EUA-EPUE
European Platform of Universities in Energy Research & Education

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EUA-EPUE Response to SET-Plan Consultation

Action No. 5: Develop new materials and technologies for energy efficiency solutions for buildings

BACKGROUND

This "Input Paper" provides the perspective of the European Platform of Universities in Energy Research & Education (EUA-EPUE) to the consultative process on the European Strategic Energy Technology Plan (SET Plan) - Key Action No. 5 – Developing new materials and technologies for energy efficiency solutions for buildings.

EUA-EPUE responds to the consultation from the perspective of the universities' role in society. Universities constitute a significant part of the research capacity in Europe. At the same time, they educate the highly skilled work force of our societies. We consider therefore that setting up the SET Plan projects with ensured integration of innovative research with education, including industrial partners, will provide a high pay-off towards achieving the energy system transition that is the objective of the SET Plan.

Prioritisation

Proposed prioritisation for the SET- Plan Key Action 5
For the main expected outcome: To make specific recommendations on the priorities/targets proposed in the issues paper(s)

- Do you agree with the prioritisation set in the issue paper?
- Do you think that the level of ambition is correct?
- Are there any standing issue(s) in the way to reaching the proposed priorities?

It may be useful to understand the broader context in which these priorities need to be achieved. If possible, we suggest that the following is addressed as well:

- *What are your specific recommendations on prioritising R&I activities on these issues (and building where appropriate on relevant existing initiatives)?*
- *Who are the best placed actors to implement the priorities (Industry, EU, Member States, regions, groups of countries/organisations/etc.)?*

The Issues Paper No. 5 provides a good synopsis of the current situation with respect to energy efficiency in buildings in Europe. Buildings represent 40% of our final energy demand and they consume more energy than any other sector of the European economy. Their energy consumption is influenced by various factors such as age, size, location (climate, level of urbanisation), number and behaviour of occupants or the presence of appliances.

With the legislative framework that the EU has in place, it has set itself ambitious policy objectives which include, for instance, that all new buildings must be Nearly Zero Energy Buildings (NZEB) by 31st December 2020 (public buildings by 31st December 2018), that minimum energy performance requirements should be set for major renovations and for the replacement or retrofit of building elements, and that at least 3% of the heated and/or cooled floor area of buildings owned and occupied by central governments should be refurbished each year.

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The main barriers to achieving these objectives are a combination of technical, societal, behavioural, political and economic factors. It is believed that the societal, political and economic barriers require as much attention as the technical challenges.

Prioritisation- Step 1: Where are the energy saving potentials in buildings?

The energy saving potentials in buildings include:

- Better individual and collective behaviours and their interaction in relation to different usages, both at the scale of a building and its equipment and also at the scale of a city and the life in a city – accommodation, tertiary, mobility, social life, etc.
- The establishment of 'observation parks' for both new and existing buildings for supporting the innovations for energy saving in buildings (construction databases, equipment, energetic performance, environmental impacts, health, and comfort).
- Development of new business models and financial models (see Prioritisation – Step 2)
- Investment in relevant R&I activity (see Prioritisation – Step 3)

Prioritisation- Step 2: What are the obstacles to increasing energy efficiency in buildings?

- The 'issues paper' summarises the obstacles to increase energy efficiency in buildings very well. Most of them are non-technological barriers (e.g. social or financial factors and barriers related to the structure of the construction business and construction processes). It is important to underline that R&I addressing these non-technological issues (e.g. process innovation) is also essential to reach the projected goals (even though non-technological R&I is not part of this 'issues paper');

- Energy retrofit of residential buildings is not yet a cost-effective practice; Energy Service Companies (ESCOs) experience difficulties in operating because the pay back periods of energy retrofit interventions are too long;

- New business models and financial models have to be improved in order to remove technical and non-technical barriers and to promote renovation interventions with significant reduction of energy consumption;

- In housing renovation processes, from design to operation, a large gap between the expected and actual performances often occurs because a quality-assuring chain between designers and builders is missing; the consequence is that investors and users are not assured about the results;

- Potential information deficits and behaviour of owners and occupants;

- Professionals and contractors involved in renovation / retrofit activities often lack adequate competences to take full advantage of the energy conservation opportunities offered by building refurbishment;

- Lack of innovative solutions concerning the building (new or existing) envelope, which guarantee optimal energy efficiency in relation to a) the heating/cooling needs, to b) the integration of renewable energy, and to c) the diversity conservation of building architectures with low environmental impact.

- Difficulty in assessing, and therefore in optimising various innovations and their different impacts (energy, security, health, environment, etc.) due to the lack of a systemic approach which should integrate sociological, economic and technological aspects.

- Lack of management systems for internal energy operations, with a systemic approach considering a) energy efficiency improvement, b) various building equipment based on their functions, c) local limiting conditions and d) constraints related to the network optimization at urban scale.

Possible solutions to remove the above obstacles:

- Development of innovative business models for renovation works decided by real estate companies in order to improve the quality of single apartments in multi-family buildings; such models could involve innovative contracts between landlords and tenants based on the results of the renovation (e.g. the renovation's impact on energy savings, consumption and efficiency);

- Development of innovative financing model for renovation works of individual buildings; such models could involve innovative loan contracts between families and lenders based on the results of the renovation;

- Promotion of training programmes aimed at improving the awareness and skills of building contractors with respect to energy saving interventions. Training programmes for owners and tenants should also be considered.

- Investment and R&I in technological solutions as indicated in Step 3 (see below).

Prioritisation- Step 3: How R&I could address the most technological barriers?

A notion of two different scales should be introduced which helps identify and overcome the technological barriers for both new buildings and renovations:

- Scale of a building as a system integrating the materials, components and equipment;
- Scale of a district or a city integrating different types of buildings.

These two scales are interconnected via networks such as power distribution, water, transport, waste collection.

Priorities

The priorities are directly linked to the SET-Plan Integrated Roadmap and some parts and aspects of the multi-annual roadmap prepared by the Energy-efficient Buildings (EeB) PPP13.[1]

Existing buildings
New building
Cross-cutting barriers

[1] http://ec.europa.eu/research/industrial_technologies/energy-efficient-buildings_en.html

R&I targets for SET-Plan Key Action 5

Proposed R&I targets for the SET- Plan Key Action 5
For the main expected outcome: To make specific recommendations on the targets proposed in the issues paper(s)

- Do you agree with the targets set in the issue paper?
- Do you think that the level of ambition is correct?
- Are there any standing issue(s) in the way to reaching the proposed targets?

It may be useful to understand the broader context in which these targets need to be achieved. If possible, we suggest that the following is addressed as well:

- *What are your specific recommendations on prioritising R&I activities on these issues (and building where appropriate on relevant existing initiatives)?*
- *Who are the best placed actors to implement the targets/priorities (Industry, EU, Member States, regions, groups of countries/organisations/etc.)?*

Following the above prioritization exercise, and building upon the outcomes of the Integrated Roadmap, the table in page 6 of the Issues Paper defines the **five key specific research and innovation targets** which have been defined for existing buildings, new ones and cross-cutting areas.

Comments

The five key specific research and innovation targets which have been defined for existing buildings, new buildings and cross-cutting areas provide a good synthesis of the possible. Some comments and ideals are listed below:

- For the highly replicable and standardised refurbishment packages tailored to the main building typologies in Europe, each building has its own specific features depending on climate, age, etc. So does the refurbishment process. Costs and benefits are not all over the same, as well.
- The term ‘package’ should be clarified. Does it imply ‘guidelines and best-practices’ for owners, investors, developers, architects, construction companies etc. on how to refurbishment a specific building typology in an (energy- and cost-)efficient way or does it refer to prefabricated construction elements (e.g. prefabricated façade elements with integrated HVAC components). Both approaches are very important and deserve action. It should be underlined, that many buildings require individual refurbishment solutions due to their originality. It should therefore be specified whether these buildings are part of ‘packaged solutions’ or whether this concept solely applies to buildings for which refurbishment solutions based on standardised prefabricated elements are applicable.
- It should be specified if the "at least 60% of primary energy-reduction" is a specific target for each refurbishment case or something like an ‘average number’ over many refurbishments.
- For new building, what is the baseline for "10% in average"? Inflation and the increase of the building-cost index is going to lead to more expensive buildings in 2025.

- For cross -cutting issue, the goal is to reduce the average construction works duration by at least 20%. This goal requires substantial efforts (also R&I) on administrative, legal and (construction) process level. The topic is also country (or at least region) dependent. Construction works also depend on national legislation.
- To reduce the gap between the predicted and the actual energy performance to 10% by 2025" is not reasonable as a target, due to differing personal behaviour.
- The air quality is an important criterion for both new and existing buildings, maybe more particular for new buildings.

Concrete recommendations based on the Integrated Roadmap

Following the above prioritization exercise, and building upon the outcomes of the Integrated Roadmap, the table in page 8&9 of the Issues Paper defines the **five main research and innovation areas and High potential technologies and solutions**.

Comments

- Higher performance insulation with e.g. lower lambda values and reduced thickness may not offer major gains due to Lambda values already being down to 0.03 and less. A lower value would mean vacuum insulation, not appropriate for walls and roofs, just for windows. We recommend to also consider dynamic insulation systems.
- Highly reflective surfaces for roofing materials require careful consideration taking into account the reduced heat gain effect in winter time and urban pollution soiling rendering it less effective.
- The only solution usually compatible with historical buildings is inside insulation.
- Regarding high performance heat pumps two distinct issues here require consideration:
    - The improvement of heat pump performance, irrespective of the exploited low temperature source (air, water or ground), based on technological innovation of the HP components (compressors, heat exchangers, expansion valves, part load controls, etc.), taking into account the constraints imposed by environmental legislation (e.g., F-gas regulation, etc.)
    - The development of efficient high-temperature HP systems suitable for replacing boilers in buildings equipped with radiators
- "Innovative heating and cooling systems" should be better specified, e.g. whether it refers to all components of an HVAC system: heat / cold generation, distribution, terminals and controls or whether it means new heating/cooling terminals.
- We agree with the emphasis given to "High efficient lighting systems".
- For Energy equipment/system, different t renewable energy technologies for buildings should be considered under this point. Domestic Hot Water preparation should not be omitted.

- Ventilation products tailored to the renovation market: Domestic Hot Water and cooking appliances will cover around 30-40% of building energy demand, and they are among the most ineffective existing energy conversion devices. DHW efficiency is reduced by distribution losses. *"Only a small part of cooking energy goes into the pot."* Future challenges will also include the matching of local renewable energy reduction and energy demand.

- Decision making in construction processes can be an important topic. Energy efficient design requires the "right decisions" right from the beginning of a project (e.g. putting the right criteria into architectural competitions). Experience shows that developers, building-owners and investors often face difficulties in setting up projects that take aspects such as energy efficiency into full account. Achieving optimum solutions require an integrated design approach right from the beginning (this is for sure one of the biggest challenges due to the scattered nature of the construction sector with many stakeholders being involved in a project).

Other topics worth mentioning:

- Super-thin insulation materials for renovation: The currently available solutions occupy usually very large volume which is a major obstacle for the renovation, from the viewpoint of house-owners and architects.

- Multifunctional envelopes ensure reliable energy uptake, protection against heat or cold, based on the constructing materials with low environmental impact, leading to the industrialization of the envelope.

- Energy systems – heat pumps, ventilations, hot water generation – are capable of recovering heat from different sources: external air, soil, waste air, grey hot water, electro-appliances, computers, etc., allowing improved comfort reduced cooling need in summer.

- Active/passive solutions for the improvement of indoor air quality (material, filtration).

- Low grade thermal waste (water, air and gas) recovery and integrated control systems technologies have a large energy-saving potential in buildings.

- Solutions for storage – electricity, heat (short/medium term) at different scales as well as sensors and control systems enabling a systemic approach for energy efficiency optimization in terms of energy use and target performances.

- The question of ventilation should deserve more attention. When creating air-tight building envelopes (as mentioned above), it is essential to have appropriate ventilation strategies for air-exchange and moisture control. The right design and control of ventilation systems (and maintenance) is substantial for energy efficiency.

- Micro-cogeneration systems applicable at the domestic scale based on Fuel Cells or Stirling Cycles

- Advanced integrated control – measurement systems to achieve a more reliable heating cost allocation among end users, as foreseen by the Energy Efficiency Directive.

Comments on the specific mission of universities

- Creating research and curricula encouraging a thorough and holistic understanding of the building energy balance, progressing backwards from the demand to the supply. Mechanical engineering is usually providing skills for the design of heating and cooling installations, but generally neglects the building demand and electrical issues. Architects and building engineers tend to know too little about installations, and even less about energy supply. Curricula aiming at creating real building system experts are not very popular yet.
- Increasing the awareness of building engineers and architects about local energy production by renewable energy sources, mainly solar PV and thermal (biomass only out of urban contexts). There is no good reason to try to minimize the demand below certain levels, because, due to the law of diminishing returns, the cost of energy saved will become much too high compared to the cost of energy produced from renewable, especially for existing buildings, where retrofits are particularly expensive. *A good building engineer/architect should know where to stop working on the demand, and start looking around for available cheap renewable energy supply sources*.
- Developing reliable simulation tools which not only can be taught to students, but fully understandable and usable by professionals. Hour-by-hour simulations require too many input data, while quasi-static models completely fail when trying to estimate cooling energy demand.

CONTACT

Dr. Lidia Borrell-Damian
Lidia.borrell-damian@eua.be
Director, Research & Innovation
European University Association

Lennart Stoy
Lennart.stoy@eua.be
Project Manager, Research & Innovation
European University Association