International Energy Agency

ECBCS | Annual Report 2007

Energy Conservation in Buildings & Community Systems Programme

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Participating countries in ECBCS: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Israel, Italy, Japan, Republic of Korea, the Netherlands, New Zealand, Norway, Poland, Portugal, Sweden, Switzerland, Turkey, United Kingdom and the United States of America.

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Preface

International Energy Agency

The International Energy Agency (IEA) was established in 1974 within the framework of the Organisation for Economic Co-operation and Development (OECD) to implement an international energy programme. A basic aim of the IEA is to foster co-operation among the twenty-four IEA participating countries and to increase energy security through energy conservation, development of alternative energy sources and energy research, development and demonstration (RD&D).

Energy Conservation in Buildings and Community Systems

The IEA sponsors research and development in a number of areas related to energy, through a number of Implementing Agreements (IA's). The mission of one of those Implementing Agreements, the ECBCS - Energy Conservation for Building and Community Systems Programme, is to facilitate and accelerate the introduction of energy conservation, and environmentally sustainable technologies into healthy buildings and community systems, through innovation and research in decision-making, building assemblies and systems, and commercialisation. The objectives of collaborative work within the ECBCS R&D program are directly derived from the on-going energy and environmental challenges facing IEA countries in the area of construction, energy market and research. ECBCS addresses major challenges and takes advantage of opportunities in the following areas:

- exploitation of innovation and information technology;
- impact of energy measures on indoor health and usability;
- integration of building energy measures and tools to changes in lifestyles, work environment alternatives, and business environment.

The Executive Committee

Overall control of the program is maintained by an Executive Committee, which not only monitors existing projects but also identifies new areas where collaborative effort may be beneficial. To date the following projects have been initiated by the executive committee on Energy Conservation in Buildings and Community Systems:

Our Mission

"To facilitate and accelerate the introduction of energy conservation and environmentally sustainable technologies into healthy buildings and community systems, though innovation and research in decision-making, building products and systems, and commercialization"

Research and Development Strategies

Derived from research drivers, national programs within IEA countries, and the IEA Future Building Forum, the R&D strategies represent a collective input of the Executive Committee members to exploit technological opportunities to save energy in the building sector, and to remove technical obstacles to market penetration of new energy conservation technologies. The R&D strategies apply to residential, commercial, and office buildings, and will impact the building industry in three aspects:

1. Design and Business Environment
2. Building Technologies and Systems
3. Outreach and Commercialisation

1. Load Energy Determination of Buildings
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3. Energy Conservation in Residential Buildings
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36. Retrofitting of Educational Buildings
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38. Solar Sustainable Housing
39. High Performance Insulation Systems
40. Building Commissioning to Improve Energy Performance
41. **Whole Building Heat, Air and Moisture Response (MOIST-ENG)**
42. **The Simulation of Building-Integrated Fuel Cell and Other Cogeneration Systems (COGEN-SIM)**
43. **Testing and Validation of Building Energy Simulation Tools**
44. **Integrating Environmentally Responsive Elements in Buildings**
45. **Energy Efficient Electric Lighting for Buildings**
46. **Holistic Assessment Tool-kit on Energy Efficient Retrofit Measures for Government Buildings (EnERGo)**
47. **Cost-Effective Commissioning for Existing and Low Energy Buildings**
48. **Heat Pumping and Reversible Air Conditioning**
49. **Low Exergy Systems for High Performance Buildings and Communities**
50. **Prefabricated Systems for Low Energy Renovation of Residential Buildings**

Working Group - Energy Efficiency in Educational Buildings

Working Group - Indicators of Energy Efficiency in Cold Climate Buildings

Working Group - Annex 36 Extension: The Energy Concept Adviser

Ongoing projects in Bold

Introduction

In the past calendar year, I am pleased to report key developments within the ECBCS Programme which have included:

- ***The development of a new Strategic Plan*** for research and development activities for the period up to 2012. The Plan seeks to provide an integrated approach to buildings and community systems and has been developed in conjunction with the other IEA buildings-related research programmes.
- ***The initiation of a timely new research project on energy efficient communities*** which will progress work from three earlier projects and advance research into new non-technology-based areas. This takes the total of ongoing projects within the Programme to twelve, of which three are now in the reporting stage.

Strategic Planning

The new ECBCS Strategic Plan looks forward for the next five years to 2012 and aims to lead the transition of the building sector to near-zero primary energy use and carbon emissions. Any sustainable solution needs to fulfil the demands of ecological (energy and environment), economic (market and business) and social sustainability (end-users). The final goal is a solution that fulfils all three criteria in a balanced way.

To move towards an energy efficient and environmentally sustainable building sector and community, technologies still need to be developed, especially for compact, building integrated storage of heat, cold and electricity. In the design of energy efficient communities, three actions are imperative, and should be approached in the following order:

1. Reduce heating, cooling and lighting loads to a minimum.
2. Use the exergy of renewable and waste energy sources as effectively as possible.
3. Make fossil fuel use as effective and clean as possible.

The resulting solutions should also be intuitive and robust, so that people would automatically be able to use the technology correctly, and not be able to cause fatal defects to the system, even if they fail to use it as it was designed to be used. The final goal should be integrated and performance-based solutions for energy efficient and environmentally friendly buildings and communities that support sustainability and produce carbon-free energy according to demand.

Barriers and Drivers

- The increasing scarcity of natural resources versus population growth
- Legislation
- Human health and wellbeing aspects
- Urbanisation
- Lack of skilled resources
- Rise in living standards in developing countries - The 80 % of the world's population now living in developing countries will soon require the same quality of life as the people of the industrialised countries.

The R&D strategies are derived from research drivers, national programs within IEA countries, and the IEA Future Building Forum Think Tank Workshop, held in March 2007. The R&D strategies represent a collective input of the Executive Committee members to exploit technological opportunities to save energy in the building sector, and to remove technical obstacles to market penetration of new energy conservation technologies. They apply to residential, commercial, office buildings and community systems, and will impact the building industry in three focus areas of R&D activities: dissemination, decision-making and building products and systems.

Dissemination

The strategic goal is to develop and improve information mechanisms, methods and tools in order to create powerful, environmentally aware end-users and to create a basis for an attractive environment for new business models.

Areas of Focus:

- Improve information mechanisms
- Develop performance information platforms of existing building stocks
- Develop information platforms of best practice business models
- Implement reportive buildings and ratings
- Influence legislation and authorities

Decision Making

The strategic goal is to develop methodologies, methods and validated tools for the life cycle decision-making enabling processes to produce high-performance building and community solutions on demand.

Areas of Focus:

- Develop performance indicators and criteria for sustainability
- Develop tools for integrated design, construction and management
- Develop life-cycle commissioning methodology

and ICT based commissioning tools

- Develop local energy planning tools

Building Products and Systems

The strategic goal is to develop and demonstrate highly resource-efficient new and retrofit / refurbishment building and community solutions, and advanced operating systems for controlling and using them.

Areas of Focus:

- Develop solutions for carbon neutral energy production and use
- Design and demonstrate prefabricated and modular energy retrofit solutions
- Develop advanced control systems, sensor networks and user-interfaces

Eliminating Energy Waste in Communities

It makes sense for us to minimise our energy use for many reasons. The move to a low or even a zero carbon economy worldwide is gaining momentum, and there has never been a more urgent need for a unified global approach. Eliminating energy waste goes hand in hand with transforming energy production, and eliminating energy waste has been the goal of the Energy Conservation in Buildings and Community Systems programme since 1979. With twenty-four member countries and forty-two research projects completed, the ECBCS is looking positively towards a low-energy, sustainable future. Twelve projects are now ongoing, and other new projects are in the planning stage, such as the new Energy Efficient Communities project, which will expand the target area from single buildings to whole urban quarters and cities, and move the emphasis from research to reality – establishing solid strategies to maximise the take-up of solutions. I look forward to the successful outcome of this new undertaking.

Dr Morad R. Atif

ECBCS Executive Committee Chairman

Ongoing Research Projects

Air Infiltration and Ventilation Centre

Integrating Environmentally Responsive Elements in Buildings

Energy Efficient Future Lighting for Buildings

Holistic Assessment Toolkit on Energy Efficient Retrofit Measures for Government Buildings

Cost Effective Commissioning of Existing and Low Energy Buildings

Heat Pumping and Reversible Air Conditioning

Low Exergy Systems for High Performance Buildings and Communities

Prefabricated Systems for Low Energy Renovation of Residential Buildings

Energy Efficient Communities: Case Studies and Strategic Guidance for Urban Decision Makers

Air Infiltration and Ventilation Centre

Ventilation and air infiltration into buildings represent a substantial energy demand which can account for between 25% and 50%+ of a building's total space heating (or cooling) needs. Unnecessary or excessive air change can therefore have an important impact on global energy use. In addition insufficient ventilation may result in poor indoor air quality and consequential health problems.

Designing for optimum ventilation performance is therefore a vital part of building design. This task is made especially difficult, however, by the complexities of airflow behaviour, climatic influences, occupancy patterns and pollutant emission characteristics.

The AIVC was established in 1979 and aims to offer industry and research organisations technical support to optimise ventilation technology. A range of services and facilities are offered, including a comprehensive database of literature, standards and ventilation data.

The project also produces a series of guides and technical notes. An annual conference is held, together with a technical workshop. Up-to-date news is published in a quarterly newsletter, 'Air Information Review' with an accompanying CD. A dynamic website provides the publications in electronic format for download, together with subscription information. (Access is free of charge for researchers in Belgium, France, Germany, Greece, Netherlands, Norway and USA.)

Latest Products

Recent publications include:-

- A new 'Ventilation Information Paper' (VIP) entitled 'Report of the 2nd European Blower Door Symposium 2007'
- A new 'Ventilation Information Paper' (VIP) entitled ' Air Quality in Passenger Aircraft'
- National 'VIPs' available on 'Trends in National Building Ventilation Markets and Drivers for Change' for Belgium, England, France, Finland, Norway, US, Brazil, Poland, Japan and Korea
- A new Technical Note: 'Energy and Indoor Environmental Quality of Low Income Households'
- A new Technical Note: 'Natural and Hybrid Ventilation in the Urban Environment'
- A new Literature List: 'Overview of Reports from the EU-RESHYVENT Project on Residential Hybrid Ventilation'
- A new 'Contributed Report' entitled 'Air Leakage of US Homes: Model Prediction'
- A new 'Contributed Report' entitled 'Ventilation Behaviour and Household Characteristics in New California Houses'.

The proceedings of the annual AIVC conference are available to order. Recent conferences were entitled 'Building Low Energy Cooling and Advanced Ventilation Technologies in the 21st Century' (2007 - Crete) and 'Advanced Building Ventilation and Environmental Technology for Addressing Climate Change Issues' (2008 - Kyoto)

Access is also provided to many external publications such as technical reports, conference proceedings and newsletters from various agencies concerned with aspects of ventilation such as European Collaborative Action on Urban Air, Indoor Environment and Human Exposure; Lawrence Berkeley National Laboratory; IBSPA; IAQVEC; PALENC; CLIMA and many others.

The Operating Agent is Peter Wouters of INIVE eeig and the Belgian Building Research Institute.

Participating Countries are: Belgium, Czech Republic, France, Greece, Japan, Netherlands, Norway, Republic of Korea, and USA

Quarterly newsletter 'Air Information Review'

Leading participants

The AIVC Website

Integrating Environmentally Responsive Elements in Buildings

Energy usage from room heating, cooling and ventilation still accounts for more than one third of the total, primary energy demand in the industrialised countries, and is in this way a major polluter of the environment with CO_2 and greenhouse gases. To achieve the targets set out in the Kyoto protocols it is necessary to identify innovative energy technologies and solutions for the medium and long term which facilitate the implementation and integration of low carbon technologies, such as renewable power generation devices within the built environment.

Research into building energy efficiency over the last decade has focused on efficiency improvement of specific building elements, such as the building envelope, and building equipment such as heating, ventilation, air handling, cooling equipment and lighting. The greatest future potential however, lies with technologies that promote the integration of active building elements and communication among building services. In this perspective, 'whole building concepts' are defined as solutions where reactive building elements together with service functions are integrated into one system to reach an optimal environmental performance in terms of energy performance, resource consumption, ecological loadings and indoor environmental quality.

'Reactive building elements' are defined as building construction elements which are actively used for the transfer of heat, light, water and air. This means that construction elements (such as floors, walls, roofs, foundation etc) are logically and rationally combined and integrated with building service functions such as heating, cooling, ventilation and energy storage. The development, application and implementation of reactive building elements are considered to be a necessary step towards further energy efficiency improvements in the built environment.

With the integration of reactive building elements and building services, building design completely changes from design of individual systems to integrated design of 'whole building concepts', augmented by 'intelligent' systems and equipment. The development of enabling technologies such as sensors, controls and information systems is needed to enable the integration. Design strategies should allow for optimal use of natural energy strategies (such as daylighting, natural ventilation, passive cooling) as well as the integration of renewable energy devices.

This project aims to:

- Define state-of-the-art of reactive building elements
- Improve and optimise reactive building elements and technologies
- Develop and optimise new building concepts with the integration of reactive building elements and building services, as well as natural and renewable energy strategies
- Develop tools for the early assessment of the impact of reactive building elements on the environmental performance of buildings
- Develop guidelines for procedures and tools for detailed simulation of environmental performance of reactive building elements and integrated building concepts.

Products

Results from this project will be collected and transformed into information that meets the needs of the main target groups. The products will be available from the project website, when the project is finished. The main products will be:

- A State-of-the-Art Report on responsive building elements, integrated building concepts as well as integrated design methods and environmental performance assessment tools (The main target group here is researchers)
- A Manufacturers' Guide for the development, optimization and performance assessment of responsive building elements, including examples of application in integrated building concepts (The main target group here is manufacturers)
- A Designers' Guide for the design of integrated building concepts, including integration of responsive building elements and HVAC-systems and built examples, and for the rough evaluation of building performance with regard to functionality, flexibility, energy savings, indoor climate, robustness and cost. (The main target group here is architects)
- An Experts' Guide with detailed information regarding the design and analysis of integrated building concepts, integration strategies of responsive building elements and HVAC-systems and optimum use of simulation methods and tools to assess the environmental performance and robustness of integrated building concepts. (The main target group here is engineers)
- A General Booklet describing the principles of responsive building elements and integrated building concepts, their benefits and limitations, economical feasibility and impact on energy savings, company image, comfort, productivity, building functionality and flexibility. (The main target group here is building owners, developers and end users)
- Journal articles, conference papers and working reports with detailed information of project research results. (Themain target group here is researchers)

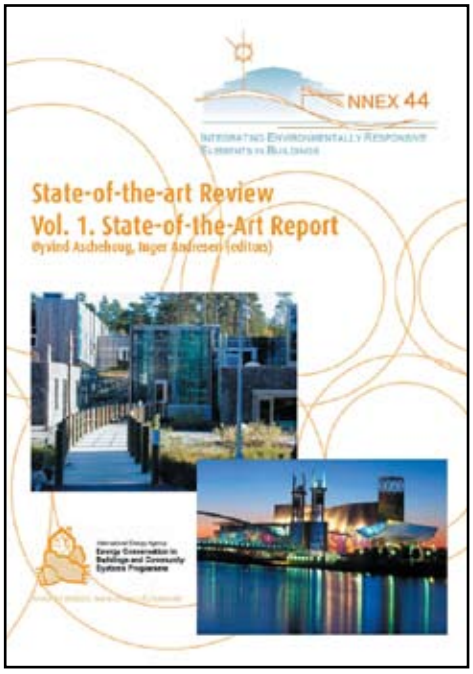
State-of-the-Art Report

The first product, a State-of-the-Art Report, was published in June 2007, and is available at the ECBCS and project websites. The project focuses on five specific responsive building elements (RBE), whose perspective of improvement and widespread implementation in the building sector seem to be promising. The report presents the state-of-the-art of these five RBEs and analyses the working principles, design criteria and typical application fields, as well as the benefits claimed and limitations. The five RBEs are:

- An Advanced Integrated Façade
- Thermal Mass
- Earth Coupling
- Dynamic Insulation Walls
- Phase Change Materials

The report includes descriptions of twenty-two case study buildings with integrated building concepts.

It also includes a review of three different integrated design methods and five computer-based tools.



This project will run for four years from 2005-2008 and involves about twenty-five research institutes, universities and private companies from fourteen countries around the world.

The Operating Agent is Per Heiselberg, Aalborg University, Denmark.

Participating Countries are: Austria, Canada, China, Denmark, France, Italy, Japan, Norway, Portugal, Sweden, Netherlands, UK, USA

Energy Efficient Future Lighting for Buildings

The goal of this project is to identify and to accelerate the widespread use of appropriate energy efficient high-quality lighting technologies and their integration with other building systems, making them the preferred choice of lighting designers, owners and users.

The aim is to assess and document the technical performance of existing promising but largely underutilised, innovative lighting technologies as well as future lighting technologies and their impact on other building equipment and systems (i.e. daylighting, HVAC). These novel lighting system concepts have to meet the functional, aesthetic and comfort requirements of building occupants.

The more efficient use of lighting energy would limit the rate of increase of electric power consumption, reduce the economic and social costs resulting from constructing new generating capacity, and reduce the emissions of greenhouse gases and other pollutants. Interesting aspects of desired lighting are energy savings, daylight use, individual control of light, quality of light, emissions during life cycle and total costs. The demands for the new light sources are: higher efficiency, ecological aspects, lower costs, better light quality, a longer lifetime, suitability for dimming, control and other value added features.

Research Areas

- Targets for Energy Performance and Human Wellbeing

This area of the research aims to document the effect of design on energy use, lighting quality and human performance, as well as assessing barriers to the adoption of energy efficient human-friendly lighting design.

- Innovative Technical Solutions

Aims to identify, assess and document the performance, energy and economic criteria of existing promising and innovative future lighting technologies, and their impact on other building equipment and systems. The purpose is to reduce the energy used by transferring information on concepts and products to consultants, public authorities and building owners.

- Energy Efficient Controls and Integration

This research area will focus on controls that enable the occupant and facility manager to modify the electric lighting according to personal needs and preferences, within acceptable building operative requirements. Based on modern communication technology, personalisation and integration of these controls with other building systems will be important.

- Documentation and Dissemination – including a design guidebook, semi-annual newsletter, seminars and a website

The objective here is to positively influence current lighting practices in a manner that accelerates the use of energy efficient products, improves overall building performance and enhances occupant's environmental satisfaction. The main target groups are designers and end-users/owners. The results are also disseminated by delivering information to standards and recommendations and by providing educational material to educational institutions in order to positively influence future lighting professionals.

Products

The Guidebook of Energy Efficient Lighting will be the final product of the project. It will be published as a book, a CD and on the web. In addition there will be newsletters and seminars. Technical reports, scientific papers and conference papers will also be published during the project.

Meetings

The most recent Expert Meeting included an International Workshop “Visual Quality and Energy Efficiency in Indoor Lighting: Today for Tomorrow” at University “La Sapienza”, Italy. The work of this project was presented by Prof Liisa Halonen, while many presentations focused on the launching of LED technology, as it is one of the major tools to reduce electricity consumption related to lighting, and on efficient solutions to integrate natural and artificial light to save energy and improve visual quality in buildings.

The project will run from 2004-2008

The Operating Agent is Liisa Halonen of Helsinki University of Technology, Finland.

Participating countries are: Austria, Belgium, Canada, Finland, France, Norway, Poland and Switzerland.

Project participants attend ‘Visual Quality and Energy Efficiency in Indoor Lighting: Today for Tomorrow’ - Workshop held in Rome

Holistic Assessment Toolkit on Energy Efficient Retrofit Measures for Government Buildings

Analysis of non-residential building structures shows that many government buildings are characterised by high energy consumption. Decisions to retrofit are also often made without sufficient consideration of the many energy saving options available to retrofit designers, and energy saving measures are seldom applied when these buildings are retrofitted. In fact, such considerations can be facilitated by the use of some simple tools. The 'IT Toolkit' being developed in this project will help the target group make informed decisions on government building energy retrofits.

The government non-residential buildings considered may include, for example, office buildings, hospitals, large one-storey production facilities and maintenance shops and specialty warehouses.

The target audience will be executive decision makers and energy managers of government buildings, performance contractors and designers. The IT-Toolkit EnERGo, supplemented by guidelines and best practice examples, will support these different user groups, and facilitate communication between them.

The objectives of this project are:

- To provide tools and guidelines for decision makers and energy managers, performance contractors and designers, to improve the working environment of government buildings through energy-efficient retrofitting projects. (Though the focus of this project is on government buildings, many results can be applied to similar private sector buildings);
- To provide recommendations on how to operate the retrofitted buildings;
- To promote energy- and cost-efficient retrofit measures by providing successful examples;
- To support decision makers in evaluating the efficiency and acceptability of available concepts;
- To find improved ways of using Energy Performance Contracts (ESPC's) for government building retrofit measures.

To accomplish these objectives, the researchers will carry out research and development to produce the following:

- An energy assessment and analysis methodology/protocol and a tool, "Energy Assessment Guide for Energy Managers and ESCO's "

Since the beginning of the project, team members have analysed best practices and procedures for identifying energy conservation opportunities in retrofitted government and public buildings. The opportunities relate to the building envelope, lighting, internal loads, HVAC, and other mechanical and energy systems. The first Energy Assessment Protocol focused on industrial buildings, and was published by U.S. Army Corps of Engineers in October 2006. It was reviewed and tested during energy assessments at some U.S. Army installations in Germany and the USA in 2006 and 2007. The protocol helped streamline the energy audit process and reporting, increase the scope and effectiveness of energy assessments, and reduced their costs. Experiences gained in these field tests will be used to improve the Energy Assessment Protocol for industrial buildings and to further develop the protocol for non-industrial buildings. New showcase assessments in Germany, Italy, Korea and the USA to be conducted by international teams have been planned for 2008.

- A database of "Energy Saving Technologies and Measures for Government Building Retrofits" with examples of best practice

This project team is developing a database of promising energy saving technologies and measures. These include technologies/measures that relate to the building envelope, internal load reduction, lighting, HVAC systems, energy consuming processes in the building, and supplemental energy systems such as compressed air.

The computer programs ESPr and Energy Plus have been identified to screen selected candidate technologies. The first set of twenty industrial energy conservation measures has been developed using the designed templates, showing energy savings and payback analyses for twelve USA climatic conditions. The figure shows a sample daylighting technology information included in the templates.

- "Best Practice Guidelines for Innovative Energy Performance Contracts"

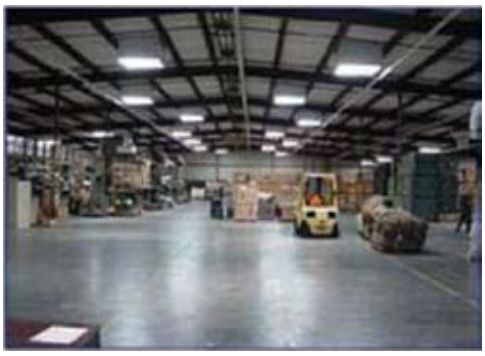
This part of the project aims to identify and document the approaches countries have used to implement successful EPCs projects at government facilities in their countries, and to develop a set of consensus recommendations that can be used to improve existing EPCs programs, and to implement new programs in countries that lack them. These recommendations will be compiled in a 'Best Practice Guide for Innovative Energy Performance Contracts'. The guide will be translated as necessary into other languages for use by participating countries.

- The IT-Toolkit "EnERGo"

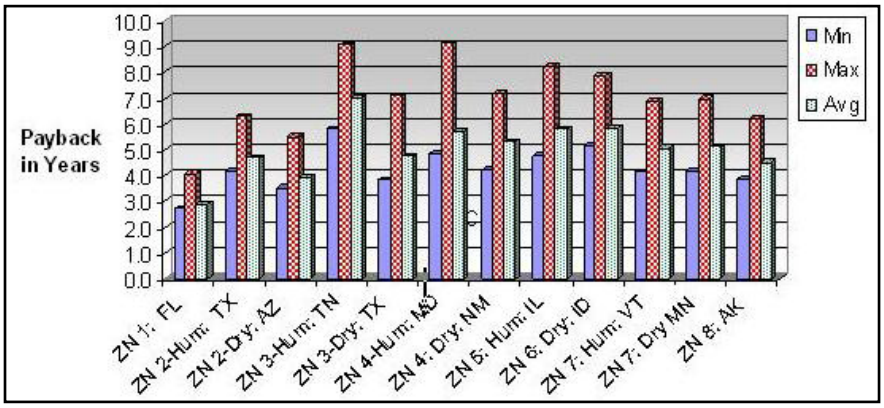
This research team will develop an electronic interactive source book. A central database will include all project results and will allow users to obtain extensive information, according to their individual focus of interest: energy saving opportunities, design inspirations, design advice, decision tools, design tools, commissioning methods, long-term monitoring systems and measures that require no financial investment. The German

standard DIN V 18599 is the agreed calculation code to be used with the following national databases to be provided: climate, fuel data, age-dependent components/systems, standard user profiles, alternative efficiency figures, costs. Two calculation tools were defined to make validation tests for the IT-Toolkit: ESP-r and RETSCREEN.

So far a total of seven project workshops have been organised in Canada, Finland, France, and the USA. A special workshop was held as part of the EPIC 2006 AIVC Conference in Lyon, France. These presentations have gained support for the project from international industry experts. A further workshop, “Energy Efficient Technologies for Government Buildings – New and Retrofits” took place in New York, USA in January 2008.



A typical commercial application



Estimated payback shown for high, medium and low energy rates

The project will run from 2005 to 2008.

The Operating Agent for this project is Dr Alexander Zhivov, US Army Corps of Engineers, Energy Branch, USA.

Participating Countries are: Canada, Denmark, Finland, France, Germany, Italy, Russia, UK, and USA

Cost Effective Commissioning of Existing and Low Energy Buildings

This project, underway since June 2006, includes twelve participating countries represented by over fifty organisations.

Commissioning methods and tools are necessary to ensure that buildings reach their technical potential and operate energy-efficiently. However, documented commissioning methods are currently only available for some conventional HVAC systems and do not address the advanced systems and system combinations that are important for low energy buildings. Although the current focus of commissioning practice is to attempt to make buildings work as designed, significant additional energy savings can be achieved by commissioning to optimise building operation based on actual occupancy and use. This approach to 'field optimisation' of building HVAC systems considers the long-term persistence of savings and benefits achieved during the commissioning process.

The goal of this project is to enable the cost-effective commissioning of existing and future buildings in order to improve their operating performance. The commissioning techniques developed here will help move the industry from the intuitive approach that is currently employed in the operation of buildings to a more systematic operation that focuses on achieving significant energy savings. It will also exchange information on commissioning practices in different countries and disseminate relevant information to national practitioners.

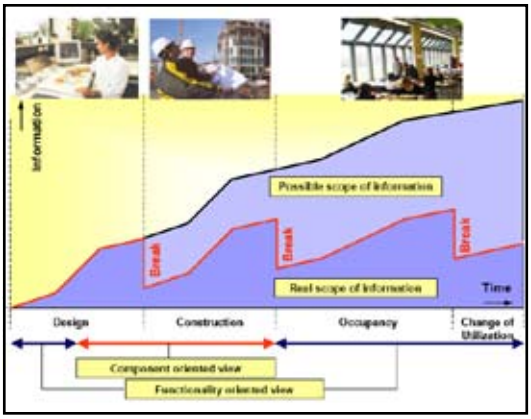
The objectives of this project are:

- To extend existing methods and tools to address advanced systems and low energy buildings, utilizing design data and the buildings' own systems in commissioning.
- To automate the commissioning process to every extent practicable
- To develop methodologies and tools to improve the operation of buildings in use.
- To quantify and improve the costs and benefits of commissioning, including the persistence of benefits and the role of automated tools in improving persistence and reducing costs without sacrificing other important commissioning considerations.

The scope includes initial commissioning for advanced and low energy systems, re-commissioning and optimising existing buildings, and quantifying the costs and benefits of commissioning.

Key outputs of the project will include:

- Methods and tools for commissioning advanced systems and low energy buildings;
- Methods and tools for field application;
- Information on the costs and benefits that can be used to promote the wider use of commissioning



Design, construction, commissioning, and operations and maintenance are typically done by different people and even different companies. By changing the players within a project, knowledge that would be helpful or even important for future tasks is often lost. Due to the difficulty of maintaining consistent information representation, not all data available in the previous phase is made available when transitioning to subsequent phases. Design intent information is no longer kept in working drawings and design specifications, the complete design specifications are no longer available in the commissioning report, and O&M manuals rarely contain information about the insights gained during commissioning. Therefore, information rapidly atrophies during these transition points (e.g., 'Real scope of information') and has to be subsequently recovered.

Data Collection

An ambitious project to document the energy savings and non-energy benefits of commissioning forms part of the project. The data collected will be used to demonstrate the cost-effectiveness of commissioning to building owners and to assist in government policy-making. The survey forms can be downloaded at the project's website, and all interested parties are invited to participate.

Recommissioning and Optimising Existing Buildings – One Phase of the Research

For conventional buildings, the interest to improve methodologies and develop automated and semi-automated tools for commissioning and optimisation is based on the sheer number of buildings, their high energy consumption, and the fact that very few have been commissioned. Therefore significant energy savings are achievable at the national level by applying cost effective processes for commissioning and optimisation of building envelopes, HVAC systems, and building energy

management systems (BEMS) in conventional buildings.

Conventional buildings often lack design data, have limited monitored data and the addition of new sensors and minor refinement of present systems must be shown to be cost-effective. Also the goal for recommissioning is usually to get the best performance with existing systems - in contrast, new low energy buildings do have design data and the goal for commissioning is performance verification.

In all buildings, thorough documentation is important to build the benchmark for the persistence of energy savings and system performance.

The tools that are being adapted and/or developed by this project are classified as follows:-

- Tools for active testing, where setpoint changes or control overrides are used to force equipment and system responses;
- Tools for passive monitoring, where performance is assessed under normal and optimal operating conditions
- Tools for data management, which help facilitate testing and data analysis
- Tools for system operator training

More than a dozen tools are under development in the specific project research area of 'Recommissioning and Optimising Existing Buildings', such as the following:-

- Commissioning (Cx) tool for HVAC systems
- Cx tool for the whole building
- Cx tool for energy plants
- Control loop Cx Software

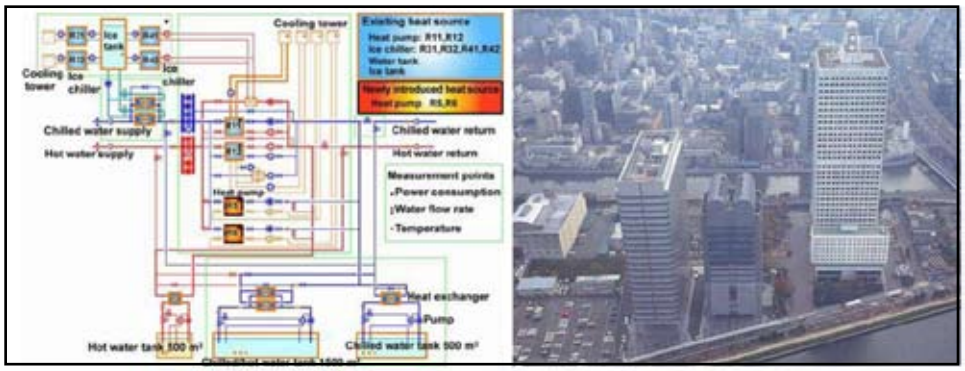
These tools will be tested and documented in case studies that will be published as part of the project deliverables.

The project will run from 2005 to 2008

The Operating Agents are Daniel Choinière and Natascha Castro

The Participating Countries are: Belgium, Canada, Czech Republic, Finland, France, Germany, Hong Kong/China, Hungary, Japan, Netherlands, Norway, and USA

Project participants



A generic commissioning tool is under development for the energy plant which supplies chilled/hot water to three commercial buildings.

Heat Pumping and Reversible Air Conditioning

Substituting a boiler with a heat pump may save more than 50% of primary energy, if electricity is produced by a modern gas-steam power plant (and even more if a part of that electricity is produced from a renewable source). 'Heat pumping' is probably today one of the quickest and safest solutions to save energy and to reduce CO_2 emissions. The aim of this project is to promote the best heat pumping techniques applicable in the air conditioning of commercial buildings. Focus is given to the integration of these techniques inside the whole air conditioning system.

The project's specific objectives include:-

- Making air conditioning as reversible as possible;
- Making the best use of the currently available technology;
- Making extensive use of information gathered in other past ECBCS, Solar Heating and Cooling and Heat Pump projects;
- Taking careful account of the specific characteristics of the building, the occupancy and the climate;
- Establishing guidelines on where and how to use each type of equipment and identifying optimal control strategies;
- Establishing a selection of (new and existing) building types during the initial phase, according to the priorities expressed by the participants and to the specific expertise available.

Aspects of the project include:-

- Analysis of building heating and cooling demands;
- Performance analysis and comparisons among the different components and systems available;
- Design;
- Global performance evaluation and commissioning methods;
- Case studies and/or demonstration
- Dissemination

First Case Study

A recent case study carried out by this project investigated an attractive energy saving opportunity consisting of integrating a heat pumping system into an existing HVAC system. The subject is a laboratory building, erected in 2003 near Liège, Belgium. The building has offices, laboratories, a technical room, sanitary facilities and small meeting rooms. Numerical models of the building and of the coupled HVAC installation were developed on EES (Engineering Equation Solver© F-Chart Software) and used to run annual hourly simulations. Two heat pumping models were considered: condenser heat recovery and reversible heat pumping.

The building is characterised by comparable heating and cooling peak demands. Cooling and heating demands can sometimes be simultaneous in different building zones. Hence both heat pumping and condenser heat recovery strategies can be used to satisfy the building demands.

The existing air-cooled chiller has been replaced by a dual-condenser chiller equipped with air and water condensers connected in parallel. A three-way valve ensures the control of the machine and the supply of one or both condensers. The water condenser delivers hot water at a maximum of 55°C.

To enable heat pumping, the hot and humid extracted air will be used as a heat source. Around 33,000 m^3/h of hot and humid air is extracted from the laboratories. Additional air/water coils will be designed to recover the largest part of the available energy to supply the heat pump evaporator. The boilers will intervene when necessary as back-boosting devices, to provide additional heating demand.

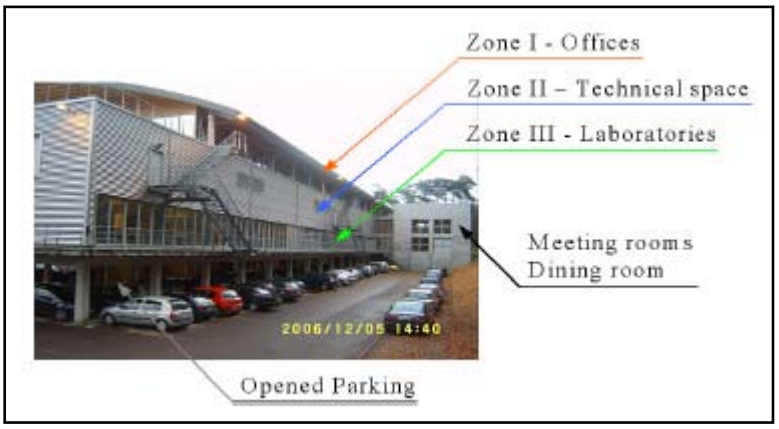
The cooling coils will be used as secondary heating coils. In this case cooling and heating coils are never used simultaneously because there is no dehumidification control. So during heating periods, the cooling coils constitute large unused heat exchangers. The changeover technique consists of using these heat exchangers to heat the air as well (In addition to the heating coils already available). The use of a larger heat transfer area permits a decrease in the hot water temperature and an improvement of the performances of the heat pump.

The economic and environmental studies reveal quite a short payback time (about seven years) and a significant reduction of natural gas consumption. Also considering the slight increase in electricity consumption, the reduction of total CO_2 emissions is about 18% below current emissions.

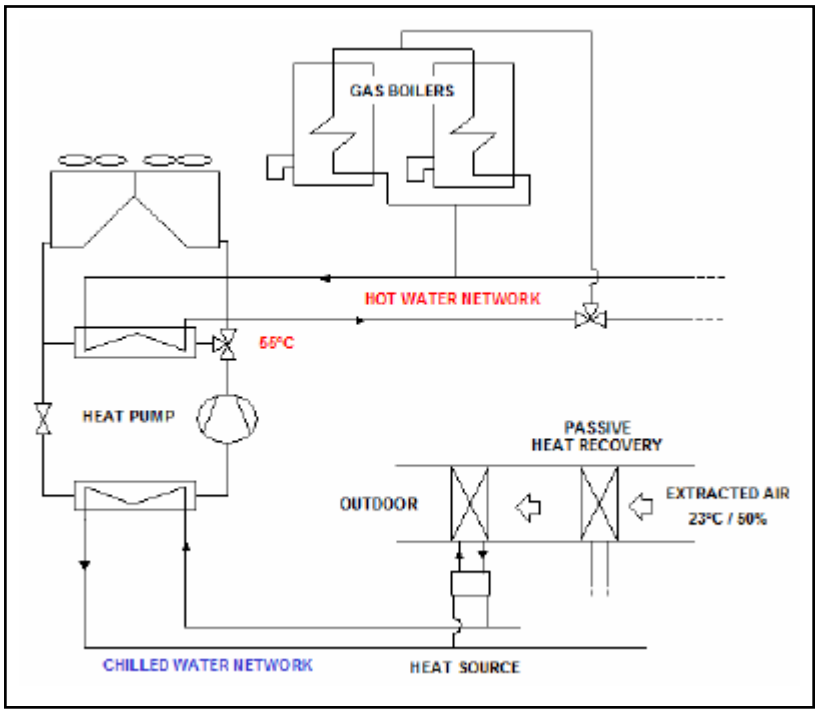
The project will run from 2006 to 2009

The Operating Agent is Professor Jean Lebrun, Lab. de Thermodynamique, Université de Liège, Belgium

Participating Countries are: Belgium, France, Germany, Italy, Switzerland



Building South Frontage



Heat pumping using the extracted air as a heat source

Low Exergy Systems for High Performance Buildings and Communities

There is an indisputable need for more efficient energy use and the reduction of CO_2 emissions, and a huge effort will have to be made to conserve high quality or primary energy resources. Even though there is still considerable energy saving potential in the building stock, there is an equal or greater potential in exergy management. This implies looking at the whole energy chain and taking into consideration the different quality levels involved, from generation to final use, in order to significantly reduce the fraction of primary or 'high-grade' energy used, thereby minimising exergy consumption.

There is a huge potential for introducing new components, technologies and system solutions to create low exergy built environments. The exergy conversion (i.e. heat or electricity production) plays a crucial part in possible future activities in the overall system optimisation of the entire energy system within a building. The target should be to establish a holistic approach for an affordable, comfortable and healthy built environment, while obtaining a minimum input of exergy, and implementing a substantial amount of renewable energy sources into the energy supply of buildings.

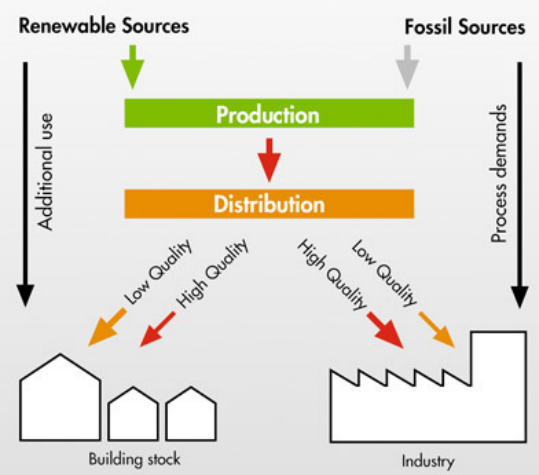
The strategies developed for a better and exergy-optimised building design, aiming at a future of clean, clever and competitive energy use will help in pinpointing specific actions to reach this goal. In addition the exergy demand of buildings will be reduced, due to new, enhanced heating and cooling systems.

This project will address the following research items:

- Combined exergy/energy analyses for community supply structures and buildings, especially those with changing ambient and boundary conditions. This will lead to the implementation of dynamic analyses for complex systems.
- Optimisation strategies for low exergy distribution and building technology system configurations.
- A mandatory holistic system approach to investigate the dependencies between energy production and the use of energy in buildings. This implies the feedback and the response of the building to the grid and energy production strategies.
- Integrated use of local renewable energy sources. Known and new innovative techniques will be evaluated using new analysis tools. The results will indicate directions for new developments.
- Better control strategies for building service systems to reduce the overall exergy demand.
- Exergy as an indicator for sustainability and for long term, cost efficient solutions.
- Indoor comfort provided by placing the minimum possible exergy demand on building service systems.

Definitions

The two parts of an energy flow can be defined as exergy and anergy. Only the exergy part of any energy flow can be converted into some kind of high-grade energy such as mechanical work or electricity. Anergy, on the other hand, refers to the part of the energy flow which cannot be converted into high-grade energy, e.g. low-grade waste heat from a power plant.



Desirable energy/exergy flow to the building stock and industry

The Project

The exergy content required to satisfy the demands for the heating and cooling of buildings is very low, since a room temperature level of about 20°C is very close to ambient conditions. Nevertheless, high quality energy sources like fossil fuels are commonly used to satisfy these small demands for exergy.

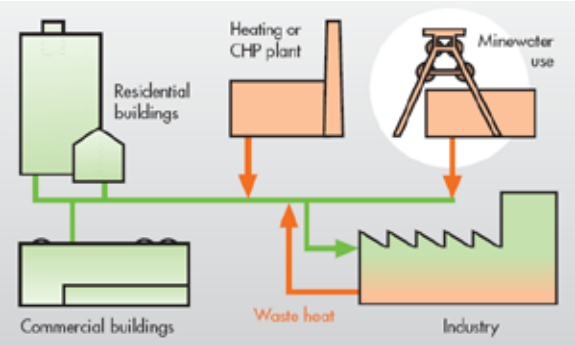
The new approach is not necessarily focused on a further reduction of the energy flow through a building's envelope: when the demands for heating and cooling have already been minimised, the low-exergy approach aims at satisfying the remaining thermal energy demand using only low quality energy.

The project aims to improve, both on a community and building level, the design of energy use strategies which account for the different qualities of energy sources, from generation and distribution to consumption within the built environment.

Low Exergy in Practice: The European Mine Water Project

Abandoned and flooded mines can be re-utilised as new sustainable energy supplies for the heating and cooling of buildings. The mine water project in Heerlen, the Netherlands shows that temperatures of 28°C to 30°C can be found at 700m depth, and 16°C to 17°C at 200m. These temperatures can be used for heating and cooling buildings if the buildings are very well insulated, have energy efficient ventilation systems and have suitable emission systems which can be operated with moderated temperatures like floor heating or concrete core activation. Despite the rather high investment costs, such projects can be economically profitable by avoiding additional cooling systems and with integrated design, and if energy exploitation is organised by the investors.

A series of expert meetings, workshops and a conference are planned for the near future.



The integration of energy sources from our environment, e.g. the use of water from abandoned mines for heating or cooling of buildings, requires exergy efficient supply systems at the community level and adapted building service systems.

Planned Results

The primary presentation of the project is expected to be an IT based guidebook on how to implement advanced 'LowEx' technology at a community level in the built environment and how to optimise supply structures to ensure low exergy demand of the system solution, while providing good comfort to the occupants and users of the buildings.

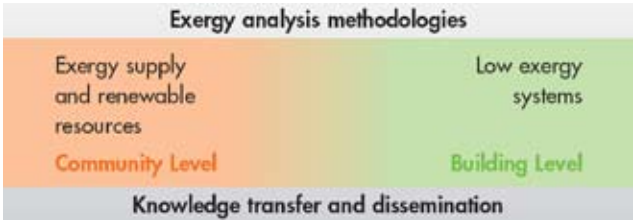
Other expected results include the following:-

- Design guidelines regarding exergy metrics for performance and sustainability
- Open-platform exergy software for building design and performance assessment
- Best practice examples for new and retrofit buildings and communities
- Demonstration projects
- Policy measures and pre-normative work

The project will run from 2005 to 2009.

The Operating Agent is Dr Dietrich Schmidt, Fraunhofer-Institute for Building Physics, Germany.

Participating Countries are: Austria, Canada, China, Finland, Germany, Greece, Japan, Poland, Sweden, Switzerland, Netherlands, and USA



Project structure

Prefabricated Systems for Low Energy Renovation of Residential Buildings

Existing buildings account for more than 80% of energy consumption in the housing stock. If building renovation were to continue at the current rate and with the present common policy, it would take between one and four centuries to improve the building stock to the energy level of current new construction.

Achieving optimal energy improvement results demands a whole building approach as opposed to addressing isolated building components, e.g. roofs, façades or heating systems. This project aims to develop and demonstrate an innovative whole building renovation concept for typical apartment buildings (apartment buildings represent approximately 40% of the European dwelling stock) based on:-

- Prototype, prefabricated roof systems with integrated HVAC, hot water and solar systems;
- Highly insulated envelopes with integrated new distribution systems for heating, cooling and ventilation.

The advantages of these prototypes include:

- Achieving energy efficiency and comfort for existing apartment buildings comparable to new advanced low energy buildings;
- Optimised construction and quality and cost efficiency due to prefabrication;
- Opportunity to create attractive new living space in the prefabricated attic space and by incorporating existing balconies into the living space;
- A quick renewal process with minimisal disturbance for the inhabitants.

The project will concentrate on:

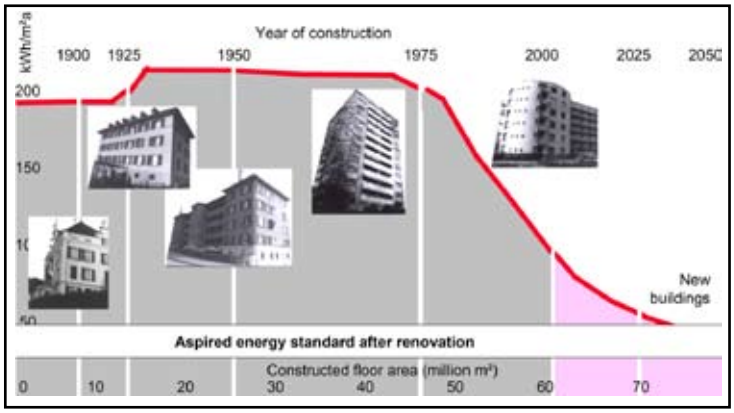
- Minimising the primary energy consumption (in the range of 30-50 kWh/(m^2·year) for heating, cooling and hot water, per gross floor area);
- Optimising the integration of solar energy use;
- Increasing living comfort by better space use;
- Ensuring good thermal and acoustical comfort, good indoor air quality and daylighting conditions;
- Ensuring a fast, high quality and cost-effective construction process.

The research will fall into five categories: concept definition and specification; integrated roof systems; HVAC and solar systems; façade elements; monitoring and dissemination.

Major improvements are expected regarding standardisation of renovation processes and energy levels for retrofitted buildings. The figure shows the relationship between unrefurbished existing (Swiss) residential buildings and the ambitious energy standard aspired to in the project.

Energy consumption of Swiss residential buildings (Canton of Zurich) for different construction periods and the aspired-to energy standard for buildings constructed 1925-1990.

The project's renovation concept is based on standardised renovation modules that have been designed and developed by the research partners in close cooperation with the building industry. About 150 buildings from all the participating countries have been analysed to create a typological profile containing 36 building parameters for each building.



Energy consumption of Swiss residential buildings (Canton of Zurich) for different construction periods and the aspired-to energy standard for buildings constructed 1925 – 1990

A set of representative European building types will be described and used for the development of the modular renovation concept, hence the modules will have a large multiplication potential. Twelve types are presently being studied and specified.

Figure: Typology of renovation modules

A novelty of this project is the integration of a ventilation system into the façade construction. Innovative solutions are studied to integrate the piping system into the insulation layer and to apply vacuum insulation to compensate locally for the additional thermal loss. This concept avoids extensive construction work inside the building and makes it possible for the building to be inhabited during refurbishment.

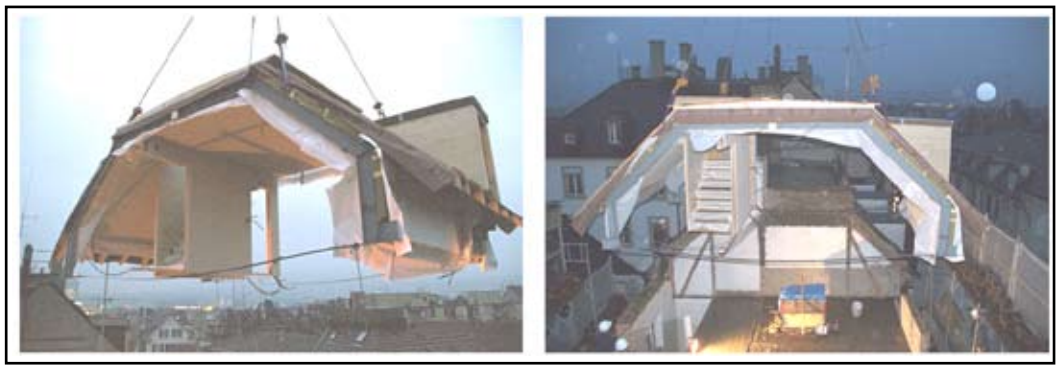
3-D Laser Scanning

One of the challenges specifically related to the prefabrication of large renovation modules is the availability of reliable three-dimensional geometrical data of the buildings. Existing buildings normally have dimensions that differ from those the building plans show, and are often not right-angled as one would expect. A special subtask of the project therefore deals with advanced geomatics using laser scanning to obtain an accurate three-dimensional picture of the building.

The aim of the project is to apply the most advanced metrology and to develop suitable, cost-effective measurement procedures for building refurbishment.

Products of the Research

Most of the participating countries are planning to build demonstration buildings to apply the newly developed technologies. Among the final results will be a 'Retrofit Advisor' based on a software tool that will allow users to evaluate the best strategy for the building refurbishment. It will include the results of the building typology, and will do an economic, environmental and social evaluation of retrofit and reconstruction strategies.



New roof elements are lifted onto the building. The new roof is completed within hours.

Apartment building after renovation

The project will run from 2007 to 2010.

The Operating Agent is Mark Zimmermann, EMPA, Switzerland.

Participating Countries are: Austria, Belgium, Czech Republic, France, Germany, Netherlands, Portugal, Sweden, and Switzerland

Energy Efficient Communities: Case Studies and Strategic Guidance for Urban Decision Makers

This project is currently in its preparation phase, with the full launch due in January 2009.

The project's scope covers the design of long-term energy conservation and greenhouse gas mitigation strategies and their continuous optimisation either on a community level or on the level of a municipal quarter. A holistic approach is decisive for the spectrum of measures that are to be developed – encompassing generation, supply, transport and use/demand of energy and considering short-term as well as long-term measures – in order to ensure the best possible economic management methods using delegation of responsibilities, marketing and conflict resolution.

It will be necessary to use integrated evaluation methods and tools suited to identifying an optimised combination of measures that will increase the overall energy chain efficiency in communities 'from cradle to grave' will be necessary.

The project will address the following research issues:

- The energy conservation approach: how to find the economic minimum of energy demand using recent advances in building physics, heating/ventilating innovations and "smart building" potentials
- The low exergy approach: how to minimise exergy consumption during energy distribution and supply in communities
- The renewables approach: how to maximise contributions of solar, biomass, geothermal technologies etc., by integrating them into existing or new supply structures. Potentials of existing and novel technologies will be evaluated using new analysis tools.
- The holistic system approach: evaluation of the dependencies between energy supply and energy demand within the communities and development of a long-term strategy for the system as a whole including distribution.

An experts' workshop took place in Eindhoven, Netherlands as part of the project's preparation phase, with presentations from experts from France, Canada, Netherlands, Germany and Japan giving an overview of the ongoing activities in these countries concerning urban energy issues.

The discussion identified a strong increase of interest in sustainability issues in community administrations as a result of pressure both from national and urban politics. Ambitious targets have subsequently been set – such as a decrease of CO_2 emissions by 50% within the next 20 years – but with limited understanding of the consequences. The difficulties in achieving such targets are not caused by a lack of available technologies, but by insufficient know-how on strategic planning, management abilities during the implementation process, and availability of tools and instruments for decision making, planning and monitoring. The project's work plan aims to reflect this situation and – as its main objective – provide a practical guide for urban decision makers on how to achieve ambitious energy and CO_2 targets on a local and urban scale.

The purpose will be to provide urban administrations, urban planners and other urban stakeholders with the necessary knowledge and means to be able to define reasonable goals in terms of energy efficiency, energy conservation and GHG abatement on a community level. The project's focus therefore is not on technical innovation, as in most other ECBCS projects, but on innovation in terms of the planning approach and implementation strategies, enabling stakeholders within communities to establish a successful local energy or climate change policy.

The research will be divided into four areas:

- Organisational Models, Implementation Instruments and Planning Tools for Local Administration and Developers – a State of the Art Review
- Case Studies on Energy Planning and Implementation Strategies for Neighbourhoods, Quarters and Municipal Areas
- Case Studies on the Preparation of Integrated Energy and CO_2 Abatement Concepts for Towns or Cities and Implementation Strategies.
- Instruments for a Successful Community Energy Policy.

Deliverables

- Dissemination

A web-based information platform, open seminars (on a national basis) and scientific publications will be used for the dissemination of information, targeted at decision makers in communities: city administration, housing companies, utilities, and planners.

- The Community Energy Concept Adviser

This tool aims to support the conception of energy efficiency and conservation technologies and the optimisation of supply structures to ensure a low fossil-energy consumption of a typical neighbourhood/quarter. It is a new approach that needs to prove that it will deliver a tool that will be usable in practice.

- 'Energy Efficient Communities: A Practical Guidebook for Successful Urban Energy Planning'

This project is focused on the practical approaches and methods and their use in concrete urban planning projects based on the project's evaluated case studies.

Also

- Design guidelines based on criteria for performance and sustainability, distinguishing between newly built areas and urban retrofit projects. This will include a possible classification of energy supply technologies in communities in terms of performance and improvement potential.
- Catalogue of verified open-platform and commercial software for the design of “LowExergy” (in collaboration with Annex 49, “Low Exergy Systems for High Performance Buildings and Communities”) as well as for conventional energy supply structures and energy conservation measures in communities, in order to determine energy use performance.
- Recommendations for policy measures - local and national - within participating countries.

The project will run from 2007 to 2011.

The Operating Agent is Reinhard Jank of Volkswohnung GmbH, Germany.

Participating Countries are to be confirmed shortly.

ECBCS and the IEA

The International Energy Agency

The International Energy Agency (IEA) was established as an autonomous body within the Organisation for Economic Co-operation and Development (OECD) in 974. Its purpose is to strengthen co-operation in the vital area of energy policy. As one element of this programme, member countries take part in various energy research, development and demonstration activities that are instituted through a series of Implementing Agreements. There are numerous advantages to international energy technology RD&D collaboration through the IEA, including:

- Reduced cost and duplication of work
- Greater project scale
- Information sharing and networking
- Linking IEA member countries and non-member countries
- Linking research, industry and policy
- Accelerated development and deployment
- Harmonised technical standards
- Strengthened national RD&D capabilities
- Intellectual property rights protection

More information may be found at: www.iea.org/textbase/papers/2005/impag_faq.pdf

About ECBCS

Approximately one third of primary energy is consumed in non-industrial buildings such as dwellings, offices, hospitals, and schools where it is utilised for the heating and cooling, lighting and operation of appliances. In terms of the total energy end-use, this consumption is comparable to that used in the entire transport sector. Hence the building sector represents a major contribution to fossil fuel use and carbon dioxide production. Following uncertainties in energy supply and concern over the risk of global warming, many countries have now introduced target values for reduced energy use in buildings. Overall, these are aimed at reducing energy consumption by between 5% and 30%. To achieve such a target, international cooperation, in which research activities and knowledge can be shared, is seen as an essential activity.

In recognition of the significance of energy use in buildings, the International Energy Agency has established an Implementing Agreement on Energy Conservation in Buildings and Community Systems (ECBCS). The function of ECBCS is to undertake research and provide an international focus for building energy efficiency. Tasks are undertaken through a series of “Annexes”, so called because they are legally established as annexes to the ECBCS Implementing Agreement. These Annexes are directed at energy saving technologies and activities that support technology application in practice. Results are also used in the formulation of international and national energy conservation policies and standards.

Objectives and Strategy

The objectives of the collaborative work conducted by the Energy Conservation in Buildings and Community Systems (ECBCS) Implementing Agreement are derived from the major trends in construction and energy markets, energy research policies in the participating countries and from the general objectives of the International Energy Agency (IEA).

The principal objective of the ECBCS is to facilitate and accelerate the introduction of new and improved energy conservation and environmentally sustainable technologies into buildings and community systems.

Specific objectives of the ECBCS programme are:

- To support the development of generic energy conservation technologies within international collaboration;
- To support technology transfer to industry and to other end-users by the dissemination of information through demonstration projects and case studies;
- To contribute to the development of design methods, test methods, measuring techniques, and evaluation/assessment methods encouraging their use for standardisation;
- To ensure acceptable indoor air quality through energy efficient ventilation techniques and strategies;
- To develop the basic knowledge of the interactions between buildings and the environment as well as the development of design and analysis methodologies to account for such interactions.

The research and development activities cover both new and existing buildings, and residential, public and commercial buildings. The main research drivers for the programme are:

- The environmental impacts of fossil fuels;
- Business process to meet energy and environmental targets;
- Building technologies to reduce energy consumption;
- Reduction of Green House Gas emissions;
- “Whole Building” performance approach;
- Sustainability;
- The impact of energy measures on indoor

health, comfort and usability;

- The exploitation of innovation and information technology'
- Integrating changes in lifestyles, work and business environment.

Mission Statement

The mission of the IEA Energy Conservation in Buildings and Community Systems Programme is as follows:

"To facilitate and accelerate the introduction of energy- conservation and environmentally sustainable technologies into healthy buildings and community systems, through innovation and research in decision-making, building assemblies and systems, and commercialisation"

Nature of ECBCS Activities

a. Formal co-ordination through shared tasks:
This represents the primary approach of developing the work of ECBCS.
The majority of Annexes are task-shared and involve a responsibility from each country to commit manpower.

b. Formal co-ordination through cost shared activities:
ECBCS currently supports one cost shared project, Annex 5, the Air Infiltration and Ventilation Centre (AIVC). In recent times, Annex 5 has sub-contracted its information dissemination activities to the Operating Agent, by means of a partial subsidy of costs and the right to exploit the Annex's past products.

c. Informal co-ordination or initiation of activities by participants:
Many organizations and groups take part in the activities of ECBCS including government bodies, universities, non-profit making research institutes and industry.

d. Information exchange: Information about associated activities is exchanged through the ECBCS and through individual Annexes.
The ECBCS Website (www.ecbcs.org), for example, provides links to associated research organizations. Participants in each Annex are frequently associated with non-IEA activities and can thus ensure a good cross-fertilization of knowledge about independent activities.
Information exchange additionally takes place through regular technical presentation sessions and 'Future Buildings Forum' workshops.
Information on independent activities is also exchanged through the ECBCS Newsletter, which, for example, carries regular reports of energy policy development and research activities taking place in various countries.

ECBCS Participating Countries

Australia	Japan
Austria	Republic of Korea
Belgium	New Zealand
Canada	Netherlands
Czech Republic	Norway
Denmark	Poland
Finland	Portugal
France	Sweden
Germany	Switzerland
Greece	Turkey
Israel	United Kingdom
Italy	United States of America

There are now twenty two IEA participating countries and two non-IEA countries in the Agreement. During the last operating period, the Czech Republic joined both the IEA and this Agreement. IEA countries that are not participants in the ECBCS Agreement are Hungary, Ireland, Luxembourg, and Spain. It is anticipated that Singapore will soon become a member country of the programme.

Coordination with Other Bodies

In order to achieve high efficiency in the R&D programme and to eliminate duplication of work it is important to collaborate with other IEA building-related Implementing Agreements. The coordination of strategic plans is a starting point to identify common R&D topics. Other actions are exchange of information, joint meetings and joint projects in areas of common interest. The duty of the chairs of the Executive Committees is to keep the others informed about their activities, seeking areas of common interest.

Collaboration with IEA Building-Related Implementing Agreements

The ECBCS Programme continues to co-ordinate its research activities, including Annexes and strategic planning, with all BRIA's (Building-Related Implementing Agreements) through collaborative Annexes and through the BCG (Buildings Coordination Group), constituted by:

District Heating And Cooling (DHC) Executive Committee Chair

Demand Side Management (DSM) Executive Committee Chair

Energy Conservation in Buildings and Community Systems (ECBCS) Executive Committee Chair

Energy Conservation through Energy Storage (ECES) Executive Committee Chair

Heat Pumping Technologies (HPT) Executive Committee Chair

Photovoltaic Power Systems (PVPS) Executive Committee Chair

Solar Heating and Cooling (SHC) Executive Committee Chair

Energy End Use Working Party (EUWP) Vice Chair for Buildings

Beyond the BCG meetings, ECBCS meets with representatives of all building-related IA's at Future Buildings Forum (FBF) Think Tanks and Workshops. It is planned that the outcome from the Future Buildings Forum Think Tank will be used strategically by the various IEA buildings-related Implementing Agreements to help in the development of their work programmes over the next five years.

Proposals for new research projects are discussed in co-ordination with these other programmes to pool expertise and to avoid duplication of research. Co-ordination with SHC is particularly strong and joint meetings are held between the programmes every two years. Both ECBCS and the Solar Heating and Cooling (SHC) programmes focus primarily on buildings and communities.

Collaboration with the IEA Solar Heating and Cooling Programme

While there are several IEA programs that are related to the building sector, the ECBCS and the Solar Heating and Cooling (SHC) programmes focus primarily on buildings and communities. Synergy between these two programmes occurs because one programme seeks to cost-effectively reduce energy demand while the other seeks to meet a large portion of this demand by solar energy. The combined effect results in buildings that require less purchased energy, thereby saving money and conventional energy resources, and reducing greenhouse gas emissions. The areas of responsibility of the two programs were reviewed and agreed. ECBCS has primary responsibility for efficient use of energy in buildings and community systems. Solar designs and solar technologies to supply energy to buildings remain the primary responsibility of the SHC Programme.

The Executive Committees coordinate the work done by the two programmes. These Executive Committees meet together every two years. At these meetings matters of common interest are discussed, including planned new tasks, program effectiveness and opportunities for greater success via coordination. The programmes agreed to a formal procedure for coordination of their work activities. Under this agreement during the initial planning for each new Annex/Task initiated by either program, the other Executive Committee is invited to determine the degree of coordination if any. This coordination may range from information exchange, inputting to the draft Annex / Task Work Plan, participating in Annex / Task meetings to joint research collaboration.

The mission statements of the two programmes are compatible in that both seek to reduce the purchased energy for buildings; one by making buildings more energy efficient and the other by using solar designs and technologies. Specifically, the missions of the two programmes are:

ECBCS programme - to facilitate and accelerate the introduction of energy- conservation and environmentally sustainable technologies into healthy buildings and community systems, through innovation and research in decision-making, building assemblies and systems, and commercialization

SHC programme - to facilitate an environmentally sustainable future through the greater use of solar designs and technologies.

The two programmes structure their work around a series of objectives. Four objectives are essentially the same for both programmes. These are:

- Technology development via international collaboration;
- Information dissemination to target audiences;
- Enhancing building standards;
- Interaction with developing countries.

The other objectives are different. The ECBCS programme addresses life cycle environmental accounting of buildings and their constituent materials and components as well as indoor air quality, while the SHC Programme addresses market impacts, and environmental benefits of solar designs and technologies. Both Executive Committees understand that they are addressing complementary aspects of the building sector and are committed to continue their coordinated approach to reducing the use of purchased energy in building sector markets.

Non-IEA Activities

A further way in which ideas are progressed and duplication is avoided is through co-operation with other building related activities. Links are maintained with other international bodies including:

The International Council for Research and Innovation in Building and Construction (CIB),

The European Commission (EC),

The International Standards Organization (ISO),

The American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE), and

International Initiative for a Sustainable Built Environment (iiSBE).

CIB: This organization, sponsored by individual groups, has its main area of interaction in spon-

sored workshops, conferences and publications. ECBCS has a formal memorandum of understanding with CIB to assist in the dissemination of results and avoidance of duplication of effort. The Secretariat of CIB periodically attends ECBCS ExCo meetings.

EC: A level of co-operation exists between the European Commission and ECBCS. The EC Framework Program sponsors research, primarily within the European Union. Typically half the project funding comes from EU resources so it can be more attractive than IEA participation. IA's provide opportunity for a wider range of country participation and hence a broader knowledge base. There is, however, much cross-pollination of ideas between the IEA and EU.

International Standards Organization: This group sets standards that can be adopted by individual countries or communities. ISO interacts with ECBCS and its information for developing standards is drawn from many sources including output from IEA activities.

iiSBE: This is the international initiative for Sustainable Built Environment. iiSBE is an international non-profit organization whose overall aim is to actively facilitate and promote the adoption of policies, methods and tools to accelerate the movement towards a global sustainable built environment. Its specific objectives include the following:

- Map current activities and establish a forum for information exchange on SBE initiatives for participating organizations, so that gaps and overlaps may be reduced and common standards established; and Increase awareness of existing SBE initiatives and issues amongst non-participating organizations and in the international user community;
- Take action on fields not covered by existing organizations and networks. ECBCS is involved with iiSBE design and information dissemination.

Latest Publications

Computer-Aided Evaluation of HVAC System Performance

Technical Synthesis Report: Computer-Aided Evaluation of HVAC System Performance

Demonstrating Automated Fault Detection and Diagnosis Methods in Real Buildings: Proceedings of VTT Symposium: 217 (external website)

Design of Energy Efficient Hybrid Ventilation (HYBVENT)

Technical Synthesis Report: Control Strategies for Hybrid Ventilation in New and Retrofitted Office Buildings (HybVent)

Hybrid Ventilation: State of the Art Report

Principles of Hybrid Ventilation

An Integral Solution for Ventilation, Health and Energy: The Second International One-Day Forum on Hybrid Ventilation

A comprehensive list of technical reports and research papers for this annex is also available at the Hybvent Website

Retrofitting of Educational Buildings

Technical Synthesis Report: Retrofitting in Educational Buildings - Energy Concept Adviser for Technical Retrofit Measures

Case Study Reports

Energy Concept Adviser

KULU – a tool for commissioning

State of the Art Overview: Questionnaire Evaluations

Overview of Retrofitting Measures

Calculation Tools for the Energy Concept Adviser

Energy Audit Procedures

Annex 36 Newsletters can also be viewed

Low Exergy Systems for Heating and Cooling of Buildings (LowEx)

Technical Synthesis Report: Low Exergy Systems for Heating and Cooling of Buildings

Heating and Cooling with Focus on Increased Energy Efficiency and Improved Comfort - Guidebook to IEA ECBCS Annex 37 Low Exergy Systems for Heating and Cooling of Buildings

The LowEx Guidebook is available at the Website, together with the following brochures, books, newsletters and software:-

Towards Sustainable Architecture (Brochure)

Guidebook Summary Report

Introduction to the Concept of Exergy - for a Better Understanding of Low-Temperature-Heating and High-Temperature-Cooling Systems

Brochure with Case Studies

Newsletters

Analysis Tool for the Exergy Chain (Excel Tool)

Solar Sustainable Housing

Sustainable Solar Housing (2 volumes) (print only)

Bioclimatic Housing: Innovative Designs for Warm Climates (print only)

The Environmental Brief: Pathways for Green Design (print only)

Business Opportunities in Sustainable Housing: A Marketing Guide Based on Houses in Ten Countries

Exemplary Sustainable Solar Houses - a set of 40 Brochures

High Performance Insulation Systems

Vacuum Insulation Panels: Study on VIP Components and Panels for Service Life Prediction of VIP in Building Applications

Vacuum Insulation in the Building Sector: Systems and Applications

Vacuum Insulation: Panel Properties and Building Applications - Summary

High Performance Thermal Insulation Systems - Vacuum Insulated Products (VIP): Proceedings of the International Conference and Workshop

Building Commissioning to Improve Energy Performance

Commissioning Tools for Improved Energy Performance: Final Report

Annex 40 CD

Commissioning Projects - around 30 papers and presentations available

Whole Building Heat, Air and Moisture Response (MOIST-ENG)

Final Report Volume 1: Modelling Principles and Common Exercises, by Monika Woloszyn and Carsten Rode

Final Report Volume 2: Experimental Analysis of Moisture Buffering, by Staf Roels

Final Report Volume 3: Boundary Conditions and Whole Building HAM Analysis, by Kumar Kumaran and Chris Sanders

Final Report Volume 4: Applications: Indoor Environment, Energy, Durability, by Andreas Holm

CD-Rom available

The Simulation of Building-Integrated Fuel Cell and Other Cogeneration Systems (COGEN-SIM)

Review of Residential Cogeneration Technologies

Methodologies for the Performance Assessment of Residential Cogeneration Systems

Review of Existing Residential Cogeneration Systems Performance Assessments and Evaluations

Residential Cogeneration Systems: A Review of the Current Technologies

European and Canadian non-HVAC Electric and DHW Load Profiles for Use in Simulating the Performance of Residential Cogeneration Systems

Specifications for Modelling Fuel Cell and Combustion-Based Residential Cogeneration Devices within Whole-Building Simulation Programs

Annex 42 Data Files

A number of data files created within this project are available for download

Testing and Validation of Building Energy Simulation Tools

In-Depth Diagnostic Cases for Ground Coupled Heat Transfer Related to Slab-on-Grade Construction, by Joel Neymark and Ron Judkoff

Annex 43/Task 34 Final Task Management Report - Testing and Validation of Building Energy Simulation Tools, by Ron Judkoff

Empirical Validations of Shading/Daylighting/Load Interactions in Building Energy Simulation Tools, by Peter Loutzenhiser, Greg Maxwell, Heinrich Manz

Double Skin Facades: A Literature Review, by T Poirazis, O Kalyanova

Integrating Environmentally Responsive Elements in Buildings

Responsive Building Elements, Integrated Building Concepts and Environmental Performance Assessment Methods: State of the Art Review

With very few exceptions, these publications are available for free download at the ECBCS website - www.ecbcs.org

Past Projects

Load Energy Determination of Buildings
Ekistics and Advanced Community Energy Systems
Energy Conservation in Residential Buildings
Glasgow Commercial Building Monitoring
Energy Systems and Design of Communities
Local Government Energy Planning
Inhabitants Behaviour with Regard to Ventilation
Minimum Ventilation Rates
Building HVAC System Simulation
Energy Auditing
Windows and Fenestration
Energy Management in Hospitals
Condensation and Energy
Energy Efficiency in Schools
BEMS 1- User Interfaces and System Integration
BEMS 2- Evaluation and Emulation Techniques
Demand Controlled Ventilation Systems
Low Slope Roof Systems
Air Flow Patterns within Buildings
Thermal Modelling
Energy Efficient Communities
Multi Zone Air Flow Modelling (COMIS)
Heat, Air and Moisture Transfer in Envelopes
Real time HEVAC Simulation

Energy Efficient Ventilation of Large Enclosures

Evaluation and Demonstration of Domestic Ventilation Systems

Low Energy Cooling Systems

Daylight in Buildings

Bringing Simulation to Application

Energy-Related Environmental Impact of Buildings

Integral Building Envelope Performance Assessment

Advanced Local Energy Planning

Computer-Aided Evaluation of HVAC System Performance

Design of Energy Efficient Hybrid Ventilation

Retrofitting of Educational Buildings

Low Exergy Systems for Heating and Cooling of Buildings

Solar Sustainable Housing

High Performance Insulation Systems

Building Commissioning to Improve Energy Performance

Whole Building Heat, Air and Moisture Response

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Energy-Efficient Future Electric Lighting for Buildings

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Holistic Assessment Toolkit on Energy Efficient Retrofit Measures for Government Buildings

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Cost Effective Commissioning of Existing and Low Energy Buildings

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