

Introduction to Panel 7

Innovative building technologies

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Introduction

It might be known already to all specialists, but the “raison d’être” of the contributions to this panel still is that within the sustainability and energy efficiency agenda, buildings present a vast and complex challenge. They account for about 40% of European final energy consumption, associated CO₂ emissions and costs.

Member States and industry have committed themselves to achieve overall energy efficiency improvements by 20%, to reduce greenhouse gas emissions by 20%, and to increase the share of renewables by 20% by 2020. On 12 December 2008, EU Heads of State and Government adopted the specific legislation aimed at achieving these ambitious targets. The recast of the EPBD will be the crucial instrument in achieving the EU’s objectives. It is an excellent opportunity too for the European Commission, the European Parliament and Council to show EU leadership in tackling both climate challenge, security of supply and fuel poverty by adopting ambitious requirements to develop very low energy and very low carbon emission buildings for both existing and new buildings as soon as possible

Buildings are the subject of many policy instruments (regulatory, financial, developmental, promotional) aimed at improving their energy efficiency, by influencing the perspectives, skills and decisions of key actors responsible for the planning, design, construction, operation and maintenance of buildings. There is a variety of actors responsible for the quality of market and regulatory decisions in relation to the built environment, including clients, public authorities, planners, designers and specifiers, building and installation contractors, surveyors and economists, financial institutions, operating and maintenance management personnel, as well as education, training and professional bodies. “Business as usual” will not deliver the ambi-

tious goal setting. Better application of existing technologies and their integration with new technologies is necessary. New and existing technologies have been tested in the past years that will have to be applied in order to realise these ambitious goals in the building sector. In the past years existing and proven technologies were applied in new combinations and with new innovative technologies and management systems. Now that the best available technology has matured it has to be installed in new and retrofitting projects as quite regular and common solutions.

The Panel 7 contributions report from technologies, policies, policy implementations, regulations, new planned demo projects and from realised low energy and zero carbon buildings. The contributions in paper and posters report, with detailed analysis, experiences and evaluations from products, systems, and projects where existing and new innovative solutions were applied. They conclude and recommend on the basis of facts and figures and on lessons learned. The analyses, findings and experiences aim to contribute to the solutions we need to improve the energy efficiency of new and existing buildings and their energy supply.

The panel structure

The panel groups **17 papers** and **5 posters**, describing experiences in the research, development and application of a wide range of measures directed at energy efficiency in buildings in relation to **innovative building technology**. Papers and posters can be grouped into policy measures, low energy buildings/zero carbon buildings and technology innovations.

The (at this moment provisional) program will present the papers in 6 sessions:

- **Session 1 and 2:** Technology innovations
- **Session 3 and 4:** Policy measures
- **Session 5 and 6:** Low energy buildings
- **Posters:** our 5 poster presentations will be presented in the poster session, and deal with innovative technologies, policies and innovations, and project analyses.

Technology innovations

Of course we leave it open for discussion whether the grouping of papers and posters is done well by allocating them to “technology”, “policy” or “low energy buildings”, as all have elements of each included.

Nevertheless, our allocation of the topics show 9 papers and posters in “technology”, dealing with: geothermal heating and cooling systems, thermal storage, storage batteries, windows, double skin facades, photovoltaic, stand-by stoppers, furnace motors and ventilations.

Al Sabawi (7047) is reporting on the Palestinian experiences and results of geothermal heating and cooling systems applied in dense populated areas to residential buildings. The analysis of several projects shows that developing countries are in fact in a unique position to incorporate renewable energy in new constructions as their economies rapidly develop and demonstrates an interesting option to decouple the consequences from growing comfort improvements from increasing energy demands.

The interaction between thermal storage and various sources of variation in heat supply and demand to a building are described by Gether et al (7189). The variation in ambient air temperature, solar radiation or patterns of energy usage, optimised in conjunction with heat pumps and dynamic thermal energy storage (DTS), promise to save large amounts of energy used for the heating and cooling of buildings. DTS may be combined with borehole thermal energy storage (BTES) to allow summer heat to be used for heating in wintertime, whilst cooling during summer. But also further opportunities are gained by combining BTES and DTES facilities.

Combining and optimising supply and demand also is analysed by Stadler et al (7301). The addition of storage technologies such as flow batteries, conventional batteries, and heat storage can improve the economic, as well as environmental attraction of micro-generation systems (e.g. PV or fuel cells with or without CHP) and contribute to enhanced demand response. This contribution focuses on an analysis of storage technologies in micro-generation optimization on a building level. Whether the reference frame is either on cost efficiency or on a CO₂ minimization strategy, the results of the analysis made are quite contrary to established expectations.

Philipson and Couillaud (7288) present the intelligent and passive window systems for both new low energy housing and for existing residential buildings in Southern Europe. Their activated insulation shutter, ventilation and shading reduce the energy demand for heating and as well as contribute to an improved indoor climate and daylight conditions in the building. Modern office buildings nowadays are all window. Their facades then best should be designed and built as double skin facades, according to Eriksson and Blomsterberg (7159). The

linked functions of a double skin facade are manifold and have to be optimised. Choices which are optimal in a cold climate, will not work very well in a warm climate, and vice versa.

Users and technology innovations

Widen and Karlsson (7050) demonstrate how difficult it is to match energy demand and supply in electricity in households with photovoltaics and wind power. In a quantitative and qualitative study, they have investigated the differences in the load-matching capability of PV systems in Swedish households.

But it seems to be even more difficult to change our user behaviour when reducing the energy demand coming from all the small guzzlers of energy: best by switching off electronic devices that are not in use. But we know reality. Even the standby modes on all new and modern equipment keep contributing to the growing energy demand from all kind of existing and new electronic devices. But clever application of newly developed standby killers might turn the trend down as shown by Blomsterberg and Avasoo (7139). Also hidden to the majority of the public is the saving potential from furnace motors. What can convince building owners in the residential sector installing variable speed furnace motors? Sulyma and Tiedemann (7303) explain that it requires more than evident facts and figures on the technical specifications, costs and savings. Smart solutions that would by-pass the user behaviour have been applied in Northern Ireland and in the Republic of Ireland. Sunderland and McLean (7230) report from the experiences with two types of solar powered ventilation systems and draw lessons from the project management and evaluation design on critical issues and considerations around the treatment of existing homes.

Policy and supportive tools

Dyrbøl et al (7226) have some very interesting recommendations to the European Commission. The work was carried out to assist the European Commission, the Parliament and Council as well as Member States in the continued priority of developing a strategy for very low energy/carbon neutral buildings. The study investigates the impact of introduction of very low energy buildings in Europe with the resulting potential of energy savings and CO₂ emission reduction from very low energy buildings. The analysis provides a good overview on the status of developed strategies in the member states, the policy measures, promoting and supportive activities.

Policies that have a goal setting on cost efficiency and policies that have an environmental goal setting, like CO₂-emission levels, most often guide to different technical solutions. Shorrock and Henderson (7023) examined this by considering the cost-effectiveness of the different levels of the UK Code, the cost-effectiveness of energy efficiency measures that can be applied to the existing housing stock, and their respective carbon dioxide savings.

According to Eriksen (7151) so far the different national standards for low energy housing have mainly been focusing on energy savings, but now some new standards also focus on energy saving in combination with indoor comfort requirements and some the EU Renewable Energy Directive. Therefore, a new approach, where energy efficiency, indoor climate and integration of renewable energy are included, is needed.

In reducing CO₂ emissions from non-domestic buildings Jenkins et al (7046) report from different intervention packages that cover both the demand side and supply side applied to different sectors. They conclude on the possibility of passively heating and cooling of offices and the overheating of schools as well as on problems with reducing the CO₂ emissions of energy-intensive retail buildings.

No doubt that Austria may claim already a long experience with low energy or with the “Passiv Haus”. Ornetzeder and Rohracher (7175) report about the experiences and lessons learned with the new building types that have given rise to new actors and organisations. The report specifies the crucial importance for the coordination and shaping of the socio-technical system and managing such transformation in the building sector.

To underpin commercial and political developments on national level appropriate tools are required, creating better understanding regarding how greenhouse gas reduction targets can be achieved. These tools need to represent the options in a technically credible manner, but avoid dictating superlative transformational pathways. Hawkes (7194) presents relevant developments in UK energy policy, and outlines an optimisation-based framework for selection and integrated control of appropriate suites of technologies; it will enable timely analysis relevant to all involved stakeholders. The paper of Gupta and Chandiwala (7309) describes the development, application and analysis of an interactive user-friendly toolkit to evaluate the technical and economic feasibility of achieving specified performance levels of new-build dwellings. The research emphasises the importance of maximising energy efficiency improvements to the fabric and form of a dwelling, before adding low/zero carbon systems, and promotes a ‘low-energy first and then low-carbon’ approach.

Low energy buildings – analysed experiences so far

Anno 2009 Europe has gained some experiences with low energy buildings, low or zero carbon buildings or Passive houses. The experiences with the world’s first multi-story passive houses with 23 and 17 apartments for tenants therefore are quite unique. Hermelink (7344) has in-depth analyses of various kinds, like an environmental life-cycle assessments (LCA). Real data on the household energy consumption have been analysed for the first six years of operation and fed into the LCA. Two approaches for the cost efficiency analysis were carried out and both see the passive house as the winner. A surprising result however, is that even in this favourable case the CO₂ emissions per cap still exceed what may be regarded as a sustainable level.

The energy use of several 2001 built Swedish multifamily houses was monitored. According to Bagge (7336) the variations in total energy use between the different properties were large. Key values are presented that can be used to critically examine different designs, systems and results from energy calculations.

Lindstrij and Avasoo (7306) have analysed in many details the planning, design, applied technology and the impact of the quality of the workmanship of an energy-efficient multi-family building realised in Sweden. Lessons can be learned from the occupants’ perceptions, the cost analysis and the benchmarking of the design value of energy performance with the actual realised energy consumption.

And how to design an attractive Scandinavian energy neutral house – beautiful, functional and inspiring – in a contest, is shown by Pedersen (7114).

Low energy buildings in the warm climate

Much is known and many experiences have been gained on the cold and moderate climate low energy buildings. The applicability of the German “Passiv Haus” Standard however has not yet been sufficiently tested in European areas with warm climates, where reducing cooling needs under growing summer comfort requirements poses a challenge. Zangheri et al (7402) have worked in the Passive-On Consortium for a new “Passiv Haus” Standard that meets the requirements for comfort in the warm climate. This IEE Passive-On project has drafted a proposal to adapt that Standard to the conditions that characterize Southern Europe. Compared with the original definition, one of the main changes is the introduction of explicit requirements on internal comfort during summer, in parallel to a limit to energy needs for cooling. Some ventilation plant simplifications can be compensated by an increased role of thermal insulation of the building envelope and some of the choices can make energy needs tend to zero.

In line with the before mentioned Passive-On project Pagliano et al (7403) are pleased to present the first results of the IEE project Keep Cool 2, that cover amongst others the assessment of the energy savings related to “sustainable summer comfort” solution, which are achieved by specific retrofit actions being traditional and innovative solutions. The project includes case studies of technical solutions to buildings up to the analysis of case studies of “comfort policies” adopted by public and private bodies to ensure summer comfort with low energy consumption which are reported here. Some of the effective passive cooling solutions that are applied as an integral part to new buildings could be very suitable and successful as well when implemented also in retrofit actions.