International Energy Agency

ECBCS I Annual Report 2008

Energy Conservation in Buildings & Community Systems Programme

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Participating countries in ECBCS: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, 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:

Our Mission

"To develop and facilitate the integration of technologies and processes for energy efficiency and conservation into healthy, low emission, and sustainable buildings and communities, through innovation and research."

Research and Development Strategies

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

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

1. Load Energy Determination of Buildings
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**
51. ***Energy Efficient Communities**
52. ***Towards Net Zero Energy Solar Buildings**
53. ***Total Energy Use in Buildings: Analysis & Evaluation Methods**

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

Introduction

The vision of the ECBCS Programme is for "near-zero primary energy use and carbon emission solutions to have been adopted in buildings and communities, in which energy is produced on demand". To attain this vision ECBCS is now implementing a carefully considered research and development strategy. The implementation of this strategy also requires increasing and effective dissemination activities to enable knowledge transfer to end users.

During the past year, ECBCS has pursued the vision in a number of key areas. Such an ambitious goal requires that changes to design and construction practice intended to reduce energy use are no longer merely incremental, but rather necessitate large 'step' changes. In fact, the current reality is that in communities, towns and cities - with very few exceptions - energy use is actually increasing rather than decreasing.

Thus the emphasis of the Programme has been re-focused away from activities related to buildings in isolation and towards those which include consideration of buildings and the communities in which they are located, or are planned to be. Our project "Energy Efficient Communities" is based on the realisation that community-wide energy concepts must find optimized solutions in economic terms rather than introducing cutting-edge technical innovations. Otherwise practical implementation would not be achievable. This is a significant difference between community level projects and those that just concern a single building.

The major transition we are anticipating requires that whole building integrated concepts should be developed. In this regard, the work we are now undertaking includes:

- For existing apartment buildings, a project **"Prefabricated Systems for Low Energy Renovation of Residential Buildings"** to develop and demonstrate innovative concepts.
- For new buildings, the project **"Towards Net Zero Energy Solar Buildings"** has been initiated within the last year. This intends to study current net-zero, near net-zero and very low energy buildings and to develop a common understanding, a harmonised international definitions framework, tools, practical innovative solutions and industry guidelines.
- **"Holistic Assessment Tool-kit on Energy Efficient Retrofit Measures for Government Buildings"**, which is providing a whole building retrofit toolkit.

The delivery of building services must also undergo fundamental changes to achieve our objective. To this end we are developing new concepts as follows:

- In **"Energy-Efficient Future Electric Lighting for Buildings"** we are providing proof of concepts for future lighting strategies, including understanding how LEDs may be applied.
- In **"Cost Effective Commissioning of Existing and Low Energy Buildings"** we are determining how both existing and low energy buildings may best be made to operate in practice as designed or to an even better level.
- The building integration of renewable energy and other technologies is being explored in **"Integrating Environmentally Responsive Elements in Buildings"**.
- **"Heat Pumping and Reversible Air Conditioning"** is seeking to take advantage of expensive air conditioning equipment as fully as possible, for example by applying exhaust air heat recovery in heat pumping mode.

We are facilitating the introduction of new energy sources by means of two major projects:

- **"Low Exergy Systems for High Performance Buildings and Communities"** has been successful in applying the 'exergy' concept (that quantifies the 'quality' of an energy source) in community wide energy systems.
- **"The Simulation of Building-Integrated Fuel Cell and Other Cogeneration Systems"** has recently been completed. This has established robust protocols for implementing models of residential cogeneration systems within thermal modelling environments.

Performance benchmarking is important both for buildings and for the tools used to design them. Therefore, it is necessary to research a number of vital areas:

- The understanding of fundamental building physics has been improved by **"Whole Building Heat, Air and Moisture Response"**.
- **"Testing and Validation of Building Energy Simulation Tools"**, which has recently ended, has added new cases to the renowned BESTEST approach.
- A new project has been created during 2008, **"Total Energy Use in Buildings: Analysis & Evaluation Methods"** to develop common methodologies to understand differences in energy use between buildings by relating energy use to the service it is delivering.

Dr Morad R. Atif

ECBCS Executive Committee Chair

New Research Projects

Towards Net Zero Energy Solar Buildings

Total Energy Use in Buildings

Towards Net Zero Energy Solar Buildings

This is a joint project with IEA-Solar Heating and Cooling Programme Task 40.

Energy use in buildings worldwide accounts for over 40% of primary energy use and 24% of greenhouse gas emissions. Energy use and emissions include both direct, on-site use of fossil fuels and indirect use from electricity, district heating/cooling systems and embodied energy in construction materials.

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

Achieving 'Zero'

The first strategy is to reduce energy demand through suitable architectural design and improved building envelopes. Measures include insulation, improved glazing and daylighting, airtight building envelopes and natural ventilation as well as active or passive shading for control of solar gains. To use the energy supplied more efficiently, it is necessary to improve the efficiency of energy systems and services through better heating, cooling and ventilation systems, controls and lighting. To reach 'zero' however requires intensive use of renewable energy concepts including solar heating, solar cooling, solar PV, and biofuels or other clean energy generation sources.

The 'net-zero' approach focuses on achieving an annual balance of energy supply and demand economically through interactions with electricity grids and other utilities such as community energy systems. To minimise the impact to grids by reducing the mismatch of supply and demand, the NZEB approach requires a very high level of energy efficiency, smart controls, load management, and on-site solar energy utilisation. This approach applies to the existing building stock as well as to new buildings.

The objective of the project is to study current net-zero, near net-zero and very low energy buildings and to develop a common understanding, a harmonised international definitions framework, tools, innovative solutions and industry guidelines. To achieve this objective the project will document and propose practical NZEB demonstration projects, with convincing architectural quality.

The planned outcome is to support the conversion of the NZEB concept from an idea into practical reality in the marketplace. Demonstrating and documenting real projects will also lower industry resistance to adoption of these concepts.

The project will cover major building types (both residential and non-residential), new and existing, for the climatic zones represented by the participating countries. Individual buildings, clusters of buildings and small settlements will be considered.

Research Areas

- To establish an internationally agreed understanding on NZEBs based on a common methodology.
- To identify and refine a suite of design tools to support industry adoption of NZEBs.
- To develop and test innovative, whole building net-zero solution sets for cold, moderate and hot climates with exemplary architecture and technologies that would be the basis for demonstration projects and international collaboration.
- To support knowledge transfer and market adoption of NZEBs on a national and international level by wide dissemination of the project's results.

The project's sourcebook and datasets will provide realistic case studies of how NZEBs can be achieved.

The project's results will be disseminated via a dedicated web page, a source book, targeting specific groups such as national policy groups, industry associations, utilities, academia and funding programmes, and also via the establishment of an education network, summer school and contributions to the Solar Decathlon event and similar student activities. There will also be workshops and articles and features in magazines to stimulate adoption.

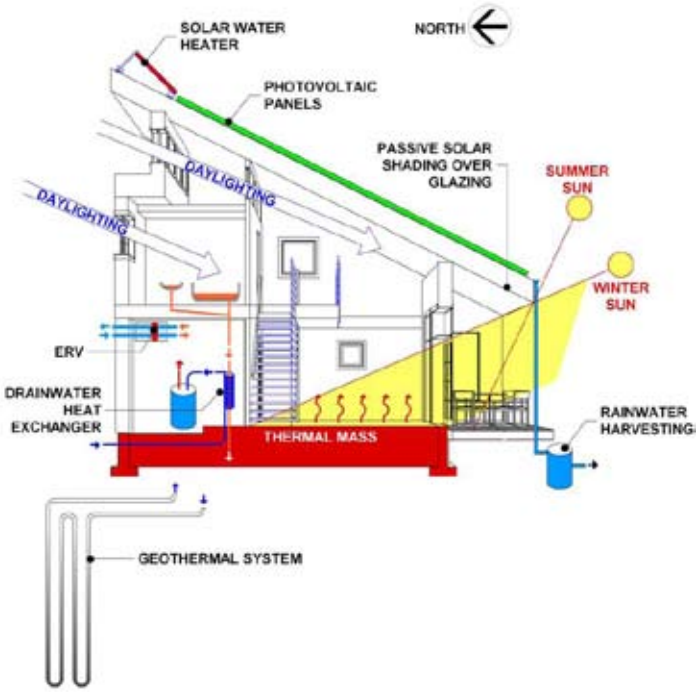
Net Zero Energy Buildings Database

The database profiles net zero energy residential and commercial buildings from around the world, including buildings that were designed to be zero energy and those that actually achieve zero energy. The database is being expanded and interested parties are invited to submit their zero energy residential or commercial building to be included. This will form part of the US Department of Energy, Energy Efficiency and Renewable Energy (EERE) Section's High Performance Buildings Database, which lists many additional projects.

Duration: 2008-2013

Operating Agent: Mark Riley

Participating Countries: to be finalised



Tsuchiya Twoby Net-Zero-Energy Home, Sapporo, Japan

Total Energy Use in Buildings: Analysis & Evaluation Methods

One of the most significant barriers to improving energy efficiency in buildings is a lack of knowledge about the determinant factors for energy use. Another frequent cause of problems is inconsistency in building-related technical terms. Technical words are needed for very precise communication in order to enhance the quality of building energy design research.
Six factors that influence energy consumption in buildings

1 Climate and site

2 Building envelope and form

3 Building services and energy systems

4 Building operation and maintenance

5 Occupants' activities and behaviour

6 Indoor environmental quality provided

Current research focuses in the main on the first three factors in this list. However, factors four, five and six, reflect human behaviour – how people operate equipment, how many children they have, where they live etc. These factors can strongly influence building energy use. Another key problem is lack of scientific method to account for the interactions between these six factors and energy use in a clear and thorough way, so that energy use in a building can be assessed accordingly.

This project aims to enrich understanding of the effective energy data for the performance of buildings and building systems over the long-term, broadening knowledge about determinant factors for total energy use in buildings and the specific interactions between these factors and newly developed energy saving strategies, technologies, methodologies and policies.

Analysing methodology, case studies, statistical studies, measurement technology and analysis, the project will cover residential and office buildings.

- Methodology: A coherent series of definitions of terms related to building energy use, energy efficiency, and related expressions will be made. New methodology for data collection and analysis of building energy use will be developed that will make it possible to investigate the effects of determinant factors for total energy use.
- Case studies: Existing case studies exploring energy use of residential and office buildings will be identified and quality data obtained for analysis.
- Statistical studies: Statistical energy use studies will be carried out for both residential and office buildings.
- Measurement technology: Contemporary technologies in measurement and data acquisition in long-term applications will be assessed to appraise methods for online evaluation of monitored data.
- Analysis: Effects of building and occupant related factors on building energy use will be analysed. Reference values of indicators of building energy use for different building types are expected to be provided. The effect of energy saving technologies on building energy use will be predicted by using this information.

The main objective of is the production of new knowledge of total building energy use that will enable the development of new strategies and policies for energy savings.

Deliverables

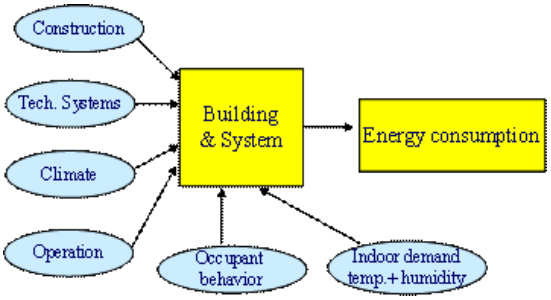
- A methodology for analysis of building energy use by end use
- Case studies of energy consumption by end use in buildings
- Statistical studies of energy consumption by end use in buildings
- Indicators of energy consumption by end use (e.g. refrigeration, lighting, heating etc) in several building types
- Assessment of measurement and data acquisition technology for long term monitoring and of methods for on-line evaluation of monitored data
- A methodology to predict the effect of energy saving policies and technologies on building energy use.

A first meeting, hosted by University of Liege, Belgium, in February 2009, was attended by 29 participants from 11 countries who enthusiastically discussed the research proposals, approving future plans.

Duration: 2008-2012

Operating Agent: Hiroshi Yoshino

Participating Countries: to be finalised



Indoor environmental quality provided

Completed Research Projects

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

Whole Building Heat, Air and Moisture Response

The project aimed to acquire a better knowledge of whole-building heat, air and moisture balance and its effects on the indoor environment, on energy consumption for heating, cooling, air humidification and air drying, and on the envelope's durability. The research follows on from 'Condensation and Energy' (Annex 14), 'Heat, Air and Moisture Transport in Insulated Envelope Parts' (Annex 24) and 'Integral Building Envelope Performance Assessment' (Annex 32).

The project had two main objectives:

A detailed exploration of the complex physics involved in whole building heat, air and moisture response (HAM-response). This included basic research, a further development of existing and new models, measurement of the moisture storage function of materials, measurement of the air permeance of envelope parts as built, mock up testing, field testing and validation by inter-comparison of models through common exercises and confrontation with measured data.

This first objective aimed to foster a basic understanding of transient moisture storage in different finishing materials and moisture exchange with the indoor air. For this purpose material storage properties were measured. This should help develop numerical models and backup experiments that link the heat and moisture storage and HAM-transfer in enclosures to the performance of the building and the HVAC system. Mock-up and field measurements have to prove the effectiveness of moisture storage under different weather conditions (cold, warm and dry, warm and humid and maritime).

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

The research work was divided into four sections:

- Modelling principles and common exercises
- Experimental investigations
- Boundary conditions
- Long term performance and technology transfer

Participants:

Austria, Canada, Belgium, Denmark, , Finland, France, Germany, Japan, Netherlands, Norway, Portugal, Sweden, , Switzerland, UK, USA, UK

Observers:

Brazil, Estonia, Israel, Slovakia, Spain

Duration: 2003-2008

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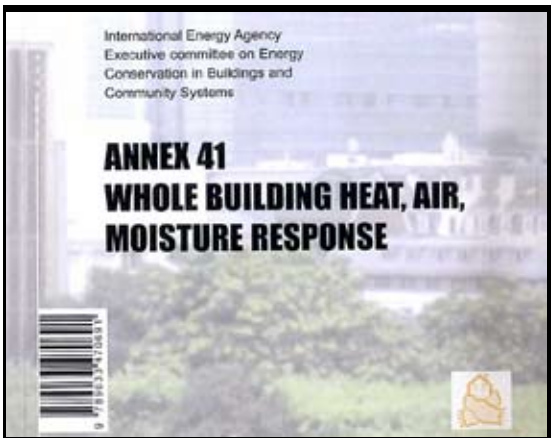

The Simulation of Building-Integrated Fuel Cell and Other Cogeneration Systems

This international research project focussed on the modelling of fuel cell and other cogeneration technologies in the built environment.

Residential cogeneration (also known as micro-cogeneration and small0scale combined heat and power) is an emerging technology with a high potential to deliver energy efficiency and environmental benefits. The concurrent production of electrical and thermal energy from a single fuel source can reduce primary energy consumption and associated greenhouse gas emissions. Reductions in combustion by-products such as nitrogen oxides, sulphur dioxide, and hydrocarbons are also a possibility. The distributed generation nature of the technology also has the potential to reduce electrical transmission and distribution inefficiencies and alleviate utility peak demand problems.

The project focussed on natural gas fired cogeneration dvices with electrical outputs varying from under 1 kW to 15 kW.

It looked at:

- proton exchange membrane fuel cells
- solid oxide fuel cells
- Stirling engines
- internal combustion engines

Its objectives included:

- the characterisation of occupant-driven electrical and domestic hot water usage patterns,
- the development and validation of models of fuel cell and cogeneration technologies
- the integration of these models into existing, publicly available whole-building simulation programs, and
- the technical, environmental and economic assessment of selected cogeneration applications using the models developed within the project

The project addressed its goals by developing and incorporating cogeneration models within whole-building simulation programs. Emphasis was placed on fuel cell cogeneration systems and technologies suitable for use in new and existing single- and low-rise multi-family residential dwellings. The models were developed at a resolution appropriate for whole-building simulation operating at sub-hourly time-steps.

The overall goal of the project was to develop simulation methods that advance the design, operation, and analysis of residential cogeneration systems.

The project was organised into three research areas:

- Characterization of cogeneration systems and occupant-driven electrical and domestic hot water usage patterns
- Development, implementation and validation of cogeneration system models in building simulation programs
- Technical, environmental and economic assessment of selected cogeneration applications using the developed models

Conference

The project culminated with the 1st International Conference and Workshop in Micro-Cogeneration that was held in Ottawa, Canada in April and May 2008.

Future

Discussions are currently ongoing for the formation of a follow-on ECBCS Annex to continue the study of this emerging field that has much potential to reduce energy consumption and associated environmental emissions in the buildings sector.

Participants

Belgium, Canada, Finland, Germany, Italy, Netherlands, Norway, Switzerland, United Kingdom, USA,

Duration: 2003-2008

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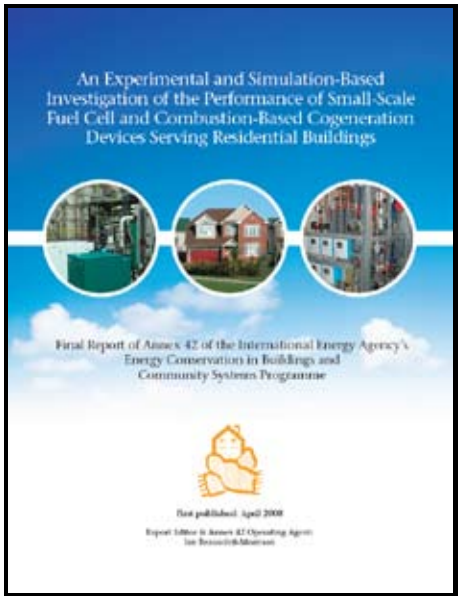


Testing and Validation of Building Energy Simulation Tools

Architects and engineers rely on building energy simulation tools. Accuracy improvements in simulation models have increased the confidence of building design professionals in the use of these complex models.

The project developed software quality assurance for complex building energy analysis tools and engineering models that are used to evaluate the performance of innovative low-energy buildings. these tools can often include hundreds of thousands of lines of complex code.

The software is increasingly used in the design and planning of buildings. The goal of this project was to undertake pre-normative research to develop a comprehensive and integrated suite of building energy analysis tool tests involving analytical, comparative, and empirical methods. These methods will provide for quality assurance of the 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 was pursued with the following objectives in mind:

- To create and make widely available a comprehensive and integrated suite of IEA Building Energy Simulation Test (BESTEST) cases for evaluating, diagnosing, and correcting building energy simulation software. Tests addressed modelling of the building thermal fabric and building mechanical equipment systems in the context of solar and low energy buildings.
- To maintain and expand as appropriate analytical solutions for building energy analysis tool evaluation.
- To 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.

There were two research areas: comparative tests, and empirical validation.

Participating Countries:

Australia, Belgium, Canada, Denmark, France, Germany, Japan, the Netherlands, Sweden, Switzerland, United Kingdom, USA

Observer: Ireland

Publications

Ground Coupling Comparative Tests

Final Report: IEA BESTEST In-Depth Diagnostic Cases for Ground Coupled Heat Transfer Related to Slab-on-Grade Construction, Joel Neymark and Ron Judkoff, 2008

Documents a set of idealised in-depth diagnostic test cases for use in validating ground coupled floor slab heat transfer models. these test cases represent an extension to IEA BESTEST 1 which originally focused on testing and validation of building thermal fabric models, but addressed only cursorly the modelling of heat transfer between the building and the ground.

Multi-Zone and Air Flow Comparative Tests

Final Report: IEA BESTEST Multi-Zone Non-Airflow In-Depth Cases: MZ320-MZ360, Joel Neymark and Ron Judkoff, et al, 2008

Final Report: BESTEST Airflow Cases Including Multi-Zone (preliminary title), Utsumi, Mitarmura, due early 2009

Shading/Daylighting/Load Interaction Empirical Validation Tests

Final Report: Empirical Validations of Shading/Daylighting/Load Interactions in Building Energy Simulation Tools, Peter Loutzenhiser, Greg Maxwell, Heinrich Manz, 2007

These studies are some of the most detailed empirical validations of solar gain models implemented in building energy simulation programs. The purpose of this project was to create data sets for use when evaluating the accuracies of models for glazing units and windows with and without shading devices. Program outputs were compared with experiments performed at an outdoor test cell in Switzerland and a facility in the United States. The authors' intention is that the data are widely used by program developers and modelers for future validation efforts.

(Modellers' Reports, ERS Daylighting Experiments and EMPA Exercises are also available.)

Mechanical Equipment and Control Strategies Comparative and Empirical Validation Tests

Final Report: Mechanical Equipment & Control for a Chilled Water and a Hot Water System, Felsmann, due early 2009

Simulation of HVAC Components with the Help of an Equation Solver, Lemort, Rodriguez and Lebrun, 2008 Download

Presents models of different HVAC mechanical equipment components. These models have been developed with the help of EES (Engineering Equation Solver). This modelling tool

allows an equation-based approach: each component is modelled by a set of equations which describe the main physical processes/peculiarities inherent to the component.

(Chilled Water System Tests and Hot Water System Tests are also available.)

Double Facade Building Comparative and Empirical Validation Tests

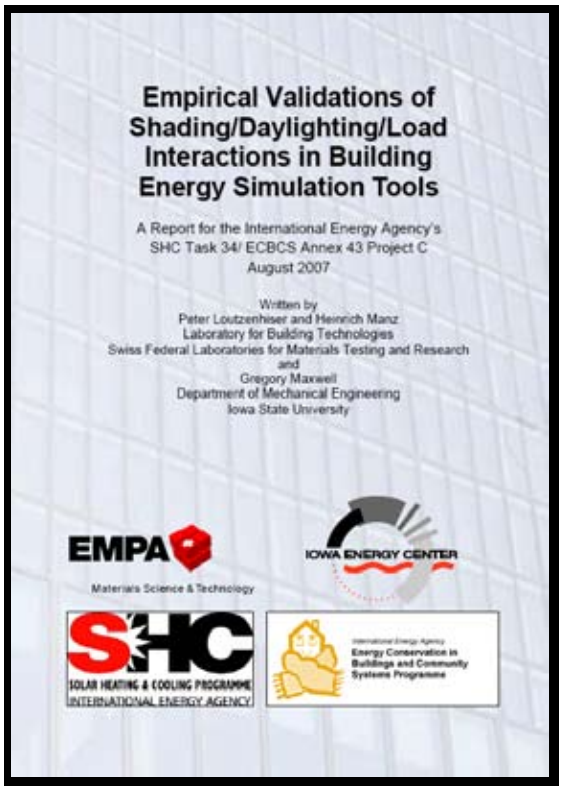
Final Report: Double Skin Facades: A Literature Review, Poirazis and Kalyanova, 2007

Final Report: Double Skin Facade Empirical Validation Tests at Aalborg Univeristy, Denmark (preliminary title), Kalyanova, Heiselberg, due early 2009

Working Document: Double-Skin Facade Comparative Tests, Kalyanova, Heiselberg, due early 2009

Final Task Management Report

Annex 43/Task 34 Final Task Management Report - Testing and Validation of Building Energy Simulation Tools, Ron Judkoff, 2008



Comments on the Project

"Without this IEA subtask for ground coupling, we would have had not means to check the results from our model, nor had a reason to make improvements to our model. there should be no question that the IEA subtask has improved the TRNSYS ground coupling model and, in doing so, has also provided energy modellers a greatly increased sense of confidence when modelling heat transfer to the ground."

"Bestest and IEA-34/43 tests brough a number of new errors to the surface. This shows the importance of these test [cycles]!! And still there will be errors in the software! Development of new specific test cases is of big importance!"

From the project leaders...

"...the expertise available through IEA and the dedication of the participants were essential to the success of this project. Over the four-year field trial effort, there were several revisions to the BESTEST specifications and subsequent re-executions of the computer simulations. This iterative process led to the refining of the new BESTEST cases, and the results of the tests led to improving and debugging of the simulation models. The process underscores the leveraging of resources for the IEA countries participating in this project. Such extensive field trials, and resulting enhancements to the tests, were much more cost effective with the participation of the IEA SHC Task 34/ECBCS Annex 43 experts."

Duration: 2003-2008

Operating Agent: (in conjunction with IEA Solar Heating and Cooling Task 34)

Ongoing Research Projects

Air Infiltration and Ventilation Centre

Integrating Environmentally Responsive Elements in Buildings

Energy Efficient Future Electric Lighting for Buildings

Holistic Assessment Toolkit on Energy Efficient Retrofit Measures for Government Buildings

Cost Effective Commissioning of Existing and Low Energy Buildings

Heat Pumping and Reversible Air Conditioning

Low Exergy Systems for High Performance Buildings and Communities

Prefabricated Systems for Low Energy Renovation of Residential Buildings

Energy Efficient Communities

Air Infiltration and Ventilation Centre

The Air Infiltration and Ventilation Centre (1979-present) furthers its prodigious output this year with a number of new and highly informative publications on ventilation. Among the most significant are sixteen new Ventilation Information Papers, including a number from several different countries looking at trends in the building ventilation market and drivers for change. A series of 'National Trends' Information Papers has also begun, featuring various topical subjects such as envelope and ductwork airtightness and innovative ventilation systems.
The popular annual conference provides an opportunity for researchers and practitioners from around the world to exchange ideas and present their latest findings. The proceedings and conference report are available at the AIVC website from mid 2009.

Perhaps the richest source of up-to-date information in the field is the AIVC's quarterly newsletter, 'Air Information Review', which this year has covered many topics, such as the ones below:-

AIR March 2008

'Indoor Air Quality in Residential Microenvironments in Athens, Greece'

'Improvement of the performance of ventilation systems in existing buildings'

'Health risk for children'

ASHRAE publishes user manual for Standard 62.1'

AIR June 2008

'ASHRAE publishes nation's first airplane cabin air quality standard 161-2007'

'The EC REVIVAL project'

'New UNEP publication on buildings and climate change'

AIR September 2008

'Recent efforts of French professionals from the building sector to account for airtightness'

'EnVIE announces a strategy for IAQ and health for EU before the end of 2008'

'Former brewery converted to a student center'

'Earth to air heat exchangers: new information booklet'

AIR December 2008

'Recent ENTPE/LASH laboratory actions to enhance hybrid ventilation systems performance'

'Diffuse ceiling ventilation: a new concept for healthy and productive classrooms'

'Estimating indoor air quality using integrated 3D CAD building models'

There have also been interviews with leading researchers in the field of ventilation, indoor air quality and energy efficiency in buildings: Professor Hugo Hens, Dr Shuzo Murakami, Dr Morad Atif and Professor Francis Allard.

Latest Products:

New Ventilation Information Papers

VIP 15 Report of the Second European Blower Door Symposium 2007

VIP 16 Air Quality in Passenger Aircraft

VIP 17 Trends in the Building Ventilation Market in England and Drivers for Change

VIP 18 Trends in the Belgian Building Ventilation Market and Drivers for Change

VIP 19 Trends in the French Building Ventilation Market and Drivers for Change

VIP 20 Trends and Drivers in the Finnish Ventilation and Air Conditioning Market

VIP 21 Trends in the Norwegian Building Ventilation Market and Drivers for Change

VIP 22 Trends in the US Building Ventilation Market and Drivers for Change

VIP 23 Trends in the Brazilian Building Ventilation Market and Drivers for Change

VIP 24 Trends in the Polish Building Ventilation Market and Drivers for Change

VIP 25 Trends in the Japanese Building Ventilation Market and Drivers for Change

VIP 26 Trends in the Korean Building Ventilation Market and Drivers for Change

VIP 27 Trends in the Czech Building Ventilation Market and Drivers for Change

VIP 28 IAQ and Ventilation Efficiency With Respect To Pollutants Inside Automobiles

VIP 29 An Overview of National Trends in Envelope and Ductwork Airtightness

VIP 30 An Overview of National Trends Related to Innovative Ventilation Systems

Technical Reports

TN 63 Ventilation in the Czech Republic

TN 64 Ventilation in Korea

Literature List

LL 33 Overview of Reports from the EU-RESHYVENT project on residential hybrid ventilation

Contributed Reports

CR 10 Ventilation Behaviour and Household Characteristics in New California Houses

CR 11 Air Leakage of U.S. Homes: Model Prediction

AIVC Conference Proceedings

2008 Conference 'Advanced Building Ventilation and Environmental Technology for Addressing Climate Change Issues' held 14-16 October, at the Kyoto International Conference Centre, where the Kyoto Protocol was negotiated in December 1997. Conference papers available online mid 2008.

Duration: 1979-present

Operating Agent: Peter Wouters

Participants: Belgium, Czech Republic, France, Denmark, Greece, Japan, Netherlands, Norway, Republic of Korea, USA

AIVC Conference Delegates on the main hall stage of the Kyoto International Conference Centre where the Kyoto Protocol was negotiated in December 1997

Integrating Environmentally Responsive Elements in Buildings

Energy usage for room heating, cooling and ventilation still accounts for more than one third of the total, primary energy demand in the industrialised countries, and is in this way a major polluter of the environment with CO2 and greenhouse-gases. To successfully achieve the targets set out in the Kyoto protocols it is necessary to identify innovative energy technologies and solutions for the medium and long term which facilitates the implementation and integration of low carbon technologies, such as renewable power generation devices within the built environment. Deployment of low carbon technologies still faces major barriers in the built environment especially in relation to costs, building logistics, technological challenges, lack of understanding and knowledge and absence of requisite skills. Moreover, there is worldwide growing concern about the type of energy used for different purposes.

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 (windows, daylighting, ventilation, etc.) and building equipment such as heating, ventilation, air handling, cooling equipment and lighting. In the framework of IEA research in ECBCS Annexes has focused on:

- the optimisation of the building envelope - Annex 32 "Integral Building Envelope Performance Assessment"
- the optimisation of ventilation by intelligent hybrid ventilation - Annex 35 "Control Strategies for Hybrid Ventilation in New and Retrofitted Office Buildings (HybVent)"
- the optimisation of the heating and cooling system by low temperature heating and high temperature cooling - Annex 37 "Low Exergy Systems for Heating and Cooling"

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 active building elements and communication among building services. In this perspective Whole Building Concepts are defined as solutions where reactive building elements together with service functions are integrated into one system to reach an optimal environmental performance in terms of energy performance, resource consumption, ecological loadings and indoor environmental quality. Reactive Building Elements are defined as building construction elements which are actively used for transfer of heat, light, water and air. This means that construction elements (like floors, walls, roofs, foundation etc.) are logically and rationally combined and integrated with building service functions such as heating, cooling, ventilation and energy storage.

The development, application and implementation of reactive building elements are considered to be a necessary step towards further energy efficiency improvements in the built environment.

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

The project is based on the knowledge gained in the work so far and will address the following objectives:

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

There are four areas of research: Reactive Building Elements; Integration in Building Concepts; Design Tools and Environments Performance Assessment; Implementation

The 8th and final Experts' Meeting for this project was held in October 2008. The final reports for this project are due to be published in late 2009.

The latest research results were presented at two sessions of the 29th AIVC Conference in September 2009. The papers presented will be available at the Air Infiltration and Ventilation Centre (AIVC) website in mid 2009, and the titles were as follows:-

'Sensitivity Analysis Applied in Design of Low Energy Office Building'

'Performance Evaluation of Advanced Integrated Facades in Laboratory Facilities'

'Design Process for Integrated Concepts with Responsive Building Elements'

'Adaptive Control Which Considers Human Comfort Corresponding to Thermal Environment

Change, and its Energy Saving Effect'

'Experimental Lifestyle Simulation for Validating Energy Saving Techniques'

'Integrated Building Concepts – Current IEA Trends and Monitoring Results'

'Achieving Thermal Comfort Using Natural Ventilation? Effect of Internal Finishing'

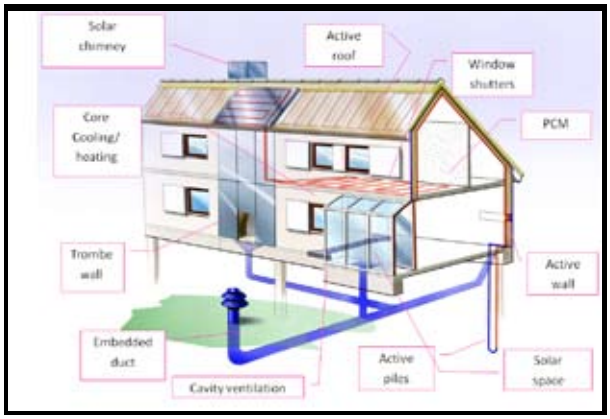
'Integrating Active Thermal Mass Strategies with HVAC Systems in Office Buildings: Development of a Concept Design Tool'

'Performance Evaluation of a Reversible Flow Double Skin Façade'

'Energy Implications of Control Strategies in Ventilated Facades'

The official publications for this project will be:

- State of the Art Report of responsive building elements, integrated buildings concepts and integrated design methods and environmental performance assessment tools (aimed at researchers)
- Experts' Guide Part 1, giving detailed information regarding design and analysis of responsive building elements, 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 (aimed at engineers).
- Experts' Guide Part 2, for the development, optimisation and performance assessment of responsive building elements including examples of application in integrated building concepts (aimed at manufacturers and engineers).
- Basic Design Guide describing the principles of responsive building elements and HVAC systems (aimed at architects, building owners, developers and end users).



Responsive building elements

Kvernhuset school, Norway is being studied in the project

Duration: 2004-2009

Operating Agent: Per Heiselberg

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

Energy Efficient Future Lighting for Buildings

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

Objectives of the project are:

- To identify and accelerate the use of energy efficient high-quality lighting technologies and their integration with other building systems
- To assess and document the technical performance of existing and future lighting technologies
- To assess and document barriers preventing the adoption of energy efficient technologies and propose means to resolve these barriers.

The final report will be a Guidebook on Energy Efficient Lighting. It will be published in the form of a 40 page summary report, with enclosed CD containing the full report. These will also be available for download on the internet. The publication is due in October 2009 and will include chapters on:

- Lighting Energy in Buildings
- Lighting Quality Criteria
- Lighting Standards and Energy Codes
- Lighting Technologies
- Lighting System Control
- Commissioning of Lighting Systems
- Case Studies
- Technical Potential for Energy Efficient Lighting and Savings
- Proposals to Upgrade Recommendations and Codes

Recent Published Papers

Papers related to this project have been presented at various conferences, workshops and journals. The following is a list of some of the titles.

- Efficient Lighting for the 21st Century.
- Integral approach to design building engineering systems design: Lighting, heating, air- conditioning as an effective way to energy saving
- Generic algorithms for lighting design optimization.
- A stand-alone solar lighting system for electrode-less fluorescent lamp
- ELI and LENI – Tools for the evaluation and presentation of human aspects and energy efficiency in lighting
- Lighting Energy Usage and Lighting Efficiency in Industrialized and Developing Countries
- Optimized illumination improving energy efficiency and quality of light
- Energy efficient lighting solutions – trends and chances
- Usability of LEDs for General Lighting
- Concepts and techniques for energy efficient lighting solutions.
- Integral approach to design building engineering systems: (lighting, heating, air- conditioning) - as an effective way to Energy Saving
- Long-term economical assessment of lighting systems.
- Future trends of energy efficient lighting.
- Lighting - Energy Consumption and Energy Efficiency.
- Energiatehokkaat valaistusratkaisut (Energy efficient lighting solutions).
- Quality and Efficiency of office lighting.
- Energy efficient electric lighting for buildings. Lighting of work places
- Long-term economical assessment of lighting systems.
- Daylight and electric light in School buildings.
- Influence of new lighting technologies into electrical networks and installations.
- Digital data transmission using low voltage power line. Silesian University of technology.
- Energy efficient lighting in buildings.
- Efficient energy consumption. Information on Silesian university of technology participation in IEA programmes.

Duration: 2004-2008

Operating Agent: Liisa Halonen

Participating Countries: Australia, Austria, Belgium, Canada, China, Finland, France, Germany, Italy, Japan, Netherlands, Norway, Poland, Russia, Singapore, Sweden, Switzerland, Turkey, UK, USA

Observers:

China, Russia, Singapore

Optimised daylighting with LEDs for general lighting

Light shelf with integrated LED light sources

Holistic Assessment Toolkit on Energy Efficient Retrofit Measures for Government Buildings

Research has shown that many government buildings are characterised by high energy consumption. Since government buildings are constructed similarly in many countries, experience gained with retrofitting such buildings with energy saving technologies should be widely applicable – on an international scale. The fact that energy saving measures are seldom applied when these buildings are retrofitted reveals that in many cases, decision makers simply lack knowledge of the many energy saving measures available to them, and of the efficiencies and return on investments that such measures can yield.

Considerations of energy saving options can be based on some simple tools. Tools such as the Energy Concept Adviser for Educational Buildings (developed in ECBCS Annex 36) provide 'rules of thumb' for quick and easy estimates of required investments and potential energy savings applicable to government buildings before analysing the building structure in detail.

Since older, energy inefficient buildings represent about 80% of the building stock, and 95% of the energy consumption, to meet the objectives of the Kyoto Protocol, we must concentrate on improving this part of the building stock. Therefore, this project focuses exclusively on the energy retrofit in selected building categories that represent a substantial part of the non-residential building stock: office/administrative buildings, large one-story production facilities, and maintenance shops.

Decision makers need to see convincing, real-world examples that show how improvements in energy conservation can go alongside improvements in comfort and functionality.

Simple tools for analysis are needed to encourage users to become more deeply involved in assessing the energy consumption of their facilities.

It is important for government buildings to demonstrate exemplary solutions and showcase them to the public, hence promoting activities is a major aspect of the project. Government buildings can potentially change public opinion and thereby help increase the market penetration of energy saving technologies.

The scope of the project is the decision making process for energy retrofitting of Government non-residential buildings, e.g. office/administrative buildings, dormitories/barracks, service buildings and production and maintenance facilities.

The decision making process needs to be improved to confront the challenges of increasing energy costs and climate change, and to avoid 'locking in' long-term commitment to energy inefficiencies by adopting sub-optimal renovations.

Though the focus is on Government buildings, many results can be applied to similar private sector buildings.

The objectives of this project are:

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

Products

The products of this project will be as follows:-

- Energy Assessment Guide for Energy Managers and ESCOs, and results of pilot studies conducted to apply and test the Guide
- A database of 'Energy Saving Technologies and Measures for Government Building Retrofits', with technology description, results of the screening analyses and case studies. This is to be published in printed from and on CD-ROM.
- Best Practice Guidelines for Innovative Energy Performance Contracts
- An IT Toolkit, 'EnERGo' – an electronic interactive source book, to be published on CD-ROM and supplemented by guidelines, best practice and case studies published as a book. A central database will include all project results and will allow users to obtain extensive information, according to their individual focus of interest: energy saving opportunities, design inspirations, design advice, decision tools, design tools, commissioning methods, long-term monitoring systems, and measures that require no financial investment.

Progress

Draft of the Energy Assessment Protocol was prepared and undergoing review by the ECBCS ExCo members and other selected experts.

A beta version of the database of 'Energy Saving Technologies and Measures for Government Building Retrofits was developed

A first set of 20 industrial energy conservation measures factsheets have been prepared with energy savings and payback analysis for twelve U.S. climatic conditions. A second set of twenty five new draft 'ECM' templates for barracks/dormitories have been prepared. Current ECMs are under development for barracks and office buildings.

The first draft of the Best Practice Guidelines and 10 case studies of successful ESPC projects/programs have been prepared and will be sent for review by the end of summer 2009.

An internal version of the IT Toolkit, 'EnERGo' with 12 different sections containing documents and tools provided by Subtasks A, B and C, was prepared and provides insights in the final IT-Toolkit. During the remaining Annex 46 phase, it will be further updated based on the progress with other subtasks.

The products are aimed at all actors involved in the decision-making process that determines the use of energy saving measures in building retrofits, specifically decision makers and energy managers of Government buildings, performance contractors, suppliers and designers.

2009 Workshop

Chicago Workshop January 26-29 2009 was conducted in conjunction with the 2009 winter ASHRAE meeting and IMCOM Energy Summit IV. The theme of the workshop was energy efficiency and conservation measures and their application to typical Government and Public buildings and building sites.

2008 Two Workshops

New York City Workshop 16-18 January 2008. The workshop provided a forum to share the information on different national and international energy conservation programs, energy saving technologies, and measures for new buildings and building retrofits.

Milan Workshop 10-12 March in conjunction with ExpoComfort Conference (46th International Congress AICARR)

The slide presentations for these workshops are available to view at the project's website.

Duration: 2006-2009

Operating Agent: Alexander Zhivov

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

Observer: Russia

Example Government buildings

Cost Effective Commissioning of Existing and Low Energy Buildings

The usual practice when commissioning buildings is to attempt to make the building work as designed. However, the "as-built" and "as-used" building virtually always differs from the original design. Hence new buildings can often operate using 5-10% less energy if they are optimised based on actual use and occupancy rather than using only the information available to the designer.
Commissioning methods and tools are required to ensure that advanced components and systems reach their technical potential and operate energy-efficiently. Likewise, commissioning methods and tools should strive to improve the energy efficiency of conventional and advanced existing buildings beyond just the design intent. However, documented commissioning methods are currently only available for conventional HVAC systems and do not address the advanced systems and system combinations that are important for low energy buildings. Without suitable methods and tools to ensure the correct interaction between components and systems, their performance in the field can be expected to fall significantly short of what is intended.

The environmental and energy saving benefits for commissioning are significant but there is a need to address technological and process barriers to achieve greater market penetration. It is generally recognized that demonstrating cost-effectiveness, including the persistence of commissioning measures will remove a major barrier to the wider market acceptance of commissioning.

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

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

Objectives

The objectives of this project are to:

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

Structure of the Work

Q: What can be done for future buildings to enable cost-effective commissioning?

Research Area:

Initial Commissioning of Advanced and Low Energy Building Systems

- Develop information flowchart
- Develop information model
- Develop general commissioning methodology for advanced and low energy buildings
    - Functional test procedures
    - Control strategies for advanced systems
    - Case studies

Q: What can be done for existing buildings and systems to conduct a cost-effective commissioning?

Research Area:

Commissioning and Optimisation of Existing Buildings

- Develop tools
    - Data visualisation
    - Field optimisation
    - Commissioning
- Perform and disseminate fully documented case studies

Q: How can the cost-benefit situation of commissioning be represented?

Research Area:

Commissioning Cost-Benefits and Persistence

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

Products

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

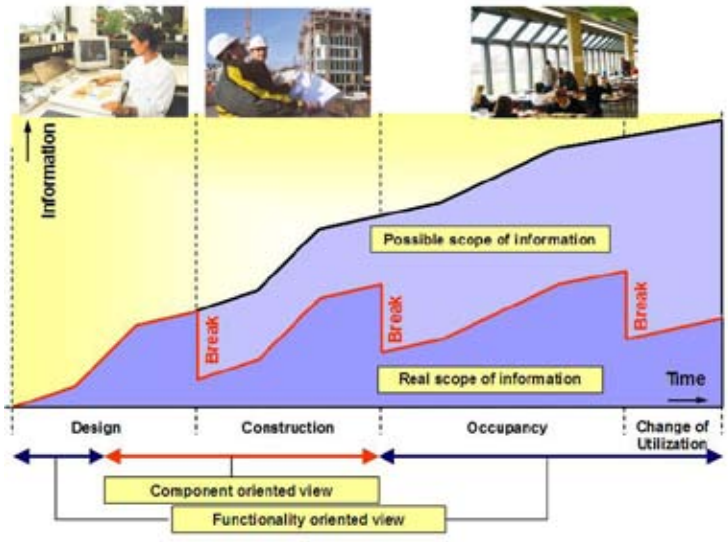
Deployment of energy metering in a commissioning project

Duration: 2005-2009

Operating Agents: Daniel Choiniere and Natascha Castro

Participating Countries: Belgium, Canada, Czech Republic, Finland, France, Germany, Japan, Netherlands, Norway, USA

Observers: Hong Kong/China, Hungary



The loss of information over the building life-cycle and the need to improve information flow.

Heat Pumping and Reversible Air Conditioning

Substituting a boiler with a heat pump may save more than 50% of primary energy, if electricity is produced by a modern gas-steam power plant (and even more if a part of that electricity is produced from a renewable source). “Heat pumping” is probably today one of the quickest and safest solutions to save energy and to reduce CO2 emissions. The aim of this project is to promote the best heat pumping techniques applicable in air conditioning of commercial buildings. Focus is given to the integration of these techniques inside the whole air conditioning system. Specific objectives include:

- This project aims to make air conditioning as reversible as possible.
- It intends to make the best use of the currently available technology.
- Technological information already gathered in previous ECBCS, SHC and HPP projects will be extensively used.
- The specific characteristics of the building, of the occupancy and of the climate will be carefully taken into account.
- Guidelines about where and how to use each type of equipment will be established. Optimal control strategies will be also identified.
- A selection of (new and existing) building types will be established during the preparation phase, according to priorities expressed by the participants and to specific expertise available.

Participants will carry out research and development in the framework of the following six research areas:

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

Products

Four deliverables are expected from this project:-

Identification Tool, Typification and Selection Guide

To help practitioners and decision makers in identifying the most "interesting" buildings, among new and existing ones. Also to help practioners in making a rational choice among existing HVAC technologies, in view of the most efficient combination between heat and cold production.

Design Guide

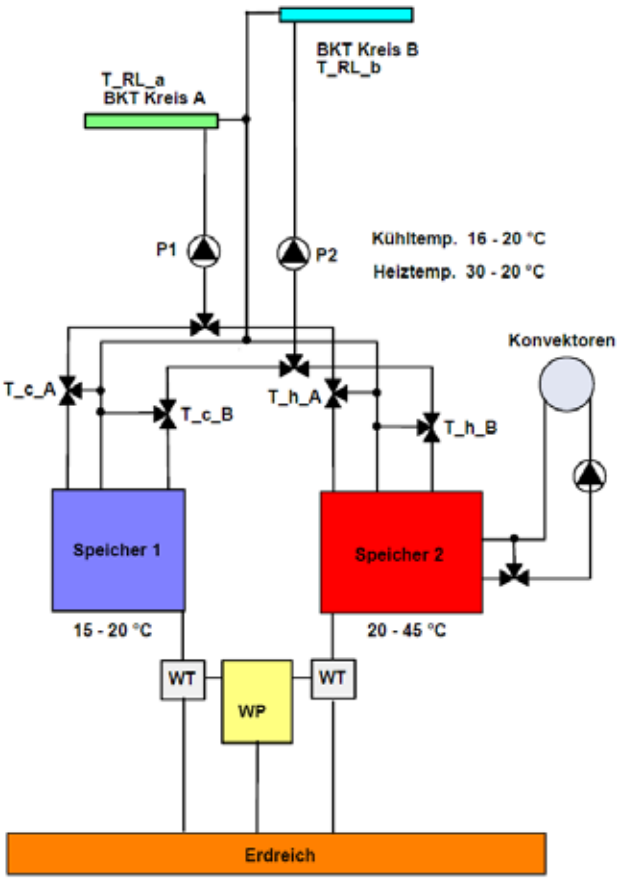
To help the designers and decision makers in preserving future possiblities, in not making irreversible choices, in not making new mistakes, but in optimising the whole HVAC and heat pump system.

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 making correct maintenance.

Documented Case Studies

These case studies are proposed as references and illustrations on how to use the other deliverables. Successful case studies will be made usable as demonstration projects.



Example system design

Case study buildings

Duration: 2005-2008

Operating Agent: Jean Lebrun

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

Low Exergy Systems for High Performance Buildings and Communities

This project is investigating the benefits of applying the exergy concept to the design and optimisation of energy supply systems for buildings and communities. Approximately eighteen research institutions and universities from twelve countries are participating.

The Exergy Concept: when the demands for heating and cooling have already been minimised (using energy conservation), the low-exergy approach aims to satisfy the remaining thermal energy demand using only low quality energy.

Aim: to improve the design of energy use strategies.

Exergy analyses pave the way for new opportunities to increase the overall efficiency of the energy chain.

Specific objectives:

- 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.

The Low Exergy (LowEx) approach entails matching the quality levels of energy supply and demand, in order to streamline the utilization of high-value energy resources, and minimise the irreversible dissipation of energy. Since the exergy content required to meet the demands for heating and cooling of buildings is very low, and the respective desired room temperature levels are very close to ambient conditions, low exergy sources (e.g. environmental heat, or the coolness of the ground) should be used to provide this demand. In turn, high quality energy sources should instead be used to supply high quality energy demands, such as electricity production or industrial processes.

This approach implies working with the whole energy chain by taking into consideration the different quality levels involved, from generation to final use, in order to significantly reduce the fraction of primary or high-grade energy used, and thereby minimise exergy consumption for a given utilization or maximise exergy efficiency of the overall system.

We first need to reduce exergy demands for heating and cooling and then utilise supply systems which only use low quality energy. To achieve this we need to develop and implement new innovative forms of technology at the building level. Waste-water heat recovery for powering heat pumps, innovative evaporative chillers, and using the ground as heat and cold storage are some of the concepts being analyzed within the project.

A simplified Excel tool for assessing the suitability of energy supply structures at the community level is also under development.

Tools for Exergy Analysis

To bring the application of the exergy concept within the built environment closer to the broader public, the following tools are being developed:

- A simplified Excel-based tool for steady-state exergy analysis of different building heating systems: the tool is focussed at the building level and allows the combination of several building systems to be analyzed, giving an idea of their exergy performance and suitability in providing heating demands.
- Several models for the dynamic analysis of building systems have also been developed in the Modelica modeling code. Although not compiled into a single tool, the models can be combined as modules, allowing for the evaluation of a great variety of building systems.
- A simplified tool, also excel based, is being developed for analyzing exergy performance energy supply structures at the community level. This is meant as a help to municipalities and decision makers involved in the community design process in the planning of optimized energy supply structures. With the help of this tool, a quantitative and qualitative view on potential improvements in such structures can be gained.

Most recently, integral optimisation strategies for buildings and communities have been discussed in detail, along with the design and decision making processes for community planning. Based on the characteristics of community planning, an effort is being made to identify the main niches for exergy optimisation.In addition, case studies to be analysed as best-practice examples, both at a community and building level, have been thoroughly discussed and collected.

Building Case Studies

A number of interesting technologies to achieve heating and cooling of buildings with

a low exergy input have been identified. They include:

- Heat pumps for low ΔT
- Waste-water heat recovery
- Novel evaporative chiller
- Fans for low-pressure head loss

- Phase change materials
- Solar collectors

Community Case Studies

A number of possible community case studies have been identified, for example, in Parma, Italy where an assessment on the futuristic hypothesis of transforming the city into a 100% renewable city by the year 2050 is planned, adopting, as a benchmark today, the best available technology.

A second example is Okotoks, Canada, where North America's first solar demonstration project incorporates the principles of low-exergy in its design, including low exergy thermal collection, and short term storage as well as long term seasonal borehole thermal energy storage. It is estimated that it will take three years to fully charge the underground storage to the design temperature of 80 Degrees Centigrade.

29th August 2008, a common workshop, 'District Energy Futures', was held with participants from this project and the IEA Implementing Agreement on District Heating and Cooling, in Reykjavik. District heating and cooling supply structures, especially those providing waste heat from industrial processes or residual heat from CHP units, are very suitable systems, from an exergy perspective, for supplying energy demands in buildings. Optimisation possibilities for these systems exist particularly if low temperatures heating and high temperature cooling systems are used.

Scientific Exchange and Input from Ongoing Research Activities

In order to enhance and promote further discussion and research, presentations have been given by participants on a variety of topics including: a new concept for utilising exergy as a planning tool at the community level; low exergy research items such as building envelope integrated solar collectors, decentralised ventilation units, PCM storage systems; energy supply concept for a new 'ecological' settlement; exergy optimisation of wastewater heat recovery; comparison of two radiant cooling systems.

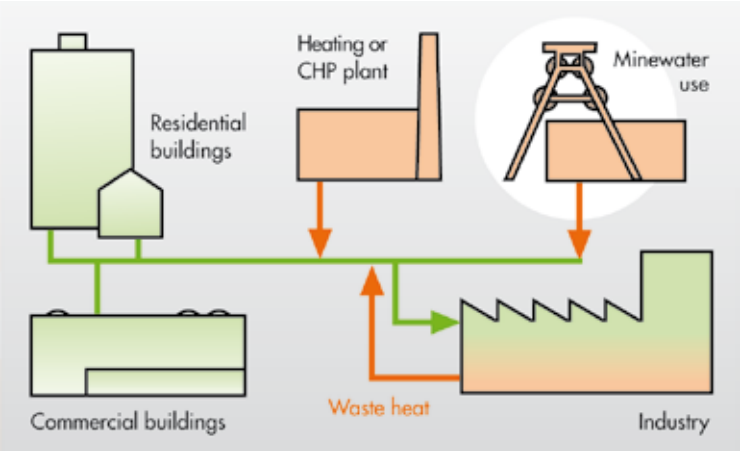
Future Conferences

A LowEx joint Annex 49-CosteXergy Conference 'The Future of Sustainable Built Environments – Integrating the Low Exergy Approach' is to be held in Heerlen, the Netherlands, april 21st 2009

A final Conference for this project is planned for Spring 2010.

Products

- State of the Art Report, 'Framework for Exergy Analysis at the Community and Building Level' – due 2009. The report will include an introduction to and discussion on different existing methodologies for applying exergy analysis to the built environment. Particular emphasis is given to the exergy analysis of renewable energy systems for the heating and cooling of buildings. The main outcomes from an extensive literature review on this issue are also included. Finally, several case studies designed according to the LowEx principles, both at community and building levels, are presented.
- Newsletters: No. 1 March 2007, No. 2 September 2007, No. 3 March 2008, No. 4 September 2008.
- Guidebook on how to implement advanced LowEx technology at a community level and how to optimise supply structures in the built environment.



Desirable energy and exergy flow to the building stock and industrial applications

Duration: 2005-2009

Operating Agent: Dietrich Schmidt

Participating Countries: Austria, Canada, Denmark, Finland, Germany, Italy, Japan, Poland, Sweden, Switzerland, Netherlands, USA

Prefabricated Systems for Low Energy Renovation of Residential Buildings

Energy conservation is largely dominated by existing buildings. In most industrialized countries new buildings will only contribute 10% - 20 % additional energy consumption by 2050 whereas more than 80% will be influenced by the existing building stock. If building renovation continues at the current rate and with the present common policy, we will need between 100 and 400 years to improve the building stock to the energy level of today's new construction.

Currently, most 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 cannot be achieved by single renovation measures and new problems can arise, including local condensation or overheating. Currently, most building renovations are neither cost effective nor energy effective. This project aims to standardise and prefabricate building retrofits for efficiency and quality.

The project's objective is the development and demonstration of an innovative whole building renovation concept for typical apartment buildings.

The aims are

- To investigate and promote cost effective low energy renovation strategies for existing apartment buildings.
- To establish optimised renovation solutions that will reduce the energy consumption by a factor of 5 to 10 (30-50 kWh/(m²·year) .
- To achieve standardisation of construction details suitable for prefabrication at lower costs.

The energy consumption aspired to for heating, cooling, ventilation and hot water is 30-50 kWh/(m²·year), ensuring that renovated buildings are again fit for the future.

The focus is on typical apartment blocks, which represent approximately 40% of the European dwelling stock.

The project concentrates on:

- Minimising the primary energy consumption (in the range of 30-50 kWh(m²·year) for heating, cooling and hot water, per gross floor area),
- Optimising the integration of solar energy use,
- Increasing living comfort by better space use,
- Assuring good thermal and acoustical comfort, good indoor air quality and daylighting conditions,
- Assuring a fast, high quality and cost-effective construction process based on prefabrication technologies.

Around 150 buildings from all the participating countries have been analysed to create a typological profile describing the renovation related parameters for each building. These building types are used for the development of the modular renovation concept. Twelve types of renovation modules are presently being studied and specified.

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

A special area of the project is dealing with advanced geomatics using laser scanning to obtain an accurate three-dimensional picture of existing buildings, which may be irregular in shape.

The main focus at present is on the technical development of renovation modules. Most of the participating countries are planning to build demonstration buildings to apply these technologies.

Research Activities

Building typology

This provides basic data for the evaluation of the renovation potential of the existing building stock, for the definition of retrofit strategies and the envelope characteristics of specific building types. It also considers the needs of owners and tenants and processes such as retrofit design, building use and maintenance.

Renovation concept and renovation modules

Based on the Building Typology research area, the building simulation group of participants is investigating the retrofit potentials and requirements for different building types and different climates.

The Swiss team has developed a prefabricated and standardised façade module that includes fenestration and ventilation. The solution concentrates nearly all construction details to be solved in a window module and allows a simple completion of the spaces between the window elements by traditional measures. A prototype that should prove the feasibility of the concept was built by industry partners.

The Austrian team have also developed a façade solution. The large prefabricated elements are up to 12 metres long and are covered by a glass cladding. Single room ventilation is integrated. A first demonstration building has already been successfully realised in the summer of 2008.

3-D laser scanning

The method presently developed foresees a two-step procedure. A first step can be done with

any computer using normalized photographs of the building and special software that allows the user to take 2-dimensional measurements on the screen. For this purpose more than 50 software tools available on the market were analysed for features and user friendliness. About 8-10 software tools are evaluated in detail. They will be used for practical tests with potential users. Only in a second step, more accurate and 3-dimensional measurements will be taken with laser scanning from selected building details needed for prefabrication.

Retrofit Advisor

A test version is has been developed. Work is ongoing to adapt it for international use.

Products of the Project

The Retrofit Advisor

One of the final products of the project will be the Retrofit Advisor, based on a software tool that will allow us to evaluate the best strategy for the building refurbishment. It will perform an economic, environmental and social evaluation of retrofit and reconstruction strategies. The idea is to develop an electronic tool, a type of 'Retrofit advisor' that will allow an internet-based evaluation of suitable renovation strategies. It will also document typical solutions for whole building renovations, including prefabricated roofs with integrated HVAC components and for advanced façade renovation.

Guidelines for System Design

Guidelines for system evaluation, design, construction process and quality assurance for prefabricated whole building renovation concepts. This publication will include the technical documentation of all developed renovation modules.

Documented Case Studies

Case studies of renovated demonstration buildings.

Technical Synthesis Report

A synthesis report for a broad audience, demonstrating the potential of prefabricated retrofit.

Meetings

Joint meetings to coordinate research between this project and the IEA-Solar Heating and Cooling Programme's Task 37, "Advanced Housing Renovation by Solar and Conservation" were/are held 18 April 2008 and 14 September 2009.

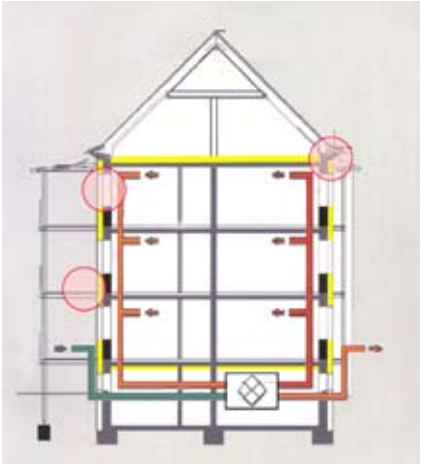
Duration: 2006-2010

Operating Agent: Mark Zimmermann

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

Problems and Solutions for Energy Efficient Retrofits

Traditional Renovation does on-site insulation of roofs and facades. This work is often difficult and unsatisfactory: difficult connections between roofs and facades, difficult situations at window openings, thermal bridges due to balcony slabs. The installation of a new ventilation system causes a lot of internal renovation work and is often unsatisfactory.



Problems of traditional renovation

The old roof is removed (when appropriate) and replaced by a new highly insulated and airtight roof construction. The new roof offers a new attractive living space that allows the integration of a new HVAC system and a solar roof system. The new ventilation system is fixed on the facades and covered by prefabricated highly insulated façade elements. Thermal bridges are eliminated, old balconies are used for a living room extension (where appropriate).

Prefabricated system renovation

The Challenges and the Opportunities

Challenges:

- Optimised solution packages
- Advanced measuring technologies
- Integration and prefabrication
- Quality assurance and risk management

Opportunities

- 'Complete' modular retrofit solution
- Highest quality standard, best technology
- Cost reduction potential
- Short construction time, low tenant disturbance.

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

This area of research is topical at the moment as in several countries public programs on energy politics in communities have either been established recently, or are in preparation. A strong increase of interest in sustainability issues is currently apparent in community administrations as a result of pressure from both national and urban politics. Consequently ambitious targets for the reduction of CO2 emissions are often set by communities, but with a limited understanding of the means to achieve them. Often the technology is in place, but difficulties are caused by:

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

This project aims to provide a practical guide for urban decision makers on how to achieve ambitious energy and CO2 targets on a local and urban scale.

Addressing small units such as neighbourhoods or quarters, and towns or cities as well, the project aims to provide urban administrations, urban planners and other urban stakeholders with the necessary knowledge and means to be able to define reasonable goals in terms of energy efficiency, energy conservation and GHG abatement on the community level.

Retrofits carried out on individual buildings can considerably reduce the specific heating demand of, say, multifamily buildings, when designed in an integrated way (envelope/windows, ventilation, boiler/furnace, controls), but to reduce this beyond a certain level becomes uneconomic. At this point a transition from individual buildings to 'many' buildings is promising. Due to economies of scale, a number of technologies, such as cogeneration or combined heat and power, waste heat recovery, biomass, geothermal energy, solar heating (and cooling), and others are more efficient technically and economically when used in large installations instead of small ones. Taking advantage of these technologies where locally available will enable the primary energy consumption to fall possibly to the best available standards for new buildings like the 'Passivhaus' group.

There are no standard solutions, however, which is where the present project comes in, aiming to provide guidance in the complex process of optimising the energy plan on a community level. The greatest difference between individual buildings and communities is a change of emphasis from cutting edge technologies to finding an optimised solution in economic terms.

Local decision makers and stakeholders are primarily addressed by this project, rather than energy planners. Hence the legal frameworks and different approaches found within the participating countries will be discussed according to their comparable suitability to enable innovative approaches for successful urban energy policies.

Research areas

- Existing organisational models, implementation instruments and planning tools for local administrations and developers – a state of the art review
- Case studies on energy planning and implementation strategies for neighbourhoods, quarters and municipal areas. This is to involve both refurbishment of existing building stock, and planning and development of new 'green' settlements.
- Case studies on the preparation of integrated energy and CO_2 abatement concepts for towns or cities and corresponding implementation strategies.
- Instruments for a successful community energy policy: to include the preparation of a guidebook to successful urban energy planning, a community energy concept adviser and dissemination activities.

Deliverables

Guidebook to Successful Urban Energy Planning

To be based on the findings of the state of the art review, and an evaluation of the case studies, and presented in a way that users will be able to apply the guidebook directly to their own work. Aimed at decision makers in urban administrations, developers and urban planners.

Community Energy Concept Adviser

Computer-based tools to support municipal administrations and urban planners faced with evaluating and monitoring tasks will be considered with respect to their capability and usability. In addition it is planned to develop a knowledge-based tool, an 'energy concept adviser'. This tool is to assist the development of energy efficiency and conservation concepts and an integrated optimisation of supply structures to ensure a low fossil-energy consumption of a typical neighbourhood or quarter.

The Adviser is to include the following sections: performance rating; case studies of energy efficient communities; energy efficient strategies and technologies for communities; energy performance assessment of communities; background and basic information; detailed planning tools; contacts.

Website Dissemination

To include bi-annual newsletters and other scien-

tific or useful publications.

Examples of Prospective Case Studies

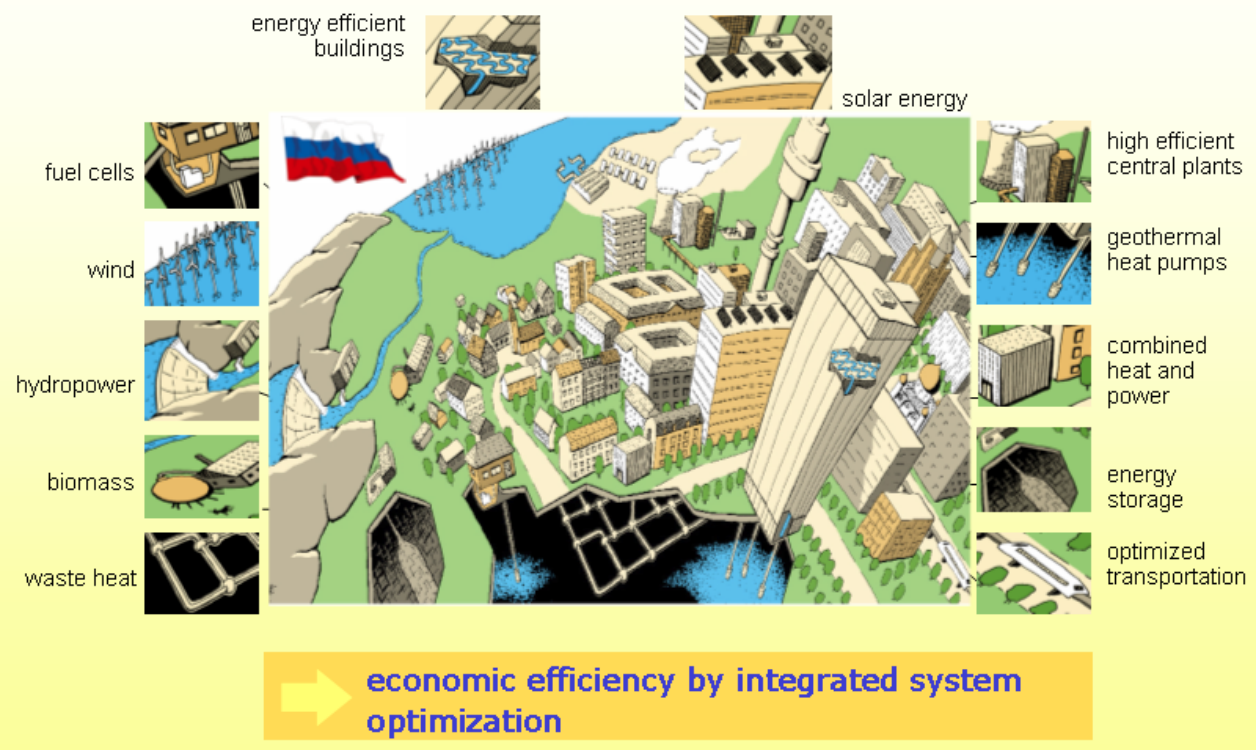
Prospective case studies intended (subject to change during project progress) include:

- Conversion and extension of a former US military station to a mixed residential and commercial “zero-energy” settlement in Germany
- Conception and implementation of a small academic demonstration neighbourhood to demonstrate cutting edge technologies in co-operation with manufacturers as knowledge and training source for planners, developers and municipal decision makers in the Netherlands
- Integrated energy supply systems for a newly developed business and residential building block for the purpose of balancing the demand loads and for optimized use of renewable energies. The system is also intended to sustain business and household supply within the block even in emergency cases such as earth quake disasters in Japan.
- Demonstration of advanced design for an integrated neighbourhood / community using local energy resources and LowEx-principles in the initial planning phase in Canada.
- Energy efficient new residential buildings with 238 new flats with optimized energy supply in Belgium.
- Long term concept for a self-sufficient municipal energy system without need of energy imports into a city in France
- Master plan and implementation concept for an optimized strategy to reduce fossil energy consumption in a German city quarter (15.000 inhabitants) by more than 50 % by 2025.

Duration: 2007-2011

Operating Agent: Reinhard Jank

Prospective Participating Countries: Belgium, Canada, France, Germany, Japan, Netherlands



Source: EnBW AG, Karlsruhe

Integrated community energy system

ECBCS and the IEA

The International Energy Agency

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

There are numerous advantages to international energy technology RD&D collaboration through the IEA, including:

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

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

About ECBCS

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

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

Objectives and Strategy

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

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

Specific objectives of the ECBCS programme are:

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

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

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

- The impact of energy measures on indoor health, comfort and usability;
- The exploitation of innovation and information technology'
- Integrating changes in lifestyles, work and business environment.

Mission Statement

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

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

Nature of ECBCS Activities

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

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

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

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

ECBCS Participating Countries

Australia
Austria
Belgium
Canada
Czech Republic
Denmark
Finland
France
Germany
Greece
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 ECBCS Agreement are Hungary, Ireland, Luxembourg, and Spain.

Coordination with Other Bodies

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

Collaboration with IEA Building-Related Implementing Agreements

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

District Heating And Cooling (DHC) Executive Committee Chair

Demand Side Management (DSM) Executive Committee Chair

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

Energy Conservation through Energy Storage (ECES) Executive Committee Chair

Heat Pumping Technologies (HPT) Executive Committee Chair

Photovoltaic Power Systems (PVPS) Executive Committee Chair

Solar Heating and Cooling (SHC) Executive Committee Chair

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

Beyond the BCG meetings, ECBCS meets with representatives of all building-related IA's at

Future Buildings Forum (FBF) Think Tanks and Workshops. It is planned that the outcome from the Future Buildings Forum Think Tank will be used strategically by the various IEA buildings related Implementing Agreements to help in the development of their work programmes over the next five years.

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

Collaboration with the IEA Solar Heating and Cooling Programme

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

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

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

ECBCS programme - to facilitate and accelerate the introduction of energy- conservation and environmentally sustainable technologies into healthy buildings and community systems, through innovation and research in decision-making, building assemblies and systems, and commercialization
SHC programme - to facilitate an environmentally sustainable future through the greater use of solar designs and technologies.

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

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

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

Non-IEA Activities

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

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

The European Commission (EC),

The International Standards Organization (ISO),

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

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.

Latest Publications

Computer-Aided Evaluation of HVAC System Performance

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

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

Design of Energy Efficient Hybrid Ventilation (HYBVENT)

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

Hybrid Ventilation: State of the Art Report

Principles of Hybrid Ventilation

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

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

Retrofitting of Educational Buildings

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

Case Study Reports

Energy Concept Adviser

KULU – a tool for commissioning

State of the Art Overview: Questionnaire Evaluations

Overview of Retrofitting Measures

Calculation Tools for the Energy Concept Adviser

Energy Audit Procedures

Annex 36 Newsletters can also be viewed

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

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

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

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

Towards Sustainable Architecture (Brochure)

Guidebook Summary Report

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

Brochure with Case Studies

Newsletters

Analysis Tool for the Exergy Chain (Excel Tool)

Solar Sustainable Housing

Sustainable Solar Housing (2 volumes) (print only)

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

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

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

Exemplary Sustainable Solar Houses - a set of 40 Brochures

High Performance Insulation Systems

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

Vacuum Insulation in the Building Sector: Systems and Applications

Vacuum Insulation: Panel Properties and Building Applications - Summary

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

Building Commissioning to Improve Energy Performance

Commissioning Tools for Improved Energy Performance: Final Report

Annex 40 CD

Commissioning Projects - around 30 papers and presentations available

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

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

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

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

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

CD-Rom available

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

Review of Residential Cogeneration Technologies

Methodologies for the Performance Assessment of Residential Cogeneration Systems

Review of Existing Residential Cogeneration Systems Performance Assessments and Evaluations

Residential Cogeneration Systems: A Review of the Current Technologies

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

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

Annex 42 Data Files

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

Testing and Validation of Building Energy Simulation Tools

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

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

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

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

Integrating Environmentally Responsive Elements in Buildings

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

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

Past Projects

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

- Low Energy Cooling Systems
- Daylight in Buildings
- Bringing Simulation to Application
- Energy-Related Environmental Impact of Buildings
- Integral Building Envelope Performance Assessment
- Advanced Local Energy Planning
- Computer-Aided Evaluation of HVAC System Performance
- Design of Energy Efficient Hybrid Ventilation
- Retrofitting of Educational Buildings
- Low Exergy Systems for Heating and Cooling of Buildings
- Solar Sustainable Housing
- High Performance Insulation Systems
- Building Commissioning to Improve Energy Performance
- Whole Building Heat, Air and Moisture Response
- The Simulation of Building-Integrated Fuel Cell and Other Cogeneration Systems
- Testing and Validation of Building Energy Simulation Tools

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