International Energy Agency

ECBCS | Annual Report 2006

Energy Conservation in Buildings & Community Systems Programme

Published by Faber Maunsell Ltd, Marlborough House, Upper Marlborough Rd, St Albans, Hertfordshire, AL1 3UT, United Kingdom

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

Contents

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:

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

Working Group - Energy Efficiency in Educational Buildings

Working Group - Indicators of Energy Efficiency in Cold Climate Buildings

Working Group - Annex 36 Extension: The Energy Concept Adviser

Ongoing projects in Bold

Introduction

The long-established ECBCS has been working towards optimising building performance and reducing carbon footprints since long before phrases such as 'sustainability' or 'global warming' became commonplace in our everyday language. From 1977 to the present, there have been over fifty ECBCS research projects, eleven of which are ongoing. The thirty-nine completed projects and three working groups have proved their efficacy not only by the large published output, now freely available to enquirers in electronic format, but by a sustained presence at conferences and workshops worldwide, and an increasing emphasis on practical application and marketability of solutions. Links with industry are well-established and enduring. The most recent achievements of the Programme are presented here. It is hoped that it will prove a stimulating introduction to our work for those who are discovering us for the first time, and an informative review for our long-term colleagues and associates.

The wide-ranging coverage of our research projects includes all types of building: residential, commercial and industrial: schools, offices, multi-family and single-family, high and low-rise and many aspects including thermodynamics, occupant behaviour, air quality, commissioning and more. Several research threads have been taken up and advanced via successive projects, such as moisture in buildings; local energy planning; thermal modelling; educational buildings, and low-exergy solutions.

In 2006, the eleven ongoing research projects reported good progress. Three are due to finish their working phase in 2007, and six in 2008. Several have already published reports, which are available at their websites, and most have presented work at major conferences such as the AIVC Annual Conference, as well as in peer reviewed journals. Focussed outreach and deployment activities are ongoing, bringing the results of our projects to the attention of our target audiences and the wider research public.

This extensive research output is maintained by a membership of twenty-four countries: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Israel, Italy, Japan, Republic of Korea, Netherlands, New Zealand, Norway, Poland, Portugal, Sweden, Switzerland, Turkey, UK and USA. Researchers from both large and small building research institutes, university faculties and private companies devote many person-hours of work to the ECBCS research effort. (A list of all participating institutions is included in the sections on ongoing research projects.)

An added benefit of participation is an increased awareness for researchers of the current state of knowledge in other member countries. The ECBCS newsletter includes regular features on the energy profiles of member countries. Recent articles include: "Korea: Energy Efficiency for Better Building Environments", in the June 2006 edition and "Norway: Energy Efficiency, New Technologies, Incentives and Standards" in the October 2006 edition. Shared expertise and minimising duplication of research are also major benefits.

Evidence of the clear topicality of our research is shown in the hundreds of thousands of downloads of project reports from the ECBCS website. The Programme is moving towards publishing the majority of its research findings and reports in electronic format for instant and charge-free accessibility to the research and wider community.

Dr Morad Atif, Chairman, ECBCS Executive Committee

Ongoing Research Projects

Air Infiltration and Ventilation Centre

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

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

Testing and Validation of Building Energy Simulation Tools

Integrating Environmentally Responsive Elements in Buildings

Energy Efficient Future Electric Lighting for Buildings

Holistic Assessment Toolkit on Energy Efficient Retrofit Measures for Government Buildings (EnERGo)

Cost Effective Commissioning of Existing and Low Energy Buildings

Heat Pumping and Reversible Air Conditioning

Low Exergy Systems for High Performance Buildings and Communities

Prefabricated Systems for Low Energy Renovation of Residential Buildings

Air Infiltration and Ventilation Centre

PROJECT DESCRIPTION

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

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

In recognition of the significant impact of ventilation on energy use, combined with concerns over indoor air quality, the Air Infiltration and Ventilation Centre was inaugurated in 1979. The AIVC offers industry and research organisations technical support aimed at optimising ventilation technology. A range of services and facilities are offered, including comprehensive database on literature, standards, and ventilation data.

A series of guides and technical notes is also produced. The Centre holds annual conferences and workshops and publishes a quarterly newsletter, Air Information Review, with an accompanying website. Through the newsletter and website readers are kept informed on a wide range of ventilation related issues.

Duration

1979 - ongoing

OPERATING AGENT

The operating agent of the AIVC is INIVE eeig (International Network for Information on Ventilation and Energy Performance).

PARTICIPANTS

Belgium, Czech Republic, France, Greece, Japan, Netherlands, Norway, USA

REPORTS/PAPERS PUBLISHED IN 2006

Building Ventilation – The State of the Art, Earthscan, August 2006

Ventilation Information Papers:

VIP 11: Use of Earth to Air Heat Exchangers for Cooling

VIP 12: Adaptive Thermal Comfort and Ventilation

AIVC Technical Notes

TN 60: Efficacy of Intermittent Ventilation

Airbase Bibliographical Database – including over 2000 full papers.

Standards Database – Online Database of CEN related ventilation and energy standards.

REPORTS/PAPERS PLANNED IN 2007

- AIVC Technical Notes on: Natural and Hybrid Ventilation in Urban Environment and Energy, Ventilation and Indoor Environmental Quality of Low Income Households
- Literature Lists and Annotated Bibliographies including: Annotated Bibliography on Residential Ventilation Requirements; Ventilation related reports from ECBCS; Reshyvent publications.
- AIVC 2006 Conference Overview Report
- AIVC "Contributed Reports" including Reshyvent WP 1 report; Reshyvent WP 2 reports
  - occupant behaviour; Reshyvent report WP 8
  - Summary Report; Economic considerations on ventilation; low-pressure drop HVAC design for laboratories; and capabilities of energy performance simulation programmes.
- Ventilation Information Papers on CEN standards; Air Quality in Planes; Ceiling Fans and Double Ventilated Facades.

MEETINGS IN 2006

27th AIVC Conference / 4th EPIC conference, Lyon, France, 20-22 November 2006

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

PROJECT DESCRIPTION

This project aims to complete the picture introduced by an earlier ECBCS Annex, “Heat, air and moisture transport in insulated envelope parts”, by focussing on the whole building. The main points of interest in the project are sorption, air movement through the building envelope, wind driven rain effects, and energy, durability and air quality.

Heat, air and moisture flows in buildings are in a permanent balance. Designers try to master that balance for good reasons. Airflows generated by air pressure differences may impact the ingress of gasses such as radon and change the heat, air and moisture response of the envelope. Resulting moisture deposits in the envelope may negatively affect energy consumption. Moisture from inside and heat and moisture from outside attack the envelope’s durability. While HVAC control systems continuously correct the injected heat so as to keep the indoor temperature at comfort level, many leave the indoor relative humidity free floating, as it is considered to be less important than temperature. Research, however, has shown that relative humidity affects thermal and respiratory comfort, impacts perception of indoor air quality (IAQ) and influences the energy consumed for conditioning. High relative humidity also favours moulds, dust mites and bugs.

That relationship between the whole building heat, air and moisture response and human comfort, energy and durability underlines the relevance of annex 41. Good comfort is part of usability. As everyone spends up to 80% of her/his time in buildings, the whole society benefits when comfort and indoor air quality is optimal. Durability in turn impacts on sustainability. A long service life economises on material usage, embodied energy and embodied pollution. In particular, moisture threatens durability, with wind driven rain and advective water vapour ingress as the most active sources. Furthermore, humidity changes, termed as latent energy, often make up over 50% of the annual cooling load in warm, humid regions. Optimal moisture storage may reduce that percentage and save in energy resources and CO2 produced.

For these reasons, an even better knowledge of the whole building heat, air and moisture balance and its effects on the indoor environment, and on energy consumption and durability, is needed.

Objectives

The annex objectives are:

1. A detailed exploration of the physics involved in the whole building heat, air and moisture response. That objective includes basic research, a further development of models, measurement of the moisture storage function of finishing materials and furniture, mock up testing, field testing, and verification and validation..
2. An analysis of the effects of the whole building heat, air and moisture response on comfort, energy consumption and enclosure durability. Measures should be studied to moderate possible negative impacts with airtightness, moisture management, thermal insulation and humidity storage as some of the possible choices to fulfil that goal

Subtasks

A. Modelling and Common Exercises

B. Experimental Investigation

C. Boundary Conditions

D. Long Term Performance and Technology Transfer

Outcome

1. Internet site. The site will contain all meeting proceedings, the annex papers and the drafts of all reports.
2. Report on whole building heat, air and moisture modelling. Appendix discussing the common exercises
3. Report on all experimental investigations, included a database of moisture storage properties of finishing materials and furnishing.
4. Report on indoor and outdoor boundary conditions for whole building heat, air and moisture simulations
5. Report on long term performances in relation to comfort, durability and energy
6. Whole annex CD-ROM with all papers presented during the eight annex meetings CD-ROM with all experimental data, used for the validation exercises (decided in Kyoto)

Duration

January 2004 - December 2007

OPERATING AGENT

Professor Hugo Hens, KU Leuven, Belgium

PARTICIPANTS

Austria: Technische Universitat Wien

Belgium: Katholieke Universiteit Leuven; Universiteit Gent

Canada: British Columbia Institute of Technology; Concordia University Montreal; National Research Council; University of Saskatchewan

Denmark: Danmarks Tekniske Universitet; Stat-

ens Byggeforskningsinstitut

Finland: Tampereen Teknillinen Yliopisto; Technical Research Center Helsinki

France: Aereco; Centre de Thermique de Lyon; Centre Scientifique et Technique du Batiment; Universite de La Rochelle

Germany: Fraunhofer Gesellschaft; Technische Universitat Dresden

Israel: Technion Israel Institute of Technology

Japan: Building Research Institute; Kinki University; Kyoto University; National Institute for Land and Infrastructure Management; Sekisui House Corporation; Tohoku University; Tokyo Gas Corporation

Netherlands: Technische Universitat Eindhoven

Norway: Norges Teknisk-Naturvitenskapelige Universitet

Portugal: Universidade do Porto

Spain: Universidade da Coruna

Sweden: Chalmers Tekniska Hogskola; Kungliga Tekniska Hogskolan; Lund Tekniska Hogskola; Sveriges Provningsforskningsinstitut

Switzerland: EMPA

UK: Glasgow Caledonian University; University College London

USA: Oak Ridge National Laboratory

OBSERVERS

Brazil: Pontificia Universidade Catolica Do Parana; Universidade Federal de Santa Catarina

Estonia: Tallinna Tehnikaulikool

Slovakia: Slovenska Akademia Vied

REPORTS/PAPERS PUBLISHED IN 2006

“Heat, Air and Moisture Transport: Improved Understanding by Moving to the Whole Building Level”, ECBCS News, October 2006, pp 5-6.

MEETINGS IN 2006

Fifth Working Meeting: Kyoto, Japan, 3-5 April 2006

Sixth Working Meeting: Lyon, France, 25-27 October 2006

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

PROJECT DESCRIPTION

Overview

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.

Subtasks

A. Cogeneration system characterization and characterization of occupant-driven electrical and domestic hot water usage patterns.

B. Development, implementation, calibration and validation of cogeneration system models.

C. Technical, environmental, and economic assessment of selected cogeneration applications, recommendations for cogeneration application.

OPERATING AGENT

Dr Ian Beausoleil-Morrison, Building Simulation, CANMET Energy Technology Centre of Natural Resources Canada.

PARTICIPANTS

Belgium: University of Liege; COGEN Europe; KUL Leuven

Canada: Natural Resources Canada/CANMET Energy Technology Centre; University of Victoria, Dept of Mechanical Engineering; National Research Council/Inst. For Research in Construction (NRC); Hydro-Quebec

Finland: Technical Research Centre of Finland, Building and Transport (VTT)

Germany: Research Institute for Energy Economy

Italy: National Agency for New Technology, Energy and the Environment (ENEA); Universita degli studi del Sannio; Seconda Universita degli Studi di Napoli

Netherlands: Energy Research Centre of the Netherlands/Renewable Energy in the Built Environment

Norway: Norwegian Building Research Institute; Telemark University College

UK: University of Strathclyde/Energy System Research Unit (ESRU); Cardiff University/ Welsh School of Architecture

USA: Penn State University/Energy Institute; Texas A&M University/Dept of Architecture; National Institute of Standards and Technology; National Renewable Energy Laboratory (NREL); National Fuel Cell Research Centre of the University of California-Irvine

Switzerland: Swiss Federal Laboratories for Materials Testing and Research/Energy Systems and Builidng Equipment Laboratory (EMPA); Swiss Federal Institute of Technology/ Laboratory for Industrial Energy Systems (EPFL); Sulzer Hexis Ltd; Siemens Building Technologies Ltd.

REPORTS/PAPERS PUBLISHED IN 2006

- Beausoleil-Morrison I., Siemens K., and Oikawa S. (2006), “On Methods for Calibrating the Heat Exchanger of a Model for Simulating the Thermal and Electrical Production of Small-Scale Solid-Oxide Fuel Cell Cogeneration Systems”, Accepted for Proc. of 7th Int Conf on System Simulation in Buildings, Liège Belgium.
- Beausoleil-Morrison I., Schatz A., and Maréchal F. (2006), “A Model for Simulating the Thermal and Electrical Production of Small-Scale Solid-Oxide Fuel Cell Cogeneration Systems within Building Simulation Programs”, Int J HVAC&R Research, 12 (3a) 1-27.
- Ferguson A. and Kelly N. (2006), “Modelling Building Integrated Stirling CHP Systems”, Proc. eSim 2006, 94-101, Toronto Canada.
- Beausoleil-Morrison I., Griffith B., Vesanen T., Lerson S., and Weber A. (2006), “A Case Study Demonstrating the Utility of Inter-Program Comparative Testing for Diagnosing Errors in Building Simulation Programs”, Proc. eSim 2006, 181-188, Toronto, Canada.

REPORTS/PAPERS PLANNED IN 2007

Report on DHW and Electric Profiles

Cogen Description Report

Model Specifications Reports (2)

Reports (2) on Empirical Validation and Comparative Testing.

MEETINGS IN 2006

6th Expert Meeting, State College Pennsylvania, USA, 28-30 March 2006

7th Expert Meeting, NIST, Gaithersburg, Maryland, USA, 18-20 September 2006.

Testing and Validation of Building Energy Simulation Tools

PROJECT DESCRIPTION

Overview

The goal of this project is to undertake 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) comparative test 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 innovative 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 Task/Annex is investigating the availability and accuracy of building energy analysis tools and engineering models to evaluate the performance of innovative low-energy buildings. Innovative low-energy buildings attempt to be highly energy efficient through use of innovative energy-efficiency technologies or a combination of innovative energy efficiency and solar energy technologies. To be useful in a practical sense such tools must also be capable of modelling conventional buildings. The scope of the Task/Annex is limited to building energy simulation tools, including emerging modular type tools, and to widely used innovative low-energy design concepts. Activities 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 Task/Annex is building energy simulation tool developers, and codes and standards 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.

Subtasks

A. Ground Coupled Floor Slab and Basement Comparative Tests

B. Multizone and Airflow Comparative Tests

C. Shading/Daylighting/Load Interaction Empirical Validation Tests

D. Mechanical Equipment and Controls Empirical Validation Tests

E. Double-Skin Buildings Empirical Validation Tests

F. Building Simulation Centre Proposal (dropped)

G. Website for Consolidation of Tool Evaluation Tests

Duration

October 2003 – December 2007

OPERATING AGENT

Dr Ron Judkoff, Buildings & Thermal Energy Center, National Renewable Energy Lab. (NREL), USA

PARTICIPANTS

Australia: CSIRO

Belgium: University of Liege

Canada: Natural Resources Canada

Denmark: Aalborg University

France: University of Reunion Island; Ecole des Mines, Paris; JNLOG; CSTB

Germany: Dresden University of Technology; Fraunhofer Institute for Building Physics

Ireland: Dublin Institute of Technology

Japan: Instutute of National Colleges of Technology; Ashikaga Instutute of Technology; National Institute of Environment Studies

Netherlands: VABI Software

Sweden: Lund University

Switzerland: EMPA; Hochschule Technik & Architectur Luzern

UK: Cardiff University; University of Strathclyde

USA: National Renewable Energy Laboratory; J. Neymark and Associates; Iowa Energy Center; Iowa State University; GARD Analytics; Thermal Energy Systems Specialists.

REPORTS/PAPERS PUBLISHED IN 2006

- Model Validation and Testing: The Methodological Foundation of ASHRAE Standard 140, Ron

Judkoff and Joel Neymark, ASHRAE Transactions, Volume 112, Part 2. August 2006.

- Zur Bilanzierung der solaren Einstrahlung in Gebauden, Joachim Seifert and Clemens Felsmann, Gesundheits Ingenieur, Jahrgang 2006
- Manz H, P Loutzenhiser, T Frank, PA Strachan, R Bundi, G Maxwell. Series of experiments for empirical validation of solar gain modeling in building energy simulation codes—Experimental setup, test cell characterization, specifications and uncertainty analysis. Building and Environment 41 (2006) 1784-1797
- Loutzenhiser PG, H Manz, PA Strachan, C Felsmann, T Frank, GM Maxwell, P Oelhafen. An empirical validation of modeling solar gains through a glazing unit using building energy simulation programs. HVAC & R Research 12 (2006) 1097-1116
- Loutzenhiser PG, H Manz, S Carl, H Simmler, GM Maxwell. Empirical validations of solar gain models for a glazing unit with exterior and interior blind assemblies (Accepted for publication in Energy and Buildings and available online March 3, 2007 at www.sciencedirect.com)
- Manz H, PG Loutzenhiser, T Frank, R Steiner, G Reber, and P Oelhafen. Empirical validation of solar gain modeling in building energy simulation codes using test cells in SHC Task 34 / ECBCS Annex 43. Proceedings of the Third International Building Physics Conference, Concordia University, Montreal, Canada (2006) 595-601
- Loutzenhiser PG and H Manz. 2006. Empirical Validation of Solar Gain Modeling, 14. Schweizerisches Status-Seminar Energieforschung im Hochbau, Eidgenössische Technische Hochschule, Zürich, Switzerland (7-8 September 2006) 301-308
- Related published articles will appear in the proceedings of EPIC2006AVIC (22-24 Nov 2006, Lyon, France): 2 papers from University of Liège (Lebrun, Andre, Adam, Lemort), 1 paper from Technical University of Dresden (Felsmann)

REPORTS/PAPERS PLANNED IN 2007

- Double Skin Facades: A Literature Review, by Harris Poirazis, Lund University, Sweden
- Empirical Validations of Shading/Daylighting/Load Interactions in Building Energy Simulation Tools, by Peter Loutzenhiser and Heinrich Manz, Swiss Federal Laboratories for Material Testing and Research, Switzerland, and Gregory Maxwell, Iowa State University, USA

Conference Papers

- Loutzenhiser PG, H Manz, C Felsmann, PA Strachan, T Frank, GM Maxwell. Empirical validation of models to compute solar irradiance on inclined surfaces for building energy simulation. Solar Energy 18 (2007) 254-267
- Loutzenhiser PG, H Manz, C Felsmann, PA Strachan, and GM Maxwell. An empirical validation of modeling solar gain through a glazing unit with external and internal shading screens. Applied Thermal Engineering 27 (2007) 528-538
- Loutzenhiser PG, GM Maxwell, and H Manz. An empirical validation of the daylighting algorithms and associated interactions in building energy simulation programs using various shading devices and windows. (Accepted for publication in Energy on February 23, 2007)
- Loutzenhiser PG, H Manz, S Moosberger. An empirical validation of window solar gain models and the associated interactions. (Submitted for publication to the International Journal of Thermal Sciences on May 16, 2007)
- Frank T, H Manz, P Loutzenhiser. Validation procedures for transient temperature, load and energy calculations in building simulation codes. Conference Proceedings of 12th Symposium for Building Physics, Dresden, Germany, 2007

MEETINGS IN 2006

6th Expert Meeting, Iowa Energy Center, Ankeny/Des Moines, USA, 10-12 April 2006

7th Expert Meeting, Lund University, Sweden, 4-6 October 2006.

Integrating Environmentally Responsive Elements in Buildings

PROJECT DESCRIPTION

Integrated Building Concepts are integrated design solutions where responsive building elements and energy-systems are integrated into one system to reach an optimal environmental performance in terms of energy performance, resource consumption, ecological loadings and indoor environmental quality.

Overview

Research into building energy efficiency over the last decade has focused on efficiency improvements of specific building elements like the building envelope, including its walls, roofs and fenestration components and building services systems such as heating, ventilation, cooling equipment and lighting.

Significant improvements have been made, and whilst most building elements still offer opportunities for efficiency improvements, the greatest future potential lies with technologies that promote the integration of responsive elements in buildings. With the integration of responsive building elements and building systems, building design completely changes from adding up individually designed elements and systems to an integrated way of designing, reflecting a holistic approach which will allow optimal use of natural energy strategies as well as integration of renewable energy devices.

Integrated Building Concepts are defined as design solutions where responsive building elements, together with energy systems, are integrated into one system to reach an optimal environmental performance in terms of energy performance, resource consumption, ecological loadings and indoor environmental quality.

Objectives

- To improve and optimise responsive building elements
- To develop and optimise new building concepts with the integration of responsive building elements,
- HVAC-systems as well as natural and renewable energy strategies
- To develop guidelines and procedures for estimation of environmental performance of responsive building elements and integrated building concepts

Deliverables

Results from the project will be collected and transformed into information that meets the needs of the main target groups. The main deliverables include:

A State-of-the-art report on responsive building elements, integrated building concepts as well as integrated design methods and environmental performance assessment tools

A Manufacturers' Guide for development, optimization and performance assessment of responsive building elements including examples of application in integrated building concepts

A Designers' Guide for design of integrated building concepts, including integration of responsive building elements and HVAC-systems and build examples, and for rough evaluation of building performance with regard to functionality, flexibility, energy savings, indoor climate, robustness and cost.

An Experts' Guide with detailed information regarding design and analysis of integrated building concepts, integration strategies of responsive building elements and HVAC-systems and optimum use of simulation methods and tools to assess environmental performance and robustness of integrated building concepts.

A General Booklet describing the principles of responsive building elements and integrated building concepts, their benefits and limitations, economical feasibility and impact on energy savings, company image, comfort, productivity, building functionality and flexibility. All deliverables will after the project period be available for download from the Annex website

(www.civil.aau.dk/Annex44) and from the ECBCS website (www.ecbcs.org).

Benefits

Integration of responsive building elements and energy-systems in integrated building concepts has a number of important advantages:

- Integration of responsive building elements with the energy-system will lead to substantial improvement in environmental and operating 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 available technologies in relation to the building users and their behaviour.
- It enhances the development of new technologies and elements in which multiple functions are combined in the same building element.

- It will lead to a better understanding of integrated design principles among architects and engineers.

Research Programme

A. Responsive Building Elements

B. Integrated Building Concepts

C. Implementation and Dissemination

Duration

November 2004 – October 2008

OPERATING AGENT

Per Heiselberg, Aalborg University, Denmark

PARTICIPANTS

About 25 research institutes, universities and private companies from 14 countries worldwide.

Austria: AEE INTEC, Institute for Sustainable Technologies

Canada: Concordia University, Dept. of Building, Civil and Environmental Engineering

Denmark: Aalborg University, Indoor Environmental Engineering; Technical University of Denmark; Aalborg University, Architecture & Design

France: ENTPE-LASH; University of La Rochelle - LEPTAB

Italy: Politecnico di Torino – DENER; Universita Politecnica delle Marche, Dipartimento di Energetica

Japan: National Institute for Land and Infrastructure Management; Tokyo Polytechnic University, Department of Architecture; University of Tokyo, Institute of Industrial Science; Building Research Instutute, Department of Environmental Engineering

Norway: Norwegian University of Science and Technology (NTNU), Faculty of Architecture, Planning and Fine Arts; SINTEF Building Research

Portugal: LNEC, National Laboratory for Civil Engineering

Netherlands: Cauberg-Huygen Consulting Engineers; Technical University of Delft

Sweden: Swedish National Testing and Research Institute – SP; University of Gavle

UK: Brunel University, Department of Mechanical Engineering; Aberdeen University, School of Engineering & Physical Sciences, FNB; Buro Happold

USA: Purdue University, School of Mechanical Engineering

OBSERVERS

China: University of Hong Kong

REPORTS/PAPERS PUBLISHED IN 2006

Integrated Building Concepts Introductory Brochure – this has been printed and distributed to interested countries according to their orders, total 3550. It is also available at the Annex 44 website.

Presentations from the Annex 44 Forum Workshops are available at the Annex 44 website.

MEETINGS IN 2006

The purpose of the forum is to disseminate information and to get feedback on the work performed within the annex both internally among annex participants and externally among the international design community and industry.

Fourth Annex 44 Forum, Turin, 29 March 2006

Fifth Annex 44 Forum, Graz, Austria, 11 September 2006

Energy Efficient Future Electric Lighting for Buildings

PROJECT DESCRIPTION

Overview

Lighting-related electricity production for the year 1997 was 2016 TWh, of which 1066 TWh was attributable to IEA member countries. Of the global lighting electricity use approximately 28% is distributed to the residential sector, 48 % to the service sector, 16 % to the industrial sector, and 8 % to street and other lighting. In 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. Of the lighting-related electricity production the corresponding carbon dioxide emissions were 1775 million tonnes, of which approximately 511 million tonnes were attributable to the IEA member countries.

The more efficient use of lighting energy would limit the rate of increase of electric power consumption, reduce the economic and social costs resulting from constructing new generating capacity, and reduce the emissions of greenhouse gases and other pollutants.

Interesting aspects of desired lighting are energy savings, daylight use, individual control of light, quality of light, emissions during life cycle and total costs. The demands for the new light sources are: higher efficiency, ecological, lower costs, better light quality, longer lifetime, suitability for dimming, control and other value added features.

Objectives

The objectives of Annex 45 are:

- 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
- Assess and document barriers preventing the adoption of energy efficient technologies and propose means to resolve these barriers.

Research Programme

- Targets for Energy Performance and Human Well-Being
- Innovative Technical Solutions
- Energy-Efficient Controls and Integration
- Documentation and Dissemination

Beneficiaries

The main target groups for the deliverables are lighting designers, electrical building services and system integrators in buildings, and the end-users/owners. The designers are a good target group while it is well defined and serving both commercial and residential lighting applications. They require references, guidelines and analysis tools which are applicable also for researchers. The end-users/owners need promotional material that is simple in content.

The results will also be disseminated by delivering information to standardisation and recommendations and by providing educational material to educational institutions in order to positively influence future lighting professionals. The integration of lighting to building services benefits the occupant, the building operator, the owner and society at large. The objective is to impact positively on the current lighting practices in a manner that accelerates the use of energy efficient products, thus benefiting the lighting industry, improving the overall building performance and enhancing the occupant's environmental satisfaction.

Dissemination

The design guidebook of energy efficient lighting will be the final product of the Annex. It will be published as a book, as a CD-ROM and on the web. The other deliverables are semi annual newsletters, seminars and a web-site. In addition to technical reports, scientific papers and conference papers will be published during the Annex.

Duration

July 2004 - 2008

PROJECT SUMMARY

ACTIVITIES DURING 2006

The following presentations were given during the Fourth Expert Meeting:

- Overview of international lighting recommendations / Marc Fontoynont
- Melatonin suppression / Wilfried Pohl
- Research activities at CSTB / Mireille Jandon (& Ahmad Husaunndee)
- Future of LEDs / Eino Tetri
- Lighting level control of the office room by using computer modelling and real time environmental measurements / Jouko Pakanen.
- Trends in Lighting / Peter Dehoff
- Energy Conservation in Buildings and Community Systems / Morad Atif Chairman of ECBCS
- Greenlighting at LESO-PB/EPFL / Nicolas Morel
- UBC Solar illumination system / Alexander

Rosemann

- Modern work lighting / Nils Svendenius
- Identifying knowledgeable people in the industry and collecting information / Eino Tetri
- Trends and new technologies / Wilfried Pohl

OPERATING AGENT

Professor Liisa Halonen, Helsinki University of Technology, Finland

REPORTS / PAPERS PUBLISHED IN 2006

Halonen L., Tetri E. 2006. ECBCS Annex 45 – Energy Efficient Electric Lighting for Buildings. Lighting of Work Places: Proceedings. Fifteenth International Symposium Lighting Engineering 2006, Bled, Slovenia. Lighting Engineering Society of Slovenia, pp. 5-10.

Newsletter 3, May 2006

Articles:

- More Comfort, Less Electrical Power for Office Spaces
- Luminaires with LEDs
- Classification Scheme of Lighting Control Systems
- New Doctors in the Lighting Field

Newsletter 4, November 2006

Articles:

- New Doctors in the Lighting Field: Effects of Lighting Parameters on Contrast Threshold in Mesopic and Photopic Luminance Range
- Comparison of LED-based Light with Traditional Light Sources
- Management of Lighting Efficiency and Human Needs
- Towards Adapted Lighting Control in Low Energy Buildings
- Energy Savings with a Modern Lighting Controls System

ECBCS News, October 2006

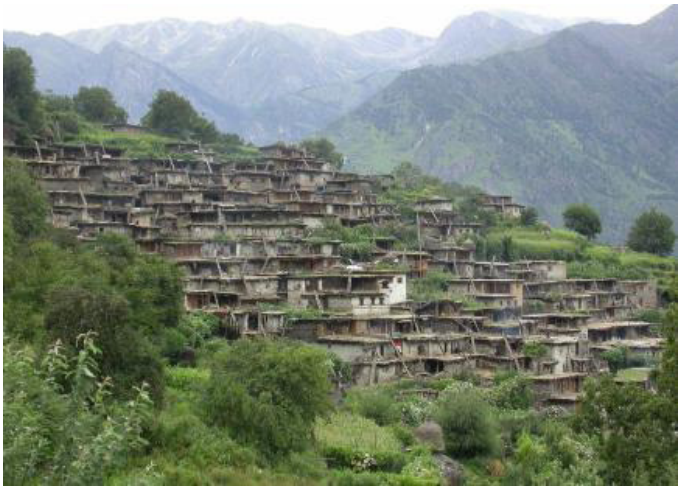
Energy Efficient Electric Lighting for Buildings: Latest Developments in ECBCS Annex 45, by Prof. Liisa Halonen.

MEETINGS IN 2006

Third Expert Meeting, Austria, 6-7 April 2006

Fourth Expert Meeting, Canada, 5-6 September 2006

EPIC 2006 AIVC Conference, Annex 45 Session, France, 20-22 November 2006



Holistic Assessment Toolkit on Energy Efficient Retrofit Measures for Government Buildings

PROJECT DESCRIPTION

Overview

The scope is to influence the decision making process that determines the use of energy-saving measures in building retrofits of Government non-residential buildings: e.g., office buildings, hospitals, large one-storey production facilities and maintenance shops and speciality warehouses

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.

Subtasks

A. To develop an energy assessment and analysis methodology/protocol and the "Energy Assessment Guide for Energy Managers and ESCOs"

B. To develop a database of "Energy Saving Technologies and Measures for Government Building Retrofits" with examples of best practices and case-studies

C. To develop "Best-Practice Guidelines for Innovative Energy Performance Contracts"

D. To develop IT-Toolkit "EnERGo."

Duration

December 2004 -

OPERATING AGENT

Dr Alexander Zhivov, US Army Corps of Engineers, Engineer Research and Development Center (ERDC/CERL) in Champaign, Ill., USA

PARTICIPANTS

Canada: Public Works

Denmark: Cenergie Energy Consultants; SBI, Danish Building Research Institute, Dept for Energy and Environment; DTU, International Center for Indoor Environment and Energy; DONG; DEA, Dansk Energy Analyse A/S

Finland: Technical Research Centre of Finland VTT

France: Ecole Nationale des Travaux, Publics de l'Etat

Germany: Fraunhofer Institute of Building Physics; Ennovatis GmbH; Schiller Engineering

Italy: Politecnical Milano

Poland: FEWE

UK: University of Strathclyde/Energy Systems Research Unit (ESRU)

USA: US Army Corps of Engineers, ERDC; US Army Corps of Engineers; NAVFAC; Oak Ridge National Laboratory; Oklahoma State University; University of Illinois, Chicago; Johnson Controls, Inc.; Plymovent Corp.

OBSERVERS

Slovakia: Slovak University of Technology

Russia: ABOK; CRIIB

ACTIVITIES DURING 2006

The first expert meeting was held in conjunction with the Workshop "Energy Efficient Technologies for Government Buildings – New and Retrofits" in Chicago, IL (USA), 19-20 January 2006, co-sponsored by US DOD, US DOE, ASHRAE and ECBCS Programme Annex 46. The workshop was attended by more than 85 participants from 9 countries. The workshop provided a forum for sharing the information on different national and international energy conservation programs, energy saving technologies and measures for building retrofits.

Annex 46 Website up and running.

Second Industry Workshop, Chicago, USA, 19-20 January 2006, included sessions on: National and International Energy Policies; ECBCS Program and Annex 46; Building Up the Database for Energy Efficient Technologies; and Implementing Energy Efficient Projects. The presentations are available to view on the Annex 46 website.

LINKS WITH INDUSTRY

The Third Expert Meeting held in conjunction with Energy Audit 2006 and the presentation of the "Energy and Process Assessment Protocol for Industrial Buildings" promoted and gained support to the Annex 46 from the international industry experts.

MEETINGS IN 2006

Second Workshop: Chicago, IL, USA, January 2006

First Expert Meeting: ERDC-CERL Chicago, USA, January 2006

Second Expert Meeting: Cenergia, Copenhagen,

Denmark, June 2006

Third Expert Meeting: VTT Finland, September 2006, in conjunction with Energy Audit 2006 Conference.

Annex 46 Workshop at the EPIC 2006 Conference, Lyon, France, 20-21 November 2006

Cost Effective Commissioning of Existing and Low Energy Buildings

PROJECT DESCRIPTION

Overview

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

Objectives

The goal of the annex is to enable the effective commissioning of existing and future buildings in order to improve their operating performance. The main objective of this Annex is to advance the state-of-the-art of building commissioning by:

- Extending previously developed methods and tools to address advanced systems and low energy buildings, utilizing design data and the buildings' own systems in commissioning.
- Automating the commissioning process as far as practicable.
- Developing methodologies and tools to improve operation of buildings in use, including identifying the best energy saving opportunities in HVAC system renovations.
- Quantifying and improving the costs and benefits of commissioning, including the persistence of benefits and the role of automated tools in improving persistence and reducing costs without sacrificing other important commissioning considerations.

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

Subtasks

1) What can be done for future buildings to enable cost-effective commissioning?

A: Initial Commissioning of Advanced and Low Energy Building Systems

The focus is set on the concept, design, construction, acceptance, and early operation phases of buildings.

- To develop information flowchart and information model
- To develop general commissioning methodology for advanced & low energy buildings

–Functional test procedures

–Control strategies for advanced systems

–Case studies

2) What can be done for existing buildings and systems to conduct commissioning cost-effectively?

B: Commissioning and Optimization of Existing Buildings

The focus is set on existing buildings where the conditions for commissioning need to be afforded without documentation and limited means for integrated commissioning.

- Develop data visualization, field optimization, and commissioning tools.
- Perform and disseminate documented case studies.

3) How can the cost-benefit situation of commissioning be represented?

C: Commissioning Cost-Benefits and Persistence

Key answers will be provided by developing international consensus methods for evaluating commissioning cost-benefit and persistence, implemented using field data.

- Develop cost-benefit methodology.
- Develop methodology & tools to enhance persistence.
- Develop international databases.

–Cost-benefit,

–Persistence

Products

Key outputs of Annex 47 include:

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

Dissemination of Information

Website:

- The Annex 47 website on-line, www.ecbcs.org/annexes/annex47.htm
- The Website contains a public site for dissemination, and private site to centralise all the

Annex documents.

Newsletter:

- Cost-Effective Commissioning for Existing and Low Energy Buildings – New ECBCS Research Project (Annex 47), August 2005
- Newsletter, June 2006

Papers and presentations:

- AQME May 2005
- ICEBO October 2005
- NCBC April 2006
- ASHRAE June 2006
- ICEBO October 2006 (24 presentations and papers from Annex 47)
- EPIC 2006 AIVC

National Interest group Meetings

- Various: Norway, Japan, USA, France, Canada

Duration

2005-2009

ACTIVITIES DURING 2006

Training Sessions on Commissioning of Existing Buildings held in Canada, June 2006 and December 2006

OPERATING AGENT AND PARTICIPANTS

The role of Operating agent for Annex 47 is shared by Canada and the USA. Canada is represented by Daniel Choiniere of Natural Resources Canada, and the USA is represented by Natascha Castro of the National Institute of Standards and Technology.

Belgium: KaHo St-Lieven,

Canada: Natural Resources Canada (CETC-Varennes), PWGSC

Czech Republic: Czech Technical University

Finland: VVT, Helsinki Technical University

France: CSTB

Germany: Ebert eng., IGS, ISE

Japan: Kyoto University, Chubu University, Kyushu Electric Power Company

Netherlands: TNO

Norway: NTNU

USA: NIST, TAMU, PECI, CMU, Johnson Controls, Siemens, LBnL

OBSERVERS

Hong Kong/China: Hong Kong Polytechnic University

Hungary: University of PECS (Observer)

REPORTS/PAPERS PUBLISHED IN 2006

Newsletter, June 2006

Conference papers and presentations:

- AQME May 2005
- ICEBO October 2005
- NCBC April 2006
- ASHRAE June 2006
- ICEBO October 2006 (24 presentations and papers from Annex 47)
- EPIC 2006 AIVC in Lyon.

REPORTS/PAPERS PLANNED FOR 2007

Cost-Effective Commissioning for Buildings – Latest Developments, ECBCS News, June 2007, p. 9-10.

MEETINGS IN 2006

Second Expert Meeting, held in Trondheim, Norway, 3-5 April 2006, attended by 28 peiple representing 12 countries and 20 organisations.

First Working Phase Meeting, held in Hong Kong. Shenzhen, China, November 2006, attended by 39 people representing 12 countries and 29 organisations.

Heat Pumping and Reversible Air Conditioning

PROJECT DESCRIPTION

Overview

Substituting a heat pump to a boiler may save more than 50% of primary energy, if electricity is produced by a modern gas-steam power plant (and even more if a part of that electricity is produced from a renewable source).

“Heat pumping” is probably today one of the quickest and safest solutions to save energy and to reduce CO2 emissions.

Most air-conditioned commercial buildings offer attractive retrofit opportunities, because:

1. When a chiller is used, the condenser heat can cover (at least a part of) the heating demand;
2. When a chiller is not (fully) used for cooling, it can be (at least partially) re-converted into heat pump.

The retrofit of an existing building and, even more, the design of a new one should take advantage of all the possibilities of heat pumping into consideration, in such a way as to make air conditioning as “reversible” as possible.

Different techniques are already available, but a recent survey of monitoring results

established in Germany still revealed a lot of faults, lack of optimisation and surprisingly low COP after, at least, one year of operation.

It appears that the many mistakes would not have been discovered without monitoring.

It also appears that these mistakes and disappointing results are mainly due to a lack of good understanding of the dynamic behaviour of the systems at the design stage, a lack of simulation work, a lack of instrumentation and for satisfactory commissioning, optimal control and fault detection.

Objectives

The aim of this project is to promote the most efficient combinations of heating and cooling techniques in air conditioning.

Specific goals:

- To allow the quick identification of heat pumping potential in existing buildings
- To help designers in preserving future possibilities and in considering “heat pumping” solutions.
- To document the technological possibilities of heat pumping.
- To improve the operation (including commissioning) of buildings equipped with heat

pumping systems.

- To make available a set of reference case studies.

Research Programme

A. Analysis of Building Heating and Cooling Demands and of Equipment Performances

B. Design

C. Global Performance Evaluation and Commissioning Methods

D. Case Studies and Demonstrations

E. Dissemination

Deliverables

Deliverable 1: Identification tool

To help practitioners and decision makers in identifying the most “interesting” buildings,

among new and existing ones.

Deliverable 2: Design guide

To help the designers and decision makers in preserving future possibilities, in not making irreversible choices, in not making new mistakes, but in optimising the whole HVAC and heat pump systems

Deliverable 3: Typification and selection guide

To help practioners in making a rational choice among existing HVAC technologies, in view of the most efficient combination between heat and cold production.

Deliverable 4: Commissioning and optimal operation guide

To help designers, installers and operators in running the system in optimal conditions, in verifying actual performances, in detecting all possible malfunctions and in performing the correct maintenance.

Deliverable 5: Documented case studies

To be proposed as reference and illustration of how to use the other deliverables.

Successful case studies will be made usable as demonstration projects.

Duration

2005-2008

ACTIVITIES DURING 2006

Building and systems database adapted to each country.

ACTIVITIES PLANNED FOR 2007

Heat recovery and reversibility index and parametric study.

Evaluation of potential energy and GES savings at national level with heat recovery and reversible solutions.

Systems description and matching table.

Report on the literature review of methods in use or recently proposed by researchers for the assessment of actual performance of HVAC systems.

First set of case studies.

OPERATING AGENT

Prof. Jean Lebrun, Lab. de Thermodynamique, Universite de Liege, Belgium

PARTICIPANTS

Belgium: University of Liege

Canada: Concordia University

France: CEA; Armines; ClimateMaster; Greth

Germany: TEB GmbH KE; Fachhochschule of Nurnberg

Italy: Politecnico de Torino

Switzerland: Fachhochschule Nordwestschweiz

REPORTS/PAPERS PUBLISHED IN 2006

Papers presented at the following conferences:

IEECB06, Frankfurt, April 2006

EPIC, Lyon, France, November 2006

- "Condenser heat recovery in air conditioning systems" Vincent Hanus, Jean Lebrun and Vincent Lemort EPIC paper November 2006
- "The GENHEPI concept: a new methodology for low energy consumption building renovation demonstration program" Laurent SARRADE, André MANIFICAT, David CORGIER EPIC paper November 2006
- " Two Case Studies on Heat Pump Systems with Ground Heat Exchanger and Thermal Concrete Core Activation for Heating and Cooling of Commercial Buildings"
- M. Madjidi and Th. Dippel EPIC paper November 2006, SSB '06, Liege, December 2006

REPORTS/PAPERS PUBLISHED IN 2007

Papers presented at the following conferences:

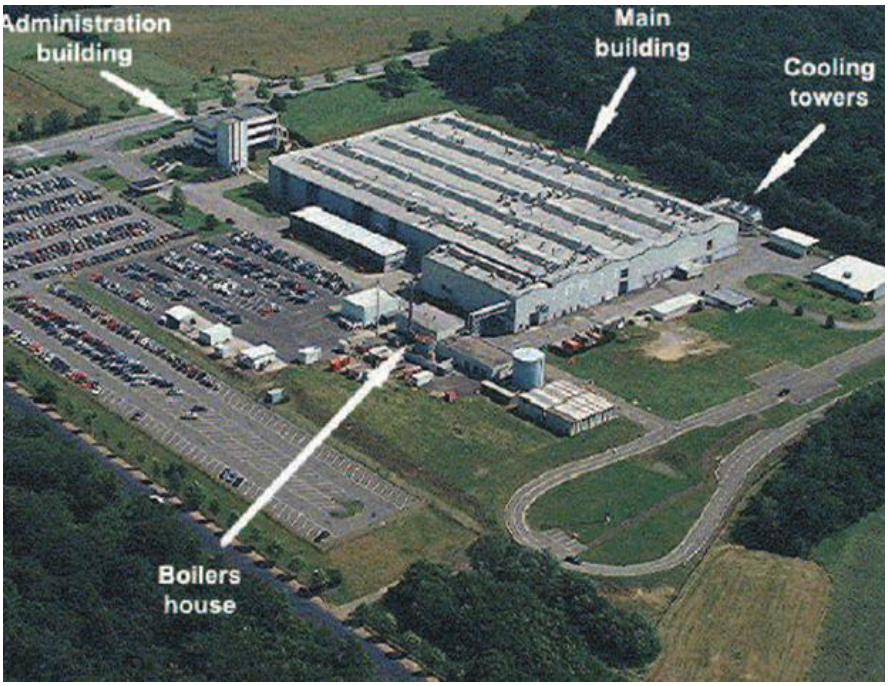
Clima2000, Helsinki, Finland, June 2007

IIR, 2007

IBSPA 2007

MEETINGS IN 2006

First Working Meeting, Paris, France, 18-19 September 2006



Low Exergy Systems for High Performance Buildings and Communities

PROJECT DESCRIPTION

Overview

The exergy content required to satisfy the demands for the heating and cooling of buildings is very low, since a room temperature level of about 20ºC is very close to ambient conditions. Nevertheless, high quality energy sources like fossil fuels are commonly use to satisfy these small demands for exergy. From an economic point of view, exergy should mainly be used in industry to allow for the production of high quality products.

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

Annex 49 aims at improving, both on a community and building level, the design of energy use strategies which account for the different qualities of energy sources, from generation and distribution to consumption within the built environment.

Annex 49 is based on an integral approach which includes the analysis and optimisation of the exergy demand in the heating and cooling systems as well as in other processes where energy/exergy is used within the building stock.

It is know that the total energy use caused by buildings accounts for more than one third of the world's primary energy demand. There is, however, a substantial savings potential in the building stock. The implementation of exergy analyses paves the way for new opportunities to increase the overall efficiency of the energy chain.

The method of exergy analyses has been found to provide the most correct and insightful assessment of the thermodynamic features of any process and offers a clear, quantitative indication of both the irreversibilities and the degree of matching between the resources used and the end-use energy flows.

Objectives

The main objective of Annex 49 is to develop concepts for reducing the exergy demand in the built environment, thus reducing CO2 emissions from the building stock and supporting structures for setting up sustainable and secure energy systems for this sector.

Specific objectives are:

- To use exergy analysis to develop tools, guidelines, recommendations, best-practice examples and background material for designers and decision makers in the fields of building, energy production and politics.
- To promote possible energy/exergy cost-efficient measures for retrofit and new buildings, such as dwellings and commercial/public buildings
- To promote the exergy-related performance analysis of the buildings, from the community level perspective.

Subtasks

A Methodologies

Objectives: development, assessment and analysis of methodology, including tools for design and performance analysis of community systems and buildings.

B Exergy Efficient Community Supply Structures

Objectives: development of energy distribution, and generation and storage systems and concepts that meet all demands of community members with a minimum input of primary energy.

C Exergy Efficient Building Technology

Objectives: the reduction of exergy demand for heating, cooling and ventilating buildings.

D Knowledge transfer, dissemination

Outcome

The tools, guidelines, recommendations, best-practice examples, pre-normative proposals and background material developed within the framework of Annex 49 will be oriented and made available to designers, planners and decision makers in the fields of building, energy production and politics. Using results from different research projects of the participant countries, a wide range of cases will be studied. At the building level, both residential and commercial buildings will be taken into consideration.

At the community and supply level, the widest spectrum of possibilties will be assessed. In addition, several climatic conditions will be taken into account. One example of innovative community supply structure integrated with suitable advanced building design that constitutes an excellent example of the LowEx principle in practice is the Minewater project, which is described in detail in the ECBCS News, June 2007.

Dissemination

In addition to regular reports and conference papers, industry workshops will be organised periodically.

The final output shall be a guidebook on how to implement advanced LowEx technology at a community level and how to optimise supply structures

in the built environment.

The design guidebook will be produced in print and on CD-ROM.

The key deliverable for Annex 49 is a report on integral optimisation strategies encompassing both buildings and supply structures.

Duration

2005-2008

ACTIVITIES DURING 2006

At the Second Preparation Meeting held in October 2006, the most important goal addressed was the development of the working plan for the whole Annex 49 working phase.

OPERATING AGENT

Dietrich Schmidt, Fraunhofer Institute for Buildings Physics (Germany)

PARTICIPANTS

Austria: Vienna University of Technology

Canada: Sustainable Buildings & Communities/ Natural Resources

Finland: VTT

Germany: TU Berlin, Hermann-Rietschel-Institut/ Fraunhofer Institute for Building Physics

Italy: Politecnico di Milano/University of Padova, Dip. Fisica Tecnica/University IUAV of Venezia, Dept of Construction of Architecture

Japan: Musashi Institute of Technology

Poland: University of Warmia and Mazury

Sweden: KTH Building Technology

Netherlands: Cauberg-Huygen R.I.B.V.

REPORTS/PAPERS PUBLISHED IN 2006

"New Research Project: Low Exergy Systems for High-Performance Buildings and Communities", by Dietrich Schmidt, ECBCS News, June 2006

"Low Exergy Supply and Energy Utilisation Structures for High-Performance Communities and Buildings – Future Building Forum Workshop Report, by Dietrich Schmidt, ECBCS News, October 2006.

REPORTS/PAPERS PUBLISHED IN 2007

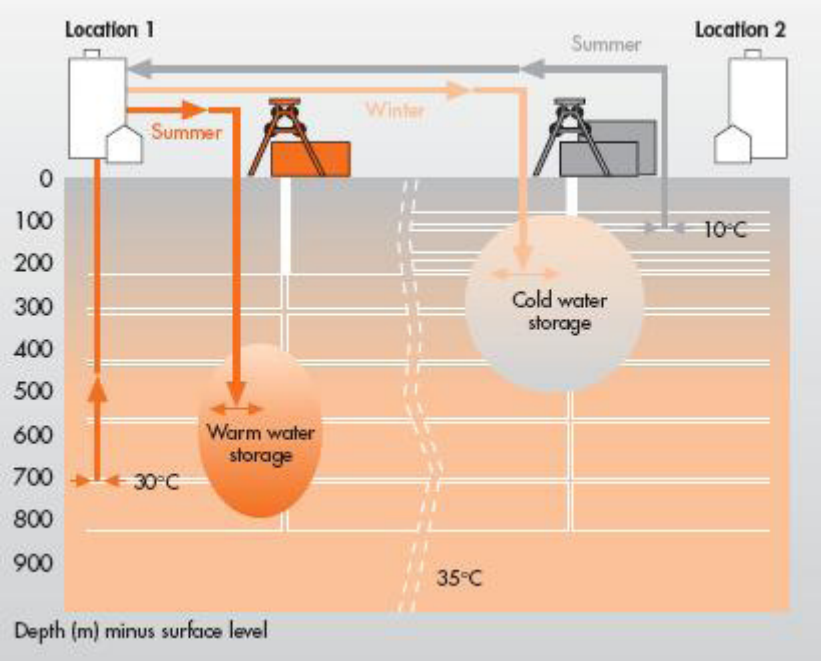
Newsletter No. 1, March 2007.

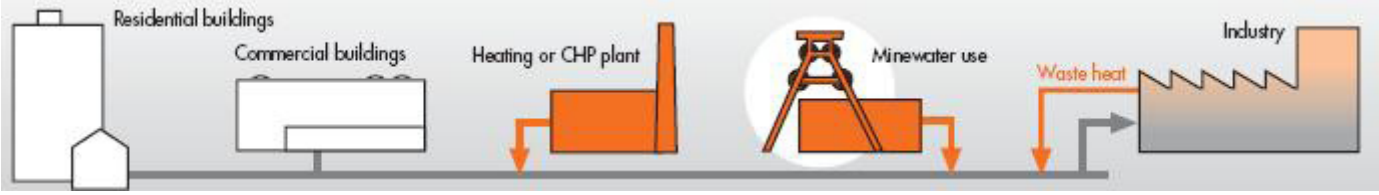
"Low Exergy in Practice: The European Mine Water Project", by Peter Op't Veld, Elianne Demollin-Schneiders, and Dietrich Schmidt, ECBCS News, June 2007.

MEETINGS IN 2006

First Preparation Phase Meeting, 25-26 May 2006, Technical University of Berlin, Germany

Second Preparation Meeting, 2-3 October 2006, KTH, Stockholm, Sweden





Prefabricated Systems for Low Energy Renovation of Residential Buildings

PROJECT DESCRIPTION

Overview

Currently, most present building renovations address isolated building components, such as roofs, façades or heating systems. This often results in inefficient and in the end expensive solutions, without an appropriate long term energy reduction. Optimal results can not be achieved by single renovation measures.

The Annex aims to develop optimized renovation concepts that guarantee advanced energy efficiency, advanced renovation standards and methods, and efficient renovation processes. Standardisation, and an increasing level of prefabrication, will substantially enhanced the quality and comfort. Advanced measurement technologies will allow for new quality standards and efficiency in prefabrication. These new concepts and methods should be developed, tested and demonstrated for residential building renovation within Annex 50.

Objectives

The objective of the Annex is the development and demonstration of innovative whole building renovation concepts for typical apartment buildings. The renovation concepts will be based on modular renovation solutions for prefabricated roof systems with integrated HVAC, hot water and solar systems, and highly insulated building envelopes with integrated new distribution systems for heating, cooling and ventilation.

The advantages of these renovation concepts include:

- Achieving energy efficiency and comfort for existing apartment buildings comparable to new advanced low energy buildings (30 kWh/m2·a ·- 50 kWh/m2·a for heating, cooling and hot water),
- Optimised constructions, and quality and cost efficiency due to prefabrication,
- The opportunity to create an attractive new living space in the prefabricated attic space and by incorporating existing balconies into the living space,
- A quick renewal process with minimised disturbances for the inhabitants.

Research Programme

A. Concept definition and specification

B. Integrated roof systems

C. HVAC and solar systems

D. Façade elements

E. Monitoring and dissemination

Deliverables

The deliverables from the Annex will be a set of condensed documentation covering:

- The building renovation guide documenting typical solutions for whole building renovations, including prefabricated roofs with integrated HVAC components and for advanced façade renovation
- Guidelines for system evaluation, design, construction process and quality assurance for prefabricated whole building renovation concepts
- Documented case studies of renovated demonstration buildings
- A synthesis report for a broad audience, demonstrating the potential of prefabricated retrofit

Duration

2006-2010

LINKS WITH INDUSTRY

Large input from industries, closely focussed on retrofitting and building services.

OPERATING AGENT

Mark Zimmermann, Swiss Federal Laboratories for Materials Testing and Research (EMPA)

PARTICIPANTS

Austria: AEE - Institute for Sustainable Technologies

Belgium: Arcelor Research Centre Liege (as part of French team)

Czech Republic: ENVIROS s.r.o., Brno University of Technology

Denmark: Velux A/S

France: Saint-Gobain Insulation

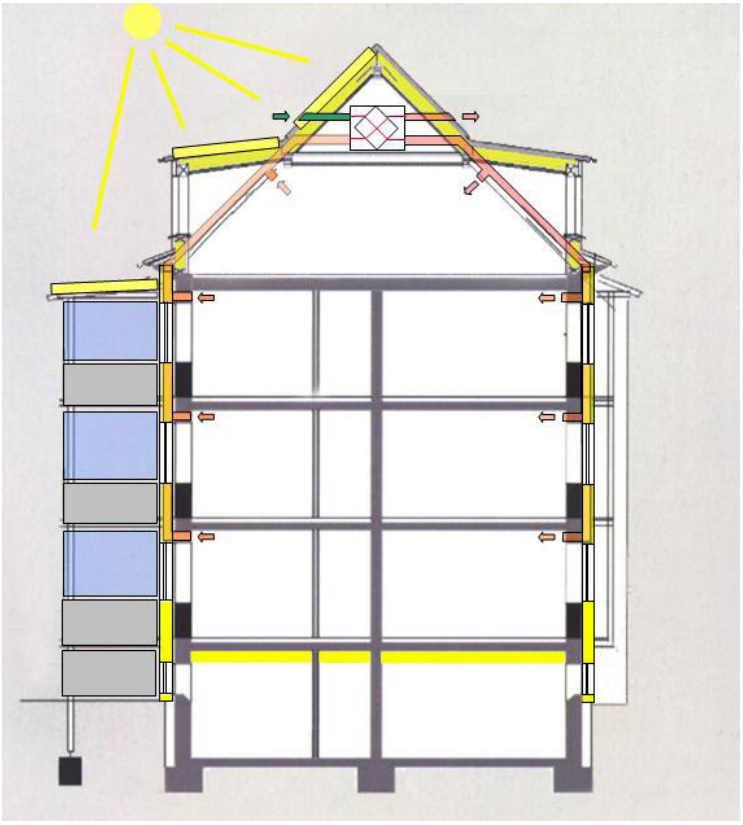
Germany: Fraunhofer-Institute for Building Physics, Variotec Sandwichelemente GmbH & Co.

Netherlands: Cauberg-Huygen Raadgevende Ingenieurs

Portugal: University of Minho, Porto University

Sweden: Lunds tekniska högskola, NCA Architects

Switzerland: Empa, HTA Lucerne, Renggli AG



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 974. Its purpose is to strengthen co-operation in the vital area of energy policy. As one element of this programme, member countries take part in various energy research, development and demonstration activities that are instituted through a series of Implementing Agreements. There are numerous advantages to international energy technology RD&D collaboration through the IEA, including:

- Reduced cost and duplication of work
- Greater project scale
- Information sharing and networking
- Linking IEA member countries and non-member countries
- Linking research, industry and policy
- Accelerated development and deployment
- 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 5% - 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 for Building and Community Systems Programme is as follows:

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

Nature of ECBCS Activities

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

b) Formal co-ordination through cost shared activities: ECBCS currently supports one cost shared project, Annex 5, the Air Infiltration and Ventilation Centre (AIVC). In recent times, Annex 5 has subcontracted 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
Austria
Belgium
Canada
Czech Republic
Denmark
Finland
France
Germany
Greece
Israel
Italy
Japan
Republic of Korea
New Zealand
Netherlands
Norway
Poland
Portugal
Sweden
Switzerland
Turkey
United Kingdom
United States of America

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

Coordination with Other Bodies

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

Collaboration with IEA Building-Related Implementing Agreements

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

- District Heating And Cooling (DHC) Executive Committee Chair
- Demand Side Management (DSM) Executive

Committee Chair

- Energy Conservation in Buildings and Community Systems (ECBCS) Executive Committee Chair
- Energy Conservation through Energy Storage (ECES) Executive Committee Chair
- Heat Pumping Technologies (HPT) Executive Committee Chair
- Photovoltaic Power Systems (PVPS) Executive Committee Chair
- Solar Heating and Cooling (SHC) Executive Committee Chair
- Energy End Use Working Party (EUWP) Vice Chair for Buildings

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

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

Collaboration with the IEA Solar Heating and Cooling Programme

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

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

The Mission statements of the two 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.

Non-IEA Activities

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

- The International Council for Research and Innovation in Building and Construction (CIB),
- The European Commission (EC),
- The International Standards Organization (ISO),
- The American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE), and
- International Initiative for a Sustainable Built Environment (iiSBE).

CIB: This organization, sponsored by individual groups, has its main area of interaction in sponsored workshops, conferences and publications. ECBCS has a formal memorandum of understanding with CIB to assist in the dissemination of results and avoidance of duplication of effort. The Secretariat of CIB periodically attends ECBCS ExCo meetings.

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

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

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

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

Latest Publications from Completed Research Projects

Output from the research projects of the ECBCS can take several different forms, be it printed books and reports, freely downloadable electronic publications in pdf format, or software programs. They are available through the ECBCS Website (www.ecbcs.org) and online bookshop.

The following is a list of the latest publications from completed projects. Please see "Ongoing Research Projects" for publications from current projects.

Annex 5 Air Infiltration and Ventilation Centre (1979-)

Building Ventilation – the State of the Art, edited by Mat Santamouris and Peter Wouters, UK Earthscan, June 2006, 352 pp., Hardback, ISBN 1844071308, £80.00

Ventilation Information Paper (VIP) 12 Adaptive Thermal Comfort and Ventilation, 2006

Annex 36 Retrofitting of Educational Buildings (1998-2002)

Energy Concept Adviser, 2005 (program and manual)

KULU – A Tool for Commissioning (program and manual)

State of the Art Overview: Questionnaire Evaluations, Edited by Tomasz Mroz, Hans Erhorn

Overview of Retrofitting Measures, edited by Tomasz M Mroz, September 2003

Case Study Buildings, O. Morck (ed.), 2003

Calculation Tools for the Energy Concept Adviser, Fritz Schmidt et al, July 2004

Energy Audit Procedures, edited by Jan de Boer, December 2003

These publications are available at *www.annex36.com*.

Annex 37 Low Exergy Systems for Heating and Cooling of Buildings (1999-2003)

The Lowex Guidebook is available at *www.lowex.net*, as well as various other short brochures and newsletters

Annex 38 Solar Sustainable Housing (1999-2003)

Exemplary Sustainable Solar Houses. A series of 40 brochures describing demonstration sustainable solar housing projects.

Sustainable Solar Housing. Edited by Robert Hastings and Maria Wall, UK, Earthscan, 2006, ISBN 1-84407-327-0, £125.00 set (Hardback), £55.00 each Paperback (Vol 1 ISBN 1-84407-325-4, Vol 2 ISBN 1-84407-326-2)

Volume 1: Strategies and Solutions

Volume 2: Exemplary Buildings and Technologies

Insights from monitoring, simulation and the experts with sections on strategies, solutions, exemplary buildings and technologies. Earthscan, 2006

Bioclimatic Housing: Innovative Designs for Warm Climates, Edited by Richard Hyde, UK, Earthscan, ISBN 1844072843, due February 2007, £49.95

The Environment Brief: Pathways for Green Design, Richard Hyde, Steve Watson, Wendy Cheshire, Mark Thomson, Taylor and Francis, 2006, 336 pp., Hardback: ISBN 9780415290449, £85.00, Paperback : ISBN 9780415290456, £37.00

Business Opportunities in Sustainable Housing: A Marketing Guide Based on Houses in Ten Countries, Download from SHC website

Annex 39: High Performance Thermal Insulation (HiPTI) (2001-2004)

Vacuum Insulation Panels. Study on VIP-components and Panels for Service Life Prediction of VIP in Building Applications ((Final Report Subtask A), Hans Simmler et al, September 2005.

Vacuum Insulation in the Building Sector. Systems and Applications, (Final Report Subtask B), Armin Binz et al.

Vacuum Insulation. Panel Properties and Building Applications. Summary, (Summary Report Subtasks A and B), Markus Erb, ed. 2005.

Annex 40: Commissioning of Building HVAC Systems for Improved Energy Performance (2001-2004)

Commissioning Tools for Improved Energy Performance – final report

Annex 40 CD: Annex 40 Commissioning of Building HVAC Systems for Improving Energy Performance

Commissioning Tools for Improved Energy Performance: Results of ECBCS Annex 40, 2005 - download from www.commissioning-hvac.org

Annex 42 The Simulation of Building-Integrated Fuel Cell and Other Cogeneration Systems (COGEN-SIM) (2003-2007)

Residential Cogeneration Systems: a Review of The Current Technologies, Knight I and Ugursal V I 2005 - download from www.cogen-sim.net

Annex 43 Testing and Validation of Building Energy Simulation Tools (2003-2007)

Shading / Daylighting / Load Interaction: Empirical Validation Experiments at ERS and EMPA [preliminary title] (Final Report Project C) (Peter Loutzenhiser, Greg Maxwell, Heinrich Manz)

Double Skin Facades: A Literature Review (Final Report Project E), (T Poirazis, O. Kalyanova)

Completed Research Projects

The following are the ECBCS research projects have been completed between 1980 and 2006.

1: Load Energy Determination of Buildings

2: Ekistics and Advanced Community Energy Systems

3: Energy Conservation in Residential Buildings

4: Glasgow Commercial Building Monitoring

6: Energy Systems and Design of Communities

7: Local Government Energy Planning

8: Inhabitants Behaviour with Regard to Ventilation

9: Minimum Ventilation Rates

10: Building HVAC System Simulation

11: Energy Auditing

12: Windows and Fenestration

13: Energy Management in Hospitals

14: Condensation and Energy

15: Energy Efficiency in Schools

16: BEMS 1- User Interfaces and System Integration

17: BEMS 2- Evaluation and Emulation Techniques

18: Demand Controlled Ventilation Systems

19: Low Slope Roof Systems

20: Air Flow Patterns within Buildings

21: Thermal Modelling

22: Energy Efficient Communities

23: Multi Zone Air Flow Modelling (COMIS)

24: Heat, Air and Moisture Transfer in Envelopes

25: Real time HEVAC Simulation

26: Energy Efficient Ventilation of Large Enclosures

27: Evaluation and Demonstration of Domestic Ventilation Systems

28: Low Energy Cooling Systems

29: Daylight in Buildings

30: Bringing Simulation to Application

31: Energy-Related Environmental Impact of Buildings

32: Integral Building Envelope Performance Assessment

33: Advanced Local Energy Planning

34: Computer-Aided Evaluation of HVAC System Performance

35: Design of Energy Efficient Hybrid Ventilation (HYBVENT)

36: Retrofitting of Educational Buildings

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

38: Solar Sustainable Housing

39: High Performance Insulation Systems

40: Building Commissioning to Improve Energy Performance

Working Group - Energy Efficiency in Educational Buildings

Working Group - Indicators of Energy Efficiency in Cold Climate Buildings

Working Group - Annex 36 Extension: The Energy Concept Adviser

ECBCS Executive Committee Members

AUSTRALIA

Mr Colin Blair
Director Building and Utilities Standards Australia International
Tel:+62 8206 6735
Email: colin.blair@standards.org.au

AUSTRIA

Werner Weiss
AEE-Intec
Tel: +43 32 58867
Email: w.weiss@aee.at

BELGIUM

Prof Jean Lebrun, Director
Lab.de Thermodynamique
Université de Liège
Tel: +32 43 664801
Tel: (Secretariat) +32 43 664800
Email: j.lebrun@ulg.ac.be

CANADA

Dr Morad R Atif (Chairman)
Director, Indoor Environment Research Program, National Research Council
Tel: +63 993 9580
Email: Morad.Atif@nrc-cnrc.gc.ca

CZECH REPUBLIC

Irena Plockova
Ministerstvo prumyslu a obchodu
Tel: +420 224 851111
Email: plockova@mpo.cz

DENMARK

Mr Jens Windeleff

Head of Section

R&D and JI Division

Danish Energy Authority

Tel: +45 33 92 68 8

Email: jew@ens.dk

FINLAND

Dr Markku J. Virtanen (Vice Chairman)
VTT
Tel: +358
Email: markku.virtanen@vtt.fi

FRANCE

Mr Pierre Hérant
Bâtiment et Collectivités, Agence de l'Environment et de la Maîtrise de l'Energie
Centre
Tel: +33 4 93 95 7947
Email: pierre.herant@ademe.fr

GERMANY

Mr Jürgen Gehrmann
Forschungszentrum Jülich, Projektträger PTJ-ERG
Tel: +49 2461614852
Email: j.gehrmann@fz-juelich.de

GREECE - To be arranged

ISRAEL

Dr. H. Avraham Arbib Deputy Chief Scientist and Director Division of R&D, Ministry of National Infrastructures
Tel: +972 2 5316128
Email: aarbib@mni.gov.il

ITALY

Dr Marco Citterio
ENEA SIRE HAB
Tel: + 39 06 3048 3703
Email: citterio@casaccia.enea.it

JAPAN

Dr Takao Sawachi

National Institute for Land and Infrastructure Management

Tel: +8298 64 4356

Email: sawachi-t92ta@nilim.go.jp

REPUBLIC OF KOREA

Seung-eon Lee
Research Fellow, Building Research Dept.
Korea Institute of Construction Technology
Tel: +82-3-90-0343
Email : selee2@kict.re.kr

NETHERLANDS

Mr Piet Heijnen
Program Adviser, Built Environment
SenterNovem
Tel: +31 46 4 202268
Email: P.Heijnen@senternovem.nl

NEW ZEALAND

Mr Michael Donn
School of Architecture
Victoria University of Wellington
Tel:+64 4 463 6221
Email: michael.donn@vuw.ac.nz

NORWAY

Jørn Lindstad
Senior Adviser
Program Coordinator Building
and Construction
Division for Innovation
The Research Council of Norway
Tel: + 47 22 03 72 89
Email: jli@rcn.no

POLAND

Prof Stanislaw Mierzwinski
Silesian Technical University
Faculty of Environmental and Energy
Engineering, Dept of Heating, Ventilation & Dust
Removal Technology
Tel: +48 32 2 37 280
Email: stanislaw.mierzwinski@polsl.pl

PORTUGAL

Prof. Eduardo Maldonado
Faculdade de Engenharia
Universidade do Porto
Tel: +3522 508 4 00
Email: ebm@fe.up.pt

SWEDEN

Mr Conny Rolén
Formas
Tel: +46 8 775 4030
Email: conny.rolen@formas.se

SWITZERLAND

Mr Andreas Eckmanns
Bereichsleiter Gebäude
Sektion Öffentliche Hand und Gebäude
Bundesamt für Energie BFE
Tel: +41 31 322 5461
Email: andreas.eckmanns@bfe.admin.ch

TURKEY - To be arranged

UK

Clare Hanmer
The Carbon Trust
Tel: +44 (0)20 770 7089
clare.hanmer@thecarbontrust.co.uk

USA

Mr Richard Karney
Office of Building Technologies, State and Community Programmes,
US Department of Energy
Tel: +202 586 9449
Email: richard.karney@ee.doe.gov

ECBCS Operating Agents

IEA Secretariat

Jeppe Bjerg
International Energy Agency
9 rue de la Fédération
75739 Paris Cedex 15
FRANCE
Tel: +33 40 57 67 6
Email: jeppe.bjerg@iea.org
Web: www.iea.org

5 Air Infiltration and Ventilation Centre

Dr Peter Wouters
INIVE EEIG
Boulevard Poincaré 79
B-060 Brussels, Belgium
Tel: +32 2 655 7711
Email: aivc@bbri.be

AIVC Steering Group Chairman
Dr Max Sherman
Indoor Air Quality Division,
Building 90, Room 3074,
Lawrence Berkeley National Laboratory
Berkeley, California 94720, USA
Tel: +50 486 4022
Email: MHSherman@lbl.gov
Web: www.aivc.org

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

Prof Hugo Hens
K.U. Leuven
Department of Civil Engineering
Laboratory of Building Physics
Kasteelpark Arenberg, 51
B-300Leuven, Belgium
Tel: +32 6 32 44
Email: hugo.hens@bwk.kuleuven.ac.be
Web: www.ecbcs.org/annexes/annex41.htm

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

Dr Ian Beausoleil-Morrison
CANMET Energy Technology Centre
Natural Resources Canada
580 Booth Street, 3th Floor
Ottawa KA 0E4, Canada
Tel: +63 943 2262
Email: ibeausol@nrcan.gc.ca
Web: www.ecbcs.org/annexes/annex42.htm

43 Testing and Validation of Building Energy Simulation Tools (Solar Heating and Cooling Task 34)

Dr Ron Judkoff
Buildings & Thermal Systems Center
National Renewable Energy Lab (NREL)
1617 Cole Blvd.

Golden, CO 80401, USA
Tel: +1 303 384 7520
Email: ron_judkoff@nrel.gov
Web:
www.iea-shc.org/tasks/task34_page.htm

44 Integrating Environmentally Responsive Elements in Buildings

Prof Per Heiselberg
Indoor Environmental Engineering
Aalborg University
Sohngårdsholmsvej 57
DK-9000 Aalborg, Denmark
Tel: +45 9635 8541
Email: ph@bt.aau.dk
Web: www.ecbcs.org/annexes/annex44.htm

45 Energy-Efficient Future Electric Lighting for Buildings

Prof Liisa Halonen

Helsinki University of Technology
Lighting Laboratory
P.O.Box 3000,
FIN-0205 HUT, Finland
Tel: +358 9 4512418
Email: liisa.halonen@hut.fi
Web: www.ecbcs.org/annexes/annex45.htm

46 Holistic Assessment Toolkit on Energy Efficient Retrofit Measures for Government Buildings

Dr Alexander Zhivov
Energy Branch
US Army Corps of Engineers
ERDC - CERL
2902 Newmark Dr.
Champaign, IL 6826-9005, USA
Tel: +27 373 459
Email: Alexander.M.Zhivov@erdc.usace.army.mil
Web: www.ecbcs.org/annexes/annex46.htm

47 Cost Effective Commissioning of Existing and Low Energy Buildings

Daniel Choinière
Technology Expert, Natural Resources Canada,
CANMET Energy Technology
Centre -Varennes, 65 Lionel-Boulet
C.P. 4800, Varennes, Qc J3X S6
CANADA
Tel: +450 652 4874
Email: Daniel.Choiniere@NRCan.gc.ca

Natascha Castro
Mechanical Engineer
National Institute of Standards and Technology
Mechanical Systems & Controls Group
00 Bureau Drive Stop 8631
Gaithersburg, MD 20899-8631
USA
Tel: +30975 6420
Email: natascha.castro@nist.gov
Web: www.ecbcs.org/annexes/annex47.htm

48 Heat Pumping and Reversible Air Conditioning

Prof Jean Lebrun, Director
Lab.de Thermodynamique
Université de Liège
Campus du Sart-Tilman, Batiment B49
Chemin des Chevreuils
B 4000 Liège, BELGIUM
Tel: +32 43 66 48 01
Tel: (Secretariat) +32 43 66 48 00
Email: J.LEBRUN@ULG.AC.BE
Web: www.ecbcs.org/annexes/annex48.htm

49 Low Exergy Systems for High-Performance Buildings and Communities

Tekn. Dr. Dietrich Schmidt
Fraunhofer-Institute for Building Physics
Project Group Kassel
Gottschalkstraße 28a
D-3427 Kassel
GERMANY
Tel: +49 561804 871
Email: dietrich.schmidt@ibp.fraunhofer.de
Web: www.ecbcs.org/annexes/annex49.htm

50 Prefabricated Systems for Low Energy / High Comfort Building Renewal

Mr Mark Zimmermann
EMPA-ZEN
Überlandstrasse 29
CH 8600 Dübendorf
SWITZERLAND
Tel: +41 44 823 4178
Email: mark.zimmermann@empa.ch
Web: www.ecbcs.org/annexes/annex50.htm

List of Abbreviations

AIVC Air Infiltration and Ventilation Centre (IEA) - www.aivc.org

AIR Air Information Review (ECBCS AIVC)

ALEP 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 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)

Published by Faber Maunsell Ltd, Marlborough House, Upper Marlborough Rd, St Albans, Hertfordshire, AL1 3UT, United Kingdom

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