European Council
of
Civil Engineers

“nZEB”
nearly Zero Energy Buildings

Implementation into praxis in EU

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EPBD Requirements

- The recast of the Energy Performance of Buildings Directive (EPBD), 2010/31/EU, introduced in Article 9, “nearly Zero-Energy Buildings” (nZEB) as a future requirement
- ➢ to be implemented
  - ➢ from 2019 onwards for public buildings and
  - ➢ from 2021 onwards for all new buildings.
- ➢ These requirements are valid also for minor renovations

Definition of the nZEB

In EPBD:

1. A nearly zero energy building is a “building that has a very high energy performance”.
2. The energy required should to a very significant extent be covered by energy from renewable sources, including renewable energy produced on-site or nearby.

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Detailed definitions of nZEB

- The definitions of Zero-Energy Buildings shall be nationally defined latest in June 2012 The definitions of Zero-Energy Buildings shall be nationally defined latest in June 2012.
- In Europe there is a large variety of concepts and voluntary standards for highly energy efficient buildings :
  - Passive house, Minergie,
  - 3-litre, plus energy, effinergie, zero energy, etc
- In addition, these definitions refer to different spheres:
  - site energy, source energy, cost or emissions.
  - depending on whether new or existing, residential or non-residential buildings are under consideration.
- The adequate means and techniques differ greatly.

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Technical concepts of nZEB

Typically, low-energy buildings will encompass

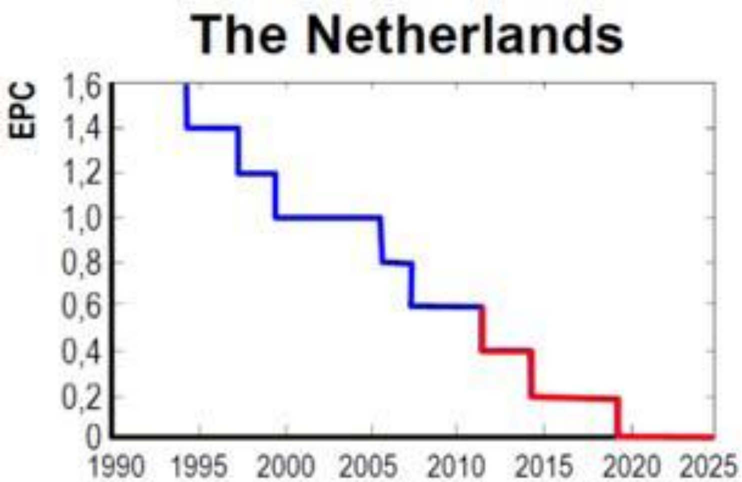
- a high level of insulation
- very energy efficient windows
- a high level of air tightness and
- mechanical ventilation with very efficient heat recovery
- architectural means and shadings to reduce cooling needs.

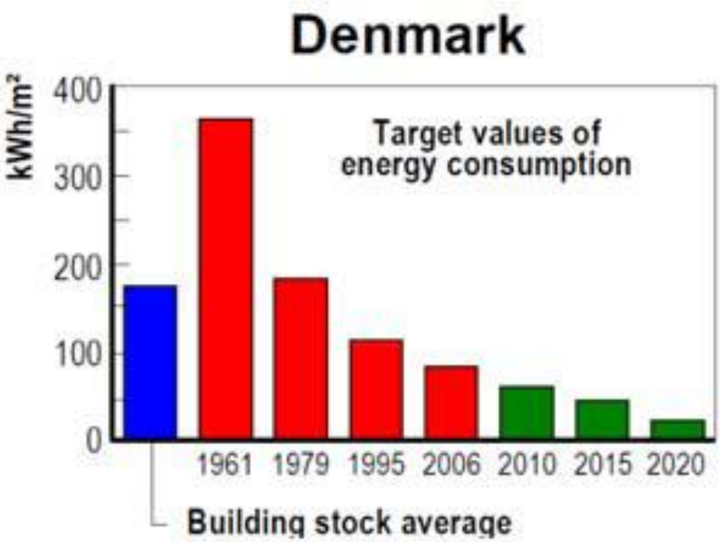
Current state of nZEB standards

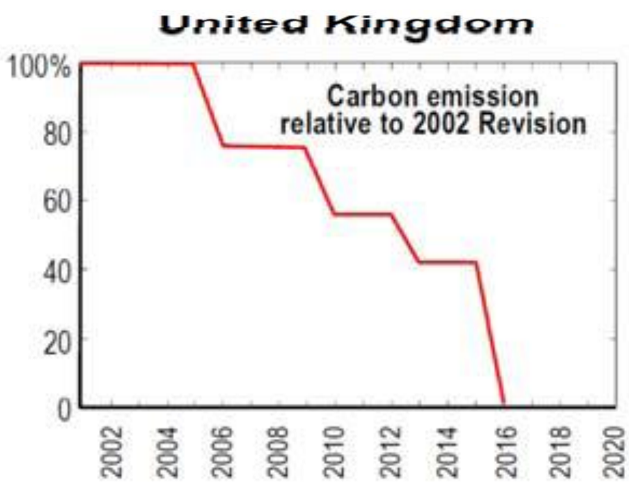
- Today, more than half of the Member States do not have an official definition for nZEB.

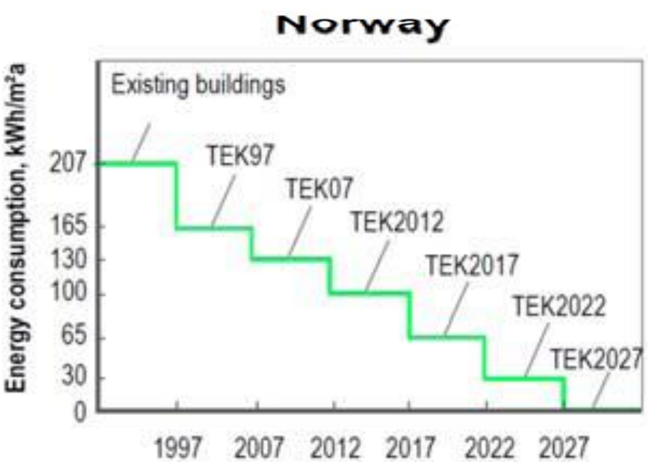
- Various Member States have already set up long-term strategies and targets for achieving nZEB standards for new houses.

Roadmap of some countries towards nearly zero energy buildings

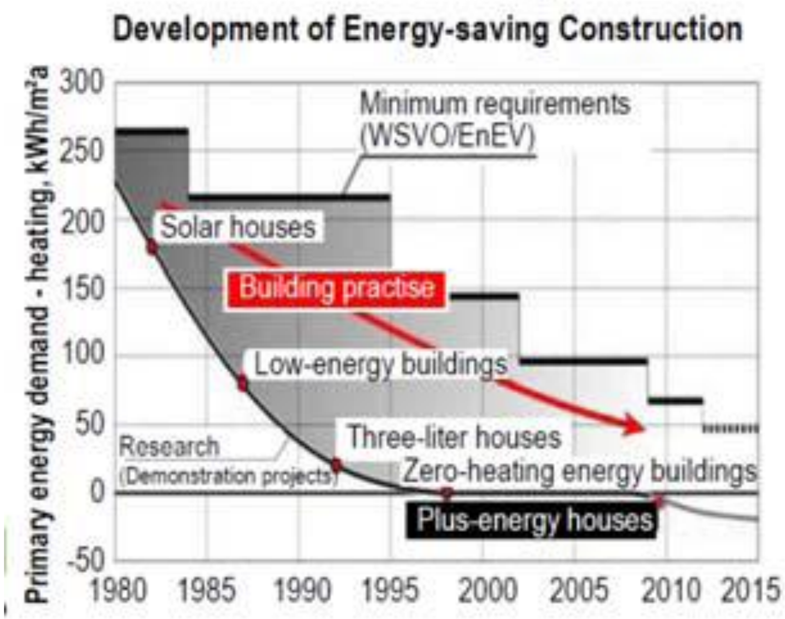




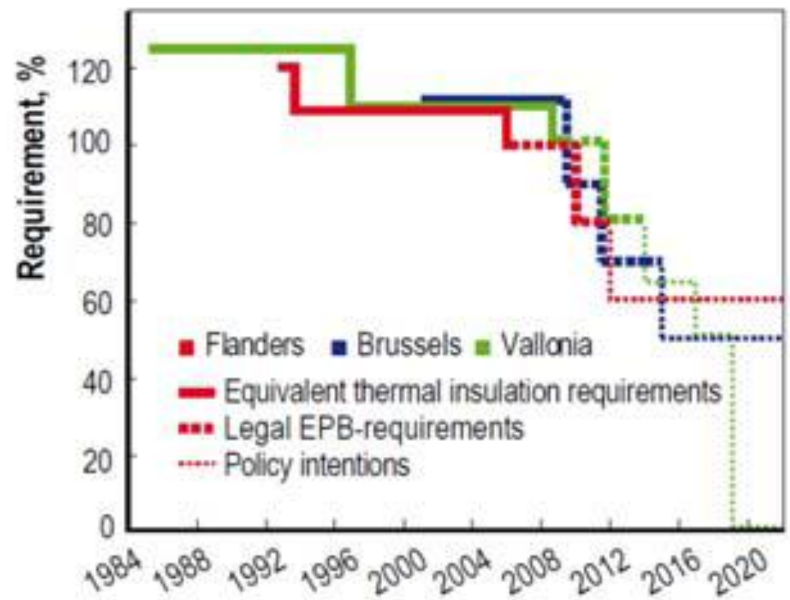




Germany



Belgium



Energy delivery of nZEB

- The minimum share of renewables to cover the remaining nearly zero or very low energy demand of the nZEB
  - in order to be consistent with EU energy and climate targets
- might be chosen in the range of 50%-90%

Renewable and CO2-free energy

- Most common types of local renewable energy sources are:
  - Geothermal energy: Earth heat pumps
  - Air heat energy: air heat pumps and exhaust air heat pumps
  - Solar energy: Solar panels and electric solar cells
  - Wind energy
- The selection in each case is depending on the geografic location (North, Central, South) and on the lifetime economy of the heating system

- The recast EPBD stipulates that the EU Member **States** shall ensure **minimum energy performance requirements** for buildings to be set ‘with a view to achieving **cost-optimal levels**.
- the **Commission** is to provide the comparative framework **cost-optimal methodology**,
- each EU Member State has to do the **calculations at country level**,
    - to compare the results with its energy performance requirements in force and
    - to improve those requirements accordingly if necessary.

Cots Optimal Level / nZEB

- ❖ Today we assume that, on the one hand, there may still be a gap to be bridged between cost-optimal levels and nZEB levels by 2021,
  - at least in some EU Member States.
- ➢ On the other hand, in several Member States it is also possible to reach convergence between cost-optimal and nZEB levels by 2021, mainly due
- ❖ to the estimated increase in energy prices and expected decrease in technology costs.

Three principles of the nZEB

First nZEB Principle: Energy demand	Second nZEB Principle: Renewable energy share	Third nZEB Principle: Primary energy and CO_2 emissions
There should be a clearly defined boundary in the energy flow related to the operation of the building that defines the energy quality of the energy demand with clear guidance on how to assess corresponding values.	There should be a clearly defined boundary in the energy flow related to the operation of the building where the share of renewable energy is calculated or measured with clear guidance on how to assess this share.	There should be a clearly defined boundary in the energy flow related to the operation of the building where the overarching primary energy demand and CO_2 emissions are calculated with clear guidance on how to assess these values.
Implementation approach: This boundary should be the energy need of the building, i.e. the sum of useful heat, cold and electricity needed for space cooling, space heating, domestic hot water and lighting (the latter only for non-residential buildings). It should also include the distribution and storage losses within the building. **Addendum:** The electricity (energy) consumption of appliances (plug load) and of the other building technical systems (i.e. lifts, fire security lighting etc.) may also be included in the nZEB definition as an additional indicative fixed value (similar to the approach on domestic hot water demand in most of the MSs building regulations).	**Implementation approach:** This could be the sum of energy needs and system losses, i.e. the total energy delivered into the building from active supply systems incl. auxiliary energy for pumps, fans etc. The eligible share of renewable energy is all energy produced from renewable sources on site (including the renewable share of heat pumps), nearby and offsite being delivered to the building. Double counting must be avoided.	**Implementation approach:** This is the primary energy demand and CO_2 emissions related to the total energy delivered into the building from active supply systems. If more renewable energy should be produced than energy used during a balance period, clear national rules should be available on how to account for the net export.

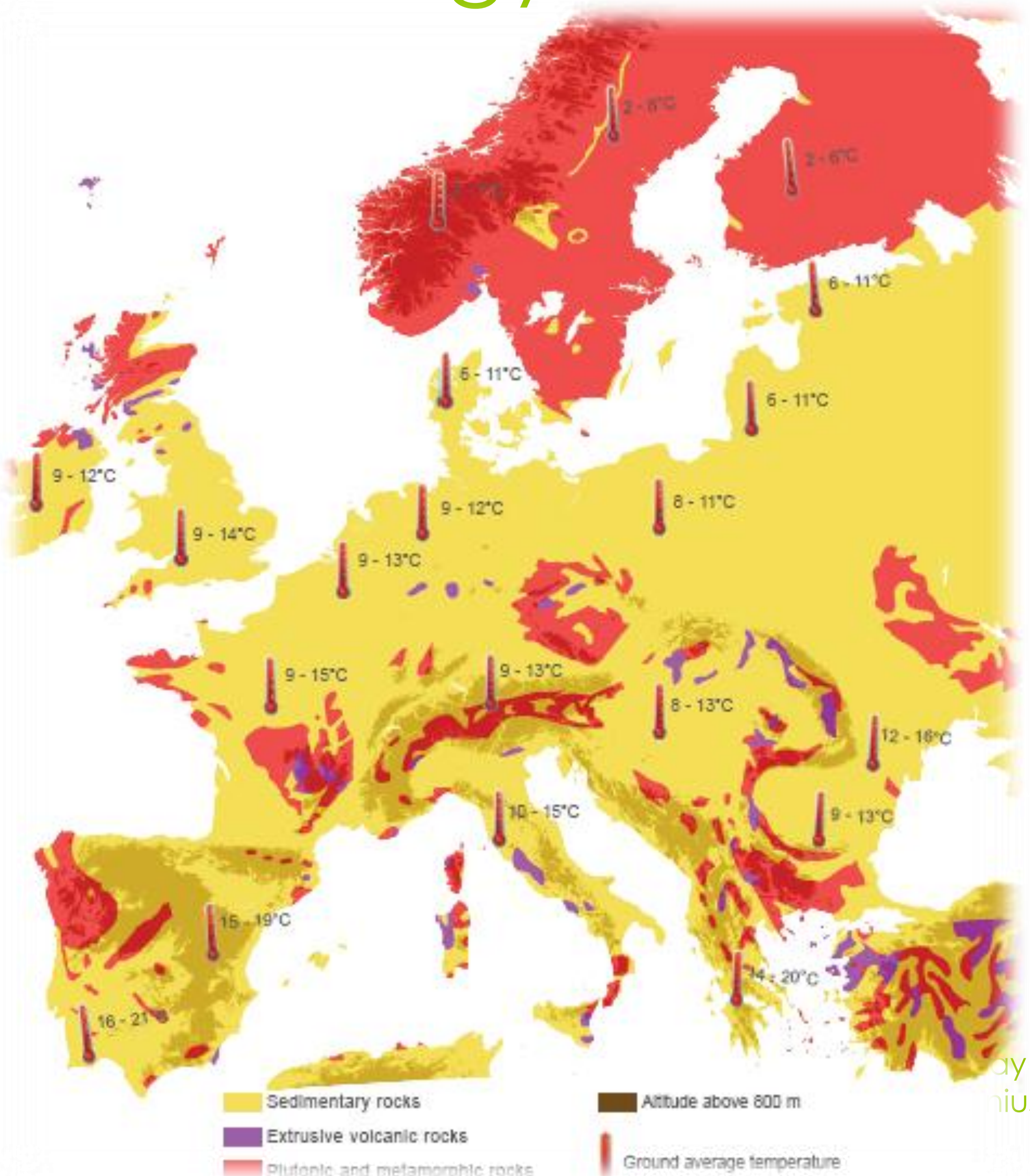
COMPARATIVE INTERPRETATION OF THE RESULTS

The simulation analysed the impact of all the above-mentioned options within the buildings' energy balance, relative to the thresholds assigned by the proposed nZEB principles and aligned to the EPBD requirements. The general findings of simulating the application of the proposed nZEB principles may be summarised as follows:

Impact of different options	
Renewable energy share between 50% and 90%	**CO_2 emissions below 3 $kgCO_2/m^2yr$**
Fossil fired solutions are already struggling to achieve a renewable share of 50%. The fossil fired systems are not an option in the case of including the energy consumption of appliances in the energy demand and imposing a requirement for a very high share of renewables (90%). A 90% renewable share may be reached by using additional off-site green electricity or, only in regions with very good solar irradiation, by installing additional on-site renewables. District heating impact depends largely on its renewable share; a 50% renewable DH system is not enough in some locations. In single family buildings, heat pump solutions easily achieve a 50% renewable share. By using additional off-site green electricity or on-site renewables, the heat pump option can secure even a 100% renewable energy share. In office buildings, biomass and heat pump solutions reach a 50% share of renewables.	For the single family building, at the basic variants (excluding appliances, green electricity and PV) all fossil fired solutions (gas boiler, micro CHP and district heating with a small renewable share) generally are clearly above the limit of 3 $kgCO_2/(m^2yr)$. Heat pump solutions come close and bio solutions (biomass boiler, bio micro CHP) clearly stay below the threshold. For office buildings, only the biomass micro CHP is below the threshold. Using green off-site electricity significantly decreases CO_2 emissions. For the single family building, the fossil fired solutions generally fail to meet the target (with or without the consideration of appliances), except at locations with very little heating and hot-water demand (in warm climate zones). In office buildings, because of the relatively high share of electricity all related variants stay below the threshold. The consideration of the electricity demand for the appliances and office equipment does not generally change this result.
For single family homes with high heat consumption, it is possible to achieve a 90% share of renewables only by using a 100% heat supply from biomass fired systems (boiler, CHP). Office buildings have a higher relative share of electricity than residential buildings. Therefore green electricity is required by all considered options (expect the fossil fuels options) in order to reach a 90% share, usually even including office equipment (appliances). Due to space restrictions, additional PV systems are less effective than in the case of the single family building.	For the single family building, additional on-site renewables (i.e. PV in this simulation) improve the situation. The fossil solutions are still above the threshold even with the considered additional PV system (which is however quite small, but enough to reach a high renewable energy share). For office buildings, additional on-site renewables (such as the 2 kW_p PV system) is much less effective. The CO_2 threshold is fulfilled only without appliances and assuming additional on-site PV power. Fossil fuel options in moderate and cold climate zone cannot fulfil the condition even with additional on-site PV power.

Asko Sarja - ECCE Meeting, May 25th, 2012, Vilnius, Lithuania

Geothermal energy



http://ec.europa.eu/energy/intelligent/index_en.html