ZERO CARBON HOMES AND NEARLY ZERO ENERGY BUILDINGS

UK Building Regulations and EU Directives

This leaflet summarises the UK's proposed Zero Carbon Standard for Homes, and the EU's new Nearly Zero-Energy Buildings (NZEB) definition. It also provides examples of NZEB energy targets from five European Member States.

Introduction

The UK Government has committed to a challenging CO_2 emissions reduction target for 2050. Europe too has implemented a number of Directives designed to move the union towards a more energy efficient and sustainable future.

As we undertake this journey towards future proofing the urban environment, the housing sector must continue to play a vital role in achieving energy demand and carbon emissions reductions.

The UK's target for all new homes to meet the Zero Carbon Standard from 2016 comes in advance of the Energy Performance of Buildings Directive (EPBD) target for all new buildings in the EU to be 'Nearly Zero-Energy Buildings' from 2020.

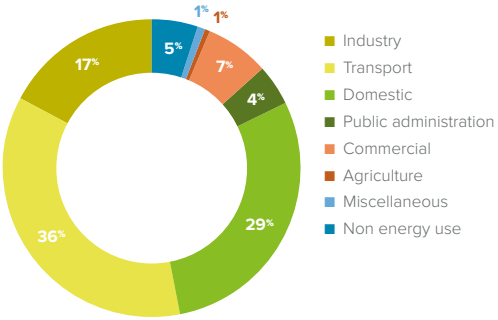
The benefits of delivering highly energy efficient homes are; helping to reduce fuel bills for consumers, providing a more comfortable living environment, reducing the impact of buildings on the natural environment, and stimulating the better use of available energy resources.

It is important to understand the differences and similarities between the two definitions, in both their impact and the metrics used. This short guide delivers key information that will assist the reader in understanding more about the UK's and EU's targets for energy efficient buildings.

Energy consumption in today's society

Today's built environment uses a significant amount of energy. More specifically, the domestic sector accounts for almost 30% of energy consumption in the UK, and contributes to around 30% of the UK's CO_2 emissions. The main sources of energy consumption in homes are heating/cooling, lighting, hot water (regulated energy) and appliances (unregulated energy).

UK Energy consumption by sector, 2012



Digest of UK Energy Statistics, 2013

Energy demand and CO_2 emissions reductions

Most of the energy used today is produced from fossil fuels (coal, oil, natural gas), and a direct consequence of using these fuels is that greenhouse gasses are released into the atmosphere, with one of the most significant being CO_2 (carbon dioxide).

These gasses, by absorbing and emitting infrared radiation, contribute to global warming and climate change.

In response to this threat, governments across the world have committed to reducing their greenhouse gasses emissions and increasing renewable energy production.

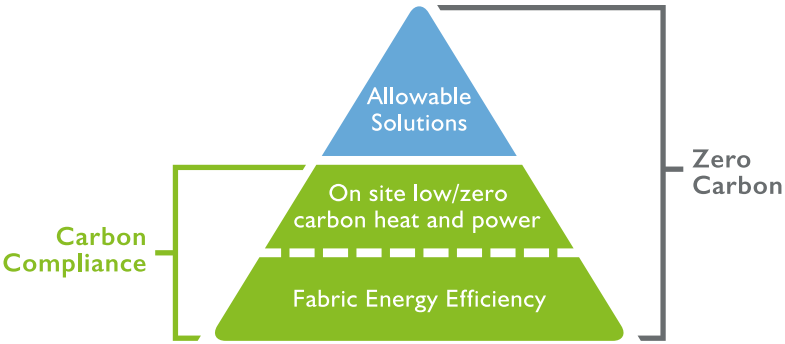
The UK, through the Climate Change Act 2008, has legally committed to ensure that the net UK carbon account for the year 2050 is at least 80% lower than the 1990 baseline. In order for this target to be realised, emissions from all sectors will have to be reduced, while at the same time renewable energy production is expected to increase.

CO_2 emissions and the energy use of buildings are controlled through Building Regulations and 'Approved Document L ' (Conservation of fuel and power). Specifically, standards for new homes are set out in Approved Document L1A (PartL1A), which is updated regularly by the Department for Communities and Local Government.

Towards Zero Carbon Homes

In 2007 Government introduced a policy stating that from 2016 all new homes constructed must meet a Zero Carbon Standard. This change is expected to be implemented primarily through the progressive tightening of Building Regulations.

Since the Zero Carbon Hub's formation in 2008, it continues to work with government and industry to create a Zero Carbon definition that can be delivered by the mainstream house building industry. The proposed definition considers CO_2 emissions from regulated energy use only, and is a stepped approach expressed through the pyramid diagram below.



Proposed Zero Carbon home definition, Zero Carbon Hub

There are three core requirements which must be met for a home to qualify as Zero Carbon.

1st : Reduce energy demand through fabric energy efficiency. The fabric performance of the property must, at a minimum, comply with the Fabric Energy Efficiency Standard (FEES).

2nd: Any CO_2 emissions that remain after consideration of fabric performance, heating, cooling, fixed lighting and ventilation, must be less than or equal to the Carbon Compliance limit established for Zero Carbon homes.

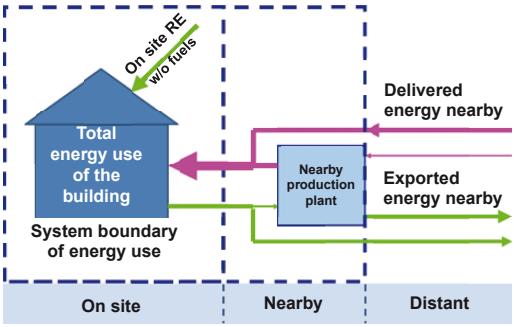
3rd: Any remaining CO_2 emissions, from the use of regulated energy sources in the property, must be reduced to zero. This requirement can be met by either overperforming on requirements 1 & 2, or by investing in off site carbon reduction projects via Allowable Solutions.

Towards Nearly Zero-Energy Buildings

The Energy Performance of Buildings Directive 2010/31/EU (EPBD recast) is the main legislative instrument, at the European level, for improving the energy efficiency of buildings. A key element of the EPBD is its requirement for 'Nearly Zero-Energy Buildings'.

According to Article 9 of the Directive: *"1. Member States shall ensure that: (a) by 31 December 2020, all new buildings are nearly zero-energy buildings; and (b) after 31 December 2018, new buildings occupied and owned by public authorities are nearly zero-energy buildings."*

NZEB System Schematic



EPBD Article 2, NZEB definition:
[..] 'nearly zero-energy building' means a building that has 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, including energy from renewable sources produced on-site or nearby.[..]

REHVA Journal May 2013

The EPBD NZEB definition, as described in Article 2, constitutes a 'broad' definition. The Directive lays down the end-results that must be achieved by every Member State. National authorities have to adapt their laws to meet these goals, but are free to decide how to do so.

In addition to members' autonomy, differences in member states' regulations, climates and level of readiness were also important factors in framing the NZEBs definition.

In order to coordinate and monitor the efforts of the member states towards NZEBs, the EU Commission requires countries to report their methodologies and approaches, explaining both the logic and processes behind their reported targets and national plans.

The EU Commission's guidelines include a set of criteria that relate to cost-optimality, national building stock mix and lifecycle analysis of buildings.

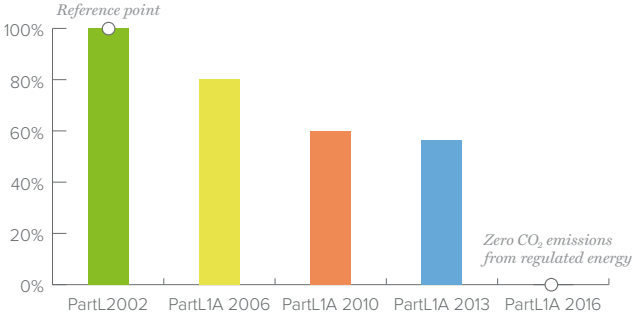
Differences between NZEBs and the UK's proposed Zero Carbon Definition

The first step for achieving Zero Carbon homes (FEES) is calculated in kWh/m^2/year energy demand. The second step is measured in kg/m^2/year of CO_2 (Carbon Compliance). Third element Allowable Solutions is calculated in £s.

NZEBs performance is exclusively calculated in primary energy consumption units, kWh/m^2/year. This metric was suggested by the EU as a common metric across the member states so a direct comparison between the levels of performance of new buildings across member states would be feasible.

The NZEB definition covers all new buildings from 2020 while the Zero Carbon Standard only refers to domestic buildings. The definition for non-domestic buildings in the UK is due to be developed shortly so that the 2019 target, for all new non-domestic buildings to be Zero Carbon, can be realised.

PartL1A Improvement over time, aggregated CO_2 emissions reductions



Aligning the two definitions

Even though the metrics appear to be different, energy consumption units and carbon emission units can be converted from one form to the other by using appropriate factors. Therefore the proposed UK's Zero Carbon Standard could be considered as the UK's definition for domestic NZEB.

However, although both primary energy [1] and FEES [2] use the same metric (kWh/m^2/year), these should not be directly compared as they express different things. For example, two homes which both achieve the same level of FEES may have different primary energy consumptions, based on their fuel sources.

Another difference relates to the mechanism of Allowable Solutions, which allows for the off-setting of CO_2 off site by investing in carbon reducing projects, most likely, within the UK. The NZEB definition includes a 'nearby' option for energy production but probably this will be restricted to solutions directly linked to the building.

[1] **Primary Energy:** *It is the energy contained in raw fuels, and other forms of energy received as input to a system.*

[2] **FEES:** *Calculated energy required for a house to maintain internal comfort conditions. It does not consider systems' efficiencies or the nature of the fuel used.*

Examples of proposed NZEBs targets reported across EU

COUNTRY	BUILDING TYPE	METRIC	ENERGY USES INCLUDED	ENERGY PERFOR-MANCE	RENEW-ABLE ENERGY SHARE	NATIONAL LEGISLATION PROVIDING THE DEFINITION
Cyprus	Residential	Primary Energy	Regulated energy	180 kWh/m^2/ year	25%	NZEB Action Plan
Belgium (Brussels)	Residential	Primary Energy	Heating, DHW, appliances	45 kWh/m^2/ year	-	Brussels Air, Climate and Energy Code
France	Residential	Primary Energy	Regulated energy	50 kWh/m^2/ year	-	RT2012
Denmark	Residential	Primary Energy	Regulated energy	20 kWh/m^2/ year	51-56%	BR10
Latvia	Residential	Primary Energy	Regulated energy	95 kWh/m^2/ year	-	Cabinet regulation No383 from 09/07/2013

NZEB definitions in Europe , REHVA Journal – March 2014

Zero Carbon House – End terrace example

END TERRACE MODEL SPECIFICATION	
Total Floor Area	76.32 m^2
Number of stories	2
Floor U-value	0.13 W/m^{2}K
External Wall U-value	0.18 W/m^{2}K
Party wall U-value	0.00 W/m^{2}K
Roof U-value	0.13 W/m^{2}K
Windows U-value	1.4 W/m^{2}K
Door U-value	1.0 W/m^{2}K
Design air permeability	5.0 m^3/hm^2
Condensing Gas Boiler	1998 or later
PV	1.6 kWp
PV orientation	South East
Overshading	<20%
y value	0.051 W/m^{2}K

PREDICTED PERFORMANCE	
Fabric Energy Efficiency	46 kWh/m^2/year
Carbon Compliance*	11 kgCO_2/m^2/yr
Primary Energy**	43.6 kWh/m^2/year

* *NHER SAP2009 output with Zero Carbon Hub 2016 carbon emission factors.*
** *NHER SAP2009 output, SAP2009 primary energy factors.*

The Zero Carbon Hub was established in 2008, as a non-profit organisation, to take day-to-day operational responsibility for achieving the government's target of delivering zero carbon homes in England from 2016. The Hub reports directly to the 2016 Taskforce.

Get in touch to find out how we can assist you

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