exhibits and study tours. Special attention will be provided to create awareness for illegal use of firewood around the Ecologically Critical Areas (ECA) in the country. *GEF support is required for the necessary TA for the promotional activities.*

- Activity 4.3: Integrated BMI Information Exchange Service – In order for the Information Center to keep abreast of developments in EC&EE technology in the brick manufacturing industry, this activity will be implemented to obtain and share information within and from outside the country. The information exchange service will involve publication of a newsletter containing information circulated through the information exchange service (local/ regional), monitoring of all brick makers in the country and preparation and updating of profiles of these facilities, inputting of information materials on brick making technology incorporated in the BMI Database, and abstracting of relevant articles from scientific and engineering journals on brick making technology. These activities are expected to continue even after the completion of the project. *GEF support is required for the necessary TA for the initial activities.*

- Activity 4.4: BMI Energy Awards Program - This is intended both for information development and as a promotional activity to encourage the BMI companies to improve their energy utilization performance. As part of the promotional campaign, this activity is intended to encourage healthy competition between brick makers to improve energy performance. Using the information gathered from the BERM program, the energy utilization performance of brick makers are evaluated, rated and ranked. The BBMOA, in cooperation with local governments and the BMI support industry will carry out this as an annual activity. *GEF support is required for the TA in developing the rating scheme.*

39. **Component 5: EEK Finance Support Program** - This component has been primarily designed to address the BMI SMEs' lack of access to finance for supporting EEK applications and energy efficiency initiatives. The major activities will include preparation of financing action plan, project feasibility reports, building capacity of banks to service small businesses, linkages with IFI-backed financial agencies and third country visits for the stakeholders. The activities of this component will be implemented through an integrated team with international financial sector experience in South Asia, with substantive experience in Bangladesh. The expected outcome from this component is the availability of financial and institutional support to encourage SME adoption of EEKs.

    - Activity 5.1: Preparation of Action Plan for Financing BMI SMEs – This will involve the conduct of a study compiling details of all demonstration sites, potential entrepreneurs, market conditions for bricks and possible financing modalities. Based on the study, an action plan will be prepared outlining the essential steps and actions to be taken to facilitate the provision of financing of energy efficiency initiatives and EEK applications for BMI SMEs. *GEF support is required for the necessary TA in the conduct of the study and preparation of the action plan.*

- Activity 5.2: Conduct of Techno-Economic Feasibility Evaluation of BMI SME Financing – This will involve the evaluation of the viability of financing EC&EE initiatives in the BMI SMEs, including the assessment of potential financing schemes. A report detailing the terms and conditions of each viable scheme will be prepared. *GEF support is necessary for the TA involved in the techno-economic feasibility assessments.*

- Activity 5.3: Capacity Building for Banks/Financial Institutions (B/FIs) – This will involve the conduct of training workshops on evaluating the financial viability of EC&EE projects. The workshops will also serve as campaigns addressed towards enhancing the B/FIs' interest in providing financing to BMI SMEs, This will also involve securing support from B/FIs in the financing scheme that the project will help develop. *GEF support is required for TA in the capacity building activities.*

- Activity 5.4: Promotion of Business Links – This will involve establishing links between prospective SMEs and commercial banks with IFI-backed financial agencies, through workshops and seminars. *GEF support is required for TA in the promotional activities.*

- Activity 5.5: Capacity Building on Accessing Financing Sources – This task will involve the conduct of training courses on project financing for the BMI (and other interested SMEs), specifically on how to access and apply for other available financing sources that they can tap to finance their EC&EE initiatives and EEK application projects. This would include sourcing additional financing (or revenue) from a "Green Tax", a mechanism now under consideration by the Bangladesh government to encourage behavioral changes of brickfield owners to adopt cleaner technologies. In addition to commercial sources of financing, there are excellent possibilities to bundle the demonstration projects and access carbon financing as supplementary financing or extra source of revenue. As such, other funding sources and not GEF funds will be targeted for CDM project development and emissions verification, and strengthen the building of GEF-CDM synergies. *GEF support is required for necessary TA in the conducting of the training courses on project financing.*

40. **Component 6: EEK Policy Development and Institutional Support Program** - This component is designed to address the policy and regulation related barriers that affect the widespread application of EEK technologies in the BMI. Presently, the environmental regulations in brick making industries are not in conformity with energy efficient brickfields. The expected outcome of the activities that will be carried out is the promulgation of, and compliance to, favorable policies and regulations that encourage adoption of EEKs and energy efficient brick making practices and methodologies. This would include brick making emission standards, coal usage policies and standardization of brick properties and qualities.

- Activity 6.1: Improvement of GoB Awareness and Commitment to Enforce a Favorable Regulatory Regime for the BMI – This activity will involve campaigns and lobbying activities to get the willingness and commitment of relevant GoB agencies to advance policy reform for the BMI towards EEKs. *GEF support is not required.*

- Activity 6.2: Formulation of Policies, and Associated Implementing Rules and Regulations (IRRs) – Policy recommendations will be prepared, along with the IRRs. This activity will also serve as part of the capacity building for the GoB in the design and preparation of environmentally sustainable policies, in general, and the same type of policies for the BMI, in particular. The project will support the Department of Environment in making suitable regulations for smooth implementation of energy

efficient kilns. *GEF support is required for the TA and capacity building in the formulation of the policy recommendations and associated IRRs.*

- Activity 6.3: Implementation of Policy Support Activities – This will involve conduct of campaigns targeting the relevant GoB agencies to encourage and lobby for the endorsement/approval of the proposed policy recommendations and IRRs. The draft policies and IRRs will be disseminated and presented to all stakeholders in workshops & seminars to also secure their support. *GEF support is not required.*

- Activity 6.4: Capacity Building on BMI Energy Efficiency Policy/Regulation Enforcement – This will involve the conduct of 3 annual national enforcement workshops to enhance capacity and skills of relevant GoB agencies and the BMI in the enforcement of, and compliance to, EE-related policies/regulations as applied to the BMI. *GEF support is required.*

- Activity 6.5: Formulation and Implementation of Strategies to Minimize Land Degradation from Brick Making Activities – This will involve the conduct of studies and workshops on environmentally sustainable clay mining practices. A rapid assessment of the impacts on land degradation of the current practices and sources of clay mining will be carried out. This will make use of GOB/UNDP's findings under its Sustainable Land Management Project, which is expected to provide a good overview of the impact of brick making on land degradation. This activity will also explore possibilities to substitute renewable resources for arable clay and/or as a major "filler" substitute. Preliminary findings of the substitution potentials during the PDF-B exercise will be examined in greater depth and tests carried out to ensure that there is no qualitative change in the brick as a result of the addition. Success in this effort may have collateral benefits in flood control efforts since silting of riverbeds is a major concern in Bangladesh. This activity will also involve the preparation and enforcement of the proposed strategies in at least 6 of the IKEBMI's demonstration sites. *GEF assistance is required in the necessary TA for the conduct of the studies and workshops.*

- Activity 6.6: Review of the BMI Energy Efficiency Policy – This activity will involve the review and evaluation of the BMI energy efficiency policy based on the results of the demonstration program (Component 2). Revised policy and implementing guidelines will be formulated and recommended for issuance and enforcement. *GEF support is required.*

- Activity 6.7: Capacity Building on EEKs and Compliance with Emission Standards – This will involve capacity building activities for BBMOA on the adoption, operation and maintenance of EEKs as a means to comply with cleaner emission standards as set by DoE. This will be carried out through regional workshops on emission standards compliance, EEK operation and maintenance, and EE practices in the BMI, as well as in the CO_2 emissions monitoring in the demonstration projects. *GEF support is required only for the necessary TA in CO_2 emissions monitoring in the demonstration projects.*

41. **Component 7: Monitoring and Evaluation Program** - This component is intended to conduct the monitoring and evaluation of the project activities as per UNDP and GEF guidelines. The detailed Monitoring & Evaluation Plan and Budget is attached in Part VI.

- Activity 7.1: Design and implement a Monitoring System – This activity will involve design and implementation of a monitoring system for the project based on the project strategy and to ensure the agreed success indicators. *GEF support is required.*

- Activity 7.2: Mid-term Evaluation – This activity will involve the mid-term evaluation of the project and assess the progress of the project, results and variance with the planned activities. The mid-term evaluation will update the work plan if necessary. *GEF support is required.*

- Activity 7.3: Terminal Evaluation – This will involve conduct of terminal evaluation of the project as per UNDP and GEF guidelines. It will assess the results, delivery and impact of the project in mainstreaming the energy efficient brick kilns and subsequent reduction of GHGs. *GEF support is required.*

42. **Component 8: Project Management Support Program**- This component is intended to provide the management support to the IKEBMI project to ensure its effective implementation. The major activities will be coordination of all stakeholders, mobilizing of all project inputs, UNDP and GEF reporting, establishment of project planning, management, support to recruitment of staffs, facilitation for recruitment of consultants, specialists and other short-time employees and sub-contract, financial management and providing necessary support etc.

Project Indicators, Risks and Assumptions

43. The project success indicators are shown in the Project Planning Matrix (PPM) in Section II, Part II. The annual target values for these indicators based on the PPM, which will be monitored during the course of the IKEBMI project implementation, are summarized in Section IV, Part VI.

44. While all possible efforts have been made to ensure the effective design and implementation of the project activities in the project design phase, there are inevitably some unavoidable residual risks that will have to be carefully monitored and managed during the project to ensure its success. The different risks that were identified during the project formulation and the recommended mitigation measures and a commentary on the need for mitigation measures are provided in detail in Section IV, Part V.

45. The overall project risk is low to moderate. IKEBMI is carefully designed to continue to facilitate close coordination and consultation of the relevant stakeholders in each of the proposed activities. Project activities will enhance local technical capacity to improve understanding and implementation of all aspects of EEK financing, installation and operations; build effective awareness programs targeted to optimize technology diffusion; build the confidence of financing institutions to reduce risks of loans to SMEs; and develop policies and regulations to reduce the regulatory efforts of installing an EEK; and therefore in combination, are sufficient to ensure mitigation of the risks.

Expected Global, National and Local Benefits (Details Contained in Section IV, Part V)

Global Benefits

46. Transforming the currently energy-intensive brick industry to cleaner-burning, less carbon intensive technology will have significant long term impacts on GHG emissions. Estimates developed during project preparation indicate a direct reduction of 1.319 million tonnes over the expected 15-year service life of the EEKs (2009-2024), as the proposed interventions begin to take hold. The CO_2 savings calculations assume emissions from internal combustion to be the same as free burning fuel. At the GEF incremental cost of US$3,000,000, the cost of avoided CO_2 emission will be about US$2.27 per tonne over the 15-year period. The project

interventions are also expected to have significant additional but unquantifiable impacts from reductions in wood fuel usage.

47. Considering the expected reduction of coal and fuel wood consumption with the implementation of EEK technologies under the alternative scenario, and the forecast annual brick production volumes, the forecast trends of energy consumption in, and CO_2 emissions from the country's BMI are shown in the following Fig. 2. It should be noted that the reductions in CO_2 would begin from the third year of the project.

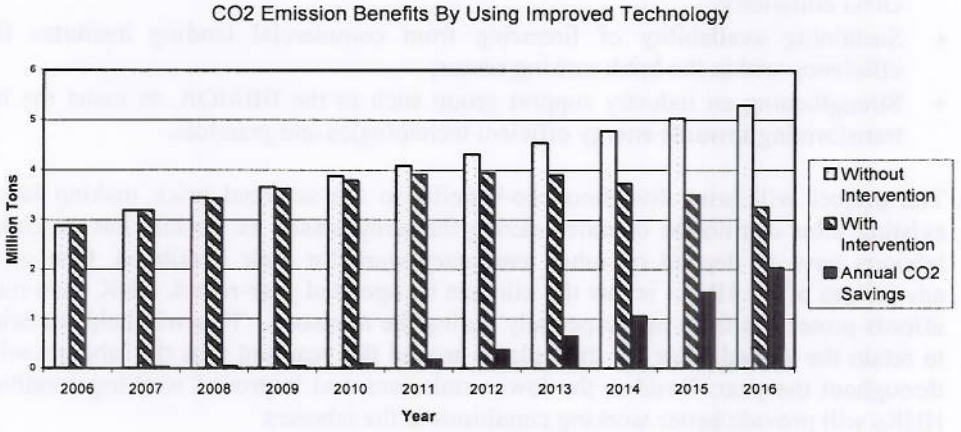


Fig. 2: Forecast BMI Annual Energy Consumption and CO_2 Emissions (Alternative Scenario)

National Benefits

48. The project will also provide an opportunity for the country to improve its management of natural resources as it pertains to the brick making industry. This would include:

- Improved management of clay sourcing. Clay is often sourced from valuable agricultural land. Through improved management, clay could instead be sourced from riverbeds that could provide flood control benefits. Official statistics indicate that farmlands are declining by 80,000 hectares a year out of a total of 14 million hectares that is, by over 0.5% annually. In addition to other non-farm activities, brickfields have been identified as a major cause for this situation in the draft National Rice Policy;
- Discouraging the illegal use of wood for brick burning through the introduction of alternative practices that create more dependence on coal and increase profitability; and
- Reducing the risks of illegal hill cutting. EEKs in general use less clay through different molding techniques that substitute coal and fly ash into the green brick and the creation of void spaces within the brick. Furthermore, an EEK will replace 3 to 5 energy inefficient kiln operations. As such, the number of kiln operations in Bangladesh will be significantly less in number and reducing the number of illegally cut hills.

49. The project will provide further national benefits from:

- Its support to strengthen the technical support services and equipment supply capabilities;
- Significantly reducing local air pollution (in particular SO_x and NO_x) since large quantities of coal are currently being used;
- Improvements in working conditions and employee health;

- Development of credible energy efficiency initiatives that will be promoted and demonstrated to Bangladesh's BMI;
- Enhancement of SME brick making operations in the context of their capacity in formal business management, to create sustainable employment, and to reduce air pollution and GHG emissions;
- Sustaining availability of financing from commercial lending institutes for energy efficiency within the brick making sector;
- Strengthening an industry support group such as the BBMOA, to assist the industry in transforming towards energy efficient technologies and practices.

50. The project will bring livelihood co-benefits to the seasonal brick making laborers. The existing kilns can not be operated during the rainy season as the kiln has no cover and the laborers have to depend on other temporary work for their livelihood. One of the added advantages of the HHKs is that the kiln can be operated year-round. HHK have roofs, which affords protection from rain especially during the monsoon. This will help the brick owners to retain the skilled labor for their plants around the year and thus the laborers will get jobs throughout the year. Besides, the lower emissions and improved working conditions in the HHKs will provide better working conditions to the laborers.

Country Ownership: Country Eligibility and Country Drivenness

51. The GOB ratified the UN Framework Convention on Climate Change on 15 April 1994. Bangladesh Government has also published the 'Initial National Communication under the United Nations Framework Convention on Climate Change (UNFCCC)' on October 2002 comprises the National Circumstances, Greenhouse Gas Inventory (1994), Vulnerability and Adaptation, Mitigation and Climate Change Response Strategies.

52. This project is designed to support Bangladesh's drive towards a sustainable energy sector. The National Energy Policy of 1996 and the draft National Energy Policy of 2005 emphasize energy efficiency and conservation as a key to increasing the energy envelope throughout Bangladesh. The GoB commitment to energy efficiency is shown in the recent approval of the "Sustainable Energy Development Authority" (SEDA) housed under the Ministry of Power Energy and Mineral Resources.

Sustainability

53. The primary objective of the project is to ensure sustainability by transferring technology, building capacity to sustain that transfer, and making bricks at lower costs thereby increasing the profitability of brick manufacturing units, reducing local pollution enabling compliance with emission standards that will be incorporated into a regulatory framework. It is envisioned that the interventions that will be carried out under the project will be sustained because of various factors such as: (1) market imperatives; (2) reduction in local pollution; and (3) improved access to finance.

54. The new kiln technology that will be promoted under the IKEBMI will bring about lower production costs resulting in lower long run real prices; better quality and more attractive bricks. This will then translates to lower construction costs and increasing demand for the new bricks; and increased profits of producers. The use of the new kiln technology will drastically reduce emission of SPMs and other local pollutants enabling manufacturers to comply with new emission standards. Lastly, the financing program that will be developed under the project will enable brickfield SMEs to access funds from commercial sources

through a limited recourse-financing package. These would help ensure the sustainability of the application of the new kiln technology.

55. The project will ensure sustainability through credible demonstration activities, creating a favorable regulatory regime for prospective investors, upgrading of SME business skill sets to qualify for bank loans, enhancing vocational and technical skills for profitable operations, streamlining SME loan approvals, and creating an industry support group that will provide advice to SMEs and others involved with the BMI.

56. To ensure the sustainability of the project beyond its end in 2011, the project will embed the various components and activities with stakeholders who are likely to be able and willing to continue the project objectives after the project ends. In particular this entails embedding the financial aspects with long-term financial institutions, the technical aspects with the country's premier technically oriented educational institution (BUET), and the policy aspects with the appropriate government agencies and ministries especially Sustainable Energy Development Authority (SEDA), which is going to be established by the Government soon, and the Department of Environment (DOE) under the Ministry of Environment and Forests. Moreover, financial sustainability will be enhanced through project linkages with IFI-backed financial agencies and capacity building measures to access carbon funding and "green" tax funds.

Replicability

57. The potential for success of this project will have significant global and regional impact. It could become a model for replication in the region and elsewhere where such types of energy efficient technologies are not in use. The baseline scenario of unabated GHG emissions from the brick industry is a matter of significant concern for the entire region. A number of neighboring countries have attempted to introduce energy efficient kilns (EEKs) and energy efficient (EE) practices, but these have not proven successful. The fundamental reason for this, experts opine, is that these have been in the nature of projects and not comprehensive market transformation programs. Therefore, a successful effort in Bangladesh will be a model for other countries to follow. The project intends to share and build awareness of these technologies, whose adoption can lead to significant abatement in GHG emissions and equally meet energy conservation goals and reduce costs.

PART III: Management Arrangements

58. Considering the innovative nature of the project - first of its kind in Bangladesh that addresses energy efficiency, air pollution and climate change mitigation - and technology intensive activities, and the direct technical assistance required by the private entrepreneurs in managing the project and accounting for emissions reduction, the project will be under UNDP execution/implementation. It will be directly implemented by the private sector under the overall framework of the Country Programme Action Plan (CPAP) and following UNDP rules, regulations, procedures and guidelines where applicable. UNDP will provide support to the private sector in managing and coordinating the project through establishment of a Project Management Unit (PMU) headed by a Project Coordinator (PC). The Project Coordinator will be a long-term National Expert, recruited by UNDP. The Project Coordinator will be responsible to UNDP for the achievement of the project objectives, for project reporting, including the submission of work plans and financial reports as per ATLAS (UNDP programme-financial system) requirements and UNDP project management guidelines. The Project Coordinator will monitor and ensure the delivery of the project outputs as expected

from the other responsible parties and oversee judicious use of the project resources. The PC will ensure delivery of high quality expertise and inputs and backstop the implementers as required. The PC will assist UNDP and the Government in their oversight role to monitor the progress of the project and evaluate the project. UNDP-Bangladesh and the UNDP-GEF Regional Technical Advisor (RTA) for Climate Change (Asia-Pacific) will undertake the GEF oversight for the project.

59. As a Responsible Party, Clean Energy Alternative (CEA) Inc., will play a major role in coordinating with the Bangladesh Brick Owners and Manufactures Association (BBOMA), the Xian Institute of China and Financial Institutions for achieving the project objectives. CEA will conduct training needs assessment, technical training, manual development, technical training to local consulting firms, engineers and technicians, capacity development of financial institutions, facilitating the financial institutions to ensure project financing, feasibility studies including baseline data, business plan preparation, liaison and field support to Xian Institute for field implementation, develop BMI monitoring and reporting system, etc. The capacity assessment of the CEA was done during the PDF-B phase for accomplishment of the above activities and was found very satisfactory. As a Responsible Party, CEA will have a Letter of Agreement (LOA) with UNDP.

60. As a Responsible Party, Xian Institute of Wall and Roof Building Materials (Xian Institute in short), the technology provider, will play a major role in detailed designing of different plants, construction supervision, operational guidance to the plants and on-job training to technical staffs in close liaison with CEA. Xian will also contribute in training manual development, development of protocol for energy performance monitoring and initial capacity building. The capacity assessment of the Xian Institute was carried out during the PDF-B phase for accomplishment of the above activities and was found very satisfactory. As a Responsible Party, Xian Institute will have a LOA with UNDP.

61. The Project Management Unit (PMU), working under supervision of UNDP, will mainly coordinate different responsible parties, support the private sector implementing partners in conducting communication and advocacy for energy efficient brick kiln and liaising with the related ministries and departments on policy and regulatory issues of the brick making industries. A Core Support Group on Advocacy will be created by PMU involving the relevant stakeholders especially the developers to promote the energy efficient bricks and environmentally friendly technology in brick making industries. The PMU will be responsible for ensuring the required reporting, monitoring of the project activities in the field and programme-financial data management following UNDP rules, regulation, procedures and financial management system ATLAS. The Project Management Unit will also coordinate with the other stakeholders of the project to ensure smooth functioning and achievement of project goals and physical and financial delivery. The PMU will also act as a "secretariat" to support the Outcome Board (CPAP Outcome Review Board/Committee) and Project Board (Project Steering Committee) in reviewing the project and supporting the Project Assurance function of UNDP.

62. The National Steering Committee (Outcome Board) will be chaired by the Secretary, Ministry of Environment & Forest in his/her capacity as GEF Operational Focal Point. The NSC will be an inter-ministerial body with representatives from Ministry of Power, Energy & Mineral Resources (Energy Division), Ministry of Environment & Forest, Ministry of Industries, Ministry of Finance (ERD), Planning Commission, Implementation Monitoring & Evaluation Division (IMED), Department of Environment, Energy Audit Cell, representatives from UNDP, GEF and any others relevant agencies/projects. The NSC/OB will also provide a formal forum for key stakeholders to discuss the progress of the project. The NSC/OB will

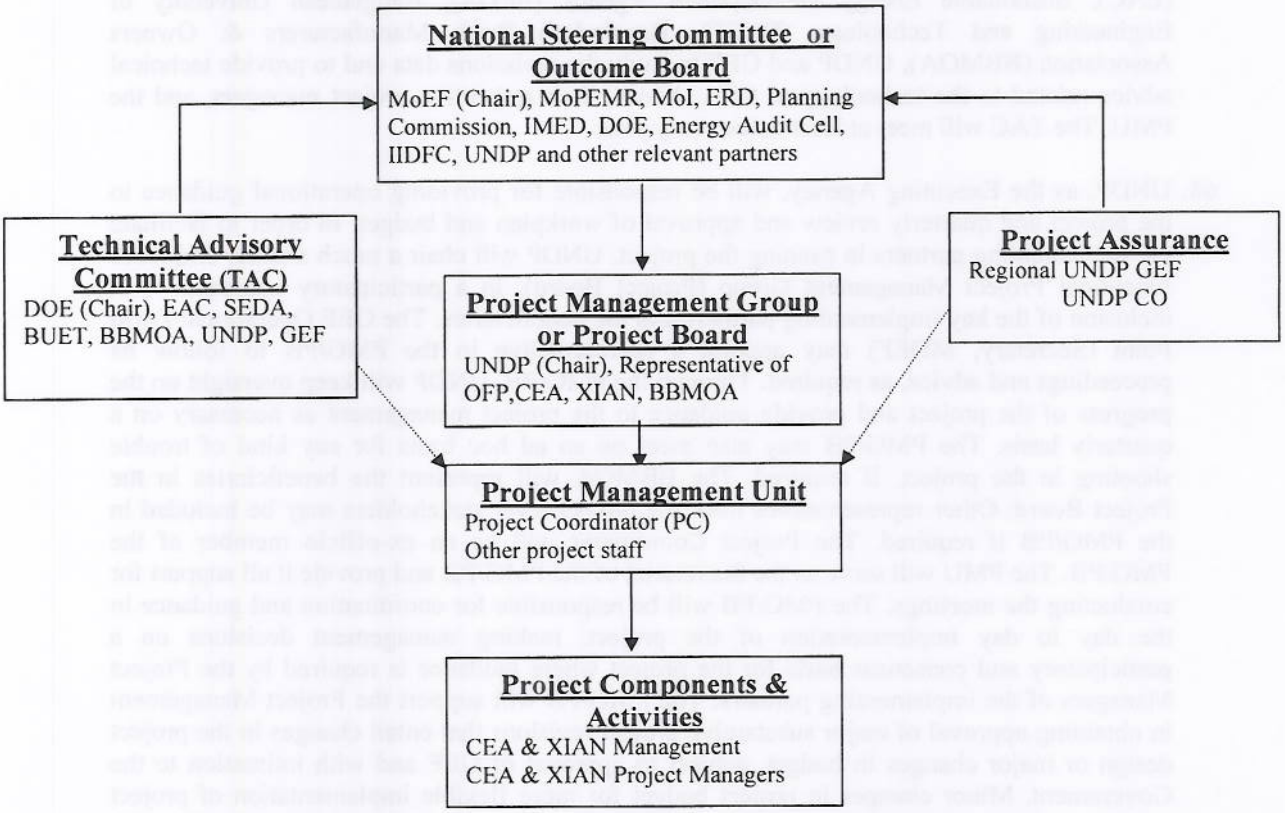
review the project "outcomes" in relationship with CPAP outcomes and country priorities and provide policy guidance on implementation of the various project components. The NSC/OB will review the results of this project vis-à-vis other relevant projects in the Climate Change & Sustainable Energy sectors. The PMU will provide it necessary support for arranging the meetings. The Project Coordinator will be an ex-officio member of the NSC/OB. The PMU will serve as the Secretariat of the NSC and provide it all necessary support for conducting the meetings. The NSC will meet at least once every year. If required, it may meet twice a year depending on the need for policy guidance by the project.

63. A core Technical Advisory Committee (TAC) will be chaired by the Department of Environment (DOE). TAC will comprise of representatives from DOE, Energy Audit Cell (EAC), Sustainable Energy Development Agency (SEDA), Bangladesh University of Engineering and Technology (BUET), Bangladesh Brick Manufacturers & Owners Association (BBMOA), UNDP and GEF to study the emissions data and to provide technical advice related to the technology to CEA, XIAN, their respective project managers, and the PMU. The TAC will meet at least twice every year.

64. UNDP, as the Executing Agency, will be responsible for providing operational guidance to the project and quarterly review and approval of workplan and budget. In order to facilitate the implementing partners in running the project, UNDP will chair a much smaller and more functional Project Management Group (Project Board), in a participatory approach, with inclusion of the key implementing partners and the beneficiaries. The GEF Operational Focal Point (Secretary, MOEF) may appoint a representative in the PMG/PB to follow its proceedings and advice, as required. Through the PMG/PB, UNDP will keep oversight on the progress of the project and provide guidance to the project management as necessary on a quarterly basis. The PMG/PB may also meet on an ad hoc basis for any kind of trouble shooting in the project, if required. The BBMOA will represent the beneficiaries in the Project Board. Other representatives from the project level stakeholders may be included in the PMG/PB if required. The Project Coordinator will be an ex-officio member of the PMG/PB. The PMU will serve as the Secretariat of the PMG/PB and provide it all support for conducting the meetings. The PMG/PB will be responsible for coordination and guidance in the day to day implementation of the project, making management decisions on a participatory and consensus basis for the project where guidance is required by the Project Managers of the implementing partners. The PMG/PB will support the Project Management in obtaining approval of major substantive project revisions that entail changes in the project design or major changes in budget, subject to approval of GEF and with intimation to the Government. Minor changes in project budget for more flexible implementation of project activities will be approved by the PMG/PB depending on need of the project. The PMG/PB will nurture a collaborative relationship among stakeholders and provide decisions and guidance on minor adjustments in project activities. The PMG/PB will also address key issues related to the institutional development, knowledge products or transfer of know-how. The PMG/PB will review the progress of the project every quarter and also endorse the next quarter's work-plan, which will be the instrument for authorization to the Project Managers of the implementing agencies and the Project Coordinator to deliver the results. Final decision making on project activities and accountability rests with UNDP as the Executing Agency in accordance with its applicable regulations, rules, policies and procedures. The OFP will be informed if a change is required on substantive matters and his guidance will be sought. The Project Board will meet at least once every quarter or more frequently should the need arise.

65. The proposed project will be implemented for five years. The project will start in the second quarter of 2009 and will conclude on 1 June 2014.

66. To accord proper acknowledgement to GEF for providing funding, a GEF logo will appear on all relevant GEF project publications. Any citation on publications regarding projects funded by GEF should also accord proper acknowledgment to GEF. The UNDP logo should also be present in all publications along with GEF logo. UNDP logo should be displayed very prominently on vehicles as UN visibility is important for security purposes on vehicles and other project hardware.



PART IV: Monitoring and Evaluation Plan and Budget

64. Project monitoring, evaluation and dissemination will be undertaken in accordance with UNDP and GEF established procedures. The Project Management Unit will be required to prepare Monthly Project Reports (MPR), Quarterly Project Reports (QPR) and combined Annual Project Reports (APR) and submit to UNDP and GOB as required. The MPR will present the expenditure and the progress of the month in a tabular reporting format. The QPR will provide the summary of the project results in terms of achievement (policy, capacity building, development knowledge, networks and knowledge sharing), organization & management (management arrangements, staff capacities, budget and delivery of outputs), partnership and lesson learnt of that quarter. It will underscore the progress and variances from the original plan (if any), implementation issues, and steps being taken to address these issues, and work plans for the next quarters for review and endorsement. The quarterly work plans will be prepared based on the overall project objectives and performance indicators. These will be used to measure performance. It is through these reports and meetings that the project approach and activities will be formally refined. The PMU will present the project status and accomplishment to the UNDP every quarter. A quarterly work plan based on

project objectives and performance indicators will be presented, evaluated and adjusted as and when necessary through the Project Management Group/Project Board.

65. The APR will provide a more in-depth summary of work-in-progress, measuring performance against both implementation and impact indicators. Any adjustments in project approach will be reported to the Project Management Group/Project Board who will evaluate and approve the adjustments recommended.

66. The Project Management Group/Project Board will review the progress of the project quarterly as well as annually, based on the report submitted by PMU and also on independent field visit to the project area. UNDP, as executing agency, will conduct periodic field monitoring of the project activities.

67. The project is subject to two in-depth independent reviews. One will be conducted in the mid-term (first quarter of the third year) and the other will be scheduled upon project termination. A terminal report would be completed prior to the completion of the project and would detail project achievements and lessons learned. Additional independent evaluation may be conducted, if UNDP and the GEF deem it necessary.

68. PMU will carry out continuous monitoring of project activities by the implementing agencies and report to UNDP. The UNDP Project Assurance Team will ensure the project performance and project delivery as per agreed plan. The Project Framework Design (PFD) states all the success indicators and means of verification for each activity that will be carried out under this project. These indicators are the parameters that will be monitored by PMU under this project.

69. To ensure coherent, coordinated and timely implementation of project activities, appropriate practical mechanisms, monitoring and evaluation (M&E) procedures and implementation arrangements will be developed. Specifically, an M&E plan for the IKEBMI implementation will be developed together with the key stakeholders, and this plan will be based on the identified success indicators and means of verification for the project goal, project purpose, project outcomes, and project activities. The Project Board will advise and approve this M&E plan.

70. Surveys will be conducted during the project to track these and other indicators of project impact. Monitoring and Evaluation (M&E) activities will be undertaken to meet the best international practice standards with reference to the International Monitoring and Verification Protocol (IPMVP) methodology. This reference to established international best practice IPMVP methodologies will be a vital element in the presentation of the results of the overall IKEBMI project to the full range of project stakeholders, including but not limited to GEF.

71. Success indicators for each objective and activity will be monitored and evaluated during the course of project implementation. The detail monitoring and evaluation plan and budget is presented in Section IV Part VI. The extent by which the GEF developmental goal is achieved will be evaluated from the monitored results. Annual target values for the indicators will be confirmed during project document finalization.

72. The project will coordinate with all the project partners of the IKEBMI project. The continuous monitoring and evaluation of all project activities, even after completion of the project period, will bring sustainability of the project with desired benefits in the long run. All evaluation reports will be uploaded to the project website for widespread dissemination. A

formal Monitoring and Evaluation Strategy will be developed and implemented in the full-scale project to track the activities and contributions of the activities by all the project partners, in terms of both in-cash and in-kind contributions as detailed in the attached letters of commitment. These M&E findings will be reported on in the project's two in-depth independent reviews.

PART V: Legal Context

73. This GEF Full Scale Project Document shall be the instrument referred to as such in Article I of the Standard Basic Assistance Agreement between the Government of Bangladesh and the United Nations Development Programme, signed by the parties on 26 November 1986.

74. The UNDP Country Director in Dhaka, Bangladesh is authorized to affect in writing the following types of revision to this Project Document, provided that he/she has verified the agreement thereto by the UNDP-GEF Unit and is assured that the other signatories to the Project Document have no objection to the proposed changes:

    a) Revision of, or addition to, any of the annexes to the Project Document;

    b) Revisions which do not involve significant changes in the immediate objectives, outputs or activities of the project, but are caused by the rearrangement of the inputs already agreed to or by cost increases due to inflation;

    c) Mandatory annual revisions which re-phase the delivery of agreed project inputs or increased expert or other costs due to inflation or take into account agency expenditure flexibility; and

    d) Inclusion of additional annexes and attachments only as set out here in this Project Document.

SECTION II: STRATEGIC RESULTS FRAMEWORK AND GEF INCREMENT

PART I: Incremental Cost Analysis

Broad Development Goals

75. Bangladesh's broad development goals include economic and social development through employment creation and poverty reduction, modernization and growth of all economic sectors, reductions in pollution (including reducing the inefficient use of fossil fuel) and contributing to global greenhouse gas reductions. Of particular relevance to IKEBMI is its goal towards ensuring environmental sustainability (MDG-7) and develop global partnerships to achieve development.

76. The GoB has supported efforts to reduce GHGs and improve air quality. The goal of Bangladesh's climate change initiatives has been to assist Bangladesh in providing affordable energy as well as reducing its dependence on foreign fuel imports. This is part of Bangladesh's commitment to responsible citizenship of the global village.

Baseline Activities

77. Studies in the 1990's show that out of 14.8 million households, 3.7 million or 25% used bricks as wall materials. Growth trends also show that demand for bricks has been steadily increasing at about 5.28% annually. The growth has come mainly from the construction industry, which has been growing above GDP rates. In the 1980's and 1990's while GDP grew at about 4%, the construction industry grew at 5.5%. The annual growth rate of the construction sector over the last 7 years has ranged from 8.1% to 8.9%[1] and is expected to remain the same over the next decade.

78. There has also been a perceptible increase in brick use in non-traditional areas as incomes have risen; bricks are a preferred material for housing since they have superior thermal properties and are visually more pleasing. The output of bricks has also been quite elastic, growing in response to increases in demand. Studies from the PDF B exercise estimate 4,159 brickfields operating in Bangladesh. The uncertainty within this estimate is due to unlicensed, informal kilns that operate every brick-making season. With Bangladesh's economy set to grow another 6% in 2006, the growth of brick making activities to support the construction industry will also expand.

79. Under a BAU scenario for the EEK demonstration projects, the following situations are expected:

- The BMI will continue to grow primarily with the use of energy inefficient kilns (EIK) operations. The number of brick kilns is expected to grow by more than 5.28% annually in the next decade due to increases in demand for bricks by a burgeoning urban population requiring additional building and transport infrastructure. This would increase the number of kilns from the current estimate of 4,000 to over 5,738 by 2014 with annual GHG emissions expected to increase by over 35% to 8.7 million tonnes of CO_2 annually;

- EEK technical capacity, management, technical and operational capacity of SMEs; technical support consultants and service providers; universities, technical institutes, polytechnics and other publicly funded providers; and local equipment suppliers of affordable technologies will remain weak. At present, only BUET has limited capacity to conduct monitoring of energy consumption and emissions of the BMI. Efforts to improve the situation will be hampered by a lack of awareness of EEK technologies, lack of capacity and a lack of standardized and comprehensive training materials. Local supply capacity for EEK related equipment would remain low;

- The level of awareness of EEKs amongst SMEs and the public will continue to be low, information on EEKs will continue to be difficult for SMEs to access, there will be no integrated information system to provide and receive comprehensive information to and from SMEs, and the limited EEK information available for SMEs will continue to lack credibility;

- Commercial banks are willing to finance EEK demonstrations on condition of the participation of capable and willing entrepreneurs and the means to reduce startup costs of an EEK operation. Notwithstanding the availability of capital, financing support for EEK

[1] (Source: Bangladesh Bank Annual Report 2004-2005).

projects from banking and financial institutions will be constrained until SMEs in the BMI upgrade their formal business skills. As a result, there will be few if any investments to modernize the BMI from its current state;

- There will be no change from the current situation where there is little if any concerted effort to reduce the emission levels of the BMI. EEK market entry into Bangladesh will be "clandestine" given the new kilns do not meet the requirement of having a 120-foot chimney. The BBMOA will continue to have a low profile and not have the capacity to address opportunities to transform their industry towards clean technologies. Moreover, the capacity of the agency responsible for regulating the BMI, the Department of Environment (DoE), is severely constrained by the lack of human resources and knowledge of other government jurisdictions successful in regulating industries. Hence, it is expected that they will not improve the current regulatory framework for the BMI.

Global Environmental Objective

80. The project will bring about the reduction of GHG emissions from the BMI by improving the specific energy consumption in the brick making processes through the widespread adoption of EEKs and alternative molding practices that also provide significant energy savings in Bangladesh. Moreover, these EEK operations will be well managed and operated to ensure optimum use of coal resources can reduce emissions and maximize profitability. The project aims to remove the barriers to widespread adoption of EEKs, alternative molding practices, management, maintenance and operational practices and will thus promote their accelerated and widespread utilization. The proposed project is consistent with GEF Operational Program #5: "Removal of Barriers to Energy Efficiency and Energy Conservation".

GEF Alternative

81. Brick manufacturing is a significant contributor to GHGs on the Indian sub-continent, and more broadly, in Asia. This situation will only exacerbate itself as urban populations expand and create a growing demand for bricks. In some countries, such as China, energy conservation was the driving force behind government interventions to improve kiln technology. This became increasingly critical as brick production expanded which led to significant investments in research and development of kiln technologies to reduce energy usage. In a developed economy such as China, the government was capable of providing the financial resources for such R&D activities. However, in less affluent, cash poor economies such as Bangladesh, there is a shortage of internal resources required to bring about such changes. Additionally, the government lacks the knowledge and wherewithal to implement a program of such magnitude and scope. Therefore, international assistance, such as that being sought from GEF, is compelling.

82. The proposed project would achieve the objectives set out in GEF OP 5 to reduce the risk of climate change by reducing industrial GHGs from the brick making industry by: (a) Removing barriers to the widespread use of EEKs; and, (b) Promoting EC&EE practices in the BMI by introducing molding and other energy-efficiency techniques (that will also have the effect of restrict wood from being used as a fuel).

83. Ensuring that OP-5 objectives will be achieved, the following interventions will be carried out:

- Confirmation and comparative studies of production, economic and environmental data of EEKs and technologies currently in use in Bangladesh to remove higher perceived risks of EEKs and EE practices;
- Implementing a demonstration program for EEK installations and operations to remove the barriers of perceived risks of EEKs and EE practices;
- Building capacity to design, construct, operate and maintain EEK kilns, manage EEK operations to address the lack of trained personnel (vocational, technical and managerial);
- Implementing innovative financing schemes in collaboration with commercial banks and development partners to remove barriers of the lack of access to credit;
- Conducting stakeholder awareness programs and technology dissemination programs on EEK technologies, emissions, financing mechanisms, and energy-environment issues to remove barriers on the lack of information;
- Assisting the Government of Bangladesh in the promulgation and dissemination of regulations and policies that favor the proliferation of EEK operations to remove barriers regarding the absence of a regulating framework; and
- Assisting the BBMOA in the compliance to new regulations and policies towards widespread adoption of EEKs and EE practices.

84. Under the alternative scenario, energy savings and cost-effectiveness estimates for new EEK operations within SMEs will gain credibility from properly planned, implemented, monitored, independently evaluated and publicized demonstrations in the targeted districts throughout Bangladesh. The demonstrations will be funded by commercial banks using financial mechanisms designed to enhance the business skills of SME managers and hence, remove perceived risks for the finance institutions. The successful demonstrations will lead to large numbers of SMEs applying for EEK financing; the replication of the demonstration projects in other districts; and banks and SMEs' own funding capacities being better mobilized.

85. The following are the expected outcomes by end of the project:

- GHG emissions reduced by 1,319 kilo tonnes CO_2 over the 15-year expected service life of the EEKs;
- Cumulative energy savings from brick kilns by about 15,415 TJ or 526 ktonnes coal by end of project;
- About 2.1% of the brick kilns are EEKs by end of project[2] or 4.4% considering the expected number of EEK replications during the course of the project implementation;
- Average energy cost per unit brick in the BMI is reduced by 20% by end of project.

86. Under the GEF supported alternative, there will be a significant strengthening of management and technical capacity of SMEs to manage EEK operations, and a pool of technical support consultants and services companies, technical institutes and local equipment suppliers of affordable technologies. Key means by which the situation will be improved will be through enhanced training capacity; mobilized local manufacturing investment to produce higher energy efficiency equipment; the development and application of standardized and comprehensive training materials; and the creation of an industry support group that can

[2] Considering that 1 HHK is roughly equivalent to 7.5 FCKs based on the annual brick production of each kiln type (15 million for HHKs versus 2 million for FCKs), the 16 demo HHKs would be 120 FCKs, which represents 2.1% of the forecast number of installed brick kilns (≈ 5,738) in Bangladesh by year 2014. The projected end of IKEBMI is in mid-2014, at which time there will be an estimated 5,454 FCKs in Bangladesh. In terms of number of EEKs deployed under the IKEBMI by 2014, this would represent a 2.1% market transformation.

provide to the BBMOA technical advice and possible improvements to the industry based on research.

87. With the GEF supported alternative to the baseline scenario, there will be increased awareness of EEKs amongst SMEs, the public and government agencies. A reliable EEK information collection and dissemination system will be established and put into operation; SMEs will report their energy use which will be assembled into a usable and accessible database; more information on EEK operations will become available, this information will be easy for SMEs to access through various media platforms; and this information will have high levels of credibility.

88. The proposed GEF supported alternative will increase consultant capacity on business development, energy auditing, energy design tools, and commercial consulting models which will lead to greater provision of high quality consulting services beneficial to the BMI.

89. With GEF support, the B/FIs will become aware of SME EEK financing opportunities, will apply consistent and understandable loan criteria, will have a realistic appreciation of actual loan risks, and will better utilize available funding sources for SME EEK investments.

90. The proposed project is comprised of 8 major components that will be implemented to achieve the project objectives including the Monitoring & Evaluation and Project Management. The major 6 project components are specific programs consisting of complementary activities designed to remove barriers to achieve the project goal.

91. Component 1: EEK Technology Support Program - This component is comprised of activities that will address the technical barriers in the BMI that hinders the widespread applications of EEK technologies. The main outcome of these activities is the thorough understanding and appreciation of technology options and their environmental impacts by brick makers, government and other stakeholders. The activities include the conduct of assessments of other energy conservation & energy efficiency (EC&EE) and energy efficient kiln (EEK) technology options and available clay resources in the country; performance evaluation of existing brick makers and identification potential improvements in their energy performances; development and implementation of an energy reporting and monitoring program for the BMI; and, the development of a local BMI engineering and consultancy service industry. The activities under this component will cost US$ 450,519. Incremental activities will cost US$ 335,710 which will be financed by the GEF.

92. Component 2: EEK Demonstration Program - This component will address the barrier concerning the need to showcase the major aspects of the application of EEKs and energy efficient brick making practices, and the limited EEK demonstrations in the BMI of Bangladesh. The main outcome of this project component is the establishment of a critical mass of demonstration projects that will provide detailed information of EEK operations, energy savings and environmental impacts to interested brick makers. The activities that will be carried out under this component include the conduct of seminar-workshops for the promotion and dissemination/presentation of the results of the EEK technology and EC&EE demonstration projects; conduct of feasibility analyses of selected demonstration sites; specific activities to ensure effective demonstration project implementations; establishment of baseline data for the demonstration projects; design, installation, operation, monitoring and evaluation of the demonstration projects. These activities will collectively cost US$ 11,821,240 to implement. The demonstration projects accounts for the largest baseline cost

(about 92% or US$10.85 million)[3]. Incremental activities will cost US$ 1,107,680 that will be financed by the GEF.

93. Component 3: EEK Managerial and Technical Capacity Development Program - This component has been primarily designed to address the barrier of inadequate technical capacity to support the installation and operation of EEKs and different energy efficient brick making practices that can also lower production costs and emissions. The expected main outcome of this component is improved local vocational, technical; and managerial capacity to manage and sustain operations of EEKs and EE practices in Bangladesh. The activities include capacity building on EC&EE, EEKs and EE brick making practices for BMI personnel and local engineering firms servicing the BMI; assessment of the capabilities of existing BMI maintenance service providers and of local manufacturers of brick kilns; feasibility study of standardization of brick making kilns and associated equipment/components; and provision of TA for the design of future BMI EC&EE projects. The activities under this component will cost US$ 564,546 of which 100% will be financed by the GEF.

94. Component 4: Communications and Awareness Program - This component is intended for addressing the barriers related to low awareness of government, public, and SMEs of technical alternatives to energy efficient brick making methodologies and practices, as well as the lack of access to information on EEKs and EC&EE in brick making. The primary outcome of the activities that will be carried out under this component is the enhanced awareness of the public and other stakeholders on EEKs, EE brick making methodologies/practices and energy efficient bricks production. The activities include the establishment of a BMI information center, and an integrated information exchange service; implementation of a promotion and advocacy program on EC&EE in the BMI; and a BMI energy awards program. The activities under this component will cost US$ 75,000 of which 100% will be financed by the GEF.

95. Component 5: EEK Finance Support Program - This component has been primarily designed to address the BMI SMEs' lack of access to finance for supporting EEK applications and energy efficiency initiatives. The expected outcome from this component is the availability of financial and institutional support to encourage SME adoption of EEKs. The activities include preparation of an action plan for financing SMEs in the BMI based on the results of a techno-economic feasibility study; capacity building for banks/financial institutions (B/FIs) on evaluating the financial viability of EC&EE projects, and on accessing financing sources for brick makers; and the establishment of links between SMEs and B/FIs. The activities under this component will cost US$ 255,906 of which 100% will be financed by the GEF.

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[3] IIDFCL will provide debt financing (@70:30 debt-equity ratio) for the 31 demonstration projects. The actual outlay for the debt financing that IIDFCL will be providing is spread over a 4 to 5 five year period such that annual lending is relatively small. This means that annual outlays will also be small and hence, normal risks associated with lending will also be low. Moreover, banks recognize that lending associated with the proposed GEF project with its barrier removal outcomes will further reduce the loan risks. During consultations with lending institutions that carried out under the PDF-B exercise, it was pointedly noted by bankers that in the past, many loans have gone sour because of the lack of training and the absence of good technology adaptation regimes on projects. Since Bangladesh relies heavily on foreign technology and capital goods, the intervention components in the proposed GEF project are unique and will provide a high degree of "comfort" to lenders and reduce risk profiles considerably. Given these circumstances and the close association of IIDFCL with the project development, there is a high degree of credibility in their commitment to finance all 31 of the demonstration projects. This conclusion is further buttressed by their agreement to finance the first four demonstration plants even before final approval of the GEF project.

96. Component 6: EEK Policy Development and Institutional Support Program - This component is designed to address the policy and regulation related barriers that affect the widespread application of EEK technologies in the BMI. The expected outcome from this component is the promulgation of, and compliance to, favorable policies and regulations that encourage adoption of EEKs and energy efficient brick making practices and methodologies. Activities that will be carried out under this component includes policy advocacy/campaign programs; formulation and implementation of strategies, policies and associated implementing rules and regulations (IRRs); and, capacity building on policy formulation and enforcement, as well as in the enforcement and compliance to BMI emission standards. The activities under this component will cost US$ 241,996 of which US$161,996 or 67% will be financed by the GEF. The remainder will be financed by the Government of Bangladesh.

97. Component 7: Monitoring and Evaluation Program - This component is intended to conduct the routine monitoring and evaluation of the project activities and also the mid-term and terminal evaluation of the project as per UNDP and GEF guidelines.

98. Component 8: Project Management Support - This component refers to the activities for the management of the IKEBMI project to ensure its effective implementation. The major activities will be coordination of all stakeholders, mobilizing of all project inputs, UNDP and GEF reporting, establishment of project planning, management, facilitation for recruitment of projects staffs, consultants, specialists and other short-time employees and sub-contract, financial management, providing necessary support etc.

Incremental Cost Matrix and Project Indicative Budget

99. The proposed budget for each project component shown in Table 2.

100. Table 3 provides indications of budget cost sharing among GEF and the co-financiers of the full-scale project by components/activities *(excluding the US$348,000 GEF plus co-financing for the PDF B exercise)*.

Table 2: Summary Cost of Each Project Component (US$)

Project Component	Baseline	Incremental	Total Cost	%
1. EEK Technology Support Program	-	450,519	450,519	3.2
2. EEK Demonstration Program	10,850,000	1,107,680	11,957,680	84.7
3. EEK Technical and Management Capacity Development Program	-	564,546	564,546	4.0
4. Communications and Awareness Program	-	75,000	75,000	0.5
5. EEK Finance Support Program	-	255,906	255,906	1.8
6. Policy Development and Institutional Support Program	80,000	161,996	241,996	1.7
7. Monitoring & Evaluation	-	139,310	139,310	1
8. Project Management Unit Support	190,000	245,043	435,043	3.1
Total	***11,120,000***	***3,000,000***	***14,120,000***	***100***

Table 3: IKEBMI Cost Sharing Matrix (US$)

No	COMPONENTS/ACTIVITIES	GEF	Nat'l Gov't	Local Gov't	Private Sector	Others	Total
1	EEK Technology Support Program	450,519					450,519
2	EEK Demonstration Program	1,107,680			10,850,000[4]		11,957,680
3	EEK Technical and Management Capacity Building Program	564,546					564,546
4	Communications and Awareness Program	75,000					75,000
5	EEK Finance Support Program	255,906					255,906
6	EEK Policy Development and Institutional Support Program	161,996	80,000				241,996
7	Monitoring & Evaluation	139,310					139,310
8	Project Management	245,043	60,000		50,000	80,000	435,043
TOTAL		**3,000,000**	**140,000**		**10,900,000**	**80,000**	**14,120,000**

101. Table 4 shows the incremental cost matrix. The baseline and alternative courses are presented together with the costs of achieving them.

[4] The total debt finance for the 31 HHK demonstration projects is US$10.85 million and not US$16 million as earlier estimated. The latter figure is considering the anticipated number of replications that would occur outside of the project. Regarding the relative cost of an HHK in Bangladesh to that in China, it is true that the direct cost of HHK in China is relatively low. The Bangladesh cost profile reflects that too. However, the total cost for each Bangladeshi plant has four components: land, kiln, back process and import costs. The kiln itself costs only $60,000 including additional roofing for protection against heavy monsoon rains. This amount is extremely competitive given the high cost of local bricks (estimated to be 3 times that in China) with which these kilns are to be constructed. The higher cost elements are in the back process, shipping and import costs. To protect against monsoon rains, the HHKs include tunnel drying arrangements and a waste heat recovery system to dry green bricks. These are additional costs which are presumably not included in China. During the PDF-B exercise, cost comparative analyses were made against other Hoffmann Kilns of similar scale that have been constructed in the recent past in Bangladesh. The last Hoffmann of comparable size built with Korean equipment and supervision in Bangladesh cost almost $1.0 million; this kiln was fueled by gas but nevertheless serves as a good indicator with respect to costs due to similar scale size and a similar back process system.

Table 4: Incremental Cost Matrix

Component	Baseline	Alternative	Increment
Global Environmental Benefits	No decline in GHG emissions due to recent SRO by the GoB and likelihood of no further SROs to clean up the BMI. Cumulative CO_2 emissions will be 135 million tonnes over a 15-year period	GHG emissions from new kiln technologies and internal fuel in green bricks will decline by more than 40%. The overall impact will result in a cumulative CO_2 emissions of 82.0 million tonnes over a 10-year period	Cumulative savings of CO_2 emissions will be 1.32 million tonnes over a 15-year expected service life of the energy efficient kilns
Domestic Benefits	• No abatement of air pollution from the BMI and continued severe but unquantified health impacts • Increasing land degradation resulting from uncontrolled clay mining activities (loss of farmland and illegal cutting of hilltops) • Continued use of firewood in certain areas reducing the country's valuable base of carbon sinks • Predominance of poor quality bricks with poor insulating and structural qualities	• New kiln technologies and molding practices that will significantly reduce and possibly eliminate visible smoke • Regulations and enforcement to clay mining to sites that minimize land degradation • Reduced dependence on firewood through adoption of new kiln design that only uses coal • Predominance of better quality bricks that have improved insulating and structural qualities	• Significant improvement in local air quality and reduced health impacts from poor air quality • Clay mining practices that serve the BMI as well as provide environmental benefits (such as clay mining from riverbeds to provide flood protection benefits) • Increased availability of carbon sinks • Improved quality of building material for insulating and structural perspectives.
Component 1: EEK Technology Support Program	Few if any coordinated efforts to improve knowledge base in cleaner technologies and EC&EE practices brought to Bangladesh; Most brickfield owners have weak concepts of EE investments; Framework for information system to manage energy consumption, GHG and air quality data; and, No credible information on the environmental impacts of the BMI	Activities addressing the technical barriers in the BMI that hinders the widespread applications of EEK technologies. The main outcome of these activities is the thorough understanding and appreciation of technology options and their environmental impacts by brick makers, government and other stakeholders.	Conduct of assessments of other energy conservation & energy efficiency (EC&EE) and energy efficient kiln (EEK) technology options and available clay resources in the country; performance evaluation of existing brick makers and identification potential improvements in their energy performances; development and implementation of an energy reporting and monitoring program for the BMI; and, the development of a local BMI engineering and consultancy service industry.
	Domestic Benefits • Few SMEs are interested in EEK technologies due to lack of information • Limited capacity to generate credible reports on environmental impacts of brick making activities	**Domestic Benefits** • Increased numbers of SMEs have necessary information on which to base their decision on an EEK investment • Generation of interest in EEK demonstration projects • Local capacity to generate credible monitoring reports on local air quality parameters and environmental impacts	**Domestic Benefits** • Increased numbers of SMEs have necessary information on which to base their decision on an EEK investment • Generation of interest in EEK demonstration projects • Local capacity to generate credible monitoring reports on local air quality parameters and environmental impacts

Component	Baseline	Alternative	Increment
		from the BMI	from the BMI
	Global Benefits • No potential for or limited energy savings and GHG reductions resulting from marginal improvements in EEK investments	**Global Benefits** • Greater potential for GHG reductions resulting from EEK investments are realized nationwide	**Global Benefits** • Greater potential for GHG reductions resulting from EEK investments are realized nationwide
COST	US$ 0	US$ 450,519	US$ 450,519
Component 2: EEK Demonstration Program	Growth of brick industry is characterized by a growing number of EIKs and no efforts to improve the energy efficiency of the industry; Commercial banks are willing to finance EEK demonstrations on condition of the participation of capable and willing entrepreneurs and the means to reduce startup costs of an EEK operation; and, Use of monitoring equipment and limited capabilities to monitor energy consumption, GHG emissions and other air quality parameters from the BMI	Activities addressing the barrier concerning the need to showcase the major aspects of the application of EEKs and energy efficient brick making practices, and the limited EEK demonstrations in the BMI of Bangladesh. The main outcome of this project component is the establishment of a critical mass of demonstration projects that will provide detailed information of EEK operations, energy savings and environmental impacts to interested brick makers.	Conduct of seminar-workshops for the promotion and dissemination/presentation of the results of the EEK technology and EC&EE demonstration projects; conduct of feasibility analyses of selected demonstration sites; specific activities to ensure effective demonstration project implementations; establishment of baseline data for the demonstration projects; design, installation, operation, monitoring and evaluation of the demonstration projects.
	Domestic Benefits • Few SMEs are confident to implement an EEK investment project • No EEK operations will be financed and implemented for demonstration purposes • Monitoring environmental impacts and air quality near brick making activities that lacks credibility	**Domestic Benefits** • Increased numbers of SMEs have confidence to implement EEK projects • Replication of EEK demonstration projects in selected districts. • Commercial banks will finance 31 sites for EEK operations • Local capacity to credibly monitor environmental impacts and air quality near EEK and EIK operations at demonstration sites	**Domestic Benefits** • Experiences, lessons learned and knowledge of EEK project implementation • Lessons learned in design, implementation, and operation of EEK projects available for dissemination • Commercial banks have some confidence in loaning funds for EEK operations • Local capacity to monitor environmental impacts and other air quality parameters for EEK and EIK operations
	Global Benefits • Few or no EEK investments carried out resulting in no energy savings and GHG reductions • Limited capacity to monitor energy consumption and GHG emissions from the BMI	**Global Benefits** • Energy efficiency and GHG reductions resulting from EEK projects are realized from demonstration projects, as well as the potential for replication • Local capacity to credibly monitor and report energy consumption and GHG emissions	**Global Benefits** • Additional GHG emission reductions with the potential for greater reductions from the replication of the demonstration project • Local capacity to credibly monitor and report energy consumption and GHG emissions
COST	US$ 10,850,000	US$ 11,957,680	US$ 1,107,680

Component	Baseline	Alternative	Increment
Component 3: EEK Managerial and Technical Capacity Development Program	No growth in energy efficiency service businesses; Unskilled personnel only have skills to operate EIKs; Limited availability of local capabilities for EEK equipment manufacturers/fabricators and importers, and evaluation of energy efficiency of EEKs; SMEs, energy consultants, technical institutes and universities, and technology suppliers lack suitably skilled human resources and have weak technical support capacity available to them; Few training courses conducted by training organizations in Bangladesh, with a lack of comprehensive approach and standardized training materials	Activities primarily designed to address the barrier of inadequate technical capacity to support the installation and operation of EEKs and different energy efficient brick making practices that can also lower production costs and emissions. The expected main outcome of this component is improved local vocational, technical; and managerial capacity to manage and sustain operations of EEKs and EE practices in Bangladesh.	Capacity building on EC&EE, EEKs and EE brick making practices for BMI personnel and local engineering firms servicing the BMI; assessment of the capabilities of existing BMI maintenance service providers and of local manufacturers of brick kilns; feasibility study of standardization of brick making kilns and associated equipment/components; and provision of TA for the design of future BMI EC&EE projects.
	Domestic Benefits • Continued limitations and low quality vocational skills of brickfield workers • Limited or no capacity of technical work force to support EEK operations • Limited capacity of entrepreneurs and business personnel to manage a formal brick making entity	**Domestic Benefits** • Trained work force with the skill and discipline to operate an EEK operation • Trained technical work pool to support the design, construction, commissioning and operation of an EEK operation, and to conduct energy audits • Trained business personnel and entrepreneurs to manage a formal business entity.	**Domestic Benefits** • Trained work force with the skill and discipline to operate an EEK operation • Trained technical work pool to support the design, construction, commissioning and operation of an EEK operation, and to conduct energy audits • Trained business personnel and entrepreneurs to manage a formal business entity.
	Global Benefits • Limited capacity of personnel to realize energy savings and GHG emission reductions from the BMI	**Global Benefits** • Improved capacity of personnel to increase energy savings and GHG emission reductions resulting from improved EEK designs, management and operations	**Global Benefits** • Improved capacity of personnel to increase energy savings and GHG emission reductions resulting from improved EEK designs, management and operations
COST	US$ 0	US$ 564,546	US$ 564,546
Component 4: Communications and Awareness Program	Limited public and stakeholder awareness of EEKs and EE molding practices; SMEs do not have credible knowledge of EEKs and their benefits; and, Fragmented efforts to disseminate information on energy efficiency in the BMI	Activities addressing the barriers related to low awareness of government, public, and SMEs of technical alternatives to energy efficient brick making methodologies and practices, as well as the lack of access to information on EEKs and EC&EE in brick making. The primary outcome of the activities that will be carried out under this component is the enhanced awareness of the	Establishment of a BMI information center, and an integrated information exchange service; implementation of a promotion and advocacy program on EC&EE in the BMI; and a BMI energy awards program

Component	Baseline	Alternative	Increment
		public and other stakeholders on EEKs, EE brick making methodologies/practices and energy efficient bricks production.	
	Domestic Benefits • Dispersed and fragmented information dissemination that is not effective in enhancing awareness of EEKs and EE practices amongst stakeholders and the general public	**Domestic Benefits** • Credible EEK information generates more interest in EEKs with organizations and stakeholders • Positive public awareness of EEK operations and bricks products from EEK operations and EE practices	**Domestic Benefits** • Credible EEK information generates more interest in EEKs with organizations and stakeholders • Positive public awareness of EEK operations and bricks products from EEK operations and EE practices
	Global Benefits • Poor public awareness of energy savings and GHG reductions of EEK operations	**Global Benefits** • Enhanced awareness of public and stakeholders of energy efficiency and GHG emission reductions from EEK operations	**Global Benefits** • Enhanced awareness of public and stakeholders of energy efficiency and GHG emission reductions from EEK operations
COST	US$ 0	US$ 75,000	US$ 75,000
Component 5: EEK Finance Support Program	Limited ability of banking and financial institutions address SME loan risks and benefits; Inadequate banking and financial institutional capacity to assess SME financing mechanisms; No linkages with other financing schemes that provide SME sector development; and, No potential for accessing other sources of funding to sustain any transformation towards a cleaner brick industry	Activities primarily designed to address the BMI SMEs' lack of access to finance for supporting EEK applications and energy efficiency initiatives. The expected outcome from this component is the availability of financial and institutional support to encourage SME adoption of EEKs.	Preparation of an action plan for financing SMEs in the BMI based on the results of a techno-economic feasibility study; capacity building for banks/financial institutions (B/FIs) on evaluating the financial viability of EC&EE projects, and on accessing financing sources for brick makers; and the promotion and establishment of links between prospective SMEs and B/FIs.
	Domestic Benefits • Few if any EEK projects financed	**Domestic Benefits** • EEK projects financed through commercial loans and IFI backed financial agencies • Sustained financing of EEKs from carbon financing after completion of the project	**Domestic Benefits** • EEK projects financed through commercial loans and IFI backed financial agencies • Sustained financing of EEKs from carbon financing after completion of the project
	Global Benefits • Increased energy consumption and no GHG emission reductions from the BMI	**Global Benefits** • Enhanced energy savings and GHG emission reductions resulting from increased financing availability from commercial banks, IFI-backed financial agencies and other funding sources.	**Global Benefits** • Enhanced energy savings and GHG emission reductions resulting from increased financing availability from commercial banks, IFI-backed financial agencies and other funding sources.
COST	US$ 0	US$ 255,906	US$ 255,906
Component 6:	No efforts within GoB to promote need for favorable regulatory regime to encourage	Activities designed to address the policy and regulation related barriers that affect the	Policy advocacy/campaign programs; formulation and implementation of

Component	Baseline	Alternative	Increment
EEK Policy Development and Institutional Support Program	EE in the BMI; No new policies drafted by GoB to encourage EE practices and technologies for the BMI; Ongoing efforts to harmonize "Brick Burning Act" administrative procedures; No emission standards for the BMI; Limited capacity to enforce regulations overseeing the BMI; No coordinated efforts to mitigate land degradation from clay mining and extraction of wood from bio-sensitive areas; and, No meaningful dialogue between BBMOA and GoB on improving the environmental performance of the BMI	widespread application of EEK technologies in the BMI. The expected outcome of the activities that will be carried out is the promulgation of, and compliance to, favorable policies and regulations that encourage adoption of EEKs and energy efficient brick making practices and methodologies.	strategies, policies and associated implementing rules and regulations (IRRs); and, capacity building on policy formulation and enforcement, as well as in the enforcement and compliance to BMI emission standards.
	Domestic Benefits • No significant changes in the brick industry due to stagnancy of policy development for the BMI • SMEs will continue to supply brick market with bricks from FCK technology investments but with little effort to curtail environmental impacts.	**Domestic Benefits** • Policy development accelerated to encourage proliferation of EE in the brick making • SMEs will be encouraged to become a cleaner and more energy efficient industry through favorable regulatory regime	**Domestic Benefits** • Policy development accelerated to encourage proliferation of EE in the brick making • SMEs will be encouraged to become a cleaner and more energy efficient industry through favorable regulatory regime
	Global Benefits • Limited or no energy efficiency in the BMI	**Global Benefits** • Higher GHG emission reductions resulting from enhanced policy and institutional support to the BMI	**Global Benefits** • Higher GHG emission reductions resulting from enhanced policy and institutional support to the BMI
COST	US$ 0	US$ 161,996	US$ 161,996
Component 7: Monitoring and Evaluation	No M&E system to evaluate the performance of brick making industries.	Activities designed to carryout routine monitoring and evaluation and also mid-term and final evaluation of project.	Activities designed to carryout routine monitoring and evaluation and also mid-term and final evaluation of project.
COST	US$ 0	US$ 139,310	US$ 139,310
Component 8: Project Management Unit Support Cost	Lack of coordination among different stakeholders in the sectors.	The component designed to increase coordination and management among stakeholders in the brick making sector.	The component designed to increase coordination and management among stakeholders in the brick making sector.
COST	US$ 190,000	US$ 435,043	US$ 245,043
TOTAL COST	**US$ 11,040,000**	**US$ 14,040,000**	**US$ 3,000,000**

PART II: Logical Framework Analysis (Project Planning Matrix)

Project Strategy	Success Indicators	Means of Gauging Success	Assumptions
GOAL: Reduction of the growth of GHG emissions from the brick making industry (BMI) in Bangladesh.	• GHG emissions reduced by 1,319 ktonnes CO_2 (direct) from 16 EEK demonstrations compared to business-as-usual scenario by end of a 15-year expected service life period of the EEKs.	• Documentation of energy savings and GHG emissions reduction from demonstration projects • BERM Program reports	• Monitoring and evaluation activities planned under the project are fully supported and implemented • GoB is supportive of the application of EC&EE and EEK technologies in the BMI to reduce air pollution and GHG emissions
PURPOSE: Removal of barriers that inhibit the adoption of energy efficient kilns and molding techniques by the BMI	• Cumulative energy savings from brick kilns by about 683 TJ or 23.3 ktonnes coal by end of project • About 5.5% of the brick kilns (including expected replications) are EEKs by end of project • Average energy cost per unit brick in the BMI is reduced by 2.2% by end of project.	• Documentation of energy savings and GHG emissions reduction from demonstration projects • BERM Program reports • Survey of brick makers	• Monitoring and evaluation activities planned under the project are fully supported and implemented • Government policies encouraging energy efficiency and conservation are rigidly enforced • Reliable data on energy savings EEKs and EIKs are available
OUTCOMES			
Component 1: EEK Technology Support Program Thorough understanding and appreciation of technology options and their environmental impacts by brick makers, government and other stakeholders	• About 4% improvement in the overall specific energy consumption in the BMI by end of project • Two local engineering firms doing business with the BMI each year starting Year 5 • 8 brick making companies (i.e., brick makers) submitting reports to BBMOA/SEDA each year starting Year 5. • 30 feedback reports submitted to brick makers incorporating suggestions for improving energy performance each year starting Year 5. • 250 brick makers planning to develop and implement EEK technology application and EC&EE projects each year starting Year 5. • 250 brick makers implementing EC&EE projects each year starting	• Documentation of energy savings and GHG emissions reduction from demonstration projects • BERM Program reports (brick maker reports and BBMOA/SEDA feedback reports) • Registry of enterprises, which include, among others, data on annual revenues and profits. • Documentation of EC&EE projects influenced by the pilot demonstrations under the IKEBMI project.	• Brick makers are willing and interested in participating and cooperating in the design, development and implementation of the BERM program • Relevant information are made available

Project Strategy	Success Indicators	Means of Gauging Success	Assumptions
	Year 5.		
Component 2: EEK Demonstration Program Establishment of a critical mass of demonstration projects that will provide detailed information of EEK operations, energy savings and environmental impacts to interested brick makers	• 16 demonstration EEK technology application projects established and operational by end of project • 4.0 x 10^{-6} TJ/brick energy consumption for bricks produced in EEKs • At least 50 visitors (researchers, suppliers, other brick makers) visiting the demo project sites each year starting Year 5.	• Documentation of demonstration project operations (including reports on plant visits) • Plant coal usage records and tests for the calorific value of coal used • IKEBMI Project M&E reports	• Demonstration projects are fully financially supported by their host companies • Host demo sites allow visitors to visit and/or study the demo project
Component 3: EEK Technical and Management Capacity Building Program Improved local vocational, technical; and managerial capacity to manage and sustain operations of EEKs and EE practices in Bangladesh	• Over 60 EEKs installed by end of project • 8 certified operators in the BMI each year starting Year 5. • 2 trained local equipment manufacturers producing equipment and/or components for the BMI by end of project • Two trained local engineering firms registered and profitably engaged in the BMI support industry providing technical services by end of project • 16 EC&EE projects developed and proposed by brick makers for funding to the GoB, investors and international donors	• Documentation of EC&EE projects influenced by the pilot demonstrations under the IKEBMI project. • IKEBMI Project M&E reports • Documentation of certified operators by BBMOA/SEDA or the relevant certifying body. • Registry of businesses providing technical services to BMI • Documentation of project proposals prepared and submitted by the brick makers to GoB, investors, international donors, etc.	• BMI SMEs are willing to adopt new business methods to adopt cleaner and energy efficient technologies • Relevant information are made available • Relevant personnel are interested and willing to participate in the training and in applying the knowledge/know-how they learn • GoB, private sector investors, and international donors are willing to provide financial support for specific EC&EE projects in the BMI.
Component 4: Communications and Awareness Program Enhanced awareness of the public and other stakeholders on EEKs, EE molding practices and EEK brick products	• Operational BMI Information Center by end of Year 1 • A fully functioning information exchange services program operated by DoE starting one year after the start of the project. • 50 satisfied clients served by the BMI Information Centre each year starting Year 2 • Brick maker energy performance rating scheme completed and implemented by mid-Year 2	• Documentation of the approved EC&EE awareness-raising program, and the program implementation results and evaluation • BMI awareness surveys indicating positive attitudes towards EEKs • Feedback communications from clients of Information Center • Documentation of the BMI Energy Awards Program • Annual results of the BMI Energy Awards	• Relevant stakeholders and target groups are interested in participating and cooperating in the design, development and implementation of program

Project Strategy	Success Indicators	Means of Gauging Success	Assumptions
	• Ranking of brick makers are considered in the overall business ranking of local SMEs by Year 4.		
Component 5: EEK Finance Support Program Availability of financial and institutional support to encourage SME adoption of energy efficient kilns:	• At least 12 banks/financial institutions offering loan/credit facilities for EC&EE projects for BMI SMEs by end of project • At least 12 successful EC&EE and EEK projects assisted through bank financing each year starting Year 3 • At least 30 business deals between the BMI entities and the bank/financial institutions by the end of the project.	• Survey of bank/finance institutions offering loan/credit facilities for EC&EE projects of BMI SMEs • Documentation of financing agreements • IKEBMI Project M&E reports	• Relevant information about local companies are made available, including data on annual revenues and profits • Full cooperation of survey respondents is ensured.
Component 6: EEK Policy Development and Institutional Support Program Promulgation of and compliance to regulations that encourage adoption of energy efficient kilns:	• New policies and regulations favorable to EC&EE initiatives in the BMI, together with policy support program implementation, developed, completed and implemented by Year 2. • Strategies and regulations on minimizing land degradation from BMI activities are developed and implemented by Year 3. • About 4.3% of brick kilns in Bangladesh are compliant to set emission standards for brick kiln operations by Year 3.	• Documentation of the policies and implementing rules and regulations for EC&EE initiatives in the BMI • Documentation of strategies and regulations on the sustainable use of clay resources • BERM Program reports • IKEBMI Project M&E reports	• Implementing rules and regulations are enforced • Continued GoB support for favorable regulatory regime throughout the project life

SECTION III: Total Budget and Work Plan

Part I: Total Project Work Plan and Budget under GEF Financing

Award ID	00045472
Award Title	PIMS 2837 CC FSP: Improving Kiln Efficiency in the Brick Making Industry
Project ID	00053721
Project Title	PIMS 2837 CC FSP: Improving Kiln Efficiency in the Brick Making Industry
Executing Agency	Sustainable Energy Development Authority/ Clean Energy Alternatives

GEF Outcome/Atlas Activity	Responsible Party	Source of Funds	Atlas Code	ERP/Atlas Budget Description/ Input Amount	Amount (USD) Year 1	Amount (USD) Year 2	Amount (USD) Year 3	Amount (USD) Year 4	Amount (USD) Year 5	Amount (USD) TOTAL
Outcome 1: Thorough understanding and appreciation of technology options and their environmental impacts by brick makers, government and other stakeholders	UNDP	GEF	72100	Sub-contract	45,300	68,050	74,500	15,900	24,500	228,250
			72100	Sub-contract	58,386	47,289	39,688	37,627	14,279	197,269
			74500	Miscellaneous	5,000	5,000	5,000	5,000	5,000	25,000
	Sub-Total				**108,686**	**120,339**	**119,188**	**58,527**	**43,779**	**450,519**
Outcome 2: A critical mass of demonstration projects is established to provide detailed information of EEK operations, EE molding practices, energy savings and environmental impacts to interested stakeholders	UNDP	GEF	72100	Sub-contract	248,782	180,634	200,046	240,400	82100	951,962
			72100	Sub-contract	39,096	39,846	30,852	25,612	20,312	155,718
	Sub-Total				**287,878**	**220,480**	**230,898**	**266,012**	**102,412**	**1,107,680**
Outcome 3: Improved local vocational, technical; and managerial capacity to manage and sustain operations of EEKs	UNDP	GEF	72100	Sub-contract	96,200	42,200	27,850	18,900	57,800	242,950
			72100	Sub-contract	61,722	59,822	61,508	65,572	42,972	291,596
			74500	Miscellaneous	6,000	6,000	6,000	6,000	6,000	30,000
	Sub-Total				**163,922**	**108,022**	**95,358**	**90,472**	**106,772**	**564,546**
Outcome 4: Enhanced awareness of the public and other stakeholders on EEKs, EE molding practices and brick products produced from EEKs	UNDP	GEF	71300	Local Consultant	11,600	8,700	9,300	9,900	10,500	50,000
			71600	Travel	1,000	1,000	1,000	1,000	1,000	5,000
			74500	Miscellaneous	4,600	4,600	2,600	2,600	5,600	20,000
	Sub-Total				**17,200**	**14,300**	**12,900**	**13,500**	**17,100**	**75,000**

Outcome 5: Availability of financial and institutional support to encourage SME adoption of energy efficient kilns	UNDP	GEF	72100	Sub-contract	69,676	73,776	63,804	25,250	23,400	255,906
	Sub-Total				**69,676**	**73,776**	**63,804**	**25,250**	**23,400**	**255,906**
Outcome 6: Promulgation of and compliance to favorable policies and regulations that encourage adoption of EEKs and EE brick making practices and methodologies	UNDP	GEF	72100	Sub-contract	17,126	11,590	21,644	32,916	31,880	115,156
			72100	Sub-contract	9,350				12,490	21,840
			74500	Miscellaneous	5,000	5,000	5,000	5,000	5,000	25,000
	Sub-Total				**31,476**	**16,590**	**26,644**	**37,916**	**49,370**	**161,996**
Outcome 7: Monitoring & Evaluation	UNDP	GEF	71200	International Consultant	0	0	17,600	0	18,300	35,900
			71300	Local Consultant	11,060	12,250	13,450	14,700	15,600	67,060
			71600	Travel/Mission	3,430	3,430	10,030	3,430	10,030	30,350
			74500	Miscellaneous	1,050	1,100	1,300	1,050	1,500	6,000
	Sub-Total				**15,540**	**16,780**	**42,380**	**19,180**	**45,430**	**139,310**
Outcome 8: Project Management	UNDP	GEF	71300	Local Consultant	21,400	23,450	24,400	25,650	27,200	122,100
			71400	Admin Support Personnel	6,600	6,900	7,360	7,640	7,950	36,450
			71600	Travel/Mission	7,850	9,200	9,315	9,450	8,678	44,493
			72200	Equipment & Furniture	12,478	7,890	4,280	3,280	2,072	30,000
			74500	Miscellaneous	2,000	2,500	2,500	2,500	2,500	12,000
	Sub-Total				**50,328**	**49,940**	**47,855**	**48,520**	**48,400**	**245,043**
Grand Total					767,984	659,548	662,310	537,719	372,439	3,000,000

SECTION IV: ADDITIONAL INFORMATION

PART I: Additional Agreements (See attached)

1. GEF Operational Focal Point Letter of Endorsement
Co-Financing Letters

Attached separately

PART II: Stakeholder Involvement Plan

During the PDF-B Exercise, stakeholders were involved in elements of the project design through frequent consultations, and participation in the various project workshops and study tours to China, participation in the Logical Framework Analysis (LFA) workshop, or were consulted through market surveys, interviews, or round table discussions. The following section details the key stakeholders of the full-scale IKEBMI and highlights their roles.

Table 6: Role of Stakeholders in EEK Dissemination

Stakeholder	Role in EEK Dissemination
Clean Energy Alternatives (CEA)	During the conceptual and PDF B stages of IKEBMI, CEA was responsible for identifying XIAN as a technology provider and BUET as technology arbiters and as such, has fostered cooperation between technology groups to setup the demonstration EEK during the PDF B Exercise. CEAs role during the full IKEMBI project will be to conduct different technical and financial studies, promote technology among potential entrepreneurs, mobilizing the financial institutions, establishing the baseline data, preparing the design of demonstration kilns and installation and operation support, preparing technical training manuals, conducting the training etc. within the schedules and budgets set by UNDP management. They will also coordinate project inputs from other co-financers including the private sector and lending institutions.
Xian Institute of Wall Building Materials (XIAN)	XIAN's engineering staffs were responsible for the first constructed and operational HHK in Bangladesh in 2006-7 during the PDF B Phase of the project. XIAN's role on the full project is essential and will involve the demonstration of HHK technology in Bangladesh, providing modifications to suit local conditions, training master trainers in design, construction, operation and maintenance of EEK kilns and brick making technology, preparing and certifying technology transfer, training materials, methodology and assessment methods.
Industrial and Infrastructure Development Finance Company Limited (IIDFCL)	IIDFCL will be the lead financial institutions to the IKEBMI Project. IIDFCL is expected to be the lead financial advisor to BBMOA and the IKEBMI Project on required capacity building measures to qualify for financing EEK projects.
Bangladesh Brick Manufacturers Owners Association (BBMOA)	BBMOAs role is primarily to facilitate and support EEK dissemination efforts by establishing an n information center within BBMOA, to organize seminars and workshops at Division level, coordinate dissemination and capacity building, and support service activities with stakeholders and other donor agencies.
Bangladesh University of Engineering and Technology (BUET)	During the PDF B Phase, BUET provided much of the technology evaluations and collection of baseline emissions data. BUET is expected to be the lead technical agency in the setup and operation of demonstration

Stakeholder	Role in EEK Dissemination
	projects, technical capacity building, and monitoring and evaluation of the demonstration projects. They will also assist other aspects on this project including emissions monitoring, technology studies and facilitation of favorable policies towards EEK adoption.
Department of Environment (DoE)	DoE is expected to play an important role in formulation of emission standards for the brick industry, initiate favorable policy formulation towards the EEK adoption (through industrial emission standards).
Ministry of Environment and Forest (MoEF)	The MoEF role in this project is to provide approvals to draft policies from the DoE, and to disseminate the new regulatory regime
Sustainable Energy Development Authority (SEDA)	SEDA's role will be to promote energy efficient technology in bricking making industries in Bangladesh.
Ministry of Power, Energy and Mineral Resources (MoPEMR)	The role of MoPEMR (Energy Division) will be to provide guidance to IKEBMI on issues related to coal supply security and sustainability to demonstration EEK sites. Coal supply security will be essential for demonstrations in the extremities of Bangladesh (such as Cox's Bazaar) where coal supplies are almost non-existent. MoPEMR have provided overall guidance and approvals for the use of new domestic coal deposits at Boropukuria and Phulbari, mainly for power generation and industrial use including brick making
Private Sector	The role of private sector stakeholders will be to spearhead EEK installations where there is an absence of a business leader who can form effective SME clusters.

The proposed IKEBMI project envisages strong links with other international programs in Bangladesh, in particular cleaner production and SME promotion.

Mechanisms to ensure ongoing stakeholder participation and effectiveness will be designed in detail once project funding is approved, and will include regular stakeholder meetings, a regular project electronic newsletter, feedback surveys, strong project office management, and close involvement by UNDP-Bangladesh and the UNDP-GEF Regional Coordination Unit (Asia-Pacific) based in Bangkok.

PART III: CO_2 Emissions Reduction Estimates

Summary

Brick making (BM) is one of the largest sources of greenhouse gas emissions (GHG) in Bangladesh. Outmoded, inefficient and poorly constructed kilns have contributed to these high levels of kiln emissions. In response to the unabated growth of GHG emissions from the BM industry, the IKEBMI project intends to transform the brick kiln market towards the use of the more energy-efficient Hybrid Hoffman Kiln (HHK) technology that is in use in China. To achieve this objective, the project will create an enabling environment through removal of existing policy, institutional, technical, informational and financial barriers that have inhibited the use of efficient technologies and practices in the past. Adoption of the HHK technology will lead to a decline in the emissions of not only GHGs, but also other pollutants and at the same time markedly improve the profitability of the small to medium enterprises (SMEs) that form the bulk of the industry.

The project will emphasize technical capacity building, including key issues such as land selection, flood proofing, road access, human capital needs, availability of clay, and kiln

installation, including supervision of civil works, construction, management of equipment procurement and delivery, equipment installation, and finally, commissioning and operation of the plants. The project will also emphasize the acquisition of coal supplies, most notably for areas where coal is not presently being supplied in large quantities.

Direct CO_2 Emissions Reductions

The IKEBMI project includes the implementation of demonstrations involving the installation of new energy efficient HHKs in the BM industry in Bangladesh. To ensure wide acceptability of the technology, 16 build, operate and transfer HHK projects will be implemented over 4 years in strategic locations throughout the country. This will create the critical mass necessary to ensure widespread acceptability of the new technology. The following are the important assumptions used in the estimation of the CO_2 emissions reduction from the IKEBMI Project:

1. All kilns (Fixed Chimney Kilns and Bull Trench Kilns) use coal as fuel. Coal is sourced from India. The carbon emission factor for coal in use is the IPCC value for Indian coal. On average, the amount of CO_2 emissions per kiln is estimated as follows:

Calorific Value of Coal	6,400 Kcal/ Kg
Coal consumption per 100,000 bricks	30.00 Tonnes[5]
Brick weight	4.3 Kg[6]
Specific Fuel Consumption	8.0E -6 TJ/ brick
Carbon emission factor for fuel	25.8 tC/ TJ
Carbon to CO_2 conversion factor	3.66
Average annual kiln production	2,000,000 bricks
Tonnes CO_2 per FCK per year	1,518 Tonnes

2. The CO_2 emissions under the GEF alternative scenario, reflects the use of Indian coal in the HHKs. The assumptions used are summarized in the table below. Note that all assumptions are the same as in the BAU calculation since it is assumed that coal will be continued to be imported from India even with the introduction of the new energy efficient brick kiln technology. It is also noted that:
   - HHKs consume 50% less energy compared to FCKs
   - One HHK replaces 7. 5 FCKs, and need only about 25 to 30% of the land required for FCK

Calorific Value of Coal	6,400 Kcal/ Kg
Coal consumption per 100,000 bricks	14.0 Tonnes
Brick weight	4.3 Kg
Specific Fuel Consumption	3.75E -6 TJ/ brick
Carbon emission factor for fuel	25.8 tC/ TJ
Carbon to CO_2 conversion factor	3.66
Average annual kiln production	15,000,000 bricks
Tonnes CO_2 per HHK per year	5,489 Tonnes

NOTE: Most of the coal (80%) is mixed with clay and the direct air contact is very limited. This will further lower the carbon emissions. In absence of data, no credits were considered to arrive at a more conservative estimate of CO_2 emissions reduction.

[5] Coal consumption is for HHK-sized bricks. Coal consumption for "bangla-sized" bricks is 24 tonnes
[6] This is brick weight for HHK-sized bricks. Actual weight of "bangla" bricks is 3.5 kg.

3. During the five-year period of 2009 through 2014, a total of 16 HHK conversion projects are anticipated. Based on an implementation rate of 5 sites per year, the total potential CO_2 reductions that would be achieved during the 5-year project period is 375,850 tonnes.

Cumulative CO_2 Direct Project Emission Savings during IKEBMI (ktonnes)

Year	New HHKs	Cumulative number	Equivalent FCK replaced	Number of bricks produced	Baseline CO_2 emissions	Project CO_2 emissions	Emission reductions
2009	8	4.08	60	61,250,000	6,733	6,710	23
2010	6	11.50	105	172,000,000	7,088	7,021	67
2011	0	16.00	105	240,000,000	7,463	7,369	94
2012	0	16	105	240,000,000	7,858	7,764	94
2013	0	16	105	240,000,000	8,272	8,178	94

Assuming that the emission reductions achieved during the fifth year are sustained each year for the following 10-year period, the additional reductions achieved would equal 943,300 tonnes. For the full 15-year period, the total would be 1,319,000 tonnes of CO_2 reduced.

Indirect CO_2 Reductions

IKEBMI will create the enabling environment that will facilitate the widespread practice of EC&EE and application of EEKs (particularly HHKs) in the BMI in Bangladesh. The primary targets of the project are all the brick makers that will benefit from the expected energy savings from the HHK applications, as well as the envisioned BMI support industry. Capacity development activities that will be conducted under the project are expected to influence the relevant stakeholder entities in the promotion, support, design and installation, financing, operation and maintenance of HHKs.

The project will also involve interventions that will bring about the necessary institutional, regulatory and financial policies and mechanisms that would enhance the promotion of HHK applications and EC&EE practices.

From the perspective of additional market penetration of the HHK technology, it is expected that full adoption of such technology (with similar operating characteristics and similar efficiencies as those applied in the demonstration projects) will be realized in 45 districts in Bangladesh. In that regard, the CO_2 emission quantities would also more or less similar as those in the demonstration projects. In the remaining 20 districts, categorized as "remote", the HHK technology may not be implemented due to poor access to resources.

On average, the life of FCK is 8 to 10 years. Including assumptions about FCK replacement by HHK, the resulting penetration of HHK in the brick-making sector after 10 years is 80%. The resulting CO_2 emission reductions are shown in the table below.

ANNUAL CO_2 EMISSIONS AVOIDANCE (MTONNES): 2009 - 2019
(DEMONSTRATIONS & REPLICATIONS)

Year	Total nos. Kilns	Nos. of FCK	Total Nos. Demo HHKs	Total Nos. Replic HHKs	Cumul Nos. FCK Kilns	CO_2 Emission (million tonnes)			
						Emissions without intervention	Emissions with intervention	Annual Emission Reductions	Cumulative Emission Reductions
2008	4214	4214	2	0	4213	6.396	6.395	0.001	0.001
2009	4436	4436	10	0	4405	6.733	6.710	0.023	0.024
2010	4670	4670	16	0	4584	7.088	7.031	0.057	0.081
2011	4917	4917	16	0	4797	7.463	7.382	0.081	0.162
2012	5177	5177	16	0	5057	7.858	7.777	0.081	0.243
2013	5450	5450	16	16	5255	8.272	8.119	0.153	0.396
2014	5738	5738	16	20	5468	8.709	8.497	0.212	0.608
2015	6041	6041	16	30	5696	9.169	8.898	0.271	0.879
2016	6041	6041	16	40	5621	9.169	8.839	0.330	1.209
2017	6041	6041	16	50	5546	9.169	8.780	0.389	1.598
2018	6041	6041	16	60	5471	9.169	8.721	0.448	2.046
2019	6041	6041	16	70	5396	9.169	8.662	0.507	2.553
Totals						***135.045***	***126.091***	***2,553***	

Considering the significant barrier removal work that will be done under IKEBMI, it is deemed that the GEF influence in achieving the abovementioned CO_2 emission reductions during the influence period, which in this case is until 2019, is considered higher relative to that during the project period (i.e. 2009-2014). In that regard, most of the indirect CO_2 reduction can be attributed partly to the interventions that will carried out during the IKEBMI such as the establishment and enforcement of enabling policies and financing mechanisms, BMI support industry enhancement, and the successful demonstration programs. In this case, indirect emissions reductions will be "bottom-up" and "top-down". The GEF bottom up replication factor (RF) can be assumed to be 1.0. This is lower than RFs recommended by GEF; there is recognition that HHKs will be replicated to the extent that the brick industry adopts this technology (as opposed to other technologies) and availability of capital financing for HHK projects. The GEF Causality Factor (CF) of 0.4 ("modest") was assumed in that there may be some policy development by the GoB that will force the brick industry to become cleaner though not necessarily through the adoption of HHKs, and notwithstanding historical precedents in attempts to introduce force new brick technologies in Bangladesh. The first attempts to introduce new technologies in brick making in Bangladesh were made in the mid 1990s when "forced draft zig-zag" and VSBK technologies were introduced with technical expertise from India. In the last 10 years, only 198 zig-zag kilns and one VSBK, constituting 2% of existing kilns were built and commissioned. This translates to a 5% penetration rate spread over a 10-year period and therefore can be considered negligible. While it is true that FCKs were widely adopted within a 12-month period, these were practically cosmetic modifications of Bull Trench Kilns (BTKs) that did not involve real technological changes. They neither changed the way in which bricks are made nor did they have any impact on emissions mitigation or on markets.

Based on these experiences, without a holistic approach encompassing training, availability of commercial financing and technology providers, adapters and champions, the possibility of widespread adoption of EEK technologies would be negligible. Since the proposed IKEBMI project aims to remove the barriers to such holistic approach in transforming the brick manufacturing industry (BMI) in the country, and the fact that brick makers in the country are willing to convert their operations to energy efficient and more productive options, it is expected

that the estimated overall potential kiln conversions and corresponding CO_2 emission reductions can be realized during the subsequent years after the project. The enabling environment (e.g., supportive regulatory regimes, enhanced environmental quality awareness fiscal and/or financial incentives, increased capacity, etc.) that the project will endeavor to establish through the barrier removal interventions (and the anticipated increase in demand for better quality bricks) is expected to influence the brick makers to apply energy efficient kilns (EEKs) in their operations. Hence, for the influence period, which in this case is 5 years after the project, the assumption of a GEF RF of 1.0 and a causality factor of 0.4 for estimating the indirect CO_2 emissions reduction is deemed valid.

Total CO_2 Emissions Reduction

Table 23: Total CO_2 Emissions Reduction Attributed to IKEBMI

Particulars	Quantity, Mtonnes	Remarks
Direct CO_2	1.319	From the 16 demo HHK installations during IKEMBI
Indirect CO_2	0.527 (bottom-up) 1.319 (top-down)	From replication projects (during 10 years after IKEMBI); GEF Replication Factor = 1.0 GEF Causality Factor = 0.4
Total	1.846 – 2.638	

Total CO_2 reduction = Direct CO_2 + Direct post-project CO_2 + [Indirect CO_2 * GEF Causality Factor]

Total CO_2 Reduction = 1.319 + 0.527 = 1.846 million tonnes (low-end)
= 1.319 + 1.319 = 2.638 million tonnes (high-end)

Part IV: Project Risks and Assumptions

While all possible efforts have been made to ensure the effective design and implementation of the project activities in the project design phase, there are inevitably some unavoidable residual risks that will have to be carefully monitored and managed during the project to ensure its success. The different risks that were identified during the project formulation and the recommended mitigation measures and a commentary on the need for mitigation measures are summarized as follows:

Risk	Commentary and Mitigating Actions
Insufficient Government Support – Delays maybe experienced in the promulgation of favorable government policies towards diffusion of EEKs. Although energy conservation and security programs have a high priority, many of these agencies have insufficient human resources, capacity, and infrastructure and focus leading to an outcome of long gestation periods for drafting new regulations and policies. .	The GoB has recently acknowledged the importance of sustainable energy and developing indigenous sources of energy. The "Sustainable Energy Development Authority" has been recently approved within the Ministry of Power Energy and Mineral Resources as a dedicated unit to create an enabling environment to promote renewable energy, energy efficiency and energy conservation. Mitigating actions in response to insufficient government support would include: ➢ focus on high level project co-ordination and support from relevant Ministries and agencies;

Risk	Commentary and Mitigating Actions
	➢ clear establishment and regular follow-up of project commitments; ➢ close tracking of progress through Project Board and other higher level meetings; ➢ assigning adequate project staff; ➢ use of champions and strong coordination in the government, NGO and private sector to ensure implementation of practical measures; ➢ detailed plans to monitor progress of regulatory development at the inception phase and early stages of the project.
Level of Risk: LOW to MODERATE	
Low Adoption of EEKs and EE practices – This may be due to failure of SMEs to form clusters, and the absence of larger entrepreneurs to lead and manage an SME cluster. This may be due to: ➢ lack of comprehension of SME clusters in the context of EEK operations; ➢ mistrust of other SME partners; ➢ unwillingness of SMEs to disrupt operations for implementation of energy efficient practices for making bricks; ➢ inability of SMEs to grasp new business skills; and ➢ unwillingness of banks to advance funds to certain SMEs.	Operations of EEKs in China indicate that higher quality bricks will be produced in Bangladesh at a significantly lower cost. As such, SMEs who choose not to participate on the EEK program and continue operation of energy inefficient kilns may risk the inability to compete with bricks from EEKs. Mitigating actions in response to low adoption of EEKs and EE practices would include: ➢ full involvement of all SMEs in all aspects of project planning; ➢ capacity building for pool of industry advisors on full range of services to install an EEK; ➢ fostering and maintaining effective working relationships with stakeholders throughout inception and implementation phases; ➢ strong emphasis on communications to stakeholders on increased profitability, environmental benefits and improved market conditions of an EEK operation; ➢ effective assistance to SMEs on improving business practices to the extent they can secure bank loans; ➢ involvement of community business leaders to facilitate SME clustering with all those currently involved with energy inefficient brick making practices.
Level of Risk: MODERATE	
Technology Risk – Failure of EEKs to deliver measurable energy cost savings as claimed for demonstration projects will result stakeholder negativity and doubts on its economic and financial viability. This failure can be due to several factors including: ➢ absence of adequate quality control on EEK construction and equipment commissioning; ➢ failure of an EEK operation to successfully troubleshoot problems; ➢ disruption of coal supply; ➢ technical support services for EEK equipment are not available.	Mitigating actions include: ➢ project resources sufficient to ensure proper management and quality control over kiln construction and equipment installations; ➢ effective capacity building activities to ensure technical support pool understand the importance of quality control during EEK installations; ➢ strong emphasis on independent third party credible monitoring and evaluation in demonstration projects; ➢ sufficient capacity built to form a technical support pool that will provide good service to entire BMI and ensure sustainability; ➢ project efforts to understand and secure coal supplies to demonstration sites.
Level of Risk: LOW	

Risk	Commentary and Mitigating Actions
Financial Risk – Failure of financial institutions to provide financing to SMEs for EEKs and EE practices will result in market transformation formation away from current energy inefficient practices. Failure of financial institutions to provide financing may be due to: ➢ their failure to adequately address risks to SME borrowers; ➢ lack of agreement between banks and SMEs on financing mechanisms ➢ difficulties of banks to enforce contracts and manage risks; ➢ inability to find entrepreneurs that can properly manage an EEK operation and provide timely debt servicing	Mitigating actions include: ➢ assisting SMEs to disclose reliable information to banks to adequately address risks ➢ collaboratively developing financial mechanisms closely with SMEs and financial institutions; ➢ ensuring capacity building for business management is effective and rigidly followed; ➢ training appropriate entrepreneurial candidates on business management skills through capacity building from local banks with assistance from a local training institute.
Level of Risk: LOW to MODERATE	
Market/Economic External Risks – This would include: ➢ Downturn in demand for bricks; ➢ Changes in domestic coal prices that would jeopardize financial sustainability; ➢ Low availability of capital increasing the cost of EEK installation; ➢ Political instability.	The general market for bricks fluctuates varies from oversupply to the ability to meet market demand. The financial model for an EEK operation indicates the investment is not overly sensitive to changes in fuel (coal) prices and shutdowns resulting from a disruption to coal supplies. Local availability of capital has not been a problem yet although reserve levels vary notably when natural disasters occur (i.e. flooding and cyclones. Political instability likely will impact coal supply lines in certain areas.
Level of Risk: LOW to MODERATE	

OVERALL LEVEL of RISK

The overall project risk is low to moderate. IKEBMI is carefully designed to continue to facilitate close coordination and consultation of the relevant stakeholders in each of the proposed activities. Project activities will enhance local technical capacity to improve understanding and implementation of all aspects of EEK financing, installation and operations; build effective awareness programs targeted to optimize technology diffusion; build the confidence of financing institutions to reduce risks of loans to SMEs; and develop policies and regulations to reduce the regulatory efforts of installing an EEK; and therefore in combination, are sufficient to ensure mitigation of the risks.

There are several entrepreneurs in Bangladesh who have expressed strong interest in EEK installations and operations. As such, there have been several banks and entrepreneurs who have pledged to implement one of these EEK installations.

Part V: Energy Efficient Kiln Technologies for the Brick Industry

This study examines various brick making technologies that have been studied and tested in Bangladesh, one of which, is a promising technology know as the Hybrid Hoffman Kiln (HHK).

1. Introduction

The manufacture of bricks is an energy intensive activity. All developed countries and some developing ones have shifted away from traditional low efficiency manufacturing processes to modern high efficiency ones. Several countries in Asia still remain locked in the traditional brick

manufacturing processes. The transition from traditional brick making kilns to modern ones poses some interesting challenges for the governments of the developing countries. The kilns used in many Asian countries including Bangladesh are extremely crude, and as a result, are energy inefficient and polluting. A recent study [AIT, 2002a] has shown that the specific thermal energy consumption varies from 1.3 to 9 MJ/kg of brick depending on the type of technology and fuel used in firing; the higher values are for the kilns in Vietnam, while Chinese and Indian kilns have lower specific energy consumption. The study further states that Vietnam's high energy consumption is due to the use of biomass like wood and rice husk in the kilns, which are inefficient (the factories in the northern Vietnam however use coal and have relatively higher energy efficiency), and is due to the use of traditional intermittent types of kilns. This study highlights that brick making in many developing countries of Asia is clearly unsustainable, and there exists an urgent need to find a solution, but as will be shown in this paper that is proving to be elusive.

Brick manufacturing is one of the significant energy consuming activities in Bangladesh. Cottage-type brick making units called Fixed Chimney Kilns (FCK) dominate the industry. These units employ an extremely crude technology and use low-grade coal to fire bricks. The pollution from FCKs, predominantly in the form of particulates, is increasing every year. The problem is compounded by the fact that these FCKs operate in the dry season when the dust pollution problem all over the country is at its peak. A few years back urban air pollution and pollution from brickfields were the leading pollution concerns in the country. Last year some significant measures adopted by the Government have dramatically improved urban air pollution thus making pollution from brick kilns the number one environmental concern in the county. In the most drastic measure ever adopted, the regulatory authority has banned the operation of Bull's Trench Kilns (BTK) from 2004, but the next best option (FCK) differs from the BTK only in terms of the chimney and alleviates the problem marginally. In India, the FCKs have a gravity settling chamber in addition to the tall stack and controlled coal feeding is practiced. These two measures are able to lower pollution below the emission standards set by the Government.

Starting in the early nineties several efforts to disseminate cleaner brick burning technologies in Bangladesh have failed [Norsker, 1992; Norsker, 1994]. The air pollution issue is often reported in newspapers and civil society maintains a constant campaign against polluting brick kilns. The predominant reason why nothing much is happening is that no one is able to offer a solution, which addresses all the issues. The problem with the Brick industry can be found in all South-Asian and several Southeast Asian countries including China. In a recently concluded study [AIT, 2002A; AIT, 2002B; AIT, 2002C], the problems related to Brick manufacturing using the BTK/FCK and other polluting and inefficient technologies have been studied, but curiously no solution to the problem is offered. Like Bangladesh, India is also grappling with the problems from polluting and inefficient brick kilns. Several research institutions have studied the problem, but few solutions of practical significance have emerged. A less polluting and more energy efficient technology, known as vertical shaft brick kiln (VSBK) popular in China, despite several attempts have not been successfully implemented in India – only about two dozen kilns are in operation in India. Well known energy research institutes like The Energy and Resources Institute (TERI) and Development Alternatives (DA) both of New Delhi, India have been trying to popularize VSBKs [Maithel et al., 2003] but with limited success. The repeated failures of efficient brick making technology dissemination programs in Asian countries bring out some important issues regarding technology diffusion. Parallels can be found with improved biomass cook stoves dissemination programs. Despite acute biomass shortage and the need to expend a great deal of labor to collect biomass fuels, people in Bangladesh have not adopted the improved biomass cook stove, which has well-known efficiency improvements. An analysis of the Brick industry reveals similar difficulties in making a transition. In Bangladesh, the Government is contemplating tightening the Brick Burning regulation.

2. Brick Manufacturing Industry in Bangladesh

In Bangladesh, brick is the predominant building material in urban areas. It has become a significant building material even in the rural areas. High prices and/or scarcity of alternate building material such as, stones, iron sheets, wood, bamboo, and straw are increasing the demand for bricks at a very high rate. To meet the increasing demand, brickfields are mushrooming all over the country with heavy concentrations at the outskirts of urban areas. With increasing demand for bricks, more and more paddy fields are being converted to brickfields thus putting tremendous pressure on the already scarce agricultural land of the country. The haphazard growth of the brick industry is completely unsustainable. There is an urgent need for making it more efficient both in terms of fuel and land usage.

Table 1 lists the four brick making technologies being used in Bangladesh along with the share of the market for each technology. The description of these technologies is presented in the next section. The totals shown in Table 1 for both kilns and bricks are approximate figures and are industry estimates [Faisal, 2001]. As can be seen of the total 9 billion bricks produced in the country, approximately 8 billion of those have been produced in FCKs. The other three technologies are responsible for 12% of the bricks.

Table 1: Market Share of the Coal-Fired Kilns Being Used in Bangladesh

Kiln Type	Number	Percentage of Total	Annual Brick Production (billions)	Percent of Total Production
FCK	3,138	76	6,276	75.9
BTK	797	19	1.59	19.3
Zigzag	198	5	0.40	4.79
Total	***4,133***	***100***	***8.27***	***100***

Brick kilns have been known to use all kinds of combustible materials including tires as fuel, but the predominant fuel is coal and firewood with some furnace oil to start and rejuvenate the flame. Even though natural gas is available, FCKs do not want to take connection because the gas utility insists on a year round demand charge, whereas FCKs are seasonal operations lasting a maximum of five months. The gas utility company disconnects gas supply to brickfields whenever it faces a supply shortage. Also the utility company charges brickfields at the commercial rate, which is much higher than the industrial rate.

Brickfields are usually located around the major urban areas to cater to their need. Bricks being a bulky commodity, the most important factor behind the location of brickfields are the ease of transportation. Not only do bricks have to be transported, but also bulky raw material like clay and bulky fuel like coal have to be procured. Major concentrations of brickfields are observed around large urban areas of Dhaka, Chittagong, Comilla, Feni, Jaipurhat, Bogra, Khulna and Satkhira. However, brickfields are scattered all over the country.

3. Brick Manufacturing Technologies in Bangladesh

3.1. Bull's Trench Kiln (BTK)

The Bull's Trench Kiln (BTK) is essentially an elliptical shaped dug out area in an open field. The kiln is about 250 ft long and 57 ft wide and has two 32 ft high moveable chimneys. The

bottom and the sidewalls of the kiln are lined with bricks with the top left open. Figure 1 shows a sketch of a BTK. Sun dried bricks are stacked in the kiln in an orderly fashion leaving enough room for fuel stoking and air circulation. After arranging the bricks in the kiln, the top of the kiln is covered with fired bricks and pebbles. The bricks are fired from the top and the fire moves forward towards the chimney. The air entrance opening (air hole) and the chimney are located at the two ends in such a way that combustion air is preheated by taking heat from the fired bricks, and the green bricks to be fired are preheated by the flue gas on its way out of the chimney. The bricks are fired all around the kiln, which means that the chimney and the air hole must be progressively moved forward, until all bricks in the trench are fired. The chimneys are made of iron sheets and during a typical season of five months these need to be replaced two to three times because the corrosive flue gases eat away the chimneys very fast. Rain and floodwater destroy the kiln every year because of which BTKs need to be constructed almost from scratch every year.

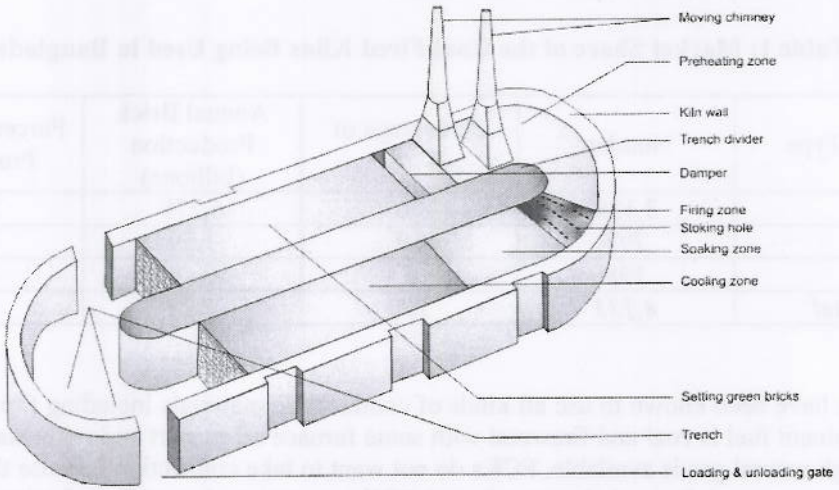


Figure 1: Bull's Trench Kiln (BTK)

3.2. Fixed Chimney Kiln (FCK)

Figure 2 shows a sketch of the Fixed Chimney Kiln. The chimney in a FCK as the name suggests is fixed and is approximately 130 ft high. This tall chimney creates a stronger draft thereby improving the combustion process, and releases the flue gas at a height 130 feet above the ground thus providing faster and better dispersion. The kiln has underground piping to divert the flue gas from anywhere in the kiln to the fixed chimney. The length of the kiln is same as that of the BTK but its width is greater to accommodate the underground piping. The FCK also has better insulation in the sidewalls, which reduces heat loss to the surroundings. The cost of constructing the chimney is Taka 1,200,000 (US$ 20,700), which is nearly 50% of the total cost of a FCK.

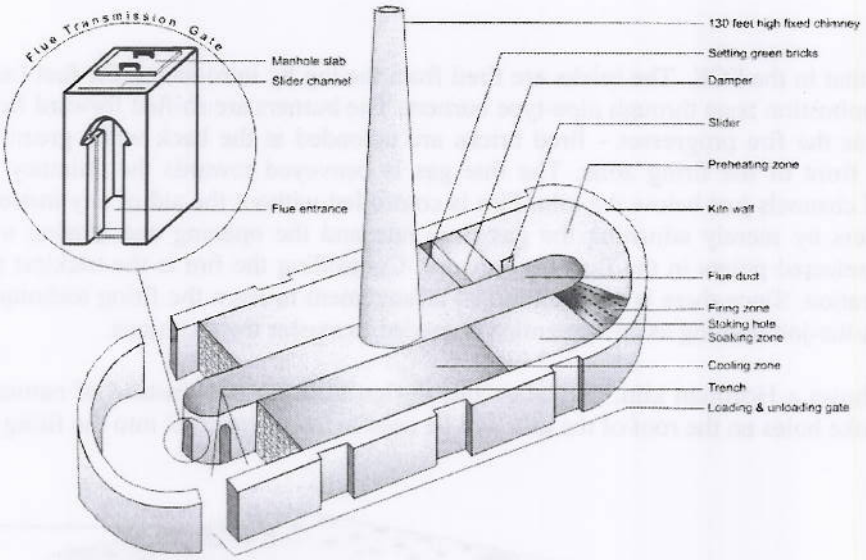


Figure 2: Fixed Chimney Kiln

3.3. Hebla or Zigzag Kiln

The Hebla or Zigzag Kiln is rectangular in shape and measures 250 ft by 80 ft. It has a 55 ft high fixed chimney located on one side of the kiln. At the bottom of the chimney there is a blower, which draws the flue gas from the kiln and discharges it to the atmosphere. The kiln is divided into 44 to 52 chambers, which are separated from each other in such a way that the hot gases move in a zigzag path through the kiln. The Zigzag Kiln is reported to be 10-15% more fuel-efficient than the FCK. This Kiln is expensive to construct and costs approximately the same as a FCK. There are about 30 such kilns in operation mainly in the Comilla region. Present FCK owners are keen to convert to the Zigzag technology if the Department approves it as an acceptable technology. The construction technology is not easily available and expertise has to be procured from the neighboring states of India.

3.4. Hoffman Kiln

A Hoffman Kiln is rectangular in shape and measures 300-400 ft by 60 ft. Its construction and operation is very similar to the FCK. The predominant difference between the Hoffman Kiln and the three kilns described above is the fixed roof, which enables bricks to be fired throughout the year although during the rainy season, which is called off-season, the production decreases significantly because of frequent rain, high humidity and greatly reduced availability of sunlight. Some manufacturers overproduce green bricks during the dry season and store them for the rainy season but to do that adequate storage facility must be made available. Also for off-season production clay has to be stored, as harvesting of clay becomes impossible due to widespread floods during the rainy season.

The inside roof of the kiln is arched and has a firebrick lining on the inside surface. The thick walls of the kiln and good insulation minimize heat loss to the surrounding. The chimney is 76 ft high with a blower at the bottom. Green bricks are stacked in the kiln in more or less the same

fashion as that in the FCK. The bricks are fired from the top by introducing the fuel (natural gas) into the combustion zone through pipe-type burners. The burners are shifted forward from section to section as the fire progresses - fired bricks are unloaded at the back while green bricks are stacked in front of the firing zone. The flue gas is conveyed towards the chimney through a network of channels just below the kiln. Fire is controlled without the aid of any instrumentation or controllers by merely adjusting the gas flow rate and the opening and closing of dampers located at selected points in the flue gas network. Controlling the fire is the trickiest part of the whole operation. Since there is no institutional arrangement to learn the firing technique, several years of on-the-job training as an apprentice is needed to master the technique.

Figure 3 shows a Hoffman kiln. To adapt this design to using coal instead of natural gas as a fuel, the stoke holes on the roof of the kiln will be used to insert coal fuel into the firing chamber.

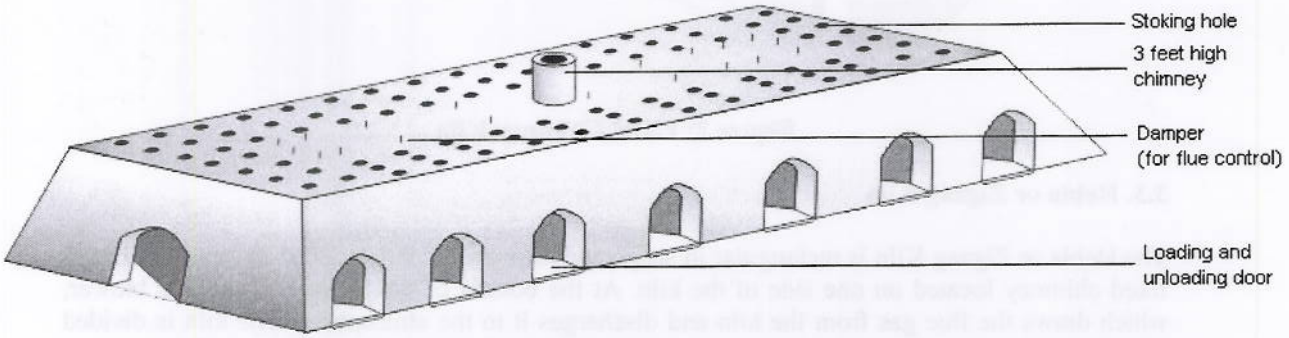


Figure 3: Hoffman Kiln

3.5. Vertical Shaft Brick Kiln (VSBK)

The Vertical Shaft Brick Kiln (VSBK) was first developed in China [Norsker, 1992; Norsker, 1994]. The VSBK is fuel-efficient consuming 20 to 30% less fuel in comparison to the BTK and FCK. In addition, the kiln is simple to construct and operate, making it ideal for rural areas. The VSBK requires 1 acre of land compared to 3 acres for the FCK. The VSBK has been tested and proven to be successful in China. In India and Nepal it has enjoyed limited success. There was one effort to construct a VSBK in Bangladesh, but that was unsuccessful due to the lack of adequate technical and financial support, and poor brick quality considering the incremental investment. In a VSBK, bricks are stacked in a shaft measuring $1 \times 1 m^2$ up to a height of 6.0 m. Green bricks are loaded from the top in batches of 224 bricks arranged in four layers. At the bottom, bricks are taken out using a special unloading device. On the average one batch of 224 bricks is unloaded every 1.5 hours. The firing occurs around the middle of the shaft. The kiln uses pulverized coal, which is loaded from the top along with the green bricks. The combustion air enters at the bottom of the shaft and moves up through the bricks already fired. The combustion air gets preheated to about 750°C by taking up heat from the fired bricks. After combustion the hot flue gases move up through the unfired bricks and in the process preheat the bricks to be fired. The VSBK is a permanent structure and can produce bricks throughout the year. It has a life of 8 to 10 years with minimum maintenance. One VSBK can have multiple shafts and can be very economical in utilizing space. A VSBK with six shafts can have the same capacity as that of a FCK but needs only 13% of the space of a FCK [Kumar et al., 1998].

4. Comparison of Various Types of Kilns

This section compares the four types of kilns being used in Bangladesh and two alternatives (the VSBK and HHK) being considered as energy efficient alternatives in Bangladesh. The characteristics of the four kilns and the VSBK (where relevant) are discussed under four headings, namely, (i) Investment and Working Capital; (ii) Fuel and Land usage; (iii); Pollution and (iv) Profitability.

4.1. Investments and Working Capital

Brick manufacturing season begins in November and ends in March, before the start of the rainy season. Brick kilns are invariably constructed on low-lying land, and every year during monsoon, the kiln gets extensively damaged by the floodwaters and needs rebuilding. The extent of rebuilding varies with the type of kilns, with the BTK requiring near total rebuilding. The FCK suffers some damage but the expensive tall fixed chimney is built to withstand flooding. The BTK, FCK and the Zigzag Kiln all have approximately the same production capacity of 2 to 2.5 million bricks per season, but in terms of initial investment, a BTK is the cheapest requiring Taka 2.5 million compared to Taka 4 million for a FCK or a Zigzag Kiln. However, as explained earlier because of the yearly rebuilding requirement of the BTK and the fuel savings of the FCK and Zigzag Kiln, on a life cycle costing basis, the cost of bricks is nearly the same for the three types of kilns. The Hoffman Kiln, which has a capacity of 7.5 to 9 million bricks, is clearly the most expensive requiring an initial investment of at least Taka 30 million. These kilns can operate throughout the year, and the useful life, with proper annual maintenance, is at least 10 years. It must however be noted that the price of land, which does not depreciate but rather appreciates, is nearly 50% of the total initial cost. Building a Hoffman Kiln requires special expertise and thus involves engaging engineering consultants. Working capital requirement for a BTK, FCK and Zigzag Kiln is approximately Taka 1 million but for a Hoffman Kiln it can go up to Taka 7.5 million because of higher inventory, maintenance and overhead costs. An HHK investment will reach Taka 22 million but will produce a higher number of bricks.

4.2. Land and Fuel Usage

Land requirement for a BTK, FCK or a Zigzag Kiln is about 2.5 acres whereas that for a Hoffman Kiln is about 10 acres predominantly because of the latter's greater production capacity. It must however be made clear that the major portion of the land requirement is for forming and drying. Bricks are formed manually and sun dried in a large open area four to five times the area occupied by the kiln. If only the kiln portion is compared then the land requirement for the Hoffman Kiln is less than half, and that for the VSBK, which is the most economical, is less than one-third of the FCK on a per brick basis.

The land requirement issue is an important one for a land scarce country of 130 million. Most brickfields are constructed in land that would otherwise be used for rice cultivation, but because the returns for land owners is much greater if leased out for brick making, the temptation for a poverty stricken agricultural community is too great to resist. This is causing serious concern because the increasing demand for bricks is causing the mushrooming of brickfields all over the country. An additional problem with brick making is that often the clay for bricks is taken from adjoining fields causing further loss of agricultural land. The temptation to sell off a few inches of topsoil is too great to resist.

The BT, FC and Zigzag Kilns all use coal. The annual coal consumption for brick burning is in excess of 1 million tonnes. The national statistics [BBS, 2002] however shows annual

consumption of only 0.5 million tonnes because more than half of the coal is smuggled into the country to avoid paying Government taxes and duties. As can be seen from Table 2, the BTK is the least efficient requiring at least 15 to 20% more coal. Fuel cost contributes significantly to the cost of production of bricks and varies between 38% and 50% [Priya, 1995; Quader and Mahmud, 1979] of the total cost of bricks produced in BTKs and FCKs. Energy efficiency in BTKs and FCKs is very low and falls in the range of 15 to 25%. Fuel efficiency can be greatly improved by improved chimney design and proper training of the firemen [Priya, 1995]. Hoffman Kilns use natural gas as fuel and the consumption rate is 15000-17000 m^3 per 100,000 bricks. On an energy basis, the Hoffman Kiln is as efficient as the FC and Zigzag Kilns.

4.3. Pollution

The BT, FC and Zigzag Kilns operating in Bangladesh often use very low grade, high sulfur coals imported from India. The burning process in these kilns is not very efficient and depends on the expertise of the firemen in charge. Exhausts from these kilns contain fly ash, carbon particles and high concentrations of CO and SO_x. These pollutants are reported to cause severe environmental damage in the surrounding areas of brickfields. The severe pollution level is readily discernable from the thick black plume emanating from the chimneys and the dismal state of the vegetation in the vicinity of the kilns.

The thick black smoke that everyone associates with BTKs and FCKs is emitted during coal charging. After the completion of coal feeding, the flue gas color changes from grayish black to milky white and remains white until the next coal charging. It is therefore abundantly clear that the pollutants that everyone notices are fly ash and carbon particles. The existence of unburnt carbon particles in the flue gas is due to the fact that during coal feeding the firing zone does not get enough air to complete the combustion of these particles. The inadequate amount of combustion air in the kiln is due to the fact that the BTK unlike the Zigzag and Hoffman Kiln works on natural draft. The FCK by virtue of the tall chimney has a much stronger draft than the BTK. The fine coal particles being very light are rapidly transported away from the combustion zone, and once that happens there remains no possibility of these particles burning out in the colder sections of the kiln. The larger coal particles get deposited on the stacked bricks and slowly burn out leaving the ash on the brick surfaces. It might well be possible to burn out the fine coal particles during coal feeding by injecting air into the combustion zone, and a scrubber can easily remove the fly ash and SO_x. It is worthwhile to point out here that one model of the Zigzag Kiln does employ a scrubber - the flue gas is drawn into an underground water reservoir and scrubbed before being released into the atmosphere. However, its performance is strongly dependent on regular changing of the scrubbing water. It is reported that brick makers often do not bother to do that, and as a result, the pollution is only marginally abated.

The Hoffman Kiln being natural gas fired is infinitely superior to the three coal burning kilns in terms of pollution. The BTK is not only more polluting because of more coal consumption on a per brick basis, but also its combustion process and dispersion is highly inefficient and ineffective. The FCK because of the tall chimney is able firstly to create a greater draft thus ensuring better combustion, and secondly to disperse the pollutants in a much larger area.

In a Zigzag Kiln, the flue gas moves in a zigzag path and most of the coarse particles are retained in the kiln preventing them from being discharged into the atmosphere. The combustion process is superior to both the BTK and the FCK because it employs a blower to create the draft.

4.4. Profitability

The selling price of bricks has increased tremendously in recent years and is now Tk 3.5 per brick for the three coal burning kilns and Tk 4 for the Hoffman Kiln. The sharp rise is due to the large increase in the coal price, which varies between Taka 4200 and 4500. The Hoffman bricks command a better price because of their superior quality. The labor and non-fuel raw material cost are the same for all the four kiln types and is approximately Taka 0.75 per brick. Coal cost varies between Taka 1.25 and Taka 1.5; lower figure is for the FC and Zigzag Kilns. The natural gas cost per brick is approximately Taka 0.75 per brick for the Hoffman Kiln. It is difficult to compare profitability of the BTK and FCK with the Hoffman Kiln in a straightforward manner because the life of a BT Kiln is only 6 months, whereas, with proper maintenance, a Hoffman Kiln can be operated for at least 10 years. The analysis is further complicated by the fact that after ten years only the kiln, whose cost is less than 40% of the total cost of the project, is depreciated. In the usual case, a BTK or FCK continues to operate in the same location for several years, but this is not always the case. The landowner may decide after some time to discontinue leasing his land. However, a lease for five years is common and is particularly true for the FC and Zigzag Kilns because substantial investment remains not depreciated in the first couple of years. Both the FC and Zigzag Kilns are relatively new in the country and profitability information is sketchy, but because of the substantial initial investment requirement, the FC and Zigzag Kilns must operate for at least five years to recover all investment and make profit.

From the initial investment requirement for the four kilns shown in Table 2, it should be clear that the profitability of the BTK would be the highest. If the season is good (long dry winter starting in early November and continuing well into April) a BTK investor is assured of a 100% return on his investment. The FC and Zigzag Kilns compared to the BTK will naturally have lower returns because of the significantly higher initial investment, but the returns are not much lower because of the fuel savings. Compared to these, the Hoffman Kiln, being a proper industry has a return of only 20 to 25%.

5. A Cleaner Alternative: The Hybrid Hoffman Kiln

A feasibility study has been undertaken to develop a model brick-making factory to manufacture high quality, technically sound and marketable solid bricks. The study is based on actual experience in China with necessary modifications for adaptation in Bangladesh.

This section presents the salient details of the demonstration HHK kiln to be built in Bangladesh. The project design combines a highly efficient kiln technology, the Hybrid Hoffman Kiln (HHK) with a unique technique of forming green bricks: granulated coal is injected for internal combustion. This approach results in lower energy usage, higher quality bricks and reduced pollution. Bricks of any size, shape and pigmentation can be produced at the plant with minor modifications. All bricks will be of uniform quality and will meet international standards for strength, quality and appearance. Figure 3 illustrates the Hoffman kiln which can be adapted to use coal as a fuel.

The proposed plant will produce 22 million bricks of size 250mmx 120mm x 60mm annually. The main features are as follows: 80% intestine combustion, raw material preparation with roller mill, shaping with vacuum extruder, tunnel drying and firing with annular kiln. Annual working days have been assumed to be of 300 days. Raw material preparation will be conducted each day in 2 shifts of 7.5 hours. Drying and firing in 3 shifts each of 8 hours.

The project has been designed by the Xian Research and Design Institute of Wall & Roof Materials. The Institute is an agency of the Central Government in China and acts as a regulatory

body. It sets standards and codes for brick making and as its name suggests it is also a research organization. The Institute will be the technical supervisor to the project and will oversee the construction of the project, commission the plant, supervise its operation for about six months and train Bangladeshi's in the technology.

In Bangladesh, brick making is primarily a seasonal operation using technologies and techniques that can best be described as primitive. The technologies are highly inefficient both in energy consumption as well as in production economies. Hence, unit costs are high and quality poor. Recently, however, UNDP and the World Environment Fund (WEF) have collaborated on a project to introduce and disseminate a new brick making technology to reduce pollution, lower CO_2 emissions and at the same time reduce costs of production. This technology is know as the Hybrid Hoffman Kiln (HHK) that combines the firing technology of the Hoffman kiln with a unique fuel injection technique for making green bricks; the HHK has been proposed as the lead technology for IKEBMI. The proposed technology will drastically reduce energy use and generate scale economies reducing production costs.

The HHK is a hybrid version of the Hoffman kiln. Structurally, it is built like the Hoffman but, unlike the traditional Hoffman, the fuel used is coal. The kiln can be made from firebricks or from green bricks. In the latter event, the green bricks get "cooked" during kiln operation. The inner kiln lining is made from refractory bricks and then plastered over by refractory cement. In this version, the firing chamber an be filled manually or automatically with green bricks, usually about 5,000 to 6000 units at one time, in line stacks of around 1,000. Thus, there are 5 line stacks; and the firing time for each line stack is about half an hour. The fuel, granulated coal, is fed into the firing zone in the kiln through stoke holes on the roof. Air required for the combustion process is forced from behind; and, as it reaches the line to be fired, it is already preheated from the previous firing zone thus reducing firing time and energy usage. The temperature in the firing zone is about 800^0C. The process is extremely simple and is carried out manually, reducing the mechanical process of the VSBK considerably.

In addition to kiln efficiency, a technique commonly used in China to make bricks is to inject fuel into the green bricks. This technique enables better thermal bonding and reduces fuel usage, and hence CO_2 and other emissions. Clay is premixed with granulated coal and then extruded to produce the green bricks. This is a unique process and is fundamental to the energy efficiency achieved in brick making in China. Almost 80% of the total energy required is injected into the bricks and only about 20% is fed externally into the firing chamber. Most of the fuel mixed into the bricks, over 95%, is completely burnt during firing. The technique has been conspicuously absent from the Indian subcontinent and it is only recently that some attempts have been made in India to combine other materials with clay to reduce clay use.

A team consisting of professors from the Bangladesh University of Engineering and Technology, members of the Bangladesh Brick Manufacturers and Owners Association and the technology promoters visited with the Xian Research and Design Institute of Wall and Roof Materials in February 2005 to study the technology and to make site visits to operating brick fields in China. The consensus of opinion was that this technology was highly suitable and could readily be adapted in Bangladesh. Bricks brought back from China were tested at BUET and found to be of superior quality than those currently being produced in Bangladesh from higher quality clay.

5.1 The Production Process

Clay Extraction, Transport and Preparation - The clay is excavated by hydraulic excavator or by hand from nearby riverbeds and transported to the plant-stacking yard by

trucks. The clay is then crushed by means of roller mills, then by double-shaft mixer where water is added in such a manner as to ensure moisture content of 15%.

Brick Shaping - The tempered material is fed into a vacuum extruder for continuous column production. The column is then cut with Cutter column and Cutter green to the required size. The green brick is set on drying car by manual loading for drying.

Brick Drying - The green bricks are then manually loaded on to the drying car, which is then transported into the drying tunnel by means of a hydraulic pusher. Hot air for drying is funneled into the tunnel from the annular kiln. The drying cycle is about 26 hours

Brick Firing - The dried green bricks are unloaded manually into the annular HHK kiln. The speed of the firing is 1.25m/h at a sintering temperature of about 950°C -1050 °C. The fired brick are unloaded and conveyed manually in carts to the stacking yard.

Main technical data includes:

Particle size after roll mill	< 2mm
Moisture content for shaping	18-20%
The rate of dried green bricks	95%
The rate of Sintering bricks	95%
Sintering temperature	950 °C -1050 °C

5.2 Financial Analysis of an HHK Operation

The total cost of the first demonstration HHK project is estimated at Tk 585.72 lakh (US$900,000). Adequate provisions for unforeseen expenses have been made. The high costs for the demonstration HHK are to ensure a well-managed demonstration and to provide technology transfer opportunities for project participants. It is anticipated that these costs will reduce with additional demonstration HHKs being setup in Bangladesh and the realization of economies of scale.

Costs for the first demonstration HHK are summarized in the following table.

Table 2: Costs of First Demonstration HHK (in 000's Tk with Tk 70=US$1.00))

Items	Local Currency	Foreign Currency	Total Cost
(i) Land	2,880	0	**2,880**
(ii) Building & civil construction	9,616	0	**9,616**
(iii) Imported Machinery (C & F Cost) = US $ 590,933.33	0	35,456	**35,456**
(iv)Other assets (tractors - 3 nos)	2,100	0	**2,100**
(v) Miscellaneous charges for importable machineries and transports Equipment	2,127	0	**2,127**
(vi) Cost of Installation	2,321	0	**2,321**
(vii)Consultation Fees for Feasibility study & plant design	0	0	**0**
(viii) Preliminary & pre-operating expenses	1,200	0	**1,200**
(ix) Unforeseen Cost	279	0	**279**
(x) Interest During Construction	2,592	0	**2,592**

Items	Local Currency	Foreign Currency	Total Cost
Period (IDCP)			
Total cost of the project excluding initial working capital	23,116	35,456	**58,572**
Initial working Capital	1,657	0	**1,657**
Total Estimated fixed cost of the project including initial working capital	**24,772**	**35,456**	**60,228**

Debt Equity Ratio is 70:30. The initial paid up capital of the company will be Tk 175.72 lakh. Brick selling prices from the demonstration HHK has been estimated at 10% below present market prices for similar quality bricks. The lower price has been assumed even though the quality of the bricks is superior as a conservative measure. Adequate provisions for raw materials costs, wages and administrative expenses have been made. Estimated profitability, calculated on the basis of the above assumptions, is satisfactory as is evident from Table 3.

Table 3: Estimated Profits from First Years of HHK Operation

Particulars	('000 Takas) Year 1	Year 2	Year 3
Sales	41,629	44,267	**45,216**
Gross Profit	23,982	25,204	**25,488**
Net Profit before Tax and Interest (Operating Profit)	23,641	24,836	**25,105**
Net Profit before Tax (Net Operating Profit)	18,478	20,558	**21,839**
Net Profit before Tax (Net Operating Profit) Less Depreciation	**13,791**	**15,871**	**17,152**

The above summary depicts a profitable picture for the project's operations. The pay back period of the demonstration investment is 2 years. The calculation is shown below:

Pay Back Period = Capital Investment (Excluding Cost of Land)	
Annual Net Profit before Tax + Depreciation and write off	
Capital Investment (Excluding cost of Land)	55,692,000
Annual Net Profit Before Tax	21,838,000
Depreciation and write off	4,686,000
Pay back period	2 years

The financial internal rate of return (FIRR) has been calculated at 43%.

6. Conclusion

Table 4 provides a comparative summary of all kilns considered in this paper. Intermediate technology transformation solutions such as the VSBK are possible; however, its viability must be convincingly demonstrated given the history of the VSBK demonstrations in Bangladesh, and some financial support as risk coverage would need to be provided. The fact that there is not a

single VSBK in Bangladesh makes it very difficult for FCK owners to consider this as an option. Moreover, many of them have expressed a lack of support for a VSBK demonstration.

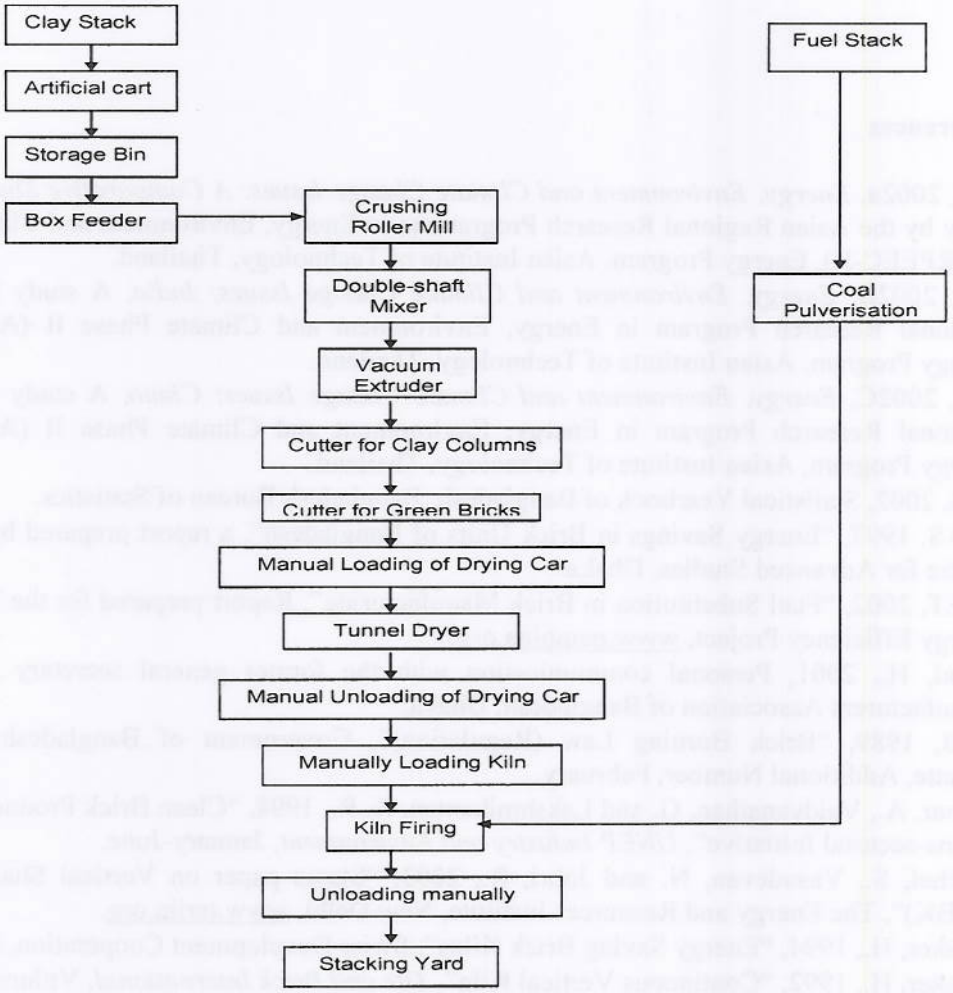
Although a detailed feasibility study of the VSBK was not done for Bangladesh, the HHK in comparison with the VSBK appears to be an attractive option considering the quality of bricks, the high rate of return calculated in the feasibility study of an HHK adapted in Bangladesh, and the additional energy efficiencies realized by the HHK. During the full implementation of IKEBMI, these figures should be re-confirmed using the latest construction and fuel costs as well as the selling prices of bricks.

Table 4: A Comparative Study of the Four Kilns Being Used in Bangladesh and the Hybrid Hoffman Kiln

Parameter	Unit	Bull's Trench Kiln	Fixed Chimney Kiln	Zigzag Kiln	Vertical Shaft Brick Kiln[2]	Hoffman Kiln	Hybrid Hoffman Kiln[7]
1.Initial Investment	Taka (Tk.) US$=Tk65	2,500,000	4,000,000	4,000,000	8,000,000	32,000,000	20,000,000[8]
2. Working Capital	Tk.	1,000,000	900,000	900,000	1,600,000	7,500,000	Tk 5 million to Tk 35 million[9]
3. Land	acres	2.5[10]	2.5[5]	2.5[5]	1	Min 10 year round	Min 10 year round
4. Raw Material	Clay ft^3	100,000	95,000	95,000	95,000 to 300,000[11]	425,000	2,000,000
	Labor	200 (5% skilled, 10% semi-skilled, rest unskilled)	200 (15% skilled, 15% semi-skilled, rest unskilled)	200 (15% skilled, 15% semi-skilled, rest unskilled)	200 (15% skilled, 15% semi-skilled, rest unskilled)	400 (25% skilled, 45% semi-skilled, rest unskilled)	150 (15% skilled, 15% semi-skilled, rest unskilled)
	Electricity	Not essential	Not essential	Necessary in small scale	Necessary in small scale	Necessary[12]	Necessary if mechanized brick molding equipt is used
	Fuel	Coal	Coal	Coal	Coal	Nat. Gas	Coal
5. Fuel Consumption	Tonnes Per 100,000 Bricks	22-26	20-24	20-24	15-18	15000-17000 m3	8 to 12
6. Pollution		Severe pollution	Pollution	Pollution	Pollution	Very little pollution	Very little pollution
7. Production Period		Nov to mid-Apr	Nov to mid-Apr.	Nov to mid-Apr.		Round the year.	Round the year
8. Estimated Annual Production	Million bricks	2.0 to 2.5	2.0 to 2.5	2.0 to 2.5	3 to 7	7.5 to 9.0	15 to 20
9. Wastage	%	10 - 12	5 - 8	5 - 8	10	15 - 18	< 5
10. Quality of Bricks		Medium	Good	Good	Medium to good	Very good	Very good
11. Bricks Sale Price	Tk/1000 Bricks	3000-3500	3000-3500	3200-3800	3200-3800	3500-4000	TBD during IKEMBI

[7] adapted to Bangladeshi conditions
[8] does not include brick molding equipment
[9] depending on the equipment chosen for an operation
[10] of which 1 acre used round the year, rest only during production
[11] depending on the number of shafts
[12] power outage hampers production

Schematic Diagram of Brick Making Process Using HHK



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Part VI: Monitoring & Evaluation Plan and Budget

Annual Targets

Project Strategy	Success Indicators	Annual Targets Yr 0	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
GOAL: Reduction of the growth of GHG emissions from the brick making industry (BMI)	Cumulative GHG emissions reduction in ktonnes CO_2 (direct – 16 pilot EEKs) compared to business-as-usual scenario	0	25	93	187	281	375
PURPOSE: Removal of barriers that inhibit the adoption of energy efficient kilns and molding techniques by the BMI	Cumulative energy savings from brick kilns in ktonnes coal	0	9	35	70	105	140
	Percentage of brick makers are utilizing EEKs (16 +)	0	0.7	1.8	2.3	2.3	4.4
	Average percentage reduction of energy cost per unit brick in the BMI	0	0	1	1.2	1.3	2.2
OUTCOMES							
Component 1: EEK Technology Support Program Thorough understanding and appreciation of technology options and their environmental impacts by brick makers, government and other stakeholders	Percent improvement in the overall specific energy consumption in the BMI	0	0.3	0.6	0.8	0.9	1.1
	Number of local eng'g firms doing business with the BMI each year	0	0	0	0	2	2
	Number of brick making companies (i.e., brick makers) submitting reports to BBMOA/SEDA each year	0	3	8	8	10	16
	Number of feedback reports per year to brick makers incorporating suggestions for improving energy performance	0	0	3	8	10	16
	Number of brick makers planning to develop and implement EEK technology application and EC&EE projects each year	0	4	15	35	75	100
	Number of brick makers implementing EC&EE projects each year	0	0	4	8	16	25
Component 2: EEK Demonstration Program Establishment of a critical mass of demonstration projects that will provide detailed information of EEK operations, energy savings	Number of demonstration (pilot) EEK technology application projects established and operational	1	4	11	16	16	16
	Tonnes of coal used in EEK technologies in comparison with FCKs per 100,000 bricks	14	14	14	14	14	14

Project Strategy	Success Indicators	Annual Targets					
		Yr 0	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
and environmental impacts to interested brick makers in Bangladesh.	Number of visitors (researchers, brick makers, etc.) visiting the demo project sites each year	50	50	50	50	50	50
Component 3: EEK Technical and Management Capacity Building Program Improved local vocational, technical; and managerial capacity to manage and sustain operations of EEKs and EE practices in Bangladesh	Number of EEKs installed	1	4	11	16	16	32
	Number of certified operators in the BMI each year	0	0	0	8	8	16
	Number of trained local equipment manufacturers producing equipment and/or components for the BMI	0	0	0	0	2	2
	Number of trained local engineering firms registered and profitably engaged in the BMI support industry providing technical services	0	0	0	0	0	2
	Number of EC&EE projects developed and proposed by brick makers for funding to the GoB, investors and international donors	0	0	1	4	8	16
Component 4: Communications and Awareness Program Enhanced awareness of the public and other stakeholders on EEKs, EE molding practices and EEK brick products	Operational BMI Information Center		Yes	Yes	Yes	Yes	Yes
	A fully functioning information exchange services program operated by DoE		Yes	Yes	Yes	Yes	Yes
	Number of satisfied clients served by the BMI Information Centre each year			50	50	50	50
	Brick maker energy performance rating scheme completed and implemented		Yes	Yes	Yes	Yes	Yes
	Ranking of brick makers in the overall business ranking of local SMEs.					Yes	Yes
Component 5: EEK Finance Support Program Availability of financial and institutional support to encourage SME adoption of energy efficient kilns:	Number of banks/financial institutions offering loan/credit facilities for EC&EE projects for BMI SMEs	0	2	6	8	10	12
	Number of successful EC&EE and EEK projects assisted through bank financing each year	0	1	4	12	20	35

Project Strategy	Success Indicators	Annual Targets					
		Yr 0	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5
	Number of business deals between the BMI entities and the bank/financial institutions	0	0	0	5	15	30

Monitoring Plan

Success Indicators	Targets	Means of Verification	Sampling Frequency	Location
GHG emissions reduction in kilo tonnes CO_2 (direct and indirect) compared to business-as-usual scenario	470 ktonnes (Year 5)	Surveys, BERM Program reports and other relevant reports	Quarterly	Kilns located in all 6 districts of Bangladesh
Cumulative energy savings from brick kilns in ktonnes coal	140 ktonnes (Year 5)	Surveys, BERM Program reports and other relevant reports	Quarterly	Kilns located in all 6 districts of Bangladesh
Percentage of brick kilns that are EEKs	4.4% (Year 5) including replications;	Surveys (registry of enterprises), BERM Program reports, IKEBMI reports of EE and EC demonstration projects and personal communications	Quarterly	Kilns located in all 6 districts of Bangladesh
Average percentage reduction of energy cost per unit brick in the BMI	2.2% (Year 5)	Surveys, BERM Program reports and personal communications	Quarterly	Kilns located in all 6 districts of Bangladesh
Reduction of coal used for the production of 100,000 bricks in the EEK in comparison to the FCK	4.0×10^{-6} TJ/brick produced or 50% (for all years)	Records of coal usage per 100,000 bricks produced in the EEK Tested calorific value of coal Baseline consumption of the FCKs that is 30 tonnes per 100,000 bricks produced	Quarterly	Kilns located in all 6 districts of Bangladesh
Percent improvement in the overall specific energy consumption in the BMI	40% (Year 5)	BERM Program reports and IKEBMI reports of EE and EC demonstration projects	Quarterly	Kilns located in all 6 districts of Bangladesh
Number of brick makers implementing EC&EE projects each year	250 (starting Year 5)	Surveys (registry of enterprises), BERM Program reports, and personal communications from Information Center	Quarterly	Kilns located in all 6 districts of Bangladesh
Number of demonstration EEK technology application projects established and operational	16 (Year 5)	IKEBMI reports of EE and EC demonstration projects and personal communications from Information Center	Quarterly	Kilns located in all 6 districts of Bangladesh
Total number of EEKs installed	32 (Year 5)	IKEBMI reports of EE and EC demonstration projects and personal communications from Information Center	Quarterly	Kilns located in all 6 districts of Bangladesh
Number of certified operators in the BMI each year	16 (starting Year 4)	Documentation of certified operators by a relevant certifying body	Semi-Annually	Kilns located in all 6 districts of Bangladesh (where training is to be located)
Number of banks/financial institutions offering loan/credit facilities for EC&EE projects for BMI SMEs	12 (Year 5)	Survey of FIs offering loan/credit facilities for BMI SMEs, IKEBMI M&E reports, documentation of financing agreements	Annually	Dhaka and other secondary cities in the other 5 districts where credit facilities exist
Number of successful EC&EE and EEK projects assisted	12 (starting Year 3)	Survey of FIs offering loan/credit facilities for BMI	Annually	Dhaka and other secondary cities in

Success Indicators	Targets	Means of Verification	Sampling Frequency	Location
through bank financing each year starting Year 3		SMEs, IKEBMI M&E reports, documentation of financing agreements		the other 5 districts where credit facilities exist

M&E Budget

Type of M&E Activity	Responsible Parties	Budget US$ *Excluding project team Staff time*	Time frame
Inception Workshop (IW)	▪ Project Manager ▪ UNDP Bangladesh ▪ UNDP/GEF	Included in Component 1 budget	Within first 2 months of project start up
Inception Report (IR)	▪ Project Team ▪ UNDP Bangladesh ▪ UNDP/GEF	Included in Component 1 budget	a) Draft IR available before IW b) Final IR available immediately following IW
Measurement of Means of Verification	▪ Project Manager ▪ Project team members	Included in M&E Component budget	Start, mid and end of project
Measurement of Means of Verification for Project Progress and Performance (measured on an annual basis)	▪ Oversight by UNDP-GEF Technical Advisor and PM ▪ Measurements by regional field officers and local IAs	Included in M&E Component budget, and the demonstration activities	Annually prior to APR/PIR and to the definition of annual work plans
APR and PIR	▪ Project Team ▪ UNDP Bangladesh ▪ UNDP-GEF	Included in Management and Coordination Component budget	Annually
TPR and TPR report	▪ GOB Counterparts ▪ UNDP Bangladesh ▪ Project team ▪ UNDP-GEF RCU	Included in Management and Coordination Component budget	Every year, upon receipt of APR
PAC/Tripartite Review Meetings	▪ Project Manager ▪ UNDP Bangladesh	Included in Management and Coordination Component budget	Following Project IW and subsequently at least once a year
Periodic status reports	▪ Project team	Included in Management and Coordination Component budget	To be determined by Project team and UNDP Bangladesh
Technical reports	▪ Project team ▪ Hired consultants as needed	Included in M&E Component budget	To be determined by Project Team and UNDP Bangladesh
Mid-term External Evaluation	▪ Project team ▪ UNDP- Bangladesh ▪ UNDP-GEF RCU ▪ External Consultants (i.e. evaluation team)	Included in M&E Component budget	At the mid-point of project implementation.
Final External Evaluation	▪ Project team ▪ UNDP Bangladesh ▪ UNDP-GEF RCU ▪ External Consultants	Included in M&E Component budget	At the end of project implementation
Terminal Report	▪ Project team ▪ UNDP Bangladesh ▪ External Consultant	Included in M&E Component budget	At least one month before the end of the project
Lessons learned	▪ Project team ▪ UNDP Bangladesh ▪ UNDP-GEF RCU	Included in M&E Component budget	Annually

Type of M&E Activity	Responsible Parties	Budget US$ *Excluding project team Staff time*	Time frame
Audit	▪ UNDP Bangladesh ▪ Project team	Included in Management and Coordination Component budget	Annually
Visits to field sites (UNDP staff travel costs to be charged to IA fees)	▪ UNDP Bangladesh ▪ UNDP-GEF RCU (as appropriate) ▪ Government / PAC representatives	Included in Management and Coordination Component budget	Annually
TOTAL INDICATIVE COST *Including project team staff time for M&E and travel expenses Excluding the UNDP staffs and Project Management staff expenses*		US$ 139,310	

PART VII: Terms of Reference for IKEBMI Subcontracts and Personnel

Sub-contract

Clean Energy Alternative

Clean Energy Alternative (CEA) is the major project proponent of the UNDP/GEF bricks project. CEA significantly contributed in developing the concepts, sourcing and identifying the technologies, initial negotiation with the technology provider as well as potential commercial financiers and brick entrepreneurs in Bangladesh. CEA was responsible for identifying XIAN as a technology provider and BUET as technology arbiters and as such, has fostered cooperation between technology groups to setup the demonstration an energy efficient kiln during the PDF B Phase. CEA was also responsible for the development and application of appropriate baseline methodologies, and developing monitoring plans and capacity to screen and select plants for project selection. CEA's considerable experience in promotional activities and its close ties with the Bangladesh Brick Manufacturing Owners Association (BBMOA) will also be invaluable to the project.

CEA's role during the full IKEBMI project will be to conduct different technical and financial studies, promote technology among potential entrepreneurs, mobilizing the financial institutions, establishing the baseline data, preparing the design of demonstration kilns and installation and operation support, preparing technical training manuals, conducting the training etc. within the schedules and budgets set by UNDP management. They will also play a major coordination role with other co-financers including the private sector, lending institutions and development partners. CEA will work closely with XIAN institute and provide the logistics and other field support to XIAN. CEA will adopt the design, training manual, monitoring system of XIAN in Bangladeshi context and will translate it in Bangla for understanding of the Brick Industries workers.

Component 1:

- Conduct techno-economic evaluation of different technology options, conduct workshops, develop a ranked proforma and prepare the final report.
- Study current practices of clay mining, mapping of clay resources, conduct workshop, formulate strategies on new clay mining practices and prepare report.
- Evaluate the operating performance of BMI companies and identify the potential improvement in operation of these facilities.
- Identify potential improvements opportunities in the energy performance of the BMI and prepare the recommendation for these facilities (jointly with XIAN).
- Conduct surveys of coal used (by origin), collect samples of all coal types being used, test coal, conduct stack analysis, create stack analysis database
- Design BMI energy reporting and monitoring programme including MIS system and data collection (jointly with XIAN).
- Implement BMI energy reporting and monitoring system including the training of stakeholders and energy auditor in monitoring energy performance of BMIs.

- Develop a local BMI engineering and consultancy service industry for design, installation, maintenance and troubleshooting of EEKs and brick making equipment and/or other components (jointly with XIAN).

Component 2:

- Conduct seminar/workshops to promote the demonstration projects and identify potential brick makers who are interested in hosting the demonstrations ion of EEK Technology and EC&EE Demonstration Projects.

- Conduct of detailed feasibility analyses of selected demonstration sites to determine and verify project implementation requirements. This will include cost calculation, design of ownership and management models, cost-benefit analysis, design of operation and maintenance concept, and assessment of financing aspects.

- Verify specific demonstration project implementation requirements- availability and quantity of clay resources, availability of materials needed and manpower for the construction of the EEKs, and financing assistance mechanism for the financing of some of the demo projects (jointly with XIAN).

- Establish baseline data for the demonstration project sites through energy consumption and production surveys as well as socio-economic conditions (jointly with XIAN).

- Finalize the detail design of the demonstration kilns (jointly with XIAN).

- Support to the local entrepreneurs in preparation of business case, processing of applications for financing.

- Provide technical assistance along with XIAN for construction, installation and operation of demonstration kilns.

Component 3:

- Assess existing knowledge and skills of workers, develop skills training courses and materials, develop modalities of service delivery, recruit master trainers, train master trainers, train workers by master trainers.

- Assess capabilities of existing BMI maintenance service providers and prepare the recommendations for improvements.

- Assess the viability of local manufacturing of EEKs and associated equipment and/or components (jointly with XIAN).

- Evaluate of the feasibility of and requirements for standardizing the procurement/supply/ manufacturing of brick making equipment and components and prepare the assessment reports highlighting findings and recommendations for possible mass procurement of brick making equipment and components.

- Develop training courses and manual on design, construction, economic feasibility evaluation, operation and maintenance of EEKs for local engineering firms and equipment manufacturers, repair and maintenance service providers and BMI personnel (jointly with XIAN).

- Develop training course and manual on EC&EE in the BMI for BBMOA staff and comprehensive training manual on modern brick making technology for local engineering firms (jointly with XIAN).
- Conduct different training courses mentioned above (initially jointly with XIAN).
- Provide technical assistance to BBMOA and brick makers in efforts towards widespread adoption of EC&EE in the BMI beyond the IKEBMI.

Component 5:

- Prepare action plan for financing BMI SMEs through conducting study for compiling details of all demonstration sites, potential entrepreneurs, market conditions for bricks and possible financing modalities.
- Conduct of techno-economic feasibility evaluation of BMI SME financing including the assessment of potential financing schemes.
- Prepare reports detailing the terms and conditions of each viable scheme.
- Build capacity of Banks/Financial Institutions (B/FIs) through conducting training workshops on evaluating the financial viability of EC&EE projects.
- Establish links between prospective SMEs and commercial banks with IFI-backed financial agencies, through workshops and seminars.
- Conduct capacity building for the brick owners on how to access and apply for other available financing sources that they can tap to finance their EC&EE initiatives and EEK application projects.

Component 6

- Formulate suitable policy to promote energy efficient brick making industries and reduction of GHGs.
- Formulate strategies to minimize land degradation from brick making industries.
- Review existing rules and policies and prepare recommendations to adopting new technology for reduction of GHGs in brick making industries.
- Formulate strategies to enforce favorable regulatory regime to promotion of energy efficient brick making industries.
- Conduct capacity development training programme for BMI energy efficiency policy/regulation enforcement
- Implement strategies to minimize land degradation

Xian Institute of Wall Building Materials (XIAN)

XIAN is a state-owned research and development institute in China that has developed the Hybrid-Hoffman Kiln (HHK) for use throughout most of China's brick industry. Moreover, XIAN is a part of a larger R&D organization, the China Building Materials Academy (CBMA) dedicated to advancing the quality of building materials and improving the efficiency of their related industrial facilities. XIAN's engineering staffs were responsible for the first constructed and operational HHK in Bangladesh in 2006-7 during the PDF B Phase of the project. After the PDF B Phase, XIAN staffs continue to be involved with the startup and operation of the first HHK in Dhamrai 20 km west of Dhaka). XIAN's role on the full project is essential and will involve the demonstration of HHK technology in Bangladesh, providing modifications to suit local conditions, training master trainers in design, construction, operation and maintenance of EEK kilns and brick making technology, preparing and certifying technology transfer, training materials, methodology and assessment methods.

Component 1

- Identify potential improvements opportunities in the energy performance of the BMI and prepare the recommendation for these facilities
- Develop protocols for monitoring energy performance of BMI industries for transfer to stakeholders.
- Assist in the development of a local engineering and consultancy service for the BMI by assessing local capacities and evaluating the viability of setting up local service businesses to support the BMI.

Component 2:

- Conduct detailed feasibility studies of selected demonstration sites with the assistance of CEA.
- Establish baseline data for the demonstration sites including energy consumption and production surveys, socio-economic conditions and baseline performance.
- Prepare detail designs for demonstration HHK projects.
- Provide technical assistance to implement entire demonstration HHK project from conceptual design, to feasibility study, engineering design, construction, installation, operation, monitoring and evaluation.

Component 3:

- Assess the viability of local manufacturing of EEKs and associated equipment and/or components.
- Design comprehensive training courses on EC&EE, EEKs and EE brick making practices and methodologies, development of a certification program for EEK operators.
- Design comprehensive training courses on the design, construction, economic feasibility evaluation, operation and maintenance of EEKs for local engineering firms and equipment manufacturers, repair and maintenance service providers and BMI personnel.
- Conduct initial training programme jointly with CEA.

- Provide training on detailed planning of a demonstration HHK.

Component 6

- Support to CEA on developing suitable policy to promote energy efficient brick making industries and reduction of GHGs using the Chinese experiences.

- Support to CEA on formulating strategies to minimize land degradation from brick making industries using the Chinese experiences.

Regular Project Staff

1. Project Manager (PM): Component 8

Duties and Responsibilities: Under the direct supervision of UNDP, the incumbent will be responsible for implementation of the project, including mobilization of all project inputs, supervision of project staff, consultants and oversight of sub-contractors. The PM will be the leader of the Project Team (PT). The PM shall liaise with the government, UNDP, and all stakeholders involved in the project. S/he will be specifically responsible for (a) overall management of the project, (b) work closely with project stakeholders and ensure the project deliveries as per project document and work plan, (c) ensure technical coordination of the project and the work related to legal and institutional aspects, (d) mobilize all project inputs in accordance with UNDP procedures and GEF principles, (e) finalize the ToR for the consultants and subcontractors and coordinate with Business Solution Center for recruitment, procurement and contracting, (f) supervise and coordinate the work of all project staff, consultants and sub-contractors, (g) ensure proper management of funds consistent with UNDP requirements, and budget planning and control, (h) prepare and ensure timely submission of monthly reports, quarterly consolidated financial reports, quarterly consolidated progress reports, annual, mid-term and terminal reports, and other reports as may be required by UNDP; (i) submit the progress reports and key issue report to the Project Board, (j) prepare quarterly and annual work plan, (k) provide regular input to UNDP corporate system ATLAS for financial and programme management on project progress, financial status and various logs, (l) arrange for audit of all project accounts for each fiscal year (m) undertake field visit to ensure quality of work, and (n) undertaking any activities that may be assigned by UNDP and Project Board.

Qualifications and Experience: The incumbent should have a minimum Bachelor degree in Engineering with MBA/Master degree or Masters in energy/environment or other relevant academic discipline and profession qualifications with at least ten (10) years professional experience at senior level. S/he should have extensive experience and technical ability to manage a large project and a good technical knowledge in the fields related to private sector development, climate change, energy efficiency and institutional development and/or regulatory aspects. S/he must have effective interpersonal and negotiation skills proven through successful interactions with all levels of project stakeholder groups, including senior government officials, financial sectors, private entrepreneurs, technical groups and communities. S/he should have ability to effectively coordinate a complex, multi-stakeholder project and to lead, manage and motivate teams of international and local consultants to achieve results. Good capacities for strategic thinking, planning and management and excellent communication skills both in English and Bangla are essential. Knowledge of UNDP project implementation procedures, including procurement, disbursements, and reporting and monitoring will be an added advantage.

2. Monitoring Officer: Component 7

Duties and Responsibilities: Under the direct supervision of UNDP and the Project Manager, the incumbent will be assigned to develop and implement a monitoring system to capture the project activities and results under the supervision of Project Manager. S/he will be responsible specifically for (a) developing and setting up the overall framework for project monitoring and evaluation (M&E), (b) prepare the monthly, quarterly and annual monitoring plan for project activities, (c) monitor and evaluate the compliance of actual progress and performance against the planned work plan and expected quality, (d) analysis of the effect of current actual performance to the project timetable and budgets, (e) prepare reports for project management including identification of problems, causes of potential bottlenecks (if any) in project implementations, (f) recommendations on how to reduce the impact of deviations vs. work plans, (g) prepare the ToRs for mid-term and final evaluation in accordance to UNDP and GEF guidelines, (h) design and implement a system to identify, analyze, and disseminate lesson learned, (i)

assist the PM in preparation of various progress report, (j) coordinate with the international and national consultants and other stakeholders, (k) facilitate exchange of experiences by supporting and coordinating participation in any existing network of UNDP/GEF projects sharing common characteristics, (l) identify and participate in additional networks, for example scientific or policy-based networks that may also yield lessons that can benefit project implementation and (m)) any other related activities as assigned by Project Manger.

Qualifications and Experience: The incumbent should have a minimum Masters degree in Energy/Environment, Statistics, Economics or other relevant academic disciplines from a recognized university. S/he should have at least five (5) years hands-on experience in energy and environment field specifically monitoring and evaluation of projects. S/he should have proven experience in planning, design and implementation of M&E systems, the logical framework approach and other strategic planning approaches, training in M&E development and implementation and/or facilitating learning-oriented analysis sessions of M&E data with multiple stakeholders, data and information analysis and analytical report writing. S/he should have the willingness to undertake regular field visits and interact with different stakeholders, especially primary stakeholders. S/he must have willingness to undertake regular field visits and interact with different stakeholders, especially primary stakeholders. Computer proficiency in MS Office (Word, Excel and PowerPoint) and other common software is a prerequisite. Computer literacy in graphic design software will be appreciated. Fluent both in written and spoken English and Bengali is essential.

3. Communication Officer: Component 4

Duties and Responsibilities: Under the direct supervision of UNDP and the Project Manager, the incumbent will be assigned to promote the urgency of energy efficient brick kiln and its positive impact on climate change and national development through well coordinated media and advocacy initiatives and to improve project results through effective use of communications under supervision of Program Manager. S/he will be responsible for (a) drafting and implementing project communications strategy and work plan; (b) coordinating various media and advocacy campaign and initiative to assure understanding and visibility of the brick kiln project; (c) responding to requests for information from brick owners association, media, government, donor and general public regarding the project activity of the project by providing them with the document and/or facilitate their access to relevant information sources; (d) producing a minimum set of visibility material, like Brochure, Newsletter, reports, case studies / beneficiary reports etc.; (e) establishing a brick making industry (BMI) Information center; (f) design and implement a energy conservation and efficiency promotion and advocacy programme for BMI; (g) developing and maintaining a list of key journalists and other individuals in the prime target group i.e., brick owners and manufacturers to ensure wide and targeted distribution of information; (h) executing various communications activities highlighting/encouraging relevant donor; (i) organizing special events related to the project involving various stakeholders; (j) responsible for photographic documentation, assisting in video production and editing, and maintain the audio-visual library; (k) introducing a BMI energy Awards programme; and (l) any other related activities as assigned by Project Manger.

Qualifications and Experience: The incumbent should have a minimum Masters degree in the field of journalism, mass communication or other relevant/similar disciplines from a recognized university. S/he should have at least three (3) years hands-on experience in journalism, public information, and/or social marketing, and/or advocacy positions and/or campaign management. Computer proficiency in MS Office (Word, Excel and PowerPoint) and other common software is a prerequisite. Computer literacy in graphic design software will be appreciated. Fluent both in written and spoken English and Bengali is essential.

4. Admin Assistant: Component 8

Duties and Responsibilities: Under the direct supervision of UNDP and Project Manager, the incumbent will be responsible to provide overall administration and financial services of the project such as processing payments, raising requisition, purchase order, projects logs etc. using UNDP corporate software ATLAS. S/he will be responsible to provide information to UNDP Project web, RRMC reporting and administrative trouble shooting. S/he will also perform (a) word processing, drafting routine letters/messages/reports, mailing (b) arrange travel, itinerary preparation for project related travels, (c) assist to arrange workshops/ seminar/training programmes and mailing, (d) work at reception desk/PABX and make appointments and schedule meeting, (e) assist in work-plan and budgeting, (f) photocopying, binding and filing, (g) maintenance of all office equipment and keeping inventory/records of supplies and their usage and any other duties assigned by Project Manager or concerned officials.

Qualifications and Experience: The incumbent should have at least a Bachelor degree in any discipline from a recognized university. S/he should have at least 3 years relevant working experience with foreign aided projects or international development or organizations. Computer proficiency in MS Office (Word, Excel and PowerPoint) and other common software is a prerequisite. Diploma in computer/secretarial science is desirable but not essential. Basic knowledge in procurement, petty cash handling, logistics supports, and filling systems is a basic requirement. Knowledge of UNDP project implementation procedures, including procurement, disbursements, and reporting and monitoring is preferable. Fluent both in written and spoken English and Bengali is required.

Short-term Consultant

National Consultant: Component 4

- Design a BMI Information Center to cater for the information needs of the BMI SMEs on Energy Conservation & Energy Efficiency (EC&EE), in general, and in energy efficient brick making methodologies/practices, EEKs, and manufacturing of energy efficient bricks, in particular.

- Design EC&EE in the BMI Promotion & Advocacy Program in line with the information dissemination and awareness raising objectives of the project.

International Consultant: Component 7

- Design the monitoring and evaluation system of the project

- Conduct mid-term evaluation as per UNDP and GEF guidelines.

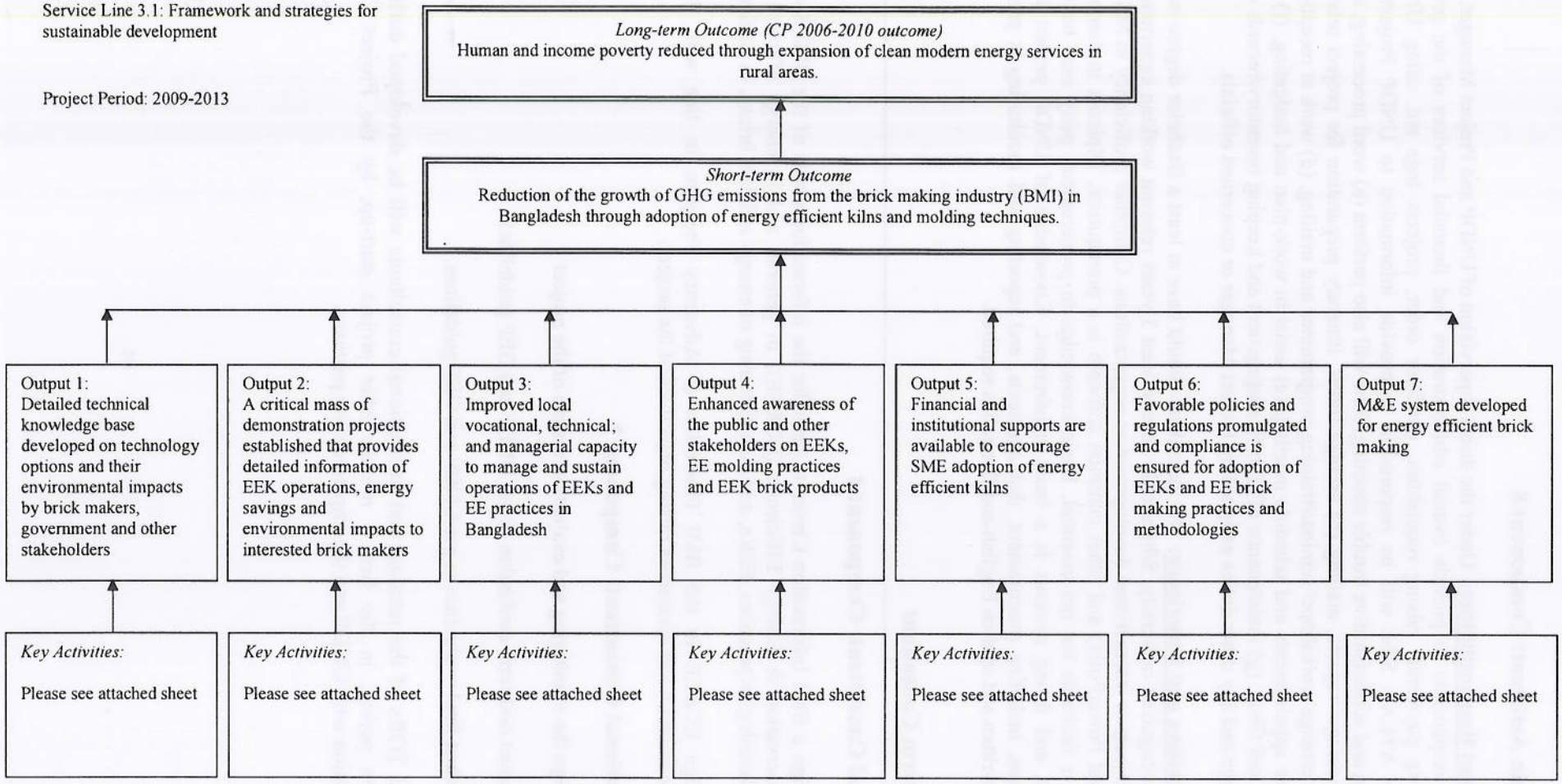
- Conduct final evaluation as per UNDP and GEF guidelines.

Detailed TORs of the national and international consultants will be developed during the Project Inception period, in the first 3 months after project start-up, by the Project Coordinator in consultation with UNDP and the implementing partners.

PROJECT RESULTS TREE
Improving Kiln Efficiency in the Brick Making Industry (IKEBMI)

Practice area 3: Energy and Environment
Service Line 3.1: Framework and strategies for sustainable development

Project Period: 2009-2013



Activities to attain Output 1:

2. Assessment of Other EC&EE and EEK Technology Options for the BMI
3. Clay Resources Assessment
4. Evaluation of the Operating Performance of BMI Companies
5. Identification of Potential Improvements in the Energy Performance of the BMI
6. BMI Energy Reporting and Monitoring (BERM) Program
7. Development of a Local BMI Engineering and Consultancy Service Industry
8. Inception Workshop

Activities to attain Output 2:

1. Promotion of EEK Technology and EC&EE Demonstration Projects
2. Conduct of Detailed Feasibility Analyses of Selected Demonstration Sites
3. Specific Demonstration Project Implementation Requirements
4. Establishment of Baseline Data for the Demonstration Project Sites
5. Finalized Design of Demonstration Projects
6. Technical Assistance for the Financing of Demonstration Projects
7. Installation and Operation of each Demonstration Project
1. Demonstration Program Results Evaluation and Dissemination

Activities to attain Output 3:

1. Technical Capacity Building for BMI Production Personnel
2. Assessment of Capabilities of Existing BMI Maintenance Service Providers
3. Assessment of the Viability of Local Manufacturing of EEKs and Associated Equipment and/or Components
4. Feasibility Study on the Standardization of Brick Making Kilns & Associated Equipment and/or Components
5. Training Course on the Design, Feasibility Evaluation, Construction, Operation and Maintenance of EEKs
6. EC&EE in the BMI Technology Education Program
7. Technical Assistance in Planning BMI EC&EE Projects

Activities to attain Output 4:

1. Establishment of a BMI Information Center
2. EC&EE in the BMI Promotion & Advocacy Program (6 workshops, 2 media events, 4 TV spots etc)
3. BMI Energy Awards Program(6 awards)

Activities to attain Output 5:

1. Preparation of Action Plan for Financing BMI SMEs
2. Conduct of Techno-Economic Feasibility Evaluation of BMI SME Financing
3. Capacity Building for Banks/Financial Institutions (B/FIs)
4. Promotion of Business Links
5. Capacity Building on Accessing Financing Sources

Activities to attain Output 6:

1. Improvement of GoB Awareness and Commitment to Enforce a Favorable Regulatory Regime for the BMI
2. Formulation of Policies, and Associated Implementing Rules and Regulations (IRRs)
3. Implementation of Policy Support Activities
4. Capacity Building on BMI Energy Efficiency Policy/Regulation Enforcement
5. Formulation and Implementation of Strategies to Minimize Land Degradation from Brick Making Activities
6. Review of the BMI Energy Efficiency Policy
7. Capacity Building on EEKs and Compliance with Emission Standards

Activities to attain Output 7:

1. Monitoring and evaluation including mid-terminal and terminal evaluation Formulation of Policies, and Associated Implementing Rules and Regulations (IRRs)
2. Coordination
3. Management
4. Reporting

Project Risk Log

Proposed title (Award ID in ATLAS): Improving Kiln Efficiency in the Brick Making Industries, Award ID 000xxxxx MYFF service line & Description: 3.1 Frameworks and Strategies for Sustainable Development							
ID	*Description of Risk*	*Level of Risk*	*Author*	*Risk Owner*	*Date Identified*	*Description of Action Taken*	*Date of Action*
01	**[Government Support]:** Delays maybe experienced in the promulgation of favorable government policies towards diffusion of EEKs. Although energy conservation and security programs have a high priority, many of these agencies have insufficient human resources, capacity, and infrastructure and focus leading to an outcome of long gestation periods for drafting new regulations and policies.	Low to moderate	PDF-B Team	Project Authority	26 February 2006	A workshop was organized with high level officials of Ministry of Environment and Forest , Power Division, department of Environment to share the key policy issues related to brick making industry. The GoB has recently acknowledged the importance of sustainable energy and developing indigenous sources of energy. The "Sustainable Energy Development Authority" has been recently approved within the Ministry of Power Energy and Mineral Resources as a dedicated unit to create an enabling environment to promote renewable energy, energy efficiency and energy conservation. Mitigating actions in response to insufficient government support would include: ➢ clear establishment and regular follow-up of project commitments; ➢ close tracking of progress through Project Board and other higher level meetings; ➢ assigning adequate project staff; ➢ use of champions and strong coordination in the government, NGO and private sector to ensure implementation of practical measures; ➢ detailed plans to monitor progress of regulatory development at the inception phase and early stages of the project.	29 March 2007

Project Risk Log (*Cont'd.....*)

Proposed title (Award ID in ATLAS): Improving Kiln Efficiency in the Brick Making Industries, Award ID 000xxxxx MYFF service line & Description: 3.1 Frameworks and Strategies for Sustainable Development							
ID	*Description of Risk*	*Level of Risk*	*Author*	*Risk Owner*	*Date Identified*	*Description of Action Taken*	***Date of Action***
02	**[Institutional]: Low Adoption of EEKs and EE practices** – This may be due to failure of SMEs to form clusters, and the absence of larger entrepreneurs to lead and manage an SME cluster. This may be due to: ➢ lack of comprehension of SME clusters in the context of EEK operations; ➢ mistrust of other SME partners; ➢ unwillingness of SMEs to disrupt operations for implementation of energy efficient practices for making bricks; ➢ inability of SMEs to grasp new business skills; and unwillingness of banks to advance funds to certain SMEs.	Moderate	PDF-B Team	Project Authority	26 February 2006	Operations of EEKs in China indicate that higher quality bricks will be produced in Bangladesh at a significantly lower cost. As such, SMEs who choose not to participate on the EEK program and continue operation of energy inefficient kilns may risk the inability to compete with bricks from EEKs. Mitigating actions in response to low adoption of EEKs and EE practices would include: ➢ full involvement of all SMEs in all aspects of project planning; ➢ capacity building for pool of industry advisors on full range of services to install an EEK; ➢ fostering and maintaining effective working relationships with stakeholders throughout inception and implementation phases; ➢ strong emphasis on communications to stakeholders on increased profitability, environmental benefits and improved market conditions of an EEK operation; ➢ effective assistance to SMEs on improving business practices to the extent they can secure bank loans; ➢ involvement of community business leaders to facilitate SME clustering with all those currently involved with energy inefficient brick making	

Project Risk Log (*Cont'd.....*)

Proposed title (Award ID in ATLAS): Improving Kiln Efficiency in the Brick Making Industries, Award ID 000xxxxx MYFF service line & Description: 3.1 Frameworks and Strategies for Sustainable Development							
ID	*Description of Risk*	*Level of Risk*	*Author*	*Risk Owner*	*Date Identified*	*Description of Action Taken*	*Date of Action*
03	**[Technical]:** Failure of EEKs to deliver measurable energy cost savings as claimed for demonstration projects will result stakeholder negativity and doubts on its economic and financial viability. This failure can be due to several factors including: ➢ absence of adequate quality control on EEK construction and equipment commissioning; ➢ failure of an EEK operation to successfully troubleshoot problems; ➢ disruption of coal supply; ➢ technical support services for EEK equipment are not available.	Low	PDF-B Team	Project Authority	26 February 2006	Mitigating actions include: ➢ project resources sufficient to ensure proper management and quality control over kiln construction and equipment installations; ➢ effective capacity building activities to ensure technical support pool understand the importance of quality control during EEK installations; ➢ strong emphasis on independent third party credible monitoring and evaluation in demonstration projects; ➢ sufficient capacity built to form a technical support pool that will provide good service to entire BMI and ensure sustainability; ➢ project efforts to understand and secure coal supplies to demonstration sites.	
04	**[Financial]:** Failure of financial institutions to provide financing to SMEs for EEKs and EE practices will result in market transformation formation away from current energy inefficient practices. Failure of financial institutions to provide financing may be due to: ➢ their failure to adequately address risks to SME borrowers; ➢ lack of agreement between banks and SMEs on financing mechanisms ➢ difficulties of banks to enforce contracts and manage risks; ➢ inability to find entrepreneurs that can properly manage an EEK operation and provide timely debt servicing	Low to moderate	PDF-B Team	Project Authority	26 February 2006	Mitigating actions include: ➢ assisting SMEs to disclose reliable information to banks to adequately address risks ➢ collaboratively developing financial mechanisms closely with SMEs and financial institutions; ➢ ensuring capacity building for business management is effective and rigidly followed; ➢ training appropriate entrepreneurial candidates on business management skills through capacity building from local banks with assistance from a local training institute.	

Project Risk Log (*Cont'd.....*)

Proposed title (Award ID in ATLAS): Improving Kiln Efficiency in the Brick Making Industries, Award ID 000xxxxx MYFF service line & Description: 3.1 Frameworks and Strategies for Sustainable Development							
ID	*Description of Risk*	*Level of Risk*	*Author*	*Risk Owner*	*Date Identified*	*Description of Action Taken*	*Date of Action*
05	**[Environmental]:** Although the technology will improve the air quality and increase energy efficiency, this type of large project needs EIA and EMP to ensure proper safeguard against environment. Improper construction and management may create environmental problem.	Low	PDF-B Team	Project Authority	26 February 2006	The requirement of EIA and appropriate EMP will be mandated for the brick kilns to be supported under the project.	
06	**[Others: Market/Economic External Risks]:** This would include: ➢ Downturn in demand for bricks; ➢ Changes in domestic coal prices that would jeopardize financial sustainability; ➢ Low availability of capital increasing the cost of EEK installation; ➢ Political instability.	Low to moderate	PDF-B Team	Project Authority	26 February 2006	The general market for bricks fluctuates varies from oversupply to the ability to meet market demand. The financial model for an EEK operation indicates the investment is not overly sensitive to changes in fuel (coal) prices and shutdowns resulting from a disruption to coal supplies. Local availability of capital has not been a problem yet although reserve levels vary notably when natural disasters occur (i.e. flooding and cyclones. Political instability likely will impact coal supply lines in certain areas.	

Overall Rating – Low to moderate risks

Issue Log

Proposed title (Award ID in ATLAS): Improving Kiln Efficiency in the Brick Making Industries
MYEF service line & Description: 3.1 Frameworks and Strategies for Sustainable Development

ID	*Description of Issue and Comments*	*Type of Issue*	*Author*	*Date Identified*	*Description of Action Taken*	*Date of Action*
1	Getting Designation of Authority (DoA) from GEF	Operational	PDF-B Team	12 January 2007	Started the required formalities closely with UNDP-GEF RCB	
2	Establishing PMU for the project	Operational	PDF-B Team	12 January 2007		

Project Workplan

Detailed Project Workplan for each year, as per requirement of ATLAS programme-financial system of UNDP, will be developed during the project inception period by the Project Coordinator (to be recruited under the project) in consultation with UNDP and the implementing partners. For initiation of project activities, a workplan (Version 1) for 2008 is attached below. This may be revised following project inception, if needed.

Annual Work Plan for 2009

(Version: 1 for initiation of activities)

Proposed title (Award ID in ATLAS): Improving Kiln Efficiency in the Brick Making Industry
MYFF service line & Description): 3.1 Frameworks and Strategies for Sustainable Development

Success Indicators: GHG emissions reduced by 376 kilo tonnes CO_2 (direct) compared to business-as-usual scenario, cumulative energy savings from demonstration brick kilns by about 4,100 TJ or 140 ktonnes coal, about 4.4% of brick kilns (including expected replications) are EEKs, at least 32 brick making companies developed (includes replication) and followed energy performance reporting, 2 trained local manufacturers producing equipment and/or components, 2 trained local engineering firms registered and profitably engaged in BMI support industry, BMI information services established, at least 12 banks/institutions offering loans/credit facilities for EC&EE projects, strategies and regulations for energy efficient brick kilns and minimizing land degradation.

Outcome (Project ID in ATLAS)	Outputs *(Activities in ATLAS)*	Activities (Detailed results to be produced for achievement of each output not to be inc. In ATLAS)	Timeframe				Responsible Party	Planned Budget		
			Q1	Q2	Q3	Q4		Source Funds	Budget Description	Amount (USD)
Reduction of the growth of GHG emissions from the brick making industry (BMI) in Bangladesh through adoption of energy efficient kilns and molding techniques.	*Output 1:* Thorough understanding and appreciation of technology options and their environmental impacts by brick makers, government and other stakeholders	1. Learning workshop 2. Evaluation of operating performance of 4 different types of BMI entities of Dhaka 3. Clay Resource Assessment of 2 locations 4. Design BMI Energy Reporting and Monitoring Programme including MIS system and data collection		X	X	X	UNDP	62000	72100 Sub-contract	20,810
									72100 Sub-contract	82,876
									74500 Miscellaneous	5,000
									Sub-total	**108,686**
	Output 2: Establishment of a critical mass of demonstration projects that will provide detailed information of EEK operations, energy savings and environmental impacts to interested brick makers	1. Promotional workshop at Demo Project Visit 2. Feasibility study, baseline information collection and technical design of 3 demonstration kilns 3. Business proposal development for 3 demonstration kilns 4. Technical support to construction of 1 demonstration kilns		X	X	X	UNDP	62000	72100 Sub-contract	39,096
									72100 Sub-contract	248,742
									Sub-total	**287,878**
	Output 3: Improved local vocational,	1. Training needs assessment of BMI and assessment of capacity of							72100 Sub-contract	61,722

	technical; and managerial capacity to manage and sustain operations of EEKs and EE practices in Bangladesh	existing BMI maintenance services 2. Training manual development for BMI production personnel 3. Training of 30 BMI production personnel 4. Capacity training to Brick Owners including exposure of energy efficient kiln sites		X	X	X	UNDP	62000	72100 Sub-contract	96,200
									74500 Miscellaneous	6,000
									Sub-total	**163,922**
	Output 4: Enhanced awareness of the public and other stakeholders on EEKs, EE molding practices and EEK brick products	1. Media reporting on energy efficiency brick kiln and GHG reduction 2. Consultation meeting for setting-up BMI information center		X	X	X	UNDP	62000	71300 Local Consultant	11,600
									71600 Travel	1,000
									74500 Miscellaneous	4,600
									Sub-total	**17,200**
	Output 5: Availability of financial and institutional support to encourage SME adoption of energy efficient kilns:	1. Study on potential entrepreneurs, market condition, possible financing modalities 2. Arrange financial support from 1 demonstration kiln 3. Organize 1 training for financial institutions		X	X	X	UNDP	62000	72100 Sub-contract	69,676
									Sub-total	**69,676**
	Output 6: Promulgation of and compliance to favorable policies and regulations that encourage adoption of EEKs and EE brick making practices and methodologies	1. Review of brick making rules in Bangladesh 2. Policy discuss and 1 seminar with GoB and BBOMA		X	X	X	UNDP	62000	72100 Sub-contract	9,350
									72100 Sub-contract	17,126
									74500 Miscellaneous	5,000
									Sub-total	**31,476**
	Output 7: Learning, Monitoring and Evaluation	1. Design detail monitoring plan and reporting		X	X	X	UNDP	62000	71300 Local Consultant	11,060
									71600 Travel/Mission	3,430
									74500 Miscellaneous	1,050

									15,540
	Output 8: Adaptive Management	1. Coordination and Management	X	X	X	X	UNDP	62000	71300 Local Consultant	21,400
									71400 Admin Support Personnel	6,600
									71600 Travel	7,850
									72200 Equipment & Furniture	12,478
									74500 Miscellaneous	2,000
									Sub-total	**50,328**
									TOTAL	**767,984**

- An AWP signed by the IP and UNDP hereby authorizes Fund Commitment, Disbursement and Expenditure ReportingThe Annual Work Plan is an instrument to plan the delivery of results and resources. Approval of the work plan authorizes the Project Director, Project Manager, Programme Manager of the responsible organizations to deliver the results and incur expenditures as given in the approved budget.
- AWP forms an integral part of the CPAP, and when completed, is annexed thereto and incorporated therein by reference
- This AWP supersedes any previous AWP for the period specified

Implementing Partner and UNDP agree that the following Official(s) of the Responsible Party (ies) is/are delegated for signing of the Funding Authorization and Certificate of Expenditure (FACE):
FACE signatory(ies) remain unchanged as specified in the previous AWP version.

Name and designation/Responsible Party **Signature**

1)
2)
3)

Project Manager	Country Director UNDP-Bangladesh.