Introduction to Panel 5B Cutting the energy use of buildings: Policy and programmes

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Introduction

The poor energy performance of the existing buildings represents a key challenge in achieving the ambitious goals of European energy and climate policies. Around 40 % of European end use of energy is spent in this sector, much of this is simply wasted energy if we relate the sector's energy performance to state of the art building and energy technologies.

Although the potentials for energy savings in the building stock have been well described in a variety of research, achieving these potentials is not a trivial task. New buildings perform increasingly well, however the existing building stock represents a huge physical structure that exhibits an inherent resistance to change, as indicated by the relatively low rates of renovation. To achieve the political goals we must ensure sufficient depth (quality) of the renovations that take place, while also aiming for increased rates of building renovations (quantity).

EU member states and regions differ substantially on many variables that are important to building energy efficiency policies. Climate and natural conditions together with economic conditions and abilities are key constraints. Building traditions and culture also explain differences in this respect. These differences may be illustrated by the lack of agreed-upon methods, concepts and terminology that we still find examples of in the building sector.

Recent times of economic hardship have demonstrated that access to the benefits of modern energy services is not guaranteed. Fuel poverty among low income households is a serious problem in many European countries. Health problems due to sub-standard living conditions often follow. Reduction of these problems is an important added social benefit from building renovations. The multiple positive social benefits from ambitious building upgrade initiatives also include increased economic activity and employment, which is much needed in current Europe.

Efficient policies – and markets – for reaping the potential energy, climate and social benefits from building upgrade activities are yet to be in place. Designing policies that ensure a cost optimal level of building upgrade in the long term, is challenging. Opportunities for energy savings locked in by suboptimal levels of renovation should be minimized. The optimal policy solutions to this problem are likely to differ among regions or countries, however the ability and willingness to learn from others' experiences and apply this knowledge in one's own policy context is important.

The papers presented in the 5B buildings panel of the eceee 2013 Summer Study illustrate and enlighten us on these issues. In order to guide the interested readers and conference participants, the contributions have been divided into five categories. Firstly we present strategic analyses that illustrate the potentials for energy efficiency in the building sector, and give a preview of the role to be played by this sector in future energy policy. Secondly, central concepts related to energy efficient buildings are discussed, taking "cost optimality" as a departure point. Some of these papers are motivated by a need to operationalize key concepts of the EPBD. In the third and largest section, the design and implementation of effective policies and measures are presented. We will learn about proposals for innovative new instruments, as well as retrospective views on what has worked. Fourth, several papers address the wider social benefits of energy efficient buildings, with a particular focus on fuel poverty. In the fifth category we find papers relating to people, or private actors, focusing on the role of behaviour, or decision making more generally, in achieving our common political goals. These behaviours, or decisions, range from the trivial daily habits of energy use to large investment decisions.

Against this general background, we briefly introduce the contributions in panel 5B.

1) The building sector at the centre of our future

What role does our building sector have in future scenarios? How central is it in our energy policy goals and what are the benefits? Ürge-Vorsatz et al. (5B-376-13) carry out a thorough examination of new mitigation scenarios, which estimate the building energy use and related CO_2 emissions at global and regional levels for the period from 2005 to 2050. Their results demonstrate that the world-wide final energy use for heating, cooling and water heating can be reduced by one-third in this period despite growing population, welfare and increased energy service levels in buildings. The research also stresses the risk of locked-in effects under current policy trends but shows that a low-energy future is possible for the building sector. Priorities and recommendations for each region are drawn.

Zooming in at the country level, Zhitenko et al. (5B-273-13) focus on the Russian building stock and draw recommendations on how to support Russia on achieving its 40 % energy intensity reduction target through the renovation of the existing residential building stock. An overview of current energy efficiency policies in Russia is presented together with a bottom-up model, estimating the savings potential for the residential sector. Preliminary estimates of the technical savings potential and investment needs for realizing this potential are discussed as well as ways on how to help the Russian government overcome challenges in the design and implementation of energy efficiency policies.

Bettgenhäuser and Hidalgo (5B-042-13) present the results of a comprehensive analysis of the German and EU building stock within the BEAM modeling framework. The model estimates relevant energy demands, greenhouse gas emissions, investment needs in both building energy efficiency and renewable energy measures, in addition to energy and total costs. Embodied energy and greenhouse gas emissions in components of retrofits and new builds are taken into account from a life cycle perspective. The authors use this approach to model different scenarios for a substantial reduction of energy demand and GHG emissions in German and European buildings within a 2050 perspective.

2) Cost optimality – what does it mean?

The recast Energy Performance of Buildings Directive (EPBD) requires EU member states to construct only nearly Zero-Energy Buildings (nZEB) from the end of this decade. In acknowledgment of the diversity across Europe and the need for some degree of flexibility in national building policies, the EPBD requires member states to specify national nZEB definitions and national plans reflecting national, regional or local conditions. Several countries have already started to do so, others are yet to start. Atanasiu et al. (5B-233-13) analyse current building policies, standards and economic conditions in Poland, Romania and Bulgaria. Relevant reference buildings are constructed and different solutions for building improvement are being simulated. On this basis, definitions and implementation roadmaps for nZEB for are suggested.

As further outlined in the EPBD, member states are required to set minimum energy performance requirements for buildings with a view to achieving cost-optimal levels. These should act as a push towards the goal of reaching nearly zero energy building levels for new constructions by 2020. Whilst the process of preparing the cost optimal levels by member states is still under way, Leutgöb et al. (5B-372-13) point out that the high degree of freedom imposed by the EU regulation could lead to different results. Following an analysis of the impact of key assumptions and parameters, the authors derive a quick check approach on the quality of cost optimality assessments which can help to understand potentially big differences in the results.

Shedding some light on what cost optimality would mean in mild climatic regions, Abela et al. (5B-064-13) consider a case study in order to explore the characteristics of minimum energy performance requirements for housing in the Mediterranean climate of Malta. They show that the energy saving measures have a reduced impact on operating costs due to lower primary energy demands in comparison to the Northern European climate, while considerable differences are evident from the two chosen methodologies. Their analyses identify the sensitivity of three issues, namely the influence of the primary energy calculation methodology, the cost factors of measures in new and existing buildings and the mild climate which can mean that the cost effectiveness is more difficult to be determined.

The implications of the cost optimality concept on buildings in a mild climate is also the focus of research undertaken by Madonna and Ravasio (5B-315-13), who applied the comparative methodology in order to derive the cost-optimal levels in Italy under two 2020 scenarios. They propose the identification of the "effort-optimal level" for global cost vs. energy performance curves with a prominent plateau section. A suggestion of "Class A+" performance as a reference for nearly Zero Energy Buildings is discussed.

The quality of renovations is key to bringing existing buildings to the desired level of energy performance. "Deep renovation" is a key concept in this respect. Although the concept of "deep renovation" is widely used, there is no common operational definition of the term, and how it relates to "cost optimality". This concept is addressed by Shnapp et al. (5B-498-13), who ask "How can we renovate deeply if we don't know what it is?" Their research and expert meetings contribute to a better understanding of the term based on contributions from international experts.

What ambitions lie beyond the nearly zero energy buildings? The vision of a building that produces more energy than it uses is put into test by Erhorn and Erhorn-Kluttig (5B-165-13) by demonstrating how the model project "Efficiency-house plus" can achieve positive energy levels. The "efficiency -house plus" allows generating more energy in the course of a year than the building actually needs. In view of achieving positive energy levels in a building, the status quo and trends in key technologies are discussed as well as cost efficiency and applicability beyond the housing sector.

3) Designing and implementing effective policies

Considering the scenario analysis presented in the first section of the panel, the focus is then put on how the current policy framework is aligned with the potential identified and what lessons can be drawn from their implementation. Thomas et al. (5B-103-13) address the question of how policy can support improved building energy efficiency most effectively at a worldwide scale. For this purpose, a theoretical, actor-centred analysis of market-inherent barriers and incentives is combined with empirical evidence on model examples of good practice policy packages. Recommended packages as well as a comparison of existing national policy packages from California (USA), China, Denmark, Germany, and Tunisia are presented. Policy-makers are advised to inter-alia consider both actors and data needs at the design phase as well as compliance, monitoring and impact evaluation requirements.

Leipziger et al. (5B-466-13) argue that discrepancies in terminologies, priorities and scopes of local initiatives make it difficult to compare different strategies across the globe, hindering the exchange of experiences on effective program and policy design. The authors propose a standard lexicon for building energy performance and identify a new set of tools which can help to facilitate sharing of best practices and move towards the harmonization of different definitions.

Ingram and Jenkins (5B-135-13) put the UK Government's most recent policy under the microscope by examining how three case study dwellings with unique challenges such as protected building status and solid walls can qualify under the Green Deal. Their undertaken assessments show that only one of the examined buildings would have improvement measures available under the Green Deal. In doing so, the authors point out several limitations inherited with the Green Deal, the assessment methodologies and the Golden Rule. Moving north to colder climates, Berube (5B-471-13) shares the experience of the US state of Alaska in addressing energy efficiency in their building sector. The paper describes the state-funded efforts of more than 30 years through its weatherization program. The analysis presented in this paper provides insights into the WAP program as well as historical successes and failures.

For more than 20 years the Energy Design Assistance (EDA) programmes have helped electricity and natural gas utility customers in the US realize significant energy savings. These programmes are offered by utilities to their customers in the design stage of major building renovations or new building projects, to identify and realize savings possibilities. Steinbock et al. (5B-442-13) look at Ongoing Energy Performance as one tool to enhance these programmes to realize even higher savings for the customer in the ongoing operation of the building.

High capital costs and long payback periods are characteristic of home energy efficiency improvements. Such investments improve the Energy Performance Certificate (EPC) rating of the house, but they are usually not reflected as an increase in the sales value of the house, and are often "lost" when the house is sold. These represent important barriers to energy efficiency investments. Croft and Preston (5B-479-13) discuss an incentive system based on property taxes that could overcome these barriers. The key in their model is to introduce a rate structure for existing (UK) property taxes that reflect the EPC rating of the building. Paired with the Green Deal financing mechanism, this approach could increase incentives for home energy efficiency investments.

Pehnt et al. (5B-076-13) propose a strategy for achieving Germany's ambitious 2050 goals for the energy performance of the building stock. With the energy labelling system for buildings as a measuring rod, a step curve defines a dynamic efficiency standard for the building stock, at the level of the individual building. This dynamic standard forms the basis for a renovation plan for each building, to be developed with the aid of certified energy consultants. This building renovation roadmap could be financed by the "climate protection obolus". This fine is paid by owners of buildings which do not comply with the demands of the dynamic standard. The climate protection obolus paid by "underperforming" renovators will be made available as financial incentive for building owners who renovate according to the roadmap. The reduced strain on public budgets is one important characteristic of the proposed strategy.

The high energy performance required by future buildings assumes a very high quality of execution throughout the construction process. To achieve this, the skill level in the construction industry must be improved from the current state, and forward looking building policies must address this crucial issue. Blomsterberg (5B-227-13) reports from the Swedish part of the BUILD UP Skills project. The article presents an assessment of the current level of knowledge and the type and scope of vocational development required by skilled workers within the construction industry in order to achieve the energy targets for buildings in 2020. Shortfalls in skills are identified, and a roadmap to improve necessary skills is indicated.

Political will to accelerate the energy renovation of the existing building stock is necessary as older buildings have not been designed with energy performance in consideration. The role of building renovation is stressed by the Directive 2012/27/EU on energy efficiency, which requires the establishment of long-term renovation roadmaps with policies and measures to stimulate cost-effective renovations. Hidalgo (5B-149-13) focuses on the roadmap for Sustainable Building in the Basque Country, which is viewed as an early example of the national building renovation roadmaps mandated by the Directive. The author outlines the main features of the roadmap and presents several lessons that can be drawn from its development and its implementation. These can be used for the strategy-setting exercise that other national administrations will need to face as requested by the directive.

4) Social benefits from improved buildings

Public programmes for improving the energy efficiency of the poorest segments of the European building stock could yield a variety of benefits to society. Apart from the obvious reductions in energy costs and carbon emissions, also health benefits from reduced air pollution and improved indoor air quality are expected to result, in addition to increased productivity, job creation and other economic effects. In the article by Joyce et al. (5B-250-13), these benefits are monetized in order to estimate the effect of such renovation programmes on public finance. Based on their findings, the authors claim that investment in energy efficient renovation of buildings brings permanent, ongoing revenue to government finances and that if we start now there will be a substantial economic stimulus effect that could greatly assist the EU economy in exiting the current financial crisis.

A very specific co-benefit of building energy efficiency is the reduction of fuel poverty. Fuel poverty is understood as a situation where low income households need to spend an unproportionately large share of their disposable income on basic energy services. Fuel poverty rates have been arguably at a rising trend over the last years in Europe. This is showcased for the Hungarian context by Herrero et al. (5B-485-13), who derive a fuel poverty rate of 10 to 30 % as of the late 2000s. The results of a social cost-benefit analysis carried out in their paper support the retrofits of Hungary's residential stock to near passive house levels. The results also confirm the relevance of co-benefits for the economic assessment of residential energy efficiency scenarios and highlight the importance of co-benefits as policy entry-points.

Scheer (5B-016-13) addresses the important issue of fuel poverty in his Ireland based analysis. The Irish government has significant budgetary outlays on energy subsidies to alleviate the immediate negative effects of fuel poverty. The author points at dwelling upgrade programs as an alternative to fuel subsidies as a more sustainable path out of this situation. Increased dwelling energy efficiency gives a long term reduction in energy outlays, and has comfort, health and climate effects as well. The cost/benefit analysis of this problem demonstrates significant public benefits from such a proposed shift in fuel poverty policy.

From a Belgian perspective, Grevisse and Brynart (5B-185-13) scrutinize the effects on energy poverty from the demands set forth in the EPBD. These demands relate mainly to inspections of heating systems, the Energy Performance Certificate, and energy requirements for new buildings and renovations. From a social justice point of view, it is feared that particularly the EPC requirements could segment the housing market in such a way that low income households will end up living in the poorest houses in terms of energy performance, thus not being able to enjoy the diverse benefits from improved housing standard. Based on a survey among social workers these issues are discussed along with policy actions that could turn these threats into opportunities.

5) Behaviour and decision making

The quality of the building envelope and technical installations is instrumental in achieving high energy performance of buildings. However, the role of people, as office workers, inhabitants, building managers or other users, may also significantly influence the energy demand of the building. This issue is addressed by Pahl et al. (5B-214-13) in their poster presentation of the eViz project. eViz is a multi-centre project between four UK Universities that takes an integrated interdisciplinary approach between behaviour and building scientists to reduce energy use and thus carbon in buildings. The presentation reports from pilot studies on i) a mental models approach to occupant perceptions of energy in the home, ii) an in-depth case study of three residential homes and iii) progress on a visualisation intervention in a student hall of residence.

Most analyses point at public programmes and financing as the back bone and catalyst of the building upgrade investments necessary to achieve climate and energy policy goals. Novikova et al. (5B-393-13) remind us that private investments are equally important in this energy transition process, and that decision making processes among households and building owners are central. Therefore, it is crucial to understand the current investment levels, potential investment gaps, and how to leverage private investment. In their article, the authors give us a comprehensive snapshot of the German Finance Landscape in 2010 by analysing how much money is being invested in Germany to reduce GHG emissions, with a focus on those investments relevant to the Energy Transition (Energiewende). By compiling data from a wide range of sources, the authors map finance flows along their life cycle, from sources, via intermediaries and financial instruments, to the sectors where the money is used. As an example, the analysis shows that climate-specific investment in the German residential sector was at least EUR 16.3 billion, and that a dominant share of it, EUR 13.8 billion, was invested by households.

With the aim to address existing bottlenecks in the pragmatic implementation of building renovation policies, Matschoss et al. (5B-235-13) examine the decision making on energy investments in owner-occupied multifamily houses. The rationale is that the collective nature of taking decisions in condominiums hinders renovation decisions as many financial, legal, technical, sociological and psychological issues arise. Although their research identifies specific efforts to solve some of the organizational barriers in their chosen case studies, it is argued that these are far from sufficient to address the magnitude and multiplicity of barriers encountered in owner-occupied multifamily homes.