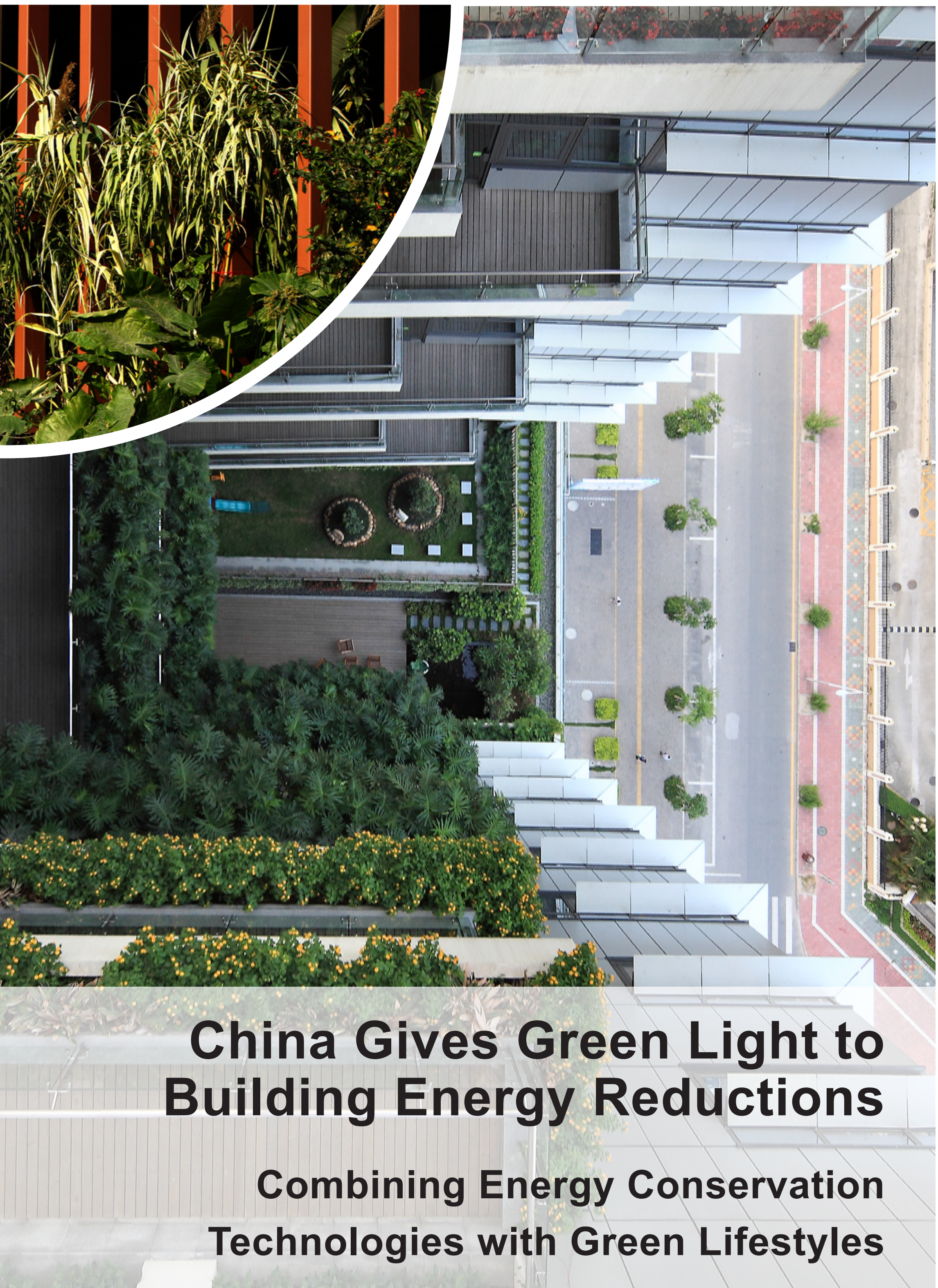
International Energy Agency

Energy Conservation in Buildings & Community Systems

www.ecbcs.org

ECBCS News June 2012 - Issue 55



China Gives Green Light to Building Energy Reductions

Combining Energy Conservation Technologies with Green Lifestyles

China Gives Green Light to Building Energy Reductions

Combining Energy Conservation Technologies with Green Lifestyles

Yi Jiang, ECBCS Executive Committee Member for China

Introduction

Building energy conservation has been one of the fundamental policies of China for the last 25 years. With the rapid economic development now taking place in China, coupled with improvements in living conditions, the size of the building stock and energy use are increasing simultaneously. Buildings presently use only about one fifth of the nation's total energy use. But, use may rise sharply without proper energy saving measures being imposed.

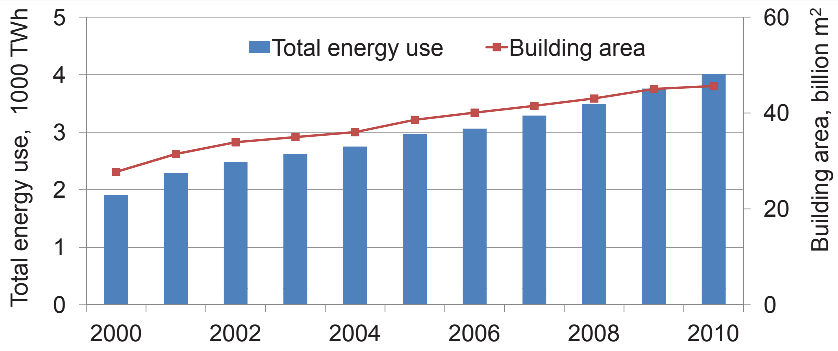


Figure 1. Building energy use in China.

Building energy conservation in China is a long term task with great importance. To achieve the goal of building energy reduction, a series of conservation approaches will be launched in different sectors. Not only should technologies to raise building energy efficiency be employed, but also so-called 'green lifestyles' should be adopted.

"buildings presently use only about one fifth of the nation's total energy use"

Overview

In 2010, total building primary energy use was 677 million TCE (tonnes of coal equivalent, 5510 TWh), accounting for 20.9% of the total. This excludes direct use of biomass, which was around 139 million TCE (1130 TWh). As the total building area is 45.7 billion m^2, annual energy intensity was around 14.8 $kg_{ce}/(m^2y)$ (kilogrammes of coal equivalent per square metre floor area, 121 $kWh/(m^2y)$. In fact, building energy use has almost doubled over the past 10 years (Figure 1). The main reason for this is the rapid growth in new construction. To meet the demands of urbanization, the total building stock has doubled every 7 to 8 years. A boost in demand for more

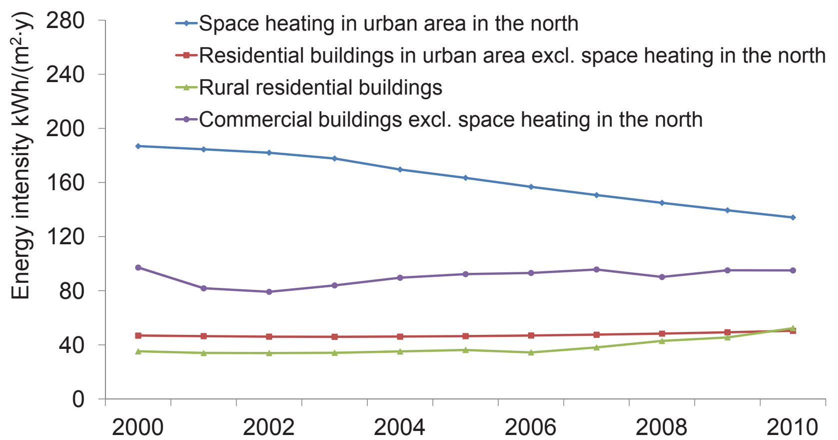


Figure 2. Building energy use trends.

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Print version (ISSN 1023-5795): printed on paper with 80% recycled content
Online version (ISSN 1754-0585): available from *www.ecbcs.org*

highly serviced buildings is another driver for the increase in energy use.

By considering the influence of the various climate zones and the huge differences between urban and rural areas, building energy use can be divided into four sectors (see Figure 2 and 3) covering:

- space heating in urban area in the north,
- residential buildings in urban areas excluding space heating in the north,
- commercial buildings excluding space heating in the north, and
- rural residential buildings.

Figure 2 shows that the energy for space heating in the north of China has been reduced during the last ten years. (In this Figure, space heating is the sum of site energy plus district heating system losses and the data only cover commercial energy: biomass and on-site renewable energy are excluded). This is due to a number of measures that have been put in place including:

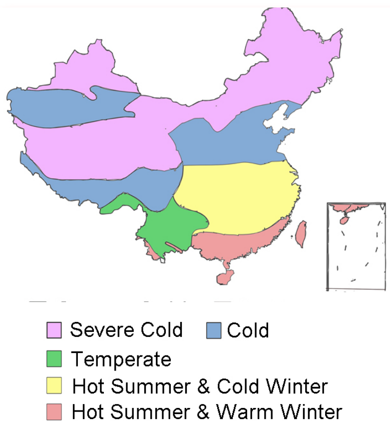
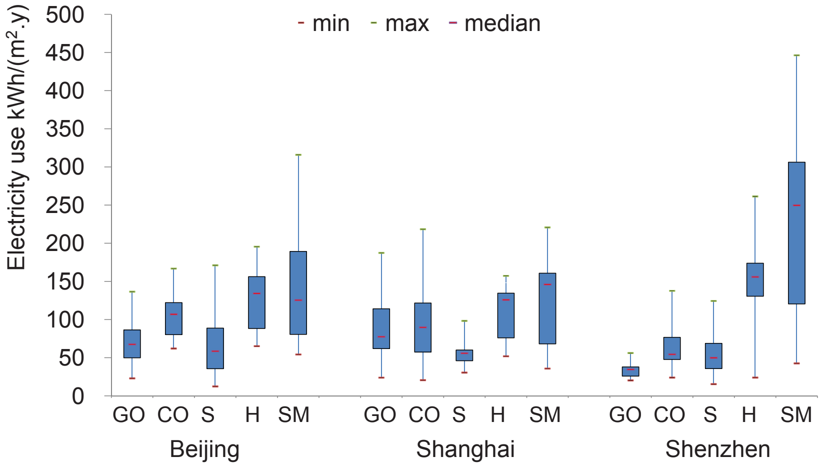


Figure 3. Climate zones in China.

- improving building fabric thermal insulation,
- replacement of small scale coal boilers with CHP or large scale high efficiency boilers or natural gas boilers, and
- wide scale application of various types of heat pump.

The major energy source for commercial buildings is electricity. Figure 4 presents the electricity consumption in different types of commercial building, showing large variations depending on building type. The main factors responsible for the differences have been found to be:



Note: GO = Governmental Office, CO = Commercial Offce, S = School, H = Hotel, SM = Shopping Mall

Figure 4. Electricity consumption in commercial buildings.

- building size,
- the heating and ventilation strategies applied in terms of time and areas (e.g. indoor climate conditioned as 'part time and part space' or 'full time and full space'), and
- whether windows are openable or fully sealed.

Figure 5 shows the electricity consumption in urban residential buildings. The possibility of opening

> *"not only should technologies to raise building energy efficiency be employed, but also 'green lifestyles' should be adopted"*

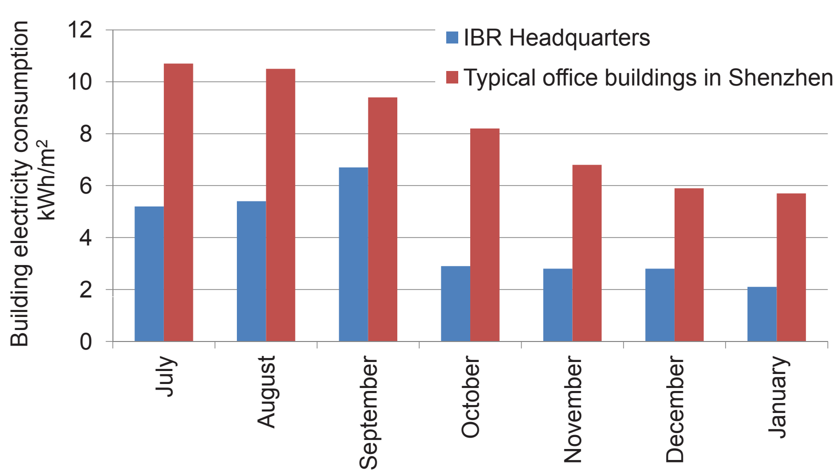
Cover picture: IBR Headquarters, Shenzhen, China

The IBR Headquarters building provides:

- an excellent indoor climate for most of the time during the year using natural ventilation,
- a decentralized HVAC system for local climate control, and
- excellent daylighting.

Location: Shenzhen, near Hong Kong, China

Floor area: 18,000 m²



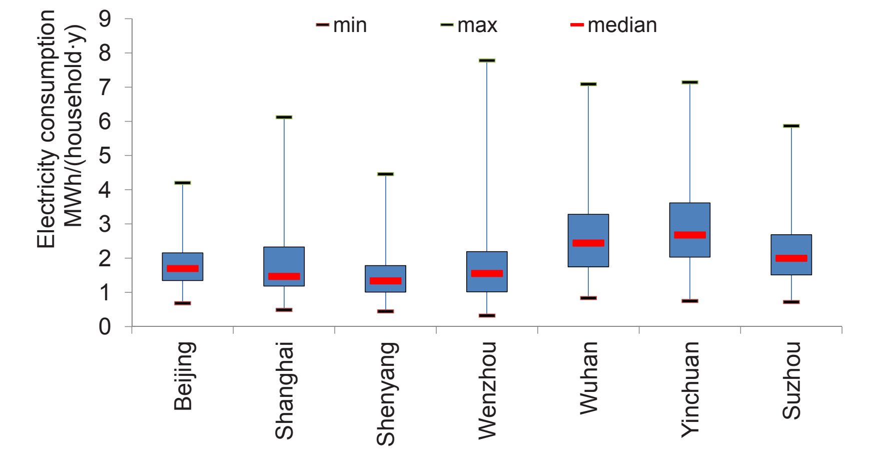


Figure 5. Electricity consumption in urban residential buildings.

windows and areas and times of space conditioning provision are the most important influencing factors. Differences in electricity consumption can also be caused by lifestyle.

The energy used by rural residents is shown in Figure 6. This has been presented as primary energy because a large proportion of the energy is supplied through direct use of biomass. However, the current trend is to replace biomass with coal, gas or electrical (commercial) energy. This is due to rapid improvements in the living standards and housing conditions in rural areas.

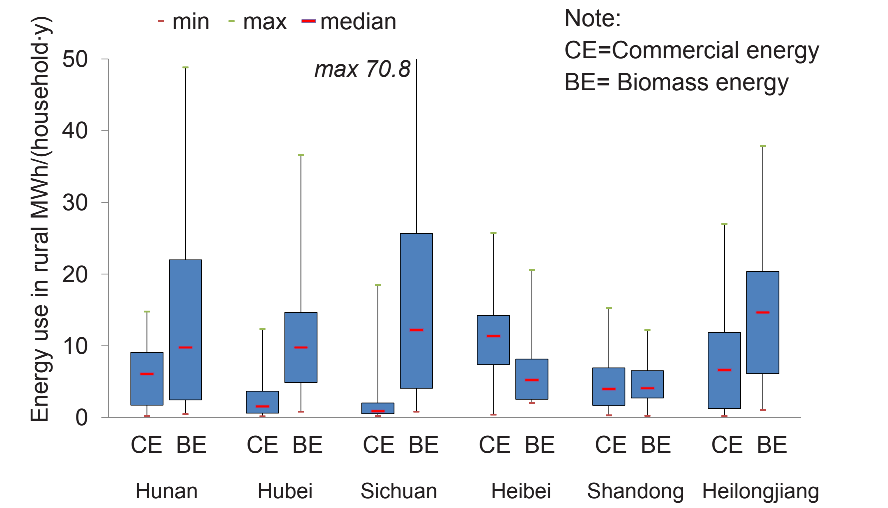


Figure 6. Energy use in rural residential buildings.

Future scenarios of building energy use

Statistical analysis has demonstrated that actual energy use in China is much lower than in OECD countries with the same climatic conditions and building functions. The reasons for the huge differences are not due to differences in energy-saving technologies, but rather to the services provided to buildings, their modes of operation, and the activities of the occupants.

Table 1 presents future scenarios for total energy use in China assuming different

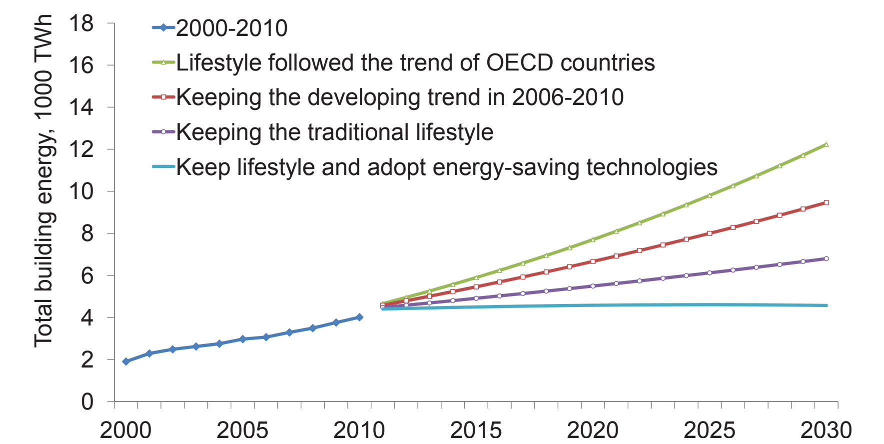


Figure 7. Energy use in rural residential buildings.

lifestyle changes and application of energy saving measures. It can be seen that adopting 'green lifestyles' with appropriate energy saving technologies will be the key to achieving building energy reduction targets.

Building energy saving targets

Space heating in the urban north

For space heating in the urban north of China, the target is to reduce primary energy use from 16 kgce/(m²y) down to 10 kgce/(m²y) or lower. The major actions required to achieve this will be to:

- improve building fabric insulation levels,
- improve heating system controls,
- change the charging method for heat from area to energy based,
- increase the proportion of combined heat and power (CHP) based heat sources and further raising the overall efficiency of CHP systems.

As well as the above, applying waste heat from industry for space heating, using heat pumps or solar thermal technologies are being encouraged.

Indoor climate conditioning for residential buildings in the Yangtze River region

Although current energy use for indoor climate conditioning in the Yangtze River

Table 1. Building energy consumption scenario analysis.

		Building floor area per capita	Energy intensity per unit floor area			
			Space heating in North China	Residential building in urban areas	Commercial buildings	Residential buildings in rural areas
Scenario 1	Lifestyle follows the trend of OECD countries	Same level as in OECD countries	Same level as in 2010	Same level as in OECD countries		Same level as in 2010 in urban areas
Scenario 2	Keeping the current trend	Keeping the current trend	Same level as in 2010	Follows the current trend		Same level as in 2010 in urban areas
Scenario 3	Green lifestyle	Same level as in Japan	Same level as in 2010	Same level as in 2010		Same level as in 2010 in urban areas
Scenario 4	Green lifestyle and appropriate energy saving technologies	Same level as in Japan	90 kWh/m^2	30 kWh/m^2	80 kWh/m^2	30 kWh/m^2

region is very low, less than 10 kWh/(m^{2}y), a trend of intensification is becoming evident. Providing a comfortable indoor climate without rapidly increasing building energy use in this region is a great challenge. Therefore, some novel technologies based on heat pumps are under development. The aim is to provide 'part time and part space' indoor climate conditioning for that region with less than 25 kWh/(m^{2}y) of electricity consumption.

Energy savings & indoor environmental quality improvements in rural residential buildings

Improvements in living conditions is the principle target for rural residential buildings in China. However, energy use should not be raised in parallel. With this objective, state-of-the-art technologies are being developed to fully exploit biomass and renewable sources such as solar and wind energy. New designs based on traditional architecture, but with improved insulation, better natural ventilation and more effective solar shading are also important. The 'Zero-Coal Village' in the north and the 'Ecological Village' in the south have been constructed as the targets for future rural villages.

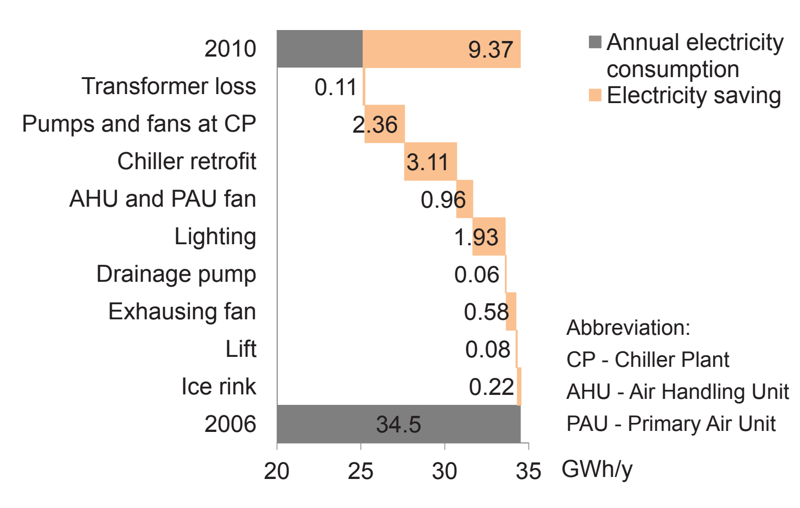
Large-scale commercial buildings excluding space heating

The target for electricity consumption for commercial buildings including lighting and equipment is 70 kWh/(m^{2}y) or below for office buildings, 40 kWh/(m^{2}y) or below for educational buildings, 120 kWh/(m^{2}y) or below in large shopping malls and 80 kWh/(m^{2}y) or below for hotels. The Online Energy Data Monitoring and Audit System for most large commercial buildings has been established, which operates as a platform for confirming energy efficient building operation and for inspection by local government. To this end, the major activities will be to:

- encourage 'green style' operation,
- improve system efficiency through state-of-the-art energy saving technologies,
- develop ESCO (energy service company) models to push energy savings into the marketplace.

Commissioning in a shopping mall in Hong Kong SAR, China

- 100,000 m^2 shopping center in Hong Kong SAR, China, with retail shops, restaurants, a multiplex cinema and an ice rink.
- Five years of continous commisioning, including chiller retrofit, optimised control of fans and pumps, etc.
- In comparison with 2006 levels before retrofitting, the total electricity saving is 9.4 GWh/y, or 27.2% of the total electricity used in 2006.



Electricity saving breakdown of the case studied shopping centre

Reliability of Energy Efficient Building Retrofitting

Probability Assessment of Performance & Cost

ECBCS Project Update: Annex 55

Carl-Eric Hagentoft, Chalmers University of Technology, Sweden

At present there is a large potential for energy savings in the existing building stock in industrialised countries.Efforts to make energy efficiency improvements to buildings are already being made by various stakeholders in many countries or will soon be initiated. Therefore, predictions of the outcome of retrofitting measures are of major importance to invest in the most appropriate technologies and to use resources effectively.

These issues are being investigated in the ECBCS project 'Annex 55: Reliability of Energy Efficient Building Retrofitting - Probability Assessment of Performance and Cost'. The project's mission is to give guidance on how to design and realise robust retrofitting to yield low energy demands and life cycle costs, while controlling risk levels for performance failure.

Project outcomes

Using probability assessment to evaluate design options gives a guide to reliable retrofit constructions and the associated spread in lifecycle cost and performance. The ultimate aim of the project is to develop knowledge and tools that support the use of probability based design strategies in energy retrofitting of buildings to ensure the anticipated benefits can be realized in practice. These will give reliable information about the true outcome of retrofitting measures regarding energy consumption, cost and performance.

Background

Results from measurements of energy use in buildings exhibit considerable variations. This may seem logical, as not all buildings have the same overall level of thermal insulation, heating system, occupancy pattern, etc. But even when the same building technologies are used, a significant spread in measured energy use is still observed. This might be caused by various factors, including:

- ventilation rates,
- airtightness,
- level of thermal insulation,
- orientation,
- internal heat gains,
- occupant behaviour in use,
- maintenance of HVAC systems,
- weather,
- workmanship, or
- durability of materials.

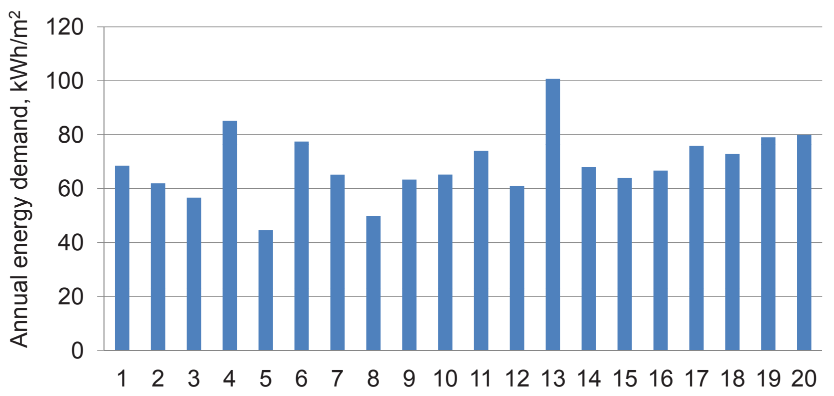


Figure 1. Distribution of annual energy demand in 20 identical Swedish low energy houses built in 2001.

Figure 1 gives as an example of the measured energy use in 20 identical recently built low energy houses in Sweden.

When retrofitting, it can be expected that energy use will vary even more between existing buildings than between new buildings, as the uncertainties are much greater. Hence, the total lifecycle costs of a population of buildings will also vary more or less randomly as one adds such factors as initial investment, operation and maintenance costs, hygrothermal performance, and performance failures.

"predictions of the outcome of retrofitting measures are of major importance to invest in the most appropriate technologies and to use resources effectively"

Examples of performance failures are:

- additional building envelope insulation not resulting in the expected reduction in heat loss due to sensitivity to workmanship;
- lack of overall thermal comfort leading to occupant compensation by higher average interior temperatures than anticipated and hence higher energy use;
- moisture damaged retrofitted wall insulation systems needing remedial work before the end of their planned service lives.

In reality, a limited set of retrofit technologies is available due to architectural, aesthetic or economic constraints. One example is the use of interior insulation to preserve the appearance of the exterior façade. This can be installed to increase thermal insulation levels, which is desirable in cold and temperate climates. The result can be colder and more moisture-sensitive constructions that are therefore more risky. From the point of view of reliability, interior insulation is not the safest method to reduce the heat transmission, but it is still commonly applied and can be relatively successful if installed correctly.

A trade off is normally necessary between different performance demands and cost. For instance, it is quick and cheap (at least in terms of initial investment costs) to thermally insulate an attic floor by blowing in loose fill insulation. But, how well will it perform in the long run and what are the consequences for the durability of the construction on the outer side of the insulation? The answer to this will depend on the somewhat random variations of moisture sources due to air leakage through the attic floor, which in turn depends on the airtightness of the construction, air pressure differences and the indoor moisture sources.

Lack of predictability

The lack of predictability of the various parameters that determine the outcome of retrofit measures is of great importance in assessing the spread in consequent performance. So, this project has collected data to characterise the distribution of, for instance, material properties, weather data, indoor moisture sources, workmanship, tolerances and airtightness.

"even when the same building technologies are used, a significant spread in measured energy use is still observed"

A probability based decision making tool

A reliable decision making tool needs to account for the random variations in performance and life cycle cost. In this way, the most suitable retrofitting technology and investments can be selected. The project has developed methods to assess the spread in performance and life cycle costs based on the uncertainties involved, shown schematically in Figure 2. The second 'hump' in the cumulative distribution function for the lifecycle costs illustrates the quite dramatic effect of failures in performance. These failures result in significant increased costs due to additional unplanned retrofit work in part of a sample of renovated buildings. By comparing alternative strategies the best one overall can then be selected. Probability assessment of performance combined with lifecycle costing provides a transparent technique to encourage a change to more sound decision making and cost assessments for building retrofits.

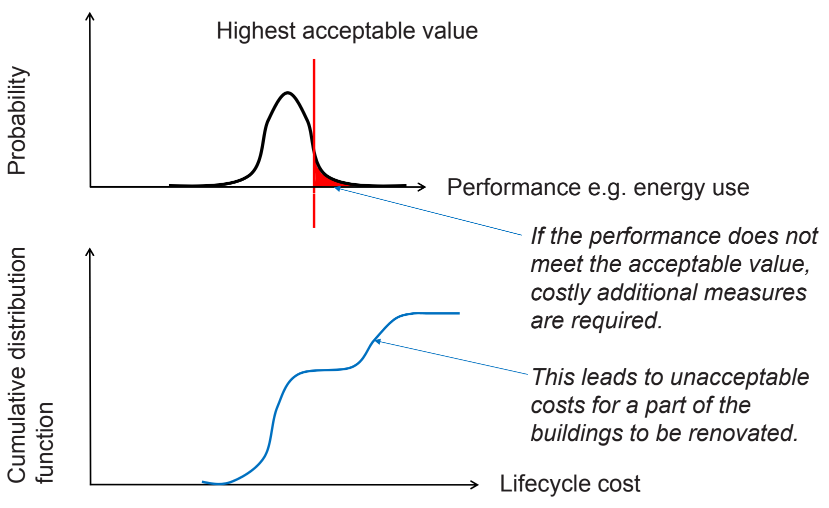


Figure 2. Probability density function of a selected performance measure and the cumulative distribution for the lifecycle costs for a sample of renovated buildings.

Assessment of retrofitting alternatives

The purpose of the project is also to provide information and methods for probabilistic assessment of hygrothermal performance of retrofitted buildings. Such probabilistic assessments involve anticipating conditions and measures that lead to diversity in performance between buildings, as well as qualifying and quantifying the distributions. If the spread is found to be unacceptable in terms of modern standards and tolerance limits, measures for reducing the spread need to be considered.

A complete probabilistic assessment is an iterative process, usually beginning with the application of qualitative methods and, if necessary and appropriate, progressing towards quantitative approaches. If a quantitative analysis is to be carried out, a probabilistic model of building performance must be created. From this model, estimates can be made of the spread in performance and also critical conditions and events identified.

In the end, the results of numerical analyses should be compared with performance targets for the retrofit and an optimal retrofitting technique may then be identified. If necessary targets are not reached, iteration is required to revise the basic assumptions for the analysis until a satisfactory solution is found. (Naturally, these changes would need to be implemented within the actual retrofit work.) With this goal, the related project outcome is a methodology tool that incorporates all of these steps in a clear and efficient way to support the decision-making process.

Further Information

For further information, please see:
www.ecbcs.org/annexes/annex55.htm

New ECBCS Chair

On 1st January, 2012, Mr Andreas Eckmanns has started a three year term as the new Chair of the ECBCS Executive Committee. Mr Eckmanns has expressed a particular wish to strengthen international research collaboration and outreach during his term as Chair, as sustained by his predecessor, Dr Morad Atif.

China has recently joined the ECBCS programme and, by targeted collaboration, Mr Eckmanns is committed to focusing on the remaining four rapidly developing 'BRICS' countries, namely Brazil, Russia, India and South Africa. He also invites other countries to join that share common research agendas with the ECBCS programme. In fact, the welcome news that Ireland has become the latest member country is announced on page 12. Mr Eckmanns further intends to strengthen strategic research cooperation within the different research and development initiatives of the European Union.

Mr Eckmanns studied electrical engineering at the University of Applied Sciences of North Western Switzerland. His background is in building integrated photovoltaics. Following this, he was responsible for research and development at a Swiss PV manufacturer and engineering company, where he specialized in multifunctional PV applications for shading, noise protection and use of thermal energy.

Since January of 2001 Mr Eckmanns has worked for the Swiss Federal Office of Energy as a senior expert in the field of energy and buildings. In June 2008 he became the head of their research domain "Buildings, Solar thermal and Heat pumps." In this capacity he is responsible for a number of federally sponsored research programmes. Moreover, he represents Switzerland in several International Energy Agency (IEA) and European Union programmes.

Mr Eckmanns aims to continue ECBCS' strong collaboration within the IEA framework, particularly among the building related research programmes. He intends to intensify communication, launch common projects and hold joint meetings with these programmes.

Conference Announcement

Joint Conference

33rd AIVC Conference and 2nd TightVent Conference

Optimising Ventilative Cooling and Airtightness for [nearly] Zero-Energy Buildings, IAQ and Comfort

10th –11th October 2012, Copenhagen, Denmark

The joint '33rd AIVC Conference' and '2nd TightVent Conference' will focus on ventilation and infiltration in nearly zero-energy buildings and, in particular, on challenges and perspectives for ventilative cooling (the use of ventilation to cool indoor spaces), as well as the rationale and solutions for better building and ductwork airtightness.

The aim of this conference is to present and foster new research and development activities, applications and market transformation with a specific focus on ventilative cooling strategies, along with envelope and ductwork airtightness. These two issues are particularly relevant in the trend towards nearly zero-energy buildings.

Visit the website at www.aivc.org for more information.

Cost-Effective Energy & CO_2 Emissions Optimization in Building Renovation

ECBCS Project Update: Annex 56

Manuela Almeida, University of Minho, Portugal

Project outcomes

As a basis for future standards, the project is creating a new methodology to enable cost effective renovation of existing buildings while optimizing energy consumption and carbon emissions. The outcome will be a flexible methodology, to be used by organisations in their renovation decisions, as well as by governmental agencies to set the basis for regulations and to:

- establish cost effective targets for energy consumption and carbon emissions,
- determine cost effective combinations of energy efficiency and carbon emissions reduction measures, and
- clarify the relationship between carbon emissions and energy targets and the optimal hierarchy of measures to meet them.

A renovation guide book will present cost effective solutions and optimised concepts, supported by case studies of exemplars and by flexible tools.

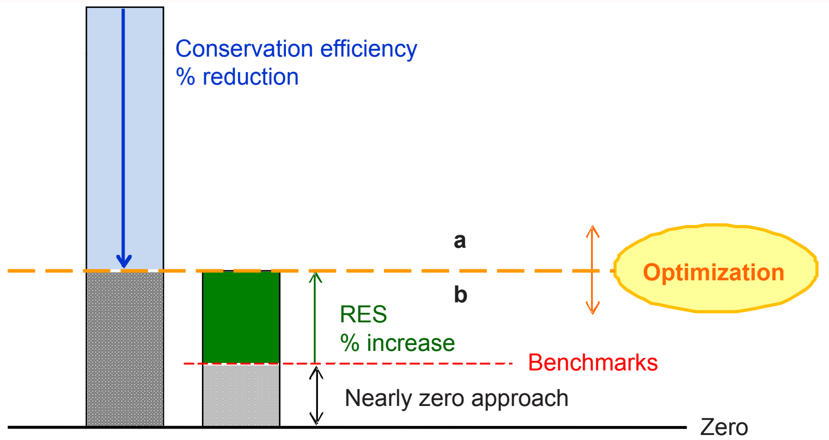
Climate change mitigation & the existing building stock

As a major energy using sector, buildings form a specific target for global actions to mitigate climate change. Measures to improve their energy efficiency and use of renewable energy sources are being promoted in industrialised countries, so reducing their energy-related carbon dioxide (CO_2) emissions.

Mainly over the last decade, many standards and regulations relating to building energy use have become more demanding. These require energy conservation and efficiency measures to be applied and involve a significant investment in the building envelope and services, as well as on-site production of energy from renewable sources. In this context, several countries have already defined a medium-term objective for all new buildings to meet very strict energy targets ('nearly zero energy'). Some even take a carbon neutral approach over the whole building life cycle, obliging significant reductions in resource requirements and energy demands and then meeting the residual demands using renewable, and preferentially on-site, energy sources.

Since buildings have very long lifetimes and the rate of replacement of the existing stock is very low, taking action only on new buildings is clearly insufficient to achieve effective results in reducing overall carbon emissions. So, it is necessary and urgent to carry out large scale upgrades of the existing stock. However, the application of existing standards and regulations in building renovation, which are mainly targeted to new buildings, results in inadequate requirements and measures with poor acceptance by owners and developers.

The international ECBCS project 'Annex 56: Cost Effective Energy and CO_2 Emissions Optimization in Building Renovation' has been established to help to resolve this issue by providing solutions and guidance suitable for single and multifamily residential buildings. These buildings, for example, account for 75% of the total stock in Europe and were responsible for 68% of the total final energy use in buildings in 2009.



Two step approach:
1. Reduction of energy demand and carbon emissions by energy conservation and efficiency measures
2. Substitution / supply with renewable energy and on-site renewables (RES) to satisfy the remaining demand as much as possible to further reduce CO_2 emissions.

Figure 1. An energy and CO_2 emissions optimized building renovation concept. (Source: S. Geier and W. Ott)

The optimization principle

Focusing on the overall objective of slowing down climate change, renewable energy supply measures for reducing carbon emissions can be as effective as energy conservation and efficiency measures, especially in the case of building renovation. Therefore, it is relevant to investigate the relationship between energy targets and where the balance point lies between these two types of measures from a cost-benefit perspective for different local conditions.

From a cost-benefit perspective, in existing buildings the balance between efficiency measures to reduce energy consumption and those generating energy from renewable sources will differ with the case of new buildings. There will also be differences between various types of existing buildings, with diverse technical, functional, cultural and economic constraints. It is therefore relevant to investigate the cost optimal balance between these two kinds of measures in order to discover how to achieve the best results in terms of:

- reduction of energy consumption,
- reduction of carbon emissions,
- comfort improvement, and
- overall added value.

These should be achieved with the least effort in terms of:

- financial investment,
- depth and duration of the intervention, and
- disturbance of users.

It is necessary to determine from a cost-benefit perspective the optimal range of ‘minimization of energy demand’ and ‘use of renewable energy’ measures, illustrated in Figure 1. In a particular context it can then be better understood how far energy conservation and efficiency measures should be taken and at which point renewable energy supply measures become more economic. Under particularly circumstances, it might be found to be more favourable to start with the latter from the outset.

The determination of cost optimal levels for energy-related building renovation implies that several packages of measures applicable to reference buildings need to be defined. These packages should be selected from combinations of compatible energy efficiency and energy supply measures, e.g. the application of high performance windows, thermal insulation, condensing boilers, solar thermal systems, and so on. For multiple combinations of commonly used and advanced measures, the energy performance, carbon emissions and life cycle costs should be calculated. This allows the economic optimum to be found from among such packages, ranging from simple compliance with current regulations to combinations that realise nearly zero-energy buildings. Furthermore, the optimised balance between energy efficiency and renewable energy supply measures can be explored.

The reference buildings need to be representative for groups with common or similar properties such as age, size, climate conditions, or construction type, so the results of the cost optimal analyses can be deployed at a large scale. In addition, the national fuel mix for centralised energy supplies has to be taken into account. The packages of measures must take into account compatible technologies related to the building envelope (reducing heat transmission and improving air tightness), space heating, domestic hot water, ventilation systems, cooling, lighting, automation and controls, as well as other building-related measures with impacts on thermal performance.

The global benefits of renovation

Although current practice prioritizes energy related parameters (consumption, conservation and generation), the renovation process and the cost optimization calculations must also consider the overall added value. This means identifying and as far as possible quantifying:

- the global quality improvement,
- economic impact of the intervention,
- operating cost reductions, and
- some associated benefits, such as comfort improvement, increased value of the building, and fewer problems related to reliability. (See page 6 for information about another ECBCS project that is providing guidance about improving the reliability of energy retrofit measures.)

The project is investigating how the full range of benefits of the renovation process may best be characterised. Aggregation into a single economic indicator based on cost-benefit analysis would be ideal, but this may not be fully achieved. However, identification and quantification of all benefits of renovation are crucial for stakeholders, who assess various issues differently and are motivated to invest for distinct reasons.

Further Information

For further information, please see:
www.ecbcs.org/annexes/annex56.htm

Figure 2. Residential building before and after renovation. (Source: Nussmueller Architekten ZT GmbH)

Evaluation of Embodied Energy & CO_2 Emissions for Building Construction

New ECBCS Project: Annex 57

Tatsuo Oka, Utsunomiya University, Japan

The accuracy of prediction methods for energy consumption and related carbon dioxide (CO_2) emissions due to building operation has been improving in recent years, resulting in more efficient building designs. 'Embodied' energy and CO_2 are defined as the energy consumption and CO_2 emissions arising from the entire process of extracting and processing of raw materials, manufacture of construction products and transportation.

As operating energy consumption is reduced, embodied energy and CO_2 become more significant. Particularly for 'low carbon' (i.e. low CO_2 emitting) building design, the embodied CO_2 may form a large proportion of the whole life emissions considering construction, operational and demolition phases.

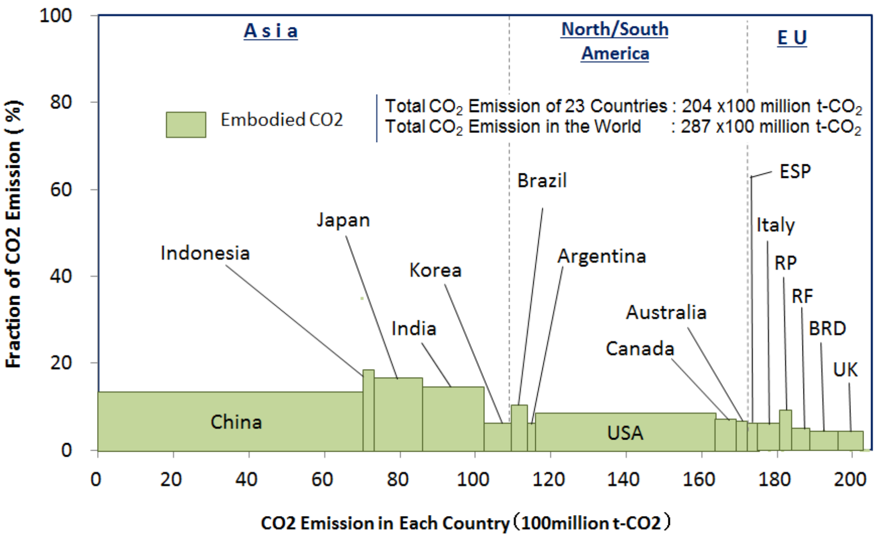


Figure 1. Relationship between annual CO_2 emissions in various countries and the fraction of embodied CO_2.

Figure 1 shows an estimation of the total annual CO_2 emissions in various countries, and the corresponding fractions of embodied CO_2 due to building construction and public works. In this Figure, the green areas indicate the total embodied CO_2. In particular, fractions of embodied energy are higher in countries with emerging economies and even often exceed building operational energy. As shown in Figure 2, the embodied energy differs among countries depending on the building design, the energy intensity of materials, and the quantity of materials used in the building.

Since reducing embodied energy due to building construction is important from a practical viewpoint, the new ECBCS project, 'Annex 57: Evaluation of Embodied Energy & CO_2 Emissions for Building Construction' is pursuing certain important areas of research, as follows:

- Although a number of databases for embodied energy and CO_2 of building materials have been published, there are few similar databases quantifying the volume of building materials, components, and services. So, guidelines for these items are being prepared because the total embodied energy is equal to the energy intensity multiplied by the quantity of materials used in the building.
- Design and construction methods for buildings with low embodied energy and CO_2 are being improved, involving the use of recycled materials, prolongation of building life, retrofitting, and also reduction of non-CO_2 greenhouse gas emissions.
- About 90% of non-behaviour related building performance is determined in the initial design stages, so other practical guidance is being developed. This will include case studies and best practice exemplars, which are effective means to promote embodied energy reductions during early building design.

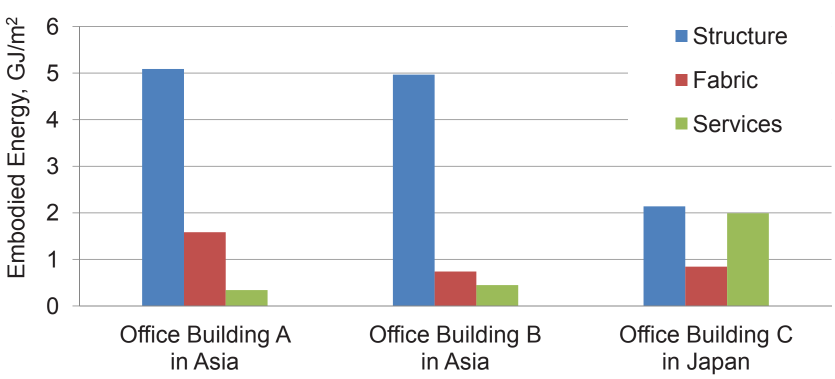


Figure 2. Embodied energy used to construct various office buildings in Asia.

Further Information

For further information, please see: www.ecbcs.org/annexes/annex57.htm

New Member Country: Ireland Joins ECBCS

On behalf of the ECBCS Executive Committee, I am pleased to announce the recent decision of the Government of Ireland to accept an invitation to join the ECBCS Programme. The Irish Government has designated the Sustainable Energy Authority of Ireland (SEAI) to represent them. SEAI is managing several national programmes that are highly relevant to ECBCS' priorities.

The 'National Retrofit Programme' is a multi-annual programme to upgrade Ireland's building stock to high standards of energy efficiency, cutting fossil fuel use, running costs and greenhouse gas emissions. The programme builds on SEAI's successful and internationally-recognised domestic and non-domestic energy saving grant programmes and in scaling up, will be centred on engaging market actors to deliver upgrades efficiently and effectively, with SEAI's oversight role ensuring quality and market confidence. So far upgrades to over 150,000 homes and over 200 non-domestic projects have leveraged a total investment of almost €450M with projected annual savings of over 600 GWh.

The new 'Better Energy' programme will deliver on national and European targets, with employment, cost efficiency and emission reduction benefits. It will involve energy supply companies, energy services providers, construction workers, energy auditors and policymakers working together to deliver energy, cost and carbon savings for both customers and the country. This programme has five objectives:

- Deliver energy efficiency upgrades to one million residential, public and commercial buildings by 2020, unlocking consistent financial savings to homeowners, businesses and the public sector.
- Realise 8,000 GWh of energy savings over the lifetime of the programme (2011-2020).
- Improve the energy affordability, health and comfort levels of vulnerable customers.
- Develop an innovative, competitive and sustainable market for efficiency goods and services in support of the Government's strategy for developing a Smart Green Economy.
- Underpin the National Climate Change Strategy through low-cost greenhouse emission reductions.

A more extensive account of Ireland's energy and buildings related research programmes will be published in a later edition of ECBCS News. I look forward to working with SEAI to pursue our common goals.

Andreas Eckmanns
ECBCS Executive Committee Chair

ECBCS Facts at Your Fingertips
www.ecbcs.org

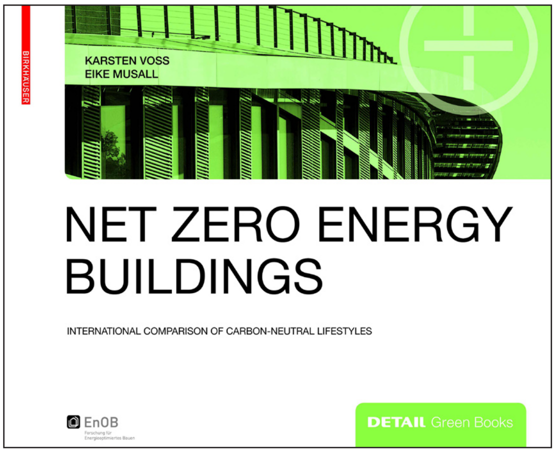
New ECBCS Publication

Towards Net Zero Energy Solar Buildings (NZEBs)

Living and working with an equalised energy balance, Strategies and experiences from the perspective of planners and users
Edited by Karsten Voss and Eike Musall, published October 2011.

This publication presents the first outcome from the joint ECBCS-SHC project 'Annex 52 / Task 40: Towards Net Zero Energy Solar Buildings'.

It focuses on analysing exemplary buildings that are near a zero-energy balance, to develop methods and tools for the planning, design and operation of such buildings. The aim of the case studies presented is to explain how an equalised annual energy balance can be achieved by bringing together architectural design, energy efficiency and the use of renewable energy technologies. Such buildings not only benefit from using energy from renewable resources, but also do not contribute to climate change.



Case studies that have already been implemented prove from a practical standpoint that the objective of 'zero energy' is already possible today.

Ordering Information

Ordering information can be found at:
www.ecbcs.org/annexes/annex52.htm

Reliable Full Scale Dynamic Performance Measurements

New ECBCS Project: Annex 58

Staf Roels, University of Leuven, Belgium

Dynamic full scale testing is a fundamental means to improve the energy performance of buildings. Quantifying the actual performance of buildings, verifying calculation models and integrating advanced energy solutions for nearly zero energy or positive energy buildings can only be effectively realised by in situ testing and dynamic data analysis.

Experience has shown that the outcome of many on-site testing activities can be questioned in terms of accuracy and reliability. The focus of nearly all full scale testing activities is on the assessment of components and buildings, often neglecting the necessity of reliable assessment methods and quality assurance. Thus a new ECBCS project 'Annex 58: Reliable Building Energy Performance Characterisation Based on Full Scale Dynamic Measurements' has been established to support robust in-situ testing to evaluate and characterise components and whole buildings.

Project aims

The research goal is to create the necessary knowledge, tools and networks to achieve reliable in situ dynamic testing and data analysis methods. These can then be used to characterise the actual energy performance of components and whole buildings.

Bridging the gap

Several recent studies have shown the actual performance of building components after completion may deviate significantly from the theoretical design intent. Full scale dynamic measurements can help to bridge this gap. This is illustrated by Figure 1, which compares the designed and realised overall heat loss (W/K) of 18 dwellings in the UK. As can be seen, none of the houses achieves the intended performance and the measured heat losses may exceed the designed values by up to 100%.

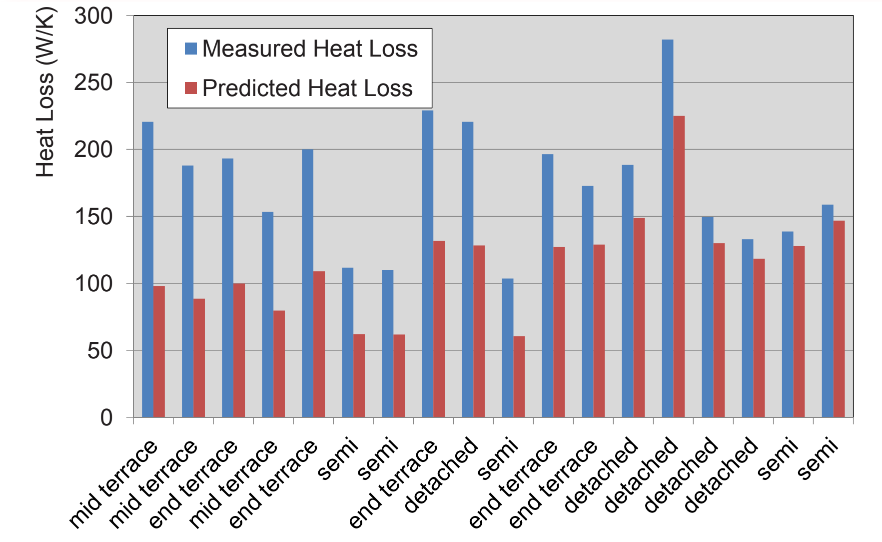


Figure 1. Measured versus predicted whole house heat losses.

Predicting dynamic response

Apart from evaluating the actual performance of components and buildings, full scale testing is also a valuable and necessary tool to integrate advanced components and systems into simulation models. As an example, Figure 2 shows the full scale testing of a ventilated photovoltaic double skin facade. Based on the dynamic data analysis of the measurement results, a so-called 'grey box' model can be deduced. Once developed, a grey box model is able to predict the thermal dynamic response of the building facade under different climatic conditions.

Figure 2. Measuring the thermal response of ventilated photovoltaic double skin facades under real climatic conditions.

Optimising smart energy grids

The evolution towards nearly zero energy buildings changes the way they interact with energy distribution grids. Buildings no longer only use energy, but can also act as distributed renewable energy sources. A characterisation of their dynamic behaviour is necessary to design and operate smart grids in a reliable way. Similarly to grey box modelling, parameter identification based on dynamic measurements can be used to identify suitable models to describe the thermal dynamics of whole buildings including the services systems.

Further Information

For further information, please see:
www.ecbcs.org/annexes/annex58.htm

ECBCS International Projects

5 Air Infiltration & Ventilation Centre

www.aivc.org

The AIVC carries out integrated, high impact activities with an in depth review process, such as delivering webinars, workshops and technical papers. The main target groups for the Centre are the research community and industry including practitioners from design through to construction and maintenance, as well as policy and other decision makers.

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Status: ongoing

47 Cost Effective Commissioning of Existing & Low Energy Buildings

www.ecbcs.org/annexes/annex47.htm

The improved operation of existing and future buildings in practice is the primary concern of this project. Not only have tools been developed to support the commissioning process, but also the business case has been strengthened by cost-benefit analysis and recognition of the persistence of savings. The beneficiaries of the work are building services commissioning providers, and also designers, building owners, and operations and maintenance personnel.

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48 Heat Pumping & Reversible Air Conditioning

www.ecbcs.org/annexes/annex48.htm

When installed, high cost air conditioning systems should be exploited as fully as possible, by allowing them to operate reversibly as required, either in heat pumping or in air cooling modes. Exhaust air heat recovery can also be applied during heat pumping. The knowledge and guidance generated by the project is targetted at designers and is also of relevance to building operators and owners.

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49 Low Exergy Systems for High-Performance Buildings & Communities

www.ecbcs.org/annexes/annex49.htm

This project has developed concepts for reducing the exergy demand (a measure of energy quality) in buildings and community energy systems. The guidance produced is of particular benefit for designers and presents an approach that evaluates how exergy is lost in energy generation, transmission and end use. This permits low exergy sources to be selected to meet heating and cooling demands.

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50 Prefabricated Systems for Low Energy Renovation of Residential Buildings

www.ecbcs.org/annexes/annex50.htm

An advanced design, manufacturing and construction approach has been created to allow existing buildings to be retrofitted using prefabricated external facade units, which are designed to upgrade the building fabric energy performance and accomodate new heating, ventilation and air conditioning systems. Crucially, the building occupants can remain in place during the renovation works. The project has focused on the needs of designers, the building industry and apartment building owners.

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51 Energy Efficient Communities

www.ecbcs.org/annexes/annex51.htm

Community-wide energy system concepts must be based on optimized solutions in economic terms rather than necessarily introducing cutting-edge technical innovations. The project is specifically targeting local decision makers and stakeholders, who are not experts in energy planning. Guidance, case studies and a decision making tool are being produced to assist in implementing robust based approaches.

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52 Towards Net Zero Energy Solar Buildings (NZEBs)

www.ecbcs.org/annexes/annex52.htm

There is now a strong interest in net-zero, near net-zero and very low energy buildings. The project is achieving a common understanding of these concepts and are delivering a harmonized international definitions framework, tools, innovative solutions and industry guidelines. The key audiences for the work are government policy makers and research funding programme managers, industry, utilities and the academic community.

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53 Total Energy Use in Buildings: Analysis & Evaluation Methods

www.ecbcs.org/annexes/annex53.htm

Knowledge of the influence of different factors on energy use in buildings is essential to accurately assess short- and long-term energy saving measures, policies and technologies. This includes an improved treatment of how occupant behaviour can be addressed. The beneficiaries of the work are policy makers, energy services contracting companies, manufacturers and designers.

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54 Integration of Micro-generation & Related Energy Technologies in Buildings

www.ecbcs.org/annexes/annex54.htm

A sound foundation for modelling small scale co-generation systems underpinned by extensive experimental validation has been established to explore how such systems may be optimally applied. The target audiences include system designers and installers and energy services contracting companies, with outputs also of value to local to government policy makers, utilities, social housing providers, technology developers and investors.

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55 Reliability of Energy Efficient Building Retrofitting - Probability Assessment of Performance & Cost

www.ecbcs.org/annexes/annex55.htm

When retrofitting existing buildings, it is vital to ensure anticipated energy benefits are realized in practice. The project is providing decision support data and tools for energy retrofitting measures for software developers, engineers, consultants and construction product developers. These tools are based on probabilistic methods for prediction of energy use, life cycle cost and hygrothermal performance.

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56 Cost-Effective Energy & CO_2 Emission Optimization in Building Renovation

www.ecbcs.org/annexes/annex56.htm

Current standards for new buildings are generally unsuited to the numerous constraints imposed by existing buildings. It is therefore urgent to agree new standards

to respond to these constraints and to develop good practice guides that integrate appropriate, applicable and cost effective technologies. To assist this process, the project is delivering accurate, understandable information and tools targeted to non-expert decision makers and real estate professionals.
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57 Evaluation of Embodied Energy & CO_2 Emissions for Building Construction

www.ecbcs.org/annexes/annex57.htm
The project is investigating methods for evaluating embodied energy and carbon dioxide (CO_2) emissions of buildings. It is developing guidelines to improve understanding of the evaluation methods, with the goal of finding better design and construction solutions with reduced embodied energy and CO_2 emissions. The main receptors for the project outcomes are practitioners, such as designers and engineers of buildings and their components, as well as decision makers, including policy makers and building owners.
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58 Reliable Building Energy Performance Characterisation Based on Full Scale Dynamic Measurements

www.ecbcs.org/annexes/annex58.htm
The project is developing the necessary knowledge, tools and networks to achieve reliable in-situ dynamic testing and data analysis methods that can be used to characterise the actual energy performance of building components and whole buildings. The state of the art on full scale testing and dynamic data analysis, including a survey of existing full scale test facilities will be determined for the benefit of the building industry, engineers and consultants.
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Status: ongoing

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International Energy Agency
Energy Conservation in Buildings and Community Systems Programme