Energy in Buildings and Communities Programme

EBC NEWS

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EBC is a programme of the International Energy Agency (IEA)

Ventilation Still Demands Our Concentration

Dear Reader,

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

The Air Infiltration and Ventilation Centre (AIVC) was established as part of the EBC Programme as an IEA information centre in 1979 and emerged from a major R&D and awareness gap identified by the first EBC project. The AIVC continues to disseminate information about energy efficient ventilation and exploits up-to-date communications to achieve this.

A challenge and a priority for the EBC Programme is how to achieve sufficient interactions and collaboration between our projects, including in terms of objectives, mutual uptake of findings and strengthening of outcomes. This cross-fertilisation of ideas is central to the EBC Programme as a whole and in fact the concepts for two EBC R&D projects now underway were developed with the help of the AIVC participants. These projects, 'Design and Operational Strategies for High Indoor Air Quality in Low Energy Buildings' and 'Ventilative Cooling', both have strongly ventilation-related aspects.

Ventilation features significantly in several other EBC projects covering in scope high temperature cooling and low temperature heating, new generation computational tools, business and technical concepts for deep energy retrofit, occupant behaviour simulation, adaptive thermal comfort in low energy buildings, and energy flexible buildings. With respect to the latter, the more global issue of balancing demand and supply within future energy systems is discussed in this edition of our newsletter. I hope you enjoy reading it.

Peter Wouters, EBC Executive Committee Member for Belgium and Operating Agent for Annex 5

Cover picture: The first Portuguese nearly zero energy building (Solar XXI), an office building in Lisbon Source: National Laboratory for Energy and Geology (LNEG)

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Portugal Profits from Energy Labelling

Rui Fragoso and Pedro Mateus

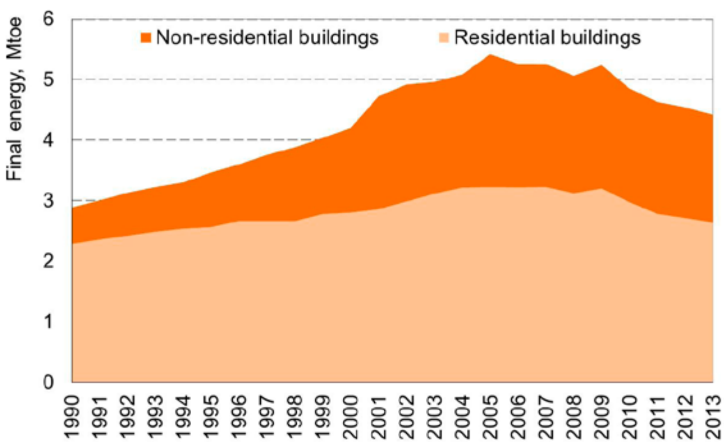
In fewer than 10 years, building energy labelling in Portugal has gained good market penetration with energy use noticeably reduced. Based on this success, the forthcoming Nearly-Zero Energy Buildings Action Plan will define measures to improve the existing stock, as a key tool for rapidly achieving real energy savings.

The introduction of Energy Performance Certificates (EPCs) in Portugal has been decisive in boosting public awarenesss about the energy performance of buildings. EPC labelling classifies buildings on an efficiency scale ranging from 'A+' (high efficiency) to 'F' (poor efficiency) and is based on calculations in terms of primary energy. This system was put into place due to the emergence of the first European Energy Performance of Buildings Directive (EPBD). As of December 2014, more than 800,000 EPCs had been issued since the scheme was launched in July 2007. Residential buildings represent 90% of those issued, covering around 12% of the total stock of 5.8 million dwellings.

In 2006, Portugal implemented the EPBD within national law. This formed a major step for realising more efficient new and retrofitted buildings, after earlier legislation was created in 1990 and 1998. By establishing stricter requirements building energy performance improved, as well as promoting use of renewable energy. In fact, solar thermal generation for domestic water heating became mandatory for all new buildings. The 2006 legislation was then revised in 2013 according to the EPBD Recast: With these tighter requirements, a cost optimal evaluation methodology and other new initiatives in place, it is now possible to establish a roadmap for market transformation up to 2020 and to properly define the concept of 'nearly-zero energy buildings' (nZEBs).

Buildings across the European Union account for 40% of total energy use, while in Portugal they represent only 28% of the national total, due in part to mild

Changes in final energy use for residential and non-residential buildings in Portugal



From 1990 to 2005, energy use in buildings grew continuously by almost 10% per year. Since 2005, there has been a decrease caused by various reasons, mainly due to an economic crisis, but also in response to increased energy efficiency and legislative measures.
Source: Eurostat

climatic conditions. Of the latter, residential and non-residential buildings are responsible for 17% and 11% of total energy use respectively.

Energy performance certification

The Portuguese Energy Agency, ADENE, designed, developed and now supports the National System for Energy Certification of Buildings (SCE), which is based on a central registry and database of EPCs. EPCs are mandatory for new buildings, for buildings undergoing major renovation, buildings for sale or rent and recently for existing non-residential buildings with more than 250 m² of floor area. For these larger non-residential buildings, the first page of the EPC must be displayed at the building entrance.

Energy performance requirements

The calculation methodology for labelling with EPCs is based on comparison with a reference building. A reference building is considered to be the same as that being evaluated, but assuming predefined values for the performance of the envelope and technical systems, and without contributions from any renewable energy or energy efficient systems (for example, no heat recovery is included in the reference building).

Non-residential buildings have requirements that limit the maximum primary energy for heating, cooling, DHW and lighting. By 2020 even tighter requirements will be set to reach nZEB status. However, the precise levels will be defined in the near future. New and large existing non-residential buildings must comply with energy performance requirements based on a comparative methodology for calculating cost-optimal energy reduction levels. In line with the EPBD Recast, this is based on a 30-year calculation period. The energy performance requirements established for residential buildings within Portugal are set in terms of maximum energy needs for heating and cooling. The total primary energy for heating, cooling and domestic hot water (DHW) is also limited to a maximum value. There is also a minimum renewable energy contribution required for DHW, based on a minimum solar thermal panel area for each building occupant.

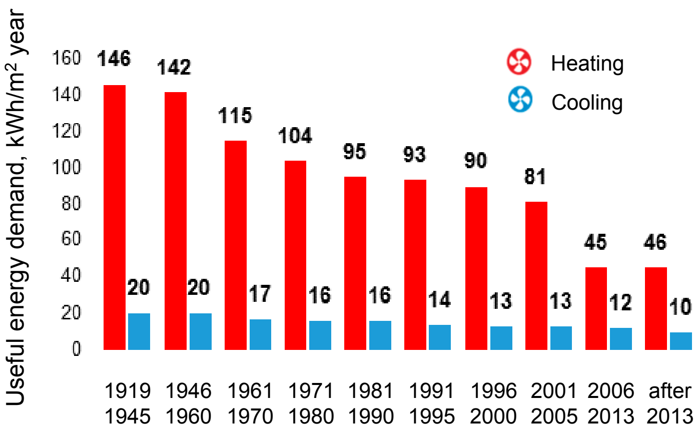
New minimum requirements for buildings

Minimum building envelope requirements were revised in 2006. The 2013 legislation strengthened these, for instance to be met with additional thermal insulation. However, the main changes in 2013 concerned the introduction of new requirements for building technical systems. These were set to transpose the EPBD Recast and to promote building energy efficiency as a whole. In fact, certain requirements even go beyond the EPBD Recast, for example, by including lifts within their scope. In general, the requirements are underpinned by European Standards or Eurovent labels.

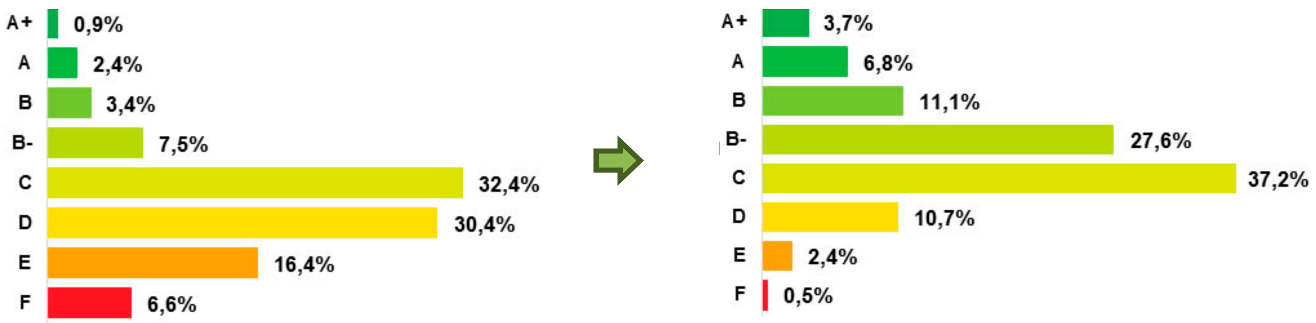
For non-residential buildings, it is now mandatory to install energy monitoring for HVAC equipment with electric power demands above 25 kW. The same is required for boilers with thermal power output over 100 kW. New buildings with HVAC thermal power above 100 kW must have a qualifying building management system. If the output is above 250 kW, then the system has to be centralized.

Furthermore, an Installation and Maintenance Technician (TIM) should be appointed for buildings with installed HVAC thermal power output above 250 kW

Energy needs of residential buildings constructed in different periods



Significant improvements in energy demand can be clearly seen after 2006, mainly for heating energy. A factor that contributed to this positive evolution was the implementation of an energy certification system (SCE). Within SCE, all requirements are evaluated by a qualified expert in both the design and construction phases, thus ensuring legal compliance of every new building and major renovation. Source: Energy Performance Certificates database



a) Existing residential buildings before improvement measures

b) Existing residential buildings after the recommended cost-effective improvement measures in the EPC are implemented

The distribution of building stock energy labels. For existing buildings the most common label is 'C' and for new buildings, 'B', with 'B-' as the required legal minimum.
Source: Energy Performance Certificates database

to guarantee correct operations and maintenance for systems. The TIM must supervise these activities and manage all relevant technical documentation. One of their roles is to promote the installation of energy metering systems in buildings.

Financial incentives and benefits

Financial incentives, supported by European Union funds, play an important role in the market and encourage building renovation through the implementation of energy efficiency measures and the use of renewable energy systems in buildings. One of the eligibility criteria is that after the investment has been implemented, an EPC should improve by at least two levels (for example, from 'E' to 'C'). From an economic perspective, the SCE also has a significant impact on taxation, as EPCs are increasingly being used by municipalities to allow tax reductions for the most energy efficient buildings.

The requirement to display EPCs in advertisements strongly promotes their visibility and influences building purchasing decisions. This creates pressure on building owners to implement the energy eficiency recommendations included in EPCs, to improve their rating. In fact, the most energy efficient buildings may also realise increased market values: Preliminary studies indicate that increases of around 5% to 10% may occur for higher rated buildings ('A' and 'A+').

Conclusions and future plans

EPCs have been a key tool in achieving a successful energy efficiency strategy in the building sector. In the near future, further developments are to be implemented, namely to provide more information on building services systems, to adapt EPCs for the nearly-zero energy buildings reality and to display labels for components when available. To evaluate the full market impact, ADENE also plans to start monitoring the implementation of the cost-effective energy improvement recommendations made in EPCs.

The SCE has been in place for seven years. During this period, much effort has taken place to reach the current high level of market penetration. The EPBD Recast brought new challenges, which inevitably led to evolution of the SCE with the intention of improving weaknesses identified during its development. The new legislation published in 2013 paves the way towards nearly-zero energy buildings and sets up a roadmap progressively tightening energy performance requirements until nZEB status is required for new buildings by 2020. However, the next challenge will be how to create nZEBs in a cost effective way.

The 'nZEB Action Plan' will be prepared in the near future. This will define measures to improve the existing building stock, and will be a key tool for rapidly achieving real energy savings, in contrast to the relatively slow rate of new construction. The general trend of increasing energy prices will certainly stimulate the adoption of energy efficient materials and technologies on top of demand for better buildings.

Further information

www.adene.pt

The authors work for ADENE.

Balancing Demand and Supply within Future Systems

Peter Tzscheutschler, Dietrich Schmidt, Evgueniy Entchev and Søren Østergaard Jensen

The fossil fuel dependent energy landscape is changing from demand led to cultivating renewables. As a major energy consumer, the buildings sector must adapt. And while good cross-sectoral integration can aid this transition, the boundary with the transportation sector is blurring.

Within the buildings sector in industrialised countries, there is currently a large energy demand for space heating and cooling to satisfy occupant comfort. Also, domestic hot water needs to be generated and electricity has to be supplied for lighting and an increasing variety of equipment and appliances. So, measures to reduce energy demands and related CO_2 emissions from building services and occupant activities have to be implemented to achieve the ambitious goals set by governments.

Renewable energy sources are often seen as ideal for future energy supplies, but their availability is related to unpredictable weather conditions. Therefore, system integration of resources such as wind or solar energy is challenging.

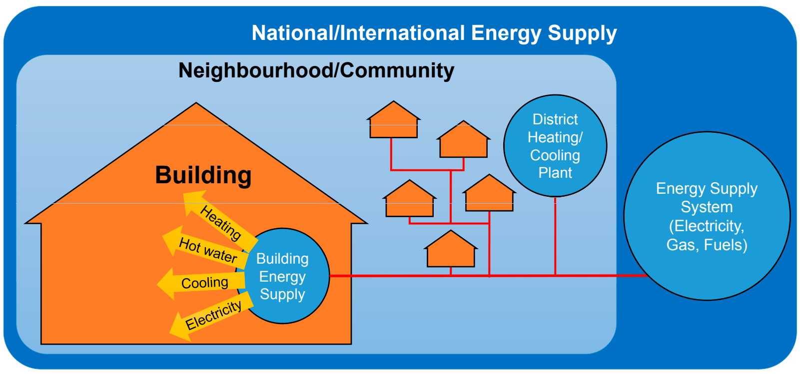
As a further trend, electric and hybrid vehicles are expected to become commonplace in the future. These will be charged from building- and community-level electrical distribution networks, contributing to increased demand in the buildings sector.

Reducing demand in buildings

For both new and existing buildings, measures to reduce energy demands and related CO_2 emissions need to be implemented by following three steps:

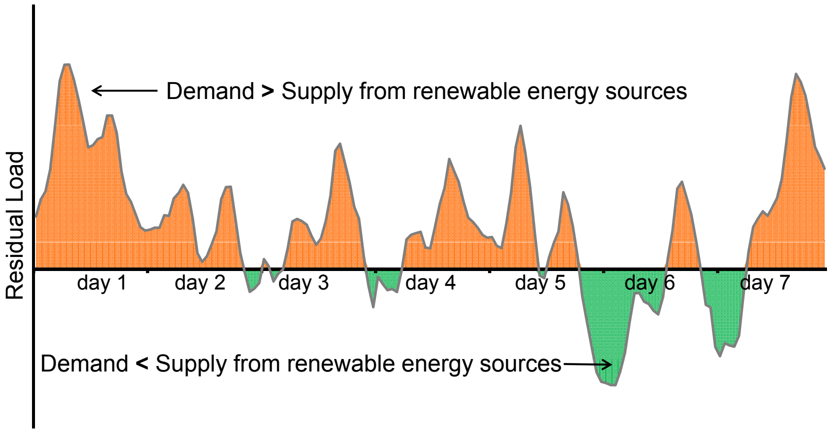
1. reduce energy demands, mainly through improvement of the building envelope (enforced by codes or regulations, for example) to achieve well insulated and airtight buildings, enabling more efficient energy use;
2. increase the overall energy efficiency using advanced technologies to reduce losses in all energy conversion and supply processes: this can be applied

Building energy supply at different scales



The electricity grid infrastructure and operation need to be redesigned to handle the new situation of unpredictable energy flows. Similar developments can be seen in the heat sector. District heating systems offer an opportunity at a community scale to utilise waste heat and decentralised heat production from renewable sources, for example solar thermal systems. Source: Peter Tzscheutschler

Residual load of energy demand against renewable energy supply



The residual load represents consumer demand not covered by renewable energy generation. The steep gradients that require highly flexible power plants are clearly visible. On the other side, periods of excess renewable production occur that can be exploited by energy storage or load shifting. Source: Based on data provided by Fraunhofer IWES

to single buildings, as well as at the neighbourhood and community levels by interconnecting buildings with electricity and thermal networks;

3. integrate renewable energy supplies to cover the remaining energy demand.

Demand transformation

Electricity from renewable sources will be a major component of future decarbonised energy supply systems. Indeed, changes are already underway influencing all sectors from typically demand-dependent production to supply driven markets. For buildings, this implies more common use of electricity for heating purposes may be expected, preferably employing high efficiency systems such as heat pumps. In this way, heat and electricity generation can be cross-linked. Small decentralised systems, such as photovoltaic panels or combined heat and power (CHP) units, will increasingly be used to generate electricity. Often these are building integrated, transforming the sector from energy consumers into active market participants as so-called 'prosumers' (producers who are also consumers).

Renewables brought into line

Presently in industrialised countries, energy demand for buildings has been mainly covered by using increasing amounts of fossil fuels. While these energy resources can be stored and supplied in large quantities to coincide with demand, their future availabilities and prices are uncertain.

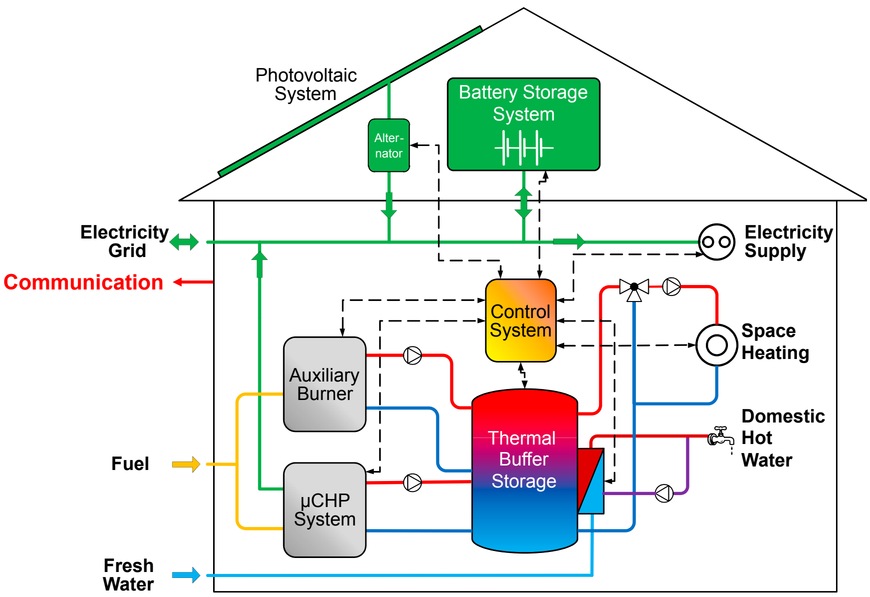
Renewable resources commonly exploited at the building or community scale are subject to weather conditions with limited short term predictability, particularly for wind or solar energy. Other renewable energy sources are generally predictable, including geothermal heat or tidal power, although these usually require large scale generation. If fluctuating renewable sources eventually dominate electricity production, other forms of production may not be able to even these out. New approaches are therefore necessary and synchronizing energy demand with supply will be essential.

The future role of buildings

The variety of practical energy supply systems for buildings has increased in recent years. Also, large scale energy supply infrastructures are undergoing significant changes to incorporate more renewable energy sources. Because of the characteristics of buildings and their significant energy demands, they will take on a primary role within future energy systems. Some aspects of this role lie in the nature of their construction, while others can be implemented in energy supply systems. Bringing together the issues of demand reduction, supply stability and integration of electric vehicle charging is a major R&D challenge for developing future systems for buildings and communities.

The existing building stock has a large thermal mass that can be activated and used as heat storage capacity for cross-sectoral load shifting. During times of excess generation from renewable energy supplies, building mass can be heated up to store energy. During short

Energy supply technologies for modern buildings



This shows an example of an energy supply system with which a building could be equipped. As an alternative to a conventional generator, a micro-cogeneration unit (µCHP), a solar thermal system, or a heat pump could provide heat, with a photovoltaic system generating electricity. Integrated thermal and electrical storage capacities even out fluctuations on the demand and supply sides. The task of the control system is to optimize the operation of the different components within the building, but also in combination with the smart grid. For warm climatic conditions, a chiller may also be added to the system.
Source: EBC Annex 54

periods of power shortages, thermal inertia can reduce the required power consumption of heat pumps, for instance. However, as occupant comfort has to be maintained, advanced control systems have to be applied taking into account building thermal behaviour. Increasing the thermal storage capacity of buildings by adding additional buffer tanks for heating and DHW systems is generally straightforward.

Energy flexible buildings will be active participants in future smart grids in their role as prosumers. One already established supply technology for buildings is micro-cogeneration of heat and electrical power (µCHP). Currently, the majority of systems are based on internal combustion engines with capacities typically between 1 kW and 10 MW electrical output. Recent developments have led to the market entry of small scale Stirling and fuel cell systems with capacities of a few kilowatts. These systems are able to provide heat, cold and electricity to single buildings with high efficiencies. Many of these systems can be interconnected to form virtual power plants.

Power-to-heat technologies use electricity to provide heat at a useful temperature level. These range in complexity from simple electric resistance heaters integrated into thermal storage vessels to more advanced electric heat pumps or chillers. The reverse path from power-to-fuel, especially power-to-gas, is currently an R&D topic: Low cost electricity could be used to perform electrolysis, hydrogen production, or methanation to produce a natural gas equivalent that can be fed into the gas grid. The scale of such a plant would be in the range of several megawatts or higher.

The emergence of smart energy networks

Currently, energy is delivered as needed to buildings and community systems through separate electricity, gas and heat networks. Over time, these have been developed in centralized arrangements. They are designed to balance supply and demand in real time, with unidirectional and centrally managed energy flows. However, with the advance of distributed energy generation technologies, higher penetration of renewables and the development of information and communication technologies (ICT), the existing ageing energy distribution networks are becoming bottlenecks for achieving energy and CO_2 emissions reduction goals.

A smart energy network (SEN) is a new concept that allows integration of main energy carriers (usually electricity, gas and heat) into one network under common ICT for better management, efficient use and increased participation of distributed generation and renewables. The integration between the carriers leads to asset sharing, common intelligence and energy supply risk mitigation. SENs will be resilient, smart and interactive, exchanging energy flows and information internally and externally, providing a base for optimal energy delivery to the customer. Cross-linking technologies such as power-to-gas, power-to-heat, micro-generation, and so on, will provide interfaces between the networks for optimal energy supply.

A technology with good potential to be used in cross-linked SENs is district heating. Innovative systems, such as very low temperature heat networks with supply temperatures of under 50°C permit very efficient use of heat pumps, the integration of environmental (ground) heat or heat from solar thermal systems, and have low distribution heat losses. With this approach, waste heat can also be distributed to buildings via district heating networks. In addition, ground heat storage and water based thermal buffer tanks may be integrated. These systems are most suitable for new development projects, but the technological solutions have also the potential to be used in retrofit projects.

Research outlook

ICT will become integral to linking technologies and multiple buildings within smart energy neighbourhoods to manage network loads in real time through micro-grids, ranging in scale from individual buildings and clusters of buildings through to the community level. Micro-grids must be able to autonomously and optimally meet demand efficiently using a range of distributed energy resources. At the same time they will be able to assist other energy networks, either by accommodating the load directly or by converting the excess energy to a form acceptable by others. The initial step will introduce sensors and software information agents for informed management decisions at the network level.

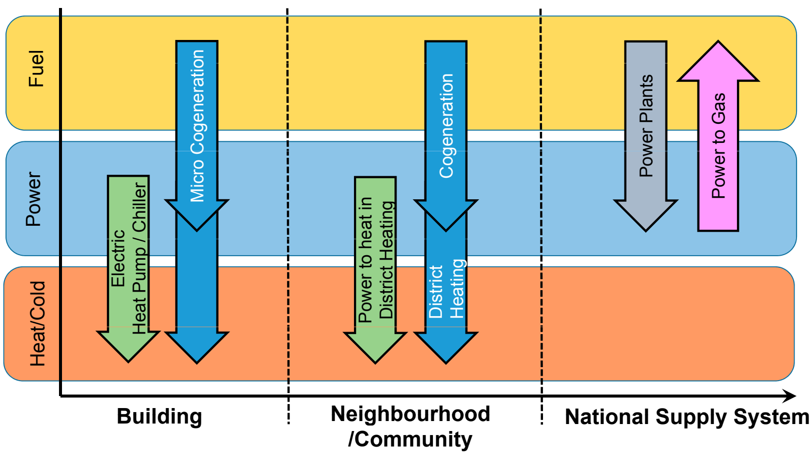
The integration of technologies for cross-linking heat and electricity networks at the building level is a current research area, due to the often unpredictable nature of the loads. System operation can be improved by implementation of energy storage systems and cross-linking of buildings. The focus is presently on larger systems for neighbourhood or community scales. Further work in this field is needed to understand how to operate these new dynamic energy systems and on how best to integrate the various components within the overall system. The integration of the transportation sector is a further aspect that needs to be addressed. The latest outcomes from EBC R&D projects have started to resolve these issues, including those from:

- 'Annex 54: Integration of Micro-generation and Related Energy Technologies in Buildings',
- 'Annex 64: LowEx Communities - Optimised Performance of Energy Supply Systems with Exergy Principles', and
- 'Annex 67: Energy Flexible Buildings'.

More information

www.iea-ebc.org

Cross-linking of fuel, heat and power at different levels



In future, there will need to be closer linkages between fuel, heat and power. Both micro-cogeneration and power-to-heat technologies enable buildings to actively contribute to grid stability and allow them to participate in the smart grid. This can be by demand side management or demand response. High electricity using buildings are already aggregated by service providers, for example cold warehouses, and their energy flexibility is available to the market.
Source: The Authors

Implementation of Energy Strategies in Communities

Current Project: EBC Annex 63

Helmut Strasser

To achieve global energy demand reduction goals, implementation of optimized solutions for whole communities is essential. Integrated approaches will benefit all stakeholders.

Cities consume the major part of energy production worldwide and account for a roughly equal share of global greenhouse gas (GHG) emissions. To mitigate climate change and avoid energy shortages, a drastic reduction of both energy and GHG emissions is essential for the large scale development of more sustainable cities and communities.

Energy planning and urban planning

One of the key findings highlighted by previous case studies is that there is an inadequate link between energy planning and urban planning. Optimized community energy strategies will only be successfully achieved when they are embedded in an urban strategy and urban planning framework. In particular, ongoing city developments should be one of the main drivers of energy optimization. Urban planning departments must identify solutions that benefit all stakeholders, including municipalities, building owners, and tenants to improve the existing building stock and to accelerate implementation of urban energy strategies. In all cases, the introduction of energy technologies at a community scale must align with urban energy strategies.

What are the most important approaches for improvement?

On examining typical planning processes, it becomes evident that ambitions of cities must be followed by effective methodologies for translation of citywide goals to the community scale. There is a desire for practical methodologies and tools for calculation and evaluation, considering community-related aspects such as embodied energy, energy demand and transportation. Practical application to urban planning procedures and instruments are also essential. So, one of the initial activities of this EBC R&D project is to analyse both energy and urban planning procedures in the participating countries to identify effective intervention points.

Furthermore, the focus is being placed on identification of a 'common language' between both aspects. It is necessary to develop a common understanding with regards to scale, calculation and evaluation methods and planning instruments. In fact, certification systems for communities covering the whole range of planning processes might already fulfil this requirement and are therefore being studied.

This project is designed as an action-research activity. To this end, intensive dialogue with municipal planning departments is being used to initiate reciprocal cooperation and will provide an in depth understanding of specific concerns, leading to practical solutions. As a project outcome, documented case studies will assist cities with examples of best practice solutions for overcoming any bottlenecks identified.

Further information

www.iea-ebc.org

Low Exergy Communities

Current Project: EBC Annex 64

Dietrich Schmidt, Christina Sager and Anna Kallert

It is important to demonstrate the potential of low exergy thinking at the community level for realising energy and cost efficient solutions with low temperature resources.

Communities are characterised by a wide range of heating and cooling energy demands for buildings. In industrialised countries, the energy required is often provided by combustion of fossil fuels, either directly in buildings or indirectly at power stations, leading to CO_2 emissions. Therefore, it is crucial to improve the efficiency of heating and cooling supplies and increase the use of low temperature sources such as renewable energy or waste heat.

The exergy generated from renewable energy technologies varies in quantity and quality. For example, electricity generated from photovoltaic panels is high exergy, but low temperature heat produced from other renewable energy sources is low exergy ('LowEx'). Low energy quality is of particular interest for heating applications at moderate temperatures, because LowEx systems can be very efficient. The main objective of this EBC R&D project is to demonstrate the potential of LowEx design approaches at the community level for realising energy and cost efficient solutions to achieve 100% renewable and energy-related CO_2 emissions-free systems. To reach this objective, the most promising and efficient technical solutions for practical implementation are being investigated. The work includes developing appropriate indicators to supplement exergy assessments. Based on these, a common basis for assessing the local potential for LowEx systems is being created, assuming that suitable low temperature resources exist.

Further information

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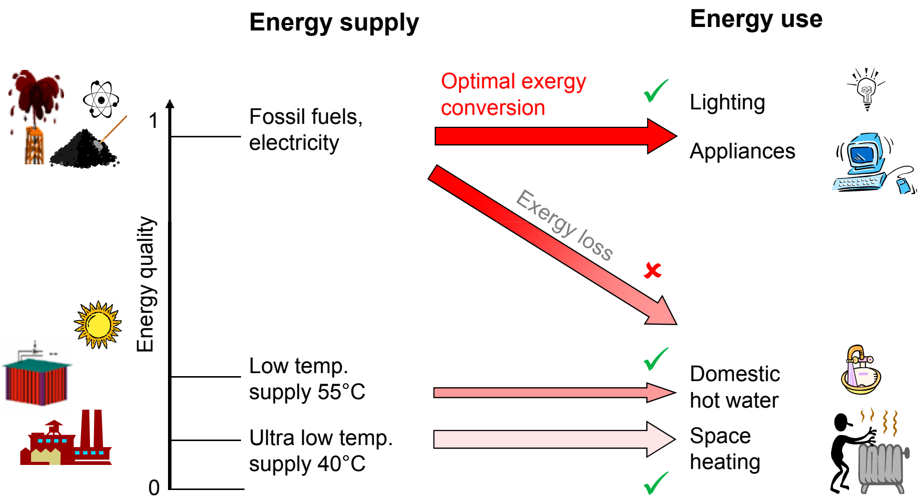


Application of the LowEx approach for optimizing community systems. LowEx energy supplies should be applied to meet LowEx demands, such as space or domestic hot water heating. Source: EBC Annex 64

Aerogel Based Insulating Render for Renovation

Current Project: EBC Annex 65

Daniel Quenard and Samuel Brunner

The use of super-insulating materials, including vacuum insulation panels and aerogel boards, begins a new era of insulation technologies. Very recently, freely formable aerogel based insulating render systems have inflated the ranks of high performance solutions.

Many existing buildings are not likely to be demolished, especially historic buildings that give evidence of each country's cultural heritage. Moreover, retrofitting can be more sustainable than demolition. Retrofitting old and historic buildings with rendered facades to improve their energy efficiency can be carried out either by applying external or internal thermal insulation systems, depending on requirements to maintain the architectural style of the facades. These insulation systems generally require a planar subsurface, adjustment, gluing, or even fastening by means of dowels, or have to be manufactured very accurately.

An alternative way to fulfill these requirements is the application of an insulating render. Rendering has the advantage of being flexible with respect to surface unevenness, is able to fill gaps, and is applicable using well-known techniques. It is even possible to deliberately reproduce the uneven appearance of the original facade, for example when insulating buildings that are several hundred years old.

Until recently, commercially available insulated renders were made with lightweight component such as EPS beads, perlite, cork, or foam glass. Their thermal conductivities range from around 65 mW/(mK) to 100 mW/(mK), and hence they do not reach the performance of commonly used insulating materials with a thermal conductivity of about 30 mW/(mK).

Aerogel granules are relatively new and have been tested as a lightweight component for render systems. Teams within the current EBC R&D project 'Annex 65: Long Term Performance of Super-Insulating Materials in Building Components and Systems' are now testing aerogel-based render systems for internal or external insulation. These materials generally consist of a mineral matrix with aerogel granules, attaining a thermal conductivity of about 25 mW/(mK) to 30 mW/(mK). Aerogel based render systems are also permeable to water vapour, a physical characteristic essential for avoiding moisture damage in historic buildings.

Further information

www.iea-ebc.org

Application of an aerogel render with hydraulic lime as the main binder.
Source: FIXIT – Switzerland

Simulation of Occupant Behaviour in Buildings

Current Project: EBC Annex 66

Tianzhen Hong, Sarah Taylor-Lange and Da Yan

Data mining can be used to extract useful and understandable patterns from big data streams, providing new knowledge to better understand occupant behaviour in buildings.

Understanding and accurately quantifying the impact of energy-related occupant behaviour (OB) in buildings is key to energy efficient design, operation, and retrofit of buildings. Nevertheless the often unpredictable nature of OB, the number of people occupying a space, the duration of the occupied period, and their collective impact on building energy use, are non-trivial aspects to characterize. State-of-the-art data mining approaches provide a powerful analysis technique that can extrapolate useful and understandable occupancy patterns from large streams of monitored building data.

The data mining process

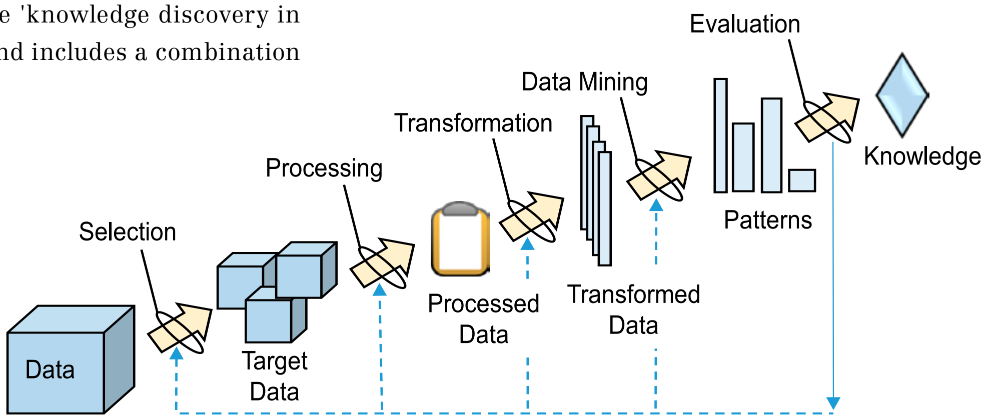
Data mining is based on the 'knowledge discovery in databases' (KDD) process and includes a combination of recent advancements in the fields of machine learning, pattern recognition, databases, statistics, artificial intelligence, knowledge acquisition and data visualization. This process of extraction is conducted following six steps as shown in the figure below.

Data mining applications

One of the objectives of the current EBC R&D project 'Annex 66: Definition and Simulation of Occupant Behavior Simulation in Buildings' is to address the fundamental research question: How should quantitative descriptions of OB be developed in order to analyse and evaluate its impact on building energy use? Advanced data mining techniques have already been applied within the project to improve occupancy schedules used in building energy modelling. In separate studies, data mining approaches have been used to identify drivers for and patterns of window opening and closing, and to analyse the influence of OB on energy use in buildings.

Further information

www.iea-ebc.org



A simplified representation of the knowledge discovery in databases process.
Source: EBC Annex 66

EBC International Projects

New Projects

Annex 68: Design and Operational Strategies for High Indoor Air Quality in Low Energy Buildings

Contact: Prof Carsten Rode
car@byg.dtu.dk

This new project is focusing on design options and operational strategies suitable for enhancing the energy performance of buildings, such as demand controlled ventilation, improvement of the building envelope by tightening and selecting better insulating products characterised by low pollutant emissions. These strategies are being investigated to analyse their effects on indoor air quality (IAQ) and to determine optimal solutions.
High IAQ and low energy buildings can only be achieved by carrying out a multi-facetted optimization process. Therefore, the project is using and combining elements of knowledge that are outcomes from other EBC projects, regarding ventilation, chemical emissions from building products, hygrothermal conditions in buildings and their materials, and building simulation.
The key project objective is to develop design and operational strategies for energy efficient buildings that do not compromise IAQ. Operational parameters being taken into account include means of ventilation and its control, thermal and moisture control and air purification strategies.

Further information

www.iea-ebc.org

Annex 69: Strategy and Practice of Adaptive Thermal Comfort in Low Energy Buildings

Contact: Prof Yingxin Zhu
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For the buildings sector globally, reducing energy consumption and providing comfortable indoor environments for occupants are both important tasks. However, it is challenging to find a good balance between these two issues. The key point is to understand the actual thermal requirements of occupants. Previous research on adaptive thermal comfort has revealed it is not necessary to continuously maintain a steady indoor thermal environment with mechanical cooling or heating. Resources such as natural ventilation can play a role in achieving thermal comfort, so also reducing energy consumption. Besides this, the opportunity for control by occupants was found to have a positive impact, enhance people's satisfaction with their indoor thermal environments.
This new project is providing a scientifically based explanation of the underlying mechanism of adaptive thermal comfort, and is applying and evaluating the thermal adaptation concept to reduce building energy consumption through design and control strategies.
The project is creating a database including information on human thermal responses, together with behaviour patterns and related energy consumption. Using this database, a modified adaptive thermal comfort model and criteria can then be established. Guidelines for low energy building and device design are also being produced.

Further information

www.iea-ebc.org

EBC International Projects

Current Projects

Annex 5 Air Infiltration and Ventilation Centre
The AIVC carries out integrated, high impact dissemination activities with an in depth review process, such as delivering webinars, workshops and technical papers.
Contact: Dr Peter Wouters
aivc@bbri.be

Annex 55 Reliability of Energy Efficient Building Retrofitting - Probability Assessment of Performance and Cost
The project is providing decision support data and tools concerning energy retrofitting measures for software developers, engineers, consultants and construction product developers.
Contact: Dr Carl-Eric Hagentoft
carl-eric.hagentoft@chalmers.se

Annex 56 Cost-Effective Energy and CO_2 Emission Optimization in Building Renovation
The project is delivering accurate, understandable information and tools targeted to non-expert decision makers and real estate professionals.
Contact: Dr Manuela Almeida
malmeida@civil.uminho.pt

Annex 57 Evaluation of Embodied Energy and CO_2 Emissions for Building Construction
The project is developing guidelines to improve understanding of evaluation methods, with the goal of finding better design and construction solutions with reduced embodied energy and related CO_2 and other GHG emissions.
Contact: Prof Tatsuo Oka
okatatsuo@e-mail.jp

Annex 58 Reliable Building Energy Performance Characterisation Based on Full Scale Dynamic Measurements
The project is developing the necessary knowledge, tools and networks to achieve reliable in-situ dynamic testing and data analysis methods that can be used to characterise the actual energy performance of building components and whole buildings.
Contact: Prof Staf Roels
staf.roels@bwk.kuleuven.be

Annex 59 High Temperature Cooling and Low Temperature Heating in Buildings
The project aim is to improve current HVAC systems, by examining how to achieve high temperature cooling and low temperature heating by reducing temperature differences in heat transfer and energy transport processes.
Contact: Prof Yi Jiang
jiangyi@tsinghua.edu.cn

Annex 60 New Generation Computational Tools for Building and Community Energy Systems
The project is developing and demonstrating new generation computational tools for building and community energy systems based on the non-proprietary Modelica modelling language and Functional Mockup Interface standards.
Contact: Michael Wetter, Christoph van Treeck
mwetter@lbl.gov, treeck@e3d.rwth-aachen.de

Annex 61 Business and Technical Concepts for Deep Energy Retrofit of Public Buildings
The project aims to develop and demonstrate innovative bundles of measures for deep retrofit of typical public buildings to and achieve energy savings of at least 50%.
Contact: Dr Alexander M. Zhivov, Rüdiger Lohse
alexander.m.zhivov@erdc.usace.army.mil, ruediger.lohse@kea-bw.de

Annex 62 Ventilative Cooling
This project is addressing the challenges and making recommendations through development of design methods and tools related to cooling demand and risk of overheating in buildings and through the development of new energy efficient ventilative cooling solutions.
Contact: Prof Per Heiselberg
ph@civil.aau.dk

Annex 63 Implementation of Energy Strategies in Communities
This project is focusing on development of methods for implementation of optimized energy strategies at the scale of communities.
Contact: Helmut Strasser
helmut.strasser@salzburg.gv.at

Annex 64 LowEx Communities - Optimised Performance of Energy Supply Systems with Exergy Principles
This project is covering the improvement of energy conversion chains on a community scale, using an exergy basis as the primary indicator.
Contact: Dietrich Schmidt
dietrich.schmidt@ibp.fraunhofer.de

Annex 65 Long-Term Performance of Super-Insulating Materials in Building Components and Systems
This project is investigating potential long term benefits and risks of newly developed super insulation materials and systems and to provide guidelines for their optimal design and use.
Contact: Daniel Quenard
daniel.quenard@cstb.fr

Annex 66 Definition and Simulation of Occupant Behavior in Buildings
The impact of occupant behaviour on building performance is being investigated with the objectives of creating quantitative descriptions and classifications, developing effective calculation methodologies, implementing models within building energy modelling tools, and demonstration using case studies.
Contact: Dr Da Yan, Dr Tianzhen Hong
yanda@tsinghua.edu.cn, thong@lbl.gov

Annex 67 Energy Flexible Buildings
The aim of this project is to demonstrate how energy flexibility in buildings can provide generating capacity for energy grids, and to identify critical aspects and possible solutions to manage such flexibility.
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sdj@teknologisk.dk

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EBC

Energy in Buildings and Communities Programme

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