

# Introduction to Panel 5: Energy efficient buildings

Panel leader: **Jens Laustsen**  
International Energy Agency  
Jens.Laustsen@iea.org

Panel leader: **Kevin O'Rourke**  
Sustainable Energy Ireland  
Kevin.orourke@sei.ie

## Introduction

Within the sustainability and energy efficiency agenda, buildings present a vast and complex challenge. En masse, they account for about 40 % of European final energy consumption, associated CO<sub>2</sub> emissions and costs. The complexity of the challenge lies firstly in the diversity of building characteristics in the marketplace – by function, operating regime, built form, size, age, building fabric design, building services specification and climate. Secondly, it lies in the 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.

It is thus no surprise that 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. These instruments can apply at local, regional, national or EU/ international level, and particularly topical at present are EU directives in the form of EPBD and ESD, the Action Plan on energy efficiency and other demand reduction policies driven in particular by the fusion of security of supply, cost competitiveness and environmental protection objectives.

The panel groups **27 papers** and **13 posters**, describing experiences in the research, development and application of a wide range of measures directed at energy efficiency in buildings. These include approaches to implementing EU directives, tools for practitioners, technical good practices and innovations, ini-

tatives for healthy buildings, zero energy buildings, financial and institutional instruments and scenario explorations aimed at extending future boundaries of ambition. Recurring themes are the seeking of pathways to large scale mobilisation of superior efficiency solutions in both new and refurbishment markets, and the associated issue of identifying and tackling risks and barriers to the pursuit of such solutions.

These approaches extend from micro (individual building) level to national policy levels. Collectively, this suite of presentations and posters are expected to animate discussion focussed on learning from shared experiences across a complex web of topics, and contributing to actionable measures applicable to the built environment at appropriate levels.

## The panel structure

The presentations have been grouped in nine sessions of three papers each, covering most of the desired aspects. Two of the sessions (2 and 3) are in parallel, for scheduling reasons. The sequence of themes is as follows:

1. EPBD: Planning for energy certification of homes
2. EPBD: Other challenges & tools
3. Energy efficiency: health, comfort and other benefits
4. ESD: Making energy efficiency into good business?
5. Upgrading existing building stock: realities, rewards, impacts
6. Comprehensive design and upgrading of buildings: tools, realities, rewards

7. Energy efficiency from design to reality: risks, conflicts, success factors
8. Beyond Europe: policies, planning, projections
9. Building the future: environment, challenges, pathways

The first two sessions look at the practical implementation of the EPBD, which is a multifaceted action based directive, the central principle being to empower market change through the structured provision of actionable information to building owners and other decision makers. **Session 1** is focussed on the philosophically well understood, but still operationally complex and immature, task of implementing energy certification in homes. The opening paper, from the UK (5,266, Weatherall) reports on the structured processes of consultation with institutional stakeholder groups in the process of planning and delivering implementation of the different strands of the directive, including challenges in securing a partnership approach. A more specific focus is highlighted in the second paper, also from the UK (5,004, Shorrock), which presents the method and results of consumer trials aimed at establishing the suitability of a proposed design and content of home energy certificates. A further paper (5,171, Maes) seeks to draw lessons from early field experiences in the development of energy certification in Belgium and the Netherlands. It addresses the challenge of balancing the demands of minimising cost, assuring accuracy and quality, improving training, and managing the volume of valuable data collected. It thereby prefaces the first paper in Session 2.

A complementary **Session 2** follows, looking at other challenges in implementing the EPBD. A paper from Denmark (5,176, Jensen) deals, on the basis of several years of national experience, with issues pertinent to energy certification schemes generally: the relationship between the investment in data collection, certification procedure and quality control, and the dividend in terms of quality of obtainable knowledge, including factors relevant to evaluating the effect of the scheme on the energy performance of the building stock. System planning and design issues range from the scope of the energy rating (asset or operational) to the establishment of an efficient secretariat function. The second paper (5,172, Joosen) presents early findings from seven countries participating in the project "SENTRO" regarding proposed approaches to implementing the EPBD requirement to have feasibility assessments of alternative energy systems carried out for large new buildings. Attention is paid to an array of market barriers centred on the issue of risk – perceived or real – on the part of decision makers towards what are seen as unfamiliar and possibly unreliable and expensive technologies, and the need to tackle the contributory factors to such risk. The final paper of this session (5,241, Bory) addresses the increasingly important topic of air conditioning systems, practical and economic tools and approaches to auditing and inspecting such systems, and potential energy savings, based on analysis of several European case studies. This is directly pertinent to implementation of that element of the EPBD.

**Session 3** looks beyond direct energy savings to wider "non-energy" benefits (NEBs) of energy efficiency. A paper based on experiences in the US and elsewhere (5,313, McClain) takes a holistic perspective in relation to public sector building, high-

lighting benefits at the individual, institutional and societal level. Its core message is that NEBs have a higher valuation than direct energy savings and that this reality needs to be explicitly recognised in the commissioning of such buildings. The next paper (5,210, Lopes) reviews the actions and effectiveness of a dissemination campaign aimed at growing understanding of passive cooling and implementing standards of summer comfort on a sustainable basis, under the aegis of the project "KeepCool". A paper from Sweden (5,339, Gullberg) examines the growing importance of, and positive relationship between, energy efficiency, comfort and health. It includes the findings of indoor air quality investigations in over 100 schools. Collectively, the message from this session is that energy efficiency in buildings is a quality of life issue with multi-dimensional benefits and requires a high quality of thinking and action in the design and management of building stocks.

The EU Energy Services Directive is a target based directive, which may act as a scoring card for the EPBD and other policies, but is similarly multifaceted in terms of the menu of actions it demands. Again, it has at its core a principle of empowering market change, including the pursuit of new business structures to facilitate more energy efficient solutions. Somewhat provocatively, but with core relevance, the title of **Session 4** asks the question as to whether and how ESD can help the process of making energy efficiency into good business. The three papers in this session (5,005, Geissler, 5,179, Leutgöb and 5,200, Tritthart), drawn from Germany and Austria, seek to address this issue of developing business and financial models of operation that facilitate a win-win solution for both client and service supplier, particularly in the field of renovation and upgrading of the energy performance of building fabric and installed energy services plant and facilities. Such models or approaches include leasing financing, facility management, ESCOs and detailed variants of energy performance contracting models. The third of these papers includes the findings of a survey among experts and stakeholders across the matrix of relevant business interests. Learning from such reported experiences, both positive and negative, will be important towards realising some of the key aspirations of the ESD.

**Sessions 5 and 6** cover mainly the recurring European priority of upgrading of existing buildings. Most of the papers report positive experiences, but here again the learning that can emerge from a clear and careful exposition and analysis of risks and problems associated with particular approaches, whether "technical" or "human", is equally important. Two papers from Sweden (5,100, Joelsson) and the UK (5,201, Peacock) present the methods and findings of research investigations on particular technological interventions, grouped by building fabric, ventilation, appliances and on-site energy production as applied to representative existing building variants. The findings are expressed in terms of potential energy savings, CO<sub>2</sub> emissions reductions and cost impacts. A paper from Germany (5,277, Kraus) shows very positive findings deriving from a programme of upgrading of multi-unit residential buildings on a nationwide basis since 2003, which is now being embedded in new standards and extended to other building types. This is a strong example of how practical and visible market demonstration can leverage wider market and regulatory change.

The Session 6 papers continue with this theme, focussing on the realities and rewards attaching to comprehensive approaches to upgrading of existing buildings (5,039, Bleyl) and an overview of a voluntary networking promotional initiative, GreenBuilding (5,278, Pillen), seeking to mobilise and endorse building owners from different sectors investing in the energy performance upgrading of their buildings across ten European countries. A single paper relating to new buildings (5,310, Vaidya) addresses the fundamental barrier to the market uptake of energy efficiency opportunities, namely perceptions by key actors regarding investment costs. It outlines the development and application of suitably powerful tools to help tackle this barrier, including a proposed new methodology for cost estimation.

Another recurring and closely related theme across Europe is in the challenge of converting design aspirations for more energy efficient buildings into reality. The opening paper in **Session 7** (5,106, Beillan) explores the success factors in such realisation in the household sector, based on survey evidence from the "HabitEnergie" project covering three countries, France, Switzerland and Germany. Significantly, this evidence from a wide array of stakeholders includes data both on objective physical performance of low energy housing and on subjective attitudes and perceptions of occupants and other actors. A second paper, from the USA (5,311, Greden) presents the findings of a structured body of research on risks and uncertainty variables pertinent to this challenge. The third paper, from the UK (5,019, Hawkes) focuses on a specific technology, micro CHP, at individual house level as part of a scenario modelling study. It examines the constraints and implications for such a technology, especially in terms of configurations appropriate for future heat to power ratios, as building heat losses continue to reduce. This highlights the tension between energy efficiency and desirable supply side technologies, whereby positive results with the former tend to make the latter less economically attractive – a challenge not unique to CHP.

**Session 8** offers a wider international perspective, from the three major Asian economies. A paper from Japan (5,011, Murakoshi) faces the challenge of integration and alignment in the approach to developing and applying standards for building envelope, plant and appliances. Two papers from the US, in relation to the rapidly expanding economies of India (5,307, Letschert) and China (5,312, Bressand), provide an overview of macro scale issues, including statistical reliability and scenario explorations in relation to planning for electrical energy usage in the residential sector and total energy usage in the commercial sector respectively. The scenarios necessarily encompass provision for significant penetration of energy efficiency technologies but containment of growth remains a formidable challenge.

The panel closes with **Session 9**, focussed on building and articulating the solutions of the future. The prospect of a changed physical environment through climate change and its potential impact on thermal comfort, heating and cooling energy demand in Europe is critically reviewed in a paper from Switzerland (5,110, Aebischer). A detailed macro scale exercise in assessing the scope for upgrading the energy performance of the fabric of the EU building stock is reported from the Netherlands (5,072, Hamans). The final paper, from the UK

(5,169, Zavody), presents early findings from a scenario building project aimed at defining pathways to the achievement of long term national policy targets. Specifically, it looks at what is needed in technical and policy terms, on both demand and supply side, to reduce CO<sub>2</sub> emissions from newbuild housing to acceptable levels and contribute to an overall national emissions reduction of 60 % by 2050.

Thirteen very interesting **posters** will be shown in this panel. They cover a diversity of topics, again from micro to macro scale and illustrate and reinforce some of the messages from the paper presentations. The corresponding short papers offer a stimulating insight into work extending from new building concepts to new design and communication tools, and from theoretical models applied at individual building level to national scenario modelling exercises.

Skumatz (5,316) from the USA presents, compares and evaluates approaches to measuring non-energy benefits (NEBs), considers sample results from the differing perspectives of stakeholders and analyses the implications for planners and policymakers. A rounded appreciation of these factors is essential to any integrated approach to building practice and to the effectiveness of policy efforts at market transformation in favour of sustainable energy.

Examples of software tools to simplify the task of energy monitoring and control for building owners or managers are given by Jensen (5,230) and Stuart (5,232). The former covers a web based prototype tool developed in Denmark for benchmarking heat, electricity and water usage in schools, while the latter describes a simple software tool developed in the UK to simplify and speed up the analysis of data from "smart" utility meters, for purposes including assessment of consumption history, the effect of interventions and identification of otherwise unknown events.

Field results from two Scandinavian projects illustrate the challenge referenced in Session 7. Based on statistics from a ten year programme by Enova in Norway, Gjerstad (5,137) highlights increases in measured over predicted energy consumption for offices and other building types, and analyses five categories of energy end use functions. Data from two modern office buildings indicates problem areas to be energy usage for lighting, air conditioning/ cooling and electrical equipment. Lundh (5,239) records the objective technical and organisational problems, and the expectations and disappointed perceptions of occupants of a 50 unit residential development in Sweden supplied with heat from a large scale solar collector and borehole storage. It carries lessons regarding not only technical quality assurance and reliability, but particularly regarding the quality of communication to help consumers to feel adequately empowered in the face of new and unfamiliar technology.

The theme of stakeholder empowerment is also reflected by Hofer (5,218), this time to address a deficit in awareness and know-how among owners and developers of modern office buildings in Austria who are cognisant of the potential power of building energy certification under the EPBD and wish to achieve energy efficient buildings. This short paper outlines a comprehensive support service recently introduced by the "ecofacility" programme, and the first lessons learned from its implementation among architects, planners and builders.

Distributed energy generation is the subject of the next three papers: Firestone (5,128) looks at the scope for technologies such as on-site cogeneration (CHP), thermally activated cooling, solar electric and thermal equipment and energy storage, applied in commercial or industrial buildings, against a notional regulatory background of a CO<sub>2</sub> cap. An economic optimisation model is used to assess sensitivity to such differing US regional factors as climate, electricity infrastructure and costs, and should be of generic interest. In relation to the specific topic of biomass heating, Jenkins (5,198) estimates the maximum potential of biomass in UK housing based on the supply capacity of biomass from energy crops and other sources, and on differing scales of realistic reductions in the thermal energy demand of the housing stock. Also at a conceptual level at present, Pedersen (5,190) introduces an example from Denmark of a “zero energy house” or “energy neutral house” through the medium of an international project competition, the winning ideas from which it is hoped will be available for display at the summer school.

We conclude with some national scale scenario investigations. Nakano (5,325) explores the energy saving, CO<sub>2</sub> reduction and cost saving potential in typical housing in Japan, with particular regard to fuel switching options. Osso (5034) outlines a bottom up simulation approach being taken in France to evaluate various refurbishment scenarios of the dwelling stock. Finally, summarized by Hinnells (5,356) and Layberry (5,355) are two UK studies investigating a range of options for market transformation in the housing and non-residential buildings sectors respectively, in order to inform the design of a national policy aimed at achieving a 60 % cut in CO<sub>2</sub> emissions by 2050. Again, given the commonality of the challenge facing all countries, such approaches should be of wide interest.