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Energy efficiency and carbon abatement in the manufacture of the construction materials in India

Prepared for United Nations Industrial Development Organization (UNIDO)

TERI Project Report No. 2002CR43

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Contents

Abbreviations

BEE	-	Bureau of Energy Efficiency
BIS	-	Bureau of Indian Standards
BMTPC	-	Building Materials Technology Promotion Council
BTKs	-	Bull's trench kilns
CGCRI	-	Central Glass and Ceramic Research Institute
CO_2	-	Carbon dioxide
COP 8	-	Eighth Conference of Parties
DPR	-	Detailed project report
GDP		Gross Domestic Product
GEF	-	Global Environment Facility
GHG	-	Greenhouse gas
GOI	-	Government of India
HUDCO	-	Housing & Urban Development Corporation Ltd
IBP	-	India Brick Project
IDBI	-	Industrial Development Bank of India
IMF	-	International Monetary Fund
IREDA	-	Indian Renewable Energy Development Agency Ltd.
KVIC	-	Khadi and Village Industries Commission
LDO	-	Light Diesel Oil
MoEF	-	Ministry of Environment and Forests
MSW	-	Municipal Solid Waste

NCB	-	National Council for Cement and Building Materials
NGO	-	Non-governmental Organisation
NPC	-	National Productivity Council
PCRA	-	Petroleum Conservation Research Association
SDC	-	Swiss Agency for Development Cooperation
SIDO	-	Small Industries Development Organisation
SISI	-	Small Industries Services Institute (SISI)
Tpa	-	Tonnes per annum
Tpd	-	Tonnes per day
UNDP	-	United Nations Development Program
UNFCCC	-	United Nations Framework Convention on Climate Change
UNIDO	-	United Nations Industrial Development Organization
UPTECH	-	Integrated Technology Upgradation and Management Programme
VSBK	-	Vertical Shaft Brick Kiln

Global Environment Facility

Proposed Concept and Request for PDF Block B Grant

Country:	India
Project Title:	Energy Efficiency and Carbon Abatement in the Manufacture of Construction Materials in India
GEF Focal Area:	Climate Change
Operation Programme(s)[a]:	OP5 and OP6 (Operational Programme 5: Removal of barriers to energy efficiency and energy conservation AND Operational Program 6: Promoting the Adoption of Renewable Energy by Removing Barriers and Reducing Implementation Costs)
Requesting Agency:	UNIDO
National Counterpart Agency:	The Ministry of Environment and Forests, in close cooperation with the Ministry of Industry, Government of India
Estimated Starting Date:	July 2003
Total PDF Funding Required:	US$ 950,000
PDF Block B Requested:	US$ 710,000
Co-financing:	▪ UNIDO: US$ 121,000 ▪ Government of India: US$ 119,000
Block A Grant Awarded:	None
Duration:	15 months
Eligibility:	India ratified UNFCCC on 01 November 1993

[a] For projects proposed under the programmatic approach

1 Background

1.1 Construction Sector Context

Construction is one of the basic building blocks for India's economic progress. This is evident from the stress laid in successive Five Year Plans by the Government of India (GOI) on housing and infrastructure development projects in different sectors like Power/Energy, Oil & Gas, Transportation, Telecommunications, Urban Infrastructure, etc.

Systematic growth of the construction industry is crucial for all sectors of the national economy. Construction industry contributes around 5% to the Gross Domestic Product (GDP) annually, and accounts for 78% of the gross capital formulation. It also accounts as the single largest single element in national development expenditures. In India, around 40% of the plan provisions are being spent on construction projects. It is also one of the largest employment providers, employing around 30 million workers.

With the on-going economic liberalization and anticipated higher economic growth, it is expected that the construction industry will grow at a rapid pace providing necessary inputs for economic growth. For example, in the housing sector estimated housing shortage was around 22 million units in the year 1999. The growth rate for ten years in the urban housing stock during 2001-11 is expected to be around 40%, the corresponding growth rate in rural housing stock is expected to be around 10%. The pace of urbanization and population growth rate explains such a higher projected growth rate. Higher growth rates in the construction sector would in turn result in increased demand for construction materials. On the supply side the construction materials sector must gear up to meet this challenge in an environment friendly manner.

The construction materials sector includes both large scale and small-scale sectors. The large-scale sector includes manufacturing industries like steel, cement, ceramics, and float glass. In the small-scale sector, the industry includes brick industry, lime kilns, ceramics, foundries, and plastics. In addition, some of

the construction materials, including brick, roofing tiles, etc., are also supplied by the unorganized sector.

The manufacturing process of construction materials is highly energy intensive. A recent study on energy and GHG emissions in the construction sector has estimated that it contributes about 22% of the total GHG emissions of the country. The manufacture of the three major construction materials cement, steel and bricks also account for more than 20% of coal consumption in the country. Fuel and energy costs account for 30-50% of the production costs in these sectors.

Large scope exists for reducing GHG emissions in the manufacture of construction materials through improvements in existing manufacturing practices, adoption of energy efficient technologies and use of renewable energy. The proposed GEF intervention will focus on three sectors namely, cement, glass & ceramics, and brick. Although steel industry is very crucial from the viewpoint of output and energy consumption, it is dominated by few large-scale units having sufficient technological and financial resources. Additionally, there is a GEF proposal in pipeline for energy efficiency improvement of steel re-rolling sector. Due to these reasons, steel industry is not covered under the scope of present study on the construction materials sector. The objective is to identify various options to improve energy efficiency and reduce GHG emissions in cement, glass & ceramics, and brick industries.

The glass industry in India comprises of sheet glass and float glass manufacturers. There are around 5 large-scale float glass manufacturers using state of the art technology and were set up in collaboration with leading international companies. After the float glass entered the Indian market, the sheet glass industry has witnessed a decline with many of units closing down. Based on initial assessment of the glass industry, from the perspective of developing projects under GEF eligibility criteria, it was found that glass sector is not suitable and thus is excluded from this study.

Programmatic approach is adopted for identification/development of projects in selected industries in the construction sector. The objective of the proposed programmatic approach is to provide phased and sustained support for the implementation of a multi-year (medium to long-term) program that integrates global environmental objectives into national action plan for improvement of

energy and resource efficiency in the manufacturing of construction materials in India. From national perspective, such an integrated programme will allow for stable, phased and predictable resource flow from the GEF besides increasing the opportunity to mobilise co-financing from various donors and the private sector. This approach will also help in minimising procedural delays for project approval and reduce transaction costs. Another merit of such an approach is improved scope for catalysing action, replication and innovation. Importantly, form GEF's perspective, such an approach will help in leveraging increased country ownership and commitment to integrate and mainstream global environmental issues in national planning and development process.

Initial estimates point that it might be possible to mitigate GHG emissions in the range of 10 to 15% in ceramic and brick industries. However, for the nature of projects proposed under in the cement sector, it is difficult to estimate GHG mitigation potential at this stage.

1.1.1 Cement industry

Cement sector plays a vital role in infrastructure development, especially in a developing country like India. The Indian cement industry comprises of 113 large/medium size cement plants, spread all over the country with an annual capacity of 109.2 million tonnes and production of about 94.2 million tonnes during 1999-2000. Out of these, 64 plants have installed capacity of 1 million tonne or above. In addition, there are about 300 mini cement plants with an installed capacity of about 11 million tonnes and production of 6.2 million tonnes. The current trend is to install large size single stream cement plants of 1.2-2.5 million tonnes per annum (tpa) capacity. More than 90% of the current installed capacity of the industry is based on energy-efficient and environment-friendly dry process technology.

The cement industry in India has been radically transformed since the installation of first 100 tonnes per day (tpd) capacity cement plant based on old wet process technology in the year 1914. Innovations in technology and machinery have led the industry to an impressive technological growth and modernization. Economic liberalisation and favourable industrial policies, including decontrol of cement, has resulted in significant growth in cement production capacities. Presently, single kilns of more than 7,000 tpd capacity are in operation in India. The overall capacity, including mini plants, has been

projected to increase at a sustained rate of 8% and the cement demand is likely to be 160 million tonnes by 2006-07 and 201 million tonnes by 2009-10.

The annual turnover of the Indian cement industry is in excess of USD 6,000 million. The industry provides large direct and indirect employment to people. It is estimated that about 135,000 people are employed in the cement industry.

1.1.2 Ceramic industry

Ceramic tiles and sanitary wares form an important component of the modern construction industry. Typical application of ceramic tiles in the construction sector ranges from flooring tiles, decorative tiles, wall tiles, etc. Similarly, use of sanitary ware is indispensable in the modern construction industry. This sector has witnessed a growth rate of around 10% in past few years. With growing urbanisation and with increasing use of ceramic tiles and sanitary ware in Indian construction sector, it is expected that this industry will continue to grow.

Manufacturing of ceramic tiles and sanitary wares takes place in both large and small-scale units. Annual production of ceramic tiles and sanitary wares is estimated at around 1.5 million tonnes and 0.3 million tonnes respectively. Approximately 50% of these annual productions are accounted for by the small-scale industries.

There are around 6-7 large firms each in the tile and sanitary ware industries. These firms have several large-scale manufacturing units in different parts of the region and incorporate state of art technologies. Most of these units were set up in technical collaboration with leading ceramic tile/sanitary ware manufacturers in the world. For example, Johnson's is an internationally reputed multinational company manufacturing ceramic tiles in India. These firms are financially and technologically capable of investing in modernization and upgradation.

Small-scale industry has an important role to play in the overall development of the ceramic industry in the country. In small-scale sector, ceramic tiles and sanitary wares are produced mainly in the state of Gujarat. There are around 200 small-scale units manufacturing ceramic tiles and sanitary ware in Gujarat. Most of these small-scale units in Gujarat are located in different clusters at Morvi, Than, Himmatnagar and Naroda (Ahmedabad). There are around 70-80 units manufacturing ceramic tiles in the Morvi cluster. Additionally, there are around 20-30 units making ceramic tiles in other nearby clusters (Than and

Himmatnagar) in Gujarat. Apart from these, few small-scale ceramic tile industries are also operating in Maharashtra, Rajasthan, and Madhya Pradesh. However, the number of small-scale units in these states is low compared to that in Gujarat.

The ceramic cluster at Than is mainly populated by small-scale sanitary ware industry. Industry estimates point out that there are around 80-90 sanitary ware units operational in this cluster. There are around 10 sanitary ware units also operating in Morvi cluster.

Since large-scale units are few in number and are technologically much advanced than their counterparts in the small-scale sector, the proposed intervention will focus on improving the energy efficiency and productivity of small- scale units. As compared to the larger units, small-scale units do not have sufficient technological, financial and institutional capacity to upgrade and modernise their production process. These aspects are highlighted in more detail in the section dealing with "Barriers".

1.1.3 *Brick industry*

Common fired clay brick is one of the important building materials in India. Bricks are used as walling material in most residential and commercial buildings. They are also used for other applications, e.g. road and canal construction. India is the second largest producer of bricks in the world next to China. The estimated brick production during the year 2000–01 was 140 billion[a]. The brick production is estimated to grow at a rate of 4% per annum.

Bricks are produced at village and rural enterprise levels. The sizes of brick units are much smaller in the rural areas. However, the size of brick producing units is much larger in peri-urban areas and clustering of brick making units is quite common. Regional variations are also observed in the size and scale of the brick production units. The total number of brick making units is estimated at around 100,000.

[a] A detailed census of the brick industry in the country has not been carried out. As most of the brick units are not registered with the government, they are also not covered under small-scale industry census of GOI. The data presented here are estimates, primarily based on information received from brick manufacturer's associations and state level sample surveys of brick industry.

Traditional technologies are used for brick production. In general, bricks are hand moulded, sun dried and fired in a kiln. The entire process of brick making is manual and brick industry estimated to provide employment to 8 million workers[a].

Brick firing is an energy-intensive process. The annual estimated coal consumption in brick industry is 24 million tonne, which forms about 8% of total coal consumption in India. Apart from coal, large quantity of biomass fuels is also consumed by the Indian brick industry. The share of fuel in total production cost of bricks is in the range of 35% to 50%. The total estimated expenditure on fuel by the Indian brick industry is in excess of one billion USD.

'Bull's trench kilns (BTKs)' and 'clamps' are two prominent firing technologies used for brick making in India. BTK is continuous type kiln and has higher production capacities (15,000 –50,000 bricks per day). It also has better energy efficiency compared to clamps. BTKs account for 70% of the total brick production in the country. Coal is the main fuel used in BTKs.

Clamps are used for smaller production levels. A variety of fuels such as coal, firewood, various types of agricultural residues and dungcakes are used in clamps. Large variations in the shape, size, stacking of bricks and firing techniques are observed in clamps. Generally, energy efficiencies of clamps are lower.

Two types of air pollution are concerned with Indian brick kilns namely, stack (chimney) emissions and fugitive dust emissions (observed during brick stacking and unloading operations). Regulations specify the maximum permissible concentration of suspended particulate matter (SPM) in flue gases from the stacks of BTKs. These norms range between 750 to 1000 mg/Nm^3.

As a result of the provisions of the standards, several thousand moving chimney[b] BTKs (particularly in northern and eastern India) have been converted to fixed

[a] Brick making is a seasonal activity in India, generally carried out during the dry season. Most of the workers in brick kilns in the peri-urban areas are agriculture labourers, who migrate to brick kiln sites during the agricultural off-season.

[b] Moving chimney BTK employed one or two metal chimneys (around 50 feet in height). Fixed chimney BTKs have brick masonry chimneys (height ≥ 82 feet)

chimney type. Performance monitoring of the fixed chimney BTKs indicates decrease in the level of SPM concentrations from the stack.

However, the task of shifting towards moving chimney BTKs into fixed chimney, had been slow in many of the states and occurred in an ad-hoc manner [a]. As a result, majority of the new kilns does not fulfil all the criteria specified by the emission standards. The kiln conversion process had been hampered by the non-availability of appropriate technological alternatives (particularly for small moving chimney BTKs) and shortage of skilled masons for constructing fixed chimney kilns.

On the positive side, the implementation of the standard has helped in improving awareness among brick kiln owners regarding energy efficiency and air pollution. The need for energy efficient and less polluting brick kiln technologies has been realised, and some progress has been made in the form of development of fixed chimney BTK designs as per regional requirements and introduction of energy efficient Vertical Shaft Brick Kiln (VSBK) in the country.

One of the problems associated with Indian brick industry is regarding the use of good quality topsoil from agricultural fields for brick making. Usually, the depth of soil excavation is shallow and usually ranges from ½ – 2 metres. The unplanned and unregulated exploitation of good quality agriculture soil for brick making has been a major area of concern. Present level of production requires around 540 million tonnes of soil. Assuming an average depth of excavation of 0.75 m, around 500 sq. km of agriculture land is adversely affected by brick production every year.

The Indian brick industry produces mainly one product i.e. red coloured, hand moulded solid brick. For long-term sustainability of brick industry, it is important to diversify the product range and move towards products that are less resource intensive and fulfil market requirements. Production of less resource intensive clay products and use of alternate building materials can result in significant conservation of topsoil.

[a] Except Punjab, where a state government agency (Punjab State Council for Science and Technology) played an important role in providing the fixed chimney BTK technology to brick producers.

1.2 Government policies and initiatives

Development of infrastructure, housing and industry are foremost priority of the GOI. Successive plan documents have highlighted the importance of infrastructure and industrial growth. The approach paper to the Tenth Plan of GOI also outlines the importance of all these sectors in the overall economic development of the country.

To promote energy conservation in the various sectors of the economy, the GOI has recently passed the Energy Conservation Act, 2001. The Act has provisions for various mandatory and voluntary measures to promote energy efficiency in the industry and commercial sector. The provisions of the Act cut across all the sectors of the industry and other energy users. The Act has a special mention of improving energy efficiency in selected "designated consumers" of energy that are major consumers of energy. The list of designated consumers also includes a few industries in the construction materials sector like cement, iron and steel, and aluminum. The Act also recognizes commercial buildings or establishments as designated consumers. The Act however, does not specifically address the issue of energy efficiency in small-scale industries.

To promote energy efficiency in industry, a Bureau of Energy Efficiency (BEE) has been set up at the national level. For designated consumers, various provisions to promote energy efficiency include energy consumption norms, energy audits, energy management plans, etc. The Act, through its implementing arm – BEE, proposes to establish energy consumption process norms for major process industries, referred to in the Act as 'Designated Consumers'.
Similarly, the GOI has taken up a number of initiatives to address the issue of climate change. The Ministry of Environment and Forests is the nodal agency that deals with issues related to climate change and GHG emissions. The Ministry's commitment to global environment issues is also evident from the fact that India hosted the Eighth Conference of Parties (COP 8) in New Delhi in the month of October 2002.

There are a number of institutions (e.g. TERI, National Productivity Council (NPC), Petroleum Conservation Research Association (PCRA), etc.) working in the fields of energy conservation and energy efficiency for the Indian industry. In addition, there are other sector specific institutions that provide support to industry in sectors like cement, glass & ceramics, steel, etc. These institutions

have been providing support in form of R&D, technical services (energy audits), marketing support, etc. to the industry.

Apart from Energy Conservation Act, which was passed by the Parliament of India in 2001, the GOI has taken various initiatives in the past to help improve the energy efficiency in the industry. These initiatives are launched both through bilateral/multilateral funding and through direct government support at the centre/state level and help in creating an enabling environment for improving energy efficiency in Industry.

1.2.1 Small-scale industries

There are about 3.23 million small-scale industrial units in India. The small-scale sector plays a vital role in Indian economy. The sector has emerged as a dynamic and vibrant partner in the process of development by consistently recording higher levels of growth as compared to overall industrial growth. Small-scale industries not only generate large-scale employment but also help in industrialisation of rural and backward areas, thereby reducing regional imbalance, and leading to equitable development. Over the past five decades, a number of policy initiatives have been taken by the GOI to develop cottage, tiny and modern small-scale industries in the country.

To enable modernization and technological upgradation of the small-scale units, the Ministry of Small-scale Industries and Agro & Rural Industries, GOI, has launched a modernization and technology upgradation programme. Various activities under this programme include: i) Integrated Technology Upgradation and Management Programme (UPTECH), ii) Incentive Scheme for Acquiring ISO- 9000 Certification, iii) Awareness & Motivational Programme on ISO – 9000, iv) Energy Conservation, and v) Technology Trust Fund. The Ministry of Small-scale Industries and Agro & Rural Industries, through its various agencies conducts training programmes for improving the level of awareness about various issues related to energy, environment and quality.

TERI has undertaken significant work in the small-scale industries namely glass, foundry, brick and ceramics. In the three sectors, glass, foundry and brick, TERI has been involved in technology demonstration activities and subsequent large-scale diffusion of energy efficient and environment friendly technology. In the ceramic sector, TERI has been involved in carrying out detailed diagnostic study

for pottery industry at Khurja, which resulted in identification of various implementable measures for energy conservation.

1.3 Link to on-going activities

India has no GEF assisted project activities in the industries short-listed in the construction sector. Although a number of multi/bilateral agencies and donor partners such as World Bank, Asian Development Bank, UNIDO, UNDP, Swiss Agency for Development Cooperation, GTZ of Germany, etc have been working towards improving the energy efficiency in Indian industry, there has been no coordinated and integrated program as such for the construction materials sector.

1.3.1 Cement industry

In the scenario of economic liberalization the cement industry is undergoing a consolidation phase involving mergers and acquisitions. The industry has been improving its performance on the front of energy efficiency and energy conservation by way of adopting new generation technology and upgrading their plant and processes. Majority of improvement in energy efficiency has taken place based on industry's own initiative to reduce specific energy consumption and cut costs. Cement industry is one of the 'designated consumer' as defined in the Energy Conservation Act, 2001. Majority of plants carries out regular energy audits of their facility in order to identify areas for energy efficiency improvement. There are several energy auditors like TERI, National Productivity Council (NPC) and National Council for Cement and Building Materials (NCB) that provide such services to cement industries.

Given its role in the Indian economy, the cement industry has always been given priority by the GOI. National Council for Cement and Building Materials (NCB), an autonomous institute under the Ministry of Commerce and Industry, has been functioning for decades to promote the developing of cement and other related industries in the building materials sector. NCB is an apex body dedicated to continuous research, technology development and transfer, education and industrial services for the cement and building material industries.

1.3.2 Ceramic industry

There are no long-term programs to improve the energy efficiency of small-scale ceramic units in Than and Morbi. Small Industries Services Institute (SISI),

under the Ministry of Small-scale Industries and Agro & Rural Industries, has its office in the Ahmedabad. SISI-Ahmedabad has been providing assistance to the local industry in the forms of conducting training programmes in quality improvement and other related activities. The regional office of Central Glass and Ceramic Research Institute (CGCRI) near Ahmedabad provides technical assistance to the local industry for improving product quality and productivity.

There are also few local industry associations in Than and Morvi that collectively represent the member units on specific business related issues. These associations are mainly commercial associations.

1.3.3 Brick industry

Most of the brick making units are not registered and hence remain outside the organised SSI sector. The sector has not got due attention from policy makers in terms of modernization and technology upgradation. The recent initiatives by the government pertain only to the environmental regulations concerning (i) stack emissions related to SPM and (ii) use of fly ash for brick making (Fly ash technology mission).

Few R&D agencies in the government sector are active in the development and dissemination of improved brick making technologies and new clay fired products. The two agencies, which have carried out substantial work, are the Central Building Research Institute (Roorkee) and Punjab State Council for Science and Technology (Chandigarh). Other government agencies which carry out promotional activities in the Indian brick sector are the Khadi and Village Industries Commission (KVIC), Building Materials Technology Promotion Council (BMTPC), Small Industries Development Organisation (SIDO) and HUDCO.

One of the bilateral development agencies, the Swiss Agency for Development and Cooperation (SDC), New Delhi is supporting a project to improve energy efficiency in brick industry. The project, called 'India Brick Project (IBP)' was initiated during 1995 and concentrates mainly on the transfer and dissemination of 'Vertical Shaft Brick Kiln (VSBK)' technology. TERI has played a lead role in this project along with a network of other project partners in the following states – Madhya Pradesh, Maharashtra, Uttar Pradesh and Orissa. Demonstration projects were carried out at regional level to anchor the technology in different regions of the country. The project has contributed in increasing awareness

regarding energy efficiency improvements in brick industry in its areas of influence. It has also resulted in the strengthening and increased cooperation among the institutions associated with the brick sector.

2 GEF Alternative

2.1 Problem statement

The cement, ceramic and brick industries have significant potential to improve energy efficiency. In order to achieve long-term benefits of improved energy efficiency and associated GHG emission reductions it is crucial to identify and remove barriers to energy efficiency improvement in the selected construction materials industries. These barriers include technical, financial, information, institutional and capacity building related barriers. Under the proposed programmatic approach, the case of each of the three industrial sectors is given below.

2.1.1 Cement industry

Indian cement industry represents a mix of small/large, old & inefficient/modern and state of the art plants. Although majority of routine energy conservation measures has already been adopted by most of the large plants in the cement industry, efforts to introduce cogeneration technology/system, have largely met with failures due to various barriers, mainly technological risks associated with it.

Similarly, use of wastes in Indian cement industry is very limited. The use of waste materials as alternative fuel and for substituting raw materials is very limited. There are issues such as continuous availability of these materials in stable quality and prices, which restrict higher usage by the plants. User apprehensions about the quality of cement produced from wastes also needs to be addressed to increase their acceptability in the market. City waste/Municipal Solid Waste (MSW) has not been tried out for use in the cement plants in India. In this case, there are also deficiencies in waste supply management infrastructure that need to be addressed.

Based on the availability of waste materials, there is a vast potential to step up utilisation of various types of waste materials in cement manufacturing resulting in societal benefits and resource conservation.

2.1.2 Ceramic industry

Production process in small-scale sanitary ware and ceramic tile units is relatively inefficient compared to that in large industries. Also, SSIs are endowed with fewer technological, financial and human resources than the large-scale enterprises. These factors significantly limit the capacity of these units to innovate and improve their energy and environmental performance over time.

Development of technological, institutional and human capacity, along with demonstration of selected technological options to reduce energy consumption, in small-scale enterprises represents a viable option to achieve long-term sustainable growth of the small-scale tile and sanitary ware sector. Clustering of these units makes it more lucrative from the point of view of making an effective and efficient intervention.

2.1.3 Brick industry

Brick industry provides major inputs to the construction industry. In India bricks are produced in traditional kilns in the unorganised small-scale sector. The brick industry is very energy inefficient and is also responsible for local air pollution and topsoil degradation. The industry is stagnant on energy and environmental fronts for several years. In order to improve the energy/environment performance of the brick industry, it is imperative to improve the operations of the traditional brick kilns, besides introducing new products and processes in the brick-making sector.

2.2 Baseline

The baseline is provided at industry level in order to prepare specific projects and quantify the benefits.

2.2.1 Cement industry

The cement industry in India is estimated to consume about 9 billion kWh of electricity annually. The power requirement of the industry is presently met through the national grid power and the captive thermal or diesel power generators. Due to erratic power through the grid, many cement plants have set up captive generation plants to meet whole/part of their electrical load demand. Although there is significant cogeneration potential in the Indian cement industry, the same has not been exploited for past several years. It is estimated

that about 30-40% of electricity demand of cement industry can be met through cogeneration. Cogeneration technologies have been successfully demonstrated in other parts of the world including Japan, China and Southeast Asia. There is adequate international operating experience to prove that the available technology is feasible and there is not so much a case of developing new technology by carrying out R&D. However, the Indian cement manufacturers have shown reluctance to adopt the cogeneration technology due to a number of barriers, mainly technological and financial risks associated with it. These barriers need to be overcome, by identifying the technical, financial and institutional interventions that would enable the technology to be adopted by the Indian industry.

Around 15 million tonnes of energy equivalent of coal is required by the Indian cement industry to meet the existing domestic demand of cement. This represents a significant use of non-renewable primary fossil fuel, and therefore even replacing a part of the current usage of coal will have significant impact on industry, as well as on the society at large. The total CO_2 emission from Indian cement industry is estimated to be about 97 million tonnes in the year 1999-2000. Use of alternative fuels is a proven and established technology in most of the European cement industry and this has been the case for more than 10 years. For example, about 10% of the thermal energy consumption in the European cement industry originates from alternative fuels, which is equivalent to 2.5 million tonnes of coal. The proportion is gradually increasing and figures above 50% are already achieved in certain regions. In Europe and USA, a large number of plants utilized 'used tyres' conserving around 15% of coal. In contrast to the international scenario, the Indian cement industry utilizes limited type of waste (mostly agriculture residues), in a very limited quantity. Only few plants, which are located within the economic distance of waste generation sites, are in a position to utilize these wastes. In India, the waste materials that the cement industry can utilize as alternative fuels include 'used tyres', MSW/city waste, rubber, paper wastes, waste oils, waste wood, paper sludge, sewage sludge, plastics, agricultural residues, and spent solvents. Under the business as usual scenario, it is expected that industry will not take any proactive approach to utilize wastes in their plant. Similarly, other barriers related to sustained supply of waste, technology, institutions etc. are expected to delay the effective utilization of wastes in cement kilns.

2.2.2 Ceramic industry

The small-scale ceramic tile and sanitary ware units are characterised by energy inefficient operations and low awareness about energy efficiency options. These units usually do not have enough capacity to upgrade their production process and adopt energy efficient technological options. Moreover, off-the-shelf technological options are not available to these units for improving their performance. There is also lack of enabling environment (in terms of human and institutional development) to promote energy efficiency in these industries.

There is great deal of similarity among ceramic tile units in terms of technology employed and production process. The proposed project will focus on improving the energy efficiency and mitigating GHG emissions in small-scale ceramic tile and sanitary ware industry.

The small-scale ceramic tile industry in Gujarat is relatively new. The cluster of industries around Morvi came into existence in early 1990s and the number of units is still growing. As mentioned earlier, there are also some tile making units in Than and Himmatnagar ceramic clusters. Present daily production capacity in Morvi cluster is around 200,000 square meter of glazed tiles and around 50,000 square meter of floor tiles.

Growth in production capacity of sanitary ware industry cluster at Than has stagnated to a large extent. Few new units are coming up in the Than cluster and the industry is under a consolidation phase.

Majority of ceramic tile units uses continuous firing tunnel kilns for firing their products. These kilns are of varying sizes (i.e. production capacity), but the basic design features of all the kilns are very similar. Recently, a few units have also been set up in Morvi using imported Roller Hearth Kilns (mostly second hand plant from Italy). Initially, all the ceramic units in Morvi and elsewhere were using liquid fuel (LDO – light diesel oil) for firing in the kilns but now the trend is to use producer gas in the kilns. Main reasons for the fuel shift are: (a) increased fuel cost; and (b) increased market competition forcing the prices of tiles downwards. The producer gas is manufactured by firing mainly wood charcoal/coal (cheap imported coal in some cases), but in few cases biomass briquettes are also used.

In a typical tile manufacturing kiln, having an output of 28 tonnes per day, around 6MT of charcoal (equivalent of 4200 litres of kerosene) is consumed. The specific energy consumption will vary among different units depending on the type of product being fired and size of the kiln. Other small design variations between furnaces can also have influence on the specific fuel consumption of kilns.

Tunnel kilns are also used in the sanitary ware units. Sanitary ware units use only liquid petroleum fuel (LDO) for firing, presence of impurities in the producer gas make its use undesirable. Typically the size of tunnel kilns used in sanitary ware industry is smaller than that used in the tile production.

Estimated CO_2 emissions from the sanitary ware and tile making units in Gujarat (Than and Morvi) are expected to be around 525, 000 tonnes per annum.

In term of energy efficiency, there is scope to reduce the specific energy consumption (around 10%) in the kilns by incorporating incremental changes in technology, adoption of energy efficient devices and better housekeeping measures. TERI's experience of working in other small-scale industries in India indicates that significant energy savings can be achieved through improved housekeeping measures and through incremental technological changes.

From the perspective of regional development, small-scale ceramic clusters in Gujarat contribute to local economic growth and provide employment opportunities for many in the region. In addition to the sanitary ware and tile units, there are a number of units that make stoneware crockery. Intervention in the sanitary ware and tile industries will therefore have a potential for spill over benefits in other industrial clusters as well.

Competition within the country and from imports is putting increasing pressure on the industry to minimize their costs. Incremental changes in technology represents a very good option for the industry to keep minimizing their costs in the long-term.

In the baseline (without support from GEF), it is expected that majority of the units will keep operating with the same technology and operating practices. Lack of technological capacity of the units will be a barrier to improve their

technological performance and progressively improve their energy consumption. Inefficient operation of units will result in significant wastage of energy resulting in higher production costs and higher environmental damage (in terms of GHG emissions). The proposed GEF alternative will focus on developing technological and institutional capacity for upgradation and modernization of the small-scale units with special significance to replication/spill over benefits and incremental technological changes.

2.2.3 *Brick industry*

The technologies used for firing the brick and the size of kilns vary among different regions of the country. Overall, the industry is marred by inefficient use of energy and resources. There exists significant scope for improving the energy efficiency of the small-scale brick kilns. It is possible to reduce energy consumption by 5 - 15% by the way of making incremental improvements in technology. However, under the business as usual scenario the industry will keep operating inefficiently and will result in higher emissions of GHGs. It is estimated that baseline emissions of the brick industry will be around 40 million tonnes of CO_2 per annum.

The brick industry has witnessed technological stagnation over the years. Level of mechanization and technology of brick making and firing remain primitive compared to those in other developed and developing countries.

Without technological, financial and institutional support, diffusion of energy and resource efficient technologies is expected to be very slow and not uniform. Similarly, introduction and diffusion of new kiln technologies such as tunnel kiln and production of alternate building materials will not happen on its own.

Another major challenge associated with technology upgradation and modernization in the brick industry is related to development of technological capacity of the industry. The present level of technical skills of workers/operators in the brick industry is poor. The institutions are also weak and industry does not have sufficient financial resources to bring about the required change.

In the baseline, it is expected that the process of change will be very slow. Given the fact that industry has limited financial and technological capacity, the change process will be governed largely by the rate and direction of support

provided under various bilateral and national programmes to upgrade and modernize the brick industry.

2.3 Barriers

Depending on the initial assessment carried out for each of the three industrial sectors, the specific barriers to energy and resource efficiency are given below.

2.3.1 Cement industry

Main barriers towards adoption and diffusion of cogeneration technology and utilization of waste in the cement plants are given below:

Information barrier

- Lack of awareness in the industry about the technology, potential benefits, and sources of cogeneration technology
- Lack of information about the potential of using waste in cement plants
- Apprehensions, at both manufacturers and users end, about the use of waste material in the kiln and uncertainties about the impact on the quality and property of final products
- Perception as "waste disposal activity": the notion that the project activity of utilizing waste in the kilns is simply an alternative waste disposal mechanism with little or no environment/social benefits is a major barrier to large scale waste utilization in cement plants
- Lack of awareness of market opportunities: inability to identify and capitalize on sources of waste in the region that could be usefully processed

Capacity building

- There is lack of technological capacity in the industry to design and implement projects related to cogeneration and utilization of wastes.

Financial Barriers

- Financial risk: The cost involved for setting up a medium sized cogeneration project is reasonably established in the international market. Since the typical costs of these technologies are in the range of US $ 4-8 million, financing schemes will have to be evolved jointly with the promoters and various state and private funding institutions. Based on discussions held with the two manufacturers, it was observed that the availability of finance by itself did not pose a large problem, however,

reluctance to absorb the risk due to uncertainties over the performance of technology/equipment was a major constraint.

- Financial support will be needed to develop waste management system and to demonstrate waste utilization system in cement plant. Significant financial support will be needed to develop supply chain system including waste identification, collection and transfer to the site.

Technological barrier

- With regard to cogeneration systems, on of the technical constraint is non-availability of indigenously demonstrated technology and design of waste heat recovery boiler suitable to withstand high dust load in the waste gases peculiar to the conditions prevailing in Indian cement plants.
- Lack of systematic approach to identify most suitable technology: many configurations of cogeneration technology are available in the world market. Identifying the most suitable features of the specific technology available on the world market and applying this technology to the Indian cement manufacturing industry remains to be explored in a systematic way.
- Waste management infrastructure deficiencies: the proper collection, transport, and disposal systems for industrial/agricultural waste are lacking. This may create problem in continuous availability of the waste material in the required quantity to the cement plant. The remote locations of most of the Indian cement plants may also entail higher transportation cost of waste materials to the plant site.
- Changes might be required in the raw material preparation and stringent quality control would be required at every stage in order to ensure that the final product quality does not suffer. Technical and qualitative analysis is imperative to convince the stakeholders and user segment. Greater role to be played by the GOI and R&D institutions.

Institutional/Regulatory Barriers

- The existing electricity tariff policy based on cross subsidy between the various electricity purchasing sectors, the cement producers are locked in by the electricity suppliers to take or pay contracts, which discriminate against cogeneration. It will be necessary to consider the local state legislation and regulatory mechanism, which will have impact on the additional generation.

- Existing regulations/standards prescribed for the cement industry are not conducive to promote the use of waste materials.
- Environmental or Human Health Damage: evidence or perception that waste burning causes or could cause environmental or health impacts in the local area needs to be studied and explained to the stakeholders
- Lack of supportive policy to encourage cement industry to utilize waste products.

2.3.2 Ceramic industry

There are several barriers to the adoption and diffusion of energy efficient and environmentally sound technologies in the small-scale ceramic industry in Gujarat. Major barriers are given below.

Technological barriers

- For small-scale industries, off-the-shelf technological solutions to improve energy efficiency are usually not available.
- Most furnaces/equipment are locally fabricated and duplicated without an emphasis on improving energy efficiency.
- Local fabricators/equipment suppliers are not adept in providing energy efficient solution to the industry.
- Technical skills of the units are limited and/or non-existent to bring about conservation of energy in the kilns. The entrepreneurs are not technically aware to take lead in this regard.
- The production and maintenance staff employed in the units is mostly non-technical. Therefore, they have a limited capacity to innovate and implement small technical measures on their own.
- Low level of automation and control and slack in energy monitoring of plant and equipment.

Information and awareness barrier

- Limited availability of information about energy efficiency and various energy efficiency options.
- Lack of awareness in the cluster about the potential of energy conservation. Main emphasis of the units is on production and only by adopting an integrated program (including analysis, demonstration, capacity building and information dissemination) on energy efficiency can the units be encouraged to adopt energy conservation measures.

- Lack of awareness in the industry on the issue of climate change and inter-linkages between energy efficiency and climate change.
- Lack of awareness in the industry about energy, environment and sustainable business.

Institutional and other barriers

- Lack of technological capacity of local institutions like respective industry associations, consultants and other nodal agencies.
- Lack of a programmatic and integrated approach to tackle information and awareness related issues.
- Lack of demonstration of technological options to establish the efficacy of any energy efficiency project for further replication by other units in the cluster.
- Lack of long-term focus on the sustainable supply of fuel to industries in the cluster.

2.3.3 Brick industry

Following barriers, which may differ in degree across regions, exist in adoption and diffusion of new energy and resource efficient technological options.

Information barrier

Limited interaction takes place among brick makers belonging to different clusters/regions. The district, state and national brick industry associations, to some extent, provide a platform for interaction among brick makers. However, the membership of such associations is limited and is restricted only to large brick producers. There are no publications or regular events to exchange information related to technology. Most of the brick makers are not educated which is also a barrier to information dissemination. Scattered location of brick kilns makes the task of information dissemination more challenging. In the absence of efficient information dissemination system, penetration of new technologies is expected to be slow.

Also, the awareness regarding types, quality and possible applications of different types of building materials remain poor among end-users and professionals from building industry e.g. civil contractors, masons and architects. Hence, creation of awareness among end users assumes importance particularly for creating market for alternate building material products.

Technology barriers (Perceived risks of technologies)

Introduction of new technology in a new region, requires a phase of demonstration and technology adoption to local conditions. This is necessary to fine-tune the technology as per the local conditions e.g. raw materials, market, skills etc. Very few individual brick owners have sufficient capacity to undertake this task. Hence external support for such initiatives is crucial.

Successful adoption of new technologies also requires new technical and managerial skills/capability among workforce. The present levels of technical skills available with the industry (for workers/fabricators/owners etc.) are poor. Support is required for developing the necessary technical and operational skills for the workers.

Market barriers

Availability of sufficient number of technology service providers for supplying technical solutions to the brick industry is limited. This results in poor accessibility and higher costs for new technology options.

Marketing of new building materials requires a large promotional exercise, which is beyond the capacity of individual producers.

Financial barriers (Lack of access to credit)

Technology upgradation requires new investments. Majority of the brick manufacturers is not able to access institutional finance as they operate outside the organised small-scale industry system and find it difficult to fulfil the terms and conditions for availing institutional finance.

Institutional barriers

Few institutions (e.g. brick manufacturers associations, R&D institutions, NGOs, and government promotional agencies) are active in the brick sector. Brick manufacturers' associations are involved mainly with lobbying for favourable policies/ concessions for the industry. Few R&D institutions are involved in developing technical solutions for brick industry. Limited success has been achieved by NGOs and government agencies involved in technology dissemination since their capabilities and geographical coverage are not adequate. The capacity and outreach of various institutions operating in brick industries is limited. The limited capability of exiting institutions is a major

barrier in implementing an integrated national programme for technology upgradation and energy efficiency improvement in brick industry.

Policy barriers

Policy initiatives by the government in brick sector have been restricted only to environment regulations. On the other hand there is no comprehensive government policy for modernisation of this traditional industry. Despite the fact that the brick industry is a large consumer of energy (mainly coal), there has been no specific programme to improve the energy efficiency of brick kilns.

These barriers must be addressed in order to promote energy efficiency and mitigate the emission of GHGs in the long term. Lack of a comprehensive program to improve energy efficiency will result in only piece-meal approaches by various government bodies and institutions providing fragmented solutions to the problems.

2.4 GEF Alternative

2.4.1 Overall programme objectives

The objective of the entire programme is long-term improvement in energy efficiency and GHG mitigation (approximate CO_2 abatement of 2.3 million tonnes per annum, assuming adoption rate of 15-50%) in selected industries in the construction material sectors. Keeping this broader objective in mind, the specific objectives at industry level are identified as follows. The specific industry level objectives are defined keeping in mind the composition of the industry (the issue of large vs. small) and other factors that influence the energy and resource efficiency.

Cement industry

The overall objective is to improve the productivity and competitiveness of the cement industry by identifying, assessing and demonstrating certain projects having significant long-term bearing on the energy efficiency and CO_2 emissions. The proposed project is expected to have large impact on industry in terms of large-scale adoption and diffusion of demonstrated technologies. The project would systematically address all the barriers related to adoption and diffusion of selected technologies in India.

Ceramic industry

Energy efficiency improvement in ceramic tile and sanitary ware units will meet twin objectives of improving the competitiveness of the small-scale units and mitigating GHG emissions in the long-term. Holistic approach will be taken to improve the energy efficiency in the small-scale ceramic tile and sanitary ware units.

The project will be based on the following strategic principles:

- Detailed baseline study to prepare a blue print for the proposed interventions in the small-scale ceramic tile and sanitary ware industry.
- Demonstration projects based on the outcome of the baseline study to prove the techno-economics of the suggested technical measures.
- Dissemination of the results of success of demonstration projects to various stakeholders in the industry to enable wider adoption and diffusion of the demonstrated technological measures.
- Capacity building and strengthening of local institutions (like industry associations, financial institutions, commercial banks, etc.) with regard to energy efficiency and energy conservation.
- Development of technical capacity at cluster level through targeted training programs and workshops. Separate capacity building modules for entrepreneurs, production staff managing the units and fabricators.

Brick industry

The overall objective will be to address barriers in the promotion of alternate options for brick making aimed at improving resource use efficiency in brick industry and ensuring long-term sustainability of building material supply. The project would focus on promoting the following:

- Energy conservation in brick firing: Improving designs and operation of existing brick kilns; and dissemination of energy efficient technologies for brick firing
- Use of less resource intensive building materials: clay fired products (Perforated bricks, light weight insulation bricks); non-fired products; and cement blocks, soil blocks, Fal-G brick, lime /cement stabilized soil blocks, calcium silicate bricks
- Use of renewable energy in brick making: use of locally available agriculture residues for brick firing (help in replacement of coal)

2.4.2 Project Components

UNIDO and the Ministry of Commerce and Industry, GOI, have agreed to support a number of activities under a programmatic approach for Indian building material manufacturing sector. The proposed programme component deals with the initiatives to be undertaken to achieve long-term and sustained energy and resource efficiency in Indian cement industry, small-scale ceramic and brick industries. Possible sub-components for each industrial sector under the programmatic approach are identified. These project components are tentative and will be refined upon during the PDF phase.

Cement industry

Sub-project 1: Demonstration of co-generation technology in India

For implementation of the proposed activity in the country, following activities will be undertaken.

- Preparation of detailed project report and identification of partner

Based on the findings of the PDF B activities, this activity will involve identifying partners for setting up demonstration projects for cogeneration technology. This activity would also involve finalization of the configuration of the technology to be imported and identification of international technology supplier as per the required terms and conditions.

- Demonstration of cogeneration technology

The above mentioned technology will be demonstrated in the selected plant(s). The number of actual demonstration plants would be based on the discussion with the relevant stakeholders. The demonstration phase would involve detailed engineering, technology transfer, erection and commissioning.

- Training/capacity building

This would be the core activity of this sub-project. Training and capacity building of various stakeholders would be carried out based on specific requirements. The purpose of this activity would be to complement the hardware and project management capability developed in the technology demonstration phase.

- Dissemination of the results

The success story of the cogeneration plant would be disseminated to the industry and other stakeholders through workshops/seminars, field visits to the

demonstration site and through publishing and distribution of brochures/written materials on the demo project(s).

- Preparing conducive policy (strategies/action plan) to help accelerate adoption by other plants

Multi-stakeholder discussions and seminars would be conducted with policymakers and representatives from concerned government ministries for making the policy and regulatory regime conducive to promote cogeneration technology in Indian cement industry.

Sub-project 2: Enhanced use of various waste materials as alternative fuel and raw material in the manufacturing of cement

Under the proposed sub-project, the following activities would be carried out:

- Preparation of detailed project report (DPR)

A detailed project report will be prepared, considering the selected site for setting out the demonstration project (s). The DPR will address all technical, economic and financial issues concerning the project. The DPR will also assess the scope of work for capacity building, information dissemination and sustainable supply of waste materials. Any issues and concerns regarding the use of any specific waste and its effect on human health would also be explored in great detail in the DPR. The completion and acceptance of DPR will form the basis for proceeding with the execution of the project in totality.

- Awareness generation

Workshops and seminars would be organized for awareness building regarding the social and environmental impacts from the project implementation and to highlight the aspect of resource conservation. The workshops/seminars would also result in market development and are expected to create demand for such products and thus spur growth in production. Concerns and issues of various stakeholders would be addressed in these workshops.

- Establishing supply chain management system (brokerage entities)

In order to achieve high levels of waste utilization, it is imperative to have efficient and systematic waste supply system. This would require setting up facilities/capacities and infrastructure for waste segregation, waste collection,

and transport to concerned plant. Majority of background work on these issues would be carried out in the DPR phase.

- Demonstration

Setting up the demonstration project would involve engineering, procurement, and erection and commissioning of the plant. The technical assistance would be sought from technical partners identified in the DPR phase.

- Training/technical support workshops

Capacity building programs would be organized for:

- Issues related to storage, treatment, handling, drying and preparation of raw meal of waste at site
- Modifications required in the feeding system and/or firing system
- Issues related to kiln stability/operation
- Additional controls and parameter monitoring
- Issues related to quality of clinker produced

The training and capacity building components will be in line with the activities of the BEE and will in a way strengthen the work carried out by BEE for the cement sector.

- Preparing conducive policy (waste management), including national standards (based on performance)

Policy dialogue would be initiated with all relevant stakeholders to create comprehensive enabling environment for proper waste management and waste utilisation. Bureau of Indian Standards (BIS) will also be involved in the process of developing any process/equipment for waste utilisation.

This dialogue can also be initiated at programme level to look into the ways and means for promoting the use of biomass and other renewable energies in the manufacture of construction materials in India.

Ceramic industry

(a) Demonstration projects in representative sample units

The objective of the demonstration projects would be to address technological risk involved in adoption of new technological option. The project envisages few demonstration projects to cover the cluster specific requirements for demonstrating selected technological options.

Number of demonstration projects will be selected in consultation with the local industry associations and will take into account the geographical concentration of industries. Such projects will largely include incremental technological changes that will lead to improved energy efficiency and lower associated GHG emissions. Local fabricators/suppliers/ consultants will be involved during the demonstration projects to develop their technological capacity.

The demonstration projects will meet the objectives of:

- Technological viability: One of the most important aspects of demonstration projects in the context of small-scale industries would be to establish technical viability of various options to conserve energy. Since entrepreneurs in the small-scale are usually risk-averse, the demonstration projects will help overcome this barrier.
- Financial viability: Quantification of energy savings achieved through demonstration projects will prove the techno-economic viability of the projects. The energy monitoring and analysis during post and pre-demonstration projects would enable quantification of energy savings. This will demonstrate the financial viability of various options for energy conservation. Demonstration projects will require extensive pre and post implementation energy audits to monitor and assess savings.

Documentation will be done at every stage of the demonstration to codify all the learning achieved in this activity. The documentation will also enable better monitoring and review of the project progress.

(b) Dissemination of results of the demonstration projects

Dissemination activities are one of the most important aspects of the demo projects. Through dissemination activities the success story of demo projects will be communicated within the cluster and outside the cluster. Typical dissemination activities will include workshops, study tours, and publications. These activities will be jointly organised with local institutions in the cluster and industry associations. Brochures and publications will be prepared on the success of the demonstration projects for wider circulation and dissemination.

Study tours will be conducted for industry stakeholders to see the demonstration plants and get the "first-hand feel" of various demonstration systems.

(c) Development of technological capacity of small-scale units through modular training programmes

As a parallel activity to technology demonstration project(s), extensive training programs and workshops will be organised in the cluster(s). The exact number and location of such training programs will be determined based on the outcome of proposed PDF activities.

Since the training needs are going to be different for different categories, programs will be designed with specific relevance to different focus groups. For example, the training needs for entrepreneurs, operators, workers and fabricators will be very different. During the PDF activity, a detailed analysis for determining the training needs of different user groups will be carried out.

In order to expose the Indian industry with various technologies and processes being used world over, overseas study tours can be organized. The exact scope and orientation of such programmes is expected to vary for both tile and sanitary ware industries. Overseas study tours will also offer an opportunity to establish technological linkages with more technologically advanced industries abroad.

(d) Capacity building of local institutions and stakeholders

Technological capacity of local institutions like industry associations, local commercial banks, etc. will be developed by organising workshops and training programs. Participants from various institutions will be informed about the success of demonstration projects.

These programs will also be tailored as per the requirements of the target group. For example, capacity of local industry association can be developed to provide some energy services (energy audits) to their member industries. These can include capacity to do energy monitoring with the help of portable measuring instrument, technical database for ready access by the industry etc. There is large potential to offer these services to small-scale industries. Regular energy audits will help the industry to progressively identify areas for energy conservation and achieve better energy efficiency through proper diagnosis.

(e) Project management, review and documentation

Local implementing agency will manage the entire project encompassing all areas. Traditional project management and review techniques along with periodic mid-term external project progress reviews will ensure smooth progress of project over a period of time. Progress reports submitted to the local implementing agency and UNIDO will ensure that regular reviews can be carried out.

The agency executing the project will be responsible for the entire documentation. Documentation will ensure that learning achieved through the execution of the project is not lost and can be used in other similar projects.

Brick industry

(a) Energy conservation in brick firing

Use of improved designs and better operating practices

There is potential to improve energy efficiency by 5 - 15% in the BTKs and clamps by adopting technological changes requiring little or no investments. However, adoption of these measures is low mainly due to low awareness levels, lack of trained manpower and lack of technical backup support for implementing the measures. The activity would involve demonstration of these measures, training of manpower and provision of regular technical support at cluster level to enable large-scale adoption of these measures by end users. Such a campaign would require identification and strengthening of suitable local institutions to work at the cluster level. A participation-based networked approach is proposed for implementation of this activity. It is perceived that district/ cluster level brick industry associations would play an important role in this activity.

Energy conservation in brick firing by adoption and diffusion of efficient kiln technologies

Adoption of efficient brick kiln technologies would result in a significant reduction in the total fuel consumed in the brick industry. Typical specific energy consumption and firing wastage from different brick firing technologies are shown in table 2.4.2.

Table 2.4.2 Comparison of brick firing technologies

Technology	Specific Energy Consumption (MJ/kg)	Wastage during firing* (%)
Clamps	1.5-3.0	20 - 25%
Fixed chimney	1.1-1.6	5 - 10 %
VSBK	0.8-1.1	5%
Annular zig zag	Around 1.0	5%
Tunnel	NA	< 5%

* severely under fired, over fired and broken bricks
NA: Not available under Indian conditions

VSBK and annular zig-zag kiln

The VSBK and annular zig-zag kiln technologies have already been demonstrated in the country and have been found to be techno-economically viable in certain regions. For wider dissemination, following activities are proposed:

- Developing service provider network for technology delivery
- Policy support (such as environment clearance, tax relief, etc.)
- Mechanism to ensure availability of institutional financing to the small scale brick sector
- Awareness, training and capacity building activities at local/cluster level.
- Demonstration in new clusters which would require technical support to fine-tuning the technologies under local operating conditions

Technologies such as tunnel kiln are operating in other countries but have not been demonstrated in India. An evaluation of all such new technologies, followed by demonstration of the promising technologies would be taken up. The objective of the activity would be to transfer these new technologies to India, carry out a detailed techno-economic evaluation of these technologies and prepare an action plan for their dissemination on long-term.

(b) Resource conservation through promotion of alternate clay fired building materials

The objective of this activity is to diversify the range of clay-fired products and to promote products that would help in conservation of resources. The savings are: (1) resource conservation during the production process would help in reducing the energy consumption and conservation of clay, and (2) these products have better insulation properties compared to conventional solid clay bricks. For example, around 10-15% energy savings are achievable from perforated bricks. The important steps in this activity would be:

- Demonstration of the technology package at regional level. These products would require use of machinery for clay preparation and moulding,

protected room conditions for drying and better control over the firing process.

- Demonstration of the application of these products and quantification of the resource savings.
- Carrying out techno-economic viability of these products.
- Pilot marketing of these products. Initially these products could be launched in urban markets, where awareness levels are higher and it is expected that acceptability of these products would be relatively higher than in other markets.
- Preparing an action plan for large scale dissemination of these products

(c) Resource conservation through promotion of alternate building materials

The objective of this activity is to promote use of non-fired, less energy intensive products e.g. cement blocks, Fal-G bricks, lime/cement stabilized soil blocks, calcium silicate bricks etc. Various activities involved are:

- Regional resource surveys to assess the availability of resources and suitability of the alternate building products
- Demonstration of technology package at regional level
- Detailed unit-specific techno-financial analysis to determine viability of the project (Carrying out techno-economic viability of these products)
- Demonstration of the product applications and quantification of resource savings
- Market development activities: with main target group in the urban areas
- Preparing an action plan for the large scale adoption of these products

(d) Use of renewable energy in brick making

Large amount of biomass fuels (agriculture residues) is available in different regions of the country. Some of them are already used in brick kilns for the firing process. Potentially all types of agriculture residues could be utilised in brick kilns and reduce coal usage. This would help in net reduction in the CO_2 emissions from brick kilns. The quantum of coal replacement may vary between 20–80%.

Use of renewables as fuels would lead to availability of these fuels at local level and hence fewer expenses towards transportation of fuels. However, several of them require processing such as chopping, densification (briquetting), etc. The method adopted for firing these fuels are also different as compared to coal. In

some cases, these renewables can be used as 'internal fuel' (i.e. fuel addition along with clay during moulding process). The main steps under the use of renewables in brick making are:

- Regional resource surveys to assess the availability of agricultural and other biomass resources in the country
- Technology demonstration to utilise these resources at regional level
- Preparing an action plan for their large-scale utilisation

(e) Human and institutional development

Limitations in terms of human resources and institutions for carrying out development work in the brick sector was identified as one of the major barriers in the development of the industry. Therefore, the project would also focus on human and institutional development. The target institutions would be existing institutions such as brick manufacturers' associations, government agencies, non-governmental organisations, R&D institutions and service providers active in brick sector. The capacity of these institutions will be developed to provide support to local/regional brick industry. These local institutions can also provide energy audit and energy monitoring related services to the brick industry clusters. The project would also aim at developing regional networks of these institutions. This is an important activity under the project, as the implementation of the project would be carried out through these regional networks.

(f) Policy dialogue

The project would initiate dialogue between the policy makers and the stakeholders which is aimed at the formulation of national building material policy (which ensures sustainable building material supply). The activities involved are:

- Sensitisation of policy makers at different levels (state, regional and national levels)
- Creation of regional platforms for stakeholders dialogue
- Creation of platform at national level for stakeholder dialogue to steer formulation of the national policy.

(g) Improving access to institutional finance

Adoption of new technologies would require additional investments for the production facilities. Marketing of the new products would require additional investments. As mentioned earlier, lack of access to institutional finance to the

brick industry is one of the major barriers for promoting efficient technologies in Indian brick sector. Efforts to address this barrier and increasing the accessibility to institutional finance would be taken up during the project.

(h) Project management review and documentation

In order to ensure successful implementation of the project, along with all its activities, monitoring and review of the project will be carried out in line with the guidelines provided by GEF. Proper documentation will be carried out for each activity of every sub-project proposed under the project.

National level Co-ordination committee could be set-up to discuss crosscutting policy issues and for drawing synergies between various cross-sectoral activities. Such crosscutting issues will be pertaining to the use of renewable/biomass energy in the country and institutional strengthening for small-scale industries.

Capacity building component for small-scale industries will complement the activities to be undertaken by BEE with regard to energy efficiency improvement in the industries. Capacity building component will help in bridging the gap left by BEE in addressing the issues to energy efficiency and energy conservation for small-scale industries.

2.4.3 Estimated project cost

Although the final figures for cost estimate will be arrived at during the PDF Phase, the cost for implementing the programme is estimated at around US $ 43 million. Tentative break-up of cost is given in table 2.4.3.

Table 2.4.3 Tentative cost break-up

	All costs in million (US$)			
	Cement	Ceramic	Brick	For entire programme
GEF	12	3.5	7	22.5
Government	5	2	4	11
Private (Participatory)	4	0.5	3	7.5
Other donors	-	2	-	2
Total	21	8	14	43

2.4.4 Project execution

For the GEF, UNIDO is the executing agency with expanded opportunities, whereas the national counterpart agency is the Department of Industrial Policy and Promotion, Ministry of Commerce and Industry, GOI.

The Ministry of Commerce and Industry will be responsible for co-ordination and execution of project at national level. The project will be implemented by TERI along with other key stakeholders.

The Ministry of Environment and Forests (MoEF), which hosts the GEF Operational Focal point in India, will follow the progress of the project closely. Similarly, for projects dealing with the small-scale industries, consultation will be carried out with the Ministry of Small Scale Industries & Agro and Rural Industries to co-ordinate with other programs being implemented by the GOI.

2.4.5 Project stakeholders

Cement industry

Indian cement industry is the major and direct beneficiary of the proposed project. However, successful planning and implementation of the proposed project would involve several stakeholders from different segments of the economy. The stakeholders of the project will be, among others:

- Cement Manufacturers in India
- Government, through the Ministry of Industry and Commerce, in close cooperation with the Ministry of Environment and Industry
- Municipal corporations, local administration bodies,
- Technical consultants, local manufacturers and fabricators, equipment suppliers
- Industry associations and related R&D organisations
- International technology suppliers
- Financial institutions/Banks (e.g. IREDA, ICICI Bank, IDBI, etc)

Ceramic industry

The key stakeholders of the project will include: small scale industries in the ceramic tile and sanitary ware; industry associations for ceramic industries and other related industries like raw material suppliers etc; equipment suppliers/ fabricators; Government, through the Ministry of Environment and Forests, in close co-operation with the Ministry of Commerce and Industry; State government and local district administration; other local institutions working for the industry in the cluster; local support agencies; and local/regional academic/training institutions.

Brick industry

The main stakeholders in the project are brick kiln entrepreneurs who would adopt the proposed technological options for brick production. Use of these energy efficient technologies would help in reducing the pollution at kiln level, which would address the problems related to brick kiln workers. The brick industry associations at district, state and national levels would also play an important role in adoption and dissemination of the proposed options. The constituents of the supply chains, for the delivery of the technologies as well as for the marketing of the new products, are important stakeholders. The policy makers would help in the promotion of less energy intensive building materials. Financial institutions and banks who would provide loans to the brick kiln entrepreneurs for the required investments for adoption of various options discussed are also important stakeholders. The market and the end-user, who are the consumers of the bricks will be the key stakeholders in the project.

2.4.6 Sustainability and replicability

Sustainability of the project is most important to ensure that once the GEF support is over, the impact of the proposed project will not die down and benefits/activities of the projects will sustain on its own. Similarly, replicability of a project ensures that the benefits achieved through a given project will be replicable in other industries. The replicability aspect becomes even more important in case of demonstration projects.

Cement industry

The cement industry is highly competitive and undergoing a consolidation phase. The industry has always shown signs of technological development over past few years. The technical capability and financial health of industry is very good and is conducive for the implementation of the proposed project.

Through the implementation of the proposed cogeneration project, initial barriers associated with technology risk will be removed and once the merits of the technology are established large-scale replication will be undertaken.

Similarly, with regard to the use of waste in cement industry, project addresses various technical, supply chain management and capacity building related barriers. It is proposed to engage end users of cement in the capacity building process to improve the uptake of cement produced by utilising waste. Demonstration of technology/process in cement plant would form a model case

for other cement plants to emulate in future. Conducive government policies and strategies to promote the use of blended cements and waste utilisation in cement plants is expected to result in large-scale adoption and diffusion of the technologies.

Ceramic industry

Sustainability of the project is most important to ensure that once the GEF support is over, the impact of the proposed project will not die down and benefits/activities of the projects will sustain on its own. Similarly, replicability of a project ensures that the benefits achieved through a given project will be replicable in other industries. The replicability aspect becomes even more important in case of demonstration projects.

The sustainability and replicability of this project are very good because of the fact that the project aims at making an integrated intervention in the small-scale sector. Unlike any other intervention in small-scale industries involving just demonstration projects, the proposed project will also simultaneously tackle barriers related to capacity building, information dissemination, awareness generation and financing. The project is aimed at improving energy efficiency of the tile and sanitary ware industry in the long-term through stakeholder participation and institutional linkages, and will not rely on continued support from outside funding sources. This is possible because there would exist techno-economic viability of all the demonstration undertaken and once the initial barriers are addressed; progressive cost of replication is expected to come down further. It will lead to local collective technological learning that will be achieved by way of implementation of the project in totality.

Experience shows that, once the techno-economic viability for a particular project is demonstrated and other units are exposed to success of the demo projects, the replication projects will occur on their own. Initially there might be a need for facilitating the development of replication project by the way of providing technical assistance, but subsequently it is expected that implementation of projects will take place on their own.

It is also expected that the proposed intervention will have spill over effects on other ceramic industries (crockery etc.) in the vicinity. There are lot of similarities between ceramic units operating in a cluster. The units are similar in terms of kilns used and type of fuel being use (in some cases). Therefore, many

of the demonstration projects will have relevance in other units as well and might be adopted by those units resulting in spill over benefits. For example, modification in the kilns to improve their thermal insulation can by adopted by other similar units also.

Continuous support from the Ministry of Commerce and Industry for upgrading the technological capacity of industries will ensure that the project will have long-term and sustained benefits. This can be achieved through training programs, workshops, publications etc. Since local institutions will play a significant role in this regard, this project would also aim to strengthen the technological capacity of local institutions in the cluster.

For replication and sustainability of demonstration projects, it is crucial that the units have access to financial resources. Since majority of small-scale units lack enough financial reserves to fund projects, it is important to involve local financial institutions in the process of capacity building. This will enable the financial institutions to understand the relevance of energy efficiency options as measures to achieve monetary savings. This will encourage the financial institutions to fund such projects in the industries. Additionally, the government can channel finance, at commercial terms, to these units for upgrading their operations.

Brick industry

The project envisages a win-win situation for all the stakeholders. The proposed strategy would help the brick industry to introduce new products at competitive prices thereby help in sustainability of the sector, which is mostly small and unorganised. The options would also help the entrepreneurs in reducing the present level of energy consumption (savings in fuel) and improving the product quality thereby increasing the profitability of the entrepreneurs. Reduced emissions from the kilns would also help in meeting the statutory requirements. Adoption of various technological options would help in reducing CO_2 emissions at kiln and cluster levels. The project has a strong focus on human and institutional development which would ensure its sustainability beyond the project lifetime.

Brick kilns are located in clusters. The proposed demonstration projects would lead to improved awareness amongst the brick community/ entrepreneurs,

which would significantly improve the chances of adoption of these technologies.

The study tours and field visits, awareness seminars, meetings proposed for the brick kiln entrepreneurs and information on internet would improve the awareness level on various options available in brick industry for improving the energy efficiency, pollution reduction, resource enhancement and product quality and options. These are expected to motivate the brick kiln entrepreneurs to undertake projects on their own for adoption of newer technological options. Improved market conditions for the new products would also enhance the production and replication in other units.

Availability of supply chain and trained manpower would also help in replication of the proposed options in other brick kiln units in different regions.

3 Justification for the PDF Grant

3.1 Country eligibility

India's commitment for finding lasting solutions to global environmental issues is evident from its ratification of the Framework Convention on Climate Change on 01 November 1993. The proposed GEF intervention is designed to be a programmatic approach for "Energy Efficiency and Carbon Abatement in the Manufacture of the Construction Materials in India". A number of projects have been proposed in three sub-sectors in the construction materials manufacturing sector viz. Cement, Brick and Ceramics. Proposed projects are consistent with the GEF Climate Change Operational Programmes 5 and 6.

India is a Non-Annex-I developing country and India's economy is undergoing rapid growth spurred by recent policy changes to reflect its global concerns. GOI is strongly committed to the energy and environmental sustainability in the country. There is a separate Ministry of Environment and Forests that looks after issues related to environment and climate change.

India has been a recipient of loans from the World Bank / IMF as well as other monetary grants and technical assistance from UNIDO and other UN bodies (like UNDP) in the past. Similarly, India has been receiving several bilateral grants for improving energy efficiency and protecting the environment.

3.2 Relevant GEF operational Program

The identified projects, in the programmatic approach, fall under GEF Operational Programmes 5 & 6 on Climate Change. Operational Programmes 5 and 6 focus on 'Removal of Barriers to Energy Efficiency and Energy Conservation' and 'Promoting the Adoption of Renewable Energy by Removing Barriers and Reducing Implementation Costs'. There are some projects proposed in the cement and brick industry that emphasize the use of renewable energy and therefore fall under Operational Program 6.

3.3 Rationale for PDF support

PDF support is required to identify and define the scope of activities and the steps to be undertaken to enable effective implementation of the envisioned GEF supported projects. Since the proposed project is designed to have programmatic approach for the construction materials sector, PDF B grant will fund the design and development of various projects that would lead to removal of barriers for setting up and replication of various energy efficiency options and use of renewable energy in the industries. The PDF activities will provide comprehensive analysis at the sectoral level and prepare a blueprint for execution and implementation of the entire programme.

The proposed PDF activities are targeted for a fully consultative and participatory approach. Outcome of the PDF phase will assist in developing the detailed project activities for each component. Specifically the PDF activities will identify, evaluate and design meaningful avenues to address technological, capacity building, information, financial and institutional barriers hampering the adoption of energy efficient and environmentally sound technology options.

Under the programmatic approach, the PDF phase will also determine the incremental cost for the entire programme and also for proposed projects at sectoral level. Where the small-scale industries are involved, the PDF activities will take a cluster-based approach with strong focus on replication benefits. Initial activities will focus on a carefully selected demonstration projects in region/cluster, from where replication activities will be designed for implementation of similar projects in other appropriate areas in the country.

3.4 Execution

For GEF, UNIDO is the executing agency with expanded opportunities, whereas the national counterpart agency is the Ministry of Environment and Forests (MoEF), in close cooperation and coordination with the Ministry of Commerce and Industry, GOI. The Ministry of Environment and Forests will supervise the programme execution.

A Project Steering Committee will be set up to advise UNIDO and MoEF on the direction of project development and implementation.

3.5 Description of proposed PDF activities and outputs

Although the PDF activities will be executed at sectoral level, the final project brief will be prepared for the entire construction sector under the proposed Programmatic Approach. The proposed PDF activities were discussed and agreed upon in the multi-stakeholder workshop held at TERI in November 2002. The details of PDF activities in each of the industrial sub-sectors are given below.

3.5.1 Cement Industry

The proposed PDF activities for all the alternative projects are the following:

Activity 1: Constitute a Project Steering Committee and draw up appropriate linkages with national government, state governments, public/private sector organization, entrepreneurs and financial institutions based on stakeholder analysis. This will also involve examining the policy, financial, technical and legal hurdles in the cement sector for smooth implementation of the projects.

Activity 2: Conduct a survey for assessment of representative plants (having a capacity of 1 mtpa and above for cogeneration and waste utilization projects at different cement clusters to identify and establish project specific parameter details. The PDF activities will also assess the ability and willingness of cement plant management to participate in the projects.

Activity 3: Development of criteria (managerial, technical, financial) for shortlisting of cement plants, which are suitable for project implementation.

Activity 4: Identification of proven technologies/systems, at national and international level, and evaluating these for identifying suitable technologies/systems for Indian cement plants.

Activity 5: Identification of one demonstration plant for testing of the technologies/systems from the shortlisted plants (applicable for cogeneration and utilization of waste projects).

Activity 6: Conducting preliminary analysis/study for each of the project in one of the identified cement plants (in case of cogeneration and waste utilization projects, the one identified plant would be same as demonstration plant).

Activity 7: Assessing the technical, financial, and institutional needs and suggest schemes/measures for replication of the projects in other plants.

Activity 8: Determination of the incremental and baseline costs of the projects as per GEF guidelines. Estimation of the overall financial requirements, sources of finance and the time horizon.

Activity 9: Finalization of the project brief as per GEF guidelines.

3.5.2 Ceramic industry

Activity 1: Survey of industries

The background survey of industries will cover the tile and sanitary ware industries and prepare an industry profile from the perspective of the project(s). General industry information like, product segment, market size, demand-supply issues, number of units, size of units and location of units (clustering of small-scale units) etc. will be collected. Industry profiling will also be done at the cluster level for industries. This will form the basis for selecting/targeting industries in a particular cluster and undertaking the detailed baseline assessment.

Activity 2: Detailed baseline assessment

As part of this activity, detailed energy and technology assessment will be carried out to determine the present level of energy consumption and energy efficiency in the industry. Detailed energy audits will be carried out in representative tile and sanitary ware manufacturing units in the cluster to determine areas/options for energy conservation. Techno-economic analysis will be carried out for various options that would be identified for demonstration. Based on the collected data, estimates for emissions reduction will be worked out at the cluster level. For ceramic tiles, although the main focus will be on Morvi cluster, other smaller clusters of ceramic tile industry will also be included in the detailed study for estimating the replication potential and demonstration projects. Similarly, the study will also look at sanitary ware industry in clusters other than at Than, mainly to assess the possibility of spill over benefits.

Activity 3: Information dissemination and public awareness
This activity will begin with a survey of target industries to determine the types of energy efficiency and energy conservation information that is currently lacking in small-scale ceramic tile industry and therefore acting as a barrier to energy efficiency improvement. Potential small-scale industries, equipment manufacturers, fabricators, local consultants, institutions, financial institutions, and entrepreneurs will be targeted. The present level of information and public awareness will be assessed about various energy efficiency options. Based on the analysis, information gaps will be analysed and it will lead to development of an action plan to bridge this information gap in the long-term.

Activity 4: Review of policy and institutional framework
Existing policies, with relevance to the small-scale industries, will be reviewed with the perspective of this project. Under this activity, all existing policies, legislation, and regulations will be reviewed and assessed to identify policy barriers/gaps to the adoption and promotion of energy efficiency options and policy changes that could facilitate adoption and diffusion of energy efficient technology options. In addition to the review of the Energy Conservation Act, 2002, an assessment of policies specific to upgradation and modernisation of SSI clusters will be carried out. Issues related to project financing for SSI units will also be discussed in this activity.

Long-term policy recommendations can be made for providing an enabling environment for the energy efficiency improvements to take place in the small-scale ceramic industries in Gujarat.

Activity 5: Needs assessment for capacity building and training
Capacity building and training are core to meeting the objectives of this project. This activity will identify the focus areas for development of technological capacity at cluster level. Priority areas for capacity building will be identified and detailed action plan will be made for implementation of the full-size project. Candidate targets for capacity building and organised training include entrepreneurs, technical and non-technical staff employed at the units, consultants, R&D organisations, local institutions, financial institutions, academia, equipment suppliers, fabricators, etc. Once the training needs have been prioritised after interaction with stakeholder groups, this activity will proceed to survey and review relevant training or capacity building programmes,

manuals and modules and assess the feasibility of their application in SSI clusters.

A detailed implementation plan will be developed for this activity along with all sub-components.

Activity 6: Stakeholder workshops

In order to achieve multi-stakeholder consultative process, a number of workshops/meetings will be carried out with various relevant stakeholders at regional/cluster level. This activity will be very crucial in shaping the outcome of various activities proposed under activities 1 to 5 above. The consultative meetings and workshops at the beginning of the project will inform the stakeholders about the proposed GEF initiative and seek inputs from these stakeholders in the process. Likewise, workshops/roundtables at the end of the PDF activities will allow to present outcome to the stakeholders and receive their feedback on the proposed project. It is anticipated that stakeholders from industry, technical and financial institutions, representatives of relevant bilateral and multilateral institutions, NGOs, suppliers, consultants, etc, will attend these workshops.

Activity 7: Preparation of full-sized project brief

A project brief that includes all the required GEF criteria, notably the estimation of baseline and incremental cost, the logical framework, CO_2 calculations and a methodology for monitoring and evaluating the full-size GEF intervention will be prepared. In addition to the preparation of the project brief, the co-financing arrangements for the full-size project will be detailed and secured to the extent possible.

3.5.3 Brick industry

Activity 1: Regional survey

The regional survey covering different regions (North, Central, West, East and Southern) to understand specific issues and requirements in the region. These surveys would cover:

- Brick /building material technologies being used in the country
- Resource (clay, non-clay, fuel etc.) availability
- Institutions (govt, NGO, industry associations, R&D etc.) active in the sector
- Local policies influencing the building material sector

- Technical support and service provider network

Activity 2: Baseline assessment and sectoral analysis
An assessment of energy and technology performance will be carried out at different regions to establish the baseline. Various aspects that will be covered as part of this activity would be technology assessment, market evaluation, determination of the level of existing technological and institutional capabilities, and products commonly used in the construction sector.

As part of this exercise, few case studies will be made to determine the techno-economic viability of various projects proposed for demonstration. Under this activity, an assessment will be made about the potential GHG emissions under the business as usual scenario.

Activity 3: Pre-feasibility studies for new technologies
During the PDF phase, the project would carry out pre-feasibility studies for selected new technologies that will be taken up for demonstration during implementation phase. The scope and nature of work might vary for each individual project. In case of large/advanced technologies, a Detailed Project Report/Detailed Feasibility Report might be required as a separate activity during the implementation phase.

Activity 4: Stakeholder consultations at regional level
For a better understanding of the requirements of brick industry at cluster/ regional levels, workshops/meetings will be organised to consult with various relevant stakeholders. This activity is crucial in shaping the outcome of various activities proposed above. The consultative meetings and workshops will inform the stakeholders about the proposed GEF initiative and seek inputs from these stakeholders in the process.

It is anticipated that stakeholders from industry, technical and financial institutions, representatives of bilateral and multilateral institutions, NGOs, suppliers, consultants, etc, will attend these workshops. The stakeholder consultations at regional level would result in formulation of regional action plans.

The regional action plans would be discussed at the national level to formulate a national plan.

Activity 5: Preparation of full-sized project brief
A project brief that includes all the required GEF criteria, notably the estimation of baseline and incremental cost, the logical framework, CO_2 calculations and a methodology for monitoring and evaluating the full-size GEF intervention will be prepared. In addition to the preparation of the project brief, the co-financing arrangements for the full-size project will also detailed and secured to the extent possible.

3.6 Monitoring and evaluation

All the activities proposed under PDF B will be completed in a period of fifteen months. The implementation of the project will be monitored by the UNIDO Headquarter staff (Industrial Energy and Climate Change Branch) as well as by the UNIDO Regional Office in India. Standard evaluation of the project will be carried out according to the well established UNIDO Evaluation procedures and GEF guidelines. Additional evaluation can be performed as and when required by the GEF.

3.7 National level support

The GOI is committed to the improvement of energy efficiency in the industry and promotion of use of renewable energy. India's concern for issues related to climate change are evident by signing/ratification of the UNFCCC and the Kyoto Protocol, declared and published policies for energy conservation and use of renewable energy. Recently adopted Energy Conservation Act presents a good example of India's commitment to improve energy efficiency in long-term.

3.8 Summary of project preparation work outputs

The main outputs of the planned PDF B activity are summarized below:

- A GEF project brief for an integrated programme to improve energy and resource efficiency of Indian Construction Materials Industry. The programme will comprise of various full-size projects (in the identified industries) that address the activities required for assisting reduction/removal of identified barriers to improve energy and resource efficiency.
- A financing plan will be developed as an integral part of the project brief. The financing plan will be prepared at individual project level and co-financing for the full-scale projects will be committed to the extent possible for identified projects

- Foundation will be laid for the realization of selected number of demonstration projects as well as the activities identified for replication of these demonstration projects in the country/regions.
- For large-scale implementation projects (in the cement industry), requiring large investment, foundation would be laid towards the preparation of Detailed Project Report for final implementation.
- Develop, to the best possible extent, an institutional and implementation arrangements of the programme as a preliminary draft work plan, including time and activity schedule
- Indicators and a methodology for monitoring and evaluation of the GEF intervention during the implementation of the full-size project
- Workshops to initiate, review and revise the (draft) project brief preparation process.
- Identify a pool of regional, national and international consultants for implementing the full-sized projects

3.9 Costs

The total budget for undertaking PDF activities in three industries is estimated at US $ 950,000. The break-up of total budget for different industries is given in table 3.9.

Table 3.9 PDF Budget for different industries

		GEF	Co-funding (UNIDO)	GOI contribution	Total
Cement Industry					
1.	Survey of industries	20000			20000
2.	Technical assessment and economic evaluation	100000			100000
3.	Technology identification		20000		20000
4.	Identification of Demo units		10000	10000	20000
5.	Needs assessment	50000		50000	100000
6.	Establishing baseline and incremental cost	170000	50000	30000	250000
7.	Workshops and seminars/study tours	150000			150000
8.	Report preparation	20000			20000
	Total	*510000*	*80000*	*90000*	*680000*
Ceramic Industry					
1.	Survey of industries	10000			10000
2.	Baseline assessment	60000	10000		70000
3.	Information dissemination and public awareness		5000	5000	10000
4.	Review of policy and institutional framework			3000	3000

		GEF	Co-funding (UNIDO)	GOI contribution	Total
5.	Needs assessment for capacity building	10000			10000
6.	Stakeholder workshops		6000	6000	12000
7.	Report preparation	10000			10000
	Total	*90000*	*21000*	*14000*	*125000*
Brick Industry					
1.	Regional survey	20000			20000
2.	Baseline assessment and sectoral analysis	70000	10000		80000
3.	Pre-feasibility studies for new technologies	10000	5000	5000	20000
4.	Stakeholder consultations		5000	10000	15000
5.	Report preparation	10000			10000
	Total	*110000*	*20000*	*15000*	*145000*

3.10 Timing

It is anticipated that PDF Block B activities will commence in the second half of 2003 and will be completed within fifteen months.