



**Energy Conservation in Buildings
and Community Systems**

Annual Report 2004



International Energy Agency
Energy Conservation in Buildings & Community Systems
Annual Report 2004

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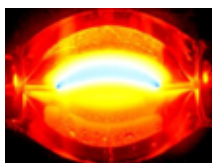
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(Front cover illustration: adapted from results showing gas discharge of a metal halide lamp, picture courtesy of TU Berlin Lichttechnik, Annex 45)



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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 (completed projects are identified by (*)):

Annex 1: Load Energy Determination of Buildings (*)
Annex 2: Ekistics and Advanced Community Energy Systems (*)
Annex 3: Energy Conservation in Residential Buildings (*)
Annex 4: Glasgow Commercial Building Monitoring (*)
Annex 5: Air Infiltration and Ventilation Centre
Annex 6: Energy Systems and Design of Communities (*)
Annex 7: Local Government Energy Planning (*)
Annex 8: Inhabitants Behaviour with Regard to Ventilation (*)
Annex 9: Minimum Ventilation Rates (*)
Annex 10: Building HVAC System Simulation (*)
Annex 11: Energy Auditing (*)
Annex 12: Windows and Fenestration (*)
Annex 13: Energy Management in Hospitals (*)
Annex 14: Condensation and Energy (*)
Annex 15: Energy Efficiency in Schools (*)
Annex 16: BEMS 1- User Interfaces and System Integration (*)
Annex 17: BEMS 2- Evaluation and Emulation Techniques (*)
Annex 18: Demand Controlled Ventilation Systems (*)
Annex 19: Low Slope Roof Systems (*)
Annex 20: Air Flow Patterns within Buildings (*)
Annex 21: Thermal Modelling (*)
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 (*)
Annex 31: Energy-Related Environmental Impact of Buildings (*)
Annex 32: Integral Building Envelope Performance Assessment (*)
Annex 33: Advanced Local Energy Planning (*)
Annex 34: Computer-Aided Evaluation of HVAC System Performance (*)
Annex 35: Design of Energy Efficient Hybrid Ventilation (HYBVENT) (*)
Annex 36: Retrofitting of Educational Buildings (*)
Annex 37: Low Exergy Systems for Heating and Cooling of Buildings (LowEx) (*)
Annex 38: Solar Sustainable Housing
Annex 39: High Performance Insulation Systems
Annex 40: Building Commissioning to Improve Energy Performance
Annex 41: Whole Building Heat, Air and Moisture Response (MOIST-ENG)
Annex 42: The Simulation of Building-Integrated Fuel Cell and Other Cogeneration

Systems (COGEN-SIM)

Annex 43: Testing and Validation of Building Energy Simulation Tools

Annex 44: Integrating Environmentally Responsive Elements in Buildings

Annex 45: Energy Efficient Electric Lighting for Buildings

Annex 46: Holistic Assessment Tool-kit on Energy Efficient Retrofit Measures for Government Buildings (EnERGo)

Working Group - Energy Efficiency in Educational Buildings Working Group (*) Working Group - Indicators of Energy Efficiency in Cold Climate Buildings (*) Working Group - Annex 36 Extension: The Energy Concept Adviser

(*) - Completed



Introduction

Dr Morad Atif, Chairman, ECBCS Executive Committee

As Executive Committee Chairman of the IEA Energy Conservation in Buildings and Community Systems Programme, I am pleased to report that 2004 has been a very productive year. This commences the 3rd year covered by the present Strategic Plan, and marks 27 years since the founding of the Programme. By joining ECBCS, national governments and programmes enable their researchers and industry to take part in a well-established international programme, which annually carries out over 67 person-years of work (see Figure 1). This is achieved with an average work load of only approximately 3 person-years per country, therefore offering outstanding leverage to nationally-based R&D programmes. Some of the benefits for participating countries include immediate access to well-established international networks of expertise; technology transfer; cost reduction and avoidance of duplication of research efforts; increased understanding of and potential for international markets for technologies and expertise. Few other major international programmes of collaborative research are able to offer such a high return on investment.

The Executive Committee would like to congratulate the project experts and leaders for the completion of major research and development milestones and for implementing a successful outreach strategy. Ongoing projects have made substantial progress, and those nearing completion have produced major tools, guidelines, and technologies to support the energy and sustainability mandate of ECBCS and the associated National Programmes.

The previous year has seen the initiation of two new ECBCS research projects (known as 'Annexes'), and the successful completion of two of the existing projects, with another eight still ongoing. A notable success of the programme is that ECBCS Annex 5 (Air Infiltration and Ventilation Centre - AIVC) in 2004 celebrated 25 years of leadership and excellence in the dissemination of reliable and effective information on building ventilation. The new Annexes that have been formally approved in the past year cover the following topics:

- Energy Efficient Electric Lighting for Buildings (Annex 45), and
- Holistic Assessment Toolkit on Energy Efficient Retrofit Measures for Government Buildings (Annex 46).

During the same period, two Annexes have successfully completed their work:

- Retrofitting of Educational Buildings – the 'Energy Concept Adviser' is now being tested on real buildings and translated for national application (Annex 36);

- Low Exergy Systems for Heating and Cooling – the ‘Low Exergy Design Guidebook’ has been published by Annex 37.

Meanwhile, continuing leading-edge projects are investigating the feasibility of certain new technologies:

- High Performance Insulation (Annex 39)
- Modelling Co-Generation and Fuel Cell Applications in Housing (Annex 42)

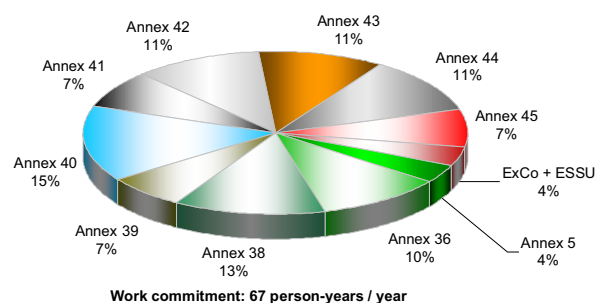
Besides the scientific and technological impacts, the following outreach activities from the past year are important achievements:

- Project work has been disseminated through external conferences, for example the Annex 44 programme was presented at the CIB '04 conference in Canada.
- Agreement has been reached for ECBCS sponsorship and the inclusion of ECBCS sessions at the forthcoming Sustainable Buildings'05 and Building Simulation '05 conferences.
- A series of international workshops related to project work and proposals has been initiated.
- Engagement of industry and networks in ECBCS activities - project experts have formed new international associations, including the LowExNet (Low Exergy Network).
- Effective newsletters for the target audiences have been produced, for example covering commissioning of HVAC systems (by Annex 40) and low-exergy systems (by Annex 37).

Particularly encouraging is the realisation that 52 of the current 202 organisations actively involved in ECBCS activities are already from industry. In the last year, for instance, COGEN Europe have joined as a new industry partner in Annex 42. The participants from industry include energy utilities, consulting engineers, architects and manufacturers. Even so, efforts will continue to increase still further industrial participation in the Programme.

It is my privilege to present the ECBCS Annual Report for 2004 to you and I look forward to another successful year.

Figure 1 Summary of Current ECBCS Programme Annual Work Commitment



Success Stories from 2004

AIVC Celebrates 25 Years of Excellence

In 2004, the Air Infiltration and Ventilation Centre, AIVC (ECBCS Annex 5), celebrated 25 years of leadership and excellence in the dissemination of reliable and effective information on ventilation. As an example of their leadership, since 1980 the Annual AIVC Conferences have been an important meeting point for presenting and discussing developments and results about ventilation in buildings. The 2004 conference, held in September 2004 in Prague, the Czech Republic, was the 'Silver Jubilee' 25th AIVC Conference. The theme of this conference was 'Ventilation and Retrofitting'. AIVC continue their programme of information dissemination through a quarterly newsletter, with an accompanying CD, 'Air Information Review' with the content mirrored on the web at www.aivc.org. This CD contains a wealth of information from the AIVC, with over 100 of their own, as well as a large number of publications from other organisations.

New Research Projects Approved

During the course of 2004, two new ECBCS research projects have been formally approved:

- Energy Efficient Electric Lighting for Buildings (Annex 45), and
- Holistic Assessment Toolkit on Energy Efficient Retrofit Measures for Government Buildings (Annex 46).

Energy Efficient Electric Lighting for Buildings

Lighting electricity use ranges from 5% to 15% in industrialized countries, and up to 86% in developing countries of the total electricity use. In fact, the components affecting the total lighting energy use are:

- lighting equipment,
- lighting performance targets and design of lighting, and
- control and integration of lighting.

To this end, 2004 has seen the approval of ECBCS Annex 45, 'Energy Efficient Electric Lighting for Buildings'. This new project will operate from 2004 to 2008 and intends to:

- identify and accelerate the use of energy efficient high-quality lighting technologies and their integration with other building systems,

-
- assess and document the technical performance of existing and future lighting technologies, and assess and document barriers preventing the adoption of energy efficient technologies and propose means to resolve these barriers.

More information can be found at: www.ecbcs.org/annexes/annex45.htm

Research Projects Successfully Completed

Two ECBCS research projects have recently successfully completed their work programmes:

- Retrofitting of Educational Buildings (Annex 36): This project has produced an 'Energy Concept Adviser', ECA, for retrofit of educational buildings. An extension project (through a 'Working Group') is now testing the ECA on real buildings and translating it from the original English, into German, Italian, Greek, Danish, French, Polish and Finnish.
- Low Exergy Systems for Heating and Cooling – the 'Low Exergy Design Guidebook' has been published (Annex 37).

Low Exergy Systems for Heating and Cooling of Buildings

The objective of ECBCS Annex 37, 'Low Exergy Systems for Heating and Cooling of Buildings', has been to promote rational use of energy by means of facilitating and accelerating the use of low-valued and environmentally sustainable energy sources for heating and cooling of buildings. (Exergy expresses the quality of an energy source and quantifies the useful work that may be done by a certain quantity of energy.) This project, now completed, has carried out the following tasks:

- Exergy Analysis Tools for the Built Environment - assessed and developed a set of tools of low exergy technologies;
- Low Exergy Concepts and Technologies – created a database of low exergy concepts;
- Case Studies and Market Potentials - collected practical experiences and analyzed market potential.

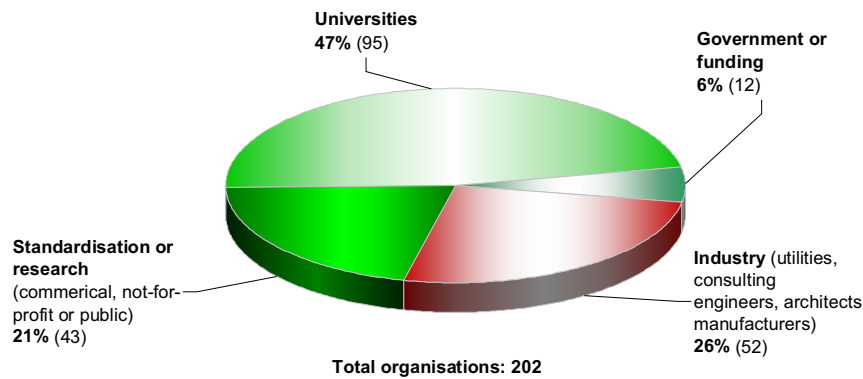
More information can be found at: www.ecbcs.org/annexes/annex37.htm

Outreach Activities

Engagement of Industry

The ultimate intent of the ECBCS Programme is the successful deployment of energy conservation and environmentally sustainable technologies, systems and knowledge. To this end, the objectives of the Programme are principally achieved through joint international projects, known as 'Annexes'. An important mechanism by which the impact of the Programme is maintained is by the active involvement of industry in the Annex work, who are required to implement the outcomes in practice. In this respect, the ECBCS Programme has an advantage with over 25% of the 202 organisations participating from industry, including energy utilities, consulting engineers, architects and manufacturers. This close involvement helps to ensure the objectives are met. For participants from industry, the most immediate benefit is access to cutting edge research leading to a competitive advantage.

Figure 2 Summary of Current ECBCS Programme Participating Organisations



Co-operation with Other IEA Programmes

The ECBCS Programme co-ordinates its research activities, including projects and strategic planning, with the Chairs of the Executive Committees of the other IEA buildings-related 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)

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. There are currently two SHC – ECBCS joint projects:

- Solar Sustainable Housing (Annex 38), and
- Testing and Validation of Building Energy Simulation Tools (Annex 43).

New proposed projects on building energy retrofits are currently being considered with SHC. Aside from ongoing close co-operation with SHC, progress has been made in working effectively with other IEA buildings related activities. For example, collaboration with the IEA District Heating and Cooling Programme is being improved. The ECBCS Strategic Plan requires more emphasis on communities and therefore the Executive Committee has decided to pursue follow-on work on Advanced Local Energy Planning (to continue the work of Annexes 22 and 33).

ECBCS has been developing the concept for a project with the IEA Heat Pump Programme on heat pumping and reversible air conditioning. Further, it is anticipated IEA Demand-Side Management Programme will work with ECBCS Annex 46, “Holistic Assessment Tool-kit on Energy Efficient Retrofit Measures for Government Buildings (EnERGo)”, concerning energy service performance contracting.

ECBCS meets with representatives of all building-related Programmes at Future Buildings Forum (FBF) Think Tanks and Workshops. It is planned the outcome from the Future Buildings Forum Think Tank will be used strategically by the various IEA buildings-related Programmes to

help in the development of their work programmes over the next five years. Most recently, ECBCS were represented at the IEA Future Buildings Forum, “Cooling Buildings in a Warming Climate “ (held June 2004, Sophia Antipolis, France).

International Conferences

This year has seen several international conferences and workshops organised by ECBCS Annexes:

- International Conference on Energy-Efficient Building Operation. Annex 40 in partnership with Texas A&M University and CSTB - Paris, France, October 2004.
- International Workshop: “New Energy Systems for Domestic Dwellings” Annex 42 with Scotland’s Energy Environment Foundation, Energy Efficiency Office, and the University of Strathclyde Energy Systems Research Unit – Glasgow, UK, May 2004
- International Workshop: “Energy-Efficient Lighting for Buildings”, Annex 45, in collaboration with the other buildings-related IEA programmes - Helsinki, Finland, April 2004
- International Workshop: “Better and Efficient Heat Pumps in Buildings”. ECBCS Annex proposal - Liege, Belgium, March 2004
- 25th AIVC Annual Conference, Prague, Czech Republic, September 2004

Co-Ordination With Other Institutions

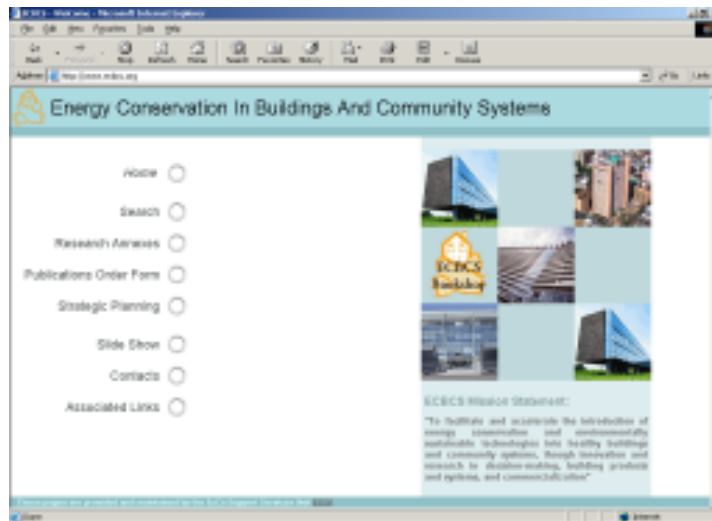
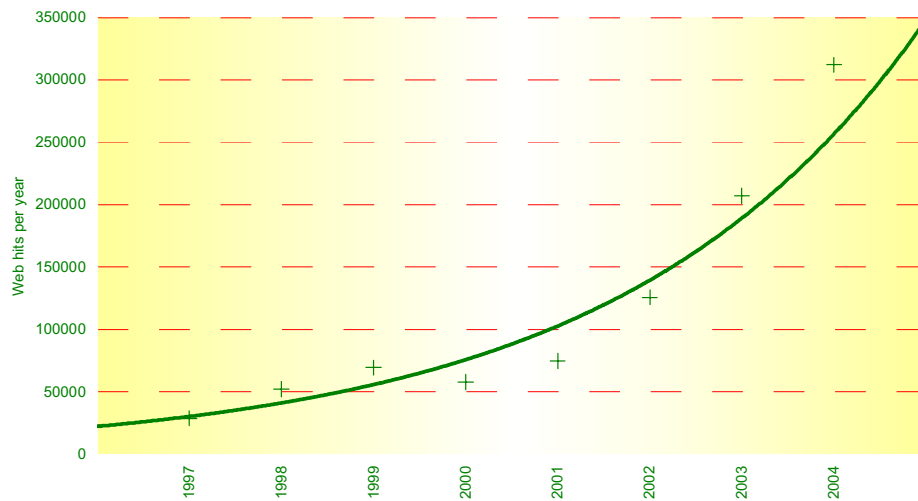
- ECBCS has agreed to sponsor and lead a session at the Sustainable Buildings Conference '05 in Japan.
- Annex experts have themselves recently formed independent networks to promote the Annex work beyond the formal operating period - LowExNet (the Low Exergy Network), for example, has been formed by the participants of Annex 37.
- In addition, ECBCS co-ordinates with a number of non-IEA organisations on an on-going basis, including CIB and iiSBE.

Web Dissemination

The dramatic rise in use of the World Wide Web has led to changes in ECBCS research project dissemination strategies in recent years. The use of Web based dissemination is now central to most new and on-going ECBCS projects, as can be seen in Table 1. 2004 has continued the

exponential growth in downloads from ECBCS' own Web site, www.ecbcs.org .This site is considered to be central to increased dissemination of Programme outcomes. It is anticipated many existing completed ECBCS project reports will soon be made available through the site.

Figure 3 ECBCS Web Site - Trend of Hits per Year 1997 to 2004



Overview of Programme Deliverables

The following Table presents an overview of the deliverables being produced by the ECBCS Programme:

Table 1(i) Summary of Current ECBCS Programme Deliverables

	Published ?	Publications								Total distribution	Conferences / seminars				
		Format		Target audience							Number of events held to date	Average number of external attendees per event			
		CD	Web	Print	Research	Policy makers	Industry	Practitioners	Clients				Architects	Standardisation	Designers
Annex 40															
Web site	Y												3	100	
Commissioning of building HVAC systems for improved energy performance													tba		
Tools for commissioning of Building HVAC systems for improved energy performance													tba		
Annex 41															
Web site	Y														
Whole building HAM modelling measurements and database													tba		
Boundary conditions for whole building HAM simulation													tba		
Long term performance in relation to comfort, durability and energy													tba		
Annex 42															
Web site	Y														
System characteristics, models, and validation													tba		
Whole building simulation tools for co-gen													tba		
Applications													tba		
Occupant-driven electric and dhw usage patterns													tba		
Annex 43															
Web site	Y														
Ground Coupled Floor Slab & Basement Comparative Tests													tba		
Multi-Zone Heat Transfer Comparative Tests													tba		
Shading/Daylighting/Load Interaction Empirical Tests													tba		
Radiant Heating & Cooling Comparative and Empirical Tests													tba		
Heat Pump Comparative Tests													tba		
Systems, Components, & Controls Empirical Tests													tba		
Double-Façade Empirical Tests													tba		
Annex 44															
Web site															
State of the Art Review													Web		
Manufacturers' Guide													Web		
Designers' Guide													Web		
Experts' Guide													Web		
General Booklet													Web		
Information Brochure													Web + tba		
Annex 45															
Web site															
Design Guidebook of Energy Efficient Lighting													Web + tba		
Annex 46															
Web site													Web + tba	3	40

Table 1(ii) Summary of Current ECBCS Programme Deliverables

	Publications										Conferences / seminars			
	Published ?	Format			Target audience					Total distribution	Number of events held to date	Average number of external attendees per event		
		CD	Web	Print	Research	Policy makers	Industry	Practitioners	Clients				Architects	Standardisation
ECBCS Programme														
Web site	Y													
Annex Technical Synthesis Reports (11 Annexes)	Y											250 per Annex		
Newsletter	Y											1200 Web + 1700, every 6 months		
Annual Report 2001 - 2002	Y											10000 Web		
Strategic Plan 2002 - 2007	Y											3000 Web		
Annex 5														
Web site	Y												24	100
AIRBASE Database (~15000 records)	Y											3000 every 3 months		
AIVC Technical Notes (58 reports)	Y											3000 every 3 months		
AIVC Guides (5 reports)	Y											3000 every 3 months		
AIVC Annotated Bibliographies (12 reports)	Y											3000 every 3 months		
Air Information Review (AIR)	Y											Web + 3000 every 3 months		
AIVC Conference Proceedings (24 years)	Y											100 per conference		
VIP : Ventilation Information Papers (2 reports)	Y											3000 every 3 months		
Annex 31														
Web site	Y													
Energy-Related Environmental Impact of Buildings (Highlights Report)	Y												100	
Energy-Related Environmental Impact of Buildings	Y											Web + 200		
Energy-Related Environmental Impact of Buildings	Y											60		
Annex 35														
Web site	Y												5	83
State of the art of Hybrid Ventilation	Y											Web + 4500		
Principles of Hybrid Ventilation	Y											Web + 6000		
Annex 36														
Web site	Y												8	24
Overview of retrofitting measures	Y											Web + 40		
Case Study Reports	Y											Web + 400		
Energy Audit Procedures	Y											Web + 150		
Energy Concept Adviser	Y											Web + 500		
Annex 37														
Web site	Y												8	50
Design Guidebook	Y											2000		
LowExNet network														
Annex 38														
Web site	Y												3	25
Design Handbook for Sustainable Housing												2500		
Housing with Minimal Energy Consumption												2500		
Exemplary Sustainable Solar Housing												Web + 250		
Marketing Sustainable Solar Housing	Y											500		
Annex 39														
Vacuum Insulation Core Materials												100	5	40
Vacuum Insulation Envelope Films												100		
Vacuum Insulation Panels												300		
VIP Application Manual												300		

New ECBCS Research Annexes

During the past year, the ECBCS Executive Committee has approved two new research Annexes:

- Annex 45: Energy Efficient Electric Lighting for Buildings
- Annex 46: Holistic Assessment Tool-kit on Energy Efficient Retrofit Measures for Government Buildings (EnERGo)

These are described in more detail within this chapter.

Annex 45: Energy Efficient Electric Lighting for Buildings

Overview

Lighting-related electricity production for the year 1997 was 2016 TWh of which 1066 TWh was attributable to IEA member countries. Global lighting electricity use is distributed approximately 28 % to the residential sector, 48 % to the service sector, 16 % to the industrial sector, and 8 % to street and other lighting. For the industrialized countries national lighting electricity use ranges from 5 % to 15 %, while in developing countries the value can be as high as 86 % of the total electricity use. The corresponding carbon dioxide emissions were 1775 million tonnes, of which approximately 511 million tonnes was attributable to the IEA member countries.

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. At the moment fluorescent lamps dominate the office lighting. In domestic lighting the dominant light source is still the more than a century old, inefficient incandescent lamp. New aspects of desired lighting are energy savings, daylight use, individual control of light, quality of light, emissions during life cycle and total costs.

The goal of Annex 45 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 underutilized, 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 functional, aesthetic, and comfort requirements of building occupants. The Annex intends to reach its objective by means of four Subtasks:

Subtask A: Targets for energy performance and human well-being

The objective is to document the effect of design on energy use, lighting quality and human performance and give examples of good practice. The objective is to assess barriers preventing the adoption of energy-efficient, human-friendly lighting design.

Subtask B: Innovative technical solutions

The objective is to identify, assess and document the performance, energy and economical criteria of existing promising and innovative future lighting technologies and their impact on other building equipment and systems. Purpose is to reduce the used energy in buildings by applying information on concepts and products and their effect on energy consumption and performance to consultants, public authorities and building owners.

Subtask C: Energy-efficient controls and integration

The task 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 an important part of the subtask.

Subtask D: Information dissemination

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

Operating Period: 2004-2008

Operating Agent: Prof Liisa Halonen, Helsinki University of Technology, Finland

Website: www.lightinglab.fi/IEAAnnex45

Participants:

- Helsinki University of Technology, Finland
- TAKE, Finland
- Zumtobel Staff, Austria
- Belgian Building Research Institute, Belgium

-
- CSTB: Centre Scientifique et Technique du Bâtiment, France
 - ENTPE: École Nationale des Travaux Publics de l'État, France
 - Fraunhofer Institute for Building Physics, Germany
 - Technische Universität Berlin, Germany
 - NTNU: Norges Teknisk-Naturvitenskapelige Universitet, Norway
 - SINTEF, Norway
 - Silesian University of Technology, Poland
 - LTH: Lund University, Sweden
 - WSP Elteknik, Sweden
 - Helvar Merca, United Kingdom
 - University of Nottingham, United Kingdom

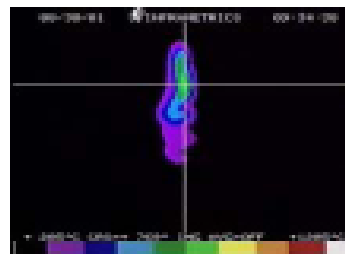
Participation to be confirmed:

- ENEA: National Agency for New Technology, Energy and the Environment - Ispra, Italy
- Delft University of Technology, Netherlands
- Miloni Lichtplanung, Switzerland
- EPFL: Ecole Polytechnique Fédérale de Lausanne - Solar Energy and Building Physics Laboratory, Switzerland
- Lawrence Berkeley National Laboratory, USA
- National University of Singapore, Singapore
- NRC: National Research Council Canada - Institute for Research in Construction, Canada
- China National Institute of Standardization, China
- Fudan University, China
- Tokai University, Japan

Annex 45 Workshop Meeting April 2004



Infrared image of hot fluorescent lamp electrode



Annex 46 Holistic Assessment Tool-kit on Energy Efficient Retrofit Measures for Government Buildings (EnERGo)

Overview

The scope of the Annex is the decision-making process for energy retrofitting of Government non-residential buildings: e.g., office buildings, hospitals, large one-storey production facilities and maintenance shops and speciality warehouses.

The Annex is meant to influence the decision making process that determines the use of energy-saving measures in building retrofits. This decision making process must improve if it is to successfully cope with the challenges of increasing energy costs and climate change, and if it is to avoid “locking in” long-term commitment to energy inefficiencies by adopting sub-optimal renovations. Consequently, the target group consists of all actors involved in this decision making process, specifically executive decision makers and energy managers of Government buildings, performance contractors and designers. The IT-tool-kit EnERGo, supplemented by guidelines and best practice examples, will support these different user groups, and facilitate communication between them.

The objectives of this Annex 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 Annex 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 acceptance of available concepts;
- To find improved ways of using Energy Performance Contracts (ESPC's) for Government buildings retrofit measures.

To accomplish these objectives, Participants will carry out research and development in the framework of the following three Subtasks and one joint working group:

Subtask A : Develop an energy assessment and analysis methodology/protocol and a tool “Energy Assessment Guide for Energy Managers and ESCO's ”;

Subtask B : Develop a database of “Energy Saving Technologies and Measures for Government Building Retrofits” with examples of best practices;

Subtask C : Develop “Best Practice Guidelines for Innovative Energy Performance Contracts;

Subtask D : Develop IT-Toolkit “EnERGo”.

Status: Ongoing (2005-2008)

Operating Agent: Dr Alexander Zhivov, Energy Branch US Army Corps of Engineers, ERDC - CERL, Champaign, IL, USA

Participants:

- U.S. Army Corps of Engineers, USA
- Fraunhofer Institute for Building Physics, Germany
- University of Stuttgart, Germany
- TEKES, Finland
- National University of Singapore
- IEA Demand Side Management Programme
- (Others to be confirmed)



Recently Completed Annexes

The period covering 2003 – 2004 has also seen the successful completion of two Annexes, which have both published their final reports.

- Annex 36: Retrofitting in Educational Buildings - An Energy Concept Adviser for Retrofit Measures
- Annex 37: Low Exergy Systems for Heating and Cooling of Buildings (LowEx)

The work of each of these Annexes is summarised below.

Annex 36: Retrofitting in Educational Buildings - An Energy Concept Adviser for Retrofit Measures

Educational buildings such as kindergartens, schools, training centres and universities display many similar design, operation and maintenance features throughout IEA countries. For example, such buildings frequently have similar structures, often need to be retrofitted and have high energy consumption. Because of the level of similarity that exists within this building sector, experiences gained in developing different approaches to combat similar problems, especially during retrofitting, can easily be transferred to other countries.

Existing studies suggest that decision-makers often have difficulty in evaluating the potential of energy saving measures. There are few “rules of thumb” to enable a quick and easy estimation of the levels of required investment. To overcome this, a ‘PC’ based ‘energy concept adviser’ for economical retrofit measures is proposed. This will incorporate:

- Simple prediction tools for retrofit concepts which allow the decision-maker to evaluate integrated construction, installation and lighting measures;
- Costs, payback and energy and environmental performance analysis;
- Simple methods for testing the efficiency of the applied measures.

This Annex is also aimed at promoting energy and cost efficient retrofit measures and providing decision-makers with the confidence to evaluate and accept these concepts.



Operating Period: 1999 - 2003

Operating Agent: Hans Erhorn, Fraunhofer Institute, Germany

Participating Countries: Denmark, Finland, Germany, Greece, Italy, Poland, Sweden, United Kingdom and the United States of America

- Cenergia Energy Consultants, Denmark
- Danish Building Research Institute, Denmark
- VTT: Technical Research Centre - Building Technology Facility Management, Finland
- VTT: Technical Research Centre - Communities and Infrastructure, Finland
- ENTPE: École Nationale des Travaux Publics de l'État, France
- Fraunhofer Institute for Building Physics, Germany
- University of Stuttgart, Germany
- Bremen University of Applied Sciences, Germany
- National Technical University of Athens, Greece
- ENEA: National Agency for New Technology, Energy and the Environment, Italy
- Norwegian Building Research Institute, Norway
- Poznan University of Technology, Poland
- Silesian University of Technology, Poland
- U.S. Department of Energy, USA
- Department for Education and Skills - Architects & Building Branch, United Kingdom

Annex 37: Low Exergy Systems for Heating and Cooling of Buildings (LowEx)

Low 'exergy' is concerned with using 'low quality' energy sources. For space heating, this means using 'low' temperature heat sources, while for cooling, it means using 'high' temperature 'waste' sources. As a consequence, the differential between the energy source temperature and the desired space conditioning temperature is very small. The development of this type of approach is a pre-requisite for the widespread use of 'alternative' energy sources. Above all, the strategy must fulfil the thermal requirements of building occupants. The overall objectives of the Annex are:



- To investigate the potential for replacing 'high value' energy sources (e.g. fossil fuels and electricity) by 'low value' sources (e.g. ground sources, 'waste' heat etc.) and to assess their impact on global issues such as the reduction of greenhouse gas emissions;
 - To assess existing technologies and components for low exergy heating and cooling in buildings and to enhance the development of new technologies;
 - To assess and provide the necessary tools for the evaluation of low exergy systems;
- To develop a strategic means for introducing low exergy solutions in buildings by demonstration, design tools and guidelines.

Project period: 2000-2003 Operating Agent: Markku Virtanen, VTT, Finland Participating Countries: Finland, Italy, Japan, the Netherlands, Norway. Observers: Canada, Denmark, France, Germany, Sweden.

- VTT: Technical Research Centre - Building and Transport, Finland
- ENEA: National Agency for New Technology, Energy and the Environment, Italy
- Musashi Institute of Technology, Japan
- Cauberg-Huygen R.I, the Netherlands
- NOVEM, the Netherlands
- NBI: Norwegian Building Research Institute, Norway
- KTH: Royal Institute of Technology - Building Technology, Sweden
- CSTB: Centre Scientifique et Technique du Bâtiment, France
- Natural Resources Canada, Canada

In addition the following countries were observers:

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- Esbensen Consulting Engineers, Denmark
 - Technical University of Denmark, Denmark
 - TU Braunschweig - Institut für Gebäude- und Solartechnik, Germany
 - Uponor-Velta, Germany
 - Silesian University of Technology, Poland

Ongoing Activities

- Annex 5: The Air Infiltration and Ventilation Centre (AIVC)
- Annex 38: Solar Sustainable Housing
- Annex 36: Retrofitting of Educational Buildings - An Energy Concept Adviser for Retrofit Measures Working Group
- Annex 39: High Performance Thermal Insulation (HiPTI)
- Annex 40: Commissioning of Building HVAC Systems for Improved Energy Performance
- Annex 41: Whole Building Heat, Air and Moisture Response (MOIST-ENG),
- Annex 42: The Simulation of Building-Integrated Fuel Cell and Other Cogeneration Systems (COGEN-SIM),
- Annex 43: Testing and Validation of Building Energy Simulation Tools, and
- Annex 44: Integrating Environmentally Responsive Elements in Buildings.

Annex 5: The Air Infiltration and Ventilation Centre (AIVC)

Annex 5, The Air Infiltration and Ventilation Centre, is a long established (since 1979) and highly regarded joint project within ECBCS. Since its inception, the AIVC has maintained a technical information service to policy makers, practitioners and researchers. It operates both technical and information dissemination programmes within its remit. The primary objective of Annex 5 AIVC is to provide a high quality international technical and information forum covering the areas of ventilation and infiltration in the built environment with respect to efficient energy use, good indoor air quality and thermal comfort. The main drivers for this work are the national and international concerns in the areas of sustainable development and responses to climate change impact. The overall grouping of activities is divided into the following key functions:

- to act as a technical forum for all relevant international and national ventilation and related activities;
- to undertake technical evaluations and analyses so as to synthesise leading edge research information into industry focused products;
- to provide synthesised information to the research community, policymakers, and industry with emphasis on the end users and practitioners.

A further objective is to provide advice on cost effective measures available to achieve energy efficient buildings with good indoor climate conditions.

Technical Programme

Four major new reports have been published by AIVC in the past year. These are:

- Technical Note - Reducing Indoor Residential Exposures to Outdoor Pollutants
- Annotated Bibliography Review of Airflow Measurement Techniques
- Ventilation Information Paper - Airtightness of Ventilation Ducts
- Ventilation Information Paper - Indoor Air Pollutants – Part 1: General Description of Pollutants, Levels and Standards

Information Dissemination

Alongside the Annex 5 technical programme, the information dissemination activities are equally valued. During the past year, the Air Information Review (AIR) together with a CDROM has continued to be distributed to over 3000 persons and organisations every month. On the AIVC-CD, all the publications produced by the AIVC since its foundation in 1979 can be found as well as information from many ventilation related activities.

Airbase: Airbase, the AIVC's bibliographic database now contains over 15000 records. It is updated every 3 months (about 150 new references every 3 months)

AIVC Conference Attendees

- AIVC conference 2003: 85 attendees, with 26 extended oral presentations + keynote, 35 short oral presentations + posters
 - AIVC conference 2002 (in conjunction with EPIC): 220 attendees, with 150 papers
- AIVC Web Site (www.aivc.org): The AIVC Web site averaged about 6000 visitors per month in 2004. For most of the time, the AIVC is the first reference in 'Google' when searching for 'ventilation', although there are some 3.5 million references.

Participation: In the past twelve months, the Fraunhofer Institute for Building Physics, Germany, has become a member organisation of the Operating Agent, INIVE eeg, and the Czech Republic has joined Annex 5.

Current Project Period: 2001 – 2004, proposed renewal 2004 - 2007 (Annex established in 1979)

Operating Agent: Peter Wouters, INIVE eeg, Belgium

Participating Countries: Belgium, Czech Republic, France, Greece, the Netherlands, Norway, and the United States of America

Organisations participating in the Operating Agent, INIVE eeg

- BBRI: Belgian Building Research Institute, Belgium
 - CETIAT: Centre Technique des Industries Aéronautiques et Thermiques, France
 - CSTB: Centre Scientifique et Technique du Bâtiment, France
 - Fraunhofer Institute for Building Physics, Germany
 - NBI: Norwegian Building Research Institute, Norway
 - NKUA: National & Kapodistrian University of Athens, Greece
 - EMPA: Swiss Federal Laboratories for Materials Testing and Research, Switzerland
 - ENTPE: École Nationale des Travaux Publics de l'État, France
- Organisations participating in Annex 5:

- BBRI: Belgian Building Research Institute, Belgium
- Technical University of Brno, Czech Republic
- Ministry of Industry and Trade, Czech Republic
- ADEME: Agence de l'Environnement et de la Maîtrise de l'Energie, France
- NKUA: National & Kapodistrian University of Athens, Greece
- TNO - Building and Construction Research, Netherlands
- NBI: Norwegian Building Research Institute, Norway
- Lawrence Berkeley National Laboratory, USA



The AIVC Website

Annex 36: Retrofitting of Educational Buildings - Energy Concept Adviser for Retrofit Measures Working Group

An extension Working Group to the completed Annex 36 Project (See 'Recently Completed Annexes') has been initiated to test the Energy Concept Adviser on real buildings, to produce national versions, and to translate it into languages other than the original English. National versions are being produced in German, Italian, Greek, French, Finnish and Russian.

Operating Period: 2004 - 2005

Operating Agent: Ove Mørck, Cenergia Energy Consultants, Denmark

Participating Countries: Denmark, Finland, France, Greece, Italy, Poland, USA, United Kingdom

Working Group Observers: Germany, Norway, Russia

- Cenergia Energy Consultants, Denmark
- VTT: Technical Research Centre - Building Technology Facility Management, Finland
- VTT: Technical Research Centre - Communities and Infrastructure, Finland
- ENTPE: École Nationale des Travaux Publics de l'État, France
- National Technical University of Athens, Greece
- ENEA: National Agency for New Technology, Energy and the Environment, Italy
- Poznan University of Technology, Poland
- Silesian University of Technology, Poland
- U.S. Department of Energy, USA
- Department for Education and Skills - Architects & Building Branch, United Kingdom

The following are participating as observers:

- Fraunhofer Institute for Building Physics, Germany
- University of Stuttgart, Germany
- Norwegian Building Research Institute, Norway
- Saratov State Technical University, Russia

Annex 38: Solar Sustainable Housing

Annex 38 has been initiated in conjunction with the IEA Solar Heating and Cooling Programme. The goal of Annex 38 is to help achieve significant market penetration of sustainable solar housing in the participating countries by the year 2010 by providing homebuilders and institutional real estate investors with:

- A website: 'Model Solar Sustainable Housing' which illustrates built projects, exemplary in design, living quality, low energy demand and environmental impact.
- A book: 'Marketable Sustainable Solar Housing: Plans, Details and Performance' which describes and analyses recently built housing. It will include a checklist and advice from the experience gained from these projects to help planners develop marketable designs.
- A handbook: 'Marketable Sustainable Solar Housing: A Design Handbook' with guidelines, graphs and tables derived from building monitoring, lab testing and computer modelling.
- Demonstration Buildings with press kits for articles and brochures in local languages to increase the multiplication effect beyond the local region.
- Workshops after the Task conclusion presenting the results of the Task.

Recently, Annex 38 have published a series of case study brochures on:

SIS demonstration housing project, Freiburg, Germany

- Demonstration house, Monte Carasso, Switzerland
- Demonstration houses, Kassel, Germany
- Demonstration houses, Hannover-Kronsberg, Germany
- Zero energy house, Kanagawa, Japan
- Sunny Eco-House, Kankyokobo, Japan

The Annex has also identified a number of marketing success stories, including:

- Dewees Island Development, South Carolina, USA
- The WWF sells sustainability in housing in the Netherlands
- Energy Saver Fund, New Zealand

Operating Period: 2000 - 2005

Operating Agent: Robert Hastings, Architecture Energy & Environmental GmbH, Switzerland

Participating Countries: Australia, Austria (through IEA SHC), Belgium, Brazil (through IEA SHC), Canada, Finland, Germany, Italy, Japan, the Netherlands, Norway, Sweden, Switzerland, United Kingdom.

- University of Adelaide - Department of Architecture, Australia

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- University of Queensland - Department of Architecture, Australia
 - Ingenieurbüro Hofbauer, Austria
 - Natur & Lehm, Austria
 - Schöberl + Pöll OEG, Austria
 - Architektbüro Sture Larsen, Austria
 - TB Christian Steininger, Austria
 - University of Klagenfurt – IFF, Austria
 - Université Catholique de Louvain - Architecture et Climat, Belgium
 - UFMG: Federal University of Minas Gerais, Brazil
 - Arise Technologies, Canada
 - Danish Technological Institute, Denmark
 - VTT: Technical Research Centre - Building and Transport, Finland
 - Ecofys, Germany
 - Fraunhofer Institute for Building Physics, Germany
 - Fraunhofer Institute for Solar Energy Systems, Germany
 - Ingenieurbüro Morhenne, Germany
 - Marburg University - Solar Energy Research, Germany
 - Niedrigenergie-Institut, Germany
 - Passivhaus Institut, Germany
 - University of Essen, Germany
 - University of Siegen - Building Physics & Solar Energy, Germany
 - Politecnico di Milano, Italy
 - PRAU, Italy
 - University La Sapienza of Rome, Italy
 - Miyagigakuin Women's College, Japan
 - Org. Akita Prefectural University - Dept. of Arch. & Env. System, Japan
 - Tokyo Metropolitan University - Department of Architecture, Japan
 - MoBius Consult, Netherlands
 - Enova SF, Norway
 - Norwegian State Housing Bank, Norway
 - SINTEF - Civil & Environmental Engineering, Norway
 - Sunlab, Norway
 - ABB Miljo, Norway

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- Göteborg Energi, Sweden
 - LTH: Lund University – Department of Construction and Architecture, Sweden
 - Vattenfall Utveckling, Sweden
 - AMENA, Switzerland
 - Architektur Energie & Umwelt, Switzerland
 - Basler & Hofmann, Switzerland
 - CUEPE Université de Genève - Instit. d'Architecture, Switzerland
 - EMPA: Swiss Federal Laboratories for Materials Testing and Research - Energy Systems / Building Equipment Laboratory, Switzerland
 - Hochschule Technik+Arch.Abt. HLK, Switzerland
 - Renggli, Switzerland
 - SUPSI - DCT - LEEE, Switzerland
 - Viriden + Partner, Switzerland
 - Robert Gordon University - Faculty of Design, United Kingdom



Annex 39: High Performance Thermal Insulation (HiPTI)

The general objective of Annex 39 is to develop reliable components for buildings based on high performance thermal insulation (HiPTI). They are known as HiPTI systems (e.g. façade element, door, and water heater). The successful developments should lead to competitive products that are available on the market. The main technology to be used in the Annex is vacuum insulation panels (VIP). They consist of a microporous core material, packed in a gas tight envelope, evacuated to a pressure of about 0.1 mbar. Three subtasks will be carried out in order to reach the objectives:

- Subtask A: Basic concepts and materials
- Subtask B: Application and system development
- Subtask C: Demonstration and information dissemination

First results

Thermal conductivity

As a first step, independent measurements of thermal conductivities of VIP's have been made. They showed the expected thermal conductivities in the centre of the panels, i.e. VIP's have a ten times lower value than conventional fibre insulations. When edge effects are considered too, the kind of envelope film used is of great importance concerning the heat conductivity. There are today basically two kinds of films, with distinct heat bridge effects:

- Type A: Aluminium foil based films (aluminium layer of 8 micrometres)
- Type B & C: Polymer based metallised films (aluminium layer of 0.09 - 0.30 micrometres)

The edge effect of Type C films (aluminium foil based) leads to a heat conductivity which is 65% higher than with Type A films (metallised). The edge effect can be reduced by applying a layer of insulation material on both sides of Type C film panels. It was calculated, that in case of two layers of glass wool of 5 mm thickness each, the edge effect is reduced from 65% to 41%.

Service Life

The service life of a VIP ends, when the internal pressure reaches a certain level. For a VIP with a fumed silica core, it is about 100 hPa. For building applications there is a need for service life durations of at least 20 years up to more than 50 years.

Pressure rise is mainly caused by penetration of water vapour, but also by air. First results of the Annex show that penetration rates depend largely on two factors:

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- Envelope film
 - Environmental conditions (temperature and humidity)

The currently available films for VIP are in a rapid development process and are being improved all the time. Development effort is focused basically on metallised films. The quality of what is on the market today varies in a quite broad range. Based on preliminary results, it can be said, that there are films available today, which meet the needs of building applications.

VIP constructions

VIP have very low thermal conductivities in comparison to all other materials used in building constructions. Heat bridges, as shown for the films, are therefore of high importance for whole VIP-based construction. To get an overall satisfying result, heat bridges must be calculated very carefully.

Operating Period: 2001 - 2004

Operating Agent: Markus Erb and Hanspeter Eicher, Dr Eicher and Pauli AG, Switzerland

Participating Countries: Canada, France, Germany, Netherlands, Sweden, Switzerland

- NRC: National Research Council Canada, Canada
- CSTB: Centre Scientifique et Technique du Bâtiment, France
- Fraunhofer Institute for Process Engineering and Packaging Germany
- ZAE-Bayern, Germany
- TU Delft: Technical University of Delft, The Netherlands
- KTH: Royal Institute of Technology, Sweden
- EMPA: Swiss Federal Laboratories for Materials Testing and Research, Switzerland
- FHBB: Fachhochschule beider Basel, Switzerland
- Dr. Eicher+Pauli, Switzerland



Size comparison for standard and VIP insulation

Annex 40: Commissioning of Building HVAC Systems for Improved Energy Performance

The primary goal of building commissioning, from an energy perspective, is to verify and optimise the performance of energy systems within a building. The objective of the Annex is to develop, validate and document tools for commissioning buildings and building services that will help facilitate the achievement of this goal. These tools will include guidelines on commissioning procedures and recommendations for improving commissioning processes, as well as prototype software that could be implemented in stand-alone tools and/or embedded in building energy management systems (BEMS).

The work performed in the annex will focus on HVAC systems and their associated control systems. Five subtasks have been identified to address specific technical and/or organisational issues. These subtasks are:

- Subtask A: Commissioning Process
- Subtask B: Manual Commissioning Procedures
- Subtask C: BEMS Assisted Commissioning Tools
- Subtask D: Design Models And Commissioning
- Subtask E: Commissioning Projects

Operating Period: 2001 - 2004

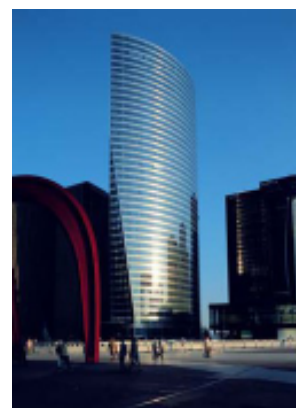
Operating Agent: Jean Christophe Visier, CSTB, France

Participating Countries: The Netherlands, Japan, France, Canada, Belgium, Switzerland, Sweden, USA, Germany, Norway, Finland Observers: Korea, China, Hungary

- University of Liège - Laboratoire Thermodynamique, Belgium
- FUL: Fondation Universitaire Luxembourgeoise, Belgium
- Marbek, Canada
- Natural Resources Canada - CEDRL, Canada
- Semaattikainteistot, Finland
- VTT: Technical Research Centre, Finland
- Tampere University, Finland
- ADEME: Agence de l'Environnement et de la Maitrise de l'Energie, France
- Cenergie, France
- EDF, France
- CSTB: Centre Scientifique et Technique du Bâtiment, France

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- Ebert-Ingenieure, Germany
 - IMI Indoor Climate, Hungary
 - Cold Region Housing And Urban Research Institute, Japan
 - Yamatake, Japan
 - Kyoto University, Japan
 - Kyushu University, Japan
 - Kajima, Japan
 - NESTEC: Nakahara Laboratory, Environmental Syst.-Tech., Japan
 - Tonets, Japan
 - Korean Institute of Energy Research, Korea
 - Cauberg-Huygen R.I, the Netherlands
 - NOVEM, Netherlands
 - TNO, Netherlands
 - NTNU: Norges Teknisk-Naturvitenskapelige Universitet, Norway
 - KTH: Royal Institute of Technology, Sweden
 - AF VVS-Projekt, Sweden
 - SP: Sveriges Provnings- och Forskningsinstitut, Sweden
 - Elyo Cylergie, Switzerland
 - Enerconom, Switzerland
 - Delta Controls, USA
 - Texas A & M University, USA
 - Lawrence Berkeley National Laboratory, USA
 - NIST: National Institute of Standards and Technology, USA
 - Iowa Energy Center, USA
 - Johnson Control, USA

*PB6 Building,
France*



*Crevecouer le Grand
Nursery*



Annex 41: Whole Building Heat, Air and Moisture Response (MOIST-ENG)

The heat and moisture flows generated by building usage, the heat, air and moisture flows that traverse the enclosure and the heat, air and moisture flows injected by the HVAC system are in a permanent balance. Designers try to master that balance for good reasons. The airflows that randomly-distributed air pressure differences inside the building generate impact the ingress of gasses such as radon and change the heat and moisture response of the envelope. Resulting moisture deposits in the envelope negatively affect energy consumption. Moisture from inside and heat and moisture from outside also attack the envelope's durability. While the HVAC control system continuously corrects the injected heat so as to keep the indoor temperature at comfort level, it leaves the indoor relative humidity in many cases free floating as it is considered to be less important than temperature. Research, however, has shown that relative humidity affects thermal and respiratory comfort. It impacts perception of indoor air quality (IAQ) and the energy consumed for conditioning. High relative humidity also favours dust mites, moulds and bugs.

Annex Objectives

A better knowledge of the whole building heat, air and moisture balance and its effects on indoor environment, on energy consumption for heating, cooling, air humidification and air drying and on the envelope's durability is needed. This was already clear at the time of the Annexes 14, 24 and 32. The whole building heat, air and moisture balance has a direct impact on the microclimate that promotes mould growth, as was studied in Annex 14. In Annex 24, the indoor environment was handled as an input parameter, although measurements showed numerous effects of adventitious air flows and humidity storage on the indoor humidity conditions. Annex 32 repeatedly underlined the linkages between envelope and whole building heat, air and moisture (HAM) performance.

The Annex has two main objectives:

First, a detailed exploration of the complex physics involved in whole building heat, air and moisture response (HAMresponse). That objective includes basic research, a further development of existing and new models, measurement of the moisture storage function of materials, measurement of the air permeance of envelope parts, such as build, mock up testing, field testing and validation by inter-comparison of models through common exercises and confrontation with measured data. That first objective should foster a basic understanding of transient moisture storage in different finishing materials and moisture exchange with the indoor air. For that purpose material storage properties will be measured. It should help develop numerical models and back experiments that link the heat and moisture storage and HAM-transfer in enclosures to

the performance of the building and the HVAC system. Mock up and field measurements must prove the effectiveness of moisture storage under different weather conditions (cold, warm and dry, warm and humid and maritime).

Second, an analysis of the effects of the whole building HAM-response on comfort, enclosure durability and energy consumption. A literature review should increase the awareness of these effects. Simultaneously, measures should be studied to moderate possible negative impacts on comfort, enclosure durability and energy consumption, with air-tightness, moisture management, thermal insulation and humidity storage as some of the measures projected.

The following four subtasks will be carried out in order to reach the objectives:

- Subtask 1: Modelling Principles and Common Exercises
- Subtask 2: Experimental Investigations
- Subtask 3: Boundary Conditions
- Subtask 4: Long Term Performance and Technology Transfer

Project Period: 2003 - 2007 Operating Agent: Hugo Hens, K.U.Leuven, Belgium

Participating Countries (to be confirmed): Belgium, Canada, the Czech Republic, Denmark, Finland, France, Germany, Japan, Netherlands, Norway, Portugal, Sweden, Switzerland, UK, USA

Observers (to be confirmed): Austria, Brazil, Estonia, Slovakia

- Centre de Thermique de Lyon, France
- Concordia University Montreal, Canada
- CSTB: Centre Scientifique et Technique du Bâtiment, France
- Chalmers Tekniska Högskola, Sweden
- Danmarks Tekniske Universitet, Denmark
- EMPA: Swiss Federal Laboratories for Materials Testing and Research, Switzerland
- Fraunhofer Gesellschaft, Germany
- Glasgow Caledonian University, United Kingdom
- Kinki University, Japan
- Katholieke Universiteit Leuven, Belgium
- Kyoto University Japan, Japan
- LTH: Lund University, Sweden
- NRC: National Research Council Canada, Canada

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- NTNU: Norges Teknisk-Naturvitenskapelige Universitet, Norway
 - Oak Ridge National Laboratory, United States
 - Pontificia Universidade Catolica Do Parana, Brazil
 - Slovenska Akademia Vied, Slovakia
 - SP: Sveriges Provnings- och Forskningsinstitut, Sweden
 - Technion Israel Institute of Technology, Israel
 - Tohoku University, Japan
 - Tallinna Tehnikaülikool, Estonia
 - Tampereen Teknillinen Yliopisto, Finland
 - Technische Universität Dresden, Germany
 - Technische Universiteit Eindhoven, Netherlands
 - Technische Universität Wien, Austria
 - University College London, United Kingdom
 - Universidade Da Coruña, Spain
 - Universidade Federal de Santa Catarina, Brazil
 - Universiteit Gent, Belgium
 - Université de La Rochelle, France
 - University of Saskatchewan, Canada
 - Universidade do Porto, Portugal
 - VTT: Technical Research Centre, Finland

Annex 42: The Simulation of Building-Integrated Fuel Cell and Other Cogeneration Systems (COGEN-SIM)

Residential cogeneration is an emerging technology with a high potential to deliver energy efficiency and environmental benefits. The concurrent production of electrical and thermal energy from a single fuel source can reduce primary energy consumption and associated greenhouse gas (GHG) emissions. Reductions in combustion by-products such as nitrogen oxides and hydrocarbons are also a possibility. The distributed generation nature of the technology also has the potential to reduce electrical transmission and distribution inefficiencies and alleviate utility peak demand problems. Leading contenders for residential building cogeneration include fuel cells, stirling cycles, and internal combustion engines. The effective exploitation of the thermal output for space heating, space cooling, and/or heating domestic hot water is critical to realizing high levels of overall energy efficiency and the associated environmental benefits. Designing and operating a building-integrated cogeneration system that delivers useful thermal output, however, is a complex task due to the strong coupling between the cogeneration unit, other HVAC components, and the building's thermal and electrical demands. Therefore the system might include some storage device to hold the thermal energy until a demand exists. Consequently, it is believed that building-integrated cogeneration will not deliver the potential benefits outlined above without detailed building simulation tools that consider the full complexities of this interconnected thermodynamic system.

Annex Objectives

The objectives of Annex 42 are to develop simulation models that advance the design, operation, and analysis of residential cogeneration systems, and to apply these models to assess the technical, environmental, and economic performance of the technologies. This will be accomplished by developing and incorporating models of cogeneration devices and associated plant components within existing whole-building simulation programs. Emphasis will be placed upon fuel cell cogeneration systems and the Annex will consider technologies suitable for use in new and existing single and low-rise multi-family residential dwellings. The models will be developed at a time resolution that is appropriate for whole-building simulation.

The Annex research is organized into three related Subtasks.

- Subtask A: Cogeneration system characterization and characterization of occupant-driven electrical and domestic hot water usage patterns.
- Subtask B: Development, implementation, and validation of cogeneration system models.
- Subtask C: Technical, environmental, and economic assessment of selected cogeneration applications.

Subtask A will produce a general description of the cogeneration technologies that will be modelled within the Annex. Although this will not be an extensive description of the technologies, it will be sufficient to lend credibility to the models developed in Subtask B.

Subtask B will focus on the development, implementation, and validation of cogeneration system models for use in integrated building simulation. To leverage against previous significant research investments, efforts will be focussed on the development of models and their implementation into existing building simulation tools rather than on the development of new simulation programs. Where appropriate, existing models will be adapted.

Subtask C will apply the models produced by the Annex to selected case studies. This effort is intended to demonstrate the potential of the models developed by the Annex and to investigate the suitability of cogeneration systems in applications that are of interest to the Annex Participants.

Project Period: 2003 - 2007

Operating Agent: Ian Beausoleil-Morrison, Natural Resources Canada

Participating Countries (to be confirmed): Belgium, Canada, Finland, Germany, Italy, Netherlands, Switzerland, United Kingdom, USA

- University of Liège, Belgium
- COGEN Europe, Belgium
- Natural Resources Canada - Building Simulation Team, Canada
- Natural Resources Canada - Integrated Energy Systems Group, Canada
- University of Victoria - Department of Mechanical Engineering, Canada
- NRC: National Research Council Canada - Institute for Research in Construction, Canada
- VTT: Technical Research Centre - Building and Transport, Finland
- ENEA: National Agency for New Technology, Energy and the Environment, Italy
- ECN: Energy Research Centre of the Netherlands - Renewable Energy in the Built Environment, Netherlands
- NBI: Norwegian Building Research Institute, Norway
- EMPA: Swiss Federal Laboratories for Materials Testing and Research - Energy Systems / Building Equipment Laboratory, Switzerland
- EPFL: Swiss Federal Institute of Technology - Laboratory for Industrial Energy Systems, Switzerland
- Sulzer Hexis, Switzerland
- Siemens Building Technologies, Switzerland

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- University of Strathclyde - Energy Systems Research Unit, United Kingdom
 - Cardiff University - Welsh School of Architecture, United Kingdom
 - Penn State University - Energy Institute, USA
 - Texas A&M University - Department of Architecture, USA
 - NIST: National Institute of Standards and Technology, USA
 - NREL: National Renewable Energy Laboratory, USA



Various products suitable for small scale cogeneration

Annex 43: Testing and Validation of Building Energy Simulation Tools

Annex 43 has been initiated in conjunction with the IEA Solar Heating And Cooling Programme. The goal of this Annex is to undertake pre-normative research to develop a comprehensive and integrated suite of building energy analysis tool tests involving analytical, comparative, and empirical methods. These methods will provide for quality assurance of software, and some of the methods will be enacted by codes and standards bodies to certify software used for showing compliance to building energy standards. This goal will be pursued by accomplishing the following objectives:

- Create and make widely available a comprehensive and integrated suite of IEA Building Energy Simulation Test (BESTEST) cases for evaluating, diagnosing, and correcting building energy simulation software. Tests will address modelling of the building thermal fabric and building mechanical equipment systems in the context of solar and low energy buildings.
- Maintain and expand as appropriate analytical solutions for building energy analysis tool evaluation.
- Create and make widely available high quality empirical validation data sets, including detailed and unambiguous documentation of the input data required for validating software, for a selected number of representative design conditions.

This Annex will investigate the availability and accuracy of building energy analysis tools and engineering models to evaluate the performance of solar and low-energy buildings. The scope of the Task is limited to building energy simulation tools, including emerging modular type tools, and to widely used solar and low-energy design concepts. Activities will include development of analytical, comparative and empirical methods for evaluating, diagnosing, and correcting errors in building energy simulation software. The audience for the results of the Annex is building energy simulation tool developers, and codes and standards (normes) organizations that need methods for certifying software. However, tool users, such as architects, engineers, energy consultants, product manufacturers, and building owners and managers, are the ultimate beneficiaries of the research, and will be informed through targeted reports and articles.

The objectives shall be achieved by the Participants in the following Subtasks:

Subtask A: Comparative Tests

In Subtask A, the Participants shall expand the SHC Task 12 and Task 22 BESTEST-type comparative / diagnostic evaluation tests to include:

- ground-coupled heat transfer with respect to floor slab and basement constructions
- multi-zone buildings
- buildings with double-skin facades

Analytical verification tests for evaluating basic heat transfer and mathematical processes in building energy analysis tools will be included where possible.

Subtask B: Empirical Validation

In Subtask B, the Participants shall expand the SHC Task 22 empirical validation tests and data sets to include validation of models for:

- Thermal and solar/optical performance of windows and shading
- Solar impacts on room heating/cooling loads
- Illuminance calculations
- Interaction between natural (day-lighting), shading, and electrical lighting and HVAC systems
- Control strategies required to increase efficiency of heating and cooling plants, and especially control models for components such as: chillers, boilers, fans and pumps in the context of solar and low energy buildings.
- Ground coupled floor slab and basement comparative tests
- Multi-zone heat transfer comparative tests
- Shading/daylighting/load interaction empirical tests
- Radiant heating and cooling (thermally activated building systems, low temperature heating and cooling system) comparative and empirical tests
- Heat pump comparative tests
- Systems, components, and controls empirical tests
- Double-façade empirical tests

Project Period: 2003 - 2007

Operating Agent: Ron Judkoff, National Renewable Energy Laboratory, USA

Participating Countries (to be confirmed): Australia, Belgium, Canada, the Czech Republic, France, Germany, Greece, Italy, Japan, Netherlands, Sweden, Switzerland, United Kingdom, USA

- Arup, Australia
- CSIRO, Australia
- University of Liège, Belgium
- PHYSIBEL, Belgium
- Natural Resources Canada - CANMET Energy Technology Center, Canada
- Technical University of Brno, Czech Republic

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- CVUT: Czech Technical University in Prague, Czech Republic
 - Aalborg University, Denmark
 - CSTB: Centre Scientifique et Technique du Bâtiment, France
 - EDMP: Ecole des Mines de Paris, France
 - Université de La Réunion, France
 - Fraunhofer Institute for Building Physics, Germany
 - TUD: Technische Universität Dresden, Germany
 - Università di Palermo, Italy
 - Miyagi National College of Technology, Japan
 - NIES: National Institute for Environmental Studies, Japan
 - YNU: Yokohama National University, Japan
 - TNO - Building and Construction Research, Netherlands
 - ACHSL Consultoria, Spain
 - LTH: Lund University, Sweden
 - EMPA: Swiss Federal Laboratories for Materials Testing and Research, Switzerland
 - HTAL: Hochschule Technik+Arch. Abt. HLK, Switzerland
 - University of Strathclyde - Energy Systems Research Unit, United Kingdom
 - Cardiff University - Welsh School of Architecture, United Kingdom
 - Iowa Energy Center, USA
 - NREL: National Renewable Energy Laboratory, USA
 - GARD Analytics, USA
 - TESS, USA

Annex 44: Integrating Environmentally Responsive Elements in Buildings

The greatest future potential for increased energy savings lies with technologies that promote the integration of active building elements and communication among building services. Responsive building elements are defined as building construction elements that assist in maintaining 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. Examples include façade systems (double skin facades, adaptable facades, dynamic insulation), roof systems (green roof systems), foundations (earth coupling systems, embedded ducts), storage (active use of thermal mass, materials such as concrete or massive wood, core activation, phase change materials).

The development, application and implementation of responsive building elements are considered to be a necessary step towards further energy efficiency improvements in the built environment. The Annex will address the following objectives:

- define state-of-the-art of responsive building elements, of integrated building concepts and of environmental performance assessment methods;
- improve and optimise responsive building elements;
- develop and optimise new building concepts with integration of responsive building elements, HVAC-systems as well as natural and renewable energy strategies;
- develop guidelines and procedures for estimation of environmental performance of responsive building elements and integrated building concepts.

Three subtasks will be carried out in order to reach the objectives:

Subtask A. Responsive Building Elements

The subtask will aim to improve responsive building element concepts, including assessment of the advantages, requirements and limitations. The subtask will focus on systems that have the potential to be successfully integrated with integrated building concepts. Such integration has a number of important advantages:

- Integration of responsive building elements with HVAC-systems will lead to substantial improvement in environmental and cost performance.
- It enhances the use and exploits the quality of energy sources (exergy) and stimulates the use of renewables and low valued energy sources (like waste heat, ambient heat, residual heat etc.)
- It will further enable and enhance the possibilities of passive and active storage of energy (buffering).

-
- It will integrate architectural principles into energy efficient building concepts.
 - Responsive building elements lead to a better tuning of technologies to each other and in relation to the integrated building concept and the building users.
 - It enhances the development of new technologies and elements in which various functions are combined in the same active building element.
 - It will lead to a better understanding of integrated design principles among architects and engineers.

Subtask B. Integrated Building Concepts

The subtask will focus on development of integrated building concepts where responsive building elements, energy systems and control systems are integrated into one system to reach an optimal environmental performance.

Subtask C. Implementation and Dissemination

The focus of the subtask will be to guide, collect, packet, transform and disseminate the findings generated in Subtasks A and B. The main target groups are manufacturers' of building elements, contractors, designers (architects and engineers), but also end-users and building owners.

Operating Period: 2004 - 2008

Operating Agent: Per Heiselberg, Aalborg University, Denmark

Participating Countries: Canada, China, Denmark, Germany, Italy, Japan, Norway, Portugal, UK

- AEE INTEC. Institute for Sustainable Technologies. Austria
- Concordia University, Canada
- Xi'an University of Architecture & Technology, China
- The University of Hong Kong, China
- Aalborg University, Denmark
- Technical University of Denmark
- Politecnico di Torino, Italy
- Universita Politecnica delle Marche, Italy
- NILIM: National Institute for Land and Infrastructure Management, Japan
- BRI: Building Research Institute, Japan
- Tokyo Polytechnic University, Japan
- University of Tokyo, Japan
- SINTEF - Civil & Environmental Engineering, Norway

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- NTNU: Norges Teknisk-Naturvitenskapelige Universitet, Norway
 - LNEC: National Laboratory for Civil Engineering, Portugal
 - UTL: Technical University of Lisbon, Portugal
 - Brunel University, United Kingdom
 - Buro Happold, United Kingdom
 - Aberdeen University, United Kingdom
 - Purdue University, USA

Participation to be confirmed:

- Danish Building Research Institute, Denmark
- ENTPE: École Nationale des Travaux Publics de l'État - LASH, France
- University of La Rochelle - LEPTAB, France
- Cracow University of Technology, Poland
- SP: Sveriges Provnings- och Forskningsinstitut, Sweden
- University of Gävle, Sweden
- Cauberg-Huygen R.I, the Netherlands
- TU Delft: Technical University of Delft, The Netherlands



Information Dissemination

A continuing objective of the programme is to broaden awareness and knowledge of ECBCS research and results. To achieve this, ECBCS and its associated Annexes have continued to develop new information and dissemination products. While many reports are disseminated through individual country mechanisms, ECBCS maintains a central bookshop through which information products are distributed throughout the world. This has had a significant effect on the penetration of Annex information, as well as increasing overall appreciation of the programme.

Annex Reports

These are the major output of each Annex and provide comprehensive detail about the work. They are usually presented at a high technical level and are often aimed at researchers and specialists.

ExCo Support Services Unit (ESSU)

Formally established in June 1999, the ExCo Support Services Unit (ESSU) provides a secretariat and dissemination outlet for ECBCS related projects. Its primary functions are:

- administration of ECBCS ExCo activities;
- programme support;
- developing and co-ordinating the dissemination of results;
- producing technical synthesis reports and other summary information;
- publishing the ECBCS Newsletter;
- maintaining the ECBCS Web Site;
- operating the ECBCS Bookshop.

The ESSU is responsible for maintaining all the ECBCS dissemination activities, beyond those carried out by Operating Agents as part of their duties.

Technical Synthesis Reports

The results of completed Annexes are summarised in the form of Technical Synthesis Reports. These aim to be relatively short but give a good technical account of the Annex activity, results and conclusions. The target audience includes policy-makers, engineers and those who wish to obtain a general overview of the topic.

Recently published reports cover:

- Multi-zone air flow modelling;
- Low slope roof systems;
- Evaluation and demonstration of domestic ventilation systems;
- Low energy cooling systems;
- Heat, air and moisture transport;
- Bringing simulation to application;
- Integral building envelope performance assessment.

Newsletter

ECBCS produces a twice-yearly newsletter that is distributed free-of-charge to interested organisations. This contains regularly updated information on Annexes and other activities of the ECBCS. Individual Annexes also produce various newsletters and information bulletins.

Other Promotional Material

Promotional material such as Annex brochures, information sheets and displays are produced on a regular basis to provide updated information about specific ECBCS activities. For instance, an ECBCS Bookshop brochure has been very successful in promoting the results of completed activities.

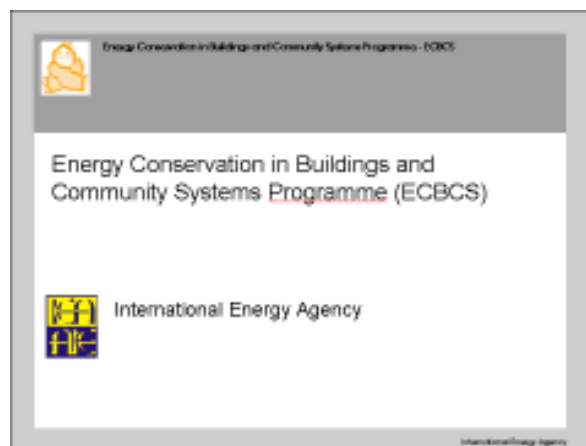
World Wide Web (www.ecbcs.org)

The ECBCS web site contains links to all active Annexes as well as other related research. It also contains details of all ECBCS and Annex reports, newsletters etc. Web page hits now average about 3000 each week from users in almost 60 countries. Through the web site it is possible to learn about and order ECBCS publications.

The Web site has proved to be particularly successful, with a long term average of about 3000 page hits per week and one of the most highly ranked sites on the Google (and other) search engine for building and community energy conservation.

Slide Show

A 'slide show' has been produced summarising all of the activities of the ECBCS. This is regularly updated and can be downloaded from the ECBCS Web site as a single PDF file.





ECBCS and the IEA

The International Energy Agency (IEA) was established as an autonomous body within the Organisation for Economic Co-operation and Development (OECD) in 1974. 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
- Harmonized 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 building. Overall, these are aimed at reducing energy consumption by between 15% - 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 by means of 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 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:
 - 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
 - Impact of energy measures on indoor health, comfort and usability

-
- Exploitation of innovation and information technology
 - Integrating changes in lifestyles, work and business environment

Mission Statement

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

“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”

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 exchanges: information about associated activities is exchanged through the ECBCS and through individual Annexes. The ECBCS Web Site (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, Belgium, Canada, Czech Republic, Denmark, European Commission, Finland, France, Germany, Greece, Israel, Italy, Japan, New Zealand, Netherlands, Norway, Poland, Portugal, Sweden, Switzerland, Turkey, United Kingdom, United States of America.

There are now twenty IEA participating countries, two non-IEA countries, and the European Commission 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 Agreement are Austria, Hungary, Ireland, Korea, 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 program 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 coordinate 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). The BCG is constituted by the Chairs of the Executive Committees of the BRIA's:

- 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)

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 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.

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 program 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 programs 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 Program - 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:

-
1. Technology development via international collaboration
 2. Information dissemination to target audiences
 3. Enhancing building standards
 4. 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.

There are currently two SHC – ECBCS joint projects:

- Annex 38 - Solar Sustainable Housing, and
- Annex 43 - Testing and Validation of Building Energy Simulation Tools.

Collaboration with Other IEA Activities

In order to enhance the dissemination of information, collaboration with IEA Information Centres is seen as important, particularly the following:

- The Centre for the Demonstration and Dissemination of Energy Technology (CADDET);
- GREENTIE;
- Energy Technology Data Exchange (ETDE).

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

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- International Initiative for a Sustainable Built Environment (iiSBE).

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: Collaboration with the European Commission has been formally established and they are a Contracting Party to the ECBCS Implementing Agreement. 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.

For Further Information

For further information about the programme, please contact:

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Tel: +44 (0)121 262 1920 Fax:+44 (0)121 262 1994 Email: essu@ecbcs.org

Web: www.ecbcs.org

Recent ECBCS Annex Publications

ECBCS

- ECBCS News, ECBCS ExCo Support Services Unit, 1984 onwards, newsletter published every six months.

Annex 5 - Air Infiltration and Ventilation Centre (AIVC)

AIR Newsletter and AIVC CD published every 3 months

- Database
- AIRBASE - bibliographical database, containing over 15,000 records on air infiltration, ventilation and related areas, MS Access format, updated every 3 months.

Guides

- Ventilation Modelling Data Guide CD, Orme M and Leksmono N, 2002

Technical Notes

- Acoustics and Ventilation, 2001, Ling M, TN 52
- Occupant Impact on Ventilation, 2001, Liddament M, TN 53
- Residential Passive Ventilation Systems: Evaluation and Design, 2001, Axley J, TN 54
- A Review of International Ventilation, Airtightness, Thermal Insulation and Indoor Air Quality Criteria, 2001, Limb J, TN 55
- A Review of International Literature Related to Ductwork for Ventilation Systems, 2002, Malmström T-G, TN 56
- Residential Ventilation, 2002, Concannon P, TN 57
- Reducing Indoor Residential Exposures to Outdoor Pollutants, 2003, Sherman M and Matson N, TN 58
- Parameters for the Design of Demand Controlled Hybrid Ventilation Systems for Residential Buildings, 2005, Dorer V, Pfeiffer A, Weber A, TN 59

Annotated Bibliographies

- Balancing Ventilation Systems, 2001, Limb M, BIB 11
- Review of Airflow Measurement Techniques, 2003, McWilliams J, BIB 12

AIVC Conference Proceedings

- Market Opportunities for Advanced Ventilation Technology, Bath, UK, 2001, CP 22

-
- Energy Efficient and Healthy Buildings in Sustainable Cities, Lyon, France, 2002, CP 23
 - Ventilation, Humidity Control and Energy, 2003, Washington, USA, CP 24
 - Ventilation and Retrofitting, 2004, Prague, Czech Republic, CP 25

Ventilation Information Papers

- Airtightness of Ventilation Ducts, 2003, Delmotte Ch, VIP 01
- Indoor Air Pollutants – Part 1: General Description of Pollutants, Levels and Standards, 2003, VIP 02
- Natural Ventilation in Urban Areas, 2004, Santamouris M, VIP 03
- Night Ventilation Strategies, 2004, Santamouris M, VIP 04
- Displacement Ventilation, 2004, Schild P G, VIP 05
- Air to Air Heat Recovery in Ventilation Systems, 2004, Schild P G, VIP 06
- Indoor Air Pollutants – Part 2: Description of Sources and Control/Mitigation Measures, 2004, Levin H, VIP 07
- Airtightness of Buildings, 2004, Dorer V, Tanner C, Weber A, VIP 08
- Energy Performance Regulations: Which Impact Can be Expected from the European Energy Performance Directive? 2004, Wouters P, VIP 09
- Sheltering in Buildings from Large-Scale Outdoor Releases, 2004, Chan W R, Price P N, Gadgil A J

See www.aivc.org for details of Annex 5 publications.

Annex 19 – Low Slope Roof Systems

- Technical Synthesis Report: Annex 19 Low Slope Roof Systems, Palmer J, 2003

Annex 22 & 33

- Forthcoming 2005 Technical Synthesis Report

Annex 24 - Heat, Air and Moisture Transport

- HAMTIE Technical Synthesis Report, ESSU, 2002.

Annex 27 - Evaluation and Demonstration of Domestic Ventilation Systems

- Technical Synthesis Report: Annex 27 Evaluation and Demonstration of Domestic Ventilation Systems, Concannon, P, 2002.
- Simplified Tools and Handbook CD with VENSET, 2002

Annex 28 - Low Energy Cooling Systems

- Technical Synthesis Report, M W Liddament, UK, Coventry, Air Infiltration and Ventilation Centre (AIVC), 2001.
- Design Tools for Low Energy Cooling: Technology Selection and Early Design Guidance, Edited by Nick Barnard and Denice Jaunzens UK, BRE Ltd, 2001

Annex 30 - Bringing Simulation to Application

- Technical Synthesis Report: Annex 30 Bringing Simulation to Application, Warren P, 2002

Annex 31 – Energy-Related Environmental Impact of Buildings

- Energy-Related Environmental Impact of Buildings (Highlights), 2002
 - Environmental Framework, 2001
 - Decision-Making Framework, 2001
 - Directory of Tools, A Survey of LCA Tools, Assessment Frameworks, Rating Systems, Technical
 - Guidelines, Catalogues, Checklists and Certificates, 2001
 - LCA Methods for Buildings, 2001
 - Forthcoming 2005 - Technical Synthesis Report: Annex 31.
- See www.annex31.com to download Annex 31 publications.

Annex 32 - Integral Building Envelope Performance Assessment

- Technical Synthesis Report: Annex 32 Integral Building Envelope Performance Assessment, Warren, P, 2003

Annex 33 - Advanced Local Energy Planning

- Forthcoming 2005 – Technical Synthesis Report

Annex 34 - Computer Aided Evaluation of HVAC System Performance

- Demonstrating Automated Fault Detection and Diagnosis Methods in Real Buildings: Proceedings of VTT Symposium : 217, Arthur Dexter and Jouko Pakanen (eds.) Finland, Espoo, VTT Building Technology , 2001

Annex 35 - Control Strategies for Hybrid Ventilation in New and Retro-fitted Office Buildings (HYBVENT)

- Principles of Hybrid Ventilation, edited by Per Heiselberg, report and CD, 2002

Annex 36 - Retrofitting of Educational Buildings

- Retrofitting of Educational Buildings - Case Study Reports, edited by Morck O, 2003

Annex 37 - Low Exergy Systems for Heating and Cooling of Buildings

- Low Temperature Heating Systems - Increased Energy Efficiency and Improved Comfort, brochure, 2002 (see www.vtt.fi/rte/projects/annex37)
- Lowex Guidebook - <http://www.lowex.net/english/inside/guidebook.html>

Annex 38 - Solar Sustainable Housing

- Sustainable Solar Housing: Marketable Housing For A Better Environment Brochure, 2003
- SIS demonstration housing project in Freiburg, Germany, 2003
- Demonstration house in Monte Carasso, Switzerland, 2003
- Demonstration houses in Kassel, Germany, 2003
- Demonstration houses in Hannover-Kronsberg, Germany, 2003
- Zero energy house, Kanagawa, Japan, 2003
- Sunny Eco-House, Kankyokobo, Japan, 2003

See www.iea-shc.org/task28 to download

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Appendix A - ECBCS Strategic Plan

R&D Strategies

The R&D strategies are derived from research drivers, national programs within IEA countries, and the IEA Future Buildings Forum, held in May 2001. 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 Commercialization

R&D Strategies for Design and Business Environment

Strategy: Develop integrated decision-making processes to include energy savings measures for healthy and sustainable buildings and communities

Energy efficiency can only occur if it is well integrated in all factors affecting the building performance. Adequate methods of optimizing between alternative solutions are lacking. All design factors such as environment, energy, economy, indoor health, sustainability, and user needs require a change in the architectural and technical design methodologies as well as new building and community concepts. The basic principle will be the service life design.

Strategy: Develop design tools, prediction methods, and techniques to ensure energy conservation while improving health and occupants' satisfaction

Decision-making at the preliminary design stage is critical. Design tools to predict energy performance, costs, and indoor environment to include such factors as lighting, IAQ, and thermal comfort, become very relevant.

Strategy: Apply scientifically-based LCA methods to account for the energy and environmental impacts of buildings and communities

Appropriate life cycle analysis methods have yet to be fully applied in building and community design and decision-making. Moreover, this strategic plan intends to include performance indicators to account for the energy and environmental impacts for a given service life of buildings

R&D Strategies for Building Products

Strategy: Develop innovative materials and related-knowledge on the environmental impacts of building materials and envelopes, which will assist in the design and construction process

There is a need to exploit major advances in other fields to develop high-performance and cost-effective materials and building envelope. Such innovation will be developed for energy efficiency, environmental impacts, and low-emissions. Building production, use and demolition also cause other environmental effects; e.g. through energy use in the production of materials and components (embodied energy), the emission of harmful compounds into inside and outside air, the consumption of non-renewable material resources, disposal production and impacts on the landscape, ground water, soil and water resources.

Strategy: Improve thermal performance of building envelopes to minimize cooling and heating loads, and integrate solutions with other buildings

Despite major achievements, there still is a need to improve thermal performance of building envelopes and ensure its integration with other buildings systems such as HVAC, and lighting/daylighting. The building envelope already serves a number of different functions. It too should be treated as a total system rather than separate components.

Strategy: Improve the performance and energy-efficiency of HVAC and lighting systems, and optimize integrated solutions

The use of electricity has a major impact on both fossil fuel use and the environment. Energy standards have been developed for HVAC systems and home appliances in many IEA countries. Furthermore, daylighting is a sustainable source of energy that can be integrated with lighting systems. The integration of lighting and HVAC systems is still at the rudimentary stage and R&D in this area is needed.

Strategy: Develop and implement scientifically based methods to reduce ventilation loads, and improve indoor air quality

Improving living standards throughout the world have put pressures on increasing comfort standards of building occupants. There is a tremendous challenge to develop energy-efficient and effective ventilation systems. The task of reducing energy for ventilation and improving IAQ include source control (emission), system efficiency, standard ventilation rates, etc. The lack of thresholds for exposure to contaminants makes it very difficult to establish ventilation guidelines

Strategy: Develop, demonstrate, and implement advanced and user-driven energy management, intelligent buildings, and control systems through advances in sensor technology, wireless technologies, system interface, and users' needs

The technical systems of buildings tend to become more complex and their optimal operation is often much too difficult for an ordinary operator to understand. New control strategies of HVAC systems are some of the fastest adaptable and most efficient energy saving technologies for both new and existing buildings. This will require advances in sensor technology, interface algorithms, and understanding of occupants' satisfaction/acceptance to these new technologies.

Strategy: Introduce cost effective retrofit concepts for buildings with the newest energy saving technologies

A major trend in the building market is the growing maintenance, repair and replacement requirements. In many industrialized countries retrofitting of buildings will dominate the building market during the coming decade.

Strategy: Assess feasibility of low-energy concepts and optimize collaboration with IEA SHC on use of renewable energy sources in buildings

Many scientists have claimed feasibility of zero-energy buildings. However, zero-energy buildings applied concepts and estimated costs, along with demonstration projects have never materialized. On the other hand, it is possible to produce very low-energy buildings at about the same cost as the current normal energy buildings.

Strategy: Develop and demonstrate innovative concepts and systems, for local integrated power, cooling and heating generation and distribution systems in buildings and communities, in collaboration with other BRIAs (e.g., Energy Storage, District Heating, and Demand-side Management)

Deregulation of energy is bringing new opportunities for power generation. Local and small-scale co-generation and district heating/cooling systems will be more widely spread.

Strategies for Outreach and Commercialization

Strategy: Demonstrate, through field experiments, innovative, energy-efficient, environmentally sustainable, and healthy technologies, within the vision of the IEA ECBCS

Strategy: Develop user-driven and applied energy-efficient technologies customized to the requirements of end-users

R&D Focus

The members of the Executive Committee and Operating Agents determined the proposed activities of the ECBCS over the years from 2002-2007. Priorities are based on the research drivers highlighted above. Urgent issues remain: performance indicators for sustainability, environmental impacts, and GHG reductions in buildings; energy reduction while improving indoor air quality; energy retrofit issues; advanced control systems; and innovation and information technology to improve energy efficiency and environmental impacts in buildings.

The Executive Committee will revise the R&D priorities after each five-year period.

Appendix B - List of Abbreviations

AIVC	Air Infiltration and Ventilation Centre (IEA) - www.aivc.org
AIR	Air Information Review (ECBCS AIVC)
ALEP annex33.htm	Advanced local energy planning (IEA) - www.ecbcs.org/Annexes/annex33.htm
ASHRAE	American Society of Heating, Refrigerating and Air-conditioning Engineers - www.ashrae.org
BCG	Buildings Coordination Group (IEA)
BEMS	Building energy management system
BESTEST	Building Energy Simulation Test (IEA)
CADDET gies (IEA)	Centre for the Analysis and Dissemination of Demonstrated Energy Technologies (IEA)
CIB	Conseil International du Bâtiment, International Council for Building - www.cibworld.nl
ECBCS -	Energy Conservation in Buildings and Community Systems Programme (IEA) - www.ecbcs.org
EETIC	Energy and Environmental Technologies Information Centres (IEA) - www.etde.org/abtetde/eetic.html
ESSU	ExCo Support Services Unit (IEA) - www.ecbcs.org/SupportServices.htm
ETDE	Energy Technology Data Exchange (IEA) - www.etde.org
EU	European Union
ExCo	Executive Committee (IEA) ExCo Executive Committee (IEA)
FBF	Future Buildings Forum (IEA) www.ecbcs.org/Futurebuldforum.htm
GHG	Greenhouse gas GREENTIE Greenhouse Gas Technology Information Exchange (IEA) - www.greentie.org
HAM	Heat, air and moisture

HiPTI	High performance thermal insulation (IEA) - www.ecbcs.org/Annexes/annex39.htm
HVAC	Heating, ventilation, air conditioning
Hybvent	Hybrid ventilation - www.ecbcs.org/Annexes/annex35.htm
IA	Implementing Agreement (IEA)
IEA	International Energy Agency - www.iea.org
iiSBE	International Initiative for Sustainable Built Environment - www.iisbe.org
ISO	International Standardization Organization - www.iso.org
LCA	life cycle analysis
LCC	life cycle costing
LowEx	Low exergy (IEA) - www.ecbcs.org/Annexes/annex37.htm
OECD	Organisation for Economic Co-operation and Development - www.oecd.org
R&D	Research and development
RD&D	Research, development and demonstration
SBE	Sustainable built environment
SHC	Solar Heating and Cooling Programme (IEA) - www.iea-shc.org
VIP	Vacuum insulated panel
WG	Working Group (IEA)

The International Energy Agency (IEA) Energy Conservation in Building and Community Systems Programme (ECBCS)

The International Energy Agency (IEA) was established as an autonomous body within the Organisation for Economic Co-operation and Development (OCED) in 1974, with the purpose of strengthening 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. The Energy Conservation in Buildings and Community Systems Programme has sponsored various research annexes associated with energy prediction, monitoring and energy efficiency measures in both new and existing buildings. The results have provided much valuable information about the state of the art of building analysis and have led to further IEA sponsored research.