

GreenBuilding – Europe wide renovations of non-residential buildings

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Abstract

In 2004, the European Commission initiated the GreenBuilding Programme, which aims at improving the energy efficiency of already existing as well as new constructed non-residential buildings in Europe on a voluntary basis. Since January 2005, thirteen organisations from ten European countries have been implementing a two-year pilot phase. The GreenBuilding project is supported by the European Commission's EIE programme. Co-ordinated by the German Energy Agency (dena), all participating countries set up so called National Contact Points (NCPs).

Building owners from different sectors are participating in the programme e.g. public authorities with schools, hospitals or swimming halls, companies from the services and industry sectors with office buildings. For their GreenBuilding application, building owners perform an energy audit at their premises and lay out an action plan. By applying they agree to reduce 25 per cent of primary energy demand of their building (if economically viable) and to report the results of the renovation measures. The NCP assists building owners in this process by providing guidelines for energy saving renovation, and a website in national language with an inventory of best-practices.

Besides reducing energy as well as operational costs, reasons for building owners to join GreenBuilding are:

- PR effects for the participating organisations
- Practical help from the NCP

- Public commitment for environmentally friendly behaviour
- Reduction of CO₂-emissions

During the pilot phase 52 GreenBuilding Partner status have been awarded leading to a reduction of primary energy of about 90.000 MWh per year. Furthermore about 22.000 tons of CO₂ emission savings will be achieved each year.

The paper will describe the main principles of the GreenBuilding Programme before presenting a summary of the refurbishment projects, including the various technologies applied. The paper also discusses possible improvements to the present programme.

Introduction

In its Green Paper on Energy Efficiency, the European Commission (EC) identified the building sector as an area where important improvements in energy efficiency can be realised. According to the Green Paper, the building sector accounts for more than 40 % of the final energy demand in Europe. At the same time, improved heating and cooling of buildings constitutes one of the largest potentials for energy savings. Such savings would also improve the energy supply security and the EU's competitiveness, while creating jobs and raising the quality of life in buildings.

In 2004, the European Commission initiated the GreenBuilding Programme. This programme aims at improving the energy efficiency and expanding the integration of renewable energies in non-residential buildings in Europe on a voluntary basis. The programme encourages owners of non-residential buildings to realise cost-effective measures which enhance the

energy efficiency of their buildings in one or more technical disciplines.

In a pilot phase in the years 2005-2006, the GreenBuilding infrastructure has been set up in ten European countries. In each participating country, a so called National Contact Point is being established for aiding organisations, who consider participation in GreenBuilding. The GreenBuilding pilot phase has been a project supported by the European Commission's Intelligent Energy Europe Programme.

The GreenBuilding Programme

The GreenBuilding Programme (GBP) is a voluntary programme that started in 2005. It aims to enhance the realisation of cost-effective energy efficiency potentials by creating awareness and providing information support and public recognition to companies whose top management is ready to show actual commitment to adopt energy efficient measures in non-residential buildings.

Participation in the GBP starts with the submittal of an action plan defining the scope and nature of the company's commitment. Based on an initial energy audit, the action plan must define the buildings in which energy efficiency actions will be undertaken as well as the energy services (heating, lighting, water heating, ventilation, air-conditioning, office equipment, etc.) and the specific measures, to which the commitment applies. If the action plan is accepted by GreenBuilding, the company is granted Partner status. Three years after the completion of the last GreenBuilding project (e.g. in case a company is participating with more than one building), the Partner status will expire.

GBP provides documents ("Modules") defining the technical nature of an appropriate commitment for each energy service covered in the programme. The modules are complemented by Guidelines on horizontal issues, such as "Financing", "Energy Audit" and "Energy Management". The GBP encourages its Partners to tap a large reservoir of profitable investments without the need for specific incentives from the Commission.

GBP investments use proven technology, products and services for which efficiency has been demonstrated. It is thereby considered to make good business sense for companies to join the GBP.

GBP Partners have direct benefits resulting from the growing attention of consumers and investors. Their ability to deal successfully with environmental issues may indeed be considered as a credible measure of management quality. GBP Partners also benefit by saving money and in most cases by improving working conditions. They realise technically and economically feasible energy savings, thereby increasing their competitiveness and the value of their buildings.

GreenBuilding provides support to the Partners in the form of information resources and public recognition, such as press coverings in newspapers and magazines, presentation at fairs and conferences across Europe, a regular newsletter, and a brochure and a catalogue of success stories. The GBP plaque allows Partners to show their responsible entrepreneurship to their clients.

The GBP will be complementary to the EU Energy Performance of Buildings Directive (EPBD) as it will stimulate additional savings in the non-residential building sector.

GREENBUILDING PARTNERS

The so-called GreenBuilding Partners are building owners or long-term tenants of non-residential buildings. An organisation may qualify to become a GreenBuilding Partner in three different ways:

- Refurbishment of one or more existing non-residential buildings, which will result in a reduction of the total primary energy consumption of at least 25 % (if economically viable), total or related to the end-use or subsystem, which is being modernised.
- New non-residential buildings, which consume 25 % less total primary energy (if economically viable) than prescribed in the building standard in force at the time, or

Main goals of GreenBuilding Programme

- *The main objective of GreenBuilding is to trigger investments in energy efficiency and renewable energy technologies in non-residential buildings with focus on existing premises on a voluntary basis.*
- *GreenBuilding is designed to help to open up markets – in particular by increased awareness, know-how and technical capabilities, the access to finance and energy service offerings – to achieve investments with high benefits and short payback times.*
- *GreenBuilding wants to initiate energy efficiency investments in non-residential buildings which are clearly profitable and are based mainly on proven technologies.*
- *GreenBuilding complements and goes beyond the standards imposed by the European building directive and national building codes in force.*
- *By encouraging energy efficiency and renewables energy measures beyond the existing regulations which are economically viable, GreenBuilding does not stop at the implementation of state-of-the-art energy standards but actively contributes to the advancement of the present state-of-the-art in energy saving techniques in the non-residential building sector.*
- *GreenBuilding intends to provide information and support as well as public recognition to companies, which are ready to make commitments to improve the energy efficiency of non-residential buildings well beyond the legal requirements with measures that are proven and profitable.*

below the consumption levels of “conventional” buildings currently constructed.

- Buildings already renovated or refurbished (after 01.01.2000), if the total primary energy consumption was reduced by at least 25 % or the buildings consume 25 % less energy than required by the building standard in force at that time.

Fulfilling one of the criteria listed above, a four-step process is necessary in order to become a GreenBuilding Partner:

1. Energy Audit of the organisation's building(s), which are selected to participate in the GreenBuilding programme (see Scope of the Commitment at page 3).
2. Formulation of an Action Plan, defining the scope and nature of the organisation's commitment.
3. Approval of the Action Plan by the Commission in consultation with the National Contact Point; Commission grants Partner status to Organisation.
4. Execution of the Action Plan, report to the Commission and to the relevant National Contact Point.

GREENBUILDING ENDORSERS

The GreenBuilding Endorser Programme has been established to help the European Commission and the GreenBuilding National Contact Points to promote GreenBuilding to potential participants and to support already registered GreenBuilding Partners in their efforts to reduce the energy consumption. The GreenBuilding Endorser Programme is open to almost all interested parties from the building sector and in particular,

- Equipment manufacturers
- Building contractors
- Energy management and system design companies
- Electric utilities and energy service companies
- Energy equipment importers, distributors and vendors

- National professional and trade associations

To become a GreenBuilding Endorser, an organisation must have assisted at least one building owner in becoming a GreenBuilding Partner. Furthermore, it is expected that a GreenBuilding Endorser will undertake specific actions to support GreenBuilding, according to the requirements below. In return, the Endorser will get public acknowledgement for their efforts. Though not entailing legally binding obligations, joining the Endorser Programme requires a commitment to the objectives of GreenBuilding. Joining proceeds through a registration whereby the company in question commits itself to fulfil the GreenBuilding Endorser Programme requirements. Endorsers may use the GreenBuilding logo, and their relevant activities and products may be included in the promotional and technical support material.

THE IEE PROJECT GREENBUILDING

In a pilot phase in the years 2005-2006, the GreenBuilding infrastructure has been set up in ten European countries. In each participating country, a so called National Contact Point (NCP) has been established for aiding organisations, which consider participation in GreenBuilding. This pilot phase of the GBP has been supported by the European Commission's Intelligent Energy Europe Programme in the context of the project GreenBuilding, which has run from January 2005 until December 2006.

Thirteen organisations from ten European countries make up the GreenBuilding consortium. The German Energy Agency (dena) has been the co-ordinator of the project and its project partners. In collaboration with the European Commission, National Contact Points in 10 European countries have been established until the end of 2006 and offer the following facilities and support structures:

- National GreenBuilding Website in mother language and adapted to national context
- GreenBuilding workshops and publications in national language

Becoming a GreenBuilding Endorser each potential Endorser shall

- *appoint a person responsible for communications with the European Commission and the GreenBuilding National Contact Points*
- *promote the GreenBuilding Programme and its goals. In particular each Endorser shall help the European Commission and the GreenBuilding National Contact Points to promote the GreenBuilding Programme and strategies for enhancing the energy efficiency in non-residential buildings to potential programme participants*
- *lay out a specific plan of how to promote the GreenBuilding Programme and send it to the European Commission and the GreenBuilding National Contact Points within three months after receiving the acceptance letter, together with a short description of the company*
- *have assisted at least one building owner in becoming a GreenBuilding Partner*
- *provide the European Commission and the GreenBuilding National Contact Points with up-to-date non-confidential and commercially available information on its products, technologies and services relevant for the GreenBuilding Programme*
- *educate its clients on the benefit of energy savings and of the GreenBuilding Programme*

Endorsers can withdraw from the Programme at any time without penalty.

- GreenBuilding guidelines and technical modules in national language
- Best practice inventory (online) and publication (printed)
- National catalogue of GreenBuilding partners and endorsers
- Presentation at national conferences and trade fairs
- Guidance to 2-4 Pilot Projects per country on the way to becoming a GreenBuilding Partner

Dissemination activities on the European level, encompassing:

- Central GreenBuilding website with all guidelines and technical modules in English language, with links to the national GreenBuilding websites
- Central Best Practices Database on this website (in construction)
- List of partners and list of endorsers
- A GreenBuilding brochure with best practice examples
- Presentation at international trade fairs and conferences
- Articles in newspapers, trade journals, and internet based information services

The following 13 organisations from 10 countries have been involved in the GreenBuilding pilot project:

Country	Organisation
Austria	Austrian Energy Agency
Finland	Motiva Oy
France	<ul style="list-style-type: none"> • ADEME – Agence de l'Environnement et de la Maîtrise de l'Energie • Ecole des Mines de Paris
Germany	<ul style="list-style-type: none"> • Deutsche Energie-Agentur GmbH (dena) – German Energy Agency (co-ordinator) • Berliner Energieagentur GmbH • Fraunhofer Institut für System- und Innovations-forschung
Greece	Centre for Renewable Energy Sources
Italy	<ul style="list-style-type: none"> • End-use Efficiency Research Group (eERG) – Building Engineering Faculty - • Politecnico di Milano
Portugal	ADENE – Agência para a Energia

Slovenia	Jozef Stefan Institute
Spain	Universitat Rovira i Virgili National
Sweden	Fastighetsägarna Sverige

Selected Examples of renovation projects

The first Swedish GreenBuilding Partner is HUSÖ Fastighets AB. HUSÖ is a private property owner with both residential and non-residential buildings in Söderhamn, Hudiksvall and Bollnäs. HUSÖ joins GreenBuilding with a police station situated in Söderhamn and a Swedish district courthouse in Hudiksvall. The district courthouse was built in 1909 and renovated in 2005. It has a total area of 2.006 m² and is heated by district heating, based on almost 100 % renewable fuels. Before the renovation, the building was heated with oil. In the process energy efficiency measures were implemented, resulting in energy savings of 131.950 kWh per year. Styr och ställer AB has carried out the energy audits for the two buildings and is currently helping HUSÖ to implement the energy efficiency measures in the police station. The expected energy savings in this building are 25 %. Styr och ställer AB is the first accepted GreenBuilding Endorser from Sweden.

The energy savings of the renovation of the courthouse resulted in that:

- The heating energy demand was reduced by 30 % (105.000 kWh) per year
- Total energy savings of 131.950 kWh per year
- The electricity demand for ventilation was reduced by 68 % (13.000 kWh) per year

Câmara Municipal de Lisboa (CML), the local authority responsible for the management of the Lisbon municipality, became the first Portuguese GreenBuilding Partner in July 2006. The candidature of CML was based on a set of 5 new municipal swimming pools built in 2005/2006 with a total area of 14.185 m² and designed to integrate energy efficient technologies, including renewables (solar thermal), as well as a modern energy management system.

The swimming pool Piscina Municipal do Vale do Fundão was built in 2005 and has an area of 2.054 m² divided on 3 floors.

The energy efficient installations in the swimming pool building include:



Figure 1. The district courthouse in Hudiksvall, which was renovated in 2005.



Figure 2. The new swimming pool building Piscina Municipal do Vale do Fundão, from the outside and inside respectively



Figure 3. The refurbished building in Nuremberg, One photograph taken in the daylight and one as a result from the thermographic analysis.

- Integration of 120 thermal solar collectors that will guarantee two thirds of hot water demand including facilities and services (restaurant, showers and general public toilet)
- Installation of electronic ballasts to achieve lighting electricity savings of about 30 %
- 4 way heat pumps (free-cooling system) to heat the main hall, allowing reductions of approximately 35 % in the consumption of electric energy and thermal energy
- Incorporation of passive solar measures (double glazing, external shading devices, etc.), resulting in energy savings of more than 30 %

The City of Nuremberg, which became the first German Green-Building Partner in March 2006, received the partner status for the refurbishment of the 19th century administration and cantina building of the Nuremberg abattoir. In the conversion of the 3-storey building to a nursery school with an information centre, the energetic standard of the building in neo-rennaissance style has been enhanced significantly. A reduction of the total primary energy demand by more than 80 % has been achieved due to an optimised building envelope, a very efficient lighting system and the installation of a highly efficient condensing boiler. The building's energy demand is 32 % below the German building regulations and even 5 % below the requirements for comparable new buildings. The thermographic analysis, which was performed after the refurbishment measures were completed, proves the excellent thermal standard of the building.

The size of the building is 1.862 m² and the refurbishment in 2005 resulted in:

- More than 80 % primary energy savings compared to before the renovation
- Heating energy demand reduced by 75 %
- CO₂ savings by 80.000 kg CO₂ / year

The energy efficiency measures performed in the renovation were:

- Installation of an efficient gas condensing boiler for heating and warm water supply (80 kW, 350 litre storage tank)
- Floor heating in ground floor and first floor with single room regulation, steel panel radiators in the top floor
- Installation of energy saving fluorescent tubes with electronic ballasts
- Installation of wood frame windows and doors with enhanced thermal protection (U 1,5 – 1,6)
- Interior insulation of all outer walls (U 0,5 – 0,7)
- Insulation of the cellar ceiling (U 0,25)
- Insulation of the outer walls (U 0,25 – 0,7)
- Insulation of the roof (U 0,25)

Results and Outlook

RESULTS

The IEE Project GreenBuilding, which was considered as pilot phase has just been completed. These years were mainly needed to design and create the infrastructure as provided via the international GreenBuilding website as well as via the different national GreenBuilding websites. A proposal for a follow up project had been submitted end of October 2006. During the preparation of this paper the National Contact Points are summarizing their experiences gained during the first two years. Therefore the following should be considered as first impression.

L. Pagliano (eERG) provided the following overview concerning GreenBuilding Partners, Endorsers, Buildings, measures applied and primary energy as well as CO₂ emission savings achieved during the pilot phase. So far 37 pilot buildings have been promoted by the GreenBuilding project. Pilot buildings were used to establish a best practise inventory and are buildings fulfilling the GreenBuilding requirements concerning primary energy demand, but these buildings have not necessarily been built during the pilot phase (2005-2006). Furthermore 52 GreenBuilding Partner statuses have been awarded and 77 building owners registered to become Partner.

The buildings represented in the project cover a broad variety of different types of non-residential buildings. More than half of the buildings are office and administration buildings (56 %). The second largest group of buildings are education facilities such as universities, schools or day-care-centres (25 %). 8 % of the buildings are sport facilities, 6 % are commercial facilities, hotels and hospitals and the remaining 5 % include an airport, a church, a prison, and a police station. The majority of the buildings belong to private institutions (65 %), another 35 % belong to public bodies.

Almost three quarters (73 %) of the 64 GreenBuildings are existing buildings which have been modernised, whereas 27 % of these buildings are newly constructed.

A variety of technical fields were addressed by the GreenBuilding Partners. The following lists the most frequently applied measures:

- 71 % heating
- 58 % control systems
- 52 % lighting
- 44 % air conditioning / ventilation
- 42 % building envelope
- 27 % renewable energies
- 21 % heat pumps
- 15 % summer heat protection
- 12 % cooling
- 6 % ground exchange
- 6 % co-generation
- 6 % electric appliances

The measures mentioned above lead to primary energy savings of almost 90.000 MWh per year. By the 52 GreenBuilding Partners 22.000 tons of CO₂ emissions will be saved each year. Assuming a lifetime of 20 years, these savings will accumulate to 1.8 TWh primary energy and 435.000 tons of CO₂.

Concerning the target numbers of the pilot project the GreenBuilding Partners number achieved the target whereas the number of Endorsers was lower than expected. This seems to be due to the requirement that Endorser status was only awarded in case the applicant provided at least one GreenBuilding Partner to the project. This process was invented in order to reduce the Endorser applications to experts which are really interested in the topic. Furthermore it proved that the Endorsers listed in the project have a minimum of experience in modernising or designing energy efficient non-residential buildings. Nevertheless agreeing to this application process also meant that becoming GreenBuilding Endorser involved at least two people interested in the project (the Endorser and the Partner).

The GreenBuilding Pilot Phase focused on providing and implementing the infrastructure for a further successful action. This included developing the international websites, the national websites, Technical Modules and Guidelines.

The following GreenBuilding Guidelines have been written during the GreenBuilding Pilot Phase:

- GreenBuilding Partner Guideline
- Short version Partner Guideline
- Endorser Guideline
- Energy Management Guideline
- Energy Audit Guideline
- Financing Module
- Benchmarking Module

Technical Modules covering the following topics have been developed during the GreenBuilding Pilot Phase:

- Air Conditioning
- Heating
- Office Equipment
- Solar Hot Water and Heating
- Combined Heat and Power
- Lighting
- Building Envelope

The experiences gained so far proved the general importance of this infrastructure. Furthermore, the experience led to the decision that the content of Technical Modules and Guidelines should be extracted and conjoined to the key messages. This will simplify addressing potential GreenBuilding Partners and Endorsers in an initial phase.

OUTLOOK

Now, with the infrastructures, Best Practise Inventory, GreenBuilding Partners and GreenBuilding Endorsers of the Pilot Phase in existence, one of the main objectives of the follow up

project will be a broadened and much more elaborated dissemination strategy to reach a much larger target group. Also, a lesson learned from the Pilot Phase is that the refurbished buildings need much more publicity in order to act as shining examples and to stimulate replication. Several new measures to this extend are foreseen.

Key outcomes targeted for the end of the follow up project will be the initiation of at least 80 additional renovation projects whose effects in terms of energy efficiency investments and resulting energy savings and energy cost reductions will be clearly measurable. The impact of the GreenBuilding energy performance measures will clearly go beyond the standards imposed by the EPBD and national building codes. The follow-up project will help to overcome some of the market barriers that are currently preventing investments by raising awareness, providing technical assistance and public recognition to the target groups and key actors. For building retrofits there are no specific energy savings targets, but depending on the energy status of the building all the energy savings opportunities with a short payback time (or a positive Net Present Value), should be implemented. The guiding principle for new buildings is that the building shall consume 30 – 50 % less energy than a building constructed according to the building code currently in force.