

Towards nZEB – some examples of national requirements and roadmaps

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A recent benchmarking study on implementation on EPBD 2002 by REHVA (Seppänen & Goeders 2010) revealed a large variation in the energy performance regulations of the different countries. Not only the performance levels are different, but even the units, in which the performance is measured are different. Primary energy, delivered energy, various energy frames and even CO₂ emissions are used. Such differences in regulations have a significant effect on the building industry, and complicate manufacturing, sales, installation, construction and design of buildings in the common market area. The experience learned

from the actions taken by CEN from the year 2002 to help the implementation of EPBD showed that technical development work takes time. However, it can be seen that EPBD is establishing a common methodology, as majority of the countries already use or are moving to use primary energy in the definition of energy performance in [kWh/m²,a]. Many countries have prepared long term roadmaps with detailed targets, **Figure 1**. Such roadmaps help the industry to be prepared and committed to the targets. For example, in Norway, zero energy buildings are expected in 2027, but in UK carbon neutral buildings already in 2017.

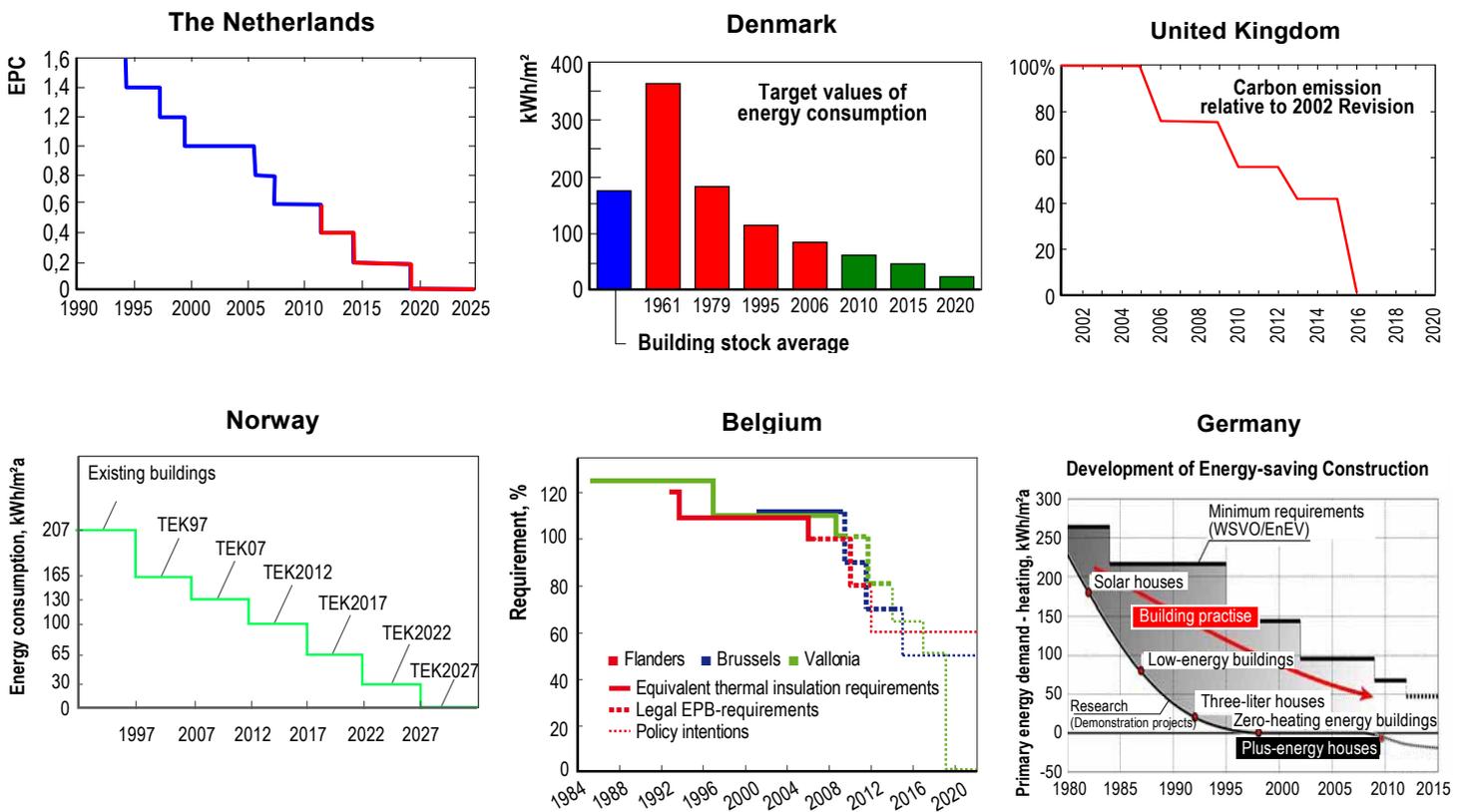


Figure 1. Roadmap of some countries towards nearly zero energy buildings to improve the energy performance of new buildings.

Summary Table of Incentives		DE	IT	FR	Hu	BE	SE	
								
		YEAR	2009	2009	2009	2009	2009	
FINANCIAL	Direct Funding of Energy Repairs	Yes	Yes	Yes	Yes	Yes	Stopped	
	Financial Help for Low-Income Households	Yes	Yes	Yes	No	Yes	No	
	Green Loans / Soft Loans	Yes	Yes	Yes	Yes	Yes	No	
	Third Party Financing	Yes	Yes	Yes	Yes	Yes	No	
TAXES	Tax Deduction	Stopped (2009)	Yes	Yes	No	Yes	Yes	
	Lower VAT on Labour and Materials	Stopping	Materials	Labour & Material	No	Labour	n.a.	
TECHNOLOGY SPECIFIC	Subsidies on Sustainable Energy Devices	Yes	Yes	Yes	Yes	Yes	Yes	
	Feed-in Tariffs	per kWh (€/kWh)	Yes	Yes	Yes	Yes	No	n.a.
		Green Certificates	No	Yes	Yes	Yes	Yes	n.a.
OTHERS	Rent Indexation (Owner-Renter Balance) ¹	n.a.	n.a.	n.a.	No	n.a.	No	

Figure 2. Available incentives in selected countries. Data shown in the figure was valid in 2009; changes are possible because incentive programs are typically revised with rather short intervals.

Most countries apply for major renovations both code requirements, which will become mandatory for all countries according to the recast of EPBD, as well as comprehensive incentive packages. This shows that improvement of existing building stock is taken seriously, **Figure 2**.

At the moment there are no official definitions of nearly nZEBs available, but the work with the national plans for nZEBs is ongoing and few results have been published. In the following the developments in the energy performance requirements in five Central European and Nordic countries are reported.

Denmark

In the Danish Building Code (BR10), a class 2015 is defined, which fulfils the future energy performance requirements in 2015.

The total primary energy use in the energy frame consists of heating, ventilation, cooling, domestic/service hot water, and lighting (except in residences). Tenants' or users' electricity is excluded. Heating (natural gas,

Table 1. Primary energy frames for new buildings in Denmark 2008, 2010 and 2015.

	Energy frame [kWh/(m ² a)]	Energy frame [kWh/(m ² a)]	Energy frame [kWh/(m ² a)]
Building Code	BR08	BR10	BR10 - Class 2015
Residential	70 + 2200/A	52,5 + 1650/A	30 + 1000/A
Non-residential	95 + 2200/A	71,3 + 1650/A	41 + 1000/A

oil or district heating) has a primary energy factor of 1, but a factor of 0.8 can be used for district heating for buildings fulfilling class 2015. Electricity has a primary energy factor of 2.5. The floor area, A, used is the gross floor area measured outside the external walls. As a small country, there is only one climate zone.

France

The new French regulation (RT2012) issued on October 26th 2010, addresses low energy buildings targets for residential buildings, office buildings, school buildings, kinder gardens etc.

The total primary energy consumption is defined for heating, cooling, hot water production, lighting, ventilation and any auxiliary systems used for these domains. It is given by an overall coefficient C_{ep} kWh/(m² a) using the net floor area of the building defined by the French building code.

The target maximum value of C_{ep} , C_{epmax} is fixed to 50 kWh/(m² a) with various correction coefficients depending on the climatic zone, the altitude, the total area of the building and the type of energy used.

Furthermore, in order to ensure a good quality of the design of the envelope, another constraint is added. A new parameter B_{bio} is added in order to check the “bioclimatic” quality of the design. This B_{bio} parameter measures the energy need of the building for heating, cooling and lighting for a whole year. It has no dimension and is evaluated by a certain number of points. It has to be lower to B_{bio} max defined in the new regulation as a function of the location, altitude, type of building etc.

Finally, the air tightness of the building is also imposed to a maximum value depending of the building type, and in summer, a limit for indoor summer temperature has to be checked if no cooling is used.

Germany

The current requirements (EnEV2009) for new residential buildings are calculated depending to a so called reference building. For the reference building there are standard U-values for the bottom floor, walls, windows and the roof and standard installation engineering given in the EnEV. The energy demand for residential buildings could be calculated with two different standards. On the one hand with DIN V 18599, on the other hand with a combination of DIN V 4108-6 : 2003-06 and DIN V 4701-10 : 2003-08. The primary energy demand of the new building must be below or equal to the energy demand of the reference building. Also a limit value for the specific transmission heat loss must be reached. A weighting factor for electricity consumption of 2.7 is being used.

Official definitions concerning the public subsidies for (residential) Low Energy Buildings are subject of the

programs run by the (state-owned) Kreditanstalt für Wiederaufbau Frankfurt (KfW). These programs are mainly fed by public sources. The current requirements are KfW 70, KfW 55 and KfW 40. The primary energy demand of these buildings has to be 70%, 55% and 40% of the reference building. In addition, there is also a subsidy program for “Passiv-Häuser”, which is defined in accordance with the Passiv-Haus-Institute as “KfW-40-buildings with an annual heat demand lower than 15 kWh/m²”. This figure can’t be directly compared with the low energy classes from the other countries as passive houses only have requirement to energy for heating combined with a requirement to the overall use of primary energy to be maximal 120 kWh/m² including energy for appliances.

Next step of enforced requirements in 2012 will be another 30% reduction for both residential and non-residential buildings. In 2020 new buildings shall be “climate friendly” with less primary energy demand.

Norway

A Low Energy Commission delivered a number of suggestions for increased energy efficiency of all sectors in Norway in the summer of 2009. The thick report also included suggestions of future net energy frame values for new buildings as well as for major renovations. The Norwegian Building Code, TEK is proposed to be sharpened every fifth year. TEK 07 was published in 1 February 2007 and is fully enforced from 1 September 2009. This building code was the first in Norway with an energy performance approach. The net energy use in the energy frame consists of heating, ventilation, cooling, domestic/service hot water, as well as tenants’ or users’ electricity. The net energy includes cooling supplied to air-cooling coils or fan coils in the rooms.

Table 2. Proposed future net energy frames for new buildings in Norway.

Building Code	Energy frame [kWh/(m ² a)]				
	TEK07	TEK12	TEK17	TEK22	TEK27
Residential	130	100	65	30	0
Non-residential	155	110	70	40	0

The floor area used is the heated floor area measured inside the external walls. Norway has a number of climate zones. The values given below are valid for the “standard” climate zone around Oslo, which is in the south-eastern part of the country. The annual energy use of the proposed building is first modelled for the actual climate zone and then for the “standard” climate zone. The results for the standard climate zone must fulfill the energy frame. The current energy frames are specified for one-family houses, multi-family houses and eleven types of non-residential buildings.

Sweden

A report of the draft Swedish plan for nZEBs was delivered by the Swedish Energy Agency to the Ministry of Enterprise, Energy and Communications on 18 October 2010. The report wants to keep the energy performance values, expressed as delivered energy per heated floor area, since the property owner cannot control how the delivered energy is “produced”. Primary energy factors are typically policy based and may be changed over time and a future report is suggested to define Swedish primary energy factors. These are mainly proposed to be used for official purposes, such as reporting to the European Commission.

The proposed maximum values for annual delivered energy per heated floor area are goals for the year 2020. They are more or less half the values in the current Building Code from 1 February 2009. The report also contains values for major renovations in 2020. The first such values in Sweden will be found in the coming Building Code of 2011. The Building Code from 2006 was the first in Sweden with an energy performance approach.

Table 3. Proposed energy performance numbers for new buildings in Sweden in 2020.

Maximum energy performance [kWh/(m ² a)]	Climate Zone		
	Zone I North	Zone II Middle	Zone III South
Residential (non-electric heating)	75	65	55
Residential (electric heating)	50	40	30
Non-residential (non-electric heating)	70 to 105	60 to 90	50 to 75
Non-residential (electric heating)	50 to 75	40 to 60	30 to 45

The midterm goal for 2015 is that at least 25% of the floor area of all erected buildings in 2015 should fulfill the energy requirements for the year 2020. For new buildings owned or used by the state the requirements are for the year 2019 and the portion in 2015 that should fulfill them is at least 50%. The delivered energy in the energy performance value consists of heating, ventilation, cooling, and domestic/service hot water. Electricity for technical building systems is also included. Tenants’ or users’ electricity is excluded. Electricity to chillers in non-electrically heated buildings shall be multiplied with the factor 3 in order to make possible comparisons with district cooling. Electric heated buildings are defined as having an installed electric power for heating of at least 10 W/m². For non-residential buildings the energy performance value is depending on the average outdoor airflow rate during the heating season. The floor area used is the heated floor area (A_{temp}) measured inside the external walls. Sweden has three climate zones. About 80% of the population lives in southern climate zone and less than 10% lives in the northern climate zone.

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