

Energy retrofit towards nZEB goals

– Interview with JRC members



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Q1) According to EPBD recast, after 2020 all new buildings are expected to be nearly-zero energy buildings but, as known, the largest energy saving potential in the building sector is represented by existing buildings. Which are the most important actions taken by EU to incentivize retrofit actions oriented to nZEB goals?

Since the early 1990s the European policy framework for buildings has quickly evolved and Member States (MS) adopted a wide array of policy measures to transpose the general principles defined by the European Directives (EPBD, EPBD recast, RED, EED).

However, it is still valid the consideration made by the Commission in the 2010 proposal for revision of EPBD: *“the sector has significant untapped potential for cost-effective energy savings”*. In fact, the (few) estimations available assess the European renovation rates between 0.5% and 2.5% of the building stock per year, and a minor part of these is represented by deep and nZEB renovations.

The economic crisis of last years did not help to push toward the desired paradigmatic revolution, and on the contrary it accentuated the importance of financial barriers. Not surprisingly, then the policies designed by national and local authorities focused mostly on this aspect. Since 2008 almost all Member States introduced or strengthened their incentive measures, encouraging cost-effective energy renovations. Generally, the main target is the deep refurbishment of residential buildings, but also specific instruments for the tertiary and public sectors have been implemented.

We are telling successful stories since long time. The time needed to convince all cultures and stakeholders composing the European Union that a strong engagement on the energy efficiency of our buildings is crucial and necessary. The quick evolution of the national legislations towards nZEBs is a good and promising signal, but a wide diffusion and application will depend crucially on the involvement of all stakeholders from local government, industry, financial institutions and civil society.

Q2) Which are instead possible obstacles to a large-scale dissemination of retrofit interventions towards nZEBs?

We see different kinds of obstacles. We would mention here the main three:

1) Financial barriers: the cost of existing solutions is still high (considering the average age or the EU building stock reaching nZEB level it usually means deep, structural refurbishment) and building owners usually do not see sufficient returns on the investment (or not in a reasonable time). Based on these issues and on the value of collateral (the increase in the value of the property is not always linked to the energy renovation efforts) also banks are not currently providing adequate financial support at individual building owners.

2) Technical barriers: technical solutions to achieve nZEBs in existing buildings are not always feasible and cost-effective because limited by the existing building structure and by location. Normally specific interventions on individual cases and customized solutions are necessary, but new integrated design approaches and innovative building processes can reduce the investment costs and the renovation time.

3) Information barriers: still not all citizens in Europe are well informed about the availability of energy efficiency solutions and incentive programs available in their territory. Information, when available is still scattered and results into a wide range of options that are difficult to compare and understand for the final user. Key stakeholders (e.g. building administrators) and professionals should be regularly updated (importance of continuous professional education program) about innovative solutions and progresses in national and local policies.

Q3) What are, in your opinion, the most common goals for the effective widespread application of retrofit interventions towards nearly-zero energy projects?

Important progresses have been made during the last years but a series of goals remain to be achieved to reach a widespread application of nZEBs retrofit interventions.

One goal would be to stimulate R&D and competition in the building sector to find affordable, cost-effective and flexible solutions that can be applied to a large number of buildings in different regions.

Another key objective would be for public administrations to provide clear and unbiased information to all stakeholders and incentives to building owners, in all the situations where the market, alone, fails to deliver the desired outcome in terms of nZEB refurbishment (e.g. positive externalities, social benefits higher than private ones) or develop and support plans for large scale deep renovation of the building stock (e.g. phasing out of the most energy inefficient buildings etc.)

In addition, despite awareness of the importance of energy efficiency retrofit has significantly increased in the recent years, to further improve the diffusion of the specific concept of nZEB also outside the policy, academic and professional circles would possibly help in the widespread application of interventions towards nearly zero energy projects. To achieve this goal education programs are of key importance, from primary schools to specialized professional courses.

Q4) Which should be the desirable role of public administrations in the process towards a broader market transformation oriented to sustainability in the built environment?

Public administrations at all levels play various roles in this process.

On one side they should be responsible for the energy renovation of their building stock, in compliance with European Directives provisions (e.g. EED Art. 5). This would also be an important indirect effect on private owners as public administrations would thus play an exemplary role in the promotion of large-scale energy retrofit program.

On the other side, public administrations are called to support the adoption of market-oriented solutions: to provide a consistent and well defined legal framework, to adopt clear medium and long-term strategies, targets definitions and measures, to remove potential barriers to R&D, technological innovation, and competition in the construction sector and to foster a widespread energy efficiency education and specialized courses for professionals.

However, there would probably still be room to public interventions aimed at financially support energy retrofit projects or to assure adequate return expectations to investors, especially in specific areas and for medium and low-income population.

Q5) Nowadays good practices of realized high performing buildings - not nZEBs - are available, such as for example passive houses or green buildings. To what extent experiences of green buildings may be considered a precedent for the evolution of nZEBs?

All past and current experiences in the field of sustainable architecture are somehow related to the development and the evolution of the nZEB concept. They share the overall objective of contributing to save energy and reduce significantly the environmental footprint of buildings. However, even if in the same line, it is worth emphasizing that there is not a direct link between them nor nZEBs represent an evolution of earlier established concepts of high-efficient buildings. While some of the established solutions and principles (e.g. green building or eco-building) can be found also under the nZEB building generation, nZEB represent something different, which could be considered as more flexible, with a specific focus on the integration of strong energy efficiency measures and renewable energy generation.

Green labels and eco-certifications, such as LEED, BREEAM, Green-Building Programme, etc., demonstrated that they can be an important incentive in the diffusion and promotion of sustainable buildings. In light of these experiences, one could suggest that a nZEB “certification”, based on the national definitions and standards, could be in principle equally important in the development of the market for nZEBs. The EPBD Directive (in article 11(9)) already requires the Commission to adopt, in consultation with the relevant sectors, a voluntary common European Union certification scheme for the energy performance of non-residential buildings.

Q6) The lack of a harmonized tool for collecting and sharing quantitative data from different case studies emerges nowadays; which would be instead the role and the influence of a common database in the process of nZEBs diffusion?

The realization of deep retrofit or nZEBs retrofit requires a wide range of technologies, systems and solutions with different degrees of complexity and sophistication, depending on the location and environment conditions, but also on local legislation and market conditions. A large-scale harmonized data-

base would provide a complete overview of the state of the art in the different regions or MS, in order to compare and assess the most important information on the available solutions, but also on local conditions (legislation, market etc.), costs, benefits and financial support schemes. A EU database would have the potential to help all stakeholders; it would increase transparency and competition, it would reduce uncertainties for investors in calculating risks and payback times, it could serve as a kind of European *vademecum* of examples which designers, administrators and owners can consult for the most appropriate and effective solution to apply to specific cases.

A large-scale harmonized dataset on nZEBs refurbishment could also provide important quantitative information and indicators to monitor and evaluate the market, consumer choices and the impact of specific policy measures as well as to formulate specific targets for policy interventions.

Q7) Which information about nZEBs is more relevant to share?

The following information should be collected for each building where possible:

Location: the climatic condition of the building location is one of the most significant factors which can influence the nZEB design and its technical equipment, also regarding renewable sources available on site.

Year of construction: permits not only common classification in the timeframe but also the analysis of the time needed in the countries to implement EU or local policies.

Geometrical data: as area in m² and/or number of floors.

Envelope typology: information about the building envelope should be given as: U value W/m²K for roof, basement, external walls and windows.

Technical equipment: type of technology should be specified for heating, cooling and ventilation system, as well as lighting and control system. Sub-categories for each sector could be detailed, in order to simplify statistical analysis. For example, sub-categories

for heating could be: district heating, heat pumps, condensing boilers, etc.

Renewable sources technology and % of RES (energy level): as the EPBD defines a nearly Zero-Energy Building as “a building that has a very high energy performance... nearly zero or very low amount of energy required should to a very significant extent be covered by energy from renewable sources, including renewable energy produced on-site or nearby”, knowing the %, the type of renewable sources (share of renewables in a quantitative or qualitative way) and the technology employed can give the measure of the understanding and implementing of the EU Directive in the different MS.

Energy demand [kWh/m²y]: energy is one of the main indicators. The value can be expressed through a model or referring to a building reference standard.

Investment costs, financial incentive and discounted payback time period (yr): economical and financial information should be given; investment costs can be given in euro or euro/m²; financial incentives are comprehensive of lease-back scheme, national and regional funds, loans and findings, etc.

Reference values or standards eventually established in the MS: if presents, labels, energy classes, standards, etc.

Socio-economic data: as type and number of occupants, age of the occupants, economic conditions, etc. These data can be very important to analyse the type of behaviour of the people living in the house and how they can influence the good functioning of the efficiency measures implemented.

For retrofit interventions the data collected should ideally allow a before and after comparison of the building energy performance.

Q8) Which is in your opinion the right approach to disseminate and to replicate retrofit actions on the building market?

The most common approach to replicate retrofit actions in the building market is to establish a number of successful representative projects across Europe, in a number of representative locations, in order to show how projects can succeed in very different climates and overcome other specific building related challenges.

These include:

- Different **construction techniques** for walls and other components.
- Different **heating systems** - for instance natural gas based systems in some locations against all -electric designs in others.
- The output of representative **photovoltaic systems** in different climates in EU locations and how these loads vary with building thermal and electrical loads.

Testimony from homeowners would certainly help to disseminate information on the success of the project. Finally, at least for high visibility initial projects, it would be important to have them monitored (e.g. with utility records compared before and after retrofit interventions) including also internal temperature and comfort conditions to help validate the nZEB retrofit approach. Also, to the extent possible, the real costs of refurbishment should be tracked (including also the often neglected “intangible” costs) and in this way the relative benefits from energy savings may be compared to the realistic costs of the remodelling effort.

However, to significantly improve the dissemination of successful retrofits two other factors are considered of key importance:

- a) The development and use of **information tools**, in order to collect and share case studies data and experiences. An open data web-based platform together with social media and crowd-source datasets would have a great potential to spread good practices, technical solutions, experiences, information on costs and benefits, policies and incentives programmes, educational initiatives.
- b) The development and diffusions of **large-scale education and information programs** targeted at all level from children to elderly, from professionals to non-professionals and policy makers.

Q9) Which are the most important technologies to be developed to reach nZEB targets?

Technologies to reach nZEB include both the efficiency and renewable generation sides. Integrated and staged technologies to be implemented are challenging tools towards the nZEBs diffusion in Europe. Among the most important technologies are:

- Lower cost high-efficiency Heat Recovery Ventilators (**HRV**) and Energy Recovery Ventilators (**ERV**) for ventilation air. Analysis shows that air tightness

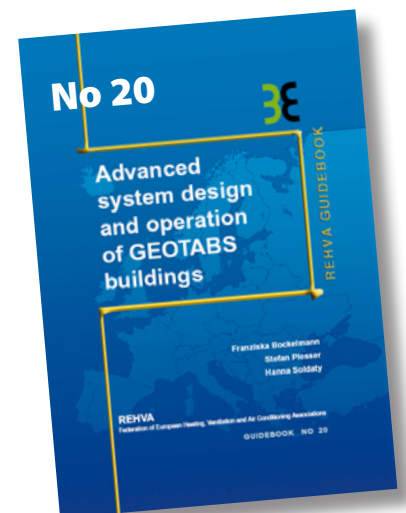
is important in heating dominated climates; with air tightness comes a need to provide sufficient ventilation airflows with heat and/or enthalpy recovery.

- Advanced **smart window systems** with automated shutters or window coatings that allow adjustment to building interior conditions.
- More compact **high performance insulation** for piping. This may include low cost Aerogel type materials with very low thermal conductance which can substantially reduce thermal losses from piping either with radiators or otherwise with solar combisystems.
- Cooking and range **hood ventilation** represents a special challenge, not only because it is not often done in the most air tight building designs, but also for indoor air quality issues.
- Improved **heat pumps** for heating and cooling; this includes both air source heat pumps used for heating and cooling in mild climates and in geothermal systems for heating in colder locations where electricity is used for heating. Higher system COPs are desirable in both equipment classes. Electric heat pump water heaters in mild Mediterranean climates will be useful to obtain supply and exhaust air from the outdoors, or during the cooling season, to provide their supply air as a source of free cooling for the building interior.

- Continuation of progress on **appliance efficiency and lighting**.
- Diffusion of **precast elements** to be easily adapted to the building type with the support of specific innovative tools able to decrease the price of industrial processes.
- **Higher PV module efficiencies**. The current poly-crystalline silicon systems have efficiencies in the 14-16% range commonly. Performance in the 20%+ range is desirable as this will allow greater rooftop generation at lower installed costs. Currently, the available roof space often limits how much PV electricity can be generated onsite. Higher module efficiencies would increase the potential power production while reducing the cost of installation labour by reducing the size and numbers of PV modules necessary for greater solar electric production.
- **Electric storage**: producing power while improving the match with the utility grid will necessitate increasing onsite electrical storage to help flatten out the load curve and to smooth out the household electrical demand to be as close to zero as possible over the daily - and eventually - over the weekly cycle. Such needs will then require 10-20 kWh of electrical storage at the lowest possible cost. ■

REHVA Guidebook on GEOTABS

This REHVA Task Force, in cooperation with CEN, prepared technical definitions and energy calculation principles for nearly zero energy buildings required in the implementation of the Energy performance of buildings directive recast. This 2013 revision replaces 2011 version. These technical definitions and specifications were prepared in the level of detail to be suitable for the implementation in national building codes. The intention of the Task Force is to help the experts in the Member States to define the nearly zero energy buildings in a uniform way in national regulation.



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