

# GreenBuilding

**GreenBuilding<sup>Plus</sup> – Leveraging the GreenBuilding Programme to promote energy efficiency and renewables in non-residential buildings**



## Contents

<b>Contents.....</b>	<b>2</b>
<b>List of illustrations.....</b>	<b>4</b>
<b>List of tables.....</b>	<b>6</b>
<b>Abbreviations.....</b>	<b>7</b>
<b>Executive summary.....</b>	<b>8</b>
<b>1 Introduction .....</b>	<b>12</b>
1.1 Definition of concepts .....	12
1.2 GreenBuilding Programme.....	12
1.3 European GreenBuilding <sup>Plus</sup> Project.....	15
1.4 Objectives of GreenBuilding <sup>Plus</sup> .....	15
<b>2 Infrastructure .....</b>	<b>16</b>
2.1 National Contact Points .....	17
2.2 Technical base.....	20
2.3 Main results .....	28
<b>3 Dissemination activities.....</b>	<b>29</b>
3.1 European dissemination.....	30
3.2 GreenBuilding Award.....	34
3.3 Main results .....	42
<b>4 Partners and Endorsers .....</b>	<b>43</b>
4.1 GreenBuilding Partners .....	43
4.2 GreenBuilding Endorsers.....	47
4.3 Main results .....	49
<b>5 Analysis of Measures Applied .....</b>	<b>50</b>
5.1 Project results .....	50
5.2 Analysis of participating projects .....	52
5.2.1 Type of intervention/type of use.....	53
5.2.2 Energy savings measures and systems.....	54
5.2.3 Building envelope .....	59
5.2.4 Energy and CO <sub>2</sub> savings achieved .....	67
5.2.5 Cost analysis .....	71

GreenBuilding<sup>Plus</sup> – Leveraging the GreenBuilding Programme  
to promote energy efficiency and renewables in non-residential buildings



# GreenBuilding

5.2.6	Climate conditions.....	74
5.3	Main results .....	75
<b>6</b>	<b>Achievements of the action project and lessons learnt .....</b>	<b>76</b>
<b>7</b>	<b>Outlook .....</b>	<b>77</b>
<b>Annex</b>	<b>.....</b>	<b>1</b>
A.	References.....	1
B.	Contact Points GreenBuilding .....	2
C.	Imprint.....	3



## List of illustrations

Fig. 1: EU end energy consumption .....	12
Fig. 2: GreenBuilding <sup>Plus</sup> organisation chart.....	19
Fig. 3: Action Plan for the building envelope .....	21
Fig. 4: Diagram of energy flows in buildings based on EN 15603 .....	23
Fig. 5: Sample template in the Data Collection Tool .....	24
Fig. 6: Excerpt from Endorser package .....	27
Fig. 7: European GreenBuilding <sup>Plus</sup> website .....	28
Fig. 8: Austrian brochure .....	30
Fig. 9: European leaflet .....	30
Fig. 10: National workshop in Greece, July 2009 .....	31
Fig. 11: National Workshop in Spain, July 2009 .....	32
Fig. 12: 2010 International Workshop in Frankfurt .....	33
Fig. 13: <i>Erlanger Nachrichten</i> No. 67, 21 March 2007 .....	34
Fig. 14: European GreenBuilding Award winners .....	40
Fig. 15: SeaBridge Logistics .....	41
Fig. 16: ENERGYbase.....	41
Fig. 17: Hengersberg Secondary School (Germany).....	42
Fig. 18: Partner certificate.....	43
Fig. 19: Manschein office building (Austria).....	45
Fig. 20: Split University Library (Croatia).....	45
Fig. 22: Corporate Partner Brostaden (Sweden).....	46
Fig. 21: ITCLab Research Centre (Italy) .....	46
Fig. 23: GreenBuilding Endorser LEVENGER (Spain).....	48
Fig. 24: GreenBuilding Endorser Bengt Dahlgren (Sweden) .....	48
Fig. 25: Total number of buildings in GreenBuilding <sup>Plus</sup> (2008 / 2010).....	51
Fig. 26: Total number of GreenBuilding Partners during GreenBuilding <sup>Plus</sup> (2008 / 2010) .....	51
Fig. 27: Number of GreenBuilding Endorsers during GreenBuilding <sup>Plus</sup> .....	52





Fig. 28: Type of intervention in GreenBuilding <sup>Plus</sup> projects .....	53
Fig. 29: Use of GreenBuilding <sup>Plus</sup> buildings .....	54
Fig. 30: Number of actions applied in each of the technical disciplines in all GreenBuilding <sup>Plus</sup> projects .....	55
Fig. 31: Heating systems .....	56
Fig. 32: Cooling systems .....	57
Fig. 33: Mechanical ventilation system: efficiency of heat recovery for each refurbished building .....	58
Fig. 34: Mechanical ventilation system: efficiency of heat recovery for each new building .....	58
Fig. 35: Thermal transmittance (U-value) of external wall: min, max, average values - New buildings .....	59
Fig. 36: Thermal transmittance (U-value) of external wall: min, max, average values - Refurbished buildings .....	60
Fig. 37: Thermal transmittance (U-value) of windows: min, max, average values - New buildings .....	60
Fig. 38: Thermal transmittance (U-value) of external wall - GERMANY .....	62
Fig. 39: Thermal transmittance (U-value) of external wall - ITALY and SWEDEN .....	63
Fig. 40: Thermal transmittance (U-value) of external wall - PORTUGAL, SPAIN, CROATIA, GREECE .....	64
Fig. 41: Thermal transmittance (U-value) of external wall – AUSTRIA and BELGIUM .....	65
Fig. 42: Average value of thermal transmittance for all envelopes ( $h_t$ ) and S/V ratio - SWEDEN, PORTUGAL, SPAIN .....	66
Fig. 43: Percentage savings in primary energy consumption after GreenBuilding <sup>Plus</sup> (minimum, maximum and area weighted averages) .....	68
Fig. 44: Total primary energy consumption with renewables [kWh/m <sup>2</sup> /a] - All buildings .....	69
Fig. 45: Total primary energy consumption with renewables [kWh/m <sup>2</sup> /a] - Office buildings after GreenBuilding <sup>Plus</sup> interventions (maximum, minimum and area weighted averages for all countries) .....	70
Fig. 46: Percentage of total extra cost for each system in all GreenBuilding projects .....	71
Fig. 47: Extra cost of investment [€/m <sup>2</sup> ] for office buildings .....	72
Fig. 48: Extra cost of investment [€/m <sup>2</sup> ] for retail buildings .....	73
Fig. 49: Heating degree days (DD heating), latitude and altitude: min, max, average values - All buildings ...	74
Fig. 50: Cooling degree days (DD cooling), latitude and altitude: min, max, average values - All buildings....	75



**List of tables**

Table 1: Categories and criteria for the GreenBuilding Award ..... 35

Table 2: Overview of weighting of quantitative criteria ..... 35

Table 3: Winner Austria ..... 37

Table 4: Winner Belgium..... 37

Table 5: Winner Croatia ..... 37

Table 6: Winner Germany ..... 38

Table 7: Winner Greece ..... 38

Table 8: Winner Italy ..... 38

Table 9: Winner Portugal ..... 38

Table 10: Winner Spain ..... 39

Table 11: Winner Sweden ..... 39

Table 12: Winner European GreenBuilding Award..... 40

Table 13: Winner / Special acknowledgement of the jury - Seabridge (Belgium) ..... 41

Table 14: Winner / Best new projects - ENERGYbase (Austria)..... 41

Table 15: Winner / Best refurbishment – Hengersberg Secondary School ..... 42

Table 16: Percentage savings in primary energy consumption after GreenBuilding<sup>Plus</sup> ..... 67



## Abbreviations

AEA	Austrian Energy Agency (NCP Austria)
ADENE	Agencia para a Energia (NCP Portugal)
BEA	Berliner Energieagentur GmbH (NCP Germany)
CEE	Central and Eastern Europe
CIP	Competitiveness and Innovation Framework Programme
COP	Coefficient of performance
CRES	Centre for Renewable Energy Sources (NCP Greece)
CREVER URV	The Group of Applied Thermal Engineering (NCP Spain)
dena	Deutsche Energie-Agentur GmbH (NCP Germany)
EC	European Commission
eERG	End-use Efficiency Research Group, Dipartimento di Energetica, Politecnico di Milano (NCP Italy)
EIHP	Energetski Institut Hrvoje Pozar (NCP Croatia)
EN	European Norm
EnOB	Energy Optimised Building
EPBD	Energy Performance of Buildings Directive
ESCO	Energy service company
EU	European Union
GDP	Gross domestic product
IEE	Intelligent Energy Europe
JRC	Joint Research Centre
NCP	National Contact Point
SPF	Swedish Property Federation (NCP Sweden)



## Executive summary

In its Green Paper on Energy Efficiency published in June 2005, the European Commission describes the building sector as of prime importance, as it is responsible for 40% of Europe's energy needs. Around 65% of the final energy used in office buildings relates to heating, hot water and lighting, and potential energy savings in commercial buildings are estimated at 30% in the period to 2020. The Green Paper states that improved heating and cooling systems alone could save significant amounts of energy.

In view of the increasing significance of climate change, rising energy prices and the limited availability of fossil fuels, the European Commission launched the GreenBuilding Programme to provide fundamental support in the field of energy efficiency for non-residential buildings and to promote the use of renewable energy sources.

GreenBuilding is a voluntary programme which was called into being in early 2005. Its aim is to extend the use of the economic energy savings potential through information and motivation. Private and public building owners are provided with advice and support in the energy-efficient refurbishment or construction of non-residential buildings, and receive public recognition for their work as a pioneer.

The GreenBuilding Programme was introduced through a pilot phase lasting from 2005 to 2007 which provided publicity, and acquired and evaluated new participants. The main aim of the pilot phase was to position the GreenBuilding Programme firmly on the market. Markets for energy efficiency were to be identified and the implementation of economic energy efficiency measures supported. The aim of the next project phase, GreenBuilding<sup>Plus</sup>, was to make the advantages of improved energy efficiency in non-residential buildings available to a wider public and to support organisations interested in active participation in the GreenBuilding Programme.

The purpose of GreenBuilding<sup>Plus</sup> was to overcome three obstacles:

- A lack of market awareness of the programme and of the advantages of energy-efficient refurbishment
- A lack of knowledge and expertise as to what is technically possible
- Difficult access to financing and energy service offerings

The GreenBuilding<sup>Plus</sup> Project was supported by the European Commission's Intelligent Energy Europe (IEE) Programme. This programme is a non-technological Community programme within the energy sector which aims to topple non-technological market barriers, alter behaviour patterns, create a favourable company environment for the promotion of energy efficiency and renewable energy markets, and improve understanding of the EU's energy policies and their implementation in the cities and regions of Europe.

A decentralised structure with National Contact Points (NCP) in nine EU Member States was set up to ensure the best possible transfer of information between the GreenBuilding Programme and interested owners of

GreenBuilding<sup>Plus</sup> – Leveraging the GreenBuilding Programme to promote energy efficiency and renewables in non-residential buildings



non-residential buildings. The NCPs form the backbone of the local infrastructure, and are represented by national energy agencies renowned research institutes and building associations .

The acquisition in the second project phase of new NCPs in two further EU Member States made a direct approach to the non-residential building market in additional countries possible, providing a platform from which to explain the advantages of energy-efficient measures and the benefits of certification to building owners.

The GreenBuilding Programme infrastructure is built around a central website managed by the JRC (<http://re.jrc.ec.europa.eu/energyefficiency/>), the national websites of the NCPs in the language of the country, guides and highlights for Partners and Endorsers, and a harmonised data collection tool developed and introduced under the GreenBuilding<sup>Plus</sup> Project. The English version of any document can be downloaded from the umbrella GreenBuilding<sup>Plus</sup> website [eu-greenbuilding.org](http://eu-greenbuilding.org), and translated versions of most of the documents are available on the national GreenBuilding<sup>Plus</sup> websites.

User-friendly support is provided to programme applicants in the form of technical modules, which are in English on the European website, and in the relevant national language on the NCP websites. The nine technical modules provide technology-related advice to building owners on the identification of cost-efficient energy savings in non-residential buildings.

The GreenBuilding<sup>Plus</sup> Project concentrated primarily on promotional and dissemination activities related to energy efficiency. The objective of the promotional activities was to:

- Create awareness of energy and cost efficiency issues for non-residential buildings
- Promote energy efficiency through best practice examples
- Introduce the GreenBuilding Programme to the target groups (branding)
- Encourage organisations to participate, explaining how this can be done
- Provide technical information on energy efficiency in non-residential buildings
- Provide publicity for the programme and its participants

The dissemination activities were supported by the creation of national GreenBuilding Awards in the European countries in which a NCP was active, and a European GreenBuilding Award for which the winners of the national awards could apply. Almost 1,100 attendees at the seven national award ceremonies are testimony to the fact that the public presentation of an award arouses great interest, helping to spread the GreenBuilding concept on the market. A growing interest in GreenBuilding was noted after presentation of the awards, and the number of visitors to the national websites increased.

In the period 2008-2010 160 Partners with 320 buildings were acquired for the GreenBuilding Programme, as well as 68 Endorsers who supported GreenBuilding Partners joining the programme in the development and realisation of their building project. The GreenBuilding<sup>Plus</sup> projects cover a wide range of building types: in



addition to office buildings, they also focus on educational buildings, health and day care centres, hotels, and many others. This is a very positive development and indicates that market acceptance is increasing.

The technical data for the projects was gathered with a harmonised data tool and subjected to a detailed analysis. The results were examined and evaluated for 85 of the buildings, the salient points being as follows:

- Types of building in the programme: offices 52%; retail/trade 12%; schools 7%; other non-residential buildings 23%
- The technical disciplines most frequently addressed in the projects were the building envelope (31%), heating system (23%), cooling system (16%), lighting system (12%) and energy management (13%)
- On average, 8 actions were applied in each intervention
- Total energy savings in the 85 buildings recorded in the database amount to around 115,000 MWh of primary energy per year
- The average percentage of savings in primary energy consumption after GreenBuilding<sup>Plus</sup> interventions amounts to 54% over all buildings. This breaks down to 58% for new buildings and 42% for refurbishments.

The analysis shows that GreenBuilding is particularly successful in those countries in which the energy efficiency market is well developed, making it possible to involve market partners in the programme quickly. It should also be noted that it was possible to establish the programme and the concept successfully in all participating countries after a sometimes difficult initial phase, and that they subsequently developed their own quite considerable momentum.

It was also discovered that transferring knowledge regarding the energy-efficient construction and refurbishment of non-residential buildings is very simple for structures which have similar characteristics, such as office buildings, as the building services are highly standardised and the expertise is readily available. The good practice projects of the GreenBuilding Partners are particularly suited to duplication in buildings as similar as these, simplifying the planning and implementation of the relevant building measures. The technical and non-technical modules provided under the GreenBuilding<sup>Plus</sup> Project provide additional support in this respect.

In view of the climate targets proposed by the European Commission in respect of primary energy consumption and carbon emissions, the enormous potential to improve energy efficiency in non-residential buildings should be unlocked in the long term through further Community actions. Increased attention should be given to the market of existing buildings to ensure that energy savings continue to be achieved in the years to come. Boosting the rate of refurbishments (the percentage ratio of buildings refurbished each year to the total number of buildings) would help to achieve climate targets, as it results in lower final and primary energy consumption in the building stock.

GreenBuilding<sup>Plus</sup> – Leveraging the GreenBuilding Programme to promote energy efficiency and renewables in non-residential buildings



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Encouraging building owners to implement the relevant measures with awards and help in their public relations, such as provided in the GreenBuilding Programme, is one means of achieving this, as is the tightening of statutory requirements and the provision of financial support.

The fact that the GreenBuilding projects returned savings which were considerably higher than required by law and reduced primary energy consumption by an average of 54% shows that the real potential lies far above the 25% required under the programme.

More attention should also be given in future to extending the transfer of know-how. A knowledge network was built up and established during the GreenBuilding<sup>Plus</sup> Project which suggests actions (e.g. technical and non-technical modules, lists of innovative technologies) for different types of buildings and provides information on the relevant experts. A potential target for future project phases could therefore be the ongoing development of technical solutions and a more far-reaching transfer of knowledge and expertise.



## 1 Introduction

### 1.1 Definition of concepts

A clear explanation of the terms GreenBuilding Programme and GreenBuilding<sup>Plus</sup> Project is necessary to ensure that they are properly understood and no misunderstanding arises in the following text.

The GreenBuilding Programme was launched by the European Commission in 2005 and is still running, unlike the GreenBuilding<sup>Plus</sup> Project which ended in May 2010.

The terms GreenBuilding Programme or just GreenBuilding are used in this report to describe the programme.

The GreenBuilding<sup>Plus</sup> Project was set up to strengthen the presence of the GreenBuilding Programme on the market and ran from December 2007 to May 2010. The term GreenBuilding<sup>Plus</sup> Project or just GreenBuilding<sup>Plus</sup> are used in the report to describe the project.

### 1.2 GreenBuilding Programme

In 2004, final energy consumption in the European Union (EU 25) accounted for 1,140 million tons of oil equivalents (Mtoe)<sup>(1)</sup>. In a business-as-usual scenario, with European GDP growth at similar rates as in the past and not taking into account the latest initiatives for enhancing energy efficiency in Europe, the EU 25 final energy demand is projected to rise to 1,400 Mtoe in 2030. Final energy consumption in the tertiary sector is projected to rise from 159 Mtoe (2000) to 225.3 Mtoe (2030). With an average increase of nearly 1.2% in the period, it is the sector with the highest energy consumption growth rates. This increase is directly connected with the growing share in gross value of this sector in the EU 25, rising from 68.4% in 2000 to a projected 72.1% in 2030<sup>(2)</sup>. This increase results to a large extent from additional space requirements, bringing about a growing demand for energy.

In its Green Paper on Energy Efficiency (June 2005) the European Commission described the building sector as a key sector, responsible for almost 40% of Europe's energy needs. This is almost 10% more than the energy required for the transport sector (Fig. 1: EU end energy consumption).

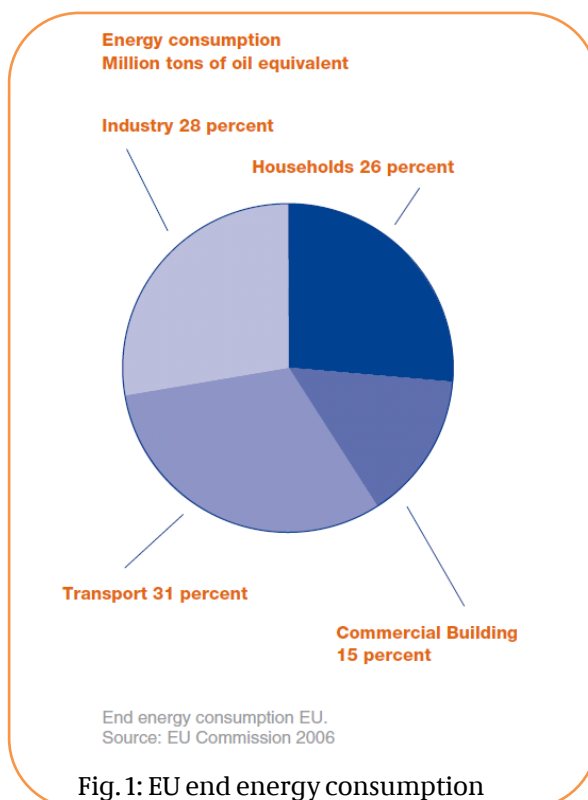


Fig. 1: EU end energy consumption



GreenBuilding<sup>Plus</sup> – Leveraging the GreenBuilding Programme to promote energy efficiency and renewables in non-residential buildings



In view of high energy prices, the potential to save energy in the various sectors should be captured. This potential is significant: 2005 figures indicate levels reaching 27% in households, 30% in commercial buildings, 26% in the transport sector, and 25% in industry<sup>(3)</sup>.

The savings potential is particularly high in non-residential buildings, and in comparison fairly easy to exploit. Heating, cooling, hot water and lighting account for around 65% of the final energy needed in office buildings, and the Green Paper states that significant energy savings could be made just by improving the heating and cooling systems. The exploitation of this potential would not only reduce energy costs and thus improve the competitiveness of the European markets, it would also mean a considerable improvement in the quality of life in the buildings, the creation of jobs, and improvements in energy security and the mitigation of climate change in the EU.

In view of the increasing significance of climate change, rising energy prices and the limited availability of fossil fuels, the European Commission launched the GreenBuilding Programme to provide fundamental support in the field of energy efficiency for non-residential buildings and to promote the use of renewable energy sources. The GreenBuilding Programme is managed by the European Commission DG Joint Research Centre.

GreenBuilding is a voluntary programme which was called into being in early 2005. Its aim is to enhance the use of the economic energy savings potential through information and motivation. To this end, private and public building owners are provided with advice and support in the energy-efficient refurbishment or construction of non-residential buildings, and receive public recognition for their work as a pioneer. Organisations achieving significant reductions in the energy consumption and carbon emissions of a building are awarded the GreenBuilding Partner status.

The GreenBuilding Programme is

- Flexible and open to ensure that it can be applied to a variety of building types and situations (both refurbishments and new buildings);
- Sufficiently precise to ensure that participating organisations achieve significant energy savings;
- Adaptable to national and regional programmes and agencies;
- Designed to publicise the requirements of the Energy Performance of Buildings Directive and aid its implementation.

For the building owner, participation in the GreenBuilding Programme begins with an audit to identify the energy consumed by the building's plants and systems and to ascertain the actions required to ensure that that energy is used efficiently. The result is an Action Plan describing the nature and scope of the efficiency measures proposed for the building.

These measures must reduce the building's primary energy consumption. The requirements are defined as follows:

- Primary energy consumption in new buildings must be 25% lower than is required by law

GreenBuilding<sup>Plus</sup> – Leveraging the GreenBuilding Programme to promote energy efficiency and renewables in non-residential buildings



- Existing buildings must use at least 25% less primary energy after refurbishment

By implementing the Action Plan the organisation can

- Maintain or improve the comfort levels and indoor quality of the building and the technical quality of the relevant systems
- Exploit the technical and economic savings potential. All measures carried out must satisfy economic efficiency criteria, as that way the use of limited financial and human resources will be justified in the eyes of the organisation

After approval of the Action Plan, the European Commission grants the GreenBuilding Partner status to the building owner.

The GreenBuilding Programme provides the owner with advice in the form of technical modules which describe concisely and comprehensibly the energy efficiency potential in various technical disciplines such as lighting, office equipment, building shell, and ventilation. It also provides documents on non-technical subjects such as financing, energy management and energy audits. The modules and documents were prepared during the GreenBuilding<sup>Plus</sup> Project and are described in more detail in Chapter 2.2.

The EU set up the GreenBuilding Programme to encourage building owners and operators to recognise and exploit the economic savings potential inherent in non-residential buildings. The publications therefore recommend and identify measures whose efficiency and technical reliability has already been tried and tested. In addition to the immediate economic benefit from lower energy costs, the measures will also often result in an improvement of working conditions. At the same time, the value of the building is increased in the long term.

GreenBuilding Partners can highlight their pioneering role by using the GreenBuilding logo and mentioning their Partner status in their publicity work. The GreenBuilding Programme also promotes the external image of the organisation in publicity measures specific to the programme. These measures include listing the Partners and their buildings in brochures, newsletters, the internet, press releases, and presentations at important fairs and conferences.

An organisation can also be granted the GreenBuilding Corporate Partner status if it owns more than ten buildings and commits to ensuring that 30% of existing buildings and 75% of new buildings in Europe fulfil the GreenBuilding criteria. A corporate partnership can also be agreed just for new buildings.

In addition, organisations active in the field of architecture, structural engineering, energy and engineer consulting, and energy service provision may become GreenBuilding Endorsers. These assist their clients in the improvement of energy efficiency and the introduction of renewable energies and thus help them to achieve GreenBuilding Partner status.

Until the spring of 2009 it was also possible to have a building recognised as an EU GreenBuilding if primary energy consumption was reduced by 70% in a refurbishment or was 50% lower than required by law in a new building. However, this type of recognition ceased to be awarded under the programme in early 2009.

GreenBuilding<sup>Plus</sup> – Leveraging the GreenBuilding Programme to promote energy efficiency and renewables in non-residential buildings



### 1.3 European GreenBuilding<sup>Plus</sup> Project

The GreenBuilding Programme was introduced in a pilot phase lasting from 2005 to 2007 which provided publicity, and acquired and evaluated new participants. The main aim of the pilot phase was to position the GreenBuilding Programme successfully on the market.

This successful pilot phase was followed by the GreenBuilding<sup>Plus</sup> Project, which was launched at the beginning of 2008 with two new consortium partners on board, and ended in May 2010. Participation was invited from organisations and companies residing in EU Member States who were prepared to promote the implementation and dissemination of the GreenBuilding Programme.

The project consortium for the second project phase comprised ten organisations from nine European countries (Austria, Belgium, Croatia, Germany, Greece, Italy, Portugal, Spain and Sweden). Two new partners (Energy Institute Hrvoje Pozar - EIHP - of Croatia and Cenergie of Belgium) joined the consortium in this second phase.

The objective of the project was to identify markets for energy efficiency and promote the implementation of economic energy efficiency measures. It aimed to make the advantages of improved energy efficiency in non-residential buildings available to a broad public and to support organisations interested in active participation in the GreenBuilding Programme. To this end, national advice centres have been set up in nine EU Member States to date.

The Deutsche Energie-Agentur (dena) – the German Energy Agency – was responsible for coordination of the GreenBuilding<sup>Plus</sup> Project, which was supported by the European Commission's Intelligent Energy Europe (IEE) Programme. This is a non-technological Community programme within the energy sector which aims to topple non-technological market barriers, alter behaviour patterns, create a favourable company environment for the promotion of energy efficiency and renewable energy markets, and improve understanding of the EU's energy policies and their implementation in the cities and regions of Europe.

With a total budget of EUR 730 million for the period 2007 to 2013, IEE is seated in the Competitiveness and Innovation Framework Programme (CIP) and helps to meet EU energy policy goals and implement the Lisbon Agenda.<sup>(4)</sup>

### 1.4 Objectives of GreenBuilding<sup>Plus</sup>

The objectives of the European Commission in the GreenBuilding Programme were adopted in their entirety for the GreenBuilding<sup>Plus</sup> Project. In addition, this second project phase aimed to enhance the publicity work related to non-residential buildings and Partners already recognised under the programme, and to acquire new Partners and Endorsers as a means of generating a greater market presence for the GreenBuilding Programme. To this end, the GreenBuilding Award was called into being, the project's dissemination and communication activities were enhanced, and an evaluation tool was developed.



GreenBuilding's main concern is to drive investment in energy efficiency and renewables in non-residential buildings, with a focus on existing buildings. The programme aims to strengthen the market for energy efficiency with high benefits and short payback times, primarily by improving public awareness, technical know-how and access to finance and energy service offerings. Aspects such as the level of investment in energy efficiency, the energy savings realised, and the cost of reducing energy requirements are therefore shown for the buildings recognised under the GreenBuilding Programme.

The programme also desires to promote exploitation of the potential to make cost-effective energy savings in non-residential buildings with measures whose efficiency and technical reliability has been sufficiently tested and which make energy savings of 20%-40% and an income capitalization of 10%-30% possible.

A large part (up to 80%) of the costs incurred during the life cycle of a building are generated during use, and on average, 50% of that cost is for energy. An energy-efficient building can therefore reduce outgoings radically. Good practice buildings serving as models for energy-efficient refurbishment or construction can make it easier for owners to comply with the energy specifications of the European Energy Performance of Buildings Directive and national legislation. As this encourages investment in energy efficiency and renewable energies which goes beyond the national requirements and is also economically viable, GreenBuilding can be expected to make an active contribution to the development of state-of-the-art technologies in the non-residential building sector.

By providing comprehensive information and ensuring public recognition of the Partner's contribution, GreenBuilding supports Partners in their commitment to improve the energy efficiency of their non-residential buildings well beyond the legal requirements with measures that are technically proven and economically viable. Participating companies can thus gain an edge over their competitors on the market.

The purpose of GreenBuilding<sup>Plus</sup> is to overcome three obstacles:

- A lack of market awareness of the programme and of the advantages of energy-efficient refurbishment
- A lack of knowledge and expertise as to what is technically possible
- Difficult access to financing and energy service offerings

## 2 Infrastructure

The Renewable Energies Unit of the European Commission's Joint Research Centre (JRC) officially administers the GreenBuilding Programme and the GreenBuilding<sup>Plus</sup> Project. The JRC is a Directorate-General of the European Commission under the responsibility of Máire Geoghegan-Quinn, European Commissioner for Research, Innovation and Science.<sup>(5)</sup>

The JRC accepts or rejects applications for GreenBuilding Partner or Endorser status upon the recommendation of the National Contact Points (NCPs), is the overall contact point for all member states and

GreenBuilding<sup>Plus</sup> – Leveraging the GreenBuilding Programme to promote energy efficiency and renewables in non-residential buildings



also hosts an English language GreenBuilding website with information on the programme and an up-to-date list of participations, guidelines and modules (<http://re.jrc.ec.europa.eu/energyefficiency/greenbuilding/index.htm>).

A set of national and international instruments has been elaborated, including websites, publications, guidelines and modules. In the GreenBuilding pilot phase an infrastructure was set up which was developed and enhanced in the second project phase, GreenBuilding<sup>Plus</sup>. During this latter phase National Contact Points were available in thirteen European countries, of which nine were participating in GreenBuilding<sup>Plus</sup>.

## 2.1 National Contact Points

The hidden potential for energy savings in non-residential buildings is particularly large in the Central and Eastern European countries (CEE), but if capturing this potential is to have a snowball effect, the infrastructure must be sound. A decentralised structure with National Contact Points (NCP) in several European countries was therefore set up to ensure the best possible transfer of information between the GreenBuilding Programme and interested owners of non-residential buildings. The NCPs form the backbone of the local infrastructure, and are represented by national energy agencies and renowned research institutes. Two new countries (Belgium and Croatia), each with an NCP, joined the consortium at the beginning of the GreenBuilding<sup>Plus</sup> Project. The new NCPs were integrated into the existing project infrastructure and have developed and implemented their own national websites.

GreenBuilding NCPs participating in the GreenBuilding<sup>Plus</sup> Project can be found in Austria, Belgium, Croatia, Germany, Greece, Italy, Portugal, Spain, and Sweden. They provide assistance and support to potential Partners in the language of their country, assisting in the application and subsequent processes, providing technical help in the form of information (such as GreenBuilding technical modules) and the use of the GreenBuilding Endorser network, and offering qualified feedback on the application documents (Energy Audit, Action Plan, Report). Public relations support can also be provided to existing Partners.

The NCPs in the GreenBuilding<sup>Plus</sup> Project are presented below with a brief overview of their activities.

### **Austria – Austrian Energy Agency (AEA)**

The Austrian Energy Agency is Austria's central competence centre for energy. Its mandate is to support and promote energy issues with well-channelled information and publicity campaigns, and research projects.<sup>(6)</sup>

### **Belgium - Cenergie cvba**

Cenergie (Antwerp) is an engineering and consulting office specialising in the domain of energy management, energy auditing and sustainable building in the offices, buildings and industry market. With its 20 highly skilled engineers and experts, it has been market leader in the Belgian market of offices and buildings since 1997.<sup>(7)</sup>



### **Croatia - Energetski Institut Hrvoje Požar (EIHP)**

The Hrvoje Pozar Energy Institute is the central scientific and professional institution in Croatia for global planning related to the energy system and its subsystems, renewable energy systems and energy efficiency. The activities of the Hrvoje Pozar Energy Institute include preparation of renewable energy legislation for the Croatian government, implementation of research and demonstration projects, market studies, energy audits and related public opinion surveys, and participation in international R&D projects in Community actions both in Croatia and abroad.<sup>(7)</sup>

### **Germany - Berliner Energieagentur GmbH (BEA)**

The Berlin Energy Agency is a private limited company founded on the initiative of the Berlin Senate in 1992 with the aim of identifying energy savings potential and facilitating the utilisation of renewable energy sources. The agency sees capturing savings potential as a means of reducing consumption and costs in buildings and plants.<sup>(8)</sup>

### **Germany – Deutsche Energie-Agentur GmbH (dena)**

The Deutsche Energie-Agentur GmbH (dena) – the German Energy Agency – is the centre of expertise for energy efficiency and renewable energy sources. It focuses on the development of sustainable energy systems which make optimum use of energy and integrate renewable energy sources. dena's mission is to generate economic growth and maintain prosperity with ever lower energy inputs. If this is to be achieved, energy must be generated and used in a national and international context as efficiently, safely and economically as possible with the least possible impact on the climate.<sup>(9)</sup>

### **Greece - Centre for Renewable Energy Sources (CRES)**

The Centre for Renewable Energy Sources is a public entity supervised by the Ministry of Development, General Secretariat of Research and Technology. Founded in September 1987, it has financial and administrative independence. In accordance with the policy of the Ministry, CRES is active in the fields of renewable energy sources, rational use of energy and energy saving. Its primary aim is to promote technological applications in its fields of expertise both at a national and an international level.<sup>(7)</sup>

### **Italy - End-use Efficiency Research Group (eERG), Building Engineering Faculty, Politecnico di Milano (eERG)**

Seated in the Energy Department of Politecnico di Milano, the end-use Efficiency Research Group is dedicated to research, technology transfer and teaching related to the efficient use of energy in buildings. The particular focus lies on low energy buildings, passive cooling techniques - night ventilation, ground coupling, etc -, efficient lighting and daylighting, technical and economic analysis of energy-using products, and the evaluation and certification of energy savings in the context of liberalised energy markets.<sup>(10)</sup>

### **Portugal - Agência para a Energia (ADENE)**

ADENE (formerly CCE - Centro para a Conservação de Energia) aims to promote and develop activities of public interest in the field of energy and its interfaces with relevant non-energy sectors and policies, to



contribute to an increase in energy efficiency in all sectors, to foster the market penetration of renewable energy sources, to participate in the national effort to reduce GHG, and to carry out projects/actions aimed at achieving goals defined by the Portuguese government for the energy sector in collaboration with the public authorities, utilities and SAVE Agencies.<sup>(7)</sup>

**Sweden - Fastighetsägarna Sverige AB (SPF)**

The Swedish Property Federation is a highly pro-active trade organisation promoting an efficient real estate market in Sweden. Almost 20,000 property owners are members organised in one of Sweden’s seven regional property associations.<sup>(11)</sup>

**Spain - Universitat Rovira i Virgili National (URV)**

The URV was created in 1991 by the Parliament of Catalonia from existing university faculties and schools. It focuses particularly on the quality of academic teaching and research, as testified by the state-of-the-art equipment in the university facilities which offer students the ideal environment for an agreeable and successful course of studies using the very latest technologies and media. The academic teaching and research of the university has been given an increasingly international slant very much in line with its call for European harmonisation.<sup>(12)</sup>

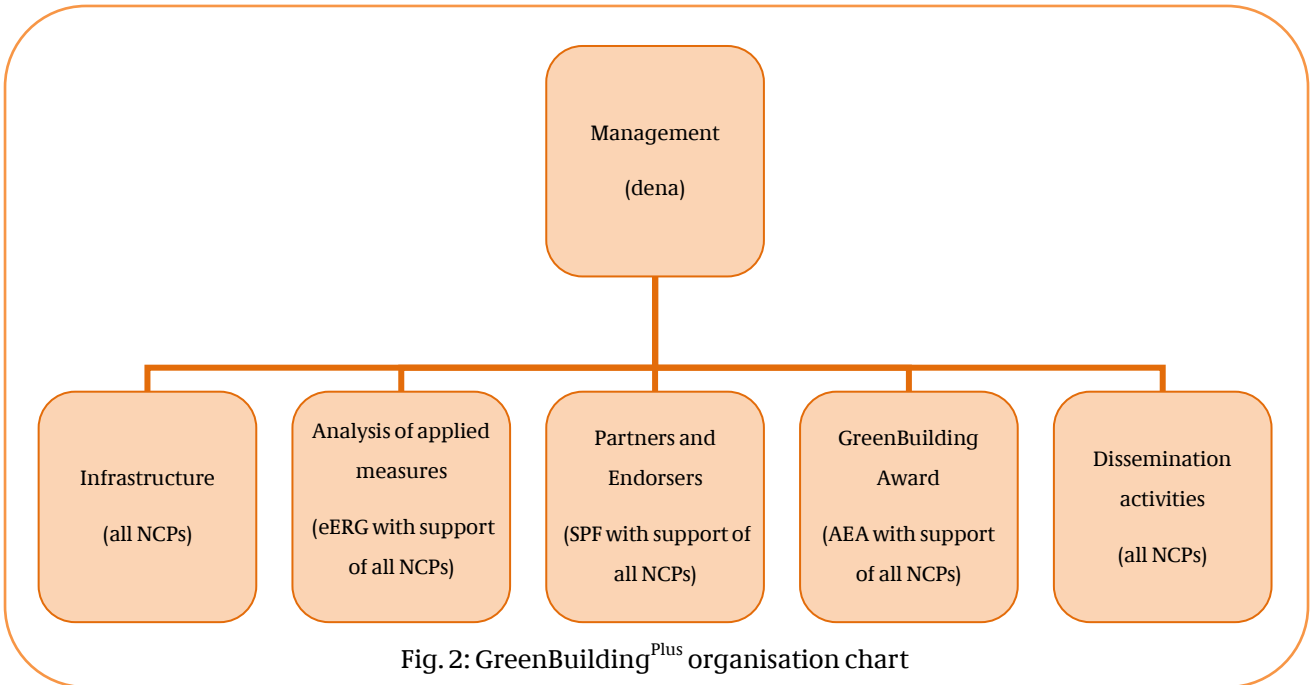


Fig. 2: GreenBuilding<sup>Plus</sup> organisation chart





## 2.2 Technical base

In collaboration with the European Commission, an extensive infrastructure was built up during the pilot phase of the GreenBuilding Programme, and this was developed and enhanced in the second project phase. The GreenBuilding Programme infrastructure is built around a central website managed by the JRC (<http://re.jrc.ec.europa.eu/energyefficiency/>), the national websites of the NCPs in the language of the country, guides and highlights for Partners and Endorsers and a harmonised data collection tool developed and introduced under the GreenBuilding<sup>Plus</sup> Project. The English versions of these documents can be downloaded from the main GreenBuilding<sup>Plus</sup> website [eu-greenbuilding.org](http://eu-greenbuilding.org), and translated versions of most of the documents are available on the national GreenBuilding<sup>Plus</sup> websites.

### Technical modules

User-friendly support is provided to the applicants in the form of technical modules, which are in English on the European website, and in the relevant national language on the NCP websites. The nine technical modules provide technology-related advice to building owners on the identification of cost-efficient energy savings in non-residential buildings. The areas addressed by the technical modules are:

- The building envelope
- Sustainable summer comfort
- Heating
- Combined heat and power
- Solar hot water and heating
- Air conditioning
- Lighting
- Office equipment
- Benchmarking

The technical modules supplement the GreenBuilding Partner Guidelines and provide assistance in the areas identified above, which should be addressed in the Action Plan of any future GreenBuilding Partner.

The technical modules are provided in the form of PDF documents which have all been given the same general structure. The first part provides a brief introduction to the options available for recognising and exploiting the energy savings potential in that particular field (e.g. building envelope). A GreenBuilding Partner should first identify suitable energy saving measures by recording the current status in the various sectors and defining the most important parameters related to their operation (Energy Audit). The modules envisage a three-stage audit, starting with a description of the systems to identify which equipment and system components should be incorporated. This is followed by a measurement of the operational parameters of the equipment/systems described, allowing them to be considered as a whole on the basis of





# GreenBuilding

the data collected (e.g. electricity/fuel consumption). In the final stage, the energy performance indicators needed to assess efficiency are defined.

Once the system has been described, the technical measures required for energy efficiency are assessed. This part of the module describes the measures which might apply in this particular area. The feasibility of the individual measures and the financial savings which can be achieved depend on the size and type of the company in question. Only with an assessment of the system and the needs of the company can a decision be made as to which measures would be both feasible and profitable. This assessment should be made by a qualified energy consultant with ICT experience or by qualified in-house staff and will identify suitable measures, the estimated cost of investment and level of savings, and the payback period. The technical modules go on to describe which items in the system description and analysis should be incorporated into the Action Plan.

The last part of each technical module details the regular progress reports to be sent to the relevant GreenBuilding<sup>Plus</sup> NCP, which should carry details of successes achieved under the Action Plan. Forms for the

Energy Savings Measures	Feasibility <sup>(1)</sup>	Specific Actions <sup>(2)</sup>	% Covered <sup>(3)</sup>	Time table <sup>(4)</sup>	HEATING Expected savings <sup>(5)</sup> (MWh/year)	COOLING Expected savings <sup>(5)</sup> (MWh/year)	LIGHTING Expected savings <sup>(5)</sup> (MWh/year)
<b>Improving insulation</b>							
localisation and elimination of thermal bridges							
Improving insulation of opaque external walls, roofs, ground floor...							
Improving insulation of window and transparent facades							
addition of a new envelope							
...							
<b>Improving Air Tightness</b>							
of windows and doors, walls, joints...							
...							
<b>Reducing unwanted solar heat gains by installation</b>							
of permanent or movable shading devices							
of solar control glazing							
...							
<b>Installing/improving control systems</b>							
of openings and shading							
...							
<b>Modifying geometry:</b>							
- Volume/Surface rate							
- Transparent/Opaque rate							
...							
<b>Using Thermal storage</b>							
<b>Using vegetation...</b>							

Fig. 3: Action Plan for the building envelope



relevant module and discipline are provided to simplify the reporting process (cf. Fig. 3: Action Plan for the building envelope).

Tables showing reference and/or target values for a particular technology are also provided where applicable.

### **Harmonised Data Collection Tool**

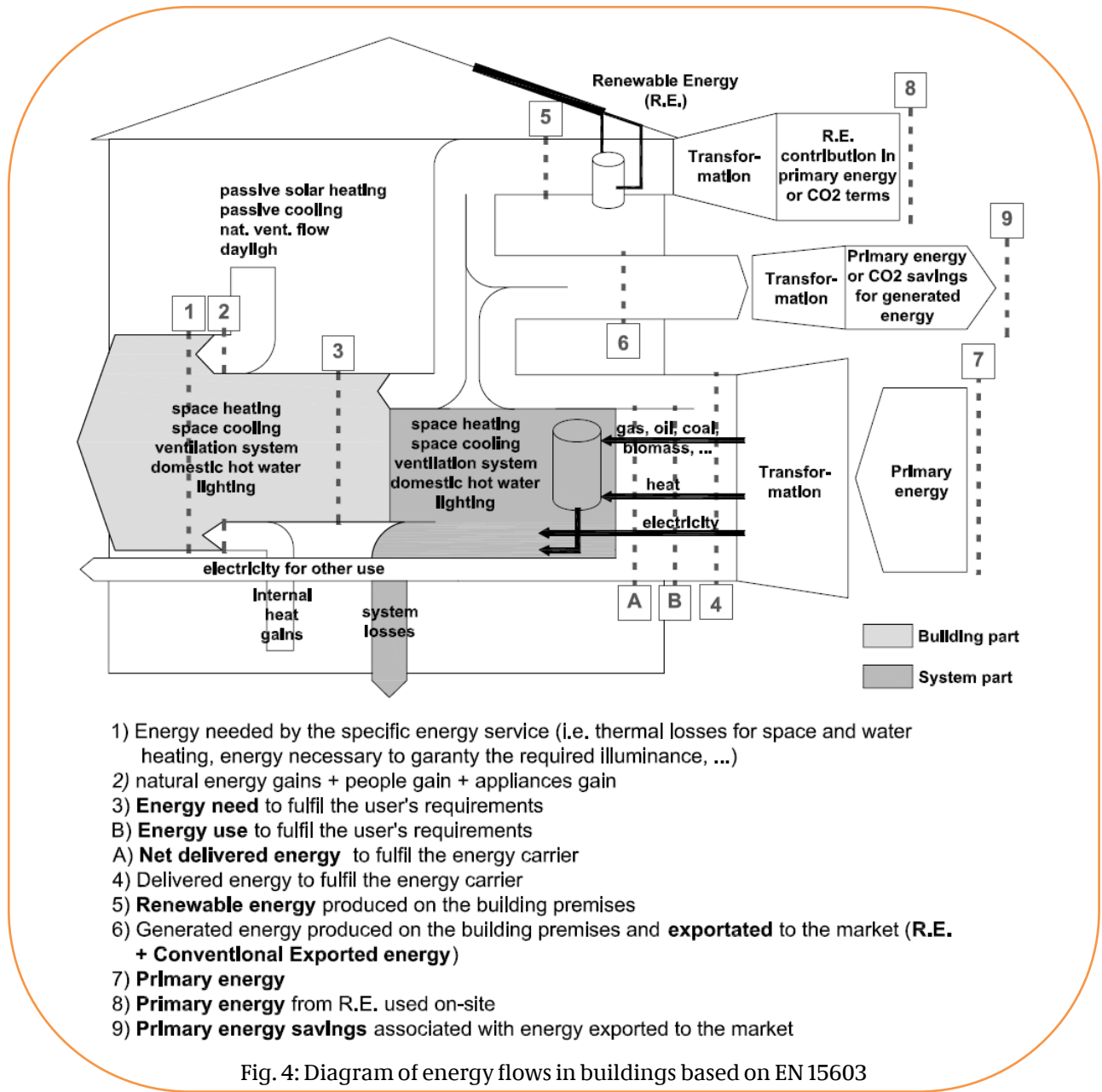
A wide range of national methods were used by the NCPs to collect, organise and evaluate data during the pilot phase. As a result, the data and evaluations often varied, making an overall assessment of the GreenBuilding Programme difficult. One of the aims of the second project phase was therefore to develop and implement a harmonised data collection and processing system. The GreenBuilding<sup>Plus</sup> Project therefore took a set of uniform GreenBuilding criteria to develop a Data Collection Tool (DCT).

These criteria developed for the classification and evaluation of GreenBuilding Partner buildings (e.g. useful net energy demand, final energy demand and primary energy demand) also serve to control strategies and the quantity and quality of the data delivered in the Energy Audit, Action Plan and Annual Report (e.g. level of disaggregation of end uses; data generated by engineering estimate, simulation, or monitoring).

The technical criteria discussed above and a set of qualitative criteria also formed the basis for a method of assessing potential GreenBuilding Award winners.

The DCT takes the form of a spreadsheet. It analyses and summarises the detailed, uniform data collected during the Energy Audit of the building in accordance with the relevant guidelines, and can be used as a basis for data collection in all participating countries. The Data Collection Tool was developed to be user-friendly and exhaustive.

The type of data used for energy consumption and energy flows in the Data Collection Tool was based on concepts and definitions set out in European standard prEN 15603. (cf. Fig. 4: Diagram of energy flows in buildings based on EN 15603) below shows a diagram of energy flows in buildings based on this standard.



The Data Collection Tool is one of the documents to be submitted with the application and is collected by the relevant NCP. The tool comprises nine Excel templates (cf. Fig. 5: Sample template in the Data Collection Tool) into which the following building data must be entered for a uniform, comprehensive description of the individual building:

- General information on building owner and building (address, contact partner etc.)
- Building information (use, climate, intervention etc.)

- Building envelope (thermal properties of components)
- Planned systems (heating, cooling, hot water, ventilation)
- Installed electric power (lighting, electrical equipment etc.)
- Special plants and systems (renewable sources used)
- Energy summary based on statutory values (primary energy, requirements and savings)
- Measures and costs (energy saving measures, extra investment costs for energy efficiency)
- Energy management (policy, design, construction, component and system choice, operation and maintenance)

The Data Collection Tool allows the significant building data for the good practice examples to be collected uniformly throughout Europe. This data can then be used to evaluate and assess the GreenBuilding<sup>Plus</sup> Project and GreenBuilding Programme.

Future plans envisage an online version of the Data Collection Tool which would allow the creation of a central database of all GreenBuilding good practice projects.

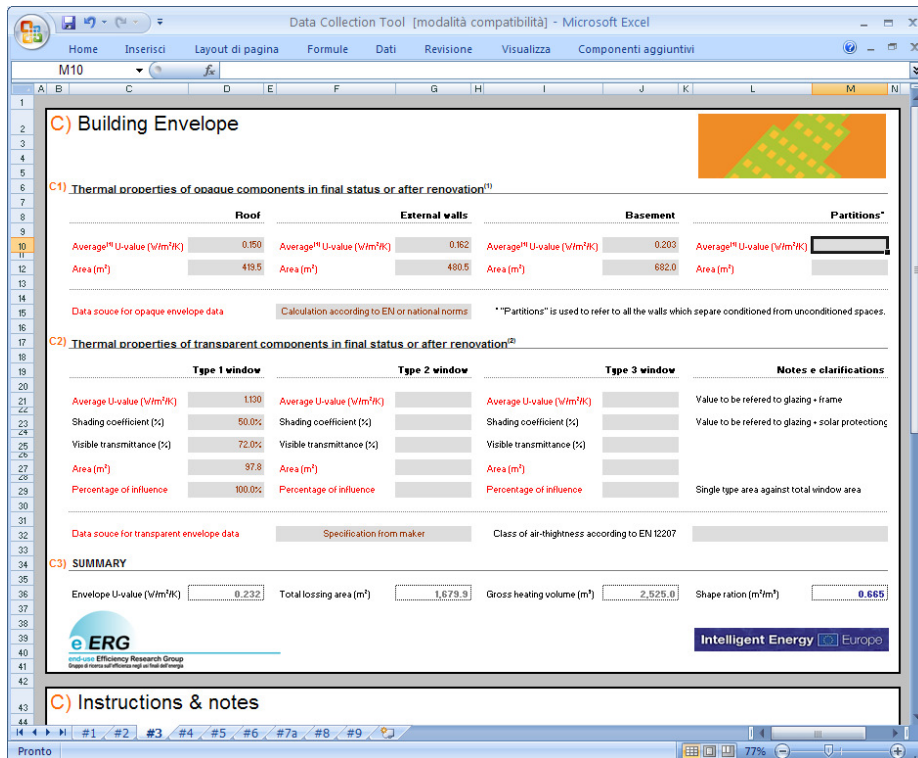


Fig. 5: Sample template in the Data Collection Tool



## **Guidelines and Highlights for Partners and Endorsers**

A set of concise supporting documents has been compiled by the GreenBuilding<sup>Plus</sup> partners in collaboration with the JRC. The GreenBuilding Guidelines provide details on the participation procedures to potential GreenBuilding Partners or Endorsers. Horizontal Modules are available on the topics of financing, energy audits, energy management and benchmarking.

This information is supplemented by initial Highlights for Partners and Endorsers which provide a clear summary of the main content of the GreenBuilding Programme.

### **Non-technical modules**

The Partner Guidelines and the technical modules are supplemented by non-technical modules regarding energy management, financing and the energy audit.

Energy management plays an important role in the GreenBuilding Programme. As the introduction of new energy management concepts can have an impact on complex strategic and operating parameters in a company, a Partner may adapt individual elements of the Energy Management Guidelines to the needs of his company.

The Energy Management Guidelines assists anyone taking part in the programme to strengthen the focus of their management priorities on energy issues and the sustainability of their investment over the complete life cycle of a building. The guidelines describe the content of an energy management programme and how this can be incorporated into the Partner's Action Plan.

A company's energy management programme should:

- Have a clearly formulated, measurable objective which reflects the organisation's commitment, culture and priorities;
- Introduce a commitment to accountability, institute a chain-of-command, define roles within the organisation, and provide employees with the authority required to implement the energy management programme;
- Ensure that improvements are made on an ongoing basis, and that the energy management programme is updated to reflect changing needs and priorities;
- Promote commitment and create an environment for the setting of goals by linking energy saving targets to the organisation's financial and environmental targets;
- Involve decision makers in policy development to ensure that they, too, support energy management;
- Communicate the programme to all staff and employees, and provide incentives for active involvement in its implementation;
- Establish reference points for measuring and rewarding good performance;



In order to assess the feasibility of a new energy management programme, the current status should be described and management responsibilities for the sustainable use of energy in the building and its systems clearly allocated. The Energy Management Guidelines suggest that an energy team be set up for this purpose.

An energy audit is an effective mechanism in energy management. An energy audit examines an energy-using system to ensure that it uses energy efficiently. In many ways it is similar to financial accounting: the building manager examines the energy balance of an energy-using system, checks the use of energy in the various building components, and whether there are inefficiencies or areas in which less energy could be used, and identifies ways of improving the energy balance. By identifying and implementing measures to achieve energy efficiency and savings, energy can not only be saved, but the life of the equipment and systems can be extended and indoor quality improved. This in turn means that money is saved and productivity improved. Based on the principle that the less energy is consumed, the less fossil fuel will be burnt, both the building and the energy company will generate less pollutants and by-products. As a result, everyone involved helps to protect the environment and at the same time promotes sustainable development.

The Energy Audit Guidelines highlight the potential of successful energy management and provide assistance in the execution of an energy audit, the preparation of the energy audit report and implementation of energy management policies, and provide information on publicity and training.

The GreenBuilding Programme encourages its Partners to tap a large reservoir of profitable investments without the need for specific financial incentives from the Commission. Antiquated supply units, inefficient utilisation techniques, insufficient operation and servicing, and a lack of consumption control are reasons for high energy consumption in all sectors. Targeted investments, modern operation management, and intelligent user motivation are preconditions for long-lasting cost reduction.

The GreenBuilding<sup>Plus</sup> Project therefore provides a module on investment financing which highlights the potential of a profitability calculation and explains a variety of financing models.

### **Marketing tool for Endorsers**

A marketing tool has been developed as an aid for GreenBuilding Endorsers. It sets out the main arguments that can be used to persuade building owners to carry out a refurbishment which improves the energy efficiency of a non-residential building (Fig. 6: Excerpt from Endorser package), and also provides a sample marketing plan which offers suggestions on how Endorsers can support the GreenBuilding Programme and the GreenBuilding Partners.





**It is easy:  
How to become GreenBuilding Partner.**

1. **Energy Audit** of the organisation's building(s), which are selected to participate in the GreenBuilding programme.
2. Formulation of an **Action Plan**, defining the scope and nature of the organisation's commitment.
3. **Approval** of the Action Plan by the National Contact Point in consultation with the European Commission .
4. **Execution** of the Action Plan
5. Participation is free of charge.



Fig. 6: Excerpt from Endorser package

**Websites**

The programme-related internet sites were successfully used as multiple information platforms for potential and accepted Partners and Endorsers, building sector stakeholders, scientists and journalists. The English language website [eu-greenbuilding.org](http://eu-greenbuilding.org) (Fig. 7: European GreenBuildingPlus website) provides comprehensive information on the GreenBuilding Programme, including:

- Introduction to GreenBuilding
- Assistance on how to become a GreenBuilding Partner or Endorser
- Downloadable GreenBuilding Guidelines and Modules
- Up-to-date list of GreenBuilding Partners
- Up-to-date list of GreenBuilding Endorsers
- Best Practice Inventory
- Event announcements, news and GreenBuilding newsletter
- Full contact details for all GreenBuilding National Contact Points

Selecting GreenBuilding Contacts in the menu brings up links to the national websites in the native language of the relevant NCP. Each national website has an individual design and layout still they all offer the same information as that on the umbrella website, supplemented by specific national requirements and tools. Depending on the type of organisation responsible for the respective NCP, GreenBuilding may be presented in connection with national activities on energy efficiency in service buildings. Examples of this can be found in the Austrian programme *Ecofacility* or the German campaigns *Zukunft Haus* and *Initiative EnergieEffizienz*.

GreenBuilding<sup>Plus</sup> – Leveraging the GreenBuilding Programme to promote energy efficiency and renewables in non-residential buildings



Average traffic recorded on the umbrella website was around 10,900 visits with 113,000 hits per month. During the GreenBuilding pilot phase in 2005-2006, around 180,000 visitors with some 600,000 page views accessed the various GreenBuilding internet platforms.

### 2.3 Main results

The aim of the GreenBuilding<sup>Plus</sup> Project was to increase publicity regarding the GreenBuilding Programme and the issue of energy efficiency in non-residential buildings in the countries of Europe and by so doing to increase its popularity. It was assumed that improving publicity would also motivate more organisations to become a Partner or Endorser.

The excellent infrastructure made it possible for GreenBuilding<sup>Plus</sup> to provide wide-ranging support to potential programme participants throughout the application process, as well as advice and publicity for GreenBuilding Partners and Endorsers. The decentralised structure involving the NCPs was particularly useful in giving interested parties, applicants, Partners and Endorsers someone close to turn to for high-quality, prompt advice, and speedy application processing.

The acquisition in the second project phase of new NCPs in two further EU Member States made a direct approach to the non-residential building market in additional countries possible, providing a platform from which to explain the advantages of energy-efficient measures and the benefits of certification to building owners.

The technical and non-technical modules and the Guidelines for Partners and Endorsers provide applicants with detailed information on potential and feasible energy-efficient measures and comprehensive assistance in the application process, project planning and implementation, and reporting under the GreenBuilding Programme.

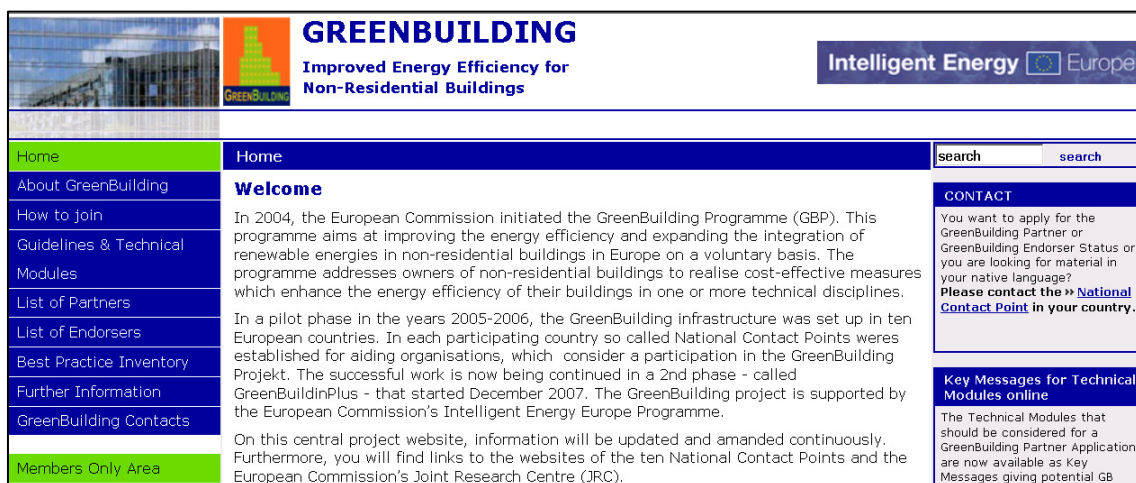


Fig. 7: European GreenBuilding<sup>Plus</sup> website





The Data Collection Tool was developed with reference to the national and European standards and requirements to enable a uniform documentation of the projects and the evaluation and analysis thereof in the GreenBuilding<sup>Plus</sup> Project. The level of standardisation achieved where the building data and properties is concerned illustrates the fact that a European standard of energy efficiency which takes account of national requirements and conditions is feasible, although much work will be necessary before this can be achieved. The evaluations are described and explained in more detail in Chapter 5 Analysis of Measures Applied.

The frequency of requests, applications and website visits shows that the GreenBuilding Programme is now much better known, and that there is great interest in the GreenBuilding issues. This aspect of the GreenBuilding<sup>Plus</sup> Project was thus clearly successful.

### 3 Dissemination activities

To increase publicity related to the programme, a wide selection of materials targeting a variety of groups was developed and published for dissemination, such as leaflets, summaries of highlights and Endorser packages. The target groups addressed included building owners and tenants, and planners, manufacturers and service providers from the energy sector. Considerable importance was attached to ensuring that the dissemination activities addressed the general public at all levels - internationally, nationally and regionally.

The primary focus of GreenBuilding<sup>Plus</sup> was public relations and communication. The objective of the promotional activities was to:

- Create awareness of energy and cost efficiency issues for non-residential buildings
- Promote energy efficiency through best practice examples
- Introduce the GreenBuilding Programme to the target groups (branding)
- Encourage organisations to participate, explaining how this could be done
- Provide technical information on energy efficiency in non-residential buildings
- Provide publicity for the programme and its participants

A particularly important aspect of the dissemination activities was use of the national languages. All media employed – be it printed material, presentations, media activities or internet publications – are also provided by the NCPs to the target groups in the respective countries in their national language. At the same time, umbrella communications use the English language.

GreenBuilding<sup>Plus</sup> – Leveraging the GreenBuilding Programme to promote energy efficiency and renewables in non-residential buildings



# GreenBuilding

## 3.1 European dissemination

### Publications

The first international GreenBuilding brochure, *GreenBuilding: enhanced efficiency for non-residential buildings*, was published in November 2006 during the first project phase. A second, updated version of the project brochure was issued during GreenBuilding<sup>Plus</sup>.

The objectives of this 12-page publication are as follows:

- To introduce the GreenBuilding Programme;
- To explain criteria and procedures to potential programme participants;
- To present examples of successful GreenBuilding projects from various European countries;
- To provide the full contact details of the GreenBuilding National Contact Points.



Fig. 8: Austrian brochure

The new and refurbished buildings presented provide an overview of the wide range of energy efficiency measures possible in all types of buildings.

Similar brochures have been created for the national audience in Austria (Fig. 8: Austrian brochure), France, Germany, Greece, Italy, Portugal, Spain and Sweden. The brochures, which were printed in large quantities, were distributed to the relevant stakeholders in the buildings sector, such as local authorities, industry, service companies, real estate companies, ESCOs, engineers, planners, and architects. The information is also



Fig. 9: European leaflet

GreenBuilding<sup>Plus</sup> – Leveraging the GreenBuilding Programme to promote energy efficiency and renewables in non-residential buildings



addressed to media representatives for energy efficiency, who can use the good practice examples highlighted in the brochures in their own publications.

To supplement the brochures, information leaflets were produced to promote the campaign more strongly. The international EU version (Fig. 9: European leaflet) was published in English, while the national versions were provided in the relevant national language.

In addition, four newsletters informing interested building owners and tenants and existing GreenBuilding Partners and Endorsers of news and events related to the GreenBuilding Programme were circulated and published on the European website during GreenBuilding<sup>Plus</sup>.

### Workshops and other events

During the GreenBuilding<sup>Plus</sup> Project, the NCPs organised a large number of workshops and events, and held seminars and presentations at conferences. The events presented methods of saving energy and improving energy efficiency in a building, and explained the objectives and benefits of the GreenBuilding Programme. The whole-day workshops, which combined the topics discussed with information on the latest statutory developments and subsidies, were particularly well received. The NCPs and guest experts presented successfully completed refurbishments or gave an overview of additional national campaigns for energy efficiency in the non-residential sector.

In some of the workshops, the Energy Performance of Buildings Directive (EPBD), its implementation at a national level and its relevance for non-residential buildings was also addressed. It was stressed that GreenBuilding is a voluntary programme complementary to the new requirements imposed by the EPBD, offering stakeholders an opportunity to present themselves proactively as leading lights in energy efficiency and to receive the corresponding public recognition.

The workshop invitations were distributed in the form of printed and electronic mailshots, and the announcements were supported by press releases and information on the national websites. Internet evaluations showed that these services were taken wide advantage of by the target groups. With a total of 53 workshops in nine countries in 2008-2010 and participation of up to 300 persons per event, the workshops were very successful. After the workshops, the NCPs were frequently addressed by newly interested institutions, often followed by an application to become a GreenBuilding Partner.



Fig. 10: National workshop in Greece, July 2009

The diversity of topics discussed at the workshops is illustrated below, taking one international and two national workshops as an example.

Two workshops were held in two different countries on 2 July 2009. A national GreenBuilding workshop on the Improvement of Energy Performance of the Building Sector was held in Athens by CRES, which presented the GreenBuilding Programme, its objectives, and the results achieved to date, with supplementary information on good practice examples from exemplary Partners and Endorsers. Key introductory speakers included the Minister of Development and representatives of the engineers who focus on energy savings in the building sector. The main topics were:

- Legislative framework for harmonisation of the European Directives in the field of energy savings
- The GreenBuilding Programme
- Energy savings in the building sector

300 participants active in all aspects of energy efficiency in buildings, such as engineers, managers and decision makers, attended the workshop. The GreenBuilding workshop had been widely advertised by the Greek press and by the National Contact Point CRES.

The second workshop was held in Tarragona. The Spanish NCP, the Group of Applied Thermal Engineering (CREVER URV), invited all Spanish Partners and Endorsers to this event, as well as anyone who had shown interest in GreenBuilding. Invitations were also sent to all players in the building sector, such as architects, engineers, building contractors, consultants, building owners and the trades. In the event, 65 persons attended the workshop which focused on the dissemination of information on energy efficiency in buildings through the GreenBuilding Programme both in Spain and in Europe as a whole, and which provided a platform for the exchange of information and experiences. Presentations were given on:

- Energy consumption control in the buildings of the Technical University of Catalonia
- Introduction of sustainable concepts in warehouses and distribution centres
- Sustainable energy management in hotels
- Key methods for energy efficiency in office buildings

An overview of technical approaches was also given by two experts who presented a variety of tools such as Bioclim, DesignBuilder and Ecotect which anticipate the behaviour of buildings through simulation. Finally, the Spanish National Contact Point took this



Fig. 11: National Workshop in Spain, July 2009



GreenBuilding<sup>Plus</sup> – Leveraging the GreenBuilding Programme to promote energy efficiency and renewables in non-residential buildings



opportunity to present the National and European GreenBuilding Awards to the audience, as well as to deliver the GreenBuilding diplomas to current Spanish Partners and Endorsers.

### Frankfurt: International Workshop 2010

April 2010 saw the final international workshop in Frankfurt, at which the winners of the European GreenBuilding Award were presented with their prizes.

The workshop on energy efficiency in non-residential-buildings and the presentation of the European GreenBuilding Award took place during the IEECB'10 Conference (Improving Energy Efficiency in Commercial Buildings, 13–14 April 2010), part of Light+Building 2010 in Frankfurt/Main, Germany. Organised by the Deutsche Energie-Agentur (dena), the workshop provided experts with a forum to present practical and effective examples of energy-reducing measures in buildings. The highlight of the conference day was the presentation of the European GreenBuilding Award (cf. Chapter 3.2 GreenBuilding Award) to the winners by Paolo Bertoldi of the European Commission, DG Joint Research Centre.

A wide audience of experts discussed the latest developments in energy efficiency in building services and integrated building service engineering. They were also able to attend interesting lectures on Building Energy Management Systems and Barriers, Financing, and Risk Analysis of Energy-Efficient Measures at the IEECB'10.

In addition, lecturers from various organisations provided first-hand information about their work. Sabine Piller of the Berlin Energy Agency talked about the Energy Saving Partnership, Berlin's successful EPC model. Dr Jörg Schlenger of Drees & Sommer Advanced Building Technologies gave a speech on Energy Efficiency in Non-Residential Buildings, and the final lecture on building envelopes was given by Christian Grayer of Dömges Architekten AG.



Fig. 12: 2010 International Workshop in Frankfurt

GreenBuilding<sup>Plus</sup> – Leveraging the GreenBuilding Programme to promote energy efficiency and renewables in non-residential buildings



# GreenBuilding

## Presentations

The NCPs presented the GreenBuilding Programme at more than a hundred national and international fairs and conferences, including the 2009 Energy Summit in Wiesbaden and the 2008 RENEXPO in Augsburg. The presentations at these events were given to a large audience of the relevant target groups, including building owners, architects, planners, building contractors and the manufacturers of energy-efficient systems.

## Reports in newspapers, journals and the online media

The intense publicity work and marketing activities carried out by GreenBuilding is illustrated by over 460 articles in the press related to the GreenBuilding Programme and over 135 articles and press releases on the GreenBuilding Programme itself. Unremitting press work was in important aspect of the project, contributing as it did to the establishment of the programme on the market and helping to highlight the currency of the issues covered. The articles were published not only in major trade journals, but also in the daily and regional newspapers to facilitate access to the broad public.

The events and publications were generally held or issued in the language of the relevant country to arouse the greatest possible interest in the target groups of that country.



Fig. 13: Erlanger Nachrichten No. 67, 21 March 2007

## 3.2 GreenBuilding Award

The GreenBuilding Award was called into being as a means of recognising particularly forward-thinking and innovative Partners and Endorsers. It created a strong media presence and presented the winning Partners and their buildings as good practice examples. It was awarded both nationally and at a European level.

Applications for the first GreenBuilding Award were called for by the European Commission in 2008. The criteria were re-defined and given more substance under GreenBuilding<sup>Plus</sup> for the second award phase in 2009/2010. Five categories were identified for which awards could be presented, with a special acknowledgement by the jury for particularly innovative projects or concepts with a high replication potential.

Category	Description
Best new project	New buildings whose primary energy consumption is at least 25% lower than required in the national building code.
Best refurbishment project	Refurbishment project with at least 25% total primary energy savings.

GreenBuilding<sup>Plus</sup> – Leveraging the GreenBuilding Programme to promote energy efficiency and renewables in non-residential buildings



<b>Best Corporate Partner</b>	Any company with at least ten buildings which incorporates the majority of its buildings into the GreenBuilding Programme (refurbishment or new building).
<b>Best Endorser</b>	A company active in the field of architecture, structural engineering, energy and engineering consulting or energy services which has supported at least one GreenBuilding Partner.
<b>Special acknowledgement of the jury</b>	Projects which deserve special recognition in the eyes of the jury.

Table 1: Categories and criteria for the GreenBuilding Award

### Award criteria

To enable full evaluation of a project nominated for the award, both the qualitative and the quantitative aspect was incorporated into the list of criteria. The quantitative criteria were assessed using a simple points system which recorded the energy savings measures. This part of the evaluation process focused on final and primary energy consumption and optimisation of the building envelope (average U-value of roof, opaque building surface, windows and basement). Further aspects included the use of renewable energies, the number of actions carried out and the introduction of energy management. The completeness of the application documents and the quality of the data and information submitted was also considered when assessing the individual properties, Partners and Endorsers.

Quantitative criteria	Maximum number of points possible per category (total number of points = 100)
<b>Total primary energy saving</b>	30
<b>Building envelope and facade</b>	
Reduction of energy needs	20
Average U-value of roof, opaque building surface, windows and basement	5
<b>Quality of data</b>	
Precision of calculation of floor areas	3
Provision of voluntary data	2
<b>Renewable energy systems</b>	10
<b>Number of applied measures</b>	5
<b>Energy management measures</b>	10
<b>Heating system</b>	5
<b>Sustainable summer comfort</b>	
Comfort model	2
Strategies to reduce solar heat gains in the building	5
Strategies to achieve sustainable summer comfort	3

Table 2: Overview of weighting of quantitative criteria



The qualitative criteria were formulated to assess the innovative principle and the potential of the project to be replicated elsewhere. The level of innovation in an individual project was assessed in respect of innovative integration of renewable energy technologies, innovative use of shading devices, and use of innovative materials and components (e.g. ecological or recycled materials, vacuum insulation material, translucent insulation material, and passive house windows). Attention was also paid to the structure and execution of the measure and covered a concept for involvement of users – participation of the user in the energy saving process, integrated planning process, integration in the general energy and environmental policy of the company (building as part of CSR strategy), integration of the concept into the surroundings and background (landscape, cityscape, historical building substance, landmarks, company background, etc.) and the use of already existing structures and resources. The replication potential was assessed according to how easy it would be to apply the energy-efficiency measures to other projects, whether the project could be financed through normal channels, and whether it fitted into the national and international legal environment (no research project, subsidies etc.). Additional attention was given to the influence the project had had on the general public (dissemination activities, information to other building owners, employees etc., presentation of the concept at conferences or events), and which measures support and promote state-of-the-art technology.

The national and European awards were announced well in advance through mailshots, websites, brochures, articles etc. In some countries Partners and Endorsers had to apply to take part in the competition. In other countries, all Partners and Endorsers automatically took part.

### **National GreenBuilding Awards**

National GreenBuilding Awards were held and national winners selected in all countries participating in the GreenBuilding<sup>Plus</sup> Project. The award ceremonies were held in the period October 2009 to May 2010.

Winners were selected at a national level in six different categories:

- Best Endorser
- Best Corporate Partner
- Best refurbishment project
- Best new project
- Most innovative project
- Project with the highest replication potential

Partners and Endorsers were assessed according to the criteria set by the NCP, in some cases by a jury or other independent experts.





## Winner Austria

- Best new project: Lower Austria Business Centre / Department of the Lower Austria state government
- Best refurbishment project: Manschein office building / Ing. Siegfried Manschein Ges.m.b.H
- Most innovative project: ENERGYbase office building / WWFF Business and Service Center GmbH
- Project with highest replication potential: Allianz insurance office building / Allianz Insurance AG

Numbers of attendees at award ceremony: 130

Table 3: Winner Austria

## Winner Belgium

- Best new project: Port of Ghent office / Port of Ghent
- Best refurbishment project: Rotonde central campus / Rotonde central campus
- Most innovative project: Stebo Homebase / Stebo
- Project with highest replication potential: SeaBridge Logistics / SeaBridge SA

Numbers of attendees at award ceremony: no ceremony

Table 4: Winner Belgium

## Winner Croatia

- Best new project: University library in Split / University of Split
- Best refurbishment project: HEP DP Elektra Koprivnica office building / HEP DP Elektra Koprivnica
- Most innovative project: Politin auto camp, Krk / Valamar turisticki project d.o.o.
- Project with highest replication potential: Kature multi-residential buildings with business units, Labin / City of Labin
- Best Endorser: HEP Esco d.o.o.
- Best integrated energy concept (own category): Phoenix Plaza / Phoenix Park d.o.o.

Numbers of attendees at award ceremony: 50

Table 5: Winner Croatia



Winner Germany
<ul style="list-style-type: none"> <li>■ Best new project: Hettich Forum / Hettich Holding GmbH &amp; Co oHG</li> <li>■ Best refurbishment project: Haus der Begegnung / Stadt Königstein</li> <li>■ Most innovative project: Abt Bernhard Hilz Secondary School / Hauptschulverband Hengersberg</li> <li>■ Project with highest replication potential: Burgebrach Primary School / Markt Burgebrach</li> <li>■ Best Endorser: Balck &amp; Partner Beratergruppe</li> </ul>
Numbers of attendees at award ceremony: 500

Table 6: Winner Germany

Winner Greece
<ul style="list-style-type: none"> <li>■ Best new project: AB Vasilopoulos, Komninon 1, Ethnomartirwn &amp; Anagenniseos / AB Vasilopoulos</li> <li>■ Best refurbishment project: Pireaus Bank Syggrou 87 / Pireaus Bank</li> </ul>
Numbers of attendees at award ceremony: n/a

Table 7: Winner Greece

Winner Italy
<ul style="list-style-type: none"> <li>■ Best new project: ITCLab / Italcementi S.p.A.</li> <li>■ Best refurbishment project: Sede Roma Laurentina / Siemens S.p.A.</li> <li>■ Most innovative project: Vipiteno Development / Siemens S.p.A.</li> <li>■ Project with highest replication potential: ASILO Cologno Monzese / Municipality of Cologno Monzese</li> <li>■ Best Endorser: Rockwool Italia S.p.A.</li> </ul>
Numbers of attendees at award ceremony: 130

Table 8: Winner Italy

Winner Portugal
<ul style="list-style-type: none"> <li>■ Best refurbishment project: Edificio sede e Museu e Centro de Arte Moderna / Fundacao Calouste Gulbenkian</li> </ul>
Numbers of attendees at award ceremony: no ceremony

Table 9: Winner Portugal



Winner Spain	
■	Best new project: Contratas y Obras New Headquarters / Contratas y Obras E.C.S.A.
■	Best refurbishment project: Area Hospitalaria Juan Ramon Jimenez
■	Most innovative project: Alexandra building / VIMUSA
■	Project with highest replication potential: NH Principe de la Paz / NH Hotels
■	Best Endorser: LEVENGER
Numbers of attendees at award ceremony: 200	

Table 10: Winner Spain

Winner Sweden	
■	Best new project: Kaggen office building / NCC Property Development Nordic
■	Best Endorser: Bengt Dahlgren
■	Best Corporate Partner: Fastighets AB Brostaden
Numbers of attendees at award ceremony: 65	

Table 11: Winner Sweden

### European Green Building Award 2010

After selection of the national winners of the GreenBuilding Programme, the European GreenBuilding Award was presented at the IE ECB'10 Conference during the Light+Building trade fair in Frankfurt/Main, Germany, on 14 April 2010.

The Award was presented to future-thinking companies and local authorities investing in the reduction of energy consumption and the carbon emissions of their buildings. A panel of five independent buildings and energy experts selected 13 outstanding projects in the categories Best Endorser, Best Corporate Partner, Best Refurbishment Projects, and Best New Projects.

The award ceremony was organised by the Austrian Energy Agency. All submissions to the respective GreenBuilding National Contact Point between January 2008 and September 2009 automatically took part in the 2009/2010 GreenBuilding Award. The national award winners in each participating country automatically qualified for entry to the European GreenBuilding Award. The 37 final projects were assessed by a panel of experts using a set of quantitative and qualitative criteria, and the winners were identified, invited to the ceremony and briefed by the GreenBuilding<sup>Plus</sup> project team. Two information packages containing information necessary for participation in the event were prepared and provided to the winners, who also received separate information from the Austrian Energy Agency or their National Contact Point. JRC prepared the certificates and presented them to the winners at the award ceremony.

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**GreenBuilding**

**The following winners were identified:**

**Best new projects:**

- Phoenix Plaza / Phoenix Park d.o.o.
- Port of Ghent office / Havenbedrijf Gent - Special recognition for replication potential
- Office ENERGYbase / WWFF - Special recognition for innovation
- ASILO Cologno Monzese / Municipality of Cologno Monzese

**Best refurbishment projects:**

- Hengersberg Secondary School / Hauptschulverband Hengersberg
- NH Principe de la Paz / NH Hotels
- Manschein office building / Siegfried Manschein GmbH
- Pireaus Bank Syggrou 87 / Pireaus Bank

**Best Endorser:**

- Levenger S.L. (ES)
- Bengt Dahlgren (S)

**Best Corporate Partner:**

- Fastighets AB Brostaden (S)

**Special acknowledgement of the jury:**

- AB Vasilopoulos, Komninon 1 / AB Vasilopoulos
- SeaBridge Logistics / SeaBridge SA

Table 12: Winner European GreenBuilding Award



Fig. 14: European GreenBuilding Award winners

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Three examples of winning projects in the European GreenBuilding Award categories Special Acknowledgement and Best New Project are presented below.

#### Seabridge Logistics (Belgium) - Special acknowledgement of the jury

The Seabridge Logistics Building exploits synergies between technology, quality, sustainability and traceability. It is located at the Port of Zeebrugge and was built in 2009 with an area of 20,000m<sup>2</sup>. The primary energy demand is 73% lower than that required under the Belgian (Flemish) building code. Energy is provided in part by 4,600 photovoltaic modules on the roof (renewable source) and a good environmental (ISO 14001) and energy management system is planned for the second half of 2010.



Fig. 15: SeaBridge Logistics

#### Table 13: Winner / Special acknowledgement of the jury - Seabridge (Belgium)

#### ENERGYbase (Austria) - Best new projects

The ENERGYbase office building employs innovative architecture with modern building services and a high level of comfort. The building also uses very little energy for heating, cooling, lightning and ventilation, and 100% of the heating and cooling energy is covered with renewable sources (groundwater, solar energy). It is located in Vienna and has 7,500m<sup>2</sup> lettable floor space: 1,300m<sup>2</sup> for study programmes, 1,000 m<sup>2</sup> for a research laboratory and 5,200 m<sup>2</sup> for office use.



Fig. 16: ENERGYbase

#### Table 14: Winner / Best new projects - ENERGYbase (Austria)



Hengersberg Secondary School (Germany) - Best refurbishment projects

Hengersberg Secondary School was built between 1967 and 1969. The existing building has a heated net floor area of 2,936m<sup>2</sup> for 290 pupils. After completion of refurbishment in December 2011 this area will be increased to 3,560m<sup>2</sup>. Heat is generated by a 580 kW gas/oil boiler. The measures being implemented cover a heating system comprising a biomass boiler (wood, 150 kW) and a solar thermal unit (28m<sup>2</sup>), a ventilation system, and heat recovery of 92%. Automatically controlled external shading and daylight controlled lighting will also be installed.



Fig. 17: Hengersberg Secondary School (Germany)

Table 15: Winner / Best refurbishment – Hengersberg Secondary School

### 3.3 Main results

The intense dissemination activities, particularly at a national level, aroused great interest in the owners and tenants of non-residential buildings and in architects and engineers, and building and energy service providers in the participating countries. Brochures and leaflets in the relevant national language were ideal aids in the acquisition of Partners and Endorsers. GreenBuilding also drew increased attention to the potential offered by energy savings in reports in newspapers, journals and the online media.

The events and workshops provided an opportunity to address a large specialist audience and give them a better understanding of the GreenBuilding Programme, and interest in and demand for the programme increased considerably after the events. This is an indication that people attending the workshops explore the subjects discussed thoroughly, and that the programme is experiencing an increasingly positive response from participants and growing acceptance on the market as a result of the raised levels of awareness.

Public recognition of the programme was promoted through the presentation of good practice examples as models for refurbishment measures and exploitation of the energy savings potential. The GreenBuilding Awards were particularly good vehicles in this respect. Measures such as these help to overcome the market barriers which still exist, such as a lack of information and prejudice against energy-efficient refurbishments assuming significantly higher expenses and input. GreenBuilding<sup>Plus</sup> was successful in demonstrating to the target group the benefits of an energy-efficient refurbishment, these being:

- Technical feasibility
- Cost effectiveness
- Energy conservation
- Independence from increasing energy prices and lower energy bills

GreenBuilding<sup>Plus</sup> – Leveraging the GreenBuilding Programme to promote energy efficiency and renewables in non-residential buildings



- Improved comfort of buildings
- Contribution to environmental protection

#### 4 Partners and Endorsers

The main focus of GreenBuilding<sup>Plus</sup> lay on the acquisition of new Partners and Endorsers.

Participation in the GreenBuilding Programme allows organisations to prove their commitment to considerable reductions in energy consumption in their non-residential buildings and to present this commitment to the outside world. Any company prepared to apply the GreenBuilding objectives to its own buildings can take part, receiving advice and technical assistance from the NCPs and the European GreenBuilding Programme coordinators.

##### 4.1 GreenBuilding Partners

Owners of non-residential buildings intending to lower primary energy consumption in their building by 25% or more can be awarded the status of GreenBuilding Partner by the European Commission. This applies both to new buildings and to refurbishments. The energy needs of a new building must be at least 25% lower than demanded in the statutory national standards for new buildings, while buildings which were refurbished up to five years before application may take part in the programme if the refurbishment reduced primary energy consumption by at least 25%, or consumption is 25% below the level required at the time of application.

GreenBuilding Partners receive a wide range of benefits, such as a GreenBuilding Certificate (Fig. 18: Partner certificate) and the right to use the GreenBuilding logo. Their projects are drawn to the attention of the public on the programme websites, in brochures, and in press and public relations work. All GreenBuilding Partners are given the opportunity to present their projects in the GreenBuilding Best Practice Database which is published on the umbrella website, and which is also available on some of the national websites.

In the context of the best practice projects, key data is provided on the building owner (GreenBuilding Partner), the building, financial investments, energy and cost savings, the energy concept, the technical measures applied, and technical details of energy-related issues such as insulation, energy demand, and carbon emissions saved. The information is supplemented by charts, diagrams or photographs. In addition, a printable summary can be generated for each best practice project.



Fig. 18: Partner certificate

GreenBuilding<sup>Plus</sup> – Leveraging the GreenBuilding Programme to promote energy efficiency and renewables in non-residential buildings



If a company owns more than ten buildings, it may apply for Corporate Partner status, in which case it must commit to applying the GreenBuilding specifications to the majority of its European buildings, whether owned or rented. In other words, 30% of existing buildings and 75% of new buildings must satisfy the GreenBuilding criteria.

Five stages must be completed for participation in the GreenBuilding Programme and attainment of Partner status:

- 1) A record of the current status of energy consumption in the building applying for participation in the GreenBuilding Programme (Energy Audit)
- 2) Creation of an Action Plan describing the steps required to improve energy efficiency
- 3) Description and explanation of the energy efficiency measures to be taken in a new building, for example in the form of an energy consultant report
- 4) Approval of the Action Plan and award of Partner status by the European Commission
- 5) Execution of the Action Plan and reports to the European Commission

Execution of the Action Plan can bring immediate benefits to an organisation as follows:

- Improvement of indoor quality and use of the building
- Awareness of technically and economically feasible energy savings measures. The plan should address the economic efficiency of the proposed actions, as this may weight the scales in favour of the allocation by the organisation of limited financial and human resources.

By implementing projects, companies with Partner status take on a pioneering role which is highly visible throughout Europe.





# GreenBuilding

## Examples of good practice projects from GreenBuilding Partners

### Office Building



## Manschein

The office building of the company Manschein was built in 1999. It has been enlarged several times over the last few years. In 2007 extensive refurbishment measures were agreed focusing primarily on solar architecture. The works covered the insulation and tightness of the building envelope, mass storage optimisation, shading, and interior comfort (natural light, indoor air quality, organic materials etc.) with reference to the heating demands of a passive house. The objective of the improvements was for the company's own office building to be a model for innovative building solutions. The concept stands for balanced energy for heating and cooling as well as the 100 percent utilisation of solar potential. Energy consumption was optimised further with glazing, shading, lighting and daylighting measures.



#### Building Data

**Building type**  
Office building (refurbishment)

**Size**  
307m<sup>2</sup>

**Year of refurbishment**  
2007

**Actions performed**

- 32m<sup>2</sup> thermal solar collectors for heating and cooling, 750 m<sup>2</sup> soil collector field for the heat pump for additional heating, passive building component cooling, floor heating, very low temperature dimensioning radiator and air heaters
- Highly insulated facade (0.18 W/mK) and roof (0.12 W/mK)
- Thermal insulation windows (0.6 W/mK)
- Ventilation with highly efficient circulating heat exchanger (83% heat recovery); regulation of fresh air with a CO<sub>2</sub> 42 m<sup>2</sup> PV unit (5 kWp); production of 100% of the electricity for the heat pump (790 kWh), refrigerating machine (329 kWh) and ancillary units (2,146 kWh)

• Energy monitoring supports the improvement of the whole system over its life cycle.

**Savings**

- Energy demand for heating after refurbishment: 4,600 kWh/a
- Heating savings: 28,551 kWh/a
- Electricity savings: 3,309 kWh/a
- Total savings: 31,860 kWh/a
- CO<sub>2</sub> savings: 8,657 kg/a



Fig. 19: Manschein office building (Austria)

### University Library



## Split

The University of Split was founded in 1774 and consists of 9 faculties, an Academy of Arts, and several institutes and scientific facilities. Scientific work focuses on the field of natural, historic, social, economic and other disciplines characteristic for the Croatian, Adriatic and Mediterranean area.

The University Library in Split uses alternative energy sources and highly efficient system with heat recovery.

The building is completely ventilated and air-conditioned for specific purposes (underground archive) and a better indoor environment.

The total net building area is 13,700m<sup>2</sup>. There are two main areas: the lower building with 6 underground levels and upper building with 7 levels.



#### Building Data

**Building type**  
Library (new building)

**Size**  
13,700m<sup>2</sup>

**Year of construction**  
2008

**Actions performed**

- Heating system: heat pumps (also for air-condition system using exhaust air and air from underground levels)
- Double skin glass facade with inner space 80cm in width in which natural air circulates, providing a buffer zone both in winter and summer
- Ventilation system with heat recovery of 80% to 92%
- Cooling energy is supplied in an adiabatic process, mechanical cooling integrated in the air-conditioning system and a compact cooling device
- CCMS coordinates air-conditioning, the production of heating and cooling energy, and individual indoor environment conditions

**Savings**

- Primary energy demand of 806,400 kWh for heating and cooling is 51 kWh/m<sup>2</sup>/a
- Total energy savings of about 79,800 e/a, an estimated 35%
- CO<sub>2</sub> savings of 149,600 kg/a

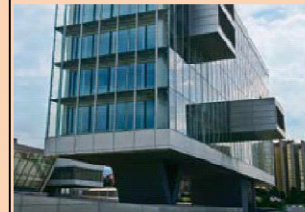


Fig. 20: Split University Library (Croatia)

GreenBuilding<sup>Plus</sup> – Leveraging the GreenBuilding Programme to promote energy efficiency and renewables in non-residential buildings



# GreenBuilding

## Research Centre



### ITCLab

Situated at the eastern end of the kilometro Rosso Scientific Technology Park in Stezzano (Bergamo, Italy), the Italcementi Centre for Research and Innovation (ITCLab) is the new iconic building designed by American architect Richard Meier for Italcementi Group.

The building is V-shaped in plan and accommodates a laboratory building in one wing and an administration building in the other; a central atrium sited in the centre of the two wings contains a public reception and a security control centre, and provides a circulation space for both wings of the ITCLab. The building benefits from a highly insulated envelope. The flat concrete roof has an important exposed thermal mass that ensures a largely inertial behaviour. Above this, a Saranall membrane with solar reflectance of 83% has been proposed to reduce absorbed solar energy and thus minimise solar loads transmitted into air-conditioned spaces during summer.

[www.italcementigroup.com](http://www.italcementigroup.com)


Building Data	
<p><b>Building type</b> Research Centre (new building)</p> <p><b>Size</b> Total floor area 17,000m<sup>2</sup> (including parking); conditioned net floor area 9,759 m<sup>2</sup></p> <p><b>Year of construction</b> 2009</p> <p><b>Actions performed</b></p> <ul style="list-style-type: none"> <li>Thermal system based on 3 geothermal heat pumps with an additional condensing boiler</li> <li>Variable speed drives for HW pumps</li> <li>External walls, roof and ground floor built with thermal resistance</li> <li>Roof has Saranall membrane with solar reflectance of 83%</li> <li>Transparent building envelope composed of triple and double glazed windows and skylights</li> <li>Fluorescent tubes powered by electronic ballasts</li> <li>Occupancy sensors in enclosed offices, conference rooms and laboratories</li> <li>Daylight dimming controls in perimeter spaces and spaces with skylights</li> <li>Ventilation: Variable speed tower fans</li> </ul>	<ul style="list-style-type: none"> <li>Geothermal system covers part of the cooling demand in addition to two chillers. Wet-bulb reset control for condenser water temperature</li> <li>Solar thermal panels supply 8% of the domestic hot water</li> <li>422 roof-mounted photovoltaic panels</li> </ul> <p><b>Savings</b></p> <ul style="list-style-type: none"> <li>Primary energy for heating about 408 MWt/a (41.8 kWt/m<sup>2</sup>a.)</li> <li>Total energy saving of 27% compared to legal level</li> <li>CO<sub>2</sub> savings of 28.4 t/a</li> </ul> 

Fig. 21: ITCLab Research Centre (Italy)

### Example of a Corporate Partner

## Corporate Partner

### Brostaden

Corporate Partner with 34 buildings

Fastighets AB Brostaden real estate portfolio consists of office and retail properties as well as warehouse and industrial properties concentrated in expensive inner suburbs with good services and communications. The through routes in Greater Stockholm run past the warehouse and industrial properties. Brostaden's head office is in Stockholm.



Fig. 22: Corporate Partner Brostaden (Sweden)



## 4.2 GreenBuilding Endorsers

A GreenBuilding Endorser is committed to supporting the programme and may apply for the Best Endorser category of the GreenBuilding Award. While building owners may become a GreenBuilding Partner on their own, a company is only allowed to become a GreenBuilding Endorser after helping at least one building owner to attain Partner status. This rule ensures that each Endorser will have been involved directly with at least one GreenBuilding project. At the same time, becoming a GreenBuilding Endorser is more complex, and the total number of Endorsers is therefore significantly lower than that of GreenBuilding Partners.

GreenBuilding Endorser status is open to:

- Architects and engineers
- Equipment manufacturers
- Stakeholders in the construction sector
- Energy management and system design companies
- Electric utilities and energy service companies
- Energy equipment importers, distributors and vendors
- National professional and trade associations

Exact criteria must be satisfied for the GreenBuilding Endorser status. Although Endorser status entails no statutory obligations, the Endorser is expected to show a strong commitment to publicising the objectives of the GreenBuilding Programme.

Any organisation wishing to support the GreenBuilding Programme must pass through the following four-stage process:

- 1) Formulation of a GreenBuilding Promotion Plan which clearly describes its activities to support the programme
- 2) Proof of assistance of at least one building owner/occupier in becoming a GreenBuilding Partner
- 3) Approval of the Promotion Plan by the European Commission
- 4) Execution of the Promotion Plan and reports to the Commission.

By approving the GreenBuilding Promotion Plan the European Commission grants the organisation the status of GreenBuilding Endorser. The organisation may now refer to this status in its external communications. It is listed on the website and in GreenBuilding publications and may use the GreenBuilding logo.

The experiences gained in the support of a GreenBuilding Partner enable a planning office for example to develop unique selling points and special competences and to communicate these to the outside world.

GreenBuilding<sup>Plus</sup> – Leveraging the GreenBuilding Programme to promote energy efficiency and renewables in non-residential buildings



**GreenBuilding**

The aim of a large large number of Endorsers from the fields of architecture, energy consulting, engineering and energy services is to strengthen the exchange of knowledge and expertise and to build up an extensive network of experts.

**Examples of GreenBuilding Endorsers**

### GreenBuilding Endorser

The origins of LEVENER date back to the very beginnings of renewable energies in Spain. Over time, LEVENER has evolved and become one of the most respected companies in the renewable sector. It is currently the benchmark company in this sector.

**A solid partner**

Several decades operating at the cutting edge of engineering technology have provided LEVENER with a level of experience and expertise which enables the company to deal with projects of all types and virtually any scale. Quality, ingenuity and reliability form the core of LEVENER operations, coupled with a high level of professionalism and first-class service.





Fig. 23: GreenBuilding Endorser LEVENER (Spain)

### GreenBuilding Endorser

## Bengt Dahlgren

One of Sweden's largest technical consultants in

- HVAC
- Energy & Environment
- Building Management Systems
- Fire engineering & Risk Management
- Facilities Management

• 300 co-workers each with a genuine interest for energy and environmental issues

• Having many years of experience in energy and environmental issues



Fig. 24: GreenBuilding Endorser Bengt Dahlgren (Sweden)

GreenBuilding<sup>Plus</sup> – Leveraging the GreenBuilding Programme to promote energy efficiency and renewables in non-residential buildings



**GreenBuilding**

### 4.3 Main results

The broad-based implementation of energy efficiency measures in non-residential buildings can only succeed if building owners are convinced of their value. Experienced architects and engineers are ideal partners in showing the owners that the benefits are worth the investment.

A targeted approach and the acquisition of GreenBuilding Partners and Endorsers is thus the most important aspect of the GreenBuilding Programme. It became apparent over the course of the project that after an initial phase the snowball effect kicked in and the market showed considerable interest in the programme.

In total, around 100 good practice examples from nine European countries had been entered into the best practice database on the umbrella GreenBuilding website when GreenBuilding<sup>Plus</sup> ended in May 2010. 160 GreenBuilding Partners took part in the programme with 320 projects, and there were 68 GreenBuilding Endorsers.



## 5 Analysis of Measures Applied

A comprehensive analysis was carried out to assess the building measures executed during the project and the energy savings achieved. The data necessary for this was collected separately for each building with the Data Collection Tool and analysed on the basis of an agreed standard structure for all countries.

This chapter presents an extract from the summary and evaluation report as a means of giving a general overview of the buildings assessed and highlighting particularly interesting aspects.

### 5.1 Project results

A large number of analyses and values regarding features and the performance of the building envelope and systems are presented in the evaluation report. An analysis of the main energy performance of the buildings and the main energy savings achieved is also provided, as is an overview of the main results of the GreenBuilding<sup>Plus</sup> Project and key data on the GreenBuilding Partners and their buildings.

The GreenBuilding<sup>Plus</sup> projects cover many different types of buildings: in addition to office buildings, the projects focused on educational buildings, health and day care centres, hotels and many others. This is a very positive development and indicates that market acceptance is increasing.

#### Geographical spread

A look at the geographical spread of the programme participants reveals that GreenBuilding has achieved strong feedback in some countries while in other countries participation is still low. The following factors were identified as being influential for the success of the programme in a certain country when evaluating the GreenBuilding pilot phase:

- Level of market development: Is there already a well-established market for energy efficiency concepts and measures in the buildings sector with a significant number of market players (e.g. ESCOs)?
- Level of awareness and know-how: Is energy efficiency already seen as a relevant issue by building owners? Are they familiar with the cost saving potential? Do they know what can be done at a technical level? Do they know whom to consult?
- Political frameworks: Do national building codes or funding schemes encourage owners of non-residential buildings to invest in the modernisation of their buildings?
- EPBD implementation: What is the attitude towards the implementation of the EPBD and the introduction of BER certificates at a national level? Is GreenBuilding seen as an opportunity to receive a possible add-on in the context of making a building more energy efficient, or do current uncertainties about final EPBD implementation make building owners hesitant to consider participation?





- Intensity of promotion work by the National Contact Points: Even in countries with an unfavourable situation where market development and frameworks are concerned, very active National Contact Points proved able to encourage organisations to join the GreenBuilding Programme.

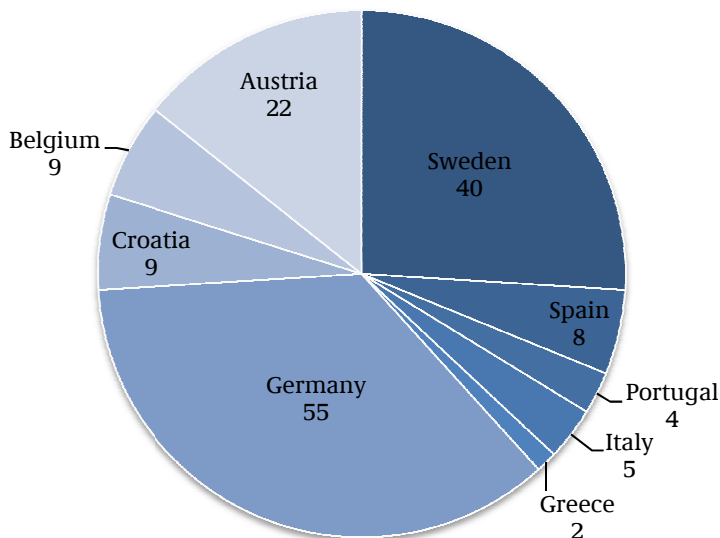


Fig. 25: Total number of GreenBuilding Partners during GreenBuilding<sup>Plus</sup> (2008 / 2010)

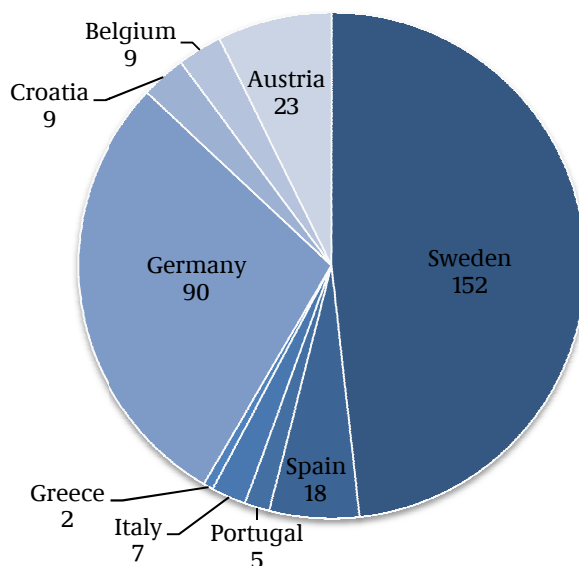


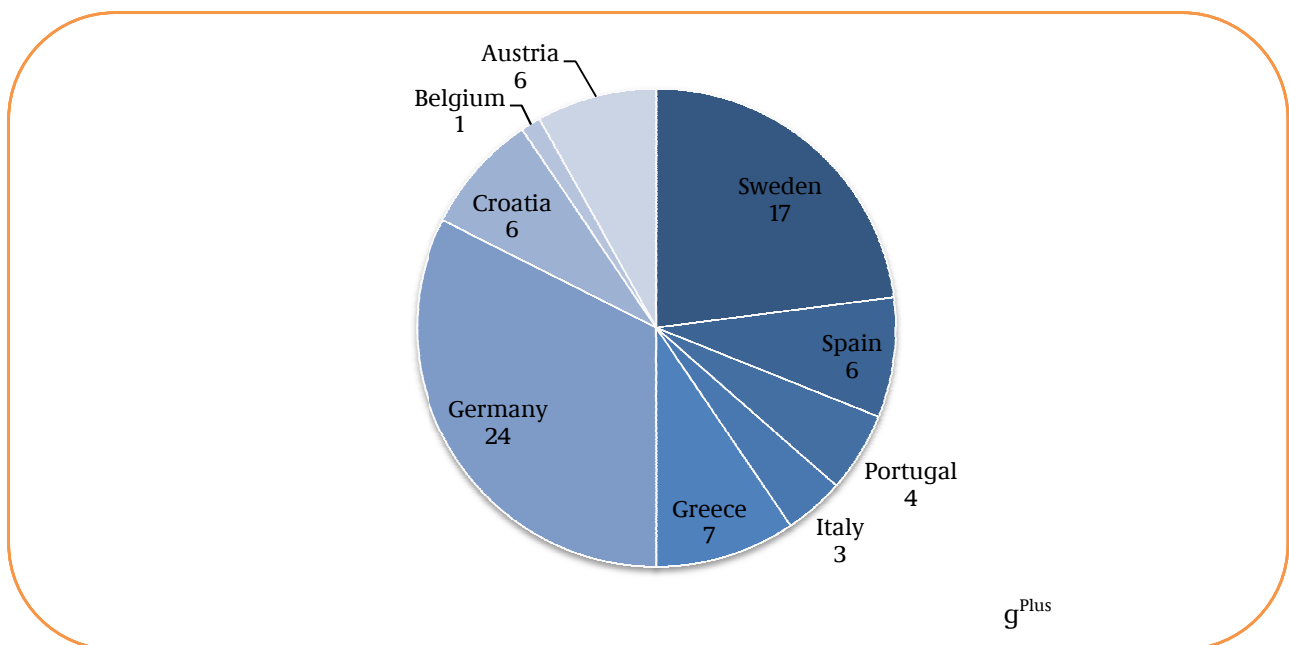
Fig. 26: Total number of buildings in GreenBuilding<sup>Plus</sup> (2008 / 2010)



In some countries, particularly Germany and Sweden, there are a large number of GreenBuilding Partner buildings, and many others, such as Belgium, Croatia, Greece, Italy, Portugal and Spain, have a good number (around ten).

GreenBuilding Partners buildings can be found in most of the European climate zones, from Sweden in the north to Greece in the south.

The geographical distribution of the GreenBuilding Endorsers, who are mainly large manufacturers of building technologies, energy service companies, engineering consultancies, energy planners and architects from nine countries is similar:



## 5.2 Analysis of participating projects

In order to assess the influence of the GreenBuilding Programme, the building data from the good practice projects, which was submitted with the application documentation, was collected and evaluated by the relevant NCPs with the help of the Data Collection Tool. This facilitated the collection of a wide range of data.

The technical data for 85 GreenBuilding projects was examined and assessed for the detailed evaluation report<sup>1</sup>.

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<sup>1</sup> It was impossible to evaluate all buildings taking part in GreenBuilding, as in some cases the required information was not available or was lacking (e.g. because the building design team did not communicate all data to the GreenBuilding Partner, or because company staff were not in possession of all technical information)





### 5.2.1 Type of intervention/type of use

More applications for new buildings were submitted than applications for refurbishments. The projects included new buildings that could achieve a higher than usual energy performance, and refurbished buildings that were very important for the improvement of energy efficiency in Europe's building stock (Fig. 28: Type of intervention in GreenBuildingPlus projects).

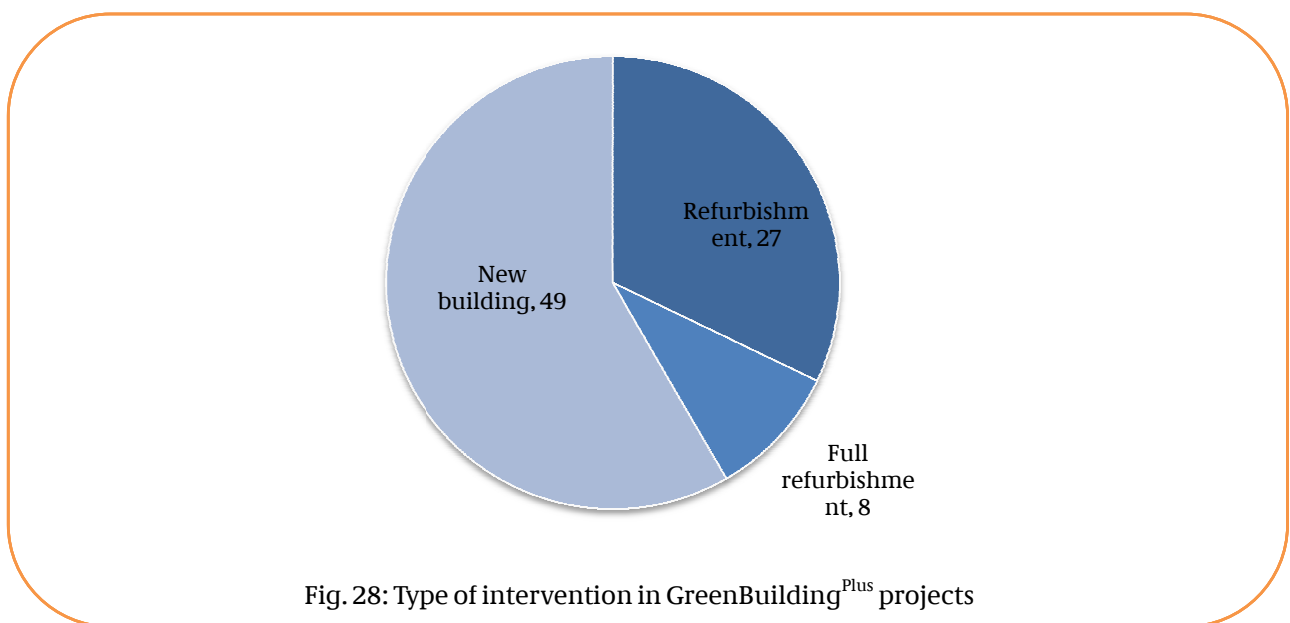
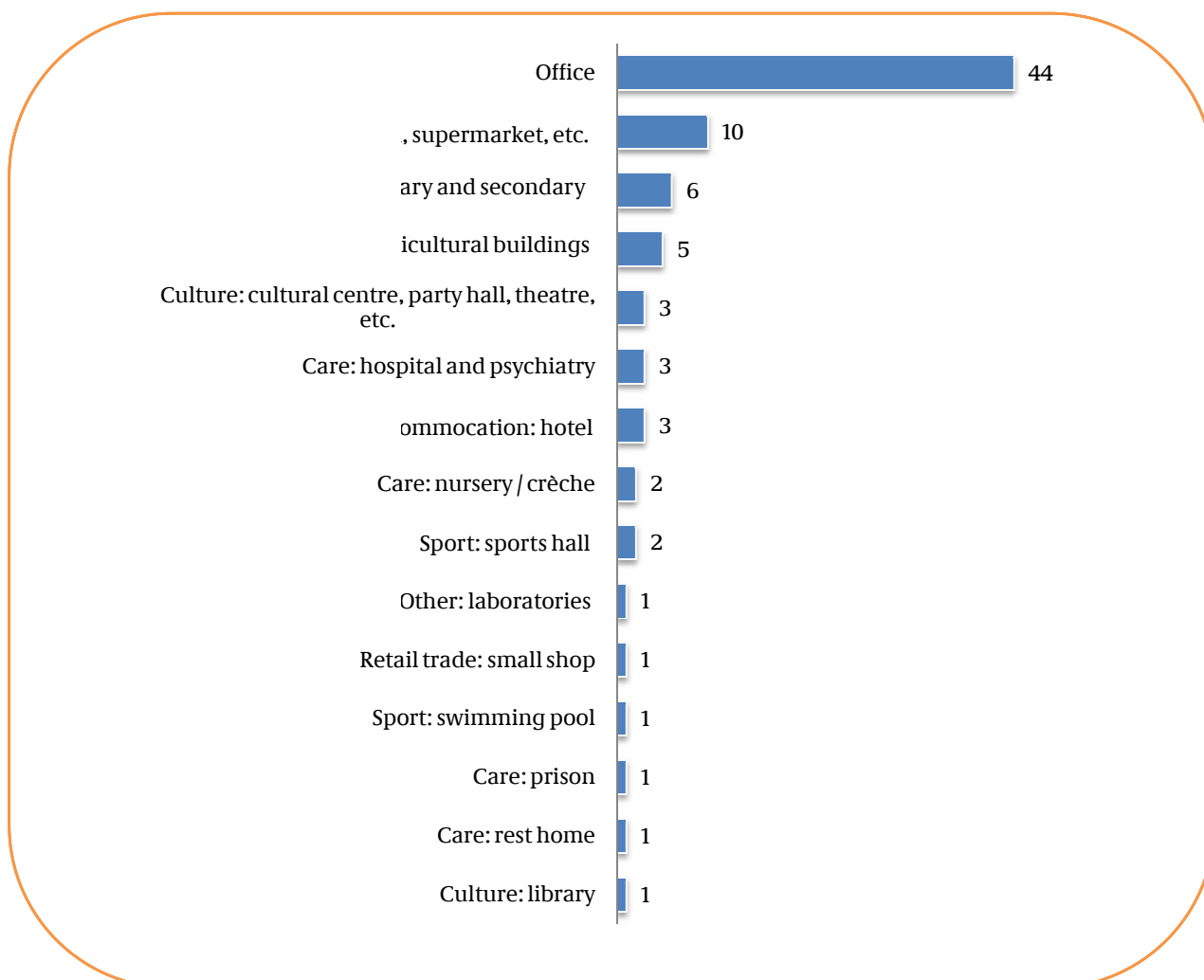


Fig. 28: Type of intervention in GreenBuilding<sup>Plus</sup> projects

In contrast, the buildings analysed were used for a wide range of purposes. Many GreenBuilding<sup>Plus</sup> buildings are offices or used for commercial purposes such as big or small shops, but other types of use are also well represented, including education and cultural buildings (schools, cultural centres, libraries etc.), care centres (hospitals, crèches etc.) and other types and sizes of buildings, such as hotel and accommodation structures, sport centres, laboratories and industrial buildings.



### 5.2.2 Energy savings measures and systems

During the application phase, potential Partners carry out an Energy Audit analysing the energy savings potential offered by their buildings, and identifying the technical disciplines with the greatest potential for economic and energy efficiency. The aim of this analysis is to encourage the participants to implement the various technical measures suggested in the Energy Audit. The evaluation report provides an overview of the energy measures executed under the scope of the GreenBuilding Programme. It also identifies the technical systems used to operate the buildings.

Energy efficiency improvements were applied to several technical fields and building subsystems. A large number of the improvements related to building envelopes and heating and cooling systems, but also to the improvement of energy management and lighting systems.

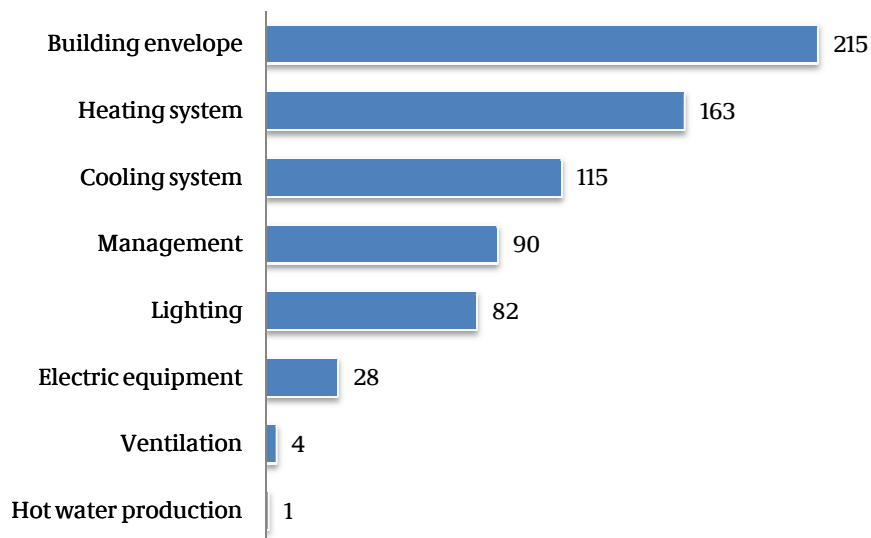


Fig. 30: Number of actions applied in each of the technical disciplines in all GreenBuilding<sup>Plus</sup> projects

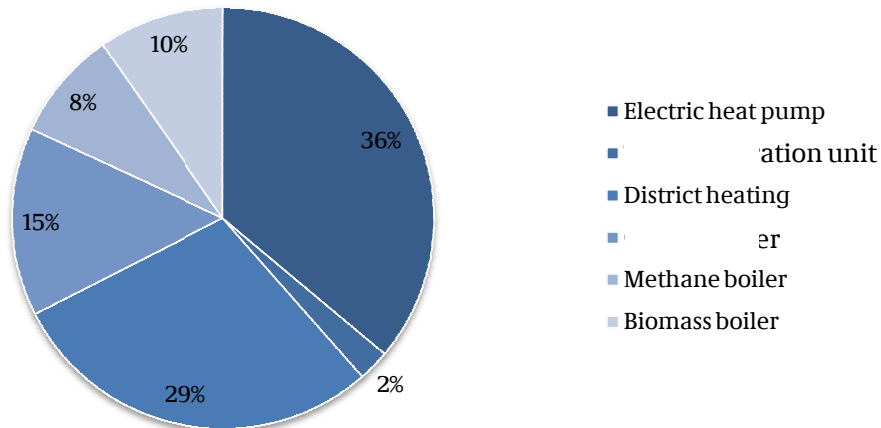
A large number of energy efficiency improvements were implemented, with a total of almost 700 actions declared by the GreenBuilding<sup>Plus</sup> Partners applied to the 85 buildings analysed. This means that on average, almost eight actions were implemented in each intervention. The GreenBuilding Partners thus clearly address a wide range of technical disciplines in order to improve their buildings and implement comprehensive measures in the various fields.

The section below assesses the systems used in the technical areas of heating, cooling and ventilation in the GreenBuilding Partner buildings. The data collected provides an overview of the technical options available for buildings in Europe and the products used.

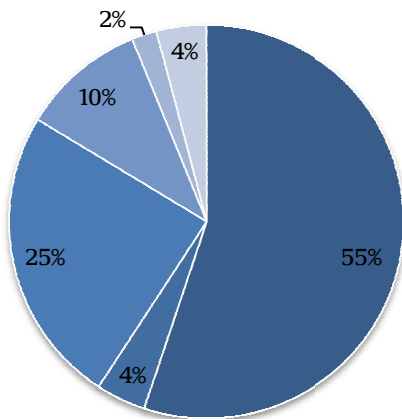
The heating systems used are mainly based on heat pumps and district heating, but energy sources such as gas, oil, methane and biomass are also employed. The type of system used differs greatly between new and refurbished buildings, with heat pumps and district heating providing the primary source of heat in new buildings, and a focus on districting heating and gas or oil boilers in refurbished buildings.



**ALL BUILDINGS** (data available for 83 of 85 buildings)



**NEW BUILDINGS**  
(49 buildings)



**REFURBISHED BUILDINGS**  
(34 buildings)

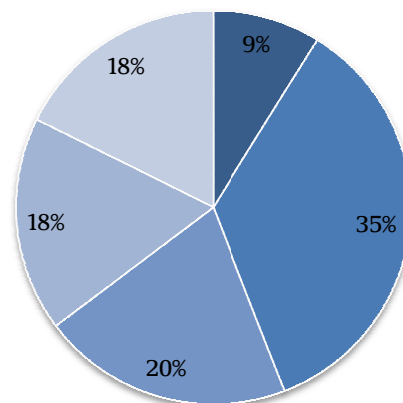


Fig. 31: Heating systems

These differences can be explained by the fact that it is often more expensive to convert to an alternative energy source in an existing building. In contrast, a heating system which offers the best energy and cost efficiency can be chosen when planning a new building.

While explicit data on heat production was received for a total of 83 buildings, data on cooling systems is only available for a total of 55 buildings. Some buildings have no active system for the generation of cooling and are cooled passively, while for other buildings no data of this type is available.

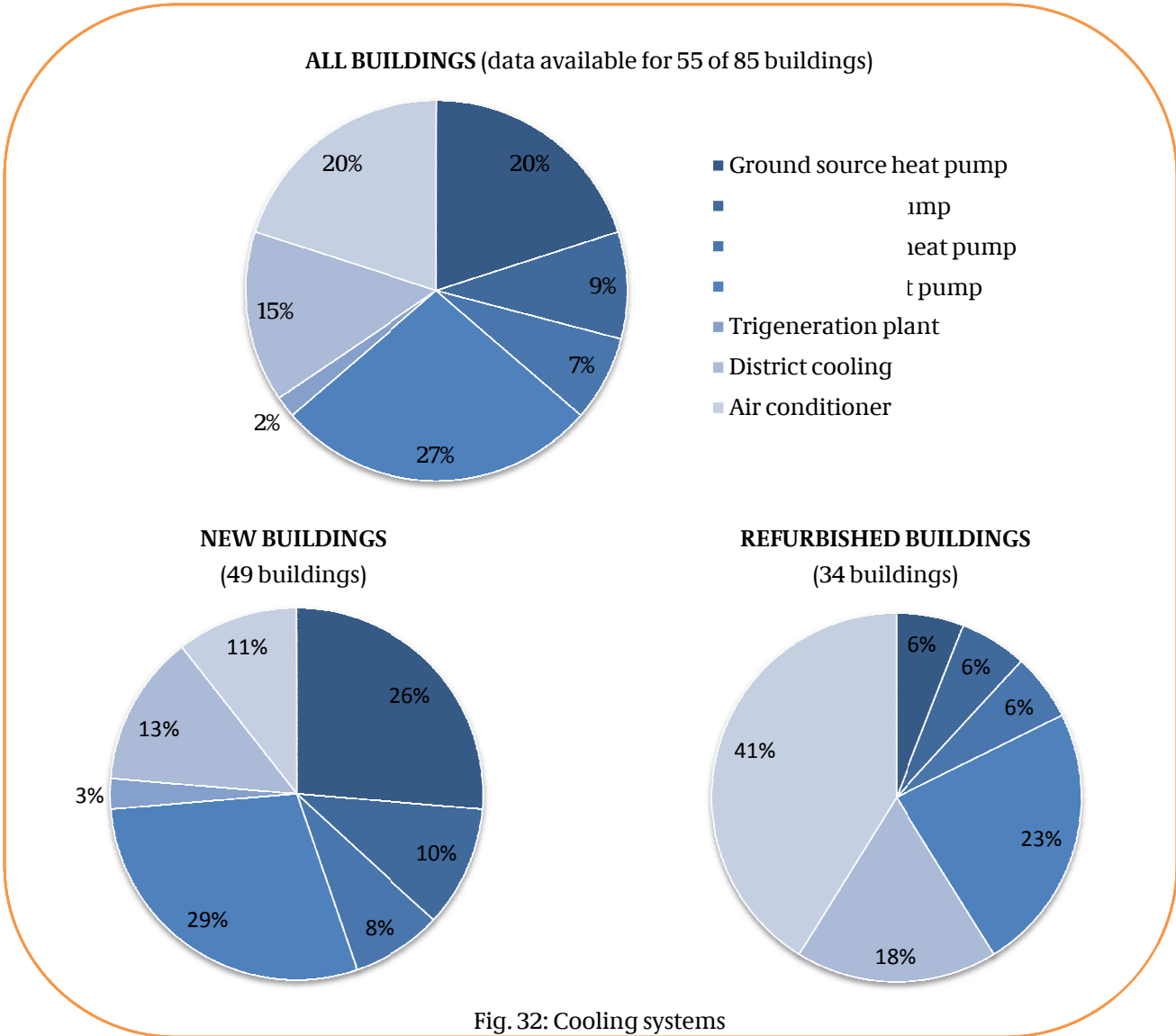


Fig. 32: Cooling systems

Here, too, there are differences in the technology used in a new or refurbished building. In contrast to new buildings, which focus mainly on ground source heat pumps, air-to-water heat pumps and air conditioners, the refurbished buildings mainly utilise air conditioners and air-to-water heat pumps.

45 of the 85 buildings installed a ventilation system to improve the indoor climate. These were mainly new buildings (35 of the 49 new buildings analysed), while only 10 refurbishments installed a ventilation system. The heat recovery of these systems differs greatly, varying between 45% and 92% and averaging out at 75%.



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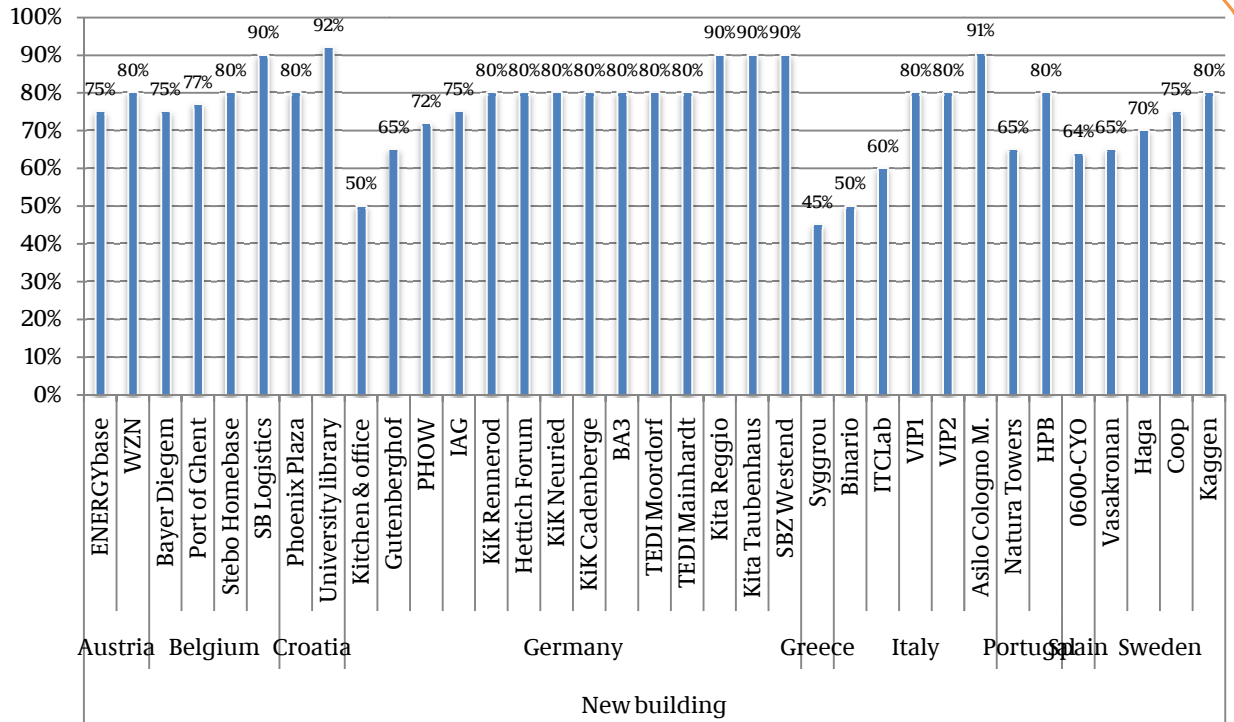


Fig. 34: Mechanical ventilation system: efficiency of heat recovery for each new building

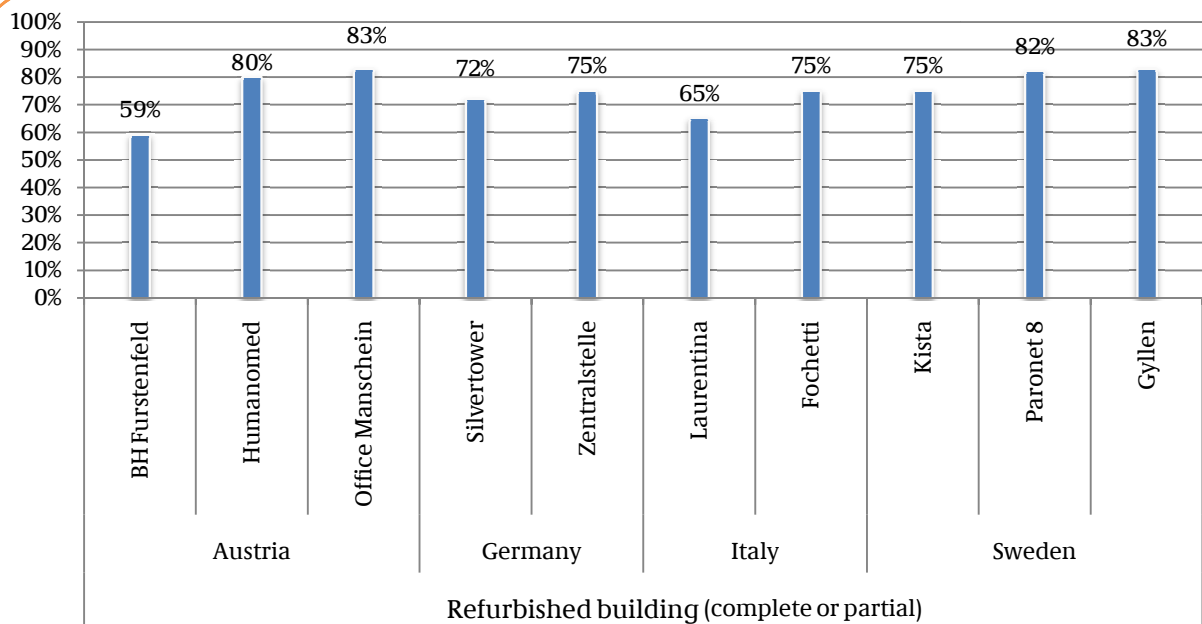


Fig. 33: Mechanical ventilation system: efficiency of heat recovery for each refurbished building





### 5.2.3 Building envelope

Comprehensive analyses of work on the building envelope were carried out in the evaluation of GreenBuilding<sup>Plus</sup>. The data collected provides an overview of the technical options available for buildings in Europe and the products used. It thus provides reference values for the status as regards building insulation and technical systems.

Several analyses are presented here by way of example. The full evaluation report is attached to this report as Annex E.

#### Average, minimum and maximum building envelope parameters for all countries

The average, minimum and maximum parameters for building envelopes, such as the thermal transmittance of individual components and of the whole shell or the surface area-to-volume (S/V) ratio are presented here for each country with a GreenBuilding<sup>Plus</sup> project. The charts below summarise the main features of the buildings, and important general information can be derived from them.

The charts consider all buildings irrespective of use, with new and refurbished buildings shown separately. The grey bar indicates the number of buildings with data available for this analysis.

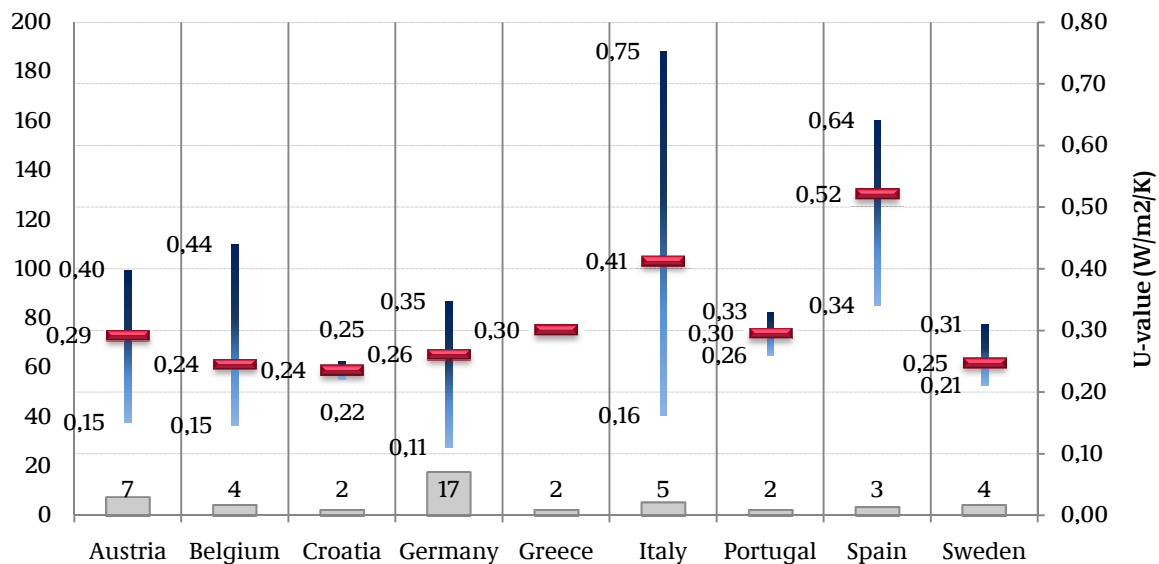


Fig. 35: Thermal transmittance (U-value) of external wall: min, max, average values  
- New buildings

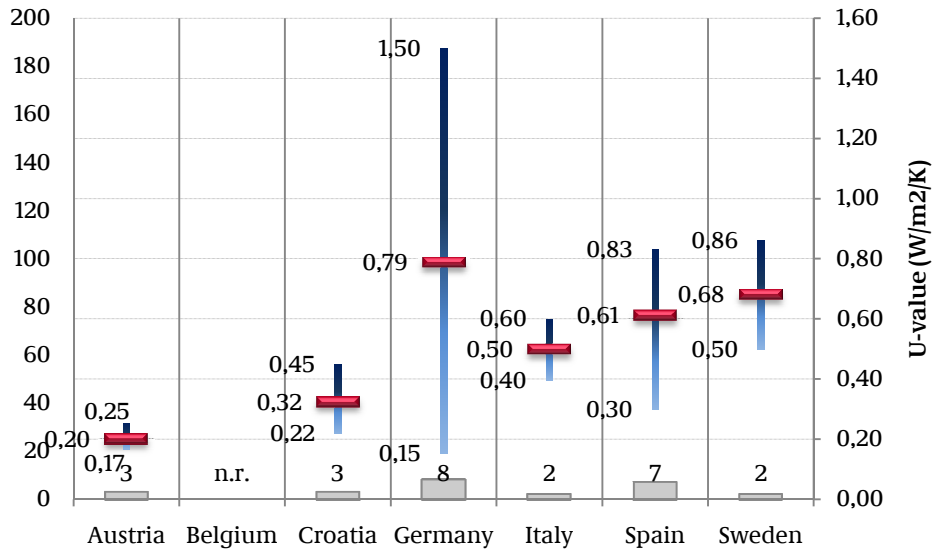
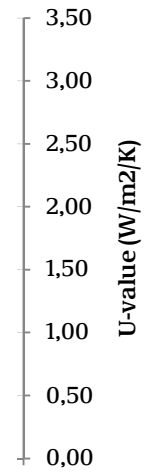


Fig. 36: Thermal transmittance (U-value) of external wall: min, max, average values - Refurbished buildings



ge values

- New buildings

GreenBuilding<sup>Plus</sup> – Leveraging the GreenBuilding Programme to promote energy efficiency and renewables in non-residential buildings



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### **Building envelope parameters for each building and country**

The main parameters of the building envelope are presented in detail for each building, both new and refurbished. This enables a complete and detailed technical description of the building envelope, i.e. the technical discipline in which the GreenBuilding<sup>Plus</sup> Partners applied the greatest number of energy efficiency improvements.

The parameters and analyses presented are:

- Thermal transmittance (U-value) of individual components
- Thermal transmittance of the complete building envelope
- Surface area-to-volume (S/V) ratio
- Important parameters related to transparent surfaces such as the solar heat gain coefficient and visible transmittance
- An interesting representation of the energy performance of the vertical building envelope, considering at the same time the thermal transmittance of the external wall and windows (average value) and the percentage of glazed area to total vertical external area
- A synthetic representation of the thermal features of all building envelopes and designs, considering the average thermal transmittance for all envelopes ( $h_t$ ) and designs (S/V ratio)

The charts consider all buildings irrespective of use. A continuous horizontal red line indicates the average value for the chart in question.



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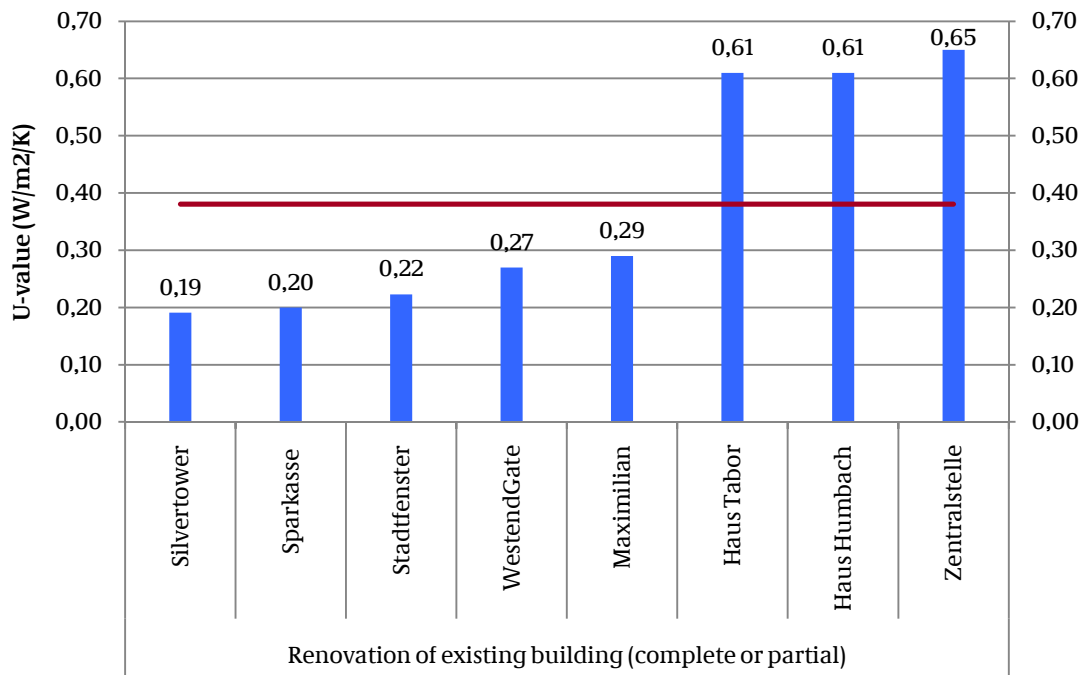
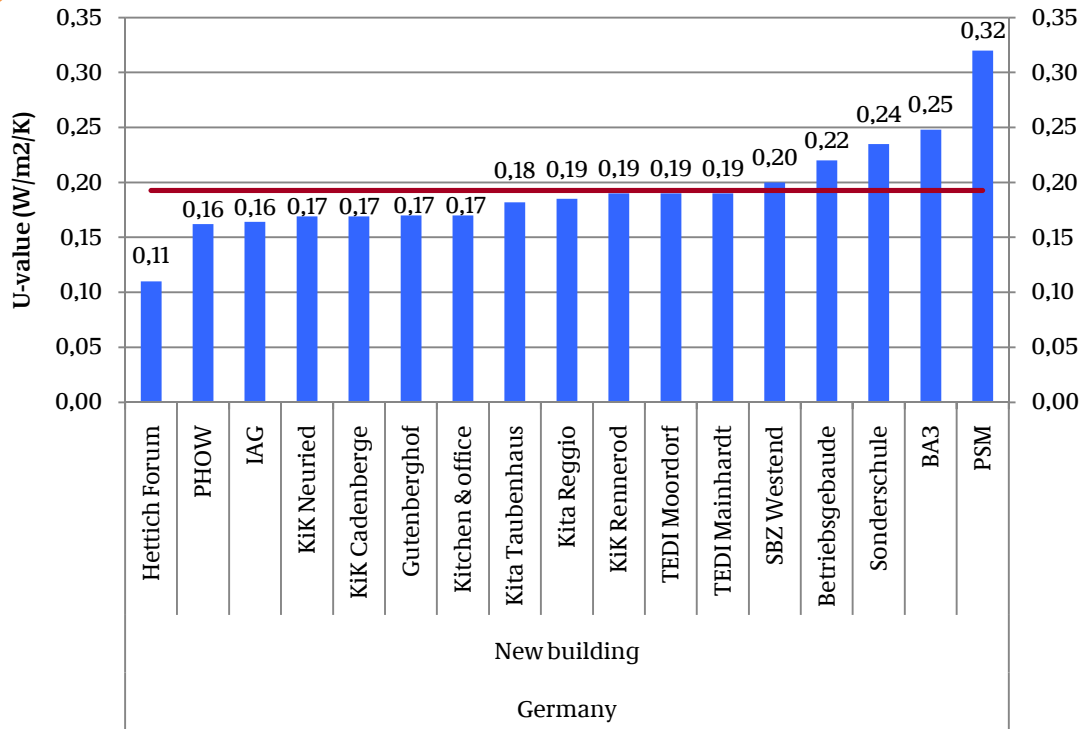


Fig. 38: Thermal transmittance (U-value) of external wall - GERMANY



# GreenBuilding

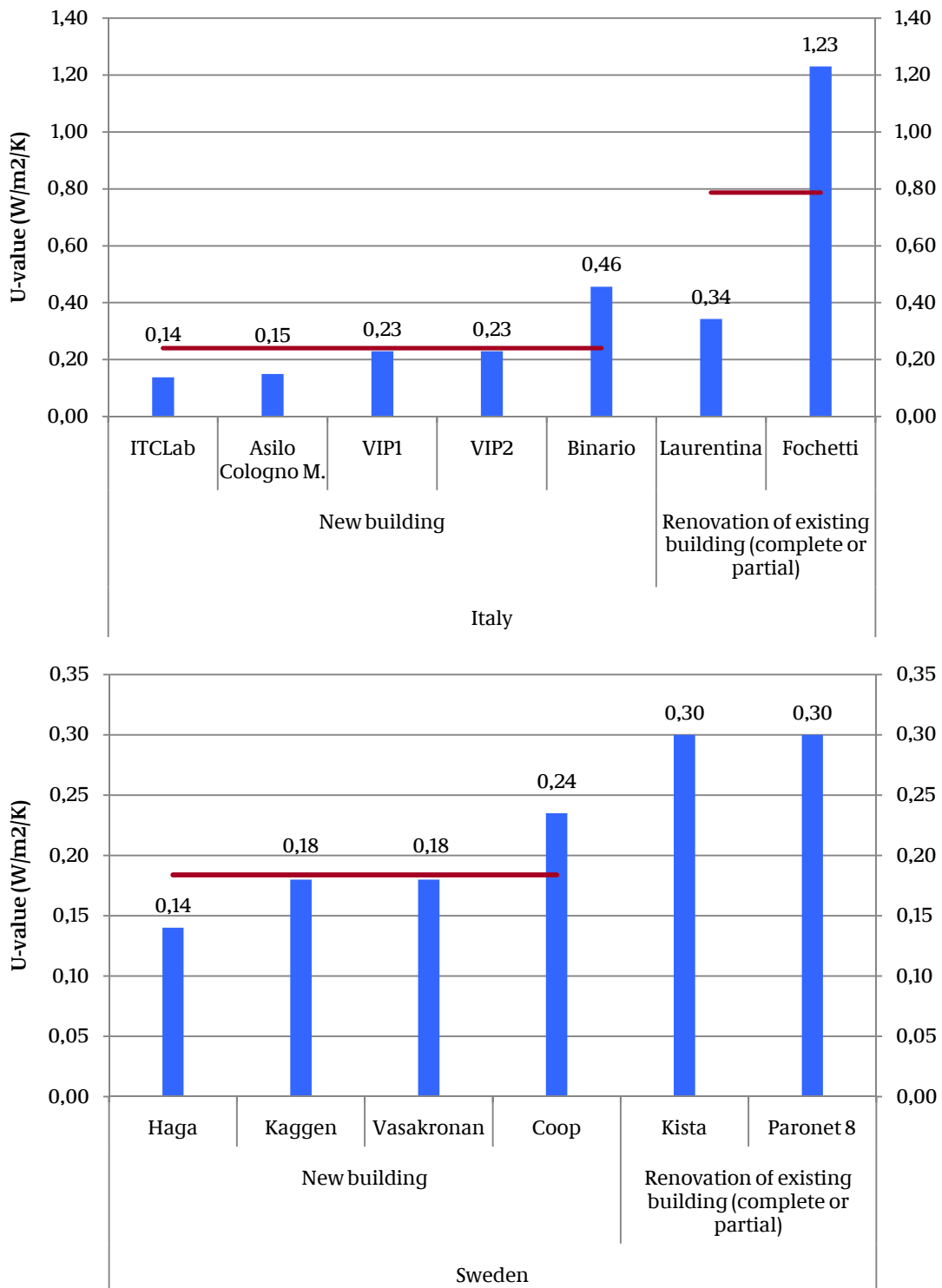


Fig. 39: Thermal transmittance (U-value) of external wall - ITALY and SWEDEN



# GreenBuilding

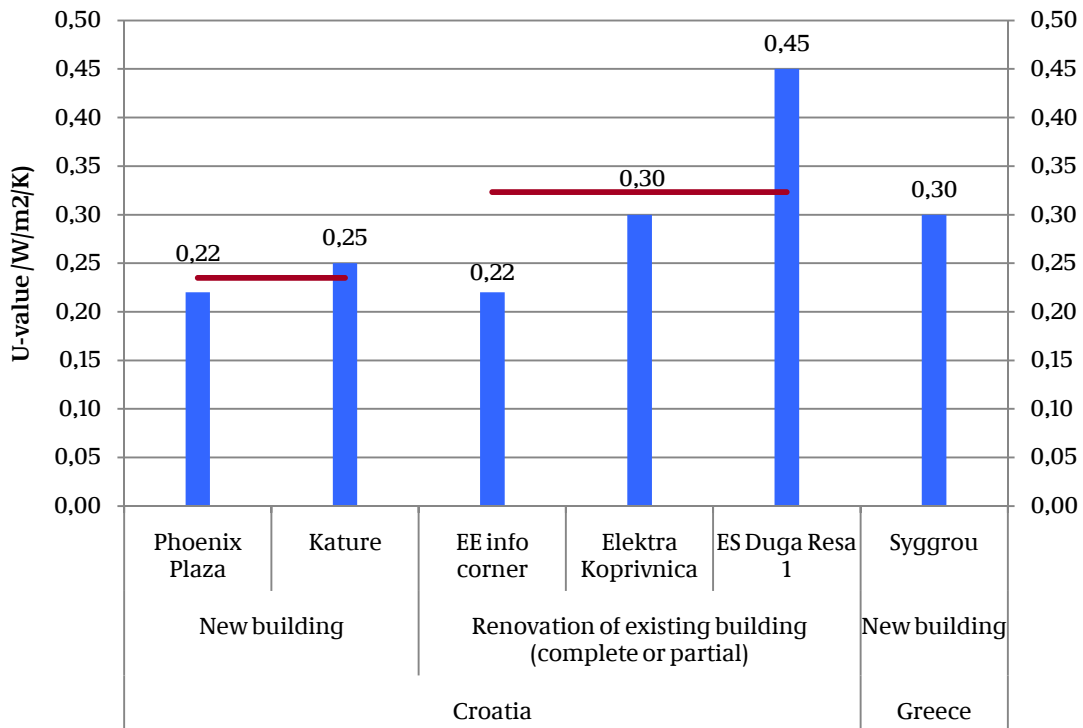
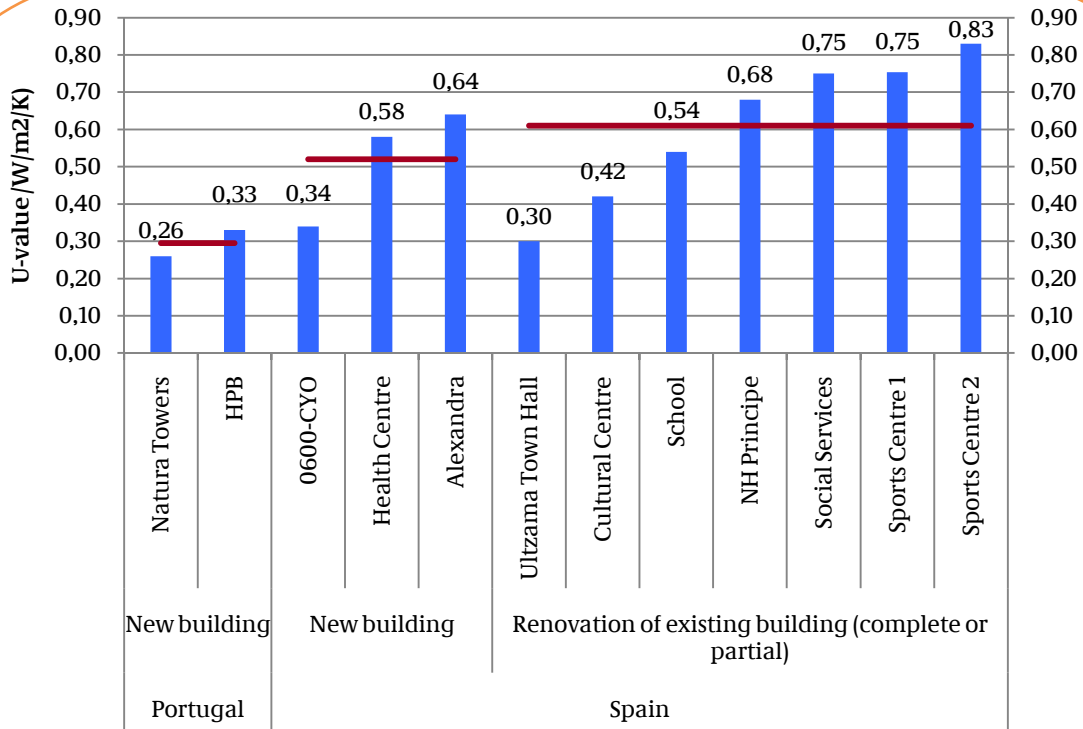


Fig. 40: Thermal transmittance (U-value) of external wall - PORTUGAL, SPAIN, CROATIA, GREECE



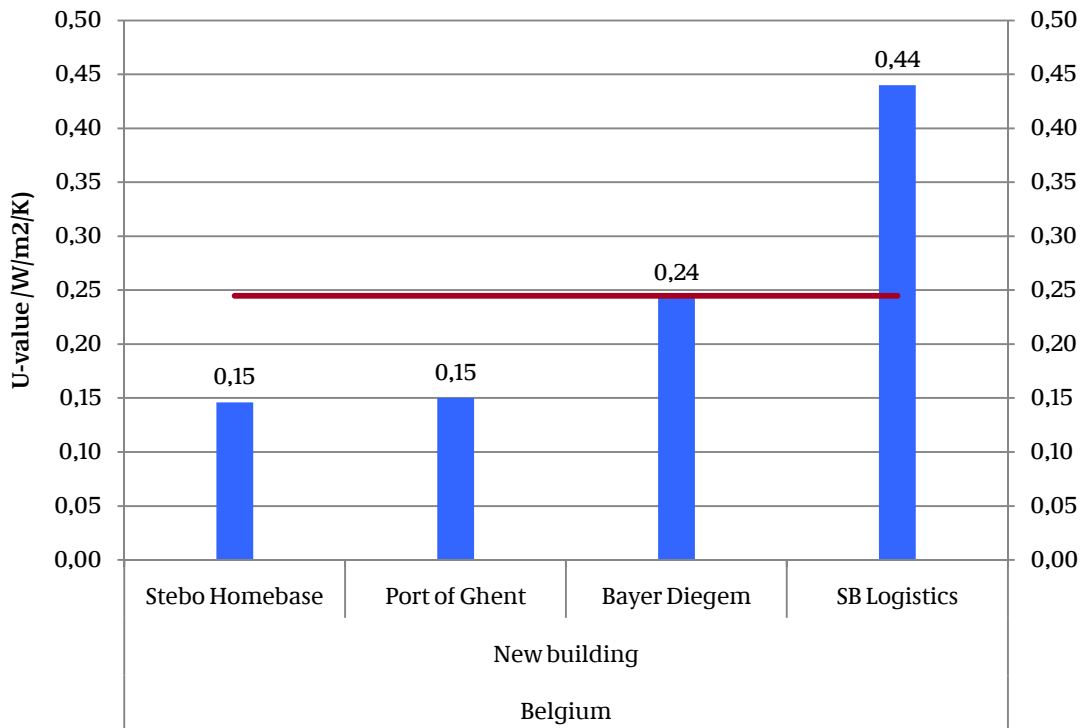
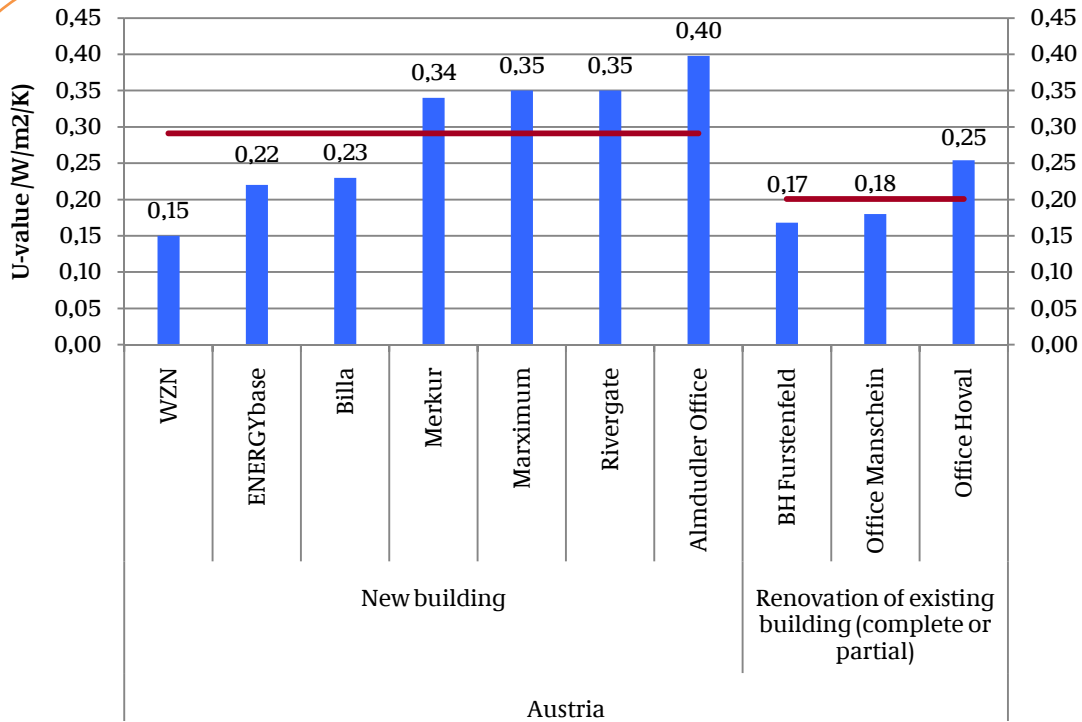


Fig. 41: Thermal transmittance (U-value) of external wall – AUSTRIA and BELGIUM



# GreenBuilding

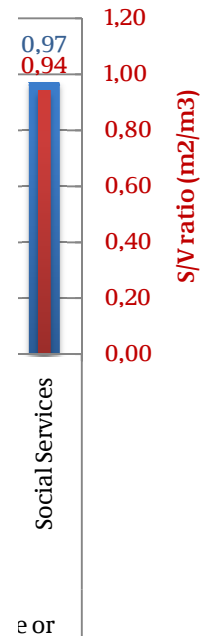
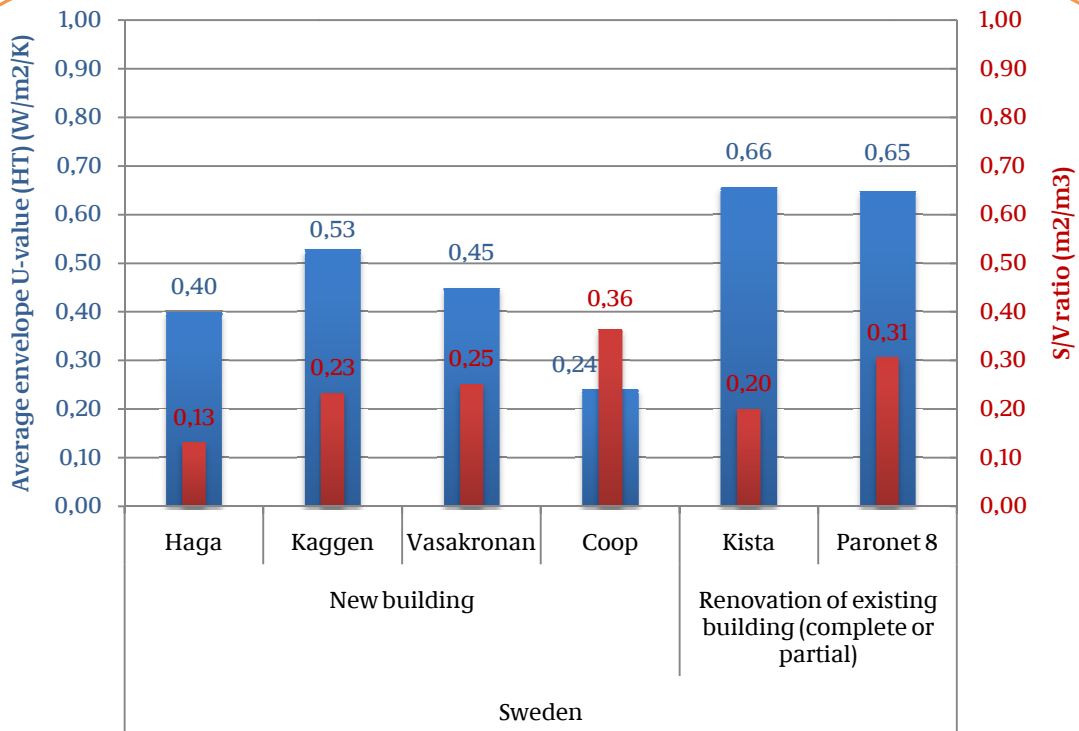


Fig. 42: Average value of thermal transmittance for all envelopes ( $h_t$ ) and S/V ratio - SWEDEN, PORTUGAL, SPAIN



### 5.2.4 Energy and CO<sub>2</sub> savings achieved

Total energy saving in the 85 buildings recorded in the database amount to about 115,000 MWh of primary energy per year. In order to appreciate the full impact of the GreenBuilding<sup>Plus</sup> Project, it is important to consider that the sample of 85 buildings with available data represents about 30% of all GreenBuilding projects to which energy efficiency improvements were applied.

The average percentage saving in primary energy consumption after GreenBuilding<sup>Plus</sup> interventions is 54% over all buildings, with 58% in new buildings and 42% in refurbishments. These savings percentages were calculated on the basis of statutory values for new buildings and consumption before intervention for refurbishments. The average values were calculated by the weighted average net floor area of the buildings to account for the differing calculation bases in the various buildings.

The savings percentages reported also include contributions from installed renewable energy systems.

PERCENTAGE SAVINGS in primary energy consumption after GreenBuilding <sup>Plus</sup> (area weighted averages)		
All buildings	Refurbished buildings	New buildings
<b>54%</b>	<b>42%</b>	<b>58%</b>

Table 16: Percentage savings in primary energy consumption after GreenBuilding<sup>Plus</sup>

On average, the savings made under the GreenBuilding Programme are much higher than the 25% required. This minimum level was, of course, satisfied by all buildings, but as can be seen, many of them achieved much higher savings. Some buildings in particular excelled with very high savings of almost 90% or 95%, with energy performances similar to what is required in the best low energy houses standards in Europe. There were some very high extremes, such as a high performance office in Germany an office and industrial group of buildings in Italy and a cultural building in Spain.

Generally speaking, new buildings achieve higher savings than refurbished ones, particularly where maximum and average values are concerned, but good results were also obtained in refurbishment projects.

The percentage of savings obtained in the GreenBuilding<sup>Plus</sup> Project is higher than what was achieved in the GreenBuilding pilot phase, where savings amounted to 34% for all buildings, with 33% for refurbished buildings and 40% for new buildings.<sup>(13)</sup>

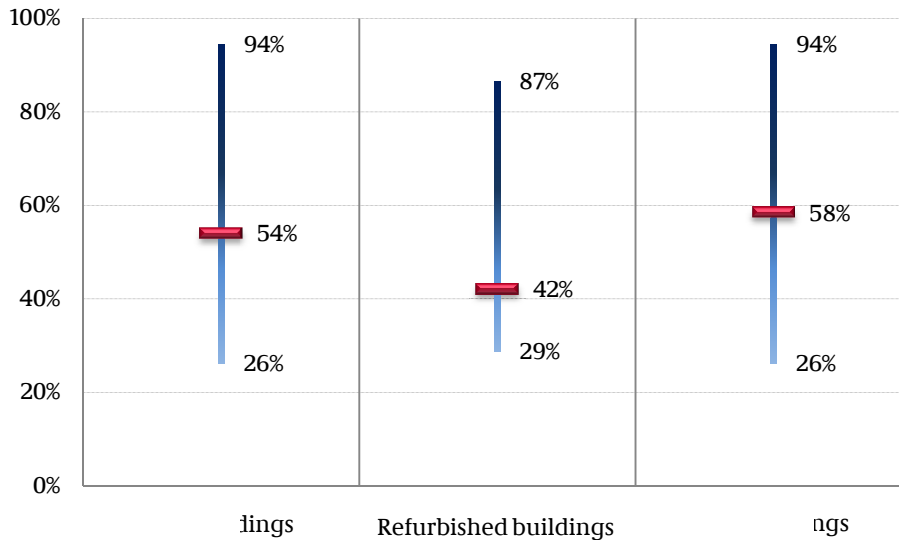


Fig. 43: Percentage savings in primary energy consumption after GreenBuilding<sup>Plus</sup> (minimum, maximum and area weighted averages)

The charts below show the maximum, minimum and area weighted average savings in total primary energy consumption for all countries with GreenBuilding<sup>Plus</sup> Partners, with contributions from renewables already included. The charts consider all buildings irrespective of use, and the grey bar shows the number of buildings with data available for this analysis (in some cases not all data necessary to calculate these parameters was available).

It can be seen that the total primary energy consumption of many buildings is lower than 100 kWh/m<sup>2</sup>/a and for the majority of buildings lower than 200 kWh/m<sup>2</sup>/a. This indicates that the energy performance of GreenBuilding Partner buildings is good, comparable even with the energy efficiency and consumption levels specified in definitive energy standards for non-residential buildings. For example, buildings monitored under the EnOB (Energy Optimised Building) research project developed in Germany may generally not exceed 100 kWh/m<sup>2</sup>/a primary energy consumption for heating, ventilation, cooling, lighting (HVACL), with electric equipment and other uses excluded<sup>(14)</sup>, while total primary energy consumption in the buildings presented under GreenBuilding<sup>Plus</sup> relates to all end uses.

Some of the buildings show very high performances, with two of them returning negative values of total primary energy, which would suggest that the building itself produces a certain amount of energy. The buildings in question are a high performance office building in Germany and a cultural building in Spain. These highly interesting examples should be analysed to a greater degree for a better understanding of their features. Attention should also be given to the verification of the calculation and metering methods applied to these high performances buildings.



# GreenBuilding

In contrast, some of the GreenBuilding<sup>Plus</sup> projects returned high total primary energy consumption values. Five of these from the total of 85 have values higher than 500 kWh/m<sup>2</sup>/a. These are buildings with special uses, such as industrial, agricultural, retail and commercial buildings that might have high energy consumption levels for electric equipment and lighting or other industrial or commercial activities. It is also possible that energy consumption for some end uses is high because no statutory restrictions apply in the relevant country.

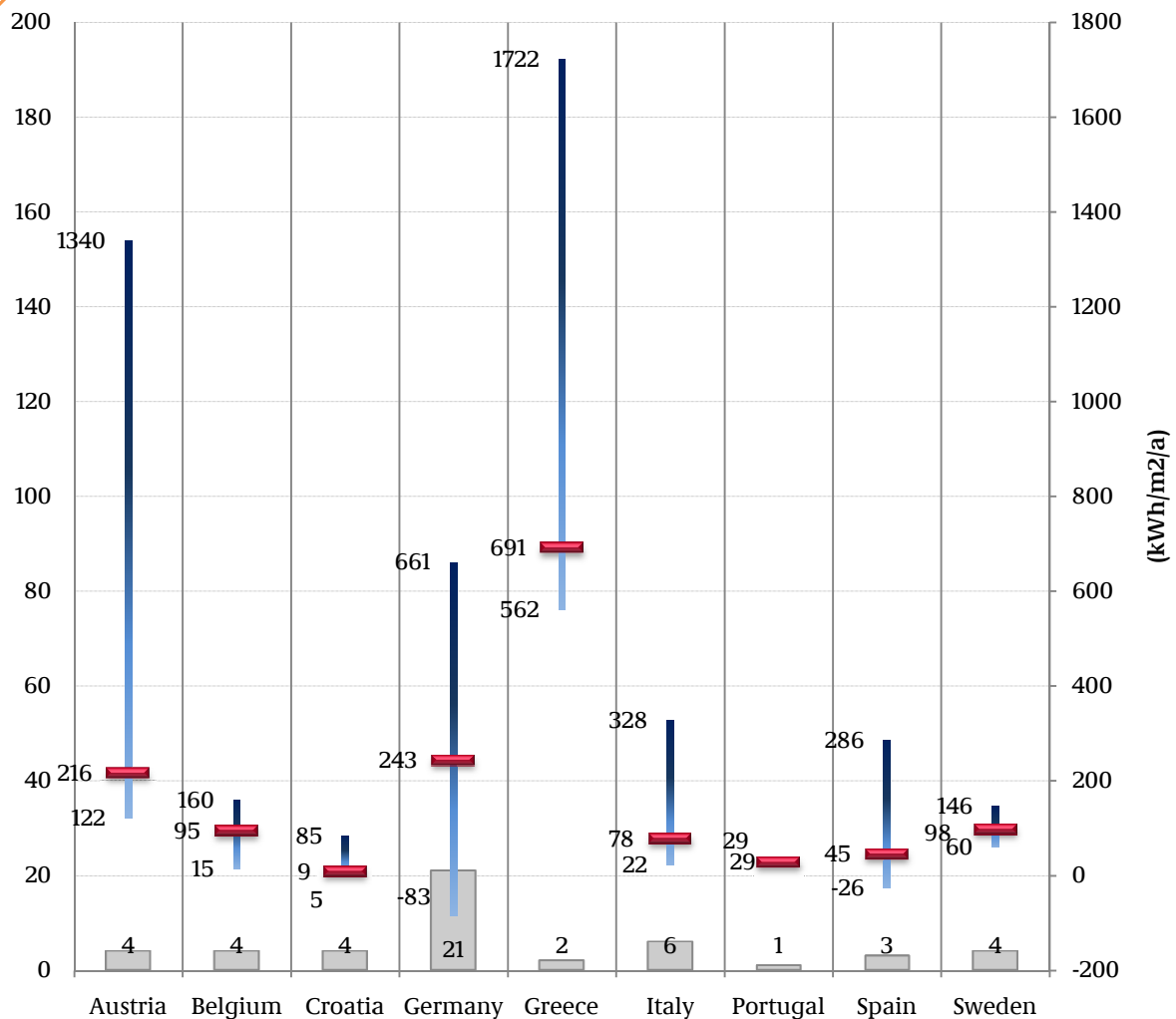


Fig. 44: Total primary energy consumption with renewables [kWh/m<sup>2</sup>/a]  
- All buildings



The chart below shows only the results for office buildings, and the data is thus less variable. Generally speaking, total primary energy consumption is close to 100 kWh/m<sup>2</sup>/a, for all buildings except for a Greek refurbishment which had very high energy consumptions before GreenBuilding intervention. This illustrates the excellent quality in energy performance returned by GreenBuilding<sup>Plus</sup> office buildings. It is also important to note that the use of buildings for offices is the most prevalent use under GreenBuilding<sup>Plus</sup>.

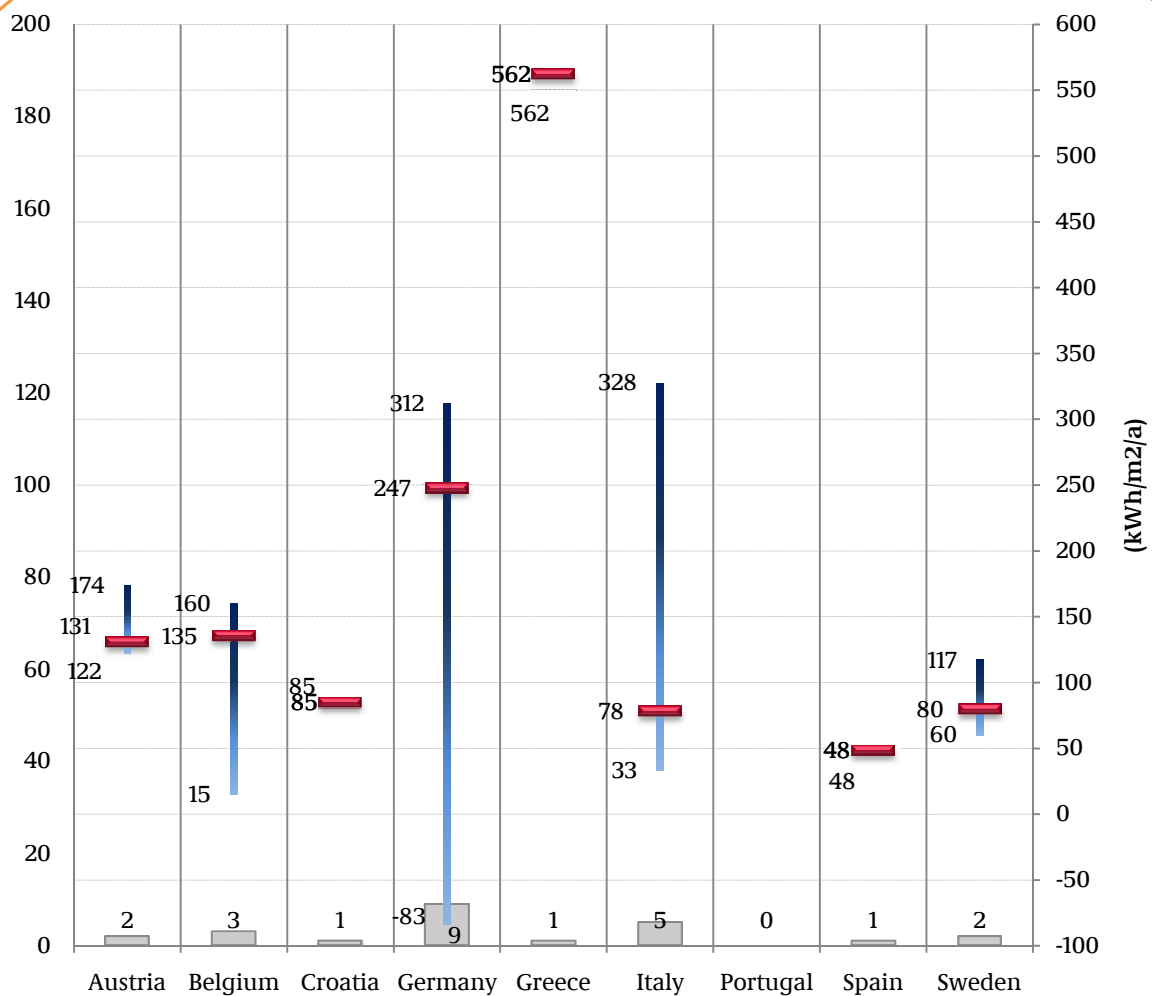


Fig. 45: Total primary energy consumption with renewables [kWh/m<sup>2</sup> /a]  
 - Office buildings after GreenBuilding<sup>Plus</sup> interventions (maximum, minimum and area weighted averages for all countries)



### 5.2.5 Cost analysis

Details of extra costs are also available for some of the GreenBuilding projects. This data relates to the extra costs incurred by the Partners to realise the interventions on their buildings, allowing them to become GreenBuilding Partners. Figure 46 below shows the systems on which the Partners concentrated their investment in order to achieve the GreenBuilding Programme objectives.

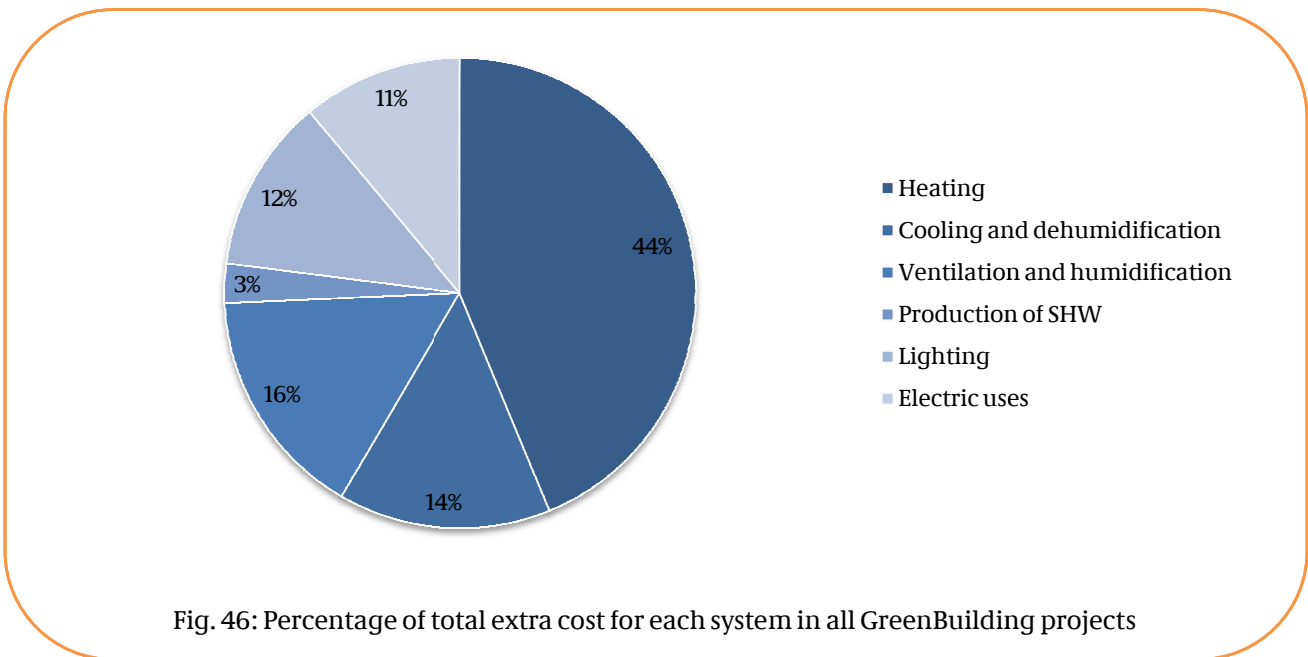


Fig. 46: Percentage of total extra cost for each system in all GreenBuilding projects

The extra cost for each of the systems in the buildings for which such data was provided is presented for office buildings and retail buildings (e.g. shopping malls and supermarkets), and also shown as a total. The charts below show the total cost of extra investment, broken down into the relevant systems.





# GreenBuilding

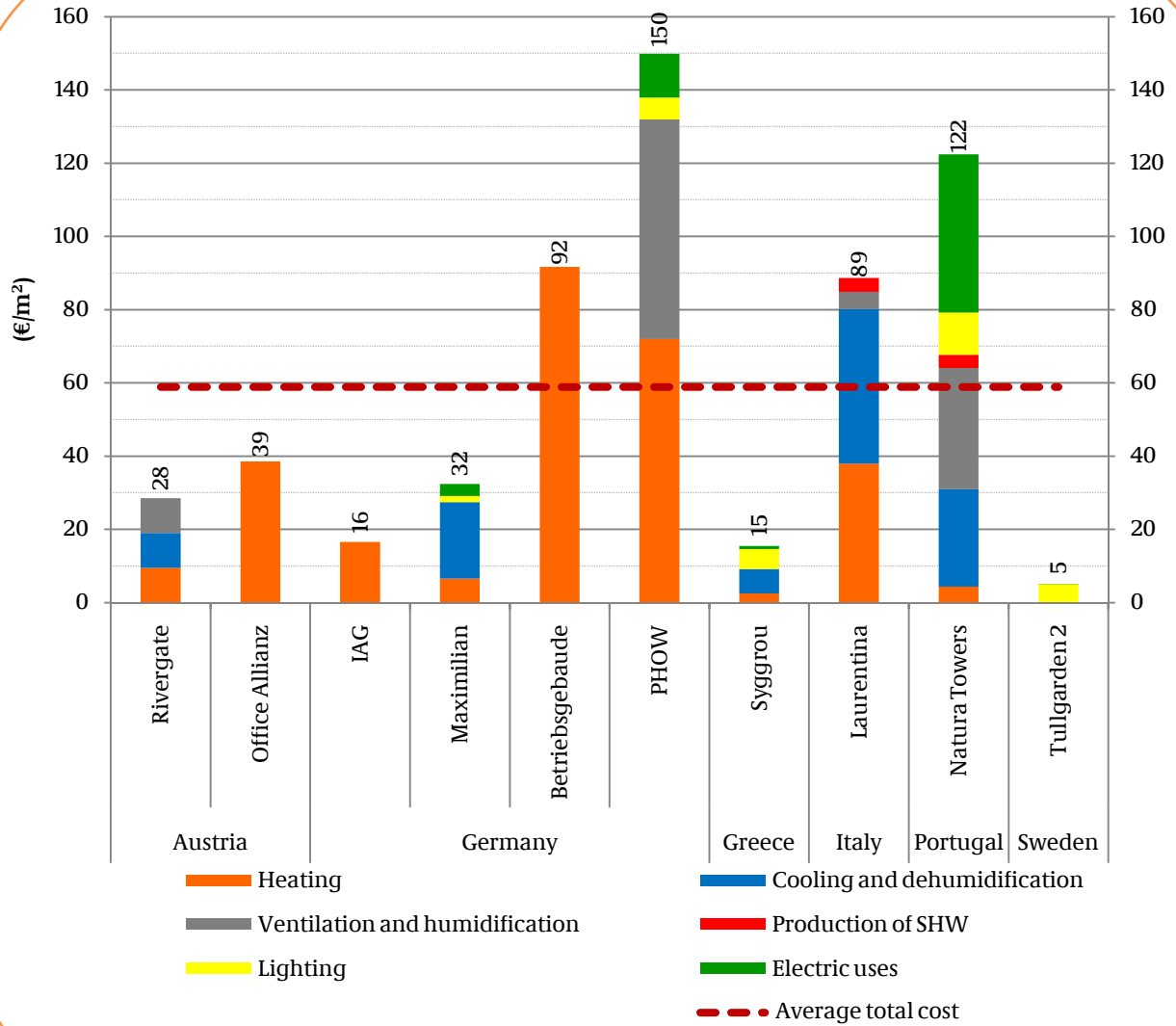


Fig. 47: Extra cost of investment [€/m<sup>2</sup>] for office buildings

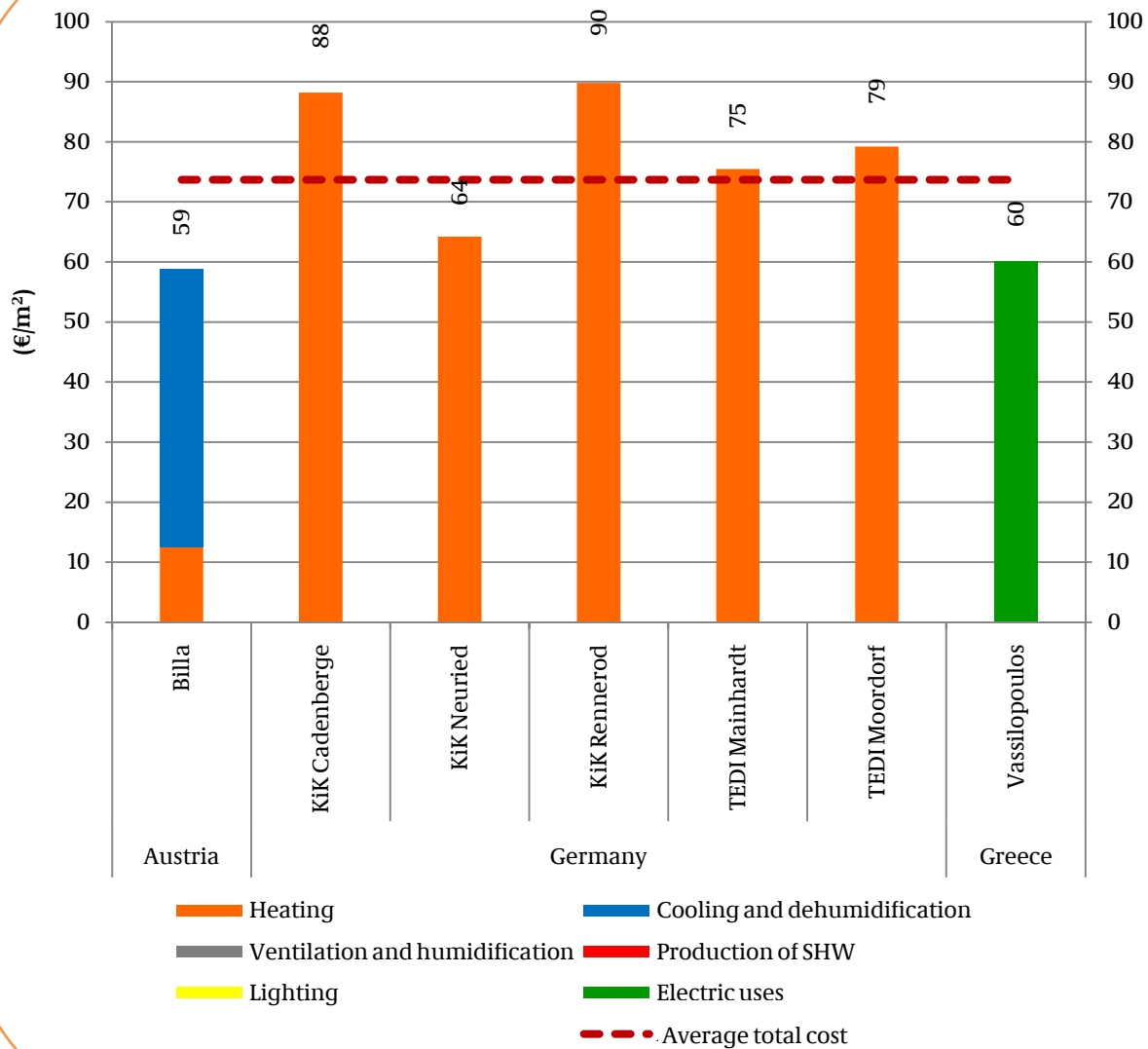


Fig. 48: Extra cost of investment [€/m<sup>2</sup>] for retail buildings

In many cases, savings higher than 50% were achieved. The actions thus proved to be cost effective for the building owners who invested in an energy efficiency retrofit or in the case of new buildings in additional energy efficiency features.



### 5.2.6 Climate conditions

Climate conditions are important in an evaluation of energy performance and the key features of a building. The main climate and geographical data provided by GreenBuilding Partners is therefore provided in the report.

The charts below show the values of degree days for heating and for cooling, and of altitude and latitude. Minimum, maximum and average values in each country were given for all buildings in the database. These parameters give information as to the severity of climate conditions for heating and cooling in buildings, and about the solar path in general.

The degree days for heating and cooling were calculated on a base temperature of 18°C.

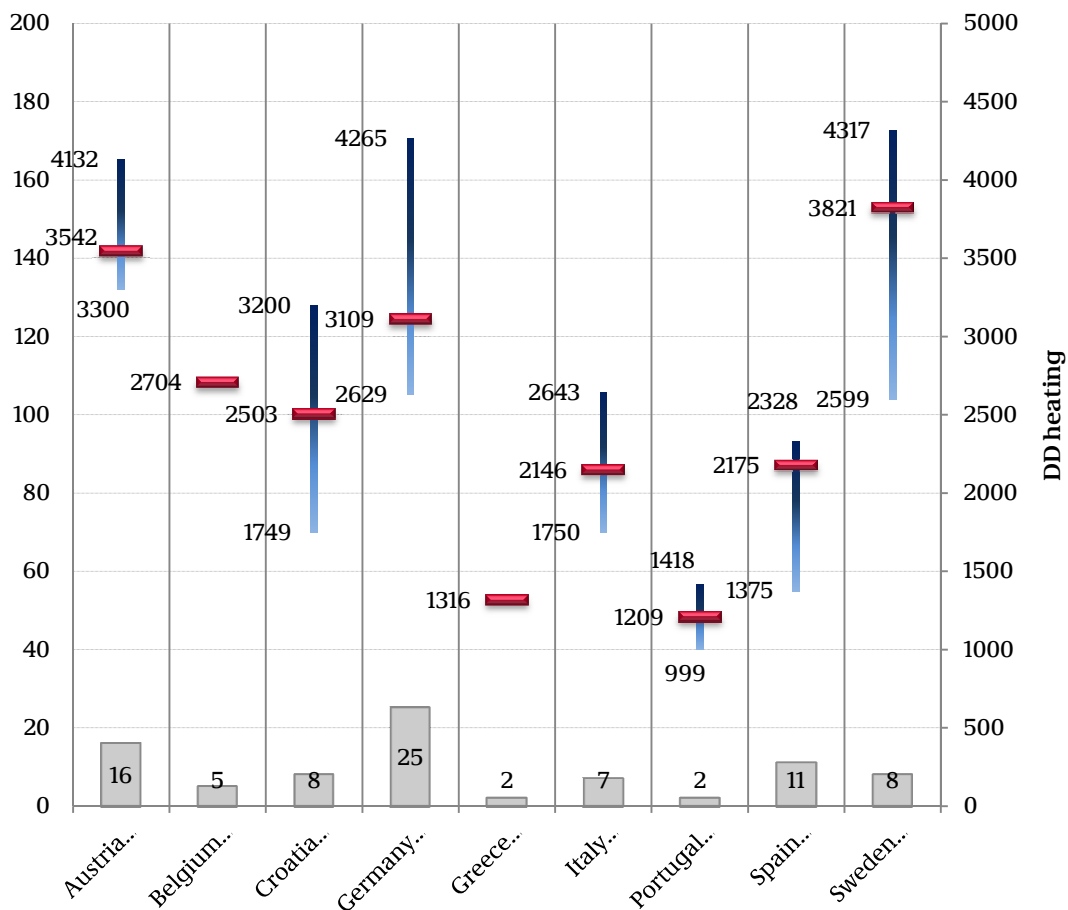


Fig. 49: Heating degree days (DD heating), latitude and altitude: min, max, average values - All buildings

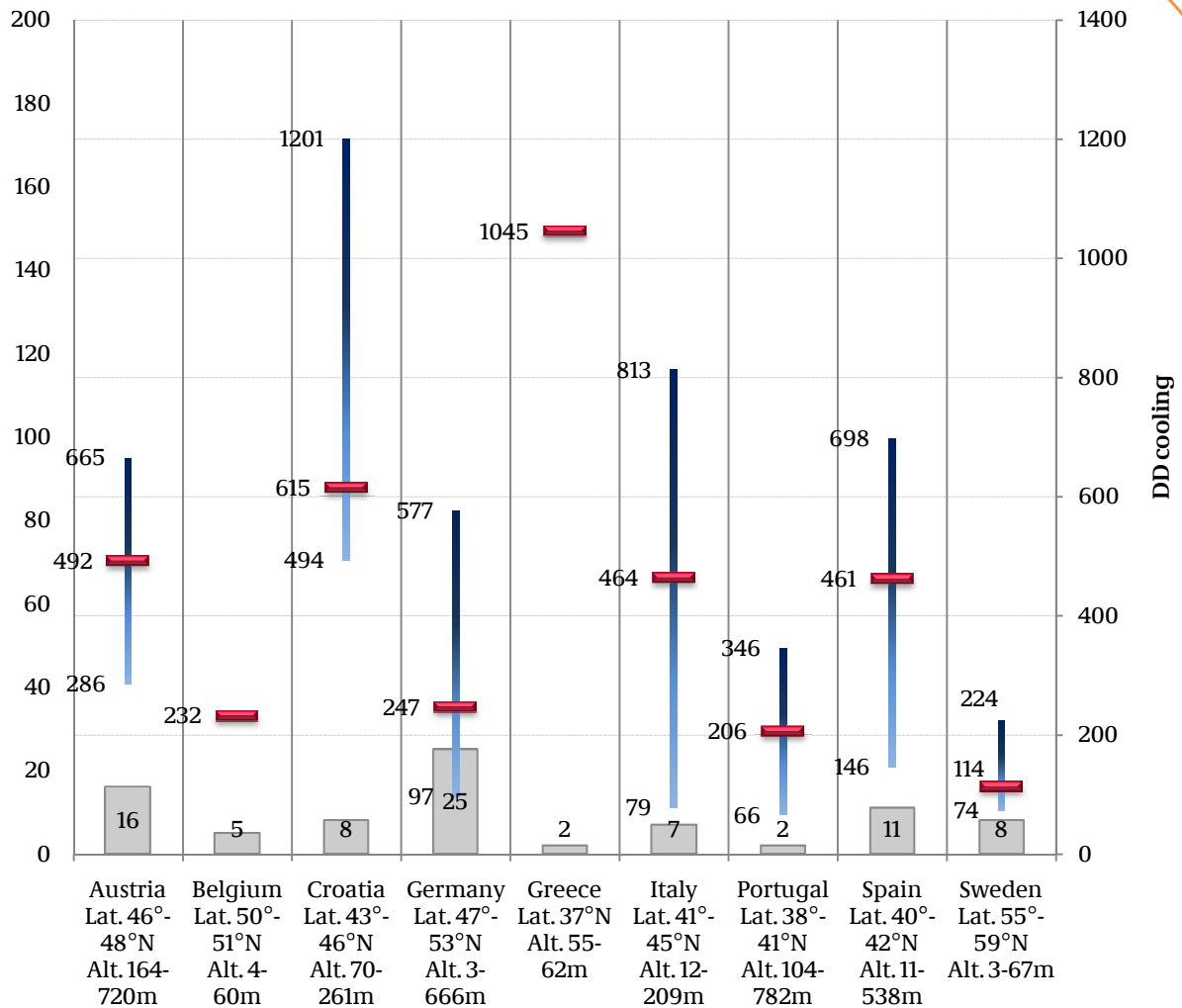


Fig. 50: Cooling degree days (DD cooling), latitude and altitude: min, max, average values - All buildings

### 5.3 Main results

At an average of eight actions affecting a variety of technical disciplines in each building, it becomes clear that energy efficiency measures need to affect the whole building if a high standard is to be achieved. The building envelope, the heating and cooling systems, the lighting and energy management all play a role.

At an average of over 50%, energy savings were more than twice the level of 25% required under GreenBuilding. This shows that great energy efficiency potential exists and that this potential can be captured in a cost-efficient fashion.

GreenBuilding<sup>Plus</sup> – Leveraging the GreenBuilding Programme to promote energy efficiency and renewables in non-residential buildings



The values given for the technical features of some systems components could also be considered benchmark figures in these fields, although a differentiation should be made between new and refurbished buildings where the use of technical systems is concerned. The options for energy-efficient technologies open to a new building are much more flexible than those for a refurbishment, where the basic structures related to building envelope and technical installations already exist, and can only be altered at great expense.

## 6 Achievements of the action project and lessons learnt

A total of 160 GreenBuilding Partners, 320 buildings and 68 Endorsers took part in the programme during the project period. As a result, the GreenBuilding Programme was able to achieve an excellent market presence in the European countries participating in GreenBuilding<sup>Plus</sup>.

The aim of the GreenBuilding<sup>Plus</sup> Project was to increase awareness for the significance of energy efficiency in non-residential buildings and this was achieved by awarding organisations particularly committed to this aim with the GreenBuilding Partner or Endorser status. The broad-based dissemination activities, and awards to selected Partners proved successful in achieving a wide media and market awareness of the subject of energy efficiency.

The optimisation of the existing project infrastructure created a platform offering services and technical assistance in the implementation of energy efficiency measures. The resulting network forms a pool of knowledge and expertise which provides both motivation and easy access to expert know-how.

The pan-European communication measures during the project were an effective incentive to participate in the programme for many Partners and Endorsers. This not only aided the transfer of knowledge, but also ensured uniform application processes throughout Europe for internationally active participants.

GreenBuilding<sup>Plus</sup> saw the successful development and establishment of a joint Data Collection Tool. Energy and technical parameters were determined on the basis of European Norm EN 15603, and taking into account existing national standards and laws, the aim being to make the key energy data for the buildings available in a harmonised form for the whole of Europe. Certain difficulties were experienced in the development of a uniform tool due to the diversity of the data, accounting standards and national standards and regulations. Each country has different requirements with respect to final and primary energy consumption, and finding suitable levels for the harmonised collection tool involved considerable ingenuity. The great advantage of this standardisation, however, is that it enables the comparison of projects no matter where they are in Europe. The lessons learnt in the project will be helpful in the ongoing development of standards and accounting at a European level.

During the project it became clear that considerable regional differences still exist in the way the energy efficiency markets are developing in each country. In some countries the number of Partners and Endorsers rose continuously, while in others it was extremely difficult to establish the programme and its objectives. There are a variety of reasons for this:



- The economic crisis has had a not inconsiderable impact, leading as it has to fewer investments in the property market, or to the postponement of ambitious building projects.
- Energy prices have fallen in some places over the last few years, and organisations therefore lack an economic incentive to invest in energy efficiency and justify the additional cost to their investors. Even if such investment is economically feasible in the long term, and despite the fact that energy prices are expected to rise, this factor can be a great barrier to implementation.
- The market benefits accruing to partners from participation in the programme lies first and foremost in the high-profile public presentation of their pioneering role in the field of energy efficiency. The motivation to participate therefore varies considerably from country to country, depending on how firmly entrenched the issue is in society.

GreenBuilding is successful in those countries whose market for energy efficiency is well developed and whose market players can therefore be involved with ease in the programme. On the other hand, the growing number of Partners in all countries involved is an indication that the programme gathers momentum as soon as the first Partner becomes involved, snowballing to attract increasing interest.

The transfer of knowledge regarding the building and refurbishment of non-residential buildings with a view to energy efficiency is a particularly important aspect of the programme. This is very easy with structures which have similar characteristics, such as office buildings, as the building services are highly standardised and the necessary expertise is readily available. The good practice projects of the GreenBuilding Partners are particularly suited to replication in buildings as similar as these, simplifying the planning and implementation of the relevant building measures. The technical and non-technical modules provided under GreenBuilding provide additional support in this respect.

The GreenBuilding Programme and the GreenBuilding<sup>Plus</sup> Project have demonstrated for non-residential buildings that a transfer of knowledge and publicity measures can overcome market barriers which prevent investment in energy efficiency.

## 7 Outlook

The GreenBuilding<sup>Plus</sup> Project ended on 31 May 2010. The GreenBuilding Programme continues to exist under the auspices of the European Commission and the supervision of Paolo Bertoldi of the DG Joint Research Centre.

The successful implementation of the GreenBuilding<sup>Plus</sup> Project has resulted in plans for a further project supporting the GreenBuilding Programme. Most of the National Contact Points supporting the GreenBuilding<sup>Plus</sup> Project will also join the next project.

The European Commission's climate goals make it imperative that we capture the enormous energy savings potential inherent in non-residential buildings. The initiation by the European Commission of the

GreenBuilding<sup>Plus</sup> – Leveraging the GreenBuilding Programme to promote energy efficiency and renewables in non-residential buildings



GreenBuilding Programme in 2005 to encourage investment in energy efficiency was an important milestone in this respect.

If the rate of implementation is to be increased in the years to come, more attention should be paid to the existing building stock. An analysis of the programme data shows that sound planning and implementation can enable primary energy savings of an average of 42% in a refurbishment. The technologies necessary for this are available on today's market throughout Europe, and future programme amendments should therefore consider an increase in the levels required. This could take the form either of an additional requirement covering for example final energy levels, or a tightening of the primary energy requirements.

A further aspect which should be given more attention in future is an extension of the know-how transfer. A knowledge network was built up and established during GreenBuilding<sup>Plus</sup> which provides an introduction to the refurbishment or construction of a building under energy efficiency aspects and provides information on the relevant experts. The many queries received during the programme are an indication of the need which exists for more expert information.





## Annex

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GreenBuilding<sup>Plus</sup> – Leveraging the GreenBuilding Programme to promote energy efficiency and renewables in non-residential buildings



**GreenBuilding**

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