



# CONCERTED ACTION ENERGY PERFORMANCE OF BUILDINGS

(CT1)

## New buildings & NZEBs

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### KEYWORDS

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## 1. Introduction

In 2010, the adoption of the Energy Performance of Buildings Directive - [EPBD \(Directive 2010/31/EU\)](#) presented both the building industry and Member States (MSs) with new challenges. One of the most prominent among them, as far as new buildings are concerned, is the progress towards Nearly Zero-Energy Buildings (NZEBs) by 2021 (or, in the case of public buildings by 2019). Thus, since 2010 and also during the current working phase, the Concerted Action EPBD (CA EPBD) has been discussing the issues related to NZEB, promoting dialogue and the exchange of best practices among MSs, and thereby contributing to a more effective implementation of the EPBD.

The work of the CA EPBD under the Central team New Buildings & NZEBs focuses on practical challenges and experiences with the early implementation of NZEBs in the MSs by collecting case studies and discussing how to integrate renewable energy systems (RES) and other innovative technologies, as well as the indoor climate issue, into the energy performance assessment methods.

This report summarises the main outcomes of the work of the CA EPBD under the Central team New Buildings & NZEBs on these topics from October 2015 to November 2016. The work is based on the active participation of the national delegates (representing national authorities in charge of implementing the EPBD), and includes information gained from questionnaires, national studies and poster presentations.

## 2. Objectives

The aim of this Central Team's work is to support the implementation of policies on new buildings, particularly including requirements for new buildings, NZEB and the inclusion of RES as part of the energy performance of new buildings, as laid out in the EPBD Articles 6, 9, 2(2) and Annex I.

Article 6 of the EPBD requires MSs to “ensure that new buildings meet the minimum energy performance requirements set in accordance” with the calculated cost-optimal level and that “the technical, environmental and economic feasibility of high efficiency alternative systems” are “considered and taken into account”.

In 2019/2021, the minimum energy performance requirements for new buildings will be defined by the national application of the NZEB definition<sup>1,2</sup>. MSs shall furthermore “draw up national plans for increasing the number of nearly zero-energy buildings” and “following the leading example of the public sector, develop policies and take measures such as the setting of targets in order to stimulate the transformation of buildings that are refurbished into nearly zero-energy buildings”.

A NZEB is defined in Article 2(2) of the EPBD as “a building that has a very high energy performance, as determined in accordance with Annex I. 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”.

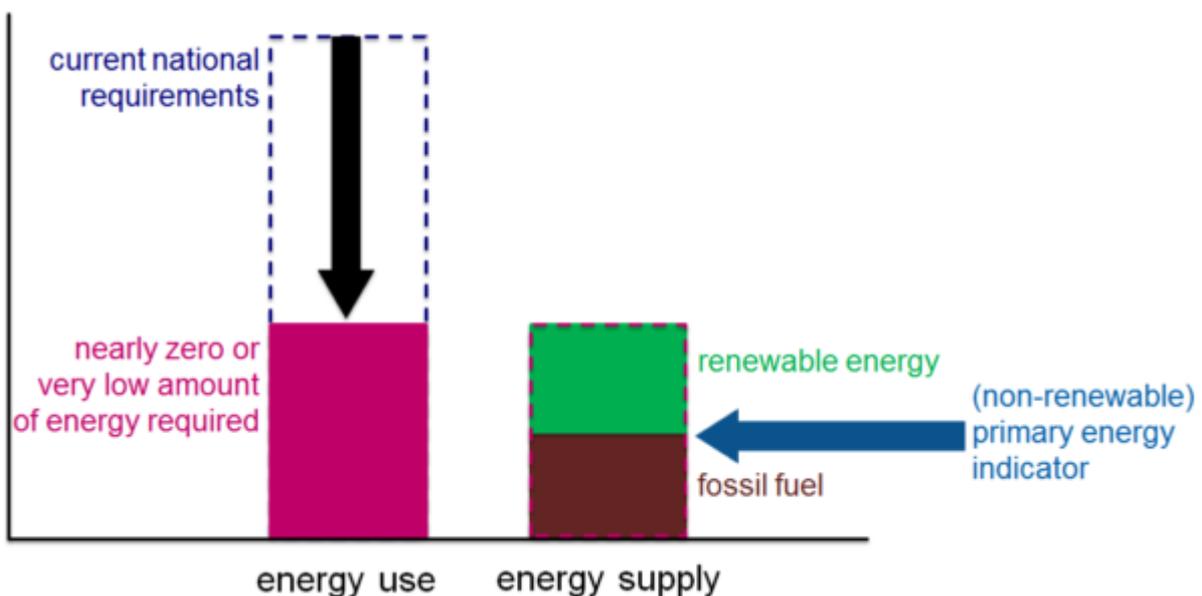


Figure 1: Graphical interpretation of the NZEB definition according to EPBD Articles 2 and 9.

The discussion topics of the Central Team New Buildings & NZEBs included the following:

- different national applications of the NZEB definition;
- suitable and innovative building and service system solutions;
- their impact on indoor comfort;
- national and European calculation methods; and
- demonstration buildings for raising awareness among the general public.

A particularly important objective has been the integration of RES into the NZEB national implementation strategies. This is part of the EPBD requirements, but it also links to the requirements of the [Renewable Energy Sources Directive \(Directive 2009/28/EC – RESD\)](#). In accordance with the RESD (Article 13(4)), by 31 December 2014, MSs must require the use of minimum levels of energy from renewable sources in new buildings and in existing buildings that are subject to major renovation. This requirement must be implemented in MSs' building regulations and codes, or by other means with equivalent effect.

The CA EPBD Central Team New buildings & NZEBs collaborates closely with the Cross-Cutting Team Technical Elements concerning innovative service systems and calculation methods, especially concerning the CEN EPB standards (Mandate 480). The discussions organised by both teams include the possible adoption and implementation of the CEN standards by the MSs. The outcome of this work is summarised in the Report of the Cross-Cutting Team Technical Elements.

## 3. Analysis of Insights and Main Outcomes

### 3.A. Analysis and insights

#### 3.A.1 National applications of the NZEB definition

Although the target dates in Article 9(1) of the EPBD are in the future, the deadline for transposition of Article 9 was 9 January 2013. By that date, all the NZEB provisions of Article 9 had to be reflected in national transposition measures. Such a lengthy run-up was considered necessary given how long it takes to plan, acquire permission for and construct a building. While the date of NZEB implementation is approaching, the development of national applications of the NZEB definition is continuously being followed by the CA EPBD. The latest complete overview of the national NZEB definitions is presented in the report "[Nearly Zero-Energy Buildings: Overview and outcomes](#)" as part of the Concerted Action EPBD report "[Implementing the Energy Performance of Buildings Directive \(EPBD\)](#)" of August 2016. This overview and the definitions summarised therein, contributed also to the "[Commission Recommendation on NZEB](#)"<sup>3</sup>.

<b>Highlights of 3.A.1</b>	The CA EPBD report "Nearly Zero-Energy Buildings: Overview and outcomes" gives a detailed overview on the status of the national applications of the NZEB definition. CA EPBD will continue to follow up the NZEB transposition process in the MSs, taking into account the corresponding Commission Recommendation.
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#### 3.A.2 Use of renewable energy systems in urban NZEBs

The overview of national applications of the NZEB definition in CA EPBD III showed that countries use different approaches to RES requirements. Some MSs request a direct RES contribution (share in percentage, or minimum amount of kWh/m<sup>2</sup> per year); others have only included an "indirect" RES requirement by setting very low primary energy requirements that can only be met with RES contributions. Earlier CA EPBD work on national applications of the NZEB definition has shown that MSs see a specific challenge in how to include RES contributions to the energy supply of multi-family houses in city centres, where roof areas and other suitable areas for the installation of RES technologies (e.g., the ground around the buildings) are limited in comparison with the buildings' floor area and are often shaded by other buildings.

In order to investigate these barriers and to present possible solutions, CA EPBD analysed which RES technology contributions can generally be assessed with the national energy performance calculation method, and which ones can fulfil possible direct RES requirements as part of national NZEB definitions. The result is an overview with information on the applicability of RES technologies across 24 countries. Large differences exist across countries regarding those RES solutions which can be included in their energy performance calculations, and those which can be used to fulfil direct NZEB RES requirements. Some technologies (e.g., solar thermal panels for domestic hot water generation and for heating, PV for self-use<sup>4</sup> as well as biomass boilers and heat pumps coupled to external air/exhaust air/ground or ground water) can in general be accounted for in the energy performance calculation in all 24 countries that took part in the evaluation. Other RES technologies (e.g., PV for feed-in, RES as part of district cooling, micro-wind turbines (self-use or feed-in) and local hydro power for self-use) can be accounted for in the energy performance calculation in about half of the countries that took part. The RES technologies that can most rarely be accounted for in energy performance calculations are RES electricity via the grid (with a specific contract) and local hydro power for feed-in (see Table 1).

Solution	Country																									
	BE-BR	BE-FL	BE-WA	BG	CY	DE	DK	EE	GR	ES	FI	FR	HR	HU	IT	LT	LV	MT	NL	NO	PL	PT	SE	SK	SL	UK
RES as part of district heating	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y		Y	N	Y	Y	Y
RES as part of district cooling	N	N	N	Y	Y	Y	N	Y	Y	N	Y	Y		N	Y	N	N	N	Y	Y	N	Y	N	N	Y	N
Solar thermal panels for DHW	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Solar thermal panels for heating support	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
PV for self-use	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
PV for feed-in	Y	Y	Y	Y	Y	N	N	Y	Y	N	N	Y	Y	Y	N	Y	Y	Y	Y	Y	N	N	N	Y	Y	N
PV for heating (input to heat storage)	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
PV/T hybrid solar collectors for self-use	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
PV/T: PV for feed-in, T for self-use	Y	Y	Y	N	Y	Y	Y	Y	N	N	N	Y	Y	Y	N	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	N
Micro wind-turbine for self-use	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
Micro wind-turbine for feed-in	N	N		N	Y	Y	N	Y	Y	N	N		N	N	N	Y	Y	Y	Y	Y	N	N	N	Y	N	N
Local hydro for self-use	N	N	N	N	N	N	Y	Y	N	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
Local hydro for feed-in	N	N	N	N	N	N	N	Y		N	N	N	N	N	N	Y	Y	N	Y	Y	N	N	N	N	Y	N
Biomass boiler	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
Biomass CHP	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y/N	Y/N	Y	Y	Y	Y/N	N	Y	Y	Y	Y		Y	N	Y	Y	Y
HP coupled to external or exhaust air	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
HP coupled to ground / ground-water	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Direct geothermal	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Direct ground water cooling	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
RES electricity via grid (specific contract)	N	N	N	Y	N	N	N	N	N	N	N	Y	N	N	N	Y	N	N	N	Y	N	N	N	N	N	N
Alternative: higher insulation level	Y	Y	N	Y	N	Y	N	Y	Y/N	Y/N	N	N	N	N	Y	N	N	N	Y	Y	N	Y/N	N	Y	N	N

Table 1: Accountable RES solutions in the MSs' energy performance calculations.

The evaluation whether the RES technologies can fulfil direct RES requirements as part of NZEB requirements (currently required in 11 of the 24 countries) resulted in a similar order as above. Solar thermal panels for hot water and PV for self-use are accepted in all 11 MSs, and solar thermal panels for heating support, biomass boilers, micro wind-turbines for self-use, and PV for heating input are accepted in 10 MSs. RES electricity via the grid with a specific contract, RES as part of district cooling and local hydro for feed-in are accepted in only a few countries. A follow-up session is planned in order to investigate reasons for differences in the national approaches.

A discussion of specific RES solutions for multi-family houses showed that most countries allow systems to be installed on associated buildings such as garages, as long as they are under the same ownership and/or on the same building plot. Most also allow the use of community systems as long as there is a direct connection to the building. Some countries allow the use of waste heat from industry or from heat pumps based on sewage water, but others do not have calculation methods to account for these. The use of higher insulation levels as an alternative to RES is only applicable in a few countries. Additional RES solutions for urban multi-family-housing identified during the discussions were heat recovery from showers, purchase of green certificates and participation in RES projects.



*Figure 2: The Solar Active House in the city centre of Frankfurt features a heat pump coupled to the sewage water and PV modules on the roof and the façade. (Source: HHS Architekten)*

### Highlights of 3.A.2

Countries differ greatly with regard to RES solutions that have been included in their energy performance calculations and in which solutions can be used to fulfil foreseen direct NZEB RES requirements. The collection of practical solutions for the use of RES at inner-city buildings presented approaches that can be applied in other MSs as well.

### 3.A.3 Best practice examples of NZEBs

EPBD (Directive 2010/31/EU) Article 9 states “MSs shall ensure that after 31 December 2018, new buildings occupied and owned by public authorities are nearly zero-energy buildings.” With this date approaching, MSs and/or municipalities in the MSs have started to design and construct pilot projects for public NZEBs. Some MSs have set up research or financial support programmes for (types of) high-performance public buildings. These form the basis of the collection of NZEB-like educational buildings that has been compiled within CA EPBD.

In total, 17 examples of educational buildings have been collected and compared, of which three are kindergartens, eight are schools (mostly primary schools), two are combined kindergartens and schools, and four are university buildings. The main results of the comparison are:

<ul style="list-style-type: none"> <li>Concrete/masonry construction was the most commonly used, although several of the buildings are of lightweight construction. The windows are triple-glazed in ten of the buildings and double-glazed in four of the buildings. U-values were found within the following ranges:</li> </ul>
<ul style="list-style-type: none"> <li>Walls: 0.09 – 0.40 W/m<sup>2</sup>K (average: 0.16 W/m<sup>2</sup>K)</li> </ul>
<ul style="list-style-type: none"> <li>Windows: 0.60 – 1.76 W/m<sup>2</sup>K (average: 0.97 W/m<sup>2</sup>K)</li> </ul>
<ul style="list-style-type: none"> <li>Roof: 0.06 – 0.30 W/m<sup>2</sup>K (average: 0.13 W/m<sup>2</sup>K)</li> </ul>
<ul style="list-style-type: none"> <li>Ground/cellar ceiling: 0.06 – 0.56 W/m<sup>2</sup>K (average: 0.19 W/m<sup>2</sup>K)</li> </ul>
<ul style="list-style-type: none"> <li>For space heating, heat pumps are used in nine of 17 examples, gas boilers in two examples, biomass in one example, district heating in six examples and a combined heat and power unit based on wood pellets in one example. Hot water is mostly generated in combination with the space heating but some buildings have additional water heating features like electrical top-up and solar thermal panels. One example uses decentralised electric water heating.</li> </ul>
<ul style="list-style-type: none"> <li>Twelve of the buildings include cooling systems with five of them using a reversible heat pump, one using a district cooling system, three using free cooling, one using adiabatic cooling, two using night ventilation and one having cooling built into the ventilation system.</li> </ul>
<ul style="list-style-type: none"> <li>All buildings include elements of demand controlled mechanical ventilation, 14 with heat recovery and three without heat recovery. Controls are based on CO<sub>2</sub> emissions, occupancy, humidity or temperature.</li> </ul>
<ul style="list-style-type: none"> <li>Lighting controls are based on manual control (four examples) or occupancy control (six examples). Daylighting control is included in five schools. One building uses DALI (Digital Addressable Lighting Interface) controls.</li> </ul>
<ul style="list-style-type: none"> <li>Four buildings have no RES system included. PV systems are installed in ten of the buildings. Three buildings have solar thermal panels on the roof. RES (waste heat and/or biomass) are also included in the district heating systems used in three of the buildings, one of which also uses water from a nearby lake for cooling.</li> </ul>
<ul style="list-style-type: none"> <li>The average final energy use for the buildings is 50.5 kWh/m<sup>2</sup>.year but includes partly differing energy demands. The average primary energy use is 55.3 kWh/m<sup>2</sup>.year.</li> </ul>
<ul style="list-style-type: none"> <li>The improvement compared to current requirements is on average 68%. The average renewable energy contribution rate is 49%.</li> </ul>
<ul style="list-style-type: none"> <li>The documented additional costs compared to conventional new educational buildings are on average 603 €/m<sup>2</sup> floor area (17% of total costs), or 204 €/m<sup>2</sup> (11% of total costs) if the by far most expensive example is not included.</li> </ul>

The variety in the thermal quality of the building envelope and the used service system technologies shows the impact of the different climatic conditions, regional building culture, user expectations and specific aims of the pilot projects.



Figure 3: Discussion of examples of NZEB-like educational buildings based on poster presentations.

<b>Highlights of 3.A.3</b>	The collection of NZEB-like educational buildings showed that many countries are using public pilot projects in order to gain experiences with the building standard and to motivate builders of private and commercial buildings to develop and realise NZEBs in advance of the 2019/2021 deadline. The analysis of the case studies showed however that the additional investment costs, with an average of 11% (or about 200 € per m <sup>2</sup> floor area), are still substantial.
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### 3.A.4 Innovative technologies

The developments towards NZEBs in the MSs lead to more and more innovative technologies being introduced into the MSs' building market over the last few years. The CA EPBD collected and exchanged first experiences with new technologies in the MSs. Information was also gathered on how MSs handle these technologies in their calculation methods or other assessment procedures. The work concentrated on the following technologies:

1. demand controlled ventilation;
2. home automation systems;
3. reversible heat pumps (for cooling in summer);
4. advanced solar shading systems.

Considering all four technologies, the used system variations and how commonly they are used in different types of buildings indicate that there is a large difference between the participating countries. According to the assessment of the CA participants, demand controlled ventilation (based on either humidity control, CO<sub>2</sub>-control or temperature control) is used in the majority of new buildings in France and Belgium, is often used for non-residential buildings in Denmark, and is more rarely used in the Eastern EU MSs. Building automation systems can be classified as defined in EN 15232. The more advanced building automation systems are currently mainly used in new non-residential buildings in Sweden, Italy, Portugal, France and Norway. However, the cost and time necessary for maintenance and repair was in general considered to be high, and it was thought that few people have a good understanding of the systems. These issues make it difficult to estimate the benefits of home automation systems. Reversible heat pumps can be based on different energy sources and are only rarely used in a few countries, and mainly in the context of residential buildings. In Norway, the use of reversible air-to-air heat pumps in residential buildings is more common, while reversible ground-to-water heat pumps are most commonly used in non-residential buildings. Use of advanced solar shading systems such as inter-pane shading devices, semi-transparent PV, switchable solar-protection glass and bio-shading remains rare in the EU MSs.

The methods of calculating the systems' impacts on the building energy use also vary across the different countries and technologies. Further information on the calculation of these innovative systems can be found in the Report of the Cross-Cutting Team Technical Elements. An exchange between the countries and CEN might help to encourage broader use of the innovative technologies.

<b>Highlights of 3.A.4</b>	Innovative technologies are entering the building market in most MSs, but the handling of these technologies in assessment procedures differs between the countries.
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### **3.A.5 Indoor climate in high performance buildings**

Inadequate design or execution of building energy efficiency improvement measures on the construction site can have negative consequences on the quality of the indoor climate in high performance buildings. Problems may include overheating due to increased thermal insulation (such as highly efficient windows) and increased airtightness, which can also result in lower indoor air quality if this is not complemented by a suitable ventilation solution. Other problems include emissions coming from the use of inappropriate materials, noise problems caused by ventilation systems, insufficient heating and poorly functioning installations. Work in the CA EPBD on the topic included the presentation of experiences from real buildings and the identification of key success factors to ensure a good indoor climate.

The main success factors identified were:

- correct installation and commissioning of ventilation and air-conditioning systems;
- in-use monitoring of the performance of building service systems;
- regulatory requirements setting targets (e.g., for minimum ventilation rate) or specifying measures to be used (e.g., solar shading, openable windows for night ventilation);
- quantitative indicator(s) of discomfort based on duration/intensity and the inclusion of comfort/discomfort indicator(s) in EPCs;
- education of users regarding behaviour, expectations of systems and possible lifestyle adaptations.

Indoor climate influence factors, such as the heat capacity of the building, outdoor CO<sub>2</sub> levels, ventilation rates etc., need to be further investigated. In general, calculation methods and energy performance requirements need to include indoor comfort issues. Different usage patterns can influence indoor comfort and therefore assessment methods need to take them into account.

<b>Highlights of 3.A.5</b>	High performance buildings, including NZEBs, benefit from reduced energy use but some of the commonly applied measures can also have a negative influence on indoor climate. In consequence, indoor climate requirements are increasingly being integrated into energy performance assessment and control procedures. Technical, regulatory and user dependent influence factors for good indoor comfort have been identified and discussed within CA EPBD.
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### 3.B. Main Outcomes

Topic	Main discussions and outcomes	Conclusion of topic	Future directions
National applications of the NZEB definition	The development of national applications of the NZEB definition is continuously followed by the CA EPBD.	The CA EPBD report " <a href="#">Nearly Zero-Energy Buildings: Overview and outcomes</a> " gives a detailed overview of the status of the national applications of the NZEB definition by mid 2015.	CA EPBD will continue to follow up the NZEB transposition process in the MSs taking into account the corresponding EC recommendations.
Use of RES systems in urban NZEBs	Countries differ greatly in the RES solutions that can be assessed by their energy performance calculations and in which solutions can be used to fulfil foreseen direct NZEB RES requirements.	The collection of practical solutions for the use of RES in inner-city buildings showed potential for MS to further learn from each other.	Further work is planned to identify and discuss RES solutions in urban building situations.
Best practice examples of NZEBs	Seventeen examples of NZEB-like educational buildings have been collected and compared.	Many countries use public pilot projects to gain experience and to motivate private and commercial builders to develop and realise NZEBs in advance of the 2019/2021 deadline.	Further work should focus on minimising the additional investment costs associated with NZEBs.
Innovative technologies	Innovative technologies are entering the building market in most MSs.	The handling of these technologies in assessment procedures differs among the countries.	Exchange between the countries and CEN might be helpful for a broader use of innovative technologies.
Indoor climate in high performance buildings	Indoor climate requirements are becoming part of the national energy performance assessment procedures.	Technical, regulatory and user dependent influence factors for good indoor comfort have been identified and discussed within CA EPBD.	Further influencing factors such as the heat capacity of the building, outside CO <sub>2</sub> level, ventilation rates etc., need to be further investigated.

## 4. Lessons Learned and Recommendations

While most EU MSs have set out their national application of the NZEB definition in legal transposition measures or in national plans on NZEB, some are still in the last phase of this development; in practice, this usually means a consultation process with stakeholders. The exchange of information in the CA EPBD has proven to be very helpful for experts responsible for the implementation of the EPBD in MSs.

According to the national CA EPBD delegates, the major challenges for tightening minimum energy performance requirements centre around the cost-optimality of the energy performance requirements, especially when one takes into consideration the following points:

- the unknown future direction of energy prices;
- the performance of new technologies;
- the investment costs of these technologies; and
- primary energy factors (mainly for electricity, district heating and cooling).

A specific difficulty lies in the integration of RES in buildings within a dense urban context. The work of the CA EPBD has shown that countries differ greatly in the RES solutions that can be included in their energy performance calculations, and in which solutions can be used to fulfil foreseen direct NZEB RES requirements. Future meetings will be used to analyse whether available solutions and assessment methods can be transferred to other MSs.

The majority of countries have built pilot NZEB projects, often using public buildings as pioneering examples, in order to gain experience with suitable technologies, costs, reliability and user-acceptance that might prevent rebound effects. However, in order to kick-start the roll-out of NZEBs throughout the EU, a significant reduction is needed in the additional costs compared to standard building regulations, from a current level of about 11% to about 5%. This development would be supported by national and EU programmes for the development of cost-efficient NZEBs.

Experts from various countries strongly suggest combining energy performance requirements with indoor comfort requirements, not only for NZEBs but also in general in the building legislation (for both new buildings and renovations). Several countries have integrated indoor comfort indicators into their energy performance assessment procedures and requirements. The work on similar approaches in other countries will be accelerated by the information exchange within the CA EPBD. This corresponds to the "[Commission Recommendation on NZEB](#)" which highlights that to avoid deterioration of indoor air quality, comfort and health conditions in the European building stock, the stepwise tightening of minimum energy performance requirements resulting from the implementation of NZEB across Europe should be done together with appropriate strategies dealing with indoor environment.

## Endnotes

1. See Article 9 of the EPBD that requires MSs to 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.
2. See also [Commission Recommendation \(EU\) 2016/1318 of July 2016](#) on guidelines for the promotion of nearly zero-energy buildings and best practices to ensure that, by 2020, all new buildings are nearly zero-energy buildings.
3. See endnote 2.
4. I.e. without using the national grid as buffer; this may include a battery.



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