

Net zero energy buildings in focus at ClimaMed 2013 Conference



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Climamed'13 Congress was held on 3–4 October 2013, in İstanbul, Turkey. ClimaMed conferences are organized by 5 member countries of the REHVA. Founders of ClimaMed conferences are France, Italy, Spain and Portugal. Turkey joined this group later 4 years ago. Main goal of the conference is discussing regional topics of the Mediterranean climate. This conference was the 7th conference in series since 2004.

Main theme of the congress was the nZEB, especially approaches to the nZEB in these Mediterranean countries. 159 abstracts were received from not only member countries but from 21 countries in the region and all over the world. Finally 90 full papers included in the proceedings book and 66 papers presented orally during the congress and 11 posters were exposed. 22 Technical Sessions were held in 7 parallel rooms during the congress. Technical sessions were designed according to congress themes. Besides, 3 invited lectures were also presented during the congress and a panel was held. Additionally, a seminar was organized by the Eurovent. 429 participants were registered formally at the conference. Including guests and other accompanying people, more than 500 people attended the conference.

Nearly Zero Energy Buildings

The theme of the congress was actually “net zero energy buildings” however the focus was on the nearly zero energy buildings. After EPBD recast announced, nZEB is on the agenda of the EU building and HVAC sector. This topic has been discussed and studied extensively during the conference. Especially approaching nZEB in terms of Mediterranean climate, Mediterranean traditions and finance was the focus point.

We certainly can achieve the nZEB target for new buildings as we achieved the building performance evolution of the last 12 years in Europe. Boundary conditions definition of the global performance evaluation needs still some work and common consensus. But the move towards nZEBs is going to be a major shift, almost a revolution, requiring many changes even to the life of professionals. Buildings of the future shall be quite different from what we are used to design and use today

The general concept of nearly zero energy building was illustrated, introducing the basic concept of “nZEB”: low energy demand, high energy efficiency of the system, energy demand cover by RES produced in situ or nearby.

The definition should be clarified first of all. It was highlighted that the indicator to classify the energy performance of an nZEB is expressed in term of primary energy. The boundary where to consider the primary energy indicators has to be clearly accepted by all the countries – a discussion is ongoing at CEN level about the new standard to be adopted. Moreover, a big challenge is how to traduce the “primary energy indicator” in a comprehensible indicator for the market: this issue is at this stage too much academic and it is important to translate this concept to the policy makers, investors and final users.

The other ambiguity is related to renewable energy production on-site or nearby. The definition of nearby is not clear enough. Actually the nZEB concept can be achieved more successfully by designing group of buildings, districts, cities instead of individual buildings. A successful nZEB design ensures a good architectural and urban integration.

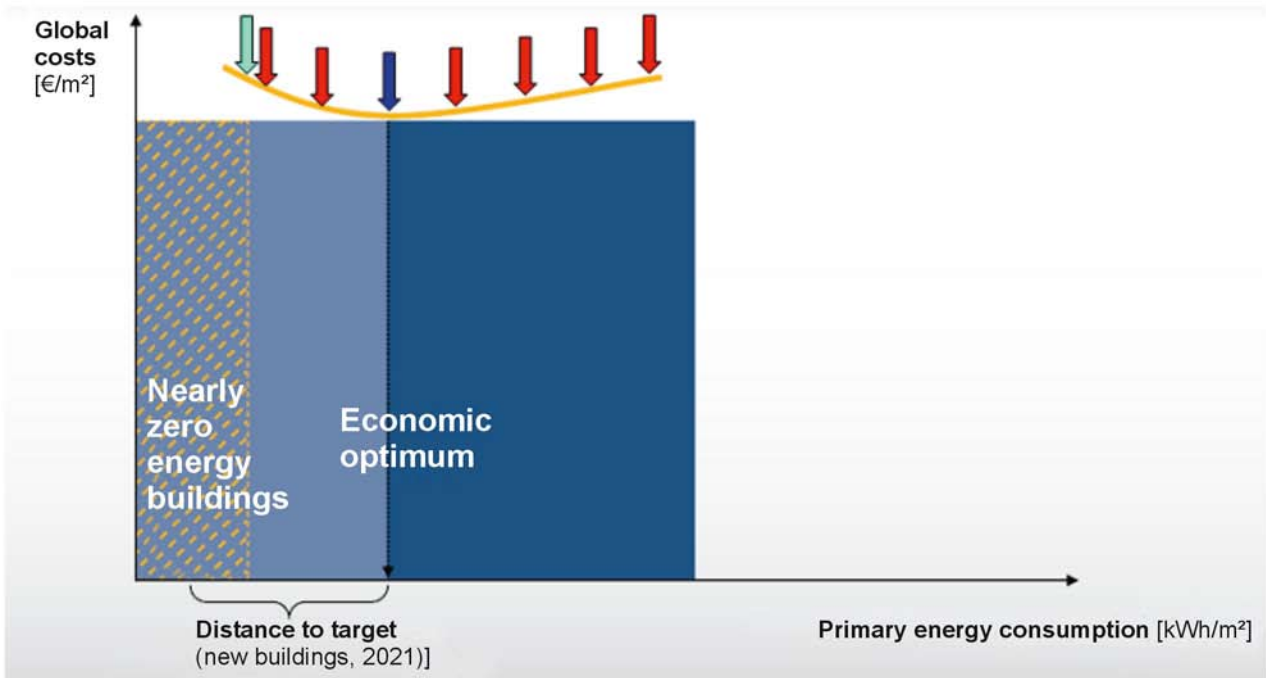


Figure 1. Nearly zero energy buildings may not be cost optimal with current technology and construction practice.

The major challenge is still applying nZEB approach/concept to present building stock. It is expressed as nZERB (nearly zero energy retrofitted buildings). We need to develop this nZERB concept. Urban transformation processes going on especially in developing countries for example in Turkey can be used effectively transforming present building stock.

All these measures should take into account economical/financial aspects using a cost optimal approach (Figure 1). The cost optimality has always to be considered when defining the targets of nZEB and cost optimal solutions cannot be achieved without integrated design.

Embedded or embodied energy in the building itself and in its HVAC systems (including renewable energy generation) is very important. Without considering embodied energy satisfactory evaluation of measures cannot be done.

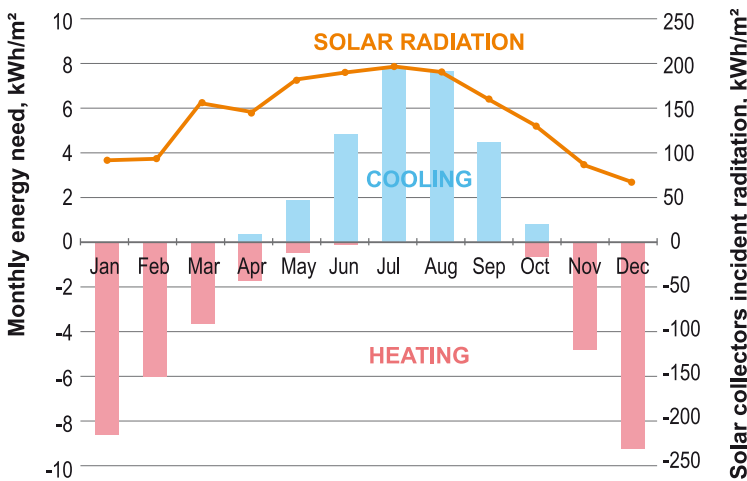


Figure 2. Typical Office Building Energy Need over a Year in Mediterranean Climate.

There is yet a clear lack of consensus on what a nZEB should be in the warmer south European climates, where summer cooling plays a fundamental role (Figure 2):

- Adequate but not too much insulation;
- Inertia activation;
- Shading;
- Role of natural and mechanical ventilation

This is a challenge at design stage. It is evident that a common and unique vision about “what a nZEB is” has yet to be found for the Med region.

The situation in different Mediterranean countries has been analyzed:

In France, the process, started with the energy certification RT2012, aimed at increasing the energy performance of buildings is going on towards nearly zero energy buildings (Figure 3). The new indications of the protocols are addressed firstly to optimize the building envelope and to control the air permeability of buildings. Moreover, the energy classification is now referred to absolute values instead of to the comparison with reference building. New voluntary labels have been set up in order to promote buildings even more efficient than the new regulation; in particular “BEPOS effinergie” is aimed to promote the design and construction of high performing buildings towards positive energy buildings.

In Italy, the transposition of the EPBD recast has been done in June 2013 by a national law. Now the national law has to be converted into regional laws. The process will require time. By now, only a couple of regions have activated tables to implement the nZEB concept. Critical aspects for these implementations have been highlighted. First, to avoid a “copy and paste” tendency that is to transfer the experiences from Germany and the Scandinavian countries without a critical investigation: in Mediterranean climate, super-insulation is not required, thermal mass activation is needed, mechanical ventilation is not always economically convenient, punctual control of solar radiation along the year is absolutely required.

Also in Portugal, the process of implementing the nZEB concept has to be yet fully developed. There is a definition and a concept, but no values yet. It is highlighted that a major goal is to handle retrofitted buildings: how to plan a deep renovation of the existing building stock toward nearly zero energy building while keeping the costs under control. An open discussion is related to ventilation: natural or mechanical? The national tradition is for natural ventilation: in fact, in the Mediterranean areas, the temperature differences between outdoors and indoors is quite low also in the extreme season. The energy production by RES is also discussed: the use of RES produced “nearby” is considered as locally produced by the Portuguese interpretation, in RES installations specifically linked to a building or a group of buildings.

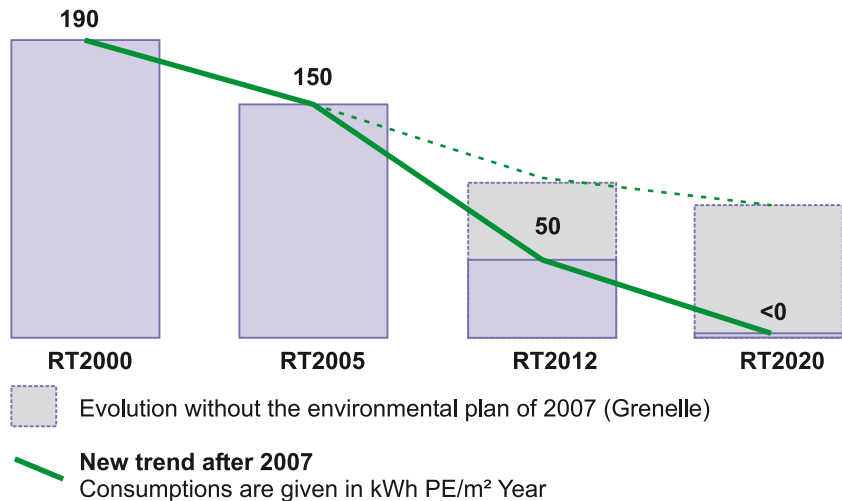


Figure 3. Evolution of the limit for primary energy consumption in French building regulations.

In Spain, the new concepts about nZEB have been transposed in a law in September 2013. The process is considered as a natural evolution of the energy certification, using the same tools and approach. Basically, the requirements about the building energy performances have been incremented (for example, lower thermal transmittance are required) in order to create a process towards nZEB.

Turkey is stating an ambitious program to follow the EU indications. The first step is the definition of reference buildings for the residential sector, and the application of packages of retrofit measures for cost optimality investigations.

Indoor air quality and nZEB

Human being is in the focal point of the whole air conditioning activities. We air condition the buildings for occupant’s comfort and health, we need to give a comfortable and reliable environment to occupants. Productivity is the primary criteria designing some type of buildings, such as office buildings or educational facilities. It is necessary to satisfy the occupant’s requirements in nZEB. The design should consider the IAQ requirements.

The other very important issue is the occupant behaviour on energy consumption. **Occupant behaviour can impact the energy consumption with a factor 3–6.** Often main reason why predicted energy use does not match measured energy use is the occupant behaviour. Assumptions regarding occupant behaviour are used as input parameters to energy calculation. Suitable models for occupant behaviour are required for a better prediction of energy consumptions of buildings.

Findings of a presented study demonstrated that predefined heating set-point preferences and air change rates used as assumption in building energy simulation are far away from actual occupant's preferences in buildings. Results of the study highlight significant influences of occupant behavior on the building energy demands. Energy consumption in the simulated high performing building in which occupants personal control is performed by probabilistic functions, raised up to 36% in comparison to the high performing building where the occupants' interaction with the controls is regulated in a deterministic way by fixed schedules.

Revision of Indoor Environmental Quality Standard EN15251, need to be complying with nZEB concept. Standard EN15251 brings new approaches. Instead of absolute values, categories and ranges are defined. Moreover, adaptive comfort approach is introduced.

Table 1. The recommended criteria are given for several categories (EN 15251:2007).

Category	Explanation
I	High level of expectation and is recommended for spaces occupied by very sensitive and fragile persons with special requirements like handicapped, sick, very young children and elderly persons
II	Normal level of expectation and should be used for new buildings and renovations
III	An acceptable, moderate level of expectation and may be used for existing buildings
IV	A level that may cause some discomfort; but no health risk.
V	Outside categories. This should only be accepted for a limited part of the year

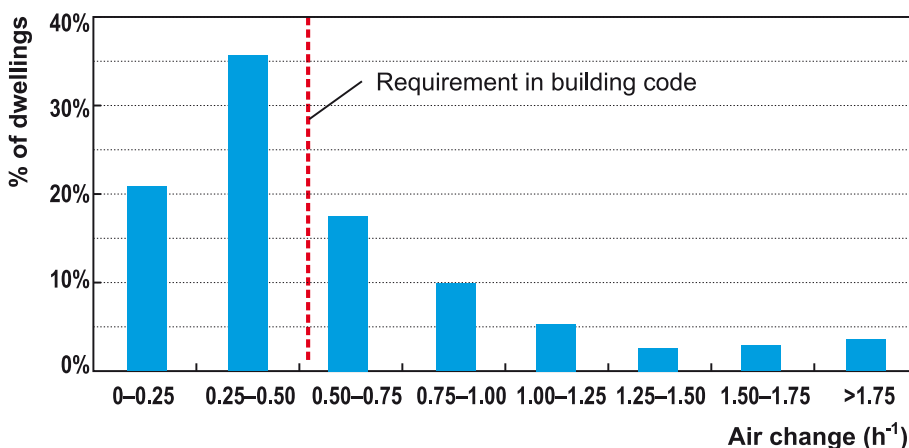


Figure 4. Air change has been measured in 500 Danish homes. In more than half of the homes ventilation was below the requirements in building code.

This European Standard specifies the indoor environmental parameters which have an impact on the energy performance of buildings.

- Set points are effective both on energy consumption, comfort and productivity.
- CO₂ sensors can effectively be used in ventilation applications, especially in demand controlled ventilation applications.
- Ventilation rates are specified for different categories and applications.
- Ventilation rates should consider both people and building (Figure 4)
- Air cleaners and ventilation can be combined.
- Occupant behavior should be considered.

Renewable Energy and nZEB

Future developments in the HVAC sector seem toward the renewable supported mixed systems. For such systems energy efficiency will be expected to reach 150%.

Photovoltaic solar power production seems most promising renewable electricity production system. There are many studies continuing on photovoltaic alone or hermetic systems. Simultaneous power and thermal energy producing special vertical sandwiching option of a PHVT module yields higher specific power outputs.

Photovoltaic panels can be used to power the compressor of an inverter air conditioning unit. This hybrid air conditioning unit simultaneously connected to grid and to photovoltaic panels. This option is especially suitable for small installations.

Variable Refrigerant Flow systems bring opportunities to reducing CO₂ emissions for hot water heating systems. Air to water VRF heat pump systems are considered as renewable heat generators and their thermal efficiency values are much higher than the conventional gas firing boilers. New generation VRF systems can work efficiently even in cold winter conditions. Combining VRF with the photovoltaic panels it was proved that net Zero Energy Building target can be achieved. This was shown by the measured data of a case study in Germany. ■