Introduction of energy efficiency in public buildings
in Afghanistan

Combating the greenhouse effect and climate change

Studying and treatment in better conditions while consuming less energy

Energy management at acceptable cost in reconstruction programmes

Summary

Some Energy Efficiency Standards

Climate change and greenhouse gases

Climate change upsets the environmental, economic and social balance. Developing countries, and in particular the least developed countries, are the first to be feel the effects of this disruption which amplifies existing vulnerabilities.

Even though the influence of greenhouse gases on the climate remains complex, their constantly increasing concentration worries scientists. Building is one of the main sectors at the origin of greenhouse gas emissions. Heating, lighting and air-conditioning systems engender more and more substantial energy consumption. In mountainous countries and in particular in Central Asia, energy sources essentially derive from biomass, which is increasingly scarce, not renewed and thus has a direct impact on global warming. Imported oil products and limited coal production complete the energy mix.
We have for several years been seeing the rapid melting of glaciers throughout the Central Asian mountain ranges. Energy, environment and climate change issues thus constitute strategic challenges for resource-poor mountainous countries like Afghanistan.

Faced with this situation, the international community is mobilizing both to promote carbon-sparing modes of development and to assist the most deprived countries in adapting to the changing climate.

Reconstruction programmes in Afghanistan

Quickly rebuilding

Since 2002, the country has been the subject of reconstruction programmes which emphasize the rehabilitation of the main public sectors (health, education, transport and energy infrastructure). This collective infrastructure is vital to economic revival and social cohesion. In a situation where the economy is exceedingly precarious, the urgency of reconstruction must not make us lose sight of the need for long-term sustainability.

If it is not to aggravate the risks which could hamper their operation later on, the reconstruction of buildings undertaken by these programmes has to try to reduce recurrent costs (maintenance and energy consumption). Added to the local difficulties in energy product supply (wood, oil and coal), these constraints make it essential to construct energy-efficient buildings, at an acceptable cost for the principals.

Afghanistan has a long tradition of construction, but many craftsmen and technicians have left or turned to new types of employment. It is now a question of finding or reintroducing successful techniques, using local products in preference for the reconstruction of urban and rural buildings.

Priority to Health and Education

The reconstruction of public buildings in the education and health sectors is considered as a priority by both the Afghan authorities and donors. In cold zone health centres, energy costs can represent up to 25% of the budget (from $5,000 to $25,000 a year according to the type of establishment). This item of expenditure is the only one where large savings are possible.
In schools, the opening periods are heavily dependent on climatic conditions. In winter, and in particular in the centre of the country, schools are obliged to close for periods as long as five months, for lack of fuel to heat them.

Some construction constraints

Rehabilited school in Kabul

Support from the international community

At the Tokyo conference held in January 2002, the international community set a framework for the reconstruction of Afghanistan.
Between 2002 and 2007, international assistance amounted to US$14.3 billion, of which approximately 8% is dedicated to health and education.
As part of this assistance, the programme supported by the FFEM helped to integrate energy efficiency from the start of the process of reconstruction, laying the foundations for long-term impacts, while it is always more difficult and less successful to work on existing infrastructure.
More recently, the ANDS (Afghanistan National Development Strategy) prepared by the Afghan government was adopted during the International Conference in Paris in June 2008. The ANDS defines eight pillars, including health and education, for the country's social and economic development strategy; it enshrines the environment as a cross-cutting priority.

The tripartite initiative AFGEI (Afghan-French-German Energy Initiative) in the energy field

In 2004, the tripartite Initiative AFGEI (Afghan French German Energy Initiative) was signed in Kabul by the three countries with a view to developing renewable energies and energy efficiency in Afghanistan. German co-operation concentrates its efforts mainly on the renewable energies sector in the remote regions (hydroelectric power plants, distribution of lamps, solar ovens and boilers, rural decentralized electrification grid). French aid targets energy efficiency in buildings.

Paris Conference (juin 2008)

Energie Efficiency in Housing Seminar

The energy efficiency project

Energy issues are very important in Afghanistan, where less than 10 % of the population, essentially in cities, has access to electricity. There is practically no access to the grid in the countryside.

Priority energy demand is mainly for heating. For example, the city of Kabul (with a population of 4,500,000) is situated at an altitude of 1800 metres and climatic conditions there are often rough, with very harsh winters. The areas surrounding the city are deforested, which limits access to wood resources for heating. In these conditions, expenditure on fuel can account for up to 40% of household income for very limited comfort and sometimes problematic health conditions (respiratory diseases engendered by smoke and poor combustion).

However, Afghanistan benefits generally from good levels of sunshine. Energy improvement of buildings can therefore benefit easily from passive solar architecture techniques combined with thermal insulation.

The introduction of these new energy efficiency practices then makes it possible to reduce energy consumption by about 50%, with additional investment costs of less than 10%. These additional costs depend on the thermal requirements prescribed in the specifications for the public buildings, on climatic conditions and on the frequency of use of the buildings. The improvements brought about in this way also help to improve the quality and lifespan of the reconstructed buildings.

Some key figures

Afghanistan's energy consumption represents 15 million TEP (tons petroleum equivalent).
61% of these needs are covered through the use of biomass and 30% through oil products.

Poorly insulated buildings mean very high energy consumption, which can exceed 300 kWh per square metre annually.

Relatively simple improvements can reduce consumption by more than 50%.

A programme to develop a sustainable approach which integrates the constraints of Afghanistan

In 2004, the French Ministry of Foreign and European Affairs (MAEE) decided to launch a project of co-operation in the priority sectors of health and education, in association with the Afghan authorities concerned, the National Environmental Protection Agency (NEPA) and the Ministries of Health (MoPH), Education (MoE) and Energy and Water (MEW).

This project, led by the National Environmental Protection Agency (NEPA) with the support of the French Global Environment Facility (FFEM), aims to introduce measures for energy efficiency improvement and the use of renewable energy in various programmes of assistance, development and reconstruction of the health and education sectors. It reuses traditional know-how and transfers new technologies. It helps with the training of craftsmen and construction workers and finally contributes towards opening up new markets for goods and services.

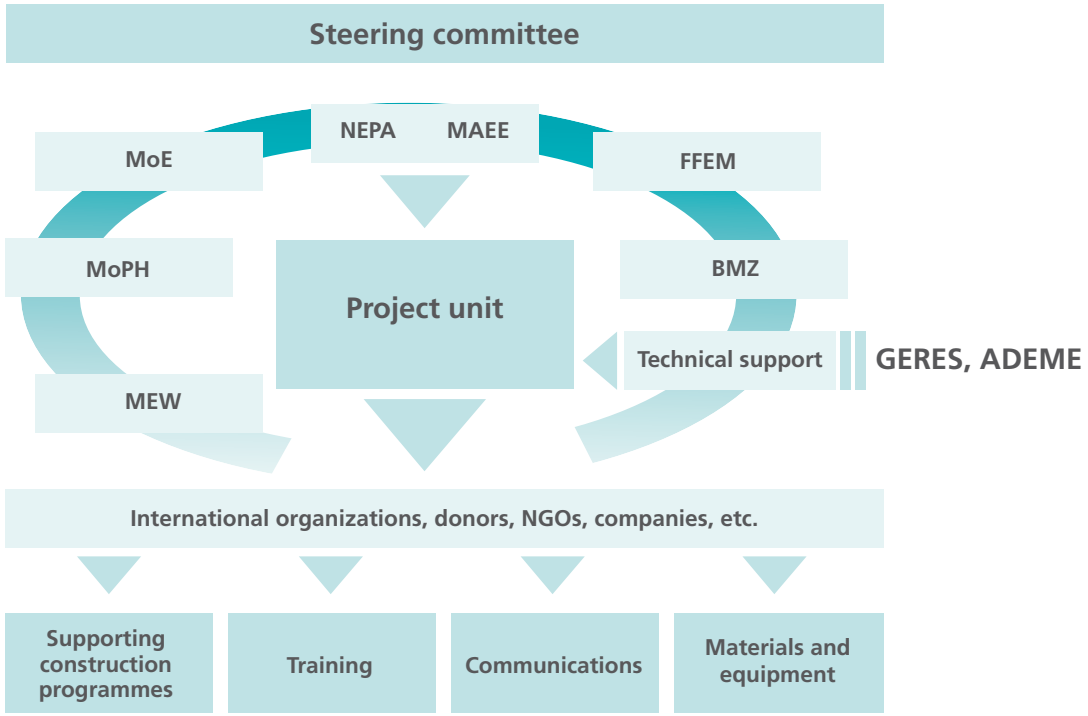
This project, funded with a grant of €1.35 million from the French Global Environment Facility (FFEM), is co-driven by the NEPA and the MAEE, co-ordinated by the Environmental and Energy Management Agency (ADEME) and implemented locally by the Renewable Energies, Environment and Solidarity Group (GERES), based in Afghanistan. **FFEM's contribution represents 10% of overall budget, estimated at 13 million euros**.

The activities of the project mainly concern the coldest regions where fuel demand is high to cope with wintry temperatures which can fall below 35°C (Kabul and its surrounding region, the northern region and the central region).

Organization, partners and implementation

The FFEM project attempted first and foremost to provide **support** for the authorities in the form of advice, **train** loperators and **build up numerous partnerships** with co-operation agencies, people in charge of programmes and non-governmental organizations. While asserting its specificity, the programme tried hard to complement the work of these actors.

Organization chart




Some Handworkers trained

The French Global Environment Facility

The French Global Environment Facility (FFEM) was set up in 1994 by the French government, following the Earth Summit in Rio de Janeiro in 1992, to facilitate environmental protection in developing countries. Funded from the government budget under the heading of official development assistance, its resources amounted to €277.5 million over the period 1994-2010. The facility is provided in addition to the contribution of France to the Global Environment Facility (GEF).
The FFEM is placed under the supervision of the Ministries of Economy and Finance, Foreign and European Affairs, Environment and Research, as well as the French Development Agency (AFD). The Ministry of Economy holds the FFEM presidency, while AFD deals with management.
The FFEM contributes, in the form of subsidies, to the funding of sustainable development projects having a significant impact on global environmental issues: biodiversity, the greenhouse effect, international waters, the ozone layer, soil degradation, including desertification and deforestation, and persistent organic pollutants.

Distribution by field and geographical area between 1994 and 2007

Field	Number of projects
Biodiversity	104
Climate Change	45
International waters	28
POP-Soil degradation	14
TOTAL	**191**

The National Environment Protection Agency

The National Environment Protection Agency (NEPA) was set up in 2005. It serves to develop environmental, economic and social policies, and as a statutory and regulatory institution. As such, it regulates, co-ordinates, monitors and applies the laws on the environment and plays a major role in environmental protection and management. In 2009, the first national park in Afghanistan (Band-e Amir) was created under its authority.

The project's achievements

French co-operation, which started with GERES in 2002, supported the construction of demonstration buildings which aroused the interest of Afghan decision-makers in the proposed techniques. Basing itself on these first results, this project was developed to provide advice to the Ministries of Education and Public Health, train operators and establish a long-term perspective on energy-efficient construction methods (donor requirements, standard plans and designs, public investment framework).

This project's components included:

- Assisting the National Environmental Protection Agency (NEPA) and the Ministries of Public Health (MoPH) and Education (MoE) with the construction of energy-efficient public buildings.
- Promoting energy efficiency amongst all actors, both national (institutions and companies) and international (bi- and multi-lateral donors involved in reconstruction).
- Training the actors contributing towards the implementation of energy efficiency: planners, architects, controllers of works, works foremen, students, etc.
- Producing in Afghanistan, through technology and know-how transfers of:
  - The components necessary for the dissemination of energy efficiency, such as internal and external thermal insulators and double-glazed, efficient windows.
  - Efficient, safe heating equipment.

Kabul Training Workshop

Technogies transfer

The results

In training • more than 750 participants attended 50 practical training sessions held on site • 250 architects, engineers and students took part in around twenty conferences run by the project.

In the promotional field • large amounts of material were put together and communications ensured through seminars, both in Afghanistan and abroad • Numerous articles were published in the AFGEI newsletter with German co-operation (GTZ).

Costs and surface areas of the improved buildings

Type of buildings	Number of buildings	Total costs of the buildings (US$)	Surface area of the buildings (m²)
Schools	13	1 472 771	7 231
Health facilities	13	2 011 303	3 219
Afghan National Army (ANA) dormitories	236	18 000 000	151 254
Demo Buildings	3	133 000 (overcost)	348
Military Academy	6	5 000 000	2 923
Kabul Museum	1	10 000 (overcost)	1 683
Kabul University and training centres	2	1 400 000	3 250
Total	**274**	**28 027 074**	**168 225**
Objectives	**100**		**38 000**

Overall, the targets were greatly surpassed.

Project achievements

The impacts

In the short term, thermal insulation of buildings brings considerable comfort gains with increases in temperature of between 5 and 10°C, with a constant budget. Currently available resources for heating public buildings do not allow them to exceed temperatures of 5-15°C. For correctly heated buildings (army dormitories), energy savings and reduction of CO_2 emissions can reach 70%.

For energy-efficient buildings, normally heated to 18°C, daytime heating needs vary, depending on climate zone, from 40 to 60 kWh / m². Emissions of 18,000 tons of CO_2 would then be avoided. In this case, a return on investment can be achieved in less than 3 years.
Summer comfort is also improved through the solutions adopted.

Theoretical impact of insulation in the subarctic climate zone (Central and North East Afghanistan Mountains)

18°C	Heating needs kWh/m²/y	CO_2 emission reduction	Return on investment (years)
New building partially insulated Daytime use	95	49%	Less than one year
New building with improved insulation Day time use	60	77%	2 à 3 ans

Theoretical impact of insulation in the continental climate zone (Out of mountains area , South-Eatern and North-West plains)

18°C	Heating needs kWh/m²/y	CO_2 emission reduction	Return on investment (years)
New building partially insulated	65	48%	Less than one year
New building with improved insulation	40	70%	3 to 4 years

Some building examples

	Khoja hassan school	Sapahi khil clinic	Military Academy Clinic
Location	Khoja Hassan village, Istalif District, Kabul Province	Sapahi Khil village, Gardiz District, Paktia Province	Kabul, near airport
Rural/urban	Rural	Rural	Urban
Use	Secondary School (4 classrooms = 150 children)	Basic Health Centre, only open during the day	Clinic with a capacity of 350 to 450 people Open 24 h
Construction cost	US$46,000	US$90,000	US$500,000
Living space	213 m²	280 m²	576 m²
Storey	Single	Single	2-storey
Implementer	Ministry of Education (MoE), Islamic Republic of Afghanistan	Ministry of Public Health (MoPH), Islamic Republic of Afghanistan	Ministry of Defence (MoD) Islamic Republic of Afghanistan
Thermal Insulation	Roof: Mud and straw blocks + cotton in one classroom Walls: Mud and straw blocks Windows: Wood frame with double glazing	Roof: Glass wool Walls: double wall with 5 cm thick polystyrene Foundation: 3 cm of polystyrene Windows: Wood frame with double glazing	Roof: Glass wool (15 cm) Walls: Exterior insulation with 10 cm thick polystyrene Foundation: 10 cm of polystyrene Windows: PVC, double glazing
Thermal insulation cost	Included in the building cost, the mud and straw blocks are at the same time construction and insulation material.	US$20.5/m²	US$22/m²

A variety of technical solutions

When the project began, there were no technical products available in Afghanistan to implement thermal insulation easily. The project focused its efforts on supporting the local production of such components, transferring know-how and establishing local control of the implementation of 9 different techniques, including:

• **Local production of polystyrene panels**: this manufacturing process, introduced in 2005 by the Yarash-Huma company of Kabul following the acquisition of equipment in China and Iran, has developed considerably with the project. It concerns internal wall insulation, with insulation distributed between 2 brick walls. The polystyrene panels are 10-15 cm thick and coated on both sides with self-supporting concrete. They can also be used in roof insulation. The estimated market of 5000 m^3 a year is rapidly expanding. The Afghan company holds a 30-40% share of the local market.

• **Transfer of know-how on external insulation techniques**: this solution is the most successful in terms of insulation quality but requires careful attention to implementation. The project facilitated the establishment of a partnership between the Afghan Ansary Engineering Products and Services company and the German company STO, the world leader in the field (training Afghan technicians, supporting demonstration operations).

• **Local production of double-glazed window** essentially in PVC is now handled by 4 local companies.

Insulation types and costs

Insulation types	Characteristics	Insulation costs (US$/m²)
Non-insulated	Concrete flat roof Brick walls Single glazing	-
Partially insulated	Roof insulation: 10 cm polystyrene or glass wool Brick walls Double glazing	**6,8**
Complete low cost insulation	Roof insulation: 10 cm polystyrene or glass wool Wall insulation: 5 to 10 cm of polystyrene Double glazing	**20,5**
Complete insulation	Roof insulation: 10 cm polystyrene or glass wool Wall insulation: 5 to 10 cm of polystyrene (STO Technique) Double glazing	**46,4**

Lessons from the project and future prospects

Supporting the project and structuring the Afghan administration

Teams from 6 ministries and 15 financial institutions were helped to adapt the energy efficiency measures to their own constraints and introduce them into their activities. This initiative required strong commitment from the project team.
Standard plans were approved by the public health authorities for basic health centres and private hospitals.
The NEPA and the Ministry of Energy developed structures to integrate energy efficiency in their work.

Convincing results

168,000 m² of buildings were improved against a target of 38,000 m². The costs of the energy efficiency measures were kept below 10%. A considerable improvement in comfort in the buildings and a substantial reduction in the maintenance costs related to efficiently heated buildings (clinics, universities, museums, training centres, army dormitories) were recorded

Trained decision-makers aware of the issues

Close on 1100 people from all walks of life - principals within national and international institutions, technicians, engineers, company architects and students **- took part in the 350 days of training** and information.

A market in course of organization

The project made a substantial contribution to **job creation** in two new sectors in Afghanistan: the production of thermal insulators and high-quality windows. Six Afghan companies are active today and 16 construction companies are now able to implement energy-efficient buildings.

Extension into the tertiary and domestic sectors

Targeted initially at schools and health facilities, the project aroused interest from other ministries. GERES also pursued the introduction of these techniques in the domestic housing environment, particularly through **setting up a vocational training centre**.

Techniques widened in the detached housing

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