CONCERTED ACTION
ENERGY PERFORMANCE OF BUILDINGS

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1. Introduction

Many of the aspects dealt with in the CA EPBD are closely interlinked with each other and may refer to both new and existing buildings, as well as to inspection and certification. This is also true for technical aspects, such as the calculation methodologies, and how to include technical systems' efficiency or how to integrate renewable energy within them. The central team for Technical Elements deals with issues of a technical nature, which are common to new and existing buildings, and/or with minimum demands, certification and inspection.

This report focuses on the implementation of Articles 3, 4 and 5 of the EPBD, as well as its Annex I on the calculation methodology and Annex III on cost-optimality.

An important element of work on EPBD implementation is the implementation of the CEN standards and their adaptation and use in the energy performance calculation methodology in MSs. This builds further on previous CA EPBD experience and existing material on cost-optimality.

In future, new technical elements of interest might be identified based on needs arising from the discussions in the CA EPBD around new buildings, existing buildings, certification and inspection. Significant interaction is expected between these areas, as well as with the CA for RESD and EED.

2. Objectives

In the past, the CA EPBD has already undertaken considerable work on CEN's first and early second versions of standards for calculating the building energy performance. Furthermore, the CA EPBD has evaluated, commented on and used the methodologies for cost-optimality.

The CA EPBD's current feedback to CEN builds on this work and supports MSs with the implementation and national adaptation of the new set of CEN standards, supporting solutions to new challenges arising from this process.

All MSs have developed and implemented national interpretations of the first version of energy performance methodologies and calculation procedures. A combination of experiences and solutions from MSs, as well as lessons learned and reflections on best practices, will facilitate the process of implementing the new set of standards.

Some of the key topics covered by the Technical Elements team are:

- adaptation of existing calculation procedures based on the ongoing revision of CEN standards;

- calculation of energy performance and cost-optimality;

- implementation of cost-optimality procedures in the national setup of minimum performance requirements;

- quality control procedures for the calculation tools used in MSs.

In parallel, lessons learned from certification and inspection schemes in MSs will be collected to improve the schemes.

Issues with accounting for onsite and offsite renewable energy in the energy performance calculations for new and existing buildings are discussed, in collaboration with CA RES, when relevant.

Similarities and/or differences between energy related products as described in the EcoDesign Directive (2009/125/EC) and as laid out in EPBD procedures form another important topic of interest. Discussions explore the "holistic approach" applied in buildings versus the more prescriptive elements for component requirements. Additionally, the needs and possibilities for easy access to reliable input data for calculation of a building's energy performance are being scrutinised.

3. Analysis of Insights and Main Outcomes

The Technical Elements analysis deals specifically with issues of technical implementation that are common to new and existing buildings, as well as with minimum requirements, certification or inspection.

Some of these topics were discussed in a wider context within the CA EPBD, and descriptions of these topics may also be found elsewhere in this book.

3.1 A new set of CEN standards

In 2010, the EU mandated (M/480 EN) CEN to create a new set of standards for the calculation of the energy performance of buildings. The participants of the CA EPBD have reviewed the development of the new standards and their possible applicability in national legislation. MSs focused especially on practical implementation and on the transition from the current standards. In particular, it seems that the new

standards are complex and can be difficult to understand, and there is a perceived gap in technical support and guidance. The main outcomes of the discussions were:

- Implementation will depend on the context within each MS.

- Calculation methods are in some MSs defined in legal documents, which can make the transition to new standards more difficult, particularly when the standards are inter-dependent.

- MSs use a mixture of monthly and hourly calculation methods, but a discussion of the relative merits of each is missing.

- Any transition to new standards must be smooth to ensure consistency.

- There is little incentive for MSs to implement new standards, unless they improve existing methods.

The overall procedure for calculating a building's primary energy performance using the new CEN standards is illustrated in Figure 1 and was put to a formal vote in late 2016. The voting resulted in acceptance of all standards, except the standard concerning indoor air quality. Now, the standards will undergo a final editing by CEN and ISO, based on the editorial comments. Then, the updated standards have to be finally approved.

In the Liaison Committee, a major focus of the dialogue with the standards developers was on the usability of the new set of energy performance of buildings (EPB) standards in relation to their implementation in national regulations. The standards now include flexibility for MSs to implement the standards in their regulations in a stepwise approach, likely beginning with the overarching standard EN/ISO 52000-1[1]. They also include flexibility to set national calculation conditions in regulations or in a national annex[2]. It is expected that this flexibility will lead to wider uptake of the new set of EPB standards in national regulations.
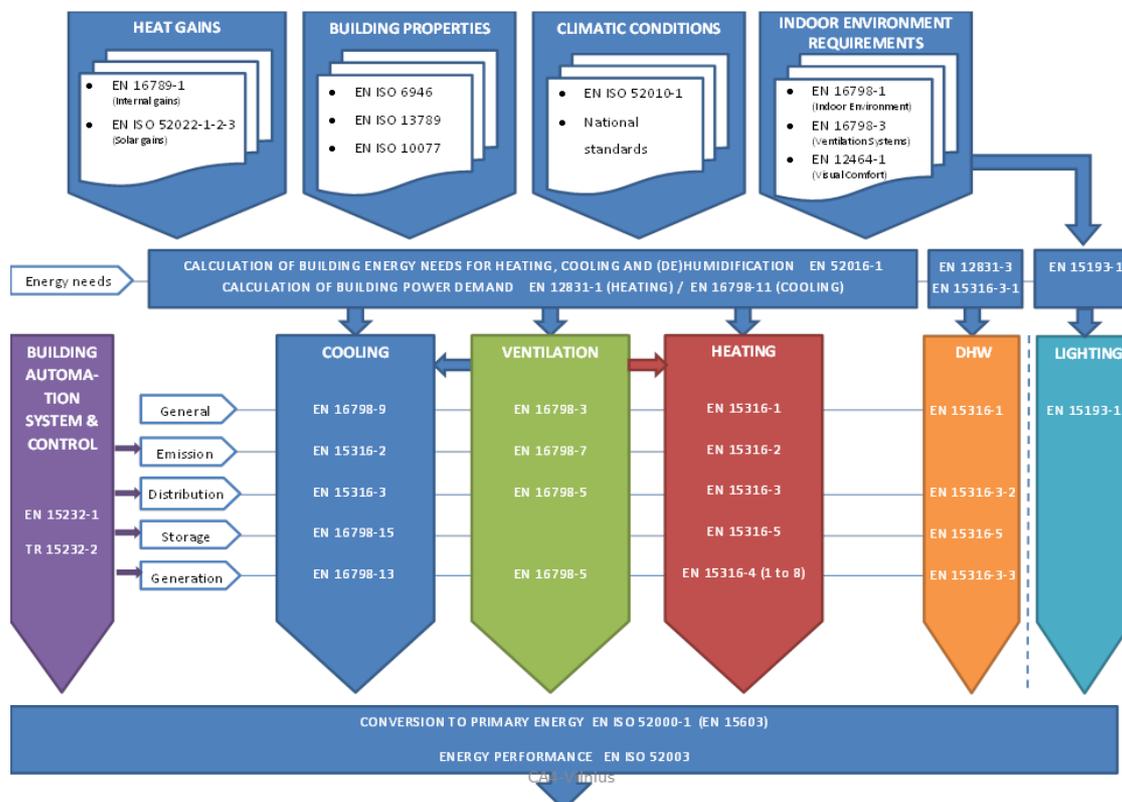

Figure 1. Schematic overview of the overall structure of the new CEN standards for calculation of a building's primary energy performance.

For each new standard, an Excel spreadsheet has been developed by CEN to demonstrate the functionality of the standard and support the further development and use of the EPB standards by software developers. This demonstrates how the rules are to be interpreted. The structure of the new CEN standards is modular, which offers the possibility of replacing single modules as long as the input/output structure is preserved.
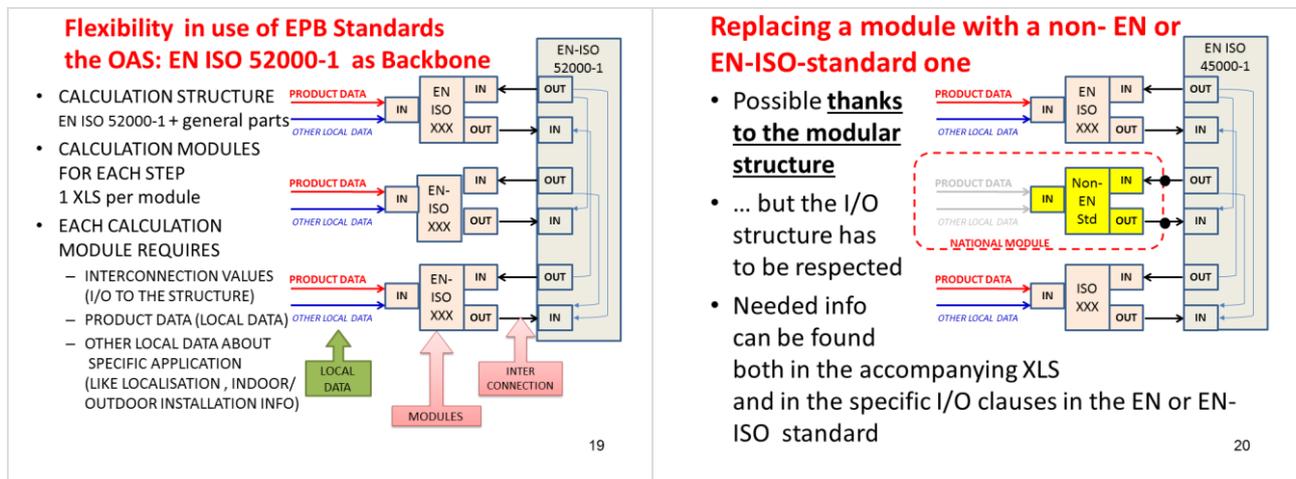

Figure 2. The new CEN standards are created as individual modules.

In general, MSs delegates felt that the new CEN EPB standards will be a good support to the implementation of the EPBD. The CEN committees emphasised that the new standards have been developed to offer flexibility for their application throughout Europe and worldwide. Furthermore, it was discussed whether the EC should invest in a common software core; it was agreed that this issue should be analysed further and that an answer would be required before MSs begin implementation.

In parallel to the development of the new standards, a consortium was established by DG Energy to assess the usability of the draft CEN standards, using example cases. The standards were examined as a package and tested for consistency between inputs and outputs. The data analysis further evaluated the degree of competence required to gather the input data as well as quality, accuracy and error rate. In addition, the usability analysis also considered the ease of use and the time and effort required. An example case calculation for a recently constructed office building produced the following statistical information:

- There are nearly 1,000 inputs for this specific building assessment.

- Of these inputs, around 500 come from "*internal*" sources, such as other standards or tables in (national) annexes.

- Around 500 inputs need to be provided by the assessor; these concern the building, the systems and some general climate or behavioural data.

- If inputs per zone are taken into account, the total number of input values to be provided can increase to around 700 (in building models with three zones).

- Systems-related inputs are by far the most numerous; these concern not only static properties (capacity or length of pipes and ducts) but also dynamic properties (functioning of the system over a certain period).

Some overall conclusions from this example case study were:

- The "one-size-fits-all" approach in the structure of the EPB standards leads to detailed calculations, in order to also cover more complex cases.

- The drawbacks of such a detailed approach are:

  - many input data need to be specified (500-700 for a typical building);

  - many details are not relevant for simple assessment situations, but choices still need to be made for every input, which negatively impacts the usability of the standards without adding value to the assessment.

- The approach does not guarantee easy incorporation of new building/system configurations, and can even impede it, e.g., for uncommon systems that are excluded from the calculation methodology described in the standards.

- The modular set-up of the EPB calculation can minimise some drawbacks, but assuring consistency in the set-up and proper exchange of data is more difficult.

- The use of default values could solve some of the problems, but it would be necessary to ensure that defaults are realistic.

- The current EPB calculation system could be converted into a user-friendly integrated energy performance calculation core that includes standard input data.

- A more systematic approach for the management of primary building input data is needed.

- The use of a reference building in the calculation can reduce the significance of systematic errors.

| Highlights of 3.1 | The new packages of final draft EPB standards have been through the final voting in CEN and ISO. The package was sent out for formal vote in late 2016 and in January 2017 the voting was finished. There will now be a final editing in CEN and ISO based on the editorial comments. The standards come from the different CEN TC's involved in mandate M/480: TC89, TC156; TC169; TC228, TC247 and TC371. The voting showed that all except one standard concerning indoor climate was accepted.

DG Energy is encouraged to support the development of a common calculation core to ease implementation of the new set of standards in MSs. Example cases have highlighted some weaknesses in the draft set of standards, and it seems that the complexity of the standards is overwhelming in some cases, e.g., in existing buildings due to the considerable input data required in combination with the lack of information. The use of default values can solve some of the problems, but it is necessary to ensure that the specific values are realistic.

The packages of final draft EPB standards will likely be released before the end of 2017. It will probably be a step-by- step release of the standards and include flexibility for the MSs to implement the standards, probably starting with the overarching standard prEN/ISO 52000-1. |
|---|---|

Main Outcomes of 3.1
The new EPB standards developed by CEN were discussed in four sessions during the first two meetings of the CA EPBD IV. MSs gave valuable input to the CEN, resulting in adaptations of the standards and development of example cases to document the standards' usability. The full set of standards was approved in January 2017. Possible implementation of the standards in MSs' legislation is expected to begin in late 2017.

3.2 Energy Performance Certificate (EPC) calculations

3.2.1 Previous changes in MSs EPC

A desk study on how MSs had rescaled or renewed their EPC between 2008 and 2014 found that many MSs had made changes. Alterations to the EPC included adding classes, changing limits, changing colours and layouts, many of them to accommodate the NZEB requirement in 2020. Many of these changes are directly connected to regulations for new buildings or general improvements for existing buildings.
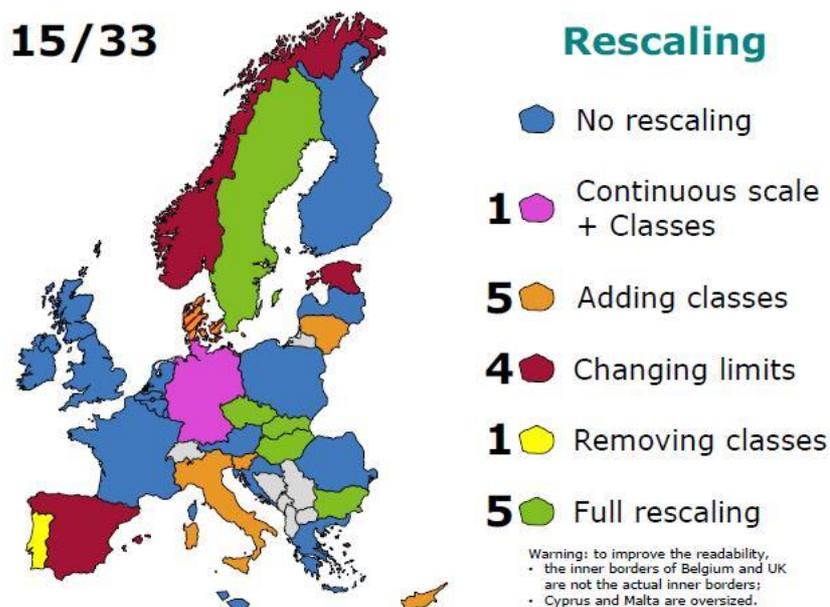

Figure 3. MSs' changes to their EPC were analysed from information collected for the Country Reports included in the 2010 and 2016 CA EPBD books.

Basically, there are 3 options for rescaling the label scale of the EPC:

1. No change is made to the existing labelling scale; buildings constructed according to new, tightened energy requirements are placed in the top category. This approach is simple, but gives no further motivation for building owners to improve their building's energy performance. Better energy performance values are not reflected in the certificates at the top of the scale, as indicated in the left column of Figure 4.

2. Certificates that have been previously issued remain unchanged, and new, narrow top categories are implemented to reflect the new energy requirements. This option avoids problems with the "old" certificates. It could work, provided that accurate and motivating new top categories are implemented and that energy perf ormance is expressed precisely according to variations in energy performance at the top of the scale. One of the drawbacks of this option is that the number of categories increases, and there are some other practicalities that need to be addressed, such as the question of colours, letters, or terms.

3. The number and the names of categories remain the same, while the thresholds are modified. The advantage to this approach is that the number of categories remains unchanged. On the other hand, the "old" certificates also need to be changed and the issuing data becomes very important, to be able to understand the full meaning of the label value on the certificate.
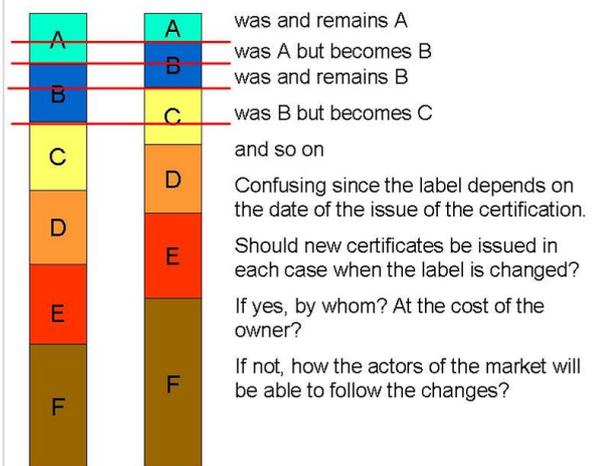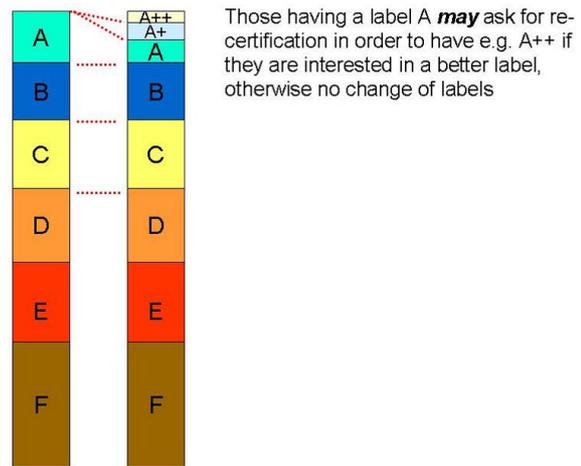
Figure 4. Different strategies for changing the EPC scale (options 2 and 3).

3.2.2 Calculating realistic energy savings

The energy performance shown in most MSs' EPC is based on a standardised calculation of the primary energy demand. This, however, may not be the same as the measured energy consumption in a building, and savings presented in the EPC might differ from the experienced energy savings. The EPBD does not envisage calculation of non-standard energy consumption, and hence expected energy savings. Nevertheless, realistic estimations of energy savings are necessary in order to determine the time scale of returns on investments. In Sweden and Bulgaria there is a guarantee on the EPC's predicted energy

consumption for new buildings, while Bulgaria is the only MS that also guarantees the predicted energy savings in existing buildings.

CA EPBD investigated the possibilities and barriers associated with using the EPC building data model (i.e., the input parameters collected from the building, in order to carry out an energy performance calculation in an approved calculation tool) for the additional purpose of calculating energy savings caused by user behaviour. Information on the physical description of the building envelope and installations in the data models that are used to calculate the energy performance in the EPC is generally accurate. However, the calculated energy demand deviates from the measured consumption, primarily due to user behaviour that varies from the standard assumptions. The building data models can then be used – after modifications of the standard input parameters, i.e., internal gains and losses, usage patterns, indoor and outdoor climates – to calculate realistic energy demand and potential savings. However, so far only the Slovak Republic, Lithuania, and Hungary allow alternative use of the EPC model for more detailed analyses of the energy saving potential.

The ownership (Figure 5) of the EPC building data model can in some cases hinder its use for alternative calculations. This can happen, for example, when the EPC data is owned by the expert who carried out the certification and created the EPC building data model, whereas additional calculations would be carried out by a third party.
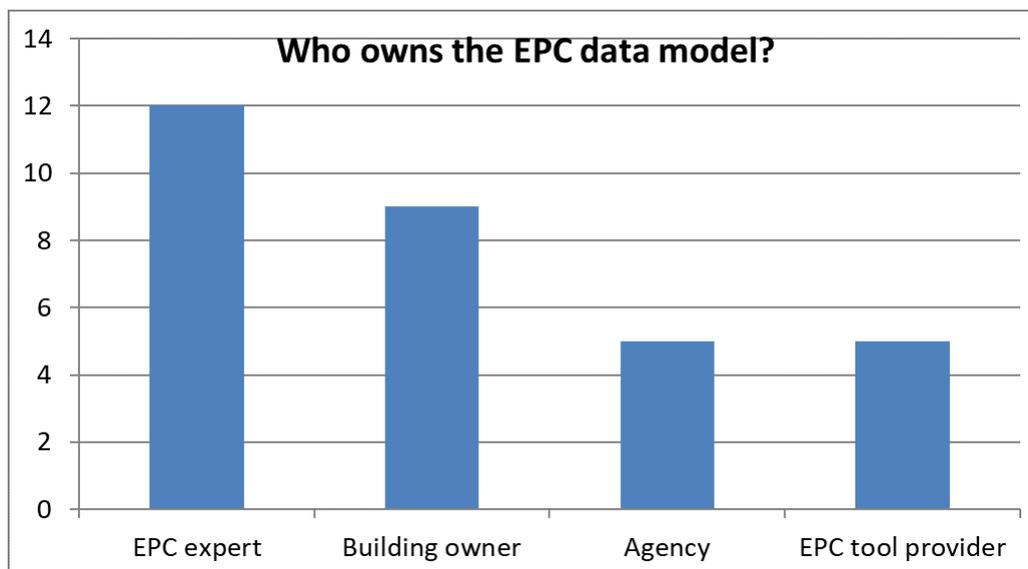
Figure 5. Ownership of EPC building data model in MSs participating in the survey. Multiple ownership occurs in some MSs.

From the selected MSs' examples, it appeared practical to modify critical input parameters to predict more realistic energy consumption calculations for energy savings. For example, the key variable parameters are occupancy behaviour (number of users, use of domestic hot water and use of appliances) and temperatures (both indoor and outdoor). From the example cases, these adapted models produced results that closely align with the measured energy consumption. MSs gave several different examples for adapting the building data model to the actual conditions:

- Denmark used the energy performance calculation model to compare the gap between actual measured data and standardised EPC.

- The Walloon Region, Belgium used an adapted model for additional reports based on the EPC model data.

- Latvia used an adapted model (calibrated against measured consumption) instead of a standardised EPC model.

- France used an adapted model to study the coherence between asset and operational rating methods.

Discussions highlighted a conflict between the clear benefits of improving model accuracy with the frequent lack of interest among consumers. This lack of interest can be explained partly by other issues (i.e., economy) garnering more attention, and partly by the inconsistency between standard calculations and measured energy consumption. The most important contribution for any calculation is in the value added to decision-making, but no direct benefit will be realised in practice if the consumer is not sufficiently engaged. For instance, building-owners tend not to calculate the energy savings they might obtain when carrying out other modifications to their property, and therefore there tends to be a lack of interest in the potential for energy savings. Decisions taken by building-owners tend to be primarily driven by comfort conditions or issues of maintenance and improved functionality. However, it is important to show in the EPC how energy saving measures would also result in co-benefits, e.g., comfort improvement in order to incentivise building-owners.

Highlights of 3.2	It has been necessary in some MSs to change the scaling of the EPC labels in order to accommodate new building standards approaching NZEB. In most cases this has been done by sub-dividing the top class into narrower classes, representing natural steps, e.g., intermediate building regulation requirements, towards the NZEB requirement in 2020. In most cases, the new and the old scale co-exist until all "old" certificates have been replaced by new ones or become outdated. In other cases, only an automatically updated on-line version of the certificates is valid.
	EPC calculations are based on standard assumptions, hence calculated energy demands and potential energy savings may not match the measured consumption. However, energy performance building data models can be used for calculation of realistic energy demands and hence equally realistic energy savings if modified to reflect the actual conditions in buildings. In some MSs, it is possible to use the EPC model for more detailed analyses of the energy demand and the energy saving potential. However, ownership of the model sometimes creates obstacles.

Main Outcomes of 3.2

The examples show that some of the main motivations to rescale have varied greatly and include:

- ensuring the EPC's contribution to making it more attractive to build or renovate very efficient buildings;

- inefficient buildings rated too high in old EPCs;

- solving problems with old EPCs for apartments;

- stricter energy performance requirements for new buildings, and introduction of NZEB in national requirements;

- changing from energy use to primary energy use.

Main Outcomes of 3.2

Much discussion has centred around the co-existence of old and new EPCs on the market, and whether this might create confusion for the public in terms of understanding the energy performance of the building.

Displaying realistic energy savings in the EPCs is not the prime focus since buildings are to be compared excluding the influence of the occupants. Building owners undertake improvements for many reasons apart from saving energy, especially when purchasing or renting a property. Improved functionality and indoor climate are generally considered the two main drivers for carrying out upgrading works. Energy savings are in many cases seen as an additional benefit to planned renovation.

Only a few MSs seemed open to the possibility of using the energy performance building data model for purposes other than issuing an EPC. Among the prime reasons for this are the ownership of the building data model and the risk of incompatibility between tools that use the same building data model, but different energy performance calculation tools.

3.3 Calculating energy performance

There are specific issues related to energy performance calculations for new buildings applying for a new building permit and for energy performance certification of an existing building.

3.3.1 Innovative systems

This topic mainly relates to new buildings, although many of the findings are equally valid for existing buildings.

The progress towards NZEB in MSs has led to more innovative technologies being introduced to the market over the last few years. The purpose of this topic was to collect and exchange initial experiences with such technologies in the MSs.

Four categories of technologies were discussed, with wide variations in the frequency and methods of their use, and in the types of buildings involved. Significant differences were also found in ways in which the systems' impacts on building energy demand were calculated. Exchange of knowledge between MSs and CEN might prove helpful for a broader use of innovative technologies in the future. The four categories of technologies are as follows:

- *Demand-controlled ventilation* is mainly divided into mechanical exhaust systems and balanced mechanical ventilation systems with heat recovery coupled to different control strategies. The calculation is often performed using a detailed dynamic simulation method as part of the simplified standard calculation method, although a few countries use fixed factors as rough estimates.

- *Building automation systems* can be grouped according to EN/ISO 15232 into classes A to D, with class A being the most advanced holistic building automation systems, and class D being simple manual controls. Classes A and B are mostly applied to new non-residential buildings. Some MSs are considering introducing requirements concerning levels of building automation. The calculation of the impact of building automation systems varies between use of fixed factors as rough estimates, detailed calculations within the assessment method, and use of external dynamic simulation tools. In several MSs, building automation systems cannot be assessed directly, using the national method and hence provision must be calculated in alternative ways. Generally, energy savings seem to be overestimated, and only occur after a thorough commissioning of the system.

- Information on seven (7) different types of *reversible heat pumps* was collected and discussed, and categorised according to the supply source and the heat delivery system. The use of specific systems differs among MSs. In Sweden, reversible heat pumps can be calculated by using a dynamic external simulation tool. Other MSs assess the impact of heat pumps either by using a detailed method within their calculation procedure or by using a fixed factor as rough estimate. The obvious advantage of a reversible heat pump is that only one system is needed for heating and cooling.

- Several still-innovative *advanced solar shading systems* were discussed by the participants, for example inter-panel shading devices, semi-transparent PV, double façade systems with integrated shading systems, movable sun-protection glazing and bio-shading. Most systems can be modelled fully only by using an external dynamic simulation tool. As an example, bio-shading is calculated in one MS within the regular calculation method by using a rough factor, and in another MS by using an external dynamic simulation tool. However, most MSs do not take bio-shading into account in their national calculation standard.

Highlights of 3.3	It is expected that new and/or innovative systems will become increasingly popular in both new buildings and existing buildings that undergo major renovation. However, the number and variety of systems handled in MSs' energy performance calculation procedures varies significantly, and many systems are excluded from standard calculation procedures. In order to support innovation, it is necessary to accommodate the effect of these systems in national calculation procedures, either by including them in the standard calculation tools or by proving their effectiveness in external, dynamic simulation tools.

Main Outcomes of 3.3
MSs have different ways of integrating new and innovative systems in buildings' energy performance calculations, which create obstacles to innovation and for these systems to penetrate the free market. It is important to continue to facilitate the promotion of new and innovative systems for energy efficient building automation.

3.4 Renewable Energy Systems (RES)

Inclusion of RES in the calculated energy performance of buildings is a key issue for new buildings that comply with national NZEB requirements. Most RES solutions are equally important for existing buildings, especially those undergoing major renovations. The following section deals with technical issues related to calculation and implementation of RES.

3.4.1 RES in an urban context

CA EPBD analysed which RES technologies can generally be assessed as part of the overall energy performance calculation and which ones can fulfil possible direct RES requirements as part of national NZEB definitions and energy performance calculations. The result is an overview by MSs of the applicability of RES technologies. Participating MSs vary considerably in the RES solutions that can be included in their energy performance calculations, and the solutions which can be used to fulfil NZEB RES requirements. Some technologies can, in general, be accounted for in the energy performance calculation in all 24 MSs that took part in the evaluation: for example, solar thermal panels for domestic hot water generation and

for heating, electricity production from PV for use in the building (self-use), biomass boilers and heat pumps coupled to external air/exhaust air/ground or ground water (Figure 6). Other RES technologies can be accounted for in the energy performance calculation in about half of the MSs examined – examples include PV for feed-in, RES as part of district cooling, micro-wind turbines (self-use or feed-in) and local hydropower for self-use. Relatively few countries allow for RES electricity via the grid (with a specific contract) and local hydropower for self-use[3] or feed-in.

Country / Solution	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	Σ Yes	Σ No	Σ Others
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	21	4	1
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	12	13	1
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	26	0	0
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	25	0	1
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	26	0	0
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	17	9	0
PV for heating (input to heat storage)	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	24	2	0
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	24	2	0
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	19	7	0
Micro wind-turbine for self-use	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	18	8	0
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	10	14	2
Local hydro for self-use	N	N	N	N	N	N	Y	Y	N	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y	Y	15	11	0
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	6	19	1
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	25	1	0
Biomass CHP	Y	Y	Y	Y	Y	Y	Y	Y	Y			Y	Y	Y	N	N	Y	Y	Y	Y		Y	N	Y	Y	Y	20	3	3
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	26	0	0
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	26	0	0
Direct geothermal	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	24	2	0
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	22	4	0
RES electricity via grid (specific contract)	N	N	N	Y	N	N	N	N	N	N	N	N	Y	N	N	N	Y	N	N	N	Y	N	N	N	N	N	4	22	0
Alternative: higher insulation level	Y	Y	N	Y	N	Y	N	Y			N	N	N	N	Y	N	N	N	Y	Y	Y	N		N	Y	N	10	13	3

Figure 6. RES sources that MSs accept to be included in their calculations of building energy performance. Legend: white – no answer, grey – answer given between yes and no.

For urban, multi-family houses, most MSs allow RES systems on garages and other associated buildings to be included in the energy performance calculation of the building, but the deciding factor is the ownership of the system and/or the boundary of the building plot. Most MSs also allow the use of community systems in the energy performance calculation as long as there is a direct connection to the building. The use of waste heat from industry or wastewater heat pumps is allowed in energy performance calculations by some MSs, 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 MSs. Some additional RES solutions for urban, multi-family houses that were identified during the discussions included heat recovery from showers, purchase of green certificates and economical participation in RES projects not directly connected to the building or the building site.

Highlights of 3.4	There is significant variation in the sources of renewable energy supplied at the building or nearby that are accepted in MSs' energy performance calculations.

Main Outcomes of 3.4

Inclusion of energy supply from renewable sources in MSs' building energy performance calculations is dealt with very differently. Some MSs only allow inclusion of energy from limited RES, while others are willing to accept input from a variety of sources and some even accept additional insulation to compensate for lack of RES supply. In an urban context with little space on the building and in its immediate surroundings, combined with limitations due to neighbouring buildings, overly rigid requirements for RES may hinder efforts to meet the requirements for a certain RES share in buildings that comply with national NZEB requirements.

4. Lessons Learned and Recommendations

The modular structure of the new CEN standards, valid for all building types, allows for a flexible system that can be easily adapted to national requirements while maintaining the overall structure of the calculation procedure. However, a methodology targeting all building types results in simple cases being overly complicated and necessitating an excessive amount of input information. It was recommended that the EU should establish a common, modular calculation core leaving establishment of national user interfaces to MSs; the recommendation has been accepted, and the process has begun.

Some MSs have, over time, changed the thresholds of their EPC to accommodate room for new, stricter building energy classes that move towards NZEB. Naturally, EPC should facilitate promotion of NZEB by distinguishing them from other buildings on the scale, and reluctance in adapting the scale should not hinder this process.

Energy savings displayed in the EPC are, in most cases, calculated based on a standardised use of the building and thus do not necessarily reflect actual energy savings. However, this does not seem to present a barrier to building owners' willingness to invest in energy savings, as this is primarily carried out in combination with planned renovation and in order to improve indoor climate and building functionality. Building energy performance calculation models should be made available for use in other calculation tools for more realistic energy saving calculations.

There is a great variety of ways in which MSs include energy from renewable sources in their energy performance calculations. In some MSs, only limited sources of renewable energy are considered in the calculations, while other MSs are willing to include a more complete spectrum of solutions. In order to meet the requirement for a share of RES in NZEB, some MSs are even willing to include additional insulation levels to compensate for a lack of RES, for example in urban contexts where there may be limited free space on or near the building.

Endnotes

1. The standard is preliminary until the final approval of the edited version.

2. By using annex A/B solutions included in all the standards.

3. Without using the national grid as a buffer. This may include a battery.

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