

# The Path towards 2020: Nearly Zero-Energy Buildings



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## Introduction

The recast of the Energy Performance of Buildings Directive, in Article 9, requires Member States to ensure that by 31 December 2020, all new buildings are nearly zero-energy buildings (NZEB) and after 31 December 2018, new buildings occupied and owned by public authorities are nearly zero-energy buildings. Member States shall draw up national plans for increasing the number of nearly zero-energy buildings and shall develop policies and take measures to stimulate the transformation of buildings that are refurbished into nearly zero-energy buildings.

Article 2 of the EPBD defines a nearly zero-energy building to be a building with a very high energy performance. The nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources produced on-site or nearby.

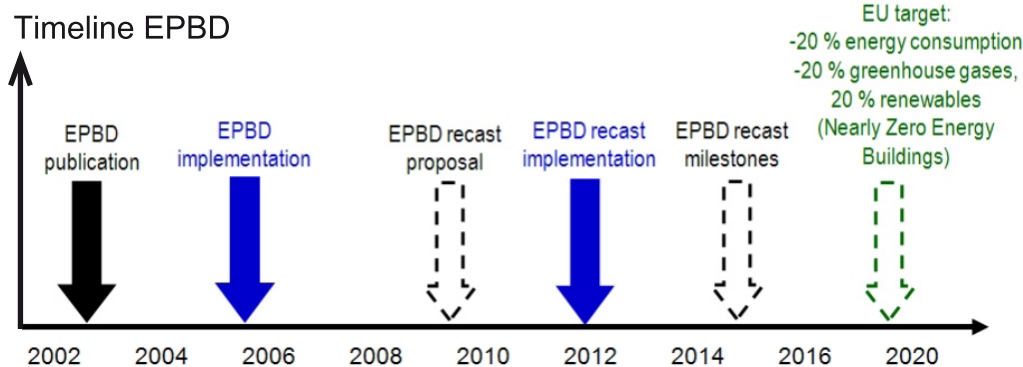
The Member States are responsible for the practical application of the definition stated in Article 2 and have to document this in their national plans.

The Concerted Action EPBD offers all EU Member States a platform for the exchange and discussion of national approaches, as well as of the challenges the countries face at defining the national application. Also policies and incentives to increase the number of NZEBs and ways to transform existing buildings into NZEBs are analysed in terms of their potential impact.

## The continuous path towards higher performance of buildings

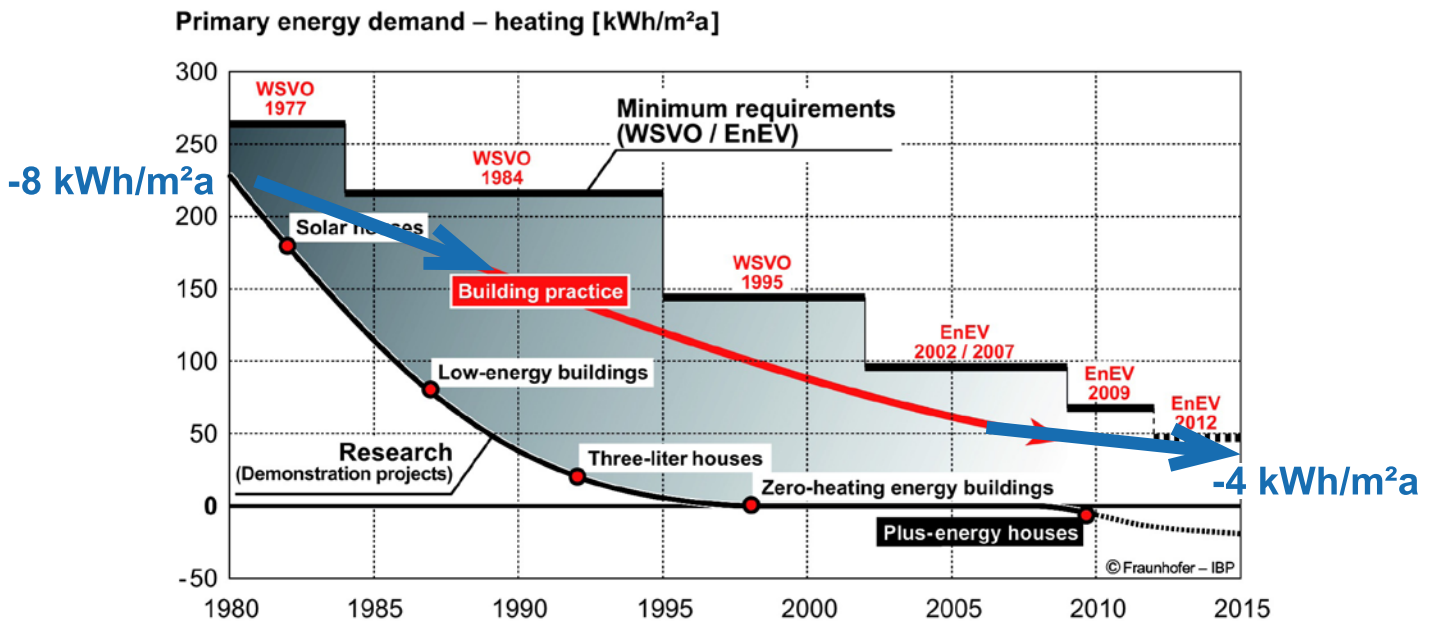
In most European countries, energy performance requirements for buildings have been imposed for more than 30 years. Often pilot building projects with ambitious energy goals have been designed, realised and evaluated successfully. The same energy performance levels have then been transferred to the building practice by top runners of the building industry and several years later an important range of builders have chosen this level as their standard energy performance level for buildings. This enabled some years later the governments to tighten the general minimum energy performance requirements to the same level. **Figure 2** shows the development of the energy performance of buildings in Germany, as a typical example of the policies adopted by many EU countries.

Meanwhile plus-energy-houses have been constructed as pilots and are currently realised by top runners in the building market. All along, innovations have been developed that allow reducing the energy demand continuously. At the



**Figure 1.** Timeline of the Energy Performance of Buildings Directive and its implementation.

# Development of Energy-saving Construction



**Figure 2.** The development of the energy-saving construction in Germany showing the minimum energy performance requirements (upper line), the high performance pilot projects (lower line) and the innovative building practice (middle line) over the last 35 years.

beginning of the process, the cost-efficient potential of energy savings per year that could be explored was significantly higher than today. In the early seventies, the mean reduction potential by new and innovative developments was approximately 8 kWh/m<sup>2</sup>a every year. In the last few years, the impact reduced to approximately 4 kWh/m<sup>2</sup>a, but there is still a significant energy saving potential available. Based on this trend, it can be estimated that the energy demand will be reduced by half in 2020 solely through the forward projection of the impact of the innovations in the building sector. Additionally, it can be predicted that the energy supply will be steadily transferred from fossil to renewable energy carriers over the next years. Thus we can expect that the primary energy factor values will be significantly decreased until 2020. Electricity will most probably be reduced to a value lower than 2 kWhP/kWhD, but the values of the other energy carriers, such as gas and oil, will also be clearly lower based on the addition of bio fuels. This trend will result in a reduction of the primary energy demand of about 1/3 by 2020. The accumulation of both developments will most probably lead to a primary energy demand of new buildings of less than 40 % of today's energy requirements. This can be forecasted as benchmark for the NZEB development.

## Status of the national applications of the nearly zero-energy building definition

One of the first actions of the Concerted Action EPBD was to get an overview on the current national applications of the NZEB definition. It turned out that only very few countries have already established a national definition. Most countries are currently still performing studies on how the definition should look like. **Figure 3** presents an overview on the status of the national applications of the definition of NZEBs.

Only two countries have a national application ready and officially approved. One additional country has the application defined. Two countries have a study on the national application completed while 10 countries are still working on such a study. Eight countries will start with the work later on. This is also the most likely situation for the countries who did not participate in the survey. That means that only 13 % of the Member States are sure how they define the NZEB. Less than half of the countries are currently working on the definition and about a half of the countries will start working on this definition during 2012 or later. Many countries only intend to address this issue after performing the cost-optimal study that is also required by the EPBD recast and is now only due in early 2013.

Several national approaches to the NZEB application have been presented at the Concerted Action and it is self-evident that the applications will be quite different from country to country. They vary from zero carbon to explicit maximum primary energy values. Besides the primary energy indicator required by the new EPBD, many countries also intend to include a list of additional indicators, dealing with the building envelope and also with the building service system efficiency as well as the generated renewable energy. A step-by-step approach in form of a roadmap towards the 2020 goals (NZEB) is planned in most countries.

## Example of a national application of the NZEB definition: Denmark

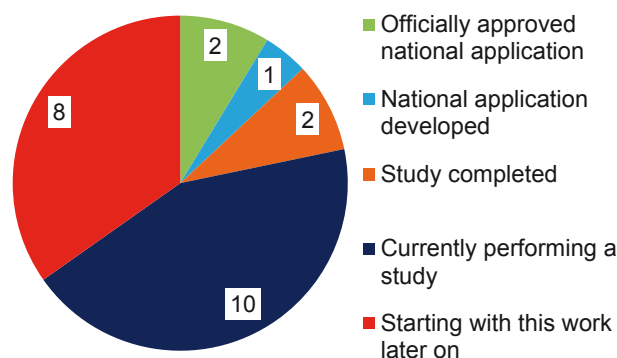
Denmark is one of the two countries that have already set-up their national application of the NZEB definition. The minimum energy performance requirements for buildings are defined by so-called energy frames. The energy frames for new buildings are fixed for 2010, 2015 and 2020. They are different for residential buildings (including other non-residential buildings with similar types of use, like hotels) and non-residential buildings. For buildings with a special use requiring, for example, high ventilation rates, there are additions to the allowed energy frames. The energy frame limits the delivered energy and includes the energy use for heating, ventilation, cooling, domestic hot water and the necessary electricity for operating the building. In the case of non-residential buildings, it also includes the lighting energy. Electricity use has to be multiplied by a conversion factor and excess temperatures are punished by an addition to the calculation.

Supplementary requirements exist for:

- Thermal losses in  $W/m^2$  dependent on the number of building storeys
- U-values, including an  $E_{ref}$ -value for windows depending on the total solar energy transmittance and the transmission coefficient
- Minimum boiler efficiency
- Pipe insulation
- Automatic control
- Low temperature heating

The tightening of the maximum primary energy demand is realised in practice by three influence factors:

- First, by building better insulated buildings with more energy efficient building service systems;
- second, and this will also be the case in most EU countries, the primary energy factor (called



**Figure 3.** Overview on the status of the development of the national application of the NZEB definition. 23 countries took part in the survey in December 2011.

conversion factor in Denmark) will drop for both, electricity and district heating. This is already predicted according to **Table 1** and will automatically decrease the primary energy demand of all buildings, existing and new, that use electricity and district heating. District heating is a quite commonly used energy source for buildings in Denmark.

- The last influence factor is the expectation that the use of renewable, on-site or nearby, will grow.

## NZEB topics to be further analysed

The country experts have already started to discuss about several major issues linked with the NZEB definition as written in the EPBD. Those include:

- Which energy aspects have to be taken or will be taken into account?
  - Cooling
  - Lighting
  - Household electricity (as a way to balance energy generated from renewables?)
- Renewable energy contribution:
  - What is precisely on-site and nearby? How “nearby” is “nearby”?
  - What about biomass (grown somewhere else)?
  - What is “a very significant part”?
  - Should there be limits for the benefits of renewable energy taken into account, e.g., only up to the amount of self-used energy? If so, how to balance that: on a yearly, on a monthly, or on a hourly basis?
  - What about the electricity fed into the grid?

**Table 1.** Comparison of an extract of the energy performance requirements set in the Danish energy frames for 2010, 2015 and 2020.

Characteristic values		Energy frame 2010	Energy frame 2015	Energy frame 2020
Maximum of delivered energy to	Residential buildings (houses, hotels, etc.)	52.5 + 1650/A in kWh/m <sup>2</sup> a	30 + 1000/A in kWh/m <sup>2</sup> a	20 kWh/m <sup>2</sup> a
	Non-residential buildings (offices, schools, institutions and other buildings)	71.3 + 1650/A in kWh/m <sup>2</sup> a	41 + 1000/A in kWh/m <sup>2</sup> a	25 kWh/m <sup>2</sup> a
Conversion factors	Electricity	2.5	2.5	1.8
	District heating	1.0	0.8	0.6

where A is the heated gross floor area

- How to make sure that renewable energy is not balanced twice (at the building and at the local or national primary energy factor)?
- Which renewable energy sources can be calculated with national calculation standards, which ones are problematic or still missing?
- What is the comparison between the current national requirements and the national application of the NZEB definition?

The Concerted Action EPBD will work on a matrix that presents all national approaches in a structured way. At the meetings, the challenges listed above will be further analysed and discussed and a report shall be released on this topic when a significant number of countries have reached conclusions about their own national definitions of NZEBs. **3E**



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