Request for GEF Funds
Medium Sized Project

A PROJECT SUMMARY

PROJECT IDENTIFIERS	
1. Project Name: Commercialisation of super-insulating building technology in Mongolia.	**2. GEF Implementing Agency:** UNDP
3. Country in which the project is to be implemented: Mongolia	**4. Country eligibility**: Ratified UNFCCC on 30 September 1993
5. GEF focal area(s): Climate change. (relates to desertification as project will also reduce wood collection in semi-arid areas)	**6. Operational programme:** #5, Removal of barriers to energy efficiency and energy conservation
7. Project linkage to national priorities, actions plans and programmes: The Government of Mongolia attaches great importance to sustainable development and the protection of natural resources. In line with this, the Government has recently prepared and approved several multi-sectoral and sectoral policies, programmes and action plans including: Environmental Action Plan (1995), Law on Environmental Protection (1995), and the Biodiversity Action Plan (1996). The Government is also completing a national Mongolia Agenda 21 Programme, and is preparing its national communication to the UNFCCC. As for all developing countries, energy is a key sector in Mongolia. Given the extreme climate, domestic heating consumes an unusually large percentage of the energy produced. The ongoing *Asia Least-Cost GHG Abatement Strategy* (ALGAS, financed under UNDP/GEF) estimates that over 50% of Mongolia's CO_2 emissions result from heating buildings – residential, industrial and administrative. At the same time, most buildings, including most newly built ones, are not well insulated. Accordingly, ALGAS recommends energy conservation from improved buildings as a priority and least-cost strategy for cutting CO_2 emissions and protecting the environment. Until recently coal, electricity and other energy resources were heavily subsidised, the result being a very inefficient and unsustainable use of coal and other energy resources, and a limited understanding of the concept of energy efficiency or conservation. The government is taking steps to correct this. For example, all subsidies to coal have been stopped. Also both national and provincial governments are allocating some funds to energy efficient initiatives including the use of super-insulating, straw-bales for construction.	
8. GEF national operational focal point and date of country endorsement: Division of International Cooperation, Ministry of Nature and Environment	
PROJECT OBJECTIVES AND ACTIVITIES	
9. Project rationale and objectives: The project is to reduce CO_2 emissions from burning coal for heating. This is to be achieved by helping super-insulating, straw-bale building technology to be commercially successful on a large-scale in Mongolia. Also, less wood will be burnt for heating, further reducing CO_2 emissions and protecting shrubs and forests.	**Indicators:** 1. Reduction in coal consumption for household heating; 2. Increased and sustained demand for certified, straw-bales and super insulated buildings; 3. Decreased levels of wood-cutting

increase. Also, individuals and private sector wish to build straw-bale buildings and request UNDP to assist them in constructing straw-bale buildings.

Straw Supply and Preparation

In the past, Mongolia had as much as 200,000 hectares of cereal under production. Now the figure so closer to 230,000 hectares, though an increase is scheduled for each of the next three or four years. If we assume that a mere 200,000 hectares of cereal production will be constant, and if we use a very reasonable figure of 40 bales per hectare, then we arrive at a figure of 8 million bales as the straw potential for Mongolia each year. If we assume that all new houses in Mongolia (estimated at about 15,000 in a year) will be built using straw bales, and if we assume that each house requires 400 bales (for a 50 square meter house), then we arrive at a total possible bale demand of 6 million output of straw in Mongolia each year. .

Straw in Mongolia is sometimes left on the field but is more commonly piled and burned. Thus, using straw to make bales will remove two smaller sources of GHGs, thereby providing further global benefits. First, most straw is burnt if not baled, this burning produces CO2 emissions. Second, some straw is left to rot, which is a common source of methane. Thus, sequestration of GHG is achieved by using straw as a building product.

According to the specialists of GHG inventory, there will not be negative impacts on preservation of sink of GHG emission because of the collection of the straw. The straw does not continue to grow after harvesting the cereals and is no longer bio-mass. As concerns the negative impact on soil and crop productivity by removing straw from fields, it is anticipated that no negative impact will be experienced since straw is already removed and burned off the field. Also, only a fraction of total straw production will be used as outlined above.

Straw production as adequately dispersed in the northern half of the country so that straw as a viable building product (without excessive transportation costs) is available to approximately 2/3 of the country population. ADRA is experimenting with the cost/benefit factors in building straw-bale buildings in southern Mongolia. ADRA estimates that, because of the high recurring cost of coal transportation, it will be more efficient building than transporting coal numerous times every winter.

The collection and transportation of straw is a private-sector activity, since cereal farms are now privately owned. Farms are eager to turn their agricultural waste into a cash crop and no shortage in supply of straw is foreseen. In addition, ADRA has designed and tested a hand powered straw baler so that the availability of a bailing machine is not a limiting factor. There are an adequate number of trucks and trucking companies to transport straw.

There are requirements in terms of quality and the shape of straw-bales that will be used for demonstration as building materials. Those are: the straw to be baled must be new and very dry, free from seeds and weeds. The bale itself must be well compacted, consistent in size and shape, and have length that is twice the width. Two or three tie bales with rectangular shapes are used for straw-bale construction. Machine or manual balers are used for baling the straw

The demonstration of specially designed curtains for straw-bale buildings in the houses / apartment is being undertaken and will continue within the framework of the project. This is at the research stage.

10. Project outcomes: By the end of the project there will be: 1. Increased awareness of and confidence in straw-bale buildings; 2. A strong and growing cadre of engineers, professionals, businesses and household representatives qualified in designing and constructing super-insulated houses; 3. Improved quality and safety of straw-bale houses; 4. Private construction and inspection companies are capable of business management skills; 5. Improved information on energy efficiency heating options for straw-bale buildings; 6. More private and public finance channelled to constructing super-insulated houses. 7. Private households can afford to purchase or build straw-bale houses.	**Indicators:** 1. More straw-bale, super-insulated houses built; 2. At least 600 people trained 3. Training Centers established 4. Straw-bale technology included in university curriculum; 5. National building codes and standardisation for straw-bale buildings established; 6. All the straw-bale houses built meet quality standards and safety guidelines; 7. Commercial operation of private construction and inspection companies; 8. Coal consumption for heating reduced; 9. Model investment contracts between investors and builders; 10. Credit lines available for customers.
11. Project activities to achieve outcomes: 1. Constructing demonstration buildings ($2,100,000 non-GEF) 2. Training builders ($505,000, of which $90,000 from GEF) 3. Training university teachers and government personnel, curriculum development ($310,000, of which $90,000 from GEF) 4. Develop national codes and standards ($50,000 from GEF) 5. Establish inspection/certification capacity ($190,000, of which $140,000 from GEF) 6. Develop business plans, business training ($150,000, of which $75,000 from GEF) 7. Public awareness and education programmes ($100,000 from GEF) 8. Develop sustainable financing mechanisms ($350,000, of which $100,000 from GEF) 9. Independent measurement and monitoring of the energy savings	**Indicators:** 1. Network of model straw-bale buildings acting as training centres and certification units 2. More certified trainees capable of building straw-bale houses; 3. Training Centers established 4. University curriculum developed; 5. National codes and standards for straw-bale houses established; 6. Commercial operation of private construction and inspection companies; 7. Awareness about straw-bale houses and energy conservation raised 8. More investment in building straw-bale houses from the private and public finance; 9. Credit lines available to potential customers 10. Increased public awareness of the life-cycle energy cost and savings for strawbale buildings
12. Estimated Budget: PDF: US$24,650 GEF: US$725,000 Co-financing: US$1,000,000 Dutch Aid US$1,800,000 Norway Fund US$35,000 Canadian Fund US$300,000 UNDP US$200,000 ADRA	
13. Information on Project Proponent: Ministry of Nature and Environment (MNE). MNE is the focal point for GEF and for environmental protection measures. MNE is involved in all GEF activities in Mongolia and most national level environment initiatives. Recently MNE has been involved in the preparation of the ALGAS study on GHG inventories and mitigation strategies, and is now involved in the preparation of the National Communication to the UNFCCC, with assistance from the Dutch Government.	
14. Information on proposed executing agency (if different from above): As above	
15. Date of initial submission of project concept: 6 February 1998	
INFORMATION OF INSTITUTION SUBMITTING THE BRIEF	
16. Project identification number: MON/98/xx	
17. Implementing agency contact person: Nandita Mongia, Regional GEF Coordinator for Climate Change	

because they are compacted firmly, they do not hold enough air to permit combustion'. This property translates into a smaller premium for fire insurance for these structures as compared to wood buildings.

Provided that the straw used to make the bales is dry or that the bales are left to dry afterwards and with appropriate construction, water will not accumulate or be trapped inside the wall. If above is taken into account, straw will not rot.

Because of being strongly compacted and plastered, straw-bale walls provide fewer havens for pests like insects and vermin than conventional wooden walls.

Straw-bale buildings in the Mongolian context

Use of local materials. In 14 of Mongolia's 21 aimags, straw is being produced. Straw is a renewable resource, grown annually, and an insignificant percentage of Mongolia's production could satisfy even widespread introduction of the technique in construction. Material costs of straw-bale walls represent less to nothing as straw in many places has become an unwanted waste product. Some straw is baled in Mongolia to be sold during the winter as feed for animals, even though its nutritional properties are insignificant. Most straw is however burned or left to rot in the fields adding to global warming.

Affordability. Straw-bale construction in Mongolia has proven inexpensive compared to other materials. ADRA, an international NGO operating in Mongolia, introduced in Mongolia the 100-year old building method used in more than 30 countries around the world. Some houses and a child care centre have been constructed for a cost lower than US$ 100 per square metre. This compares favourably to the actual costs of traditional institutional buildings of US$ 350-450 per square metre. A recent study sponsored by the Asian Development Bank, shows that building clinics and hospitals to modern standards will cost US$ 500-600 per square metre.

Energy Efficiency. While based on a very limited number of samples, ADRA has recorded savings compared to similar Mongolian structures of 80 to 90 percent of fuel consumption. Such savings are higher than those recorded in other countries, but this is due to the very-poor construction of traditional houses in Mongolia. The present problem of fuel shortages and price increases has been recorded in a recent community research that shows that Mongolians identify their most significant lifestyle- problem as the effort to keep warm. It was also found that those living in poverty (for example most of the population living in gers around Ulaanbaatar) were spending as much as 70 percent of their income on coal or wood for heating purposes. These people have a comparative disadvantages with people living in apartment blocks that have central heating provided at subsidized prices while the population living in gers has to pay the full price of non-subsidised coal or wood.

Design simplicity, adaptability, and comfort. The straw-bale houses are very simple of design, and this is an advantage as in some soums only a two room structure (50 m2) is needed. These structures are adaptable to local requirements as they can easily be expanded to include additional rooms. Straw-bale houses provide an exceptionally stable indoor temperature, good humidity level, and effective noise exclusion from outdoors.

Construction teams (skills training). Part of what makes straw-bale construction so affordable is its ability to effectively utilize homeowner participation and unskilled labour.

Popularity. Last year the UNDP Project received more than 100 official requests from the local communities to build social services oriented straw-bale buildings, and this number is going to

18. Project linkage to implementing agency programme: Environment and natural resource protection is one of the pillars of the UNDP Mongolia country programme and GEF activities are mainstreamed into this country programme. Notably, one closely related TRAC project is helping to demonstrate improved delivery of social services by reducing the budget spent on heating by introducing super-insulated technology. A pipeline SPPD is to look at Joint Implementation as a means of financing large-scale investment in Mongolia, possibly in super-insulated housing.

ANNEX II

THE STRAW-BALE BUILDING TECHNIQUE

Straw-bale building is a practical and perhaps under-utilised construction method. Initiated in the United States at the turn of the century, straw-bale buildings can have large merits in today marketplace, and most specially in cold climates as that of Mongolia. Walls of straw, easy constructed and structurally sound, can take some of the pressure on limited forest resources substituting wood as construction material and by reducing significantly the heating needs. Straw bale buildings boast super-insulated walls (R,-8.8, R, is m^2.K/W), simple construction, low cost and the conversion of an agricultural byproduct into valued building material.

These buildings use straw-bales as walls, with the interior and exterior surfaces plastered with cement, stucco or adobe. The bales which are about 1.2 metres long and with sides of 40 to 60 cm are stacked like bricks, one bale deep, with the joints staggered. Between the bale joints mortar can be used but usually the bales are fastened to each other by piercing wooden rods down through them. The bales support on a foundation of rocks and cement at the building periphery and as fastened to it by iron rods protruding some centimetres from the cement foundation. Straw is as used to insulate the attic of these buildings, provided that the ceiling is well constructed to achieve good fire protection. The bales provide a monolithic layer of straw covered on the inside and outside with stucco or plaster and this results besides the mentioned insulation on very little leakage.

Basically the buildings are divided into structural or non-structural constructions, the difference being either whether the roof is supported by the walls, or supports on its own wooden pole placed at the corners of the building and eventually inside the house. Structural wall buildings are cheaper and easier to build, but at the disadvantage of lesser flexibility in design. Also structure, walls have to be let a coupled of months to settle while the weight of the roof compacts them, a this creates an additional planning complexity when building so many buildings as is intended with this programme. Strong door and window frames are attached to the walls by steal rods insert through them.

The insulating properties of these walls have been tested by the Lawrence Berkeley Laboratory during a study commissioned by the United States Department of Energy. The tests showed the straw -which is a form of cellulose- has reasonable good insulating properties with average value of R_c-O. 166 per centimetre of straw-bale with a variation depending on moisture and density of the bale between R_c-O. 125 and R_c-O.208 per centimetre. This value compares favourably with other materials used in construction in the United States.

Some frequently asked questions about straw-bale houses concern durability, fire hazard, rotti of the straw, and pest resistance.

The durability of such houses has also been proved by the fact that many of these structures while have been built at the beginning of the century are still standing and being used. Straw-bales have been used to build houses, office buildings, farm buildings schools and churches. These structures have withstood severe weather such as blizzard winds and large temperature swings and all earthquakes.

Concerning the fire hazard the National Research Council of Canada tested plastered straw-bales and found them to perform better than conventional building materials. According to the Canada Mortgage and Housing Corporation, 'the straw-bales/mortar structure wall has proven to be exceptionally resistant to fire. The straw-bales hold enough air to provide good insulation value, but

B PROJECT DESCRIPTION

RATIONALE AND OBJECTIVES

Mongolia is a country in economic and social transition. After almost 70 years of central planning and a very close integration into the Soviet economy, a sudden drop in large-scale Soviet economic assistance in the early 1990's led to a change of government and to a more market-oriented economic policy. At the same time the economy opened considerably and subsidies to many essential commodities were stopped. These changes caused great initial hardships and an overall decline in economic indicators. However, after declining steeply until 1993, GDP is now growing at a steady rate. The use of energy and CO_2 emissions has followed a similar pattern.

Mongolia is a relatively large country covering 1.56 million km^2 with a sparse population. Approximately 50% of the population live in small cities and towns, the remainder distributed over vast rural areas. The climate is extremely harsh, for example the capital Ulaan Bataar has an average annual temperature of -2°C and is the world's coldest capital city. The climate and the limited industrial development mean that the biggest single use of energy is to heat space. Coal, although of a low-quality, is plentiful and is relatively accessible. Hence coal is the main source of energy and is likely to remain so into at least the mid-term future. Recent studies (under ALGAS) indicate that burning coal to provide heating for buildings accounts for over 50% of Mongolia's CO_2 emissions.

Until recently, heating in all buildings in Mongolia was heavily subsidised, either through cheap coal or cheap district heating. As a result, energy conservation and building insulation were not priorities. Government buildings, residential blocks, individual houses, and traditional ger (the traditional Mongolian housing, a low, round tent made from wooden supports and felt walls) all suffer from great heat losses during the cold months. Consequently, in 1990, Mongolia had the highest emissions of CO_2 per capita of all ALGAS countries, surpassing Japan and South Korea and approaching the levels of Northern Europe.

In addition to energy and heating, construction is a priority sector for the Government of Mongolia. A recent ADB study determined that 50,000 new homes are required in the Ulaan Bataar area alone. At present the construction sector consists mainly of households and micro-scale construction companies. Given this limited capacity to build large buildings, the low cost of land and cultural traditions, most existing and future buildings are small, detached, simple buildings. This applies to schools, health-centres and local administrative office as well as homes. These buildings are likely to be inefficiently built and designed.

Ongoing work by the international NGO ADRA strongly indicates that by super-insulating small buildings, the amount of coal used to heat these buildings would be cut by over 75%. Affordable super-insulating technologies do exist in Mongolia, based on straw-bales (see Annex 1), but their adoption and implementation are hindered by institutional, economic, financial, educational and informational barriers. This project, in line with GEF Operational Programme no. 5, will remove these barriers, thereby leading to wide-scale adoption of the super-insulating technology for new buildings and even the replacement of existing buildings with super-insulated buildings. The result will be major reductions in coal consumption and CO_2 emissions in Mongolia.

5. Establish certification units	0	$190,000	$140,000 GEF $25,000 Norway Fund $25,000 Dutch Aid
6. Develop business plans, business training	0	$150,000	$75,000 GEF $75,000 Norway Fund
7. Public awareness and education programme	0	$100,000	$100,000 GEF
8. Develop sustainable financing mechanism	Credit $250,000 from the Dutch Aid	$350,000	$100,000 GEF
9. Independent measurement and monitoring of the energy savings	0	$40,000	$40,000 GEF
TOTAL	$2,500,000 $1,115,000 Norway Fund $850,000 Dutch aid; $35,000 Canadian fund; $300,000 UNDP TRAC $200,000 ADRA	$3,795,000	$1,295,000: $685,000 GEF; $535,000 Norway Fund; $75,000 Dutch Aid
Support cost		$100,000	$20,000 GEF; $30,000 Dutch; $50,000 Norway;
Miscellaneous		$165,000	$20,000 GEF; $45,000 Dutch; $100,000 Norway
GEF PDF A		$25,000	$25,000
Grand total	**$2,500,000**	**$4,085,000**	**$1,585,000:** **$750,000 GEF;** **$685,000 Norway;** **$150,000 Dutch.**

In addition, small amounts of wood are used daily to start fires in most buildings. In certain places, coal is not always available, and at such times wood is used as a replacement. Often, poorer households always use wood as they cannot afford coal. Hence super-insulation will also reduce wood burning, thereby reducing the pressure on trees in arid and semi-arid areas, and so assist Mongolia in its battle against desertification and land degradation.

CURRENT SITUATION

Housing Arrangement and Household Fuel Consumption: In urban area, almost half inhabitants rent the apartments owned by the state and another half live in ghers, traditional dwellings made from felt and wooden carcass and manufactured by individuals and private companies. A small portion of the population live in private houses built from bricks, wood and mud. The state does not have a mechanism for market rated credit scheme that the people could approach and access. There is an initiative to privatize the state owned apartments, and 15,000 of apartments out of 50,000 in Ulaan baatar were privatized over the last two years. The privatization process is far slower than expected. For some time into the future, warm and comfortable housing will continue to be out of the reach of most Mongolian people. In rural areas, the majority of people live in ghers.

On average, one-room houses and ghers (25 m^2) consume an estimated 5 tons of coal, in addition to some wood, each year. Two-room houses (50 m^2) and larger buildings (150 m^2) consume proportionally more. The fuel bill for an average one-room family house or ger is about US$110 per year. According to the Fuel Use Report on Straw-bale Buildings, prepared by ADRA, a one-room straw-bale house would consume less than 1 ton of coal/year, thus straw-bale technology can save up to 80% of the coal use for heating over a brick building or a ger. Hence, the annual saving of fuel bill will be around $90.

At present, the cost of constructing one-room, two-room, and four-room straw-bale buildings is about $2,700, $5,350, and $22,000 respectively, which are much cheaper than the comparable conventional brick houses. This cost is based on using reasonable or even high-grade materials and skilled labour. With close regulation, scientific monitoring, and technical supervision, another 13% are added to these straw-bale building costs. Assuming that the cost of a lowest quality one-room straw-bale house is around $600, construction cost of a new house can be recovered by the fuel bill savings in about six years.

Private Sector and NGO Involvement: The private sector in Mongolia was newly established at the beginning of 90s. Mongolian Government fully supports private sector development, either domestic or foreign by effectively strong policy. Therefore, the Government is implementing the Privatization Programme. According to this Programme, 80 percent of the present government sector will be privatized. Last year approximately 70 percent of Gross Domestic Product (GDP) were produced by private sector, and this number is increasing each year. It should be noted that straw bale technology, once commercialised, will allow buildings to be built at affordable price, therefore encouraging private sector solutions to the huge housing deficit in Mongolia.

At present time in Mongolia, more than 2500 NGOs at different scales have been registered. NGOs with ecological, environmental and energy saving goals wish to be effectively involved in this project. The NGO sector is thriving in Mongolia, and will undoubtedly play an important and effective role in this project.

Incremental Costs Matrix

	Baseline	Alternative	Increment (Alternative - Baseline)
Global environmental benefits	15,000 conventional buildings leading to approx. 150,000 tons of CO2 emitted per year from coal burning. Very little progress on super-insulated building technology development	15,000 super-insulated buildings emitting approx. 35,000 tons of CO2 per year. Less CO2 emitted from coal combustion, wood burning, and straw burning; less methane emitted from rotting straw; less wood as fuel leading to higher carbon sequestration, as well as land and biodiversity preserved. Straw-bale, super-insulating technology commercialized in Mongolia.	Reduction of 115,000 tons of CO2/year from coal burning; reduced CO2 emission from wood burning and straw burning; reduced methane emission from rotting straw; reduced wood as fuel use leading to higher carbon sequestration, as well as land and biodiversity preservation. Large-scale commercialization of the straw-bale super-insulated buildings in Mongolia.
Domestic benefits	A small number of super-insulated buildings	15,000 super-insulated buildings keep people warm and comfort, and less chance to get sick in the winter; cost of 72,000 tons of coal saved and finance available for food, medicine, education.	Improved performance of super-insulated building technology; improved knowledge and technical skill to build straw-bale buildings; more comfort and less chance to get sick in the winter; saving of fuel bills for food, medicine, and education.
Activity	Baseline Costs	Alternative Costs	Incremental Costs
1. Constructing demonstration buildings	demonstration buildings built $2,100,000, including cash contribution from the Dutch aid, Norway fund, Canadian Fund, UNDP, and ADRA	$2,100,000	0
2. Training builders	150,000 from UNDP	$505,000	$90,000 GEF $265,000 Norway Fund
3. Training university teachers, curriculum development	0	$310,000	$90,000 GEF $170,000 Norway Fund $50,000 Dutch Aid
4. Develop national building codes and standards	0	$50,000	$50,000 GEF

National Priority: Mongolia has signed the Framework Convention on Climate Change (FCCC) in 1995 and has already completed an initial inventory of Greenhouse Gas Emission and identified options for reducing emissions from the energy sector. Mongolia also participated in the US Country Studies Program on Climate Change.

The National Development Concept of Mongolia and MAP-21 are main documents for determining the national priorities. These documents indicated that the energy conservation efficiency and reduction of GHG emissions are the national priorities. Government of Mongolia should be concerned about climate change resulting from anthropogenic GHG emissions. Energy sector is the largest emitter of GHG emissions in Mongolia.

The government of Mongolia has recognised the importance of insulation and the potential of super-insulated, straw-bale houses, and has committed itself to building a small number of straw-bale demonstration houses through the limited national and provincial budgets.

Ongoing and Previous Assistance:

UNDP: UNDP has been supporting the introduction of energy efficient, environmentally friendly and socially viable super-insulating straw-bale building technology, with the social rather than global environmental objectives, of cutting fuel bills in order to make funds available for improved health and education. UNDP has allocated US$300,000 for an ongoing project "Provision of Energy Efficient Social Services" (PEESS) aiming to support the Government efforts in the field of environmental protection including GHG reduction in Mongolia. The UNDP project has completed the training of almost 200 skilled workers in straw-bale construction, a small number of design and prototype demonstration, and conducted some information dissemination and public awareness activities.

Despite these efforts by UNDP, adoption and implementation of super-insulating technologies are still facing tremendous barriers in Mongolia. The UNDP fund is being used as seed money for further development of the project and resource mobilization.

Foreign governments: In addition to assistance from UNDP, Mongolia received grant from the Japanese Government for construction of five straw-bale buildings in 1997, and the Canadian International Development Agency funds two straw-bale buildings in 1998.

ADB: With the Technical Assistance of the ADB, the Ministry of Infrastructure Development produced the "Mongolian State Policy on Housing". Increase in building energy conservation and efficiency has been listed in this document as a priority. In addition, the positive aspects of straw-bale building technology were noted and more replication was encouraged.

ADRA: ADRA, an international NGO, introduced straw-bale building technology to Mongolia in 1995. ADRA has invested over $200,000 in developing straw bale technology in Mongolia by supporting very small scale demonstration and training, and is undertaking limited scientific monitoring of the efficiency of super-insulated houses. They will continue to invest in research and development efforts that will benefit this project.

customers with the mortgage system, government guarantee, access to market-rated credit, micro-credit, and selling the demonstration buildings and setting up revolving fund, and etc.

Then, this component will recommend the appropriate financing mechanism that suits Mongolia situation. For example, this component will analyse the credit framework in Mongolia, and will identify appropriate sources of credit. It will design a credit system including monitoring. This system should be integrated into the existing credit/fiscal systems in Mongolia, but may also be built in the demonstration sites under activity 1. The international/national team will recommend the selection procedure and the appropriate financing mechanisms. Then, the project steering committee to be set up, which will include the key stakeholders and UNDP, will evaluate the selection procedure and make a final selection.

Finally, this component will design the guidelines and criteria for the selected financing mechanism, and secure funding sources for it. For example, if the credit scheme is chosen, then the credit should be recovered into a revolving fund, and re-allocated to other replication super-insulating buildings.

As mentioned earlier, It is conservatively estimated that the demand for super-insulating housing in Mongolia would reach 15,000 in the next four years after the project implementation, about 25% of annual housing demand in Mongolia. After the financing mechanisms are in place, it is expected that this demand would be met.

Without GEF support, no related activity would take place and so all costs are incremental. Incremental costs associated with this activity total $100,000, of which GEF will cover $100,000. The $250,000 of credit is baseline and will be covered by the Dutch Aid.

Activity No. 9 – Independent measurement and monitoring of the energy savings (Cost $40,000 from GEF)

It is very important to measure, monitor and evaluate the fuel savings and temperature gains of the straw-bale houses compared to the brick houses and/or ghers. This project allocated $40,000 to support this measurement. The result will be made public and incorporated into public awareness and education programme. It is critical for future replication. Without GEF support, no related activity would take place and so all costs are incremental.

Barriers to Super-insulated Buildings in Mongolia: These efforts are insufficient to influence the majority of Mongolian people or government decision-makers. Despite the potential technological and economical advantages of straw-bales over brick, there are several reasons why families or other units do not consider the use of straw-bale, super-insulated technology when constructing new houses:

- Barrier No. 1 limited trained builders in private households and construction companies in the design and construction of super-insulated buildings;
- Barrier No. 2 lack of teaching straw-bale building technologies at the civil engineering and architect department in the national university, where only energy-inefficient brick buildings designs are taught;
- Barrier No. 3 lack of standard and simplified permit approval procedure for construction of straw-bale houses;
- Barrier No. 4 lack of national codes, standardisation, and safety guidelines for constructing straw-bale buildings;
- Barrier No. 5 lack of capacity to inspect and certify the quality and safety of straw-bale super-insulated houses, and consequently lack of consumer confidence in the product;
- Barrier No. 6 lack of business management skills;
- Barrier No. 7 lack of awareness of energy conservation both in decision-makers and in ordinary people, as a result of the many years of subsidised energy prices;
- Barrier No. 8 limited awareness of the straw-bale technology and its potential among decision-makers, local enterprise managers and households;
- Barrier No. 9 a complicated and risky investment environment to those seeking to invest in straw-bale manufacturing facilities. There are no established procedures to make a large investment in this sector. However, if it is dominated by small and household enterprises, it will not be possible to achieve economies of scale;
- Barrier No. 10 lack of easy access to credit for the households who want to build or purchase straw- bale super-insulated houses.

Due to the above barriers, without this project, the government will implement its policy of building new houses, possibly with the support of international organisations. The focus of this policy will be on brick houses. In the private sector, households and businesses requiring new buildings will continue to build brick, poorly insulated buildings. In addition, existing buildings, both individual homes and small public service buildings (schools, health centres, etc) will remain poorly insulated. Meanwhile, in rural areas, large volumes of surplus straw will be burnt thereby adding to Mongolia's CO_2 emissions. There will be a very small number of un-regulated, separate initiatives to build straw-baled houses.

Without GEF support, a great opportunity to introduce super-insulated houses at this critical moment in Mongolia's history will be missed. At best, local constructors, aware of the straw-bale technology, will exploit the opportunity on a small scale but without guidance and regulation. Experience from other countries and with similar technologies shows that this is likely to lead to a situation where a small number of low quality straw-bales come onto the market, leading to a poor reputation and a long-term lack of confidence in the product.

In sum, Table 1 lists the activities and outcomes of previous efforts on straw-bale technology in Mongolia, and the lessons learned as well as remaining barriers. This project is designed to remove the remaining barriers to achieve the envisaged abatement impact.

workers, potential large-scale investors. The young population will be a key target group. Where appropriate, the awareness programmes will use the network of demonstration buildings as inputs into awareness raising material.

In addition to the public awareness campaign of straw-bale houses, a public education program of energy efficiency and conservation will also be launched. This public education program will provide information to the straw-bale house users of energy efficiency heating options. This program is targeted at the straw-bale house users to inform them of energy efficient heating measures and improve their energy conservation awareness to ensure the actual coal saving for heating.

Although the limited demonstration buildings under previous projects have created limited awareness and demand for straw-bale building technology in Mongolia, this activity will initiate a large-scale public awareness campaign and cover a wide range of stakeholders to promote the market and understanding of straw-bale technology. These programmes will consist of campaigns through posters, newsheets, radio broadcasts, TV advertisement and programs, and video etc. This activity will directly remove Barrier No. 7 and 8. Without GEF support, no related activity would take place and so all costs are incremental. Incremental costs associated with this activity total $100,000 of which GEF will cover all $100,000.

Activity No. 8 - Develop sustainable financing mechanisms (Cost $350,000, of which $100,000 from GEF and $250,000 from Dutch Aid)

This activity includes two components: (1) developing investment framework to attract large-scale private financing into the construction companies to build straw-bale houses; and (2) establishing financing mechanisms to facilitate individual households to build or purchase the straw-bale houses. At the same time, the government financial incentive policies that will facilitate these two components will be developed and recommended, in order to attract private investment and channel public investment in the straw-bale houses.

The first component is designed to remove barrier no. 9 – complicated and risky investment environment. Therefore, this component will identify the uncertainties and risks associated with the investment in straw-bale houses, and developing the financial and institutional incentive policies to attract large-scale private investment. Innovative contractual arrangements will be considered, and if appropriate, developed for signature. For example, it is likely that contracts between investors and local authorities to build large numbers of houses can be developed. These houses would then be sold or leased by the investor. Or BOT could be investigated as an option. In addition, simplified investment approval procedures will also be investigated and recommended. This component will include seminars/workshops with potential investors.

In addition, individual households cannot afford to pay for the up-front costs of straw-bale houses, and it is difficult to obtain financing due to the lack of credit system, even if the investment can be quickly recovered by the energy savings. The second component is designed to remove barrier no. 10.

This component will explore the possible financing mechanisms to facilitate individual households to purchase straw-bale houses. The financing mechanisms could include straw-bale houses partially paid by the government, built by the government and repaid by the

Table 1. Summary of Previous Activities and Gaps

Previous Activities	Activities	Outcomes	Lessons learned and gaps
UNDP ($300,000)	1. Construct 8 straw-bale social service demonstration buildings ($150k) _ 2. Provide training to 160 people in construction of straw-bale housing ($150k)	1. Increased number of trained builders; 2. Increased public awareness of straw-bale housing technology	1. Lack of quality and safety control of the construction of straw-bale housing (Barriers No. 3-5) 2. Lack of sustainability of training program, and limited trained builders (Barriers No. 1,2 and 6) 3. Lack of awareness of energy conservation, and limited awareness of straw-bale technology (Barriers No. 7-8) 4. Lack of sustainable financing mechanisms (Barriers No. 9-10)
Canadian Fund ($35,000)	Construct 2 straw-bale demonstration buildings		
ADRA ($200,000)	1. Construct straw-bale demonstration buildings 2. Provide training in construction of straw-bale housing		

EXPECTED PROJECT OUTCOMES, WITH UNDERLYING ASSUMPTIONS AND CONTEXT

As a result of the project, straw-baled super-insulated houses will become viable and commercially successful in Mongolia. A great number of new buildings will be straw-bale, super-insulated. Straw-bales and super-insulation will have established themselves as a mainstream construction technology in Mongolia.

As a result of replication made possible by this project, it is conservatively estimated that in the four years after the project implementation, at least 15,000 super-insulated buildings will be built which would not have been built without the project. ADRA estimates that the demand for new single family housing in all Mongolia during the next seven years will be about 100,000. Thus, about 25% of annual housing demand in Mongolia is conservatively projected to be met by straw-bale buildings, after this project removes all the barriers. Hence at least 72,000 less tons of coal will be burnt, and annual CO_2 emissions will be reduced by at least 115,000 less tons.

Specifically, the expected project outcomes would be as following:

1. There will be a strong and growing cadre of engineers, businesses and household representatives qualified in designing and constructing super-insulated houses, as a result of the training programs in the project;

- A small but growing number of household owners and private construction companies will be qualified to build super-insulated buildings;
- Technical Support Units and Training centres will be established at the demonstration sites (inside the demonstration buildings) and will be operating on a financially sustainable basis;
- Due to the awareness programme, farmers will increase their efforts towards manufacturing straw-bales and to obtaining 'certification' of their products;

addition, a small unit will be established with the skills and equipment to certify the quality of straw-bales and super-insulated buildings. This will lead to a network of certification units. This activity will build consumer confidence in the technology, removing Barrier No. 5.

Without this project, no related activity would take place. At present, Mongolia only has the capacity to certify the quality of a building material, such a brick, etc. There is no such a unit that can inspect buildings in their various phases and certify them once they are completed according to specifications. This activity is essential to control the quality of straw-bale buildings, and ensure the sustainability of the technology. Therefore, all the costs of this activity are incremental. Incremental costs associated with this activity total $190,000, of which GEF will cover $140,000, $25,000 from Dutch Aid and Norway Fund $25,000.

Activity No. 6 - Develop business plans, business training (Cost $150,000, of which $75,000 from GEF and $75,000 from Norway Fund)

This activity will introduce the ESCO concept and framework, and provide business management training for the staff and managers in the private construction companies. This activity ensures the private construction companies that build straw-bale houses will run a commercial basis and ensures their financial sustainability.

At each demonstration site, business plans will be prepared to ensure that the certification unit and the training centres continue to operate after the project is finished. The business plan will focus on financial sustainability: how to ensure that the trainers and the certifiers can receive payment for the support they will give to builders and owners of buildings. Basic business training (e.g. in accountancy) will also be provided.

The business training and business plans under this activity will ensure the straw-bale construction companies, the certification units and training centers will continue to operate after the project is done. Therefore, this activity is critical to ensure the financial self-sustaining and sustainability of the certification units and training centers by training them to recover their operating costs and profits through service charges. Without this activity, the certification units and training centers could stop operating after the project is finished, because they can not keep financially self-sustaining. Thus, all the previous activities (No. 2-5) will fail, because no more training and inspection/certification activities will continue after the project is done. Therefore, this activity is crucial to ensure the sustainability of the whole project, and outputs of previous activities. Hence, this activity is indeed incremental, and specifically designed to ensure the financial self-sustaining of the straw-bale construction companies, certification units and training centers, and ensure the financial sustainability of the whole project, rather than general business training.

This activity will directly remove barrier No. 6. Without this project, no related activity would take place and so all costs are incremental. Incremental costs associated with this activity total $150,000, of which GEF will cover $75,000 and Norway Fund $75,000.

Activity No. 7 - Public awareness and education programmes (Cost $100,000 from GEF)

Public awareness programmes will be implemented to ensure that a wide range of concerned stakeholders are fully informed about the technology and its impact and availability. These awareness programme will be tailored to target the following: farmers in the provinces, house owners and builders, construction companies, government decision-makers, public-service

- The National Technical University's Faculty of Civil Engineering will have integrated insulation, super-insulation and straw-baled technology into its curriculum, and the next generation of architects and civil engineers will be capable of promoting super-insulated, straw-bale houses.

2. The quality and safety of the straw-bale buildings will be improved, as a result of the quality and safety control programs in the project;

- established national codes, standardisation, and safety guidelines for constructing straw-bale houses;
- trained technical staff who are capable of inspecting and certifying the construction of straw-bale houses;
- established Quality Inspection/Certification Units. These will be operating on a financially sustainable basis, and will operate from inside the demonstration buildings;
- trained government personnel who can make the right decision to give the permit, and standardise as well as simplify the permit approval process.

3. Public demand for the technology will be growing, as a result of the awareness and education campaigns in the project;

- established demonstration sites in the major provinces that produce straw. This network of straw-buildings will house the Quality Certifications units and Technical Support Units/Training centres (see below);
- exposed key government decision-makers, at national and provincial level, as well as general public to the success of the demonstration of straw-baled houses;
- raised awareness of the straw-bale technology and its benefits to building owners (households, schools, hospitals);
- fully introduced the concepts of super-insulated buildings and energy conservation for heating to the public.

4. Private, public and household finance will be allocated to manufacturing straw-bales and to constructing super-insulated houses.

- Local and national governments will have developed policy and allocated significant resources to the new technology, and its use in the public sector;
- Large scale investors will be attracted to invest in both straw-bale production and super-insulated buildings;
- Credit will be available to those wishing to purchase straw-baled, super-insulated buildings.

The main focus of the project is on straw-bale buildings. However the supervision provided to the construction industry can introduce other energy efficiency design factors such as south-facing windows, insulating curtains (also possibly made of straw-bales) and double doors.

ACTIVITIES AND FINANCIAL INPUTS NEEDED TO ENABLE CHANGES

Please see Annex I, "Incremental Cost Assessment", for details of the justification for the financial inputs from GEF for the activities. This project is specifically designed to remove

Mongolia teachers and translators, renting classrooms, preparing training materials, and certificates. Norway Fund will provide internal hands-on training and external in-service training as well as cover the costs for international and national experts. In addition, UNDP TRAC funding has provided $150,000 towards such training as baseline costs.

Activity No. 3 – Training university teachers/students and government personnel at Ulaan Bataar and curriculum development (Cost $310,000, of which $90,000 from GEF; $170,000 from Norway Fund; and $50,000 from Dutch Aid)

This activity will provide training to university professors and students to introduce the super-insulated technology into the curriculum at the national technical university. This will include a review of the curriculum, the preparation of necessary additions to the curriculum, and short intensive training for university professors and students. A competition of straw-bale house design among university students will be held.

In addition to university professors/students, the technical personnel and decision-makers in the central government will also be trained in straw-bale technologies, to facilitate the approval and permit process and strong support from the government. This directly removes Barrier No. 2 and 3 listed under the section 'Current Situation' above.

Without this project, no such training/curriculum development would take place and so all costs are incremental. Incremental costs associated with this activity total $310,000, of which $90,000 will be covered by GEF; $170,000 from Norway Fund; and $50,000 from Dutch Aid. The GEF funding will cover the costs hiring international experts, preparing training/curriculum/teaching materials/competition, DSA of university professors, renting a room, translation, computer, video, and information materials, and capacity building of government technical personnel. Norway Fund and Dutch Aid will provide funding for national seminars and study tours for government technical personnel and university professors.

Activity No. 4 – Develop national building codes and standards for straw-bale buildings (Cost $50,000 from GEF)

Currently, there are no national building standards and codes for straw-bale buildings to ensure the quality of straw-bale houses in Mongolia. This activity will review the international best practice of building codes for straw-bale houses, and adapt the international codes to Mongolia specific situation to develop national building codes for straw-bale houses in Mongolia. This activity is critical for quality and safety control, and will remove Barrier No. 4.

Without GEF support, no related activity would take place. Therefore, all the costs of this activity are incremental. Incremental costs associated with this activity total $50,000 of which GEF will cover all $50,000.

Activity No. 5 - Establish certification/inspection capacity (Cost $190,000, of which $140,000 from GEF, $25,000 from Dutch Aid and $25,000 from Norway Fund)

At each demonstration site, this activity will provide training to the technical personnel in local governments and inspectors in the private companies in inspection techniques and skills during and after the construction of straw-bale houses, and certification techniques. In

the institutional, financial, informational, economic, and policy barriers to the commercialisation of the straw-bale in Mongolia. To achieve this objective, this project consists of eight activities. Each activity is briefly described below.

Activity No. 1 - Constructing demonstration buildings (Cost: $2,100,000, which is not financed by GEF)

This activity will complement ongoing efforts of UNDP and ADRA. This activity will 1) build 70 super-insulating straw-bale social services buildings and 12 private demonstration houses; and 2) retrofit 20 existing institutional buildings, in five major straw-producing provinces that have 85% of the total straw and 70% of the population in the country (Selenge, Tuv, Bulgan, Khentii, and Darkhan-uul). The social services demonstration buildings will serve as health clinic, childcare centre, and primary school. These demonstration buildings will make a national network of demonstration sites. The process of construction will be used to provide on-the-job training. Once complete, the buildings will house the training centres and certification units developed under activities 2 and 5 below.

Activity No. 2 - Training construction builders at each site (Cost: $505,000 of which $90,000 is GEF financed)

This activity will 1) provide training in construction of straw-bale houses as well as quality control issues; and 2) establish regional training centres/technical support units.

In conjunction with the demonstration buildings in Activity 1, this activity will first provide training to local household representatives, construction builders, and technical personnel in the local governments in how to construct straw-bales and super-insulated houses as well as quality control issues. Straw-bale building technology requires very specific skills, which are quite different from traditional baseline building skills for brick houses. They will also be trained to be trainers in this domain. This will create a national network of skilled persons capable of constructing super-insulated buildings with high quality, of providing training to other builders, and of providing technical back-up to owners of such buildings.

Then, some of these trained persons will be selected to establish regional training centres/technical support units in each of the five provinces targeted in Activity 1, which will be housed inside the selected demonstration buildings. This activity is crucial to ensure the sustainability of training programs by providing training to a wide range of stakeholders and establishing regional training centres/technical support units, and will directly remove Barrier No. 1.

Although previous efforts have provided limited training in construction of straw-bale housing ($150,000 from UNDP as baseline costs), these training activities did not address quality control issues and support an institutional framework to ensure the sustainability of the projects. This activity, however, will 1) provide training to a wide range of stakeholders in both construction skills and quality control of straw-bale housing technology; 2) provide training to trainers; and 3) establish regional training centres/technical support units. These components under this activity are innovative compared to previous efforts, and are crucial to ensure the sustainability of the training program and ultimately the whole project.

network of demonstration sites. The process of construction will be used for some of the other activities below, particularly the training, inspection, and awareness raising. Once complete, the buildings will house the training centres and certification units developed under activities 2 and 5 below.

This activity is a baseline activity with total costs of $2,100,000, which will not be financed by GEF. The demonstration buildings will be co-financed by cash contributions of $1,115,000 from Norway Fund; $600,000 from Dutch Aid; $35,000 from Canadian Fund; $150,000 from UNDP TRAC; and $200,000 from ADRA.

Activity No. 2 – Training construction builders at each site (Cost $505,000, of which $90,000 from GEF; $265,000 from Norway Fund; and $150,000 from UNDP)

This activity will 1) provide training in construction of straw-bale houses as well as quality control issues; and 2) establish regional training centres/technical support units.

In conjunction with the demonstration buildings in Activity 1, this activity will first provide training to local household representatives, construction builders, and technical personnel in the local governments in how to construct straw-bales and super-insulated houses as well as quality control issues. They will also be trained to be trainers in this domain. This will create a national network of skilled persons capable of constructing super-insulated buildings with high quality, of providing training to other builders, and of providing technical back-up to owners of such buildings.

Then, some of these trained persons will be selected to establish regional training centres/technical support units in each of the five provinces targeted in Activity 1, which will be housed inside the selected demonstration buildings. This activity will directly remove Barrier No. 1.

Straw-bale building technology is a very specific technology, which requires completely different designs and skills to build, compared to the baseline houses – brick houses. The training will include skills from bale the straw to build a high-quality and super-insulating buildings. Without this activity, the builders will not know how to construct high-quality, super-insulating straw-bale houses, even though they have the traditional skills to build brick houses. Therefore, this activity is indeed incremental, and very specific to straw-bale houses, rather than general housing.

Although previous efforts have provided limited training in construction of straw-bale housing ($150,000 from UNDP TRAC funding as baseline costs), these training activities did not address quality control issues and support an institutional framework to ensure the sustainability of the projects. This activity, however, will 1) provide training to a wide range of stakeholders in both construction skills and quality control of straw-bale housing technology; 2) provide training to trainers; and 3) establish regional training centres/technical support units. These components under this activity are innovative compared to previous efforts, and are crucial to ensure the sustainability of the training program and ultimately the whole project.

The incremental costs associated with this activity total $255,000, of which GEF will cover $90,000 and Norway Fund $265,000. GEF funding will cover the costs for training activities at all demonstration sites, including hiring international experts, DSA of trainees/staff, hiring

Activity No. 3 – Training university teachers/students and government personnel at Ulaan Bataar and curriculum development (Cost: $310,000, of which $90,000 is GEF financed)

This activity will provide training to university professors, students, and technical personnel in the central government to introduce the super-insulated technology in Ulaan Bataar. In addition, this activity will also develop straw-bale building technology into the curriculum for the major of civil engineering and architect at the national technical university. This will include a review of the curriculum, the preparation of necessary additions to the curriculum, and short intensive training for university professors/students. A competition of straw-bale house design among university students will be held. In addition to university professors/students, the technical personnel and decision-makers in the central government will also be trained in straw-bale technologies, to facilitate the approval and permit process and strong support from the government. This directly removes Barrier No. 2 and 3 listed under the section 'Current Situation' above.

Activity No. 4 – Develop national building standards and codes for straw-bale buildings (Cost: $50,000 from GEF)

Currently, there are no national building standards and codes for straw-bale buildings to ensure the quality of straw-bale houses in Mongolia. This activity will review the international best practice of building codes for straw-bale houses, and adapt the international codes to Mongolia specific situation to develop national building codes for straw-bale houses in Mongolia. The codes and standards will include material standards, construction technique standards, safety guidelines, seismic standards, fire precaution standards, window sealing standards, electrical and plumbing standards, and etc. This activity will facilitate quality control and remove Barrier No. 4.

Activity No. 5 - Establish certification/inspection capacity (Cost $190,000 of which $140,000 from GEF)

At each site, this activity will provide training to the technical personnel in local governments and inspectors in the private companies in inspection techniques and skills during and after the construction of straw-bale houses, and certification techniques. In addition, a small unit will be established at each site to monitor, inspect, and certify the quality of straw-bales and super-insulated buildings. This will lead to a network of inspection/certification units. This activity is crucial for quality control and build consumer confidence in the technology, directly removing Barrier No. 5.

Activity No. 6 - Develop business plans, business training (Cost $150,000, of which $75,000 from GEF)

This activity will provide training for the staff and managers in the private construction companies in a) the concept, framework, and potential role of energy service company (ESCO) in construction of straw-bale buildings in Mongolia; b) market finance; c) commercial enterprise operation and management, and business accounting; d) economic/financial project appraisal; e) preparation of tender documents: and f) marketing strategies, and etc. This activity ensures the private construction companies that build straw-bale houses will run a commercial basis and ensures their financial sustainability.

The GEF project will support activities which remove barriers to straw-bale technology. Hence this technology will become commercial, and consequently a large number of super-insulated buildings (at least 15,000, and possibly as many as 30,000) will be built as a result of the replication made possible by the training and demonstration activities of this project. As a result of the insulation, each one-room straw-bale house will consume 4 tons of coal less annually, and a two-room and four-room house will save proportionally less coal. It is estimated that approximately 70% of the proposed replication buildings will be one-room straw-bale houses, 20% two-room houses, and 10% four-room houses. Hence at least 72,000 less tons of coal will be burnt, and annual CO_2 emissions will be reduced by at least 115,000 less tons.

The replication process should continue over the coming years in Mongolia, and eventually market penetration of the technique will be significant.

In addition, the project will contribute to the making this innovative, energy efficient technology commercially viable. This should have an impact on coal and wood burning in other parts of the world.

There will be four other positive global benefits. These are difficult to quantify, but are minor compared to the reduced CO2 from coal burning. These are:

1. less wood will be burnt, this also reduces CO2 emissions;
2. burning less wood means less trees will be cut. This preserves trees, which will help sequester carbon.
3. preserving trees means preserving forests, thereby reducing land degradation and biodiversity loss;
4. using straw to make bales means straw is neither burnt nor left to rot. This stops emissions of CO2 associated with the burning, and emissions of methane associated with rotting.

Alternative

In the alternative GEF project, extensive training will be held for the construction builders and university teachers, and local training centres will be established. The national codes and inspection/certification units in each site will be established to ensure the quality and safety of the straw-bale houses. Overall awareness to straw-bale buildings and energy conservation will be improved. In addition, pubic and private investment will be channelled to finance building and purchasing straw-bale houses. A series of complementary activities, as follows, will ensure that all the major barriers will be removed:

Activity No. 1 - Constructing demonstration buildings (Cost $2,100,000, of which $1,115,000 from Norway Fund; $600,000 from Dutch Aid; $150,000 from UNDP; $35,000 from Canadian Fund; and $200,000 from ADRA)

As discussed above, this activity will complement ongoing efforts of Government, ADRA and UNDP. Specifically, under close supervision, this activity will 1) build 70 super-insulating straw-bale social services buildings and 12 private demonstration houses; and 2) retrofit 20 existing institutional buildings, in five major straw-producing cities– Selenge, Tuv, Bulgan, Khentii,and Darkhan-uul. These demonstration buildings will make a national

In addition, business plans will be prepared to ensure the certification units and the training centres continue to operate after the project is finished. The business plan will focus on financial sustainability: how to ensure that the trainers and the certifiers can receive payment for the support they will give to builders and owners of buildings. Basic business training (e.g. in accountancy) will also be provided. This activity is crucial to ensure the financial self-sustaining of the straw-bale construction companies, training centres and certification units, thus, it will ensure the sustainability of previous activities (Activity 2-5), and directly remove barrier No. 6.

Activity No. 7 - Public awareness and education programmes (Cost $100,000 from GEF)

Public awareness programmes will be implemented to ensure that a wide range of concerned stakeholders are fully informed about the technology and its impact and availability. These awareness programmes will be tailored to target the following: farmers, house owners and builders, construction companies, government decision-makers, public-service workers, potential large-scale investors. The young population will be a key target group. Where appropriate, the awareness programmes will use the network of demonstration buildings as inputs into awareness raising material.

In addition to the public awareness campaign of straw-bale houses, a public education program of energy efficiency and conservation will also be launched. This public education program will provide information to the straw-bale house users of energy efficiency heating options. Currently, most straw-bale house users have little awareness to save coal for heating and adopt energy efficient heating stoves. As a result, consumers usually open the windows in the winter, as the straw-bale houses are too warm. Thus, the goal of significant reduction of coal consumption by building straw-bale houses to replace brick houses or ghers can not actually be achieved. This program is targeted at the straw-bale house users to inform them of energy efficient heating measures and improve their energy conservation awareness to ensure the actual coal saving for heating.

These programmes will consist of campaigns through posters, newsheets, radio broadcasts, TV advertisement and programs, and video etc. This activity will directly remove Barrier no. 7 and 8.

Activity No. 8 - Develop sustainable financing mechanisms (Cost $350,000, of which $100,000 from GEF)

This activity includes two components: (1) developing investment framework to attract large-scale private financing into the construction companies to build straw-bale houses; and (2) establishing financing mechanisms to facilitate individual households to build or purchase the straw-bale houses. At the same time, the government financial incentive policies that will facilitate these two components will be developed and recommended, in order to attract private investment and channel public investment in the straw-bale houses.

The first component is designed to remove barrier no. 9 – complicated and risky investment environment. Therefore, this component will identify the uncertainties and risks associated with the investment in straw-bale houses, and developing the financial and institutional incentive policies to attract large-scale private investment. Innovative contractual arrangements will be considered, and if appropriate, developed for signature. For example, it

ANNEX-1 INCREMENTAL COSTS ASSESSMENT

Introduction
(please refer to matrix)

The proposed project is substitutional, it seeks to replace inefficient brick and wood buildings with straw-baled, super-insulating ones. A series of activities will remove institutional, financial, informational, economic and policy barriers to the commercialisation of the straw-bale technology. Some of these activities are additional as no corresponding activity would occur under the baseline.

As a result of replication made possible by this project, it is conservatively estimated that in the four years after the project implementation, at least 15,000 super-insulated buildings will be built which would not have been built without the project. ADRA estimates that the demand for new single family housing in all Mongolia during the next seven years will be about 100,000. Thus, about 25% of annual housing demand in Mongolia is conservatively projected to be met by straw-bale buildings, after this project removes all the barriers.

The Asia Least-Cost GHG Abatement Strategy (ALGAS) project estimated that over 50% of Mongolia's CO_2 emissions result form heating buildings. The ALGAS project developed national GHG abatement strategies and national action plan, as well as a portfolio of GHG abatement projects for Mongolia. ALGAS concludes and recommends the energy conservation for buildings as a priority, and the straw-bale super-insulated technology is the least-cost strategy to reduce GHG emissions in the abatement projects portfolio.

Baseline
The baseline consists of what the Government, UNDP and ADRA would do without GEF support.

Under the baseline, a small number of super-insulated buildings would be built. Because constructing the straw-bale buildings is four to five times cheaper than the brick buildings or gers, construction of demonstration buildings is quite cost-effective, and therefore, is baseline activity. The Dutch aid and Canadian Fund will co-finance the demonstration buildings. The local governments will also make in-kind contribution towards preparation and transport of straw-bales. These would lead to a very small reduction in CO_2 emissions, and would have an impact on social services. They would not lead to the removal of the barriers that oppose the commercialisation of straw-bale technology, and straw bales would remain very marginal. From the viewpoint of the global environment, there would be no substantial or sustainable impact.

In addition, a small amount of credit ($60,000 from the government) would be made available to individual household, some of whom may choose to construct super-insulated buildings. The monitoring of this credit would be weak. Also the quality of the super-insulated buildings would be low. Again, from the viewpoint of the global environment, there would be a very limited, non-sustained impact.

Given the tight fiscal situation and the existing barriers, straw-bale houses will not be replicated at a large-scale in Mongolia without this project.

Global Environment Objective

is likely that contracts between investors and local authorities to build large numbers of houses can be developed. These houses would then be sold or leased by the investor. Or BOT could be investigated as an option. In addition, simplified investment approval procedures will also be investigated and recommended. This component will include seminars/workshops with potential investors.

In addition, individual households cannot afford to pay for the up-front costs of straw-bale houses, and it is difficult to obtain financing due to the lack of credit system, even if the investment can be quickly recovered by the energy savings. The second component is designed to remove barrier no. 10.

This component will explore the possible financing mechanisms to facilitate individual households to purchase straw-bale houses. The financing mechanisms could include straw-bale houses partially paid by the government, built by the government and repaid by the customers with the mortgage system, government guarantee, access to market-rated credit, micro-credit, and selling the demonstration buildings and setting up revolving fund, and etc. Then, this component will recommend the appropriate financing mechanism that suits Mongolia situation. For example, this component will analyse the credit framework in Mongolia, and will identify appropriate sources of credit. It will design a credit system including monitoring. This system should be integrated into the existing credit/fiscal systems in Mongolia, but may also be built in the demonstration sites under activity 1. The international/national team will recommend the selection procedure/criteria and the most appropriate financing mechanism(s). Then, the project steering committee to be set up, which will include the key stakeholders and UNDP, will evaluate the selection procedure/criteria and make a final selection. Finally, this component will design the guidelines and criteria for the selected financing mechanism, and secure funding sources for it. For example, if the credit scheme is chosen, then the credit should be recovered into a revolving fund, and re-allocated to other replication super-insulating buildings. As mentioned earlier, the replication potential will be at least 15,000 straw-bale housing in the next four years after the project implementation.

In addition, this activity will secure at least $250,000 as initial credit for 10 households in each of the five provinces to purchase the super-insulated houses funded by the Dutch Aid.

Activity No. 9 – Independent measurement and monitoring of the energy savings (Cost $40,000 from GEF)

It is very important to measure, monitor and evaluate the fuel savings and temperature gains of the straw-bale houses compared to the brick houses and/or ghers. This project allocates $40,000 to support this measurement. The result will be made public and incorporated into public awareness and education programme. It is critical for future replication.

SUSTAINABILITY ANALYSIS AND RISK ASSESSMENT

Sustainability

From a technical standpoint, straw-bale building is a commercially proven technology. It has been proven to be a high performance, super-insulated and low-cost building technology in several developed countries, such as the US and Canada. In addition, the UNDP PEESS project has proved the technical feasibility of the straw-bale buildings in Mongolia. This

Component	Incremental			Baseline[4]	Total
	GEF	Other Sources[3]	Subtotal		
PDF	25	0	25	N.A	25
Personnel[1]	215	300	515	400	915
Subcontracts	320	0	320	1,600	1,920
Training	90	155	245	150	395
Equipment	15	115	130	100	230
Travel	45	40	85	40	125
Miscellaneous[2]	20	145	165	100	265
Project Support	20	80	100	110	210
Total	**750**	**835**	**1,585**	**2,500**	**4,085**

1. Personnel include hiring a) international and national consultants from GEF funding; and b) project managers, coordinators, and consultants from Norway and Dutch aid.
2. Miscellaneous costs cover project monitoring & evaluation, printing, communication, and reporting .
3. Other sources include Norway Fund and Dutch Aid.
4. Baseline costs are covered by Norway Fund $1,.15,000, Dutch aid $850,000, Canadian fund $35,000, UNDP TRAC $300,000, and ADRA $200,000.

G MONITORING AND EVALUATION PLAN

The project will be monitored and evaluated in line with UNDP rules and procedures. Annual Performance Reports will be prepared and discussed through with the project executing agency and the project staff. This discussion culminates in annual Tri-partite Review meetings, leading to specific recommendations to improve project impact and implementation.

In addition, it is very important to measure, monitor and evaluate the fuel savings and temperature gains of the straw-bale houses compared to the brick houses and/or ghers. This project allocated $40,000 to support this measurement. This is critical for future replication.

The project team will undertake continuous, self-monitoring. At the outset, detailed and measurable performance indicators for the overall project will be prepared by the project team in consultation with UNDP, MNE and other concerned stakeholders. These performance indicators will be assessed each six months.

Based on the overall project objectives and these performance indicators, quarterly workplans will be prepared. These will indicate how the quarter's activities contribute to the overall objectives. Performance indicators will then be prepared for each quarter. This will be used to measure performance. In addition, this monitoring will be used to continuously refine the project approach and activities.

project will develop in-country technical capacity of building straw-bale houses through Activities No. 2-3, and quality as well as safety control through Activities No. 4-5.

From a market standpoint, straw-bale technology showed clear win-win situation. A straw-bale house is much cheaper to be built and can save up to 80% of coal consumption and fuel bill, compared to an equivalent conventional brick house. The technology is in high demand in Mongolia, and recognised as a country priority. The project will also help create a sustainable demand for the technology through Activities No.1 and No. 7. These technical and market forces should ensure the long-term sustainability of the technology in Mongolia.

From a financial standpoint, the project avoids subsidising activities that will continue after the project. For example, each demonstration/training/technical support site will receive support to start-up, but on the clear understanding that they are to become financially sustainable operations. Sufficient help will be given (through business development planning and business training under Activity No. 6) so that each site can sell its services after the project. Likewise, any credit schemes developed under Activity No. 8 will operate at market-rates, and should therefore continue to function after the project, if there is a demand.

From an institutional standpoint, the project is developing and supporting government institutional capacity and sustainability under Activities No. 2-5 and No. 7-8.

Risks

The project has the following risks associated with it. These are discussed along with the method to mitigating the risks:

1 Lack of capacity to coordinate In order to be successful the project should coordinate activities over different demonstration sites. The large distances involved and recent governmental changes lead to a risk of inefficient coordination. The Project Implementation Unit (PIU) will play a critical role in coordinating the provinces. The demonstration sites are selected to be close to Ulaan Bataar, so that it is easier to coordinate and manage. In addition, the project is designed so that activities can evolve in each province, without the constant administrative support of the central government.

2 Administrative reform the present government and administration is supportive of straw-bales and super-insulated housing. The ongoing public administrative reform means that functions are being changed, streamlined and rationalised. There is a small risk that government support for the project objectives would decrease or become less focused. The project is designed to work under all administrative structures.

Related to this is the fact that not all the political parties are fully committed to keeping heating and energy subsidies so low. Accordingly, a change of government could possibly lead to a return to subsidies, thereby affecting the competitiveness of super-insulated houses. This risk is considered very small, as none of the main political parties advocate a return to high subsidies.

3 Availability of straw. Straw is critical to build the demonstration houses and to meet the demand for super-insulated buildings. Straw is only available in certain provinces and at certain times of the year (see Annex II - The straw-bale building technique and availability of straw-bales in Mongolia). The demonstration sites are selected in the major straw-producing provinces, which generate about 85% of the total straw in the nation. The impact of seasonal

The project involves a large number and broad cross-section of people, particularly through the training and awareness campaigns. This gives the opportunity to consult fully with representatives of all stakeholders. In particular, more formal consultations will be held:

- With builders and academia through the training programs;
- With Architecture and Construction Development Agency, National Standardisation and Metrology Center, and Fire Department through the national codes program;
- With general public during the public awareness and education programs;
- With private sector investors through workshops;
- With decision-makers during the public awareness programme.

Stakeholder participation

The barriers to super-insulated buildings cannot be removed without a high degree of stakeholder participation from all stakeholders listed above. With stakeholder participation, straw-bale technology and super-insulated housing will receive wide recognition and support. The following project components ensure this participation:

i. the project design incorporates the findings of long-term, ongoing projects supported by NGOs and UNDP;
ii. the wide-scale awareness campaign will ensure the outreach of not only the technology, but also of the project;
iii. a wide cross-section of Mongolian society, including politicians, academics, entrepreneurs, households owners and farmers will participate in the project's training programme. These training programmes will be highly interactive and ensure that the project appreciates the constraints and viewpoints of the participants;
iv. participatory workshops with potential large-scale investors will ensure that the project outputs reflect their concerns.

Social and participation issues

The project will be beneficial to the poor. In particular the widespread application of super-insulated housing resulting from the project should have a positive impact on vulnerable groups, through the following mechanisms:

- infants and children will benefit from warmer houses, warmer schools, and more public and private budget allocated to education and health;
- sick and elderly people will benefit from warmer houses, warmer clinics/hospitals, and more budget allocated to health-care;
- women will have to spend less time going to the market to buy coal and less time collecting wood. Also households should have more money available for food, medicine, etc.

Coal is distributed through a semi-formal network to homes in and around Mongolia's cities. This semi-formal distribution network employs a small number of people, some of whom will have to find alternative employment when super-insulated housing becomes common-place. This concerns a very small number of people.

F BUDGET

This budget covers the incremental costs and baseline costs. All figures are in thousands of US dollars.

and weather change on straw supply is beyond the control of this project. There is a small risk that the seasonal lack of straw may lead to delays in project implementation and may dampen the market-demand for straw-bales. Careful selection of sites, careful project planning, and flexibility in the project work-plan (for example delaying the construction of demonstration buildings whilst undertaking other activities such as university curriculum development) mitigate this risk.

STAKEHOLDER INVOLVEMENT AND SOCIAL ASSESSMENT

Stakeholder involvement

The project stakeholders include farmers, the youth of Mongolia, house-owners, private construction companies, academia, Architecture and Construction Development Agency, National Standardisation and Metrology Center, Fire Department, private inspection consulting firms, construction units in local provincial governments, national government, and large-scale investors.

The project seeks commercial viability for an innovative technology in a complex economic context. A strong stakeholder involvement is essential to success in this. The approach to this is described in detail in Section E, "Public Involvement Plan".

Social Assessment

The project will have significant, positive social implications. The technology being promoted will improve the livelihoods and living conditions of general public in Mongolia by savings fuel costs.

Super-insulated housing will save approximately 4 tons of coal for the average household in Mongolia, which is equivalent to an annual saving of $70-$90 on fuel bill. This will free money to be spent on food, healthcare, education etc. In addition, despite heavy use of coal, temperatures inside most individual buildings remain below freezing point for many months of the year in Mongolia. Initial tests with super-insulation buildings indicate that not only will less coal be burnt, but inside temperatures will be substantially increased, leading to further improvements for families in terms of health and comfort.

As with homes, super-insulated schools, health centres, crèches etc not only use less coal but are warmer inside. This has obvious implications for health and education. Savings on the fuel bill will release funds for local authorities to spend, for example, on medicine and educational materials.

D PROJECT IMPLEMENTATION PLAN

The project will last for 2 years (24 months)

Activity	Quarter							
	1	2	3	4	5	6	7	8
1. Constructing demonstration buildings	xx	xx	xx					
2. Training builders	xx	xx	xx					
3. Training university teachers, curriculum development				xx	xx	xx		

4. Develop national codes and standards		xx	xx					
5. Establish inspection/certification capacity				xx	xx			
6. Develop business plans and business training						xx	xx	
7. Public awareness and education programme	-		x	x	x	x	x	X
8. Develop financing mechanism				xx	xx	xx	xx	Xx

Institutional Arrangement

Existing PIU of the UNDP PEESS project will continue closely cooperation work with several Ministries of Mongolia (the Ministry of Infrastructure Development, the Ministry of Nature and Environment, the Ministry of Education, and the Ministry of Health and Public Welfare) and international and national NGOs.

At each construction site, a small unit will be established with the skills and equipment to certify the quality of straw-bales and super-insulated buildings. This will lead to a network of certification units.

E PUBLIC INVOLVEMENT PLAN

Stakeholder identification

The project is to be implemented by the Ministry of Infrastructure Development. The project stakeholders and their specific roles are described below:

Farmers: who are responsible for producing straw bales;
Households: who are likely to build or purchase straw-bale houses;
Private construction companies: who build straw-bale houses;
Academia: technical schools responsible for training architects and civil engineers. In the future these professionals will design and promote super-insulated buildings;
Architecture and Construction Development Agency: who gives the permit for blueprint of straw-bale houses;
National Standardisation and Metrology Center: who gives the permit for national codes and standards for constructing straw-bale houses;
Fire Department: who gives the safety permit for constructing straw-bale houses;
Private inspection consulting firms: who monitor and inspect the construction of straw-bale houses to comply with the codes, standards, and safety guidelines;
Construction units in local provincial governments: who is responsible for construction of houses;
Provincial governments: who own, operate, and pay for the construction of social service centers and government employee buildings;
National government: who will promote the technology and allocate resources to it;
Potential large-scale private investors: who may invest in the technology, thereby providing capital and creating economies of scale.

Information dissemination and consultation

As one of the barriers to super-insulated buildings is lack of information, one of the aims of the project is to disseminate information through public awareness and education campaigns.