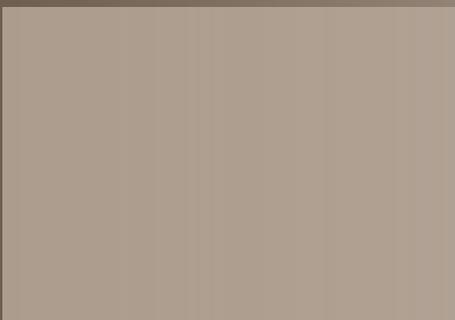
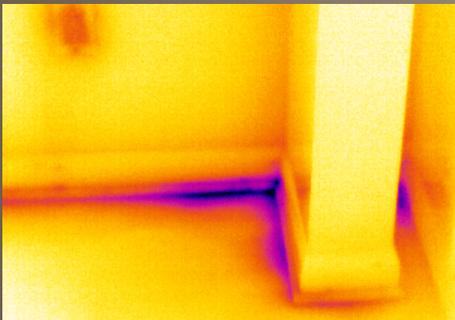




International Energy Agency

ECBCS Annual Report 2011

Energy Conservation in Buildings & Community Systems Programme



International Energy Agency

ECBCS Annual Report 2011

Energy Conservation in Buildings & Community Systems

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Energy Conservation in Buildings and Community Systems Programme



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Contents

Chair's Statement	3
New Research Projects	5
Evaluation of Embodied Energy & CO ₂ Emissions for Building Construction	
Reliable Building Energy Performance Characterisation Based on Full Scale Dynamic Measurements	
High Temperature Cooling & Low Temperature Heating in Buildings	
Completed Research Projects	9
Integrating Environmentally Responsive Elements in Buildings	
Heat Pumping & Reversible Air Conditioning	
Prefabricated Systems for Low Energy Renovation of Residential Buildings	
Ongoing Research Projects	13
Air Infiltration & Ventilation Centre	
Energy Efficient Communities	
Towards Net Zero Energy Solar Buildings	
Total Energy Use in Buildings: Analysis & Evaluation Methods	
Integration of Microgeneration & Other Energy Technologies in Buildings	
Reliability of Energy Efficient Building Retrofitting - Probability Assessment of Performance & Cost	
Cost Effective Energy & Carbon Emissions Optimization in Building Renovation	
ECBCS & the IEA	21
Background Information	27
Publications	
ECBCS Executive Committee Members	
ECBCS Operating Agents	
Past Projects	

Chair's Statement



Improving the energy efficiency of the built environment has once again become a top priority for many national administrations. Sadly, the driver for this renewed focus has arisen from a tragedy: the accident at Fukushima in March 2011, with its catastrophic consequences for people and nature, has dramatically raised the world's awareness of the risks associated with nuclear power generation. Given that the ECBCS Strategic Plan aims to provide solutions which decrease energy consumption in buildings and communities, our work has become even more important in helping to meet new policy objectives.

In the past year, our international scientific collaboration has emphasised three emerging issues: renovation of the current building stock, which consumes 40% to 50% of primary energy, occupant behaviour, which represents a key aspect of future concepts for living and working, and economic optimization of technical solutions for the reduction of energy and CO2 emissions, recalling that in OECD countries the construction sector represents an important share of GDP, up to 15%.

As presented in this Annual Report, I would like to draw attention to ECBCS' collaborative research projects, the so-called 'Annexes'. As a result of the Executive Committee's policy of addressing gaps identified in our Strategic Plan, three new projects have been initiated. Another three projects have provided final results in the form of reports and tools available to be downloaded from our webpage. Nine projects are continuing.

During the reporting period, research work conducted in the field of buildings and communities has gained further attention due to a growing number of actively participating countries. In 2011 Ireland joined the ECBCS Programme. The Executive Committee also visited France and China, where fruitful scientific exchanges have been conducted.

Finally, in the past year a regular renewal of the ECBCS Chair has taken place. The Executive Committee recognises the outstanding contribution to the leadership of the ECBCS Programme by the outgoing Chair, Dr. Morad R. Atif, during his terms between 2002 and 2011. As his successor, I greatly appreciate having received the confidence of the Committee in being elected to this important role.

There are many challenges facing the transformation of the built environment to a more sustainable state. So, I am pleased to contribute as Chair of the ECBCS programme, and as a Committee member, to the development of solutions through international research collaboration. Our Programme of research and development will continue to be conducted within a culture of open innovation.

Andreas Eckmanns

ECBCS Executive Committee Chair

New Research Projects

Evaluation of Embodied Energy & CO₂ Emissions for Building Construction

Reliable Building Energy Performance Characterisation Based on Full Scale Dynamic Measurements

High Temperature Cooling & Low Temperature Heating in Buildings

Evaluation of Embodied Energy & CO₂ Emissions for Building Construction

Annex 57

Project duration: 2011 - 2015

The total energy consumed by a building during its whole life cycle includes both embodied and operational energy. Embodied energy is 'embedded' in construction materials during all production processes, on site construction and demolition and final disposal, while operating energy is consumed in operating and maintaining the internal environment of a building.

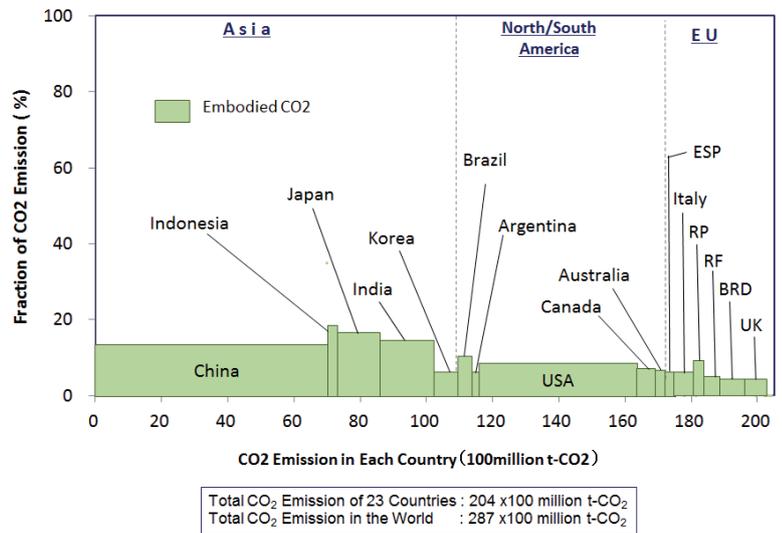
The accuracy of operational energy use and related carbon dioxide (CO₂) emissions prediction methodologies has been improving in recent years, resulting in more energy efficient building designs. As operational energy use is so reduced, the embodied energy and CO₂ emissions become proportionally more significant.

The project is investigating methods for evaluating embodied energy and CO₂ emissions of buildings, to develop guidelines that contribute to practitioners' further understanding of evaluation methods. It will then help them to find better design and construction solutions for buildings with less embodied energy and CO₂ emissions.

“Embodied energy is ‘embedded’ in construction materials during all production processes, on site construction and demolition and final disposal, while operating energy is consumed in operating and maintaining the internal environment of a building.”

Project objectives

- Collate existing research results concerning embodied energy and CO₂ emissions due to building construction, and then analyze and summarize these results within a state of the art report.
- Develop guidelines for the methods for evaluating the embodied energy and CO₂ emissions due to building construction.
- Develop guidelines for the measures to design and construct buildings with less embodied energy and CO₂ emissions.



Deliverables

- A state of the art overview of methods for evaluating the embodied energy and CO₂ emissions due to building construction
- Review of evaluation methods for embodied energy and CO₂ emissions due to building construction
- Guidelines for design and construction methods for buildings with low embodied energy and CO₂ emissions.

Progress

- A literature review is underway for existing databases and tools concerning embodied energy.
- A research framework for embodied energy intensities and the quantity of materials used in the buildings is under development.
- Development of a research framework for reduction of embodied energy is underway.

Meetings

- 1st project meeting, held in Espoo, Finland in October 2011

Operating Agent: Tatsuo Oka, Utsunomiya University, Japan

Participating Countries: Australia, P.R.China, Denmark, Finland, Germany, France, Japan, Korea, Norway, Portugal, Sweden, United Kingdom, Brazil (Observer)

Further information:
www.ecbcs.org/annexes/annex57.htm

Reliable Building Energy Performance Characterisation Based on Full Scale Dynamic

Annex 58

Project duration: 2011 - 2015

To reduce the energy use of buildings and communities, many industrialised countries have imposed stringent requirements. In most cases, evaluation and labelling of the energy performance of buildings are carried out at the design phase. Several studies have showed, however, that the actual performance after construction may deviate significantly from this theoretically designed performance. As a result, there is a growing interest in full scale testing of components and whole buildings to characterise their actual thermal performance and energy efficiency. This full scale testing approach showed not only to be of interest to study building (component) performances under actual conditions, it is also a valuable and necessary tool to deduce simplified models for advanced components and systems to integrate them into building energy simulation models.

The full scale testing studies shows that the outcome of many on site activities can be questioned in terms of accuracy and reliability. The focus of nearly all full scale testing activities is on the assessment of the components and buildings. These studies often neglect the necessity of reliable assessment methods and quality assurance issues. Full scale testing requires quality at all research phases, starting with a test environment (test cells or real buildings, accuracy of sensors and correct installation, data acquisition software, etc.). It is crucial that an experimental set-up (e.g. test lay-out, imposed boundary conditions for testing, etc.) is correctly designed, which produces reliable data. These outputs then can be used in dynamic data analysis based on advanced statistical

methods in order to provide a characteristic with reliable accuracy intervals and final use of the results. As soon as the required quality fails on one of the research phase, the results become inconclusive or useless.



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.

Project objectives

- Develop common quality procedures for dynamic full scale testing to come to a better performance analysis.
- Develop models to characterize and predict the effective thermal performances of building components and whole buildings.

Expected outcomes

- The state of the art on full scale testing and dynamic data analysis, including a survey of existing full scale test facilities for the benefit of the building industry, engineers and consultants.
- Guidance on how to perform reliable full scale dynamic testing, intended for the building industry and building research community.
- A description of the methodology to perform dynamic data analysis and performance characterisation, intended for the building research community and associates.
- A summary report (white paper) on full scale dynamic testing and data analysis to characterise building energy performance, intended for the building research community and associates.
- A few, well-documented dynamic data sets that can be used for developing dynamic data analysis procedures and for validation purpose, aimed at software developers and building research community.
- A synthesis report, demonstrating the applications of the developed framework, intended for building designers and industry, government and authorities.

Meetings

The 1st Expert Meeting was held in Leuven, Belgium in September 2011.

Operating Agent: Staf Roels, University of Leuven, Belgium

Participating Countries (provisional): Belgium, P.R.China, Czech Republic, Denmark, Finland, France, Germany, Italy, Japan, The Netherlands, Norway, Poland, Spain, United Kingdom, USA

Further information:

www.ecbcs.org/annexes/annex58.htm

High Temperature Cooling & Low Temperature Heating in Buildings

Annex 59

Project duration: 2012 - 2015

It is important to minimise temperature differences in building heating, ventilation and air conditioning (HVAC) systems because high difference result in reduced efficiencies and therefore increased energy use. The project thus is focusing on temperature differences through HVAC systems and how to minimize them in highly energy efficient buildings.

Temperature differences within HVAC systems can be classified into three types, arising from:

- heat exchange and moisture exchange,
- heat transmission through fluid media, and
- indoor terminal devices.

The project is emphasizing the above-mentioned 'temperature difference losses', and seeks to develop a unified loss analysis method. This would generate new possible solutions for building HVAC system design.

The beneficiaries of the project outcomes and deliverables will be designers and industrial manufacturers, such as chiller, radiant and supply air terminals and energy storage materials manufacturers. The outcomes will contribute to the further improvement of new HVAC terminal devices.

Research Objectives

- Establish a methodology for analysis of thermal environmental systems from the perspective of reducing mixture and transfer losses

- Develop a new concept for a temperature and humidity independent control system
- Research into radiant terminals and promising directions for the design of efficient HVAC systems for large spaces in buildings

Deliverables

- Principles of the new low temperature difference concept for use in design
- Guidelines for new HVAC system architecture for low temperature difference designs
- Proposal for new concepts, components and materials for low temperature difference systems
- Reports and source books based on case studies

Meetings

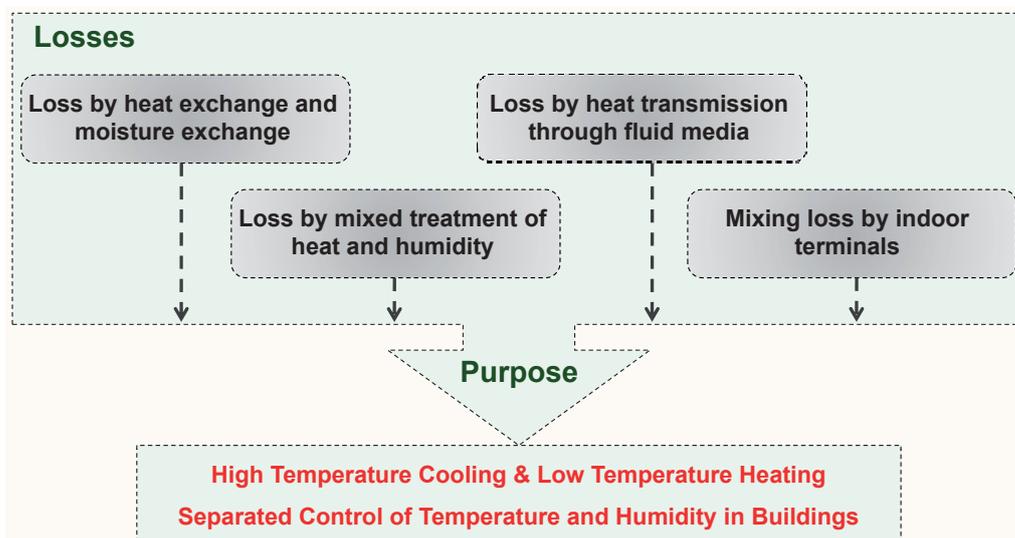
Preparatory workshop, held in San Francisco, USA, in September 2011.

Operating Agent: Yi Jiang, Tsinghua University, P.R. China

Participating Countries (provisional): Belgium, P.R.China, Denmark, Finland, Germany, Italy, Japan, USA

Further information:

www.ecbcs.org/annexes/annex59.htm



Completed Research Projects

Integrating Environmentally Responsive Elements
in Buildings

Heat Pumping & Reversible Air Conditioning

Prefabricated Systems for Low Energy Renovation
of Residential Buildings

Integrating Environmentally Responsive Elements in Buildings

Annex 44

Project duration: 2004 - 2011

The demanding energy reduction targets set in many industrialised countries require innovative building and renewable energy supply technologies to deliver substantial savings. Alongside this, recent developments in materials science, as well as information and sensor technologies offer major opportunities for creating new intelligent building components and systems.

Responsive building concepts are design solutions that maintain an appropriate balance between optimum interior conditions and environmental performance by reacting:

- in a controlled and holistic manner to changes in external or internal conditions, and
- to occupant intervention.

These concepts arise from an integrated multidisciplinary design process, which optimizes energy efficiency and includes integration of human factors and architectural considerations. So, building design teams including both architects and engineers should be formed from the outset. The design is then developed in an iterative process, progressing from conceptual ideas to the final detailed design.

In a responsive building, an optimum must be found between sometimes contradictory requirements such as energy use, health and comfort. Responsive building elements are essential technologies in the development of integrated responsive building concepts, which exploit environmental and renewable energy resources. The challenge is to achieve an optimum combination of responsive building elements and to integrate these with the building services and renewable energy systems to reach an optimal environmental performance.

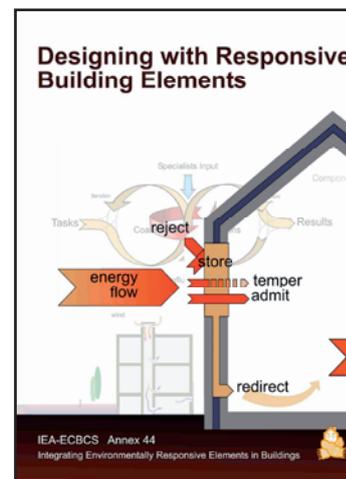
When designed using responsive concepts, buildings no longer act as rigid objects that need a large heating installation in winter and cooling equipment during summer to 'correct' the indoor climate. Rather, they become additional 'living skins' around occupants, keeping them in contact with nature, but at the same time protecting them when necessary.

The integration of responsive building elements with building services and energy-systems within responsive building concepts has a number of important advantages:

- Integration of responsive building elements with energy-systems will lead to substantial improvement in environmental and operating cost performance.
- It enhances the use and exploits the quality of energy

sources ('exergy'), by stimulating the use of renewable and low valued energy sources (like waste heat, ambient heat, residual heat, etc.)

- It will further enable and enhance the possibilities for passive and active energy storage ('buffering').
- It will integrate architectural principles into energy efficient building concepts.
- Responsive building elements lead to better tuning of available technologies in relation to the building users and their behaviour.
- It enhances the development of new technologies and elements, in which multiple functions are combined in the same building element.
- It leads to a better understanding of integrated design principles among architects and engineers



With the integration of responsive building elements, building services and renewable energy systems, building design completely changes from design of individual systems to integrated design of responsive building concepts. This should allow for optimal use of natural energy strategies (daylight, natural ventilation, passive cooling, etc.), as well as integration of renewable energy devices.

The completed ECBCS research project 'Annex 44: Integrating Environmentally Responsive Elements in Buildings' has documented expert knowledge, created guidelines and found successful examples of responsive building concepts and elements. In meeting its objectives, it has recently produced the following major publications:

- **Expert Guide. Part 1 Responsive Building Concepts**
- **Expert Guide. Part 2 Responsive Building Elements**
- **Designing with Responsive Building Element.**

Operating Agent: Per Heiselberg, Aalborg University, Denmark

Participating Countries: Austria, Canada, P.R.China, Denmark, France, Italy, Japan, Norway, Portugal, Sweden, the Netherlands, UK, USA

Further information and full publications:
www.ecbcs.org/annexes/annex44.htm

Heat Pumping & Reversible Air Conditioning

Annex 48

Project duration: 2005 - 2011

In many climates, office buildings are commonly equipped with a heat pump which has the function of providing cooling or air-conditioning of the internal spaces. The existence of this heat pump offers attractive, but rarely implemented, opportunities to improve the energy performance of the building and to reduce the energy-related carbon dioxide (CO₂) emissions.

'Heat pumping' is probably today one of the quickest and safest solutions to save energy and to reduce carbon dioxide emissions. In fact, 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). Therefore, this project is promoting the best heat pumping techniques applicable to air conditioning for commercial buildings. The specific focus is the integration of these techniques inside the whole air conditioning system. The project has investigated two options based upon the use of heat pumps, not only to provide cooling, but also to meet the heating demand, at least partially: heat recovery at the condenser and reversibility of the machine.

The project has addressed both new building projects and retrofit of existing cases. Indeed, the retrofit of an existing building, and even more so the design of a new one, should take into consideration all possibilities for heat pumping as soon as possible. Based upon a number of case studies, the research work conducted in this project has identified a number of constraints and obstacles to the application of this strategy.

This research project has examined in detail the problems raised when moving to a more systematic use of heat pumps for providing both heating and cooling to office buildings. While not all problems have been solved, the project has successfully delivered a set of tools, design methodology and practical illustrations that will help designers, commissioning agents and building operators to pay more attention to these new options and in that way to reduce the environmental impact of buildings.

Deliverables

- Analysis of building heating and cooling demand for the purpose of assessing the reversibility and heat recovery potentials
- Review of heat recovery and heat pumping solutions
- A reference book for simulation tools
- Design handbook for reversible heat pump systems with and without heat recovery
- Overview of case studies and demonstrations of heat pump systems for tertiary buildings

Co-Operating Agents: Philippe Andre and Jean Lebrun, Université de Liège, Belgium

Participating Countries: Belgium, P.R.China, France, Germany, Italy, Switzerland

Further information and reports:
www.ecbcs.org/annexes/annex48.htm

The image displays six book covers from the IEA-ECBCS ANNEX 48 Reversible Air-Conditioning series. Each cover includes the IEA logo, a title, and a list of authors and internal reviewers. The books cover various aspects of heat pumping and reversible air conditioning, from case studies and reviews to design handbooks and simulation tools.

Prefabricated Systems for Low Energy Renovation of Residential Buildings

Annex 50

Project duration: 2006 - 2011

The project has successfully investigated technologies to improve the efficiency and effectiveness of building renovation. The general concept is based on the use of large prefabricated renovation modules for façades and roofs. These modules create a new, modern building envelope, but which can be applied to existing buildings. It also offers added value features such as larger window sizes, façade integrated systems for ventilation and opportunities for room extensions or new roof top apartments. Several demonstration sites with more than 350 renovated apartments have proven that energy savings between 80% - 90% are possible. If photovoltaic cells are installed on the roof, even zero-energy buildings can be achieved with this approach. The renovated buildings are once again fit for purpose for use in future years.

“Several demonstration sites with more than 350 renovated apartments have proven that energy savings between 80% - 90% are possible”

Progress

This groundbreaking project was completed in 2011 and the outcomes have now been published (see below). The main publications are:

- **Retrofit Strategies Design Guide** - this documents typical solutions for whole building renovations
- **Retrofit Module Design Guide** - this allows a detailed system evaluation, module design and planning of the construction process. This publication includes the technical documentation of all developed renovation solutions.
- **Building Renovation Case Studies** - this documents six demonstration sites in Austria, Switzerland, and



the Netherlands. This shows the buildings before, during and after construction.

- **Summary Report** - this gives an overview over the studies, development work and project results.

Operating Agent: Mark Zimmermann, EMPA, Switzerland

Participating Countries: Austria, Czech Republic, France, the Netherlands, Portugal, Sweden, Switzerland

Further information and reports:
www.ecbcs.org/annexes/annex50.htm



Ongoing Research Projects

Air Infiltration & Ventilation Centre

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

Towards Net Zero Energy Solar Buildings

Total Energy Use in Buildings: Analysis & Evaluation Methods

Integration of Microgeneration & Other Energy Technologies in Buildings

Reliability of Energy Efficient Building Retrofitting - Probability Assessment of Performance and Cost

Cost Effective Energy & Carbon Emissions Optimization in Building Renovation

Project duration: 1979 - present

The primary objective of the ECBCS information centre, 'Air Infiltration and Ventilation Centre (AIVC)', is to be the international centre on research and development in the fields of air infiltration and ventilation. Thus the specific objective is to provide a high quality international technical and information forum covering the areas of ventilation and air infiltration in the built environment with respect to efficient energy use, good indoor air quality and thermal comfort. The mission of AIVC is to be the reference portal for information on ventilation in buildings to improve the wellbeing of people through development and dissemination of ventilation knowledge.

Since the beginning of 2011, the AIVC has been operating with a brand new approach, which is approved for the period through to 2013. A key ambition of the new AIVC is to convene integrated / combined activities (called 'projects'), resulting in different information tools, for example webinars, workshops, position papers, technical papers, and so on. These will be supported by an in depth review process and will result in an increased information dissemination impact. The projects identified are:

- Development and applications of air leakage databases
- Philosophy and approaches for airtightness requirements
- Quality of airtightness testing and reporting
- How tight and insulated ducts should be?
- Airtightness quality in the construction process
- Durability of building airtightness
- Improving the quality of residential ventilation systems
- Ventilative cooling (ventilation for passive cooling)
- Ventilation and health

For both projects and events in relation to airtightness, AIVC is joining forces with TightVent Europe. This is a platform newly-launched in 2011 that focuses on airtightness of buildings and ductwork. TightVent Europe's main goals are to:

- raise awareness of airtightness issues, which are experiencing a revived interest with the recent trend towards nearly zero-energy buildings;
- provide appropriate support tools and knowledge transfer to ease market transformation.

In 2011, the popular AIVC Annual Conference has once again provided an opportunity for researchers and practitioners from around the world to exchange ideas and to present their latest findings. The theme for the joint conference was 'Towards Optimal Airtightness

Performance'. This was arranged by INIVE for AIVC and TightVent Europe and over 160 professionals and scientists participated in the AIVC organised sessions. The proceedings and conference report are available at the AIVC website.

Given the converging interests of both bodies, the AIVC Board and the TightVent Europe Steering Committee have agreed to collaborate among other things on:

- the organization of the 2012 conference, which will again be a joint AIVC - TightVent event,
- the overall scientific approach of TightVent and the involvement of AIVC experts for scientific review of publications, and
- the joint organization of four of the projects mentioned above.



New Products in 2011

AIVC Conference Proceedings

32nd Annual Conference 'Towards Optimal Airtightness Performance', held on 12th - 13th October 2011, Brussels, Belgium.

AIVC Newsletter

December 2011

Webinars

- Airtightness and ventilation perspectives in Romania: European context, regulation changes and progress needed, held on 21st June 2011
- Achieving better envelope in practice – Recent Norwegian training and dissemination schemes, held on 9th November 2011
- Association with 6th International BUILDAIR Symposium. Held on 15th May 2011, Berlin, Germany

Operating Agent: Peter Wouters, INIVE eeig, Belgium

Participants: Belgium, Czech Republic, France, Germany, Greece, Italy, Japan, Republic of Korea, Netherlands, New Zealand, Norway, Sweden, USA

Further information and reports:

www.ecbcs.org/annexes/annex05.htm

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

Annex 51

Project duration: 2007 - 2012

Energy planning for community level systems is of increasing political importance in a number of industrialised countries. Consequently ambitious targets for the reduction of energy-related carbon dioxide (CO₂) emissions are often set by municipal administrations, but with only a limited understanding of the means to achieve them. Often the appropriate technology exists, but difficulties are caused by insufficient:

- know-how for strategic planning,
- management ability during the implementation process, or
- availability of tools and instruments for decision making, planning and monitoring.

This project is providing practical guidance for urban planners, decision makers and stakeholders on how to achieve ambitious energy and CO₂ reduction targets at local and urban scales. Addressing small units, such as neighbourhoods or quarters, as well as whole towns or cities, the project is generating the necessary knowledge and means to be able to define reasonable goals in terms of energy efficiency, energy conservation and CO₂ abatement at the community level.

Local decision makers and stakeholders are the primary audiences addressed by this project, rather than energy planners. Hence the legal frameworks and different approaches found within the participating countries are being considered according to their comparative suitability to enable innovative approaches for successful urban energy policies.

Research Areas

- Existing organisational models, implementation instruments and planning tools for local administrations and developers are being assessed in a state of the art review.
- Case studies on energy planning and implementation strategies for neighbourhoods, quarters and municipal areas. This involves both refurbishment of existing building stock and planning and development of new 'green' settlements.
- Case studies on the preparation of integrated energy and CO₂ abatement concepts for towns or cities and corresponding implementation strategies.
- Instruments for a successful community energy policy. This includes the preparation of a guidebook



to successful urban energy planning, a community energy concept adviser and dissemination activities.

Deliverables

- The 'Guidebook to Successful Urban Energy Planning' is aimed at decision makers in urban administrations, developers and urban planners. The document is based on the findings of the state of the art review, an evaluation of the case studies, and is presented in a way that users will be able to apply the guidebook directly to their own work.
- The 'District Energy Concept Adviser' is an electronic tool to support municipal administrations and urban planners faced with evaluating and monitoring.

Progress

- Evaluation of case studies on energy planning and implementation strategies for neighbourhoods, quarters and municipal areas has been finished.
- Development work on the District Energy Concept Adviser is ongoing.
- Work on the Guidebook to Successful Urban Energy Planning is underway.
- 'Description of the state-of-the-art of energy efficient projects on the scale of neighbourhoods' has been published presenting international case studies for energy efficient communities.
- 'Case Study – Energy Efficient City Ludwigsburg' has been published. The aim of this study is to show how energy efficiency can be achieved at a municipal level and how it can be implemented into the political decision making process by similarly structured administrations.
- A website for the project has been set up providing information on the project objectives, participants and periodic newsletters.

Meetings

During 2011 two project meetings took place:

- 5th meeting, held May 2011, in Linköping, Sweden
- 6th meeting, held October 2011, in Ottawa, Canada

Operating Agent: Reinhard Jank, Volkswohnung GmbH, Germany

Participating Countries: Austria, Canada, Denmark, Finland, France, Germany, Japan, the Netherlands, Sweden, Switzerland, USA

Further information:

www.ecbcs.org/annexes/annex51.htm

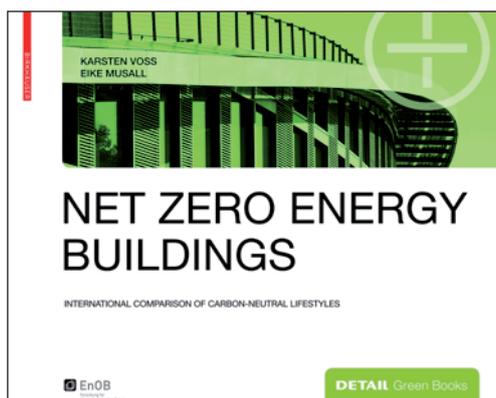
Project duration: 2008 - 2013

Several industrialised countries have recently adopted a vision of so-called 'net zero energy buildings' as long-term goals of their energy policies. However, what is missing is a clear definition and international agreement on the measures of building performance that could inform 'zero energy' building policies, programmes and industry adoption around the world.

The objective of the project is to study current net-zero, near net-zero and very low energy buildings and to develop a common understanding, a harmonized international definitions framework, tools, innovative solutions and industry guidelines. A primary means of achieving this objective is to document and propose practical net zero energy building (NZEB) demonstration projects, with convincing architectural quality. These exemplars, supported by a sourcebook, guidelines and tools, are viewed as the keys to industry adoption.

The project aims to cost-effectively equalize the small annual energy needs of such buildings through building integrated heating / cooling systems, power generation and interactions with utilities. It is learning from recent industry experiences with net-zero and low energy solar buildings and the most recent developments in whole building integrated design and operation. The joint international research and demonstration activity will address concerns of comparability of performance calculations between building types and communities for different climates. The goal is solution sets that are attractive for broad industry adoption.

The scope includes major building types (residential and non-residential), new and existing, for the climatic zones represented by the participating countries. The work is linked to national activities and is focusing on individual buildings, clusters of buildings and neighbourhoods. It is based on analysis of existing examples, which leads to the development of innovative solutions to be incorporated into national demonstration buildings.



“what is missing is a clear definition and international agreement on the measures of building performance that could inform ‘zero energy’ building policies, programmes and industry adoption around the world”

Research objectives

- Establish an internationally agreed understanding of NZEBs, based on a common methodology
- Identify and refine design approaches and tools to support industry adoption
- Develop and test innovative, whole building net-zero solution sets for cold, moderate and hot climates with exemplary architecture and technologies that would be the basis for demonstration projects and international collaboration
- Support knowledge transfer and market adoption of NZEBs at a national and international level

Progress

- Volume 1 of the Source Book has been published both in German and English, for which combined sales are now around 2000 copies.
- The 1st PhD Summer Workshop on Net-Zero energy Solar Buildings: theory, modelling and design, Montreal, Quebec, Canada was held in June 2011.
- Drafting of Volumes 2 and 3 of the Source Book is in progress.
- 12 new technical papers have been completed and submitted to refereed technical journals and / or presented at relevant international conferences.

Meetings

- 5th project meeting, held in Golden, CO, USA in April, 2011
- 6th project meeting, held in Basel, Switzerland in October, 2011

Operating Agent: Josef Ayoub, CanmetENERGY, Natural Resources Canada, Canada

Participating Countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Republic of Korea, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, USA

Further information:
www.ecbcs.org/annexes/annex52.htm

Total Energy Use in Buildings: Analysis & Evaluation Methods

Annex 53

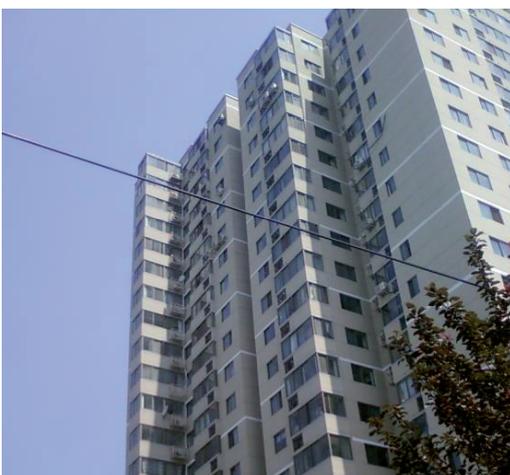
Project duration: 2008 - 2012

One of the most significant barriers for achieving a substantial improvement of building energy efficiency is a lack of knowledge about the factors determining energy use. In fact, there is often a significant discrepancy between the designed and the real total energy use in buildings. The reasons for these discrepancies are generally poorly understood, and often have more to do with the role of human behaviour than the building design. In fact, building energy use is mainly influenced by six factors:

- Climate
- Building envelope
- Building services and energy systems
- Building operation and maintenance
- Occupants' activities and behaviour
- Indoor environmental quality

In general, much current research focuses mainly on the first three factors (climate, building envelope, building services and energy systems). However, the latter three factors related to human behaviour can have an influence at least as significant as the three former ones. Detailed comparative analysis of building energy data, concerning the six factors mentioned above, would provide essential guidance in identifying energy saving potentials and opportunities.

The project is working to improve understanding of how the six factors combine to influence building energy use, with particular emphasis placed on occupant behaviour. It also aims to improve the treatment of these factors within the building energy field, and to more closely relate this to the real world. Hence, the intention is to have a better understanding of how to robustly predict total energy use in buildings, so enabling the improved assessment of energy-saving measures, policies and techniques. Five distinct areas of research have been established:



- Definitions and reporting
- Case studies and data collection
- Statistical analysis
- Energy performance evaluation
- Occupant behaviour analysis

Deliverables

- Prediction models for total building energy use (statistical and analytical methods)
- Reports of building case studies, measurement methods and total energy use data

Progress

- Work on a report on definitions of terminology, indicators and influencing factors for energy use is underway
- Measurement techniques for energy consumption and the indoor environment have been developed.
- A literature review has been completed and a state-of-the-art review has been prepared for inclusion in the final report.
- Collation and preliminary assessment of case study material for use in simulations for four building types.

Meetings

- 3rd project meeting, held in Copenhagen, Denmark in April 2011
- 4th project meeting, held in Berkeley, CA, USA in September 2011

Annex 53 outcomes were presented at:

- International Seminar on 'Occupant behaviour, total energy use in buildings and energy efficient methods providing an optimal indoor environment', April 2011, Copenhagen, Denmark
- ROOMVENT 2011 Workshop, June 2011, Trondheim, Norway, 'Annex 53: Occupants' behaviour related to ventilation and energy use'
- ISHVAC2011 Special Session, Shanghai, November 2011

Operating Agent: Hiroshi Yoshino, Tohoku University, Japan

Participating Countries: Austria, Belgium, Canada, P.R.China, Denmark, Finland, France, Germany, Italy, Japan, the Netherlands, Norway, Portugal, Spain, USA

Further information:

www.ecbcs.org/annexes/annex53.htm

Integration of Microgeneration & Other Energy Technologies in Buildings

Annex 54

Project duration: 2009 - 2013

Micro-generation comprises technologies to provide energy using small scale systems of up to about ten kilowatts, for example with photovoltaic systems or micro-wind turbines. The combined production of heat and power (CHP) in a single small scale process is called micro-cogeneration (μ CHP). This can be extended to a micro-trigeneration system if cooling power is produced in addition.

The scope of this project encompasses multi-source micro-cogeneration systems and renewable hybrid systems, including energy storage and demand side management technologies at a local level. It is investigating customised and optimum control strategies for integrated systems suitable for single or multiple residences, or small commercial premises. Effects of micro-generation on the power distribution system are also being analysed.

Research Areas

- Development of technical models for different micro-generation technologies as co-generators with combustion engines, fuel cells or Stirling engines, photovoltaic systems, thermal and electrical storage and balance of plant components. The models are being validated using data from laboratory and field measurements.
- Simulations are being used to develop an extensive library of performance assessment studies covering: different technology types and combinations, performance in different countries and with different end-users. Simulation work has initially concentrated on improving / optimising the performance of basic but realistic micro-generation systems. Subsequent work is extending this to a wider range of system components, system functions and end-users.
- Dissemination strategies for the mass deployment of micro-generation-related technologies are being investigated. This activity is being informed by a regulatory and market review along with data emerging from the technical analysis.

Expected Outcomes

- Component and system models implemented in building simulation tools
- Review of best practice in the operation and control of integrated micro-generation systems and control algorithms to maximize the performance and value of micro-generation
- Performance assessment methodologies



- Country-specific studies on the technical, economic and environmental performance of micro-generation systems and the potential benefits for the electrical distribution network in particular

Progress

- Collation of laboratory and field measured data is underway
- Existing models are being examined and then further developed to cover whole micro-generation systems
- Country specific framework data as standards, regulations, energy and economic parameters are being analysed to obtain comparable performance studies

Meetings

- The 3rd project meeting, held in Glasgow, UK, in conjunction with the 2nd International Conference on Micro-Generation and related Technologies in April 2011
- The 4th project meeting, held in Naples, Italy in September 2011

Operating Agent: **Evgeniy Entchev**, CanmetENERGY, Natural Resources Canada, Canada and **Peter Tzscheutschler**, Technische Universität München, Germany

Participating Countries: Belgium, Canada, P.R.China, Denmark, Finland, Germany, Italy, Japan, the Netherlands, UK, USA

Further information:

www.ecbcs.org/annexes/annex54.htm

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

Annex 55

Project duration: 2010 - 2014

Nowadays energy and durability issues are some of the most important topics in industrialised countries. Even though considerable progress has been achieved concerning new buildings (low energy, passive houses, zero energy and so on) and advanced building services, the building sector still accounts for the largest share of energy-related carbon dioxide (CO₂) emissions. While in many industrialised countries, new buildings are constructed every year corresponding to approximately 1% of the existing building stock, often more than 50% of the building stock dates from before the first energy crisis in the 1970s. Hence, a large potential for energy savings - and consequently a large reduction of greenhouse gas emissions - is presently available in the existing building stock.

Retrofit measures are therefore of utmost importance for upgrading the building stock. But, many consumers are only interested in the first cost and it is rare that life cycle thinking takes place. Looking at actual risks that are taken, both in performance and in cost, highlights the need for life cycle thinking and implies the need for applicable methods in this area. Probability assessment in life cycle costing of solutions supports sound decision making relating to investments. Customer relationships are based on future expectations and confidence: This will be supported by proper probability assessments.

The project is improving methods and tools for integrated evaluation and optimization of retrofitting measures, including energy efficiency, life cycle cost and durability. It will demonstrate to decision makers, designers and to end users the benefits of the renewal of the existing building stock and how to make reliable solutions.

The scope of the project is to develop and provide decision support data and tools for energy retrofitting measures. The tools are being based on probabilistic methodologies for prediction of energy use, life cycle cost and functional performance. The objectives are to:

- develop and validate probabilistic methods and tools for energy use, lifecycle cost and functional performance,
- apply and demonstrate probabilistic methodologies on real life case studies, and
- create guidelines for practitioners, including assessment of common retrofitting techniques.

Deliverables

The deliverable from the project will be:

- the methodology for probability based assessment of energy retrofitting measures,
- analyses of case studies to show how to apply probability analyses to enhance energy savings, secure performance and apply cost analyses,
- a report and electronic database for stochastic input and validation data, and guidelines for practitioners.

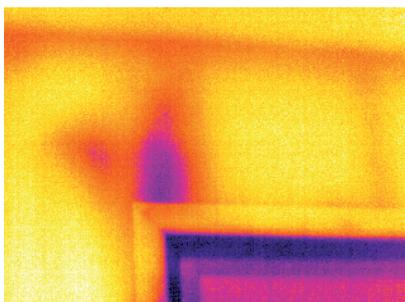
Progress

- Common exercises on stochastic data collection are running on material properties, indoor loads, airtightness and climatic data.
- Common exercises on interior insulation retrofit, focusing on qualitative and quantitative analysis. This includes 'sensitivity analysis' methods for the hygrothermal behaviour of a retrofitted attic .
- A first test of a proposed flow chart on probability assessment of the performance of renovated buildings has been successful.
- A survey is ongoing intended to list frequently used retrofitting building technologies, along with associated benefits and risks in the participating countries.

Meetings

In 2011, two Experts' Meetings took place:

- Porto, Portugal, in April 2011
- San Antonio, USA, in October 2011



Operating Agent: Carl-Eric Hagentoft, Chalmers University of Technology, Sweden

Participating Countries: Austria, Belgium, Canada, Denmark, Finland, Germany, the Netherlands, Norway, Portugal, Spain, Sweden, UK, USA

Observers: Brazil, Slovakia, Estonia

Further information:

www.ecbcs.org/annexes/annex55.htm

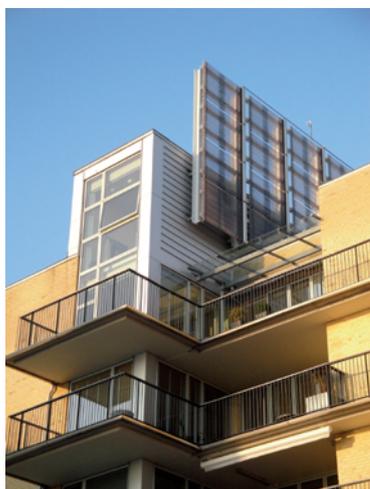
Cost Effective Energy & Carbon Emissions Optimization in Building Renovation

Annex 56

Project duration: 2010 - 2015

In recent years, various standards and regulations for energy consumption in buildings have emerged that specify greatly improved levels of energy efficiency in comparison with earlier requirements. However, these mainly focus on new buildings and do not respond effectively to the numerous technical, functional and economic constraints of the existing stock. It is common that requirements for existing buildings, which are generally targeted at energy efficiency measures, result in expensive processes and complex procedures, seldom accepted by occupants, owners or developers. But, with an objective of mitigating climate change, renewable energy supply measures can sometimes be at least as cost effective as energy conservation and efficiency measures, if not more so. Therefore, in existing buildings, the most cost-effective renovation solution is often a combination of energy efficiency measures and renewable energy supply measures.

Hence, it is important to investigate where balance point lies between these two types of measures from a cost-benefit perspective. This involves determining how the best performance (in terms of less energy consumption, less carbon dioxide emissions and overall added value achieved by the renovation) would be achieved with the least effort (in terms of investment,



interventions in the building and disturbance of occupants). Therefore, a new methodology for energy and carbon dioxide (CO₂) emissions optimized building renovation, as a basis for future standards, will be developed to be used by interested private entities and agencies for their renovation decisions, as well as by governmental agencies for the definition of regulations and their implementation.

Objectives

The project objectives are to:

- Define a methodology for establishing cost optimized targets for energy consumption and CO₂ emissions in building renovation;

- Clarify the relationship between CO₂ emissions and energy targets and their eventual hierarchy;
- Determine cost effective combinations of energy efficiency and renewable energy supply measures;
- Highlight additional benefits achieved in the renovation process;
- Develop tools to support decision makers in accordance with the developed methodology;
- Select exemplary case studies to encourage decision makers to promote efficient and cost effective renovations.

Deliverables

The following project deliverables are planned:

- 'Methodology for Cost Efficient Energy and Carbon Emissions Optimized Building Renovation',
- report on 'Integration of Embodied Energy and LCIA into the Assessment of Renovation Measures',
- report on 'Added Values of Building Renovation: Integration into Assessment and Promotion of Renovation Measures',
- supporting tools for decision makers;
- 'Shining Examples' brochure,
- report on 'Detailed Case Studies',
- 'Renovation Guidebook', and
- an executive summary for policy makers.

Progress

- The basis of the methodology is being agreed, particularly concerning the cost optimization of energy consumption and CO₂ emissions targets.
- A number of case studies are being developed.
- It has been identified that indicators and metrics vary from country to country, so a glossary is being created to establish a common approach and language.

Meetings

- The 2nd Meeting of the Preparation Phase took place in Luxembourg in May 2011
- The 1st Meeting for the Working Phase took place in Zurich, Switzerland in September 2011

Operating Agent: Manuela Almeida, University of Minho, Portugal

Participating Countries: Austria, P.R.China, Czech Republic, Denmark, Finland, Italy, the Netherlands, Norway, Portugal, Spain, Switzerland, Sweden

Further information:
www.ecbcs.org/annexes/annex56.htm

ECBCS & the IEA

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ECBCS & the IEA

The 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-eight IEA member countries and to increase energy security through energy conservation, development of alternative energy sources and energy research, development and demonstration (RD&D). The current framework for international energy technology RD&D co-operation was approved by the IEA's Governing Board in 2003.

More information about the energy technology RD&D framework can be found at:

www.iea.org/textbase/techno



This framework provides uncomplicated, common rules for participation in research programmes, known as 'Implementing Agreements', and simplifies international co-operation between national entities, business and industry. Implementing Agreements are legal agreements between countries that wish to pursue a common programme of research in a particular area. In fact, there are now over 40 such programmes. There are numerous advantages to international energy technology RD&D collaboration through the IEA Implementing Agreements, including:

- Reduced cost and avoiding 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

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, in 1977 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

ECBCS & the IEA

- 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.

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

ECBCS Participating Countries

- Australia
- Austria
- Belgium
- Canada
- P.R. China
- Czech Republic
- Denmark
- Finland
- France
- Germany
- Greece
- Italy
- Ireland
- Japan
- Republic of Korea
- New Zealand
- the Netherlands
- Norway
- Poland
- Portugal
- Spain
- Sweden
- Switzerland
- Turkey
- United Kingdom
- United States of America

ECBCS & the IEA

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 the IEA Energy End Use Working Party (EUWP) Vice Chair for Buildings and the Executive Committee Chairs of the following IEA research programmes:

- District Heating And Cooling (DHC)
- Demand Side Management (DSM)
- Energy Conservation in Buildings and Community Systems (ECBCS)
- Energy Conservation through Energy Storage (ECES)
- Heat Pumping Technologies (HPT)
- Photovoltaic Power Systems (PVPS)
- Solar Heating and Cooling (SHC)
- Energy Efficient Electrical Equipment (4E)

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 pro-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;

ECBCS & the IEA

- 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), and

- The American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).
- CIB: This organization, sponsored by individual groups, has its main area of interaction in sponsored 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 certain level of co-operation exists between the European Commission and ECBCS. The EC Framework Program sponsors research, primarily within the European Union. 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.

Background Information

[Publications](#)

[ECBCS Executive Committee Members](#)

[ECBCS Operating Agents](#)

[Past Projects](#)

Publications

Air Infiltration & Ventilation Centre

➤ Technical Notes

- TN 65 Recommendations on Specific Fan Power and Fan System Efficiency 2009
- TN 64 Ventilation in Korea 2008
- TN 63 Ventilation in the Czech Republic 2008

➤ Contributed Reports

- CR 13 Reduction of tobacco smoke in the hospitality business 2010
- CR 12 Indoor air quality in French dwellings 2009
- CR 11 Air Leakage of U.S. Homes: Model Prediction 2008
- CR 10 Ventilation Behavior and Household Characteristics in New California Houses 2008

➤ Newsletters

AIR newsletter (published every 3 months)

➤ Annual AIVC Conference Proceedings

- 2010 Korea - Seoul, Low Energy and Sustainable Ventilation Technologies for Green Buildings
- 2009 Germany – Berlin, Trends in High Performance Buildings and the role of Ventilation
- 2008 Japan – Kyoto, Advanced building ventilation and environmental technology for addressing climate change issues

➤ Ventilation Information Papers

- VIP 34 Needs and methods for ductwork cleaning in France
- VIP 33 CO₂ as indicator for the indoor air quality - General principles
- VIP 32 Hybrid Ventilation
- VIP 31 Humidity Controlled Exhaust Ventilation in Moderate Climate 2009
- VIP 30 An overview of national trends related to innovative ventilation systems 2008
- VIP 29 An overview of national trends in envelope and ductwork airtightness 2008
- VIP 28 IAQ and ventilation efficiency with respect to pollutants inside automobiles 2008
- VIP 27 Trends in the Czech building ventilation market and drivers for changes 2008
- VIP 26 Trends in the Korean building ventilation market and drivers for changes 2008
- VIP 25 Trends in the Japanese building ventilation market and drivers for changes 2008
- VIP 24 Trends in the Polish building ventilation market and drivers for changes 2008
- VIP 23 Trends in the Brazilian building ventilation market and drivers for changes 2008
- VIP 22 Trends in the US building ventilation market and drivers for changes 2008

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

- Final Report Volume 1: Modelling Principles and Common Exercises
- Final Report Volume 2: Experimental Analysis of Moisture Buffering
- Final Report Volume 3: Boundary Conditions and Whole Building HAM Analysis
- Final Report Volume 4: Applications: Indoor Environment, Energy, Durability

The Simulation of Building-Integrated Fuel Cell & 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

Testing and Validation of Building Energy Simulation Tools

- In-Depth Diagnostic Cases for Ground Coupled Heat Transfer Related to Slab-on-Grade Construction
- Final Task Management Report - Testing and Validation of Building Energy Simulation Tools
- Empirical Validations of Shading / Daylighting / Load Interactions in Building Energy Simulation Tools
- Double Skin Facades: A Literature Review
- Empirical Validation of Building Simulation Software: Modelling of Double Facades

Integrating Environmentally Responsive Elements in Buildings

- Project Summary Report
- State of the Art Review. Volume 1 State of the Art Report
- State of the Art Review. Volume 2A Responsive Building Elements
- State of the Art Review. Volume 2B Integrated Building Concepts
- State of the Art Review. Volume 2B Methods and Tools for Designing Integrated Building Concepts
- Expert Guide. Part 1 Responsive Building Concepts

Publications

- Expert Guide. Part 2 Responsive Building Elements
- Designing with Responsive Building Elements

Low Exergy Systems for High Performance Buildings & Communities

- Midterm Report

Energy-Efficient Future Electric Lighting for Buildings

- Guidebook on Energy Efficient Electric Lighting for Buildings
- Guidebook on Energy Efficient Electric Lighting for Buildings - Extended Summary

Holistic Assessment Tool-kit on Energy Efficient Retrofit Measures for Government Buildings (EnERGo)

- EnERGo IT-Toolkit
- Energy Process Assessment Protocol
- Best Practice Guidelines for Using Energy Performance Contracts To Improve Government Buildings

Cost Effective Commissioning of Existing & Low Energy Buildings

- Commissioning Overview
- Flow Charts and Data Models for Initial Commissioning of Advanced and Low Energy Building Systems
- Commissioning Tools for Existing and Low energy Buildings
- Commissioning Cost-Benefit and Persistence of Savings

Heat Pumping & Reversible Air Conditioning

- Analysis of Building Heating and Cooling Demands in the Purpose of Assessing the Reversibility and Heat Recovery Potentials
- Analysis of Building Heating and Cooling Demands in the Purpose of Assessing the Reversibility and Heat Recovery Potentials: Annexes
- Review of Heat Recovery and Heat Pumping Solutions



- Simulation tools: Reference Book
- Design Handbook for Reversible Heat Pump Systems with and without Heat Recovery
- Overview of Cases Studies and Demonstrations of Heat Pump Systems for Tertiary Buildings

Prefabricated Systems for Low Energy Renovation of Residential Buildings

- Building Renovation Guide
- Guidelines for System Evaluation
- Documented Case Studies
- Project Summary Report

Towards Net Zero Energy Solar Buildings

- Net Zero Energy Buildings: International Projects of Carbon Neutrality in Buildings

These publications are available for free download at the ECBCS website:

www.ecbcs.org

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Prefabricated Systems for Low Energy Renovation of Residential Buildings

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Energy Efficient Communities

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Total Energy Use in Buildings: Analysis & Evaluation Methods

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Integration of Microgeneration & Other Energy Technologies in Buildings

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

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Cost Effective Energy & Carbon Emissions Optimization in Building Renovation

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Evaluation of Embodied Energy & CO₂ Emissions for Building Construction

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Reliable Building Energy Performance Characterisation Based on Full Scale Dynamic Measurements

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High Temperature Cooling & Low Temperature Heating in Buildings

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Past Projects

Annex 1:	Load Energy Determination of Buildings	Annex 31:	Energy-Related Environmental Impact of Buildings
Annex 2:	Ekistics and Advanced Community Energy Systems	Annex 32:	Integral Building Envelope Performance Assessment
Annex 3:	Energy Conservation in Residential Buildings	Annex 33:	Advanced Local Energy Planning
Annex 4:	Glasgow Commercial Building Monitoring	Annex 34:	Computer-Aided Evaluation of HVAC System Performance
Annex 6:	Energy Systems and Design of Communities	Annex 35:	Design of Energy Efficient Hybrid Ventilation (HYBVENT)
Annex 7:	Local Government Energy Planning	Annex 36:	Retrofitting of Educational Buildings
Annex 8:	Inhabitants Behaviour with Regard to Ventilation	Annex 37:	Low Exergy Systems for Heating and Cooling of Buildings (LowEx)
Annex 9:	Minimum Ventilation Rates	Annex 38:	Solar Sustainable Housing
Annex 10:	Building HVAC System Simulation	Annex 39:	High Performance Insulation Systems
Annex 11:	Energy Auditing	Annex 40:	Building Commissioning to Improve Energy Performance
Annex 12:	Windows and Fenestration	Annex 41:	Whole Building Heat, Air and Moisture Response (MOIST-ENG)
Annex 13:	Energy Management in Hospitals	Annex 42:	The Simulation of Building-Integrated Fuel Cell and Other Cogeneration Systems (FC+COGEN-SIM)
Annex 14:	Condensation and Energy	Annex 43:	Testing and Validation of Building Energy Simulation Tools
Annex 15:	Energy Efficiency in Schools	Annex 44:	Integrating Environmentally Responsive Elements in Buildings
Annex 16:	BEMS 1- User Interfaces and System Integration	Annex 45:	Energy Efficient Electric Lighting for Buildings
Annex 17:	BEMS 2- Evaluation and Emulation Techniques	Annex 46:	Holistic Assessment Tool-kit on Energy Efficient Retrofit Measures for Government Buildings (EnERGo)
Annex 18:	Demand Controlled Ventilation Systems	Annex 47:	Cost-Effective Commissioning for Existing and Low Energy Buildings
Annex 19:	Low Slope Roof Systems	Annex 48:	Heat Pumping and Reversible Air Conditioning
Annex 20:	Air Flow Patterns within Buildings	Annex 49:	Low Exergy Systems for High Performance Buildings and Communities
Annex 21:	Thermal Modelling	Annex 50:	Prefabricated Systems for Low Energy Renovation of Residential Buildings
Annex 22:	Energy Efficient Communities		
Annex 23:	Multi Zone Air Flow Modelling (COMIS)		
Annex 24:	Heat, Air and Moisture Transfer in Envelopes		
Annex 25:	Real time HEVAC Simulation		
Annex 26:	Energy Efficient Ventilation of Large Enclosures		
Annex 27:	Evaluation and Demonstration of Domestic Ventilation Systems		
Annex 28:	Low Energy Cooling Systems		
Annex 29:	Daylight in Buildings		
Annex 30:	Bringing Simulation to Application		

