European Council
of
Civil Engineers

Implementation of "Energy Efficient nZEB (nearly Zero Energy) Buildings into praxis in EU

General view on European implementation plan and examples

nearly Zero Energy Buildings nZEB 2020

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.

Steps of the requirements

Steps Towards nZEB:

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 December2018, **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.
- are responsible for the practical application of the definition stated in Article 2 and have to document this in their national plans.

Definition of the nZEB

- 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**.
- National detailed definions will be defined in the national plans

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

Example of a national application of the NZEB definition: Denmark

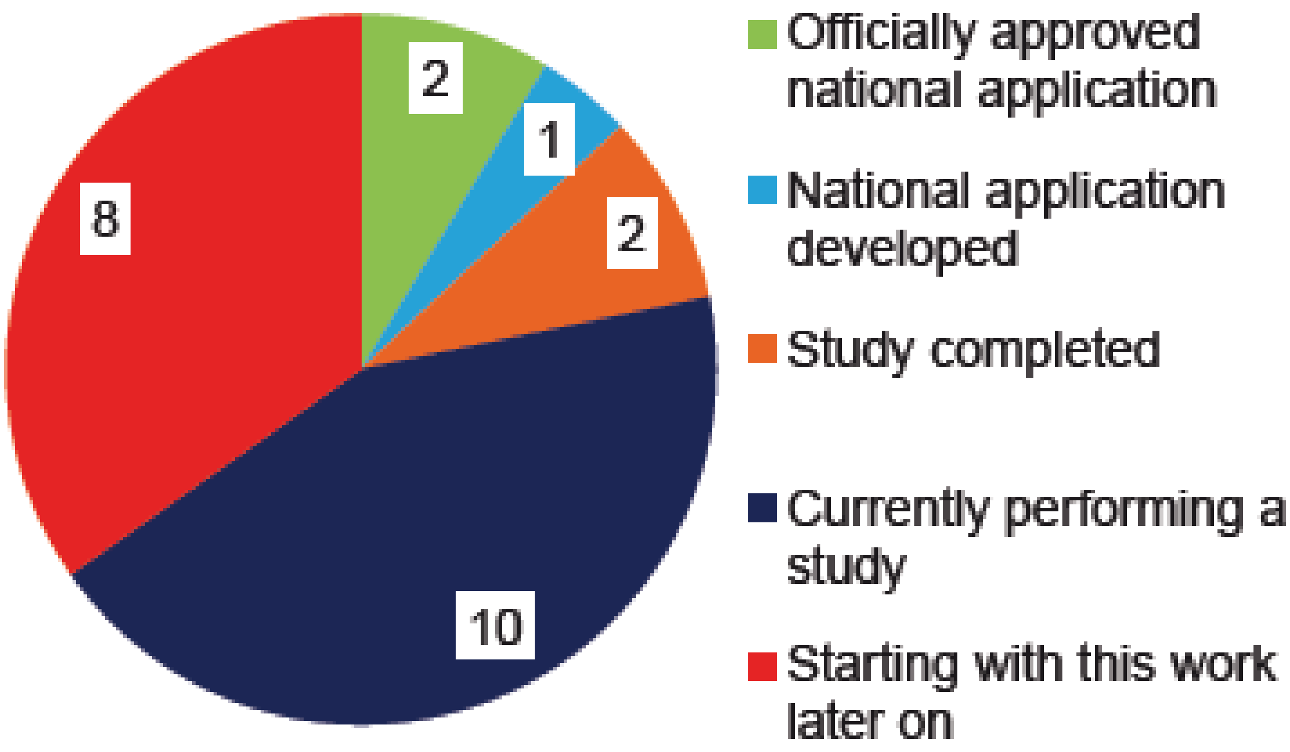
- Denmark is one of the two countries that have already set-up their national application of the NZEB definition.
- The minimum energy performance requirements for buildings are defined by so-called energy frames.
- The energy frames for new buildings are fixed for 2010, 2015
- and 2020.
  - They are 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.

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/m²a	30 + 1000/A in kWh/m²a	20 kWh/m²a
	Non-residential buildings (offices, schools, institutions and other buildings)	71.3 + 1650/A in kWh/m²a	41 + 1000/A in kWh/m²a	25 kWh/m²a
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

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.



Some latest examples of nZEB

http://www.buildup.eu/cases/

L'ESPOIR [060]:

A REFERENCE IN TERMS OF ECOLOGICAL COLLECTIVE HOUSING PROJECTS

COLLECTIVE HOUSING – A NEW BUILDING

15
kWh/m²year
Brussels average 150

U average: 0.262 W/m²K

Efficiency 84 %, n50: 0.6/h

Solar TH. (40 m²)

External sun shades, Night cooling

Bicycle parking, Public transport nearby

Climbing plants, Outside green areas

Extensive green roof (440 m²)

Rainwater tank (10 m³), Sound water use

Cellulose, wood PEFC (Scandinavian), Ecological finishing

Selective sorting during construction

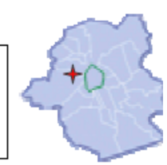
Use of healthy materials for inside finishing

Rue Fin 3-13, 1080 Molenbeek-Saint-Jean
Contracting authority: Fonds du Logement RBC
Architect: Damien Carnoy Architectes (Project manager: Dardenne David)
Design bureau: Damien Carnoy, MK Engineering, Luc Delvaux

In 2004, the non-profit-making association "Maison de quartier Bonnevie" developed a cooperation project with another association of the same type "Coordination et Initiatives pour et avec les Réfugiés et Etrangers" (CIRE) and the Brussels-Capital Regional Housing Fund. Its purpose was to enable 14 low-income, poorly housed families from Molenbeek to acquire a home at an extremely moderate building cost. The selected families united together in an association called "l'Espoir" – or "Hope" – under the patronage of the CIRE. The families met at three workshops, after which a programme emerged for the future designers (an energy-efficient building using materials with low environmental impact). The building sale took place within the framework of part II of the contract for the "Fonderie-Pierron" neighbourhood. The fund acquired the land as the developer-contracting authority and the mortgagee. The future homes were to be sold at cost-price to the members of the de facto association "l'Espoir".

IN FIGURES

Gross area	1,833 m²
Handover	End of 2009
Construction costs VAT/ grants excl.	1,150 €/m²
Exemplary building grant	100 €/m²



The description of this building is provisional as its construction has not yet been completed.

This is a case study of a SOLAR XXI very low energy building located in Lisbon, Portugal. The building was built in 2006 with the aim to reduce the energy use as much as possible.
The used technologies, which include partial natural ventilation, ground heat exchanger for supply ventilation air, solar shading, photovoltaic panels etc.
The building is expected to fulfill the future nearly zero energy building (nZEB) requirements.

|**General data**

The net zero energy building concept is comprised of the following key features with energy efficiency coming first:
•thermal optimization of the building envelope
•use of solar gains
•thermal building integrated photovoltaics (BIPV-T)
•window shading
•ground cooling system
•natural ventilation
•natural lighting

More information: Web URL(s) of the case | **http://www.rehva.eu/?download=_/532/case1---solar-xxi.pdf**

- Lessons learnt |The key to a very low energy building is: - good use of daylighting - natural ventilation strategy in combination with mechanical ventilation (hybrid) - passive heating and cooling techniques

Location	Lisbon
Owner	National Energy and Geology Laboratory (LNEG)
Project coordinator	Helder Goncalves
Architect	Pedro Cabrita, Isabel Diniz
Building costs (tax included)	800 €/m²
Typology	Office building
Number of occupants	20
Number of storeys	3
Heated net floor area	1200 m²
Gross floor area	1500 m²
Total envelope area	1436 m²
Envelope to volume ratio	0.4 1/m

The Environment Centre building Ympäristötalo in Helsinki completed in last year.
It shows the best energy performance of an office building ever built in Finland.

- **Total primary energy use of 85 kWh/(m² a) including small power loads is expected to comply with future nearly zero energy building requirements.**
- **The building is also highly cost efficient, nZEB related extra construction cost was only of 3–4%.**

TECHNICAL DATA	
Outdoor climate data:	
Design outdoor temperature for heating	-26°C
Design outdoor temperature and RH for cooling	28°C / 50%
Heating degree days (base temperature 17°C)	3 952 degree days

Table 1. Simulated energy performance (all values per net floor area).

	Net energy need kWh/(m² a)	Delivered energy kWh/(m² a)	Energy carrier factor, -	Primary energy kWh/(m² a)
Space and ventilation heating	26.6	32.2	0.7	22.6
Hot water heating	4.7	6.1	0.7	4.3
Cooling	10.6	0.3	1.7	0.5
Fans and pumps	9.4	9.4	1.7	16.0
Lighting	12.5	12.5	1.7	21.3
Appliances (plug loads)	19.3	19.3	1.7	32.7
PV		-7.1	1.7	-12.0
Total	**83**	**73**		**85**

Hotel Stadthalle in Vienna is the first urban hotel in the world to have **zero energy balance, meaning that they produce as much energy as they use.**

- To achieve this they have invested 700,000 euros in systems like
  - water volume reduction,
  - rainwater collection,
  - recycling drinking water,
  - LED lighting,
  - solar panels and
  - water pumps.

Description of Renewable Energy Technologies adopted:

RES – Electricity: **160 m² solar thermal panel**s, **PV power plant** and **4 wind turbines**.

RES-**Heating**: **Ground source heat pumps**.

RES **Cooling**: **Ground source heat pumps**.

Integration of energy efficiency/environmental measures:

- Energy Efficiency: An “instabus” system allows the hotel to manage and **control its electrical devices** and programme their use only when this is required.
- Environmental measures: **Rainwater** is used to water the garden and to flush the toilets. A **green rooftop** (made of lavender and rose plantations) removes the need for air-conditioning
- **Waste prevention** and separation policy: Organic waste composting
- **Bicycle-friendly** hotel: Beneficial rates for guests arriving by train or bicycle