Guidance document on revised Article 2, 8(1) and 8(9) EPBD

Technical Building Systems

1. INTRODUCTION

Article 8 paragraph 1 of **Directive 2010/31/EU on the Energy Performance of Buildings as originally adopted on 19 May 2010**[1] (hereafter referred to as the 'former EPBD') required Member States to set system requirements in respect of the overall performance, the proper installation, and the appropriate dimensioning, adjustment and control of technical building systems. This obligation applied to technical building systems installed in existing buildings and Member States could also apply it to technical building systems installed in new buildings. In addition, Article 2 paragraph 3 of the former EPBD defined a technical building system as a *"technical equipment for the heating, cooling, ventilation, hot water, lighting or for a combination thereof, of a building or building unit"*.

With regard to **technical building systems**, Article 1 of **Directive (EU) 2018/844 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27 on energy efficiency**[2] (hereafter referred to as the 'Amending Directive'):

1. keeps the provisions on technical building system requirements in Article 8 paragraph 1 as they were under the former EPBD (with the exception of the list of systems for which system requirements had to apply in sub-paragraph 2, which has been deleted);
2. updates and extends the definition of technical building systems (Article 2 paragraph 3);
3. introduces new provisions on the assessment and documentation of the overall performance of technical building systems (Article 8 paragraph 9).

The aim of this guidance document is to clarify the purpose of the revised and new provisions on technical building systems in Article 2 and 8 of the revised EPBD. The note states the views of the Commission services, does not alter the legal effects of the Directive and is without prejudice to the binding interpretation of Article 2 and Article 8, paragraphs 1 and 9 as provided by the Court of Justice.

2. UNDERSTANDING OF THE PROVISIONS APPLYING TO TECHNICAL BUILDING SYSTEMS IN ARTICLE 2 AND 8 OF THE REVISED EPBD

2.1. Aim and objectives

The aim of the provisions on technical building systems of Article 8, paragraphs 1 and 9, is twofold. Firstly to ensure that technical building systems are adequately designed, installed and commissioned in order to optimise their actual performance. Secondly to ensure that any intervention that can have an impact on the performance of a technical building system is tracked and documented, as such information is valuable to the owner but also, so as to facilitate the assessment of the performance of the building as a whole (e.g. in the context of energy performance certification).

[1] Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings.

[2] Directive (EU) 2018/844 of 30 May 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency.

2.2. Technical Building Systems

2.2.1. Extension of the definition

The obligations arising from Article 8 paragraphs 1 and 9 of the revised EPBD apply to technical building systems as defined in Article 2(3) thereof. According to that definition, technical building system means *"technical equipment for space heating, space cooling, ventilation, domestic hot water, built-in lighting, building automation and control, on-site electricity generation or a combination thereof, including those systems using energy from renewable sources, of a building or building unit."*

The definition of technical building systems was already provided in the former EPBD but the revised EPBD updates this definition by: 1) using a different wording for some systems, in order to clarify their scope; 2) extending it to include additional systems: 'technical equipment for building automation and control' and 'technical equipment for on-site electricity generation'.

The following table summarizes the updates made on the definition under the revised EPBD:

Former EPBD	Revised EPBD	Type of change
'heating'	'**space** heating'	Clarification of the scope.
'cooling'	'**space** cooling'	Clarification of the scope.
'ventilation'	'ventilation'	No change.
'hot water'	'**domestic** hot water'	Clarification of the scope.
'lighting'	'**built-in** lighting'	Clarification of the scope[3].
N/A	'**building automation and control**'	New technical building system.
N/A	'**On-site electricity generation**'	New technical building system.

2.2.2. New technical building systems

The following systems: 'technical equipment for building automation and control' and 'technical equipment for on-site electricity generation', have been added to the definition of technical building systems.

- 'Building automation and control systems' are defined in Article 2 paragraph 3a of the revised EPBD: *''building automation and control system' means a system comprising all products, software and engineering services that can support energy-efficient, economical and safe operation of technical building systems through automatic controls and by facilitating the manual management of those technical building systems;'*
- 'On-site electricity generation systems' shall be understood as systems designed to produce electricity and that are installed in or in the immediate vicinity of the building and that have some level of integration with the building and its electrical

[3] The focus was already on built-in lighting in the former EPBD (see Annex I, which required to take into consideration 'built-in lighting installation' in the methodology for calculating the energy performance of buildings). This is also consistent with the consideration of 'built-in lighting' as part of the energy uses which have an impact on energy performance of buildings in Annex I of the revised EPBD.

installation[4]. Such systems include, in particular, photovoltaic panels integrated to the building envelope (e.g. roof-mounted photovoltaics panels), micro combined heat and power (CHP) installations, and small wind turbines.

2.2.3. Additional relevant definitions

In addition to the definition of technical building systems, Article 2 of the revised EPBD includes definitions for 'heating system' and 'air-conditioning system'[5]:

- *''Heating system' means a combination of the components required to provide a form of indoor air treatment, by which the temperature is increased'*[6].
- *''Air-conditioning system' means a combination of the components required to provide a form of indoor air treatment, by which temperature is controlled or can be lowered'*[7].

2.3. When obligations are triggered

The provisions on technical building systems in Article 8, paragraphs 1 and 9, of the revised EPBD are triggered when a technical building system is installed, replaced or upgraded.

It should be clarified that the conditions for these obligations to apply relate only to technical building systems themselves and not to the type of building or building unit under consideration. The technical building system definition makes clear that a technical building system is an equipment of 'a building or building unit', meaning that provisions applying to technical building systems are applicable in buildings or building units, regardless of their type and characteristics.

However, the provision on setting system requirements is obligatory only with regard to the technical building systems in existing buildings. It is up to Member States whether they choose to extend the obligation also with respect to technical building systems in new buildings.

2.4. Technical, economic and functional feasibility

Article 8 paragraph 1 of the EPBD states that system requirements must be applied *'in so far as they are technically, economically and functionally feasible'*[8].

It is for Member States to detail in which specific cases the application of system requirements could not be feasible from a technical, economic and / or functional perspective. Member States must ensure that these cases are clearly identified, framed and justified[9].

[4] Member States will need to decide how to transpose the notion of 'on-site' in the case where the system is not in or on the building. The fact that the electricity generation system shares (or not) the same connection to the electricity grid should generally help in the distinction between on- and off-site systems.

[5] The definition of 'air-conditioning system' was already provided in the former EPBD and has not been modified in the revised EPBD. The definition of 'heating system' is new in the revised EPBD.

[6] The revised EPBD refers both to 'heating system' and to 'system for space heating' but these two terms are equivalent within the meaning of the Directive.

[7] The revised EPBD refers both to 'air-conditioning system' and 'system for space cooling'. These two terms are equivalent within the meaning of the Directive.

[8] This mention was already included in the former EPBD.

In particular the interpretation of technical, economic and functional feasibility must not be left to the sole judgement of owners or system installers (or another entity involved in the design, supply and installation of the system or of components of the system)[10]. Conditions under which feasibility is evaluated must be defined at Member State level or, where applicable, in the case of regional conditionalities affecting only part of the Member State territory, at regional level. However, in the latter case, regional conditionalities must be defined in national transposition measures. In any case, these conditions must be documented (e.g. in technical guidelines) and must apply uniformly on the national (or, where applicable, regional) territory. Finally, the non-application of system requirements must be assessed under clear procedures established and supervised by public authorities.

These procedures may differentiate between different types of buildings, in particular to address specific types of buildings for which technical, economic or functional feasibility might lead to certain difficulties.

One example is historical or listed buildings, which can be subject to specific constraints that can make it more difficult to apply some of the system requirements. In this context, it should however be noted that compliance with system requirements would not, in principle, alter the character or appearance of historical or listed buildings.

Furthermore, and for the avoidance of doubt, system requirements are also applicable to all categories of buildings for which the Directive allows Member States to introduce derogations in the application of minimum energy performance requirements (Article 4(2) of the revised EPBD).

Nevertheless, the specificities of certain buildings can be taken into account in the evaluation of the technical, economic and functional feasibility of the requirements. In exceptional cases, where the evidence points to the conclusion that compliance with system requirements is technically, economically or functionally impossible for a specific building, these requirements can be disregarded. Such conclusion can only be reached on a case-by-case basis, and Member States must not introduce systematic exemptions for any category of buildings.

The following table sets out how each type of feasibility can be interpreted and, for each, gives an example.

Type of feasibility	**Meaning**	**Examples**
Technical feasibility	System requirements are technically feasible when the technical characteristics of the system and the building (or building unit) allow for the requirements to be applied. System requirements are not technically feasible when it is impossible from a technical perspective to apply them,	Technical feasibility would be absent when the system as deployed does not allow for the installation of the devices needed to comply with the requirements, e.g.: • Requirements on heat recovery for ventilation

[9] It is recommended that Member States ensure an adequate involvement of stakeholders in the definition of conditions on technical, economic and functional feasibility.

[10] Meaning that, in the cases where such parties are responsible for assessing feasibility, their interpretation has to be framed by guidelines and procedures provided by public authorities, which should also ensure a degree of consistency, supervision and control of the application of these guidelines and procedures.

	i.e. when the technical characteristics of the system simply prevent the requirements from being applied.	systems: inlet and exhaust are not located in the same areas. • Requirements on the insulation of pipes: portions of pipes are not accessible.
Economic feasibility	Economic feasibility relates to the costs of the application of requirements and whether: (i) these costs are proportionate with regard to the costs of the planned intervention (e.g. system upgrade) (ii) expected benefits outweigh these costs[11], taking into account the expected lifetime of the system.	Economic feasibility can e.g. be calculated based: • On a maximum ratio between the costs of the application of the requirements and the costs of the planned intervention. • On a maximum payback period, taking into account monetary benefits from the application of the requirements.
Functional feasibility	System requirements are functionally not feasible where they lead to changes that would impair the operation of the system or the usage of the building (or building unit) considered, taking into account the specific constraints (e.g. regulations) that may apply on the system and / or building.	The application of system requirements may not be functionally feasible when e.g.: • Applicable regulations (e.g. safety) contradict considered requirements. • The application of the requirements results in a significant loss of usability of the building or building unit (e.g. substantial loss of building space)

2.5. Additional clarifications

The new provisions on the documentation of system performance (Article 8 paragraph 9 of the revised EPBD) make use of some of the concepts from the provisions on setting system requirements: 'overall energy performance', 'installation', 'replacement' and 'upgrading'. The meaning of these terms in the new provisions on the documentation of system performance is the same as in the provisions on setting system requirements. They must therefore be transposed at national level in the same way.

The provisions on the documentation of system performance also makes uses of the term 'altered part', which refers to the specific part (i.e. component) of a system that is affected when the system is upgraded. This is only relevant in the context of a system upgrade, not when a system is installed or replaced.

[11] This means that a cost-benefit assessment would be performed. This latter approach is probably the most relevant, as the application of requirements will generally pay back (in particular because they generate energy cost savings).

3. IMPLEMENTATION OF THE PROVISIONS APPLYING TO TECHNICAL BUILDING SYSTEMS IN ARTICLE 2 AND 8 OF THE REVISED EPBD

3.1. Transposition of the definitions

Member States have to ensure that the updated definition of technical building systems (Article 2(3)) and the new definitions of building automation and control systems (Article 2(3a)) and heating systems (Article 2(15a)) are correctly transposed.

Where relevant, Member States can also consider giving additional clarifications to supplement the definitions of technical building systems, for instance to describe in more detail the capabilities that building automation and control systems are expected to achieve.

3.2. Transposition of Article 8 Paragraph 1 – system requirements

3.2.1. New technical building systems

For systems that were not considered in the scope of the former EPBD (building automation and control systems and on-site electricity generation), Member States will have to define and lay down system requirements at national level and ensure that these requirements cover all the aspects referred to in Article 8 paragraph 1: 'overall energy performance', 'proper installation', 'appropriate dimensioning', 'adjustment' and 'control'. The following table outlines the meaning of each of these requirement areas, giving examples (only for illustration purposes) for the two types of systems that have been added to the list of technical building systems in the revised EPBD.

Type of requirement	**Refers to**	**Examples**	
		BACS	**On-site electricity generation**
'overall energy performance'	The performance of the system as a whole (not to be confused with the performance at product or component level and the performance of the whole building).	Control capabilities that have an impact on building energy performance (e.g. following EN 15232 standard[12])	System performance factor of a photovoltaic system (e.g. following EN 15316-4-6 standard[13])
'appropriate dimensioning'	The adequateness of the system size or capacity with regard to the needs and characteristics of the building under expected use conditions.	Determine the optimal control capabilities based on the type of building, expected usage, potential energy savings.	Determine the optimal size of the PV system based on electricity cost reduction, available mounting area and other constraints that could apply.
'proper installation'	The way the system should be installed in the building in	Installation by a trained and / or	Installation by a trained and / or

[12] EN 15232 'Energy performance of buildings - Impact of Building Automation, Controls and Building Management'.

[13] EN 15316-4-6 'Heating systems in buildings - Method for calculation of system energy requirements and system efficiencies - Part 4-6: Heat generation systems, photovoltaic systems'.

	order to operate properly.	certified installer.	certified installer.
'appropriate adjustment'	Testing and fine-tuning actions on the system, once installed, under real usage conditions.	Sequence of tests to be performed after installation to check that the system operates adequately.	Sequence of tests to be performed after installation to check that the system operates adequately.
'appropriate control'	Desired or required control capabilities of systems.	Scope of control functions.	(Where applicable) control of electricity feeding (e.g. to grid, self-consumption, or storage)

Further technical clarifications on possible requirements for the new categories of technical buildings systems introduced can be found in section 4.1.1.

3.2.2. Systems already covered under the former EPBD

For systems already covered by the former EPBD, Member States could consider using the opportunity of the transposition of the amending Directive to review and possibly update applicable system requirements. This review could in particular be an opportunity to check that the applicable requirements cover sufficiently the different areas listed in the EPBD and assess whether the requirements could be further developed. Feedback from the Concerted Action EPBD[14] suggests that the focus of applicable requirements is generally on component-level performance requirements and that the way other areas (i.e. proper installation, appropriate dimensioning, adjustment and control) are addressed can vary across the European Union. Member States are therefore encouraged to engage in this review and, where relevant, to draw from available good practices.

3.2.3. Consideration of Ecodesign and Energy Labelling regulations

Technical building systems include many products that are regulated under Ecodesign and Energy Labelling regulations (e.g. heating and cooling appliances). In relation to these regulations, it is worth emphasizing that requirements set under Article 8(1) EPBD apply to whole systems, as installed in buildings, and not to the performance of standalone components, which falls under the scope of Ecodesign and Energy Labelling regulations. By way of example, the scope of Article 8(1) EPBD requirements for a building hydronic heating system would cover the whole system (boilers, distribution and emission components), while the scope of Ecodesign requirements and Energy Labelling would in this case be limited to boilers. There is therefore a clear complementarity between the EPBD and Ecodesign and Energy Labelling regulations.

It is generally beneficial to encourage the installation of high-performance products, as mentioned in recital 58 of the Energy Efficiency Directive[15]:

[14] 'Book: 2016 – Implementing the Energy Performance of Buildings Directive (EPBD) – Featuring Country Reports', Concerted Action EPBD, 2016, https://www.epbd-ca.eu/ca-outcomes/2011-2015

[15] Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC.

'(…) Priority should be given to products offering the highest energy-saving potential as identified by the Ecodesign Working Plan and the revision, where appropriate, of existing measures'

However, one important point is that where requirements set under Article 8(1) EPBD would apply to products already covered by Ecodesign regulations, these requirements shall not go beyond the requirements set by the latter, as Ecodesign regulations are directly applicable harmonisation measures. In this respect, the Ecodesign framework (Directive 2009/125/EC[16]) states in Art. 6(1):

'Member States shall not prohibit, restrict or impede the placing on the market and/or putting into service, within their territories, of a product that complies with all the relevant provisions of the applicable implementing measure and bears the CE marking in accordance with Article 5 on grounds of Ecodesign requirements relating to those Ecodesign parameters referred to in Annex I, Part 1 which are covered by the applicable implementing measure.'

Therefore, banning specific types of products which comply with the applicable Ecodesign requirements would go beyond what the text of the revised EPBD requires and allows, because products from other Member States which comply with all EU Ecodesign requirements could not be sold on other national markets, in breach of the basic principle of free movement of goods.

However, Member States may, in certain cases, restrict the free movement of goods for environmental reasons, but only after having notified the Commission[17]. This is consistent with recital 35a[18] and Article 6[19] of the Ecodesign framework as amended by the Energy Efficiency Directive.

3.2.4. Technical, economic and functional feasibility

As explained in section 2.4, system requirements will not be applied in so far as they are technically, economically and / or functionally not feasible.

[16] Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of Ecodesign requirements for energy-related products.

[17] For further information, please see paragraphs 4 and 5 of Article 114 of the Treaty on the Functioning of the European Union (TFEU).

[18] This recital states that: *'Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings requires Member States to set energy performance requirements for building elements that form part of the building envelope and system requirements in respect of the overall energy performance, the proper installation, and the appropriate dimensioning, adjustment and control of the technical building systems which are installed in existing buildings. It is consistent with the objectives of this Directive that these requirements may in certain circumstances limit the installation of energy-related products which comply with this Directive and its implementing measures, provided that such requirements do not constitute an unjustifiable market barrier.'*

[19] The Energy Efficiency Directive adds the following sentence to Article 6 of the Ecodesign framework ('Free movement'): *'This shall be without prejudice to the energy performance requirements and system requirements set by Member States in accordance with Article 4(1) and Article 8 of Directive 2010/31/EU.'*

3.3. Transposition of Article 8 Paragraph 9 – assessment and documentation of system (or altered part) performance

3.3.1. Scope of performance assessment: system or altered part

The provisions of Article 8 paragraph 9 require that when a technical building system is installed, replaced or upgraded, the overall performance *'of the altered part and, where relevant, of the complete altered system'*, is assessed and documented.
This means that:

- In all cases, the performance of the altered part has to be assessed and documented (e.g. if the heat generator of a heating system is replaced – which corresponds to a system upgrade –, then the performance of the new heat generator has to be assessed and documented);
- In some cases ('where relevant'), the performance of the whole system shall be assessed and documented. This would be required in the following three situations:
    1. a new system is installed;
    2. a whole system is replaced;
    3. a part, or parts, of a system undergo a *major* upgrade that can significantly affect the overall performance of the system.

Cases 1 and 2 are straightforward: when a whole new system is installed or replaced (whether in a new building or in an existing building), then there is a clear need to assess and document the performance of the whole (new) system.

In the third case, a part or parts of the system are replaced or improved, thereby upgrading their energy performance which results in the upgrading of the performance of the whole system because the part is so important. In this scenario, the whole system performance must be assessed. For instance:

- Replacement of a major component (e.g. replacement of heat generator in a system) or replacement of a large number of minor components (e.g. replacement of all heat emitters in a building), with potential significant impact on overall performance, is in principle a major upgrade;
- Alteration of aspects of the whole system (e.g. improved insulation of pipes, replacement of pipes, replacement of all light sources, replacement of all radiators …) is in principle a major upgrade;
- Any upgrade or alteration that affects the balance of the system.

The following are indicative examples where the obligation would not be triggered:

- Maintenance and repairs that only aim to ensure the safe and optimal operation of the system;
- Replacement of a minor component of the system (e.g. replacement of a heat emitter).

In any case, it is up to Member States (and not to building and dwelling owners) to define in their national legislation the cases where it is relevant to assess the performance of the whole system, as opposed to those where only the assessment of the performance of the altered part is required.

In this context, Member States may differentiate between the different buildings and building units that can be affected by these provisions. This can concern e.g. the type of buildings (residential vs non-residential, individual dwelling vs multi-family building). This can also relate to system size, as it can be more relevant to ask for a more detailed assessment when a system is larger and more complex.

3.3.2. Assessment of overall performance

In the scope of these provisions, assessing the overall performance (of the altered part or of the whole system) means taking the necessary steps to evaluate and express the energy performance (of the altered part or of the whole system).

The term 'overall' emphasizes the need – where it applies – to assess the performance of the system as a whole opposed to product or component level performance. It is less relevant in the case where it is the performance of the altered part that is being assessed.

Member States must ensure that the scope of overall energy performance of technical building system under Article 8(9), for assessment and documentation purposes, includes at least the scope of overall energy performance under Article 8(1) for system requirements, and those aspects that have can affect overall energy performance under the other requirement areas (in particular control). This will ensure that the compliance with system requirements is assessed and documented, and that the owner is made aware of this compliance and can be proven (e.g. when the building or building unit is sold to a new owner).

The assessment of performance can be performed in different ways, therefore Member States will have to clarify which approaches should be followed to that end. These can vary depending on different factors (e.g. type of system considered; type of interventions: installation, replacement, upgrade, etc.). In particular, upgrades that are limited in scale and impact could lead to lighter assessment approaches (e.g. recording the intervention and ensuring that all relevant technical documents on the component(s) impacted are collected), while more substantial interventions (typically installation or replacement) should rely on a more thorough assessment of the impact on the system as a whole (e.g. relying on the simulation of system performance when the system is designed and on the verification of the key system capabilities after it is installed).

In defining these approaches for performance assessment, Member States will have to ensure consistency with the implementation of the provisions on the inspections of heating, air-conditioning and ventilation systems in Article 14-15 of the revised EPBD, in particular in relation to the requirement to assess (where relevant) the capabilities of the system under typical average operating conditions. For instance, where guidelines or templates for the inspection of technical building systems under Article 14-15 EPBD are available, references to these guidelines or templates may be made in the performance assessment under Article 8.

3.3.3. Documentation of system performance

The provisions of Article 8 paragraph 9 require that the results of the assessment of the system (or of altered part) performance are documented and passed on to the building owner. Member States are free to define the form and content of this documentation, which can vary depending on the type of intervention considered. However, in this context, Member States must ensure that the documentation covers the scope of the assessment performed and can be useful for the verification of compliance with the minimum requirements on energy performance laid down pursuant to Article 8 paragraph 1 and for energy performance certification (see next sub-section). Member States are also free to define the ways by which the documentation is passed on to the building owner.

3.3.4. Relation with building energy performance requirements and Energy Performance Certificates

The obligations on the documentation of system (or altered part) performance in Article 8 paragraph 9 aim to ensure that up-to-date information on technical building system performance is made available to building owners. Such information can be used, for instance for energy performance certification purposes or for the verification of compliance with minimum energy performance requirements (e.g. when a building undergoes a major renovation). It is up to Member States to decide whether a new Energy Performance Certificate (EPC) will have to be issued as a result of the assessment of the technical building system (or the altered part) energy performance.

4. GOOD PRACTICES

This section aims to highlight good practices in the implementation of the provisions on technical building systems in Article 8 EPBD. The information and references given in this section aims neither to be exhaustive nor to be prescriptive – these are provided only for indicative and information purposes.

4.1. Requirements on technical building systems

4.1.1. New technical building systems

Two new technical building systems are introduced in the revised EPBD: building automation and control systems (BACS) and on-site electricity generation systems. The following tables summarize how such requirements could be interpreted when implementing the revised EPBD.

As regards on-site electricity generation, our assumption is that the main target is photovoltaic panels; however, wind turbines (which size allows for on-site usage) and micro combined heat and power (micro CHP) are also within the scope.

Type of requirement	**Possible interpretations for BACS**	**Useful references[20]**
'overall energy performance'	Minimum requirements on control capabilities that have an impact on building energy performance. These requirements can concern the scope of control (i.e. which systems are controlled), the depth (or granularity) of control, or both. In defining these requirements, references can be made to available standards, for instance to BACS energy classes as defined in EN 15232	EN 15232[21], EN 16947-1:2017[22] and TR 16947-2[23]

[20] The references given all relate to standards. In addition to these, Member States can consider drawing on the practices of some industry-led schemes, which can be European, e.g. the eu.bac certification scheme (https://www.eubac.org/system-audits/index.htm) or, national, e.g. in Germany the VDMA 24186-4 'Program of services for the maintenance of technical systems and equipment in buildings – Part 4: Measurement and control equipment and building automation and control systems'.

[21] EN 15232 'Energy performance of buildings - Impact of Building Automation, Controls and Building Management'.

[22] EN 16947-1:2017 'Energy Performance of Buildings - Building Management System - Part 1'

[23] TR 16947-2 'Building Management System - Part 2: Accompanying prEN 16947-1:2015'

	standard. Requirements can vary depending on the type of buildings (e.g. residential vs non-residential) and on some characteristics of buildings (e.g. surface area).	
'appropriate dimensioning'	Dimensioning would refer here not to the system size (as it would for some other systems), but more to the way the design of a BACS can be tailored to a specific building. The aim of dimensioning is to reach the best compromise between costs and capabilities in consideration of the specific needs of the considered building. Requirements on dimensioning will list the relevant aspects that should be taken into account when designing a BACS for a specific building (e.g. expected or measured energy consumption, building usage, technical building systems installed in the building, operation and maintenance requirements, etc.) in order to reach this optimal compromise. In the scope of these requirements, it can be useful to refer to relevant standards or guidelines.	ISO 16484-1:2010[24]
'proper installation'	Requirements on the 'proper installation' is a generic reference to the need to ensure that the system (here, the BACS) is installed in a way that will ensure safe and optimal operation. Usually this is linked to requirements on the qualification of the installer (e.g. certified installer) and to specific technical guidelines.	EN 16946-1:2017[25] and TR 16946-2[26]
'appropriate adjustment'	'Adjustment' refers to post-installation test of the system in order to check that the system operates properly, and to fine-tuning when the system operates under real conditions. Such actions would generally require human intervention, but BACS give the opportunity to also consider ongoing commissioning approaches, where this process is partially automated[27].	EN 16946-1:2017[25] and TR 16946-2[26]; ISO 50003[28]
'appropriate control'	This category mostly applies to technical building systems that are controlled (e.g. heating systems) than to BACS, whose main purpose is to control other systems. However, 'appropriate control' can refer here to the functions that a BACS can offer in order to support or facilitate human control (e.g. display of consumption data or any other interaction with building operator and building occupants).	EN 15232[21], EN 16947-1:2017[22] and TR 16947-2[23]

Table 1: Possible interpretation of system requirements for BACS

[24] ISO 16484-1:2010 Preview
Building automation and control systems (BACS) -- Part 1: Project specification and implementation.
[25] EN 16946-1:2017 'Energy Performance of Buildings. Inspection of Automation, Controls and Technical Building Management'
[26] TR 16946-2 'Inspection of Building Automation, Controls and Technical Building Management — Part 2: Accompanying TR to EN 16946-1'
[27] This comment also applies to some extent to all technical building systems that are monitored and controlled by BACS.
[28] ISO 50003:2014 'Energy management systems -- Requirements for bodies providing audit and certification of energy management systems'

Type of requirement	Possible interpretations for on-site electricity generation systems	Useful references[29]
'overall energy performance'	Minimum requirements on the performance of the system (as installed) in terms of electricity generation under typical operating conditions. In defining these requirements, Member States are encouraged to consider applicable standards, in particular from the list of EPB standards (see third column), and applicable Ecodesign and Energy Labelling regulations[30].	EN 15316-4-6[31], EN 61724[32] and IEC 61853-2:2016[33] for photovoltaic systems, EN 15316-4-4 standard[34] for building-integrated cogeneration system, EN 15316–4-10[35] and IEC 61400-12-1[36] for wind power generation systems.
'appropriate dimensioning'	Dimensioning can first relate to the generation capacity of the system considered. One aim can be to ensure that this capacity is adequate with regard to considered needs (e.g. design heat load for cogeneration space heaters). Dimensioning can also relate to the physical dimensions of systems' components, taking into account the constraints that apply to the specific building[37] (e.g. position,	Calculation of design heat load: EN 12831–1[38], ISO 15927-5:2004[39].

[29] The references given focus on EU standards. In addition to these, Member States are invited to consult available resources at national level, e.g. in Belgium the 'Spécifications techniques (STS)' on photovoltaic systems: https://economie.fgov.be/sites/default/files/Files/Publications/files/STS/STS-72-1-systemes-photovoltaiques.pdf

[30] To date, the most relevant regulation for on-site electricity generation is the one on heaters and water heaters, which covers cogeneration space heaters, see 'Commission Regulation (EU) No 813/2013 of 2 August 2013 implementing Directive 2009/125/EC of the European Parliament and of the Council with regard to ecodesign requirements for space heaters and combination heaters'. In addition, the Ecodesign working plan 2016-2019 (COM(2016) 773 final) mentions that solar panels and inverters will be subject to preparatory studies, which means such systems could be covered by Ecodesign and / or energy labelling regulations in the future. See http://susproc.jrc.ec.europa.eu/solar_photovoltaics/projectplan.html for more details.

[31] EN 15316-4-6 'Heating systems in buildings - Method for calculation of system energy requirements and system efficiencies - Part 4-6: Heat generation systems, photovoltaic systems'

[32] IEC/EN 61724: Photovoltaic system performance monitoring - Guidelines for measurement, data exchange and analysis

[33] IEC 61853-2:2016 'Photovoltaic (PV) module performance testing and energy rating - Part 2: Spectral responsivity, incidence angle and module operating temperature measurements'

[34] EN 15316-4-4 'Heating systems in buildings - Method for calculation of system energy requirements and system efficiencies - Part 4-4: Heat generation systems, building-integrated cogeneration systems'

[35] EN 15316–4-10 'Energy performance of buildings – Method for calculation of system energy requirements and system efficiencies – Part 4–10: Wind power generation systems'

[36] IEC 61400-12-1 Ed. 2.0 b:2017 'Wind energy generation systems - Part 12-1: Power performance measurements of electricity producing wind turbines'

[37] The aim is to ensure that the system will have optimal performance over its lifetime. Suboptimal dimensioning could lead to poor performance, which is detrimental to the building owner.

[38] EN 12831–1 'Energy performance of buildings – Method for calculation of the design heat load'

[39] ISO 15927-5:2004 'Hygrothermal performance of buildings -- Calculation and presentation of climatic data -- Part 5: Data for design heat load for space heating'

	orientation, slope of PV panels, maximum power point tracking configuration, cable size, etc.).	
'proper installation'	Requirements on the 'proper installation' is a generic reference to the need to ensure that the system is installed in a way that will ensure safe and optimal operation. Usually this is linked to requirements on the qualification of the installer (e.g. certified installer) and to specific technical guidelines. For photovoltaic systems, standards applying to building-integrated photovoltaics (BIPV) can be relevant in this context.	For BIPV systems, EN 50583-2[40].
'appropriate adjustment'	'Adjustment' refers to post-installation test of the system in order to check that the system operates properly, and to fine-tuning when the system operates under real conditions.	For PV systems, IEC/EN 62446[41].
'appropriate control'	In this context, 'control' refers to the ability of the system to control its own operation, taking into account parameters from the environment and from the building. This is most relevant for micro CHP, due to their simultaneous production of thermal and electrical energy.	N/A

Table 2: Possible interpretation of system requirements for on-site electricity generation

4.1.2. Built-in lighting systems

Lighting systems were already part of the technical building systems under the former EPBD but they were not in the scope of the provisions on system requirements. However, under the revised EPBD, system requirements have to be established for 'built-in' lighting systems. As explained in section 2.2.1, the update of the wording is only a clarification of the scope. It emphasizes that only lighting equipment that is installed in order to implement lighting specifications defined at design time, and to fulfil related requirements, is considered.

Type of requirement	**Possible interpretations for lighting systems**	**Useful references**
'overall energy performance'	Minimum requirements on the performance of the built-in lighting system as a whole, taking into account relevant parameters. The LENI (Lighting Energy Numeric Indicator) as defined in EN 15193-1:2017 standard can e.g. be a way to express requirements on the performance of lighting systems.	EN 15193-1:2017[42], CEN/TR 15193-2:2017[43]
'appropriate	For lighting systems, 'appropriate dimensioning'	EN 12464-1[44],

[40] EN 50583-2:2016 'Photovoltaics in buildings. BIPV systems'
[41] IEC/EN 62446 'Grid connected photovoltaic systems – Minimum requirements for system documentation, commissioning tests and inspection'
[42] EN 15193-1:2017 'Energy performance of buildings - Energy requirements for lighting - Part 1: Specifications'
[43] CEN/TR 15193-2 'Energy performance of buildings - Energy requirements for lighting - Part 2: Explanation and justification of EN 15193-1, Module M9'

dimensioning'	would refer to the determination of illumination level requirements, taking into account relevant parameters (in particular intended usage of the building and its spaces) and to the translation of these requirements into design specifications for lighting systems.	CEN/TS 17165[45]
'proper installation'	Installation of electric equipment, including lighting, in accordance with applicable regulations at national level.	N/A
'appropriate adjustment'	Adjustment may refer here to checking that capabilities of lighting systems, in terms of controls in particular, comply with design specifications and perform any relevant fine-tuning.	Same as below.
'appropriate control'	In this context, 'control' refers to the ability of the lighting system to control lighting level, taking into account parameters from the environment (e.g. daylight) and from the building (e.g. occupation).	CEN/TR 15193-2[46], CIE 222:2017[47]

Table 3: Possible interpretation of system requirements for built-in lighting

4.1.3. Systems already covered under the former EPBD

Systems for space heating, space cooling, domestic hot water, and ventilation were already in the scope of the provisions on system requirements under the EPBD. However, the transposition of the revision can be an opportunity to update these requirements.

Type of requirement	**Possible interpretations for systems for space heating[48]**	**Useful references[49]**
'overall energy performance'	In this context, overall performance refers to the performance of the whole process of energy transformation in heat generators, heat distribution across the building, heat emission in individual	EN 15316 standard series, e.g. EN 15316-1[50], EN 15316-2[51], EN 15316-3[52], EN 15316-

[44] EN12464-1:2011 'EN12464-1:2011 Light and lighting – Lighting of workplaces Part 1: Indoor work places'
[45] CEN/TS 17165'Light and Lighting - Lighting System Design Process'
[46] CEN/TR 15193-2:2017 'Energy performance of buildings - Energy requirements for lighting - Part 2: Explanation and justification of EN 15193-1, Module M9'
[47] CIE 222:2017 'Decision Scheme for Lighting Controls in Non-Residential Buildings'
[48] Most of the information given in this table also applies to systems for domestic hot water.
[49] The references given focus on EU standards. In addition to these, Member States are invited to consult available resources at national level, e.g. in Belgium the 'Spécifications techniques (STS)' on thermal solar systems: https://economie.fgov.be/sites/default/files/Files/Publications/files/STS/STS-72-3-systemes-solaires-thermiques.pdf
[50] EN 15316-1:2017 'Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 1: General and Energy performance expression, Module M3-1, M3-4, M3-9, M8-1, M8-4'
[51] EN 15316-2:2017 'Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 2: Space emission systems (heating and cooling), Module M3-5, M4-5'
[52] EN 15316-3:2017 'Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 3: Space distribution systems (DHW, heating and cooling), Module M3-6, M4-6, M8-6'

	rooms or spaces of the building and, where applicable, heat storage. In particular, it is not limited to performance of heat generators and can include requirements that affect other parts of the system (e.g. insulation of distribution piping network).	4-1[53], EN 15316-4-2[54], EN 15316-4-5[55], EN 15316-4-8[56], EN 15316-5[57]
'appropriate dimensioning'	For heating systems, 'appropriate dimensioning' would refer to the determination of heating needs, taking into account relevant parameters (in particular intended usage of the building and its spaces) and to the translation of these requirements into design specifications for heating systems.	EN 12831-1[58], EN 12831–3[59], Module M8–2, M8–3EN 12828[60], EN 14337[61], EN 1264-3:2009[62]
'proper installation'	Proper installation refers to the need to ensure the system will be able to operate in accordance with design specifications. Ensuring proper installation can rely e.g. on national technical guidelines, products manufacturer documentation, certification of installers.	EN 14336[63], EN 1264-4[64], EN 14337[61]
'appropriate adjustment'	Adjustment refers here to the test and fine-tuning of the system under real-life conditions[65], in particular to check and possibly adjust system	EN 15378-1[66], EN 14336[63], EN 15378–3[67]

[53] EN 15316-4-1:2017 'Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 4-1: Space heating and DHW generation systems, combustion systems (boilers, biomass), Module M3-8-1, M8-8-1'

[54] EN 15316-4-2:2017 'Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 4-2: Space heating generation systems, heat pump systems, Module M3-8-2, M8-8-2'

[55] EN 15316-4-5:2017 'Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 4-5: District heating and cooling, Module M3-8-5, M4-8-5, M8-8-5, M11-8-5'

[56] EN 15316-4-8:2017 'Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 4-8: Space heating generation systems, air heating and overhead radiant heating systems, including stoves (local), Module M3-8-8'

[57] EN 15316-5:2017 'Energy performance of buildings - Method for calculation of system energy requirements and system efficiencies - Part 5: Space heating and DHW storage systems (not cooling), Module M3-7, M8-7'

[58] EN 12831-1:2017 'Energy performance of buildings - Method for calculation of the design heat load - Part 1: Space heating load, Module M3-3'

[59] EN 12831–3 'Energy performance of buildings – Method for calculation of the design heat load – Part 3: Domestic hot water systems heat load and characterization of needs, Module M8–2, M8–3'

[60] EN 12828:2012+A1:2014 'Heating systems in buildings - Design for water-based heating systems'

[61] EN 14337:2005 'Heating Systems in buildings - Design and installation of direct electrical room heating systems'

[62] EN 1264-3:2009 'Water based surface embedded heating and cooling systems - Part 3: Dimensioning'

[63] EN 14336:2004 'Heating systems in buildings - Installation and commissioning of water based heating systems'

[64] EN 1264-4:2009 'Water based surface embedded heating and cooling systems - Part 4: Installation'

[65] Member States may consider ensuring a degree of alignment between the methods followed for adjusting heating systems for the purpose of compliance with the provisions of Article 8(1) on heating system requirements and the methods followed to assess performance of heating systems under typical or average operating conditions, where relevant, under Article 14-15.

[66] EN 15378-1:2017 'Energy performance of buildings - Heating systems and DHW in buildings - Part 1: Inspection of boilers, heating systems and DHW, Module M3-11, M8-11'

[67] EN 15378–3 'Energy performance of buildings –Heating and DHW systems in buildings

	functions that can have an important impact on performance (e.g. control capabilities – see below).	
'appropriate control'	Concerns control capabilities that heating systems can include in order to optimize performance, e.g. automatic adaptation of heat output of emitters in individual rooms or spaces, adaptation of system temperature based on outside temperature ('weather compensation') or time schedules, dynamic and static hydronic balancing, system operation monitoring, adjustment of water / air flow depending on needs, etc.	EN 15500-1[68], EN 15316-2[51], EN 15232[12], space heater energy labelling regulations[69]

Table 4: Possible interpretation of system requirements for space heating

Type of requirement	Possible interpretations for systems for space cooling	Useful references
'overall energy performance'	In this context, overall performance refers to the performance of the whole process of energy transformation in cooling generators, cooling distribution across the building, cooling emission in individual rooms or spaces of the building and, where applicable, cool storage. In particular, it is not limited to performance of cooling generators can include requirements that affect other parts of the system (e.g. insulation of distribution piping network).	EN 16798 standard series on cooling systems, e.g. EN 16798–9[70], EN 16798–13[71], EN 16798–15[72]
'appropriate dimensioning'	Dimensioning refers to the optimal sizing of the cooling system with regard to the cooling needs of the building and its spaces.	EN 1264-3:2009[62]
'proper installation'	Proper installation refers to the need to ensure the system will be able to operate in accordance with design specifications. Ensuring proper installation can rely e.g. on national technical guidelines, products manufacturer documentation, certification of installers.	EN 1264-4[64]

– Part 3: Measured energy performance, Module M3–10 and M8–10'

[68] EN 15500-1:2017 'Energy Performance of Buildings - Control for heating, ventilating and air conditioning applications - Part 1: Electronic individual zone control equipment - Modules M3-5, M4-5, M5-5'

[69] Commission Delegated Regulation (EU) No 811/2013 of 18 February 2013 supplementing Directive 2010/30/EU of the European Parliament and of the Council with regard to the energy labelling of space heaters, combination heaters, packages of space heater, temperature control and solar device and packages of combination heater, temperature control and solar device

[70] EN 16798–9 'Energy performance of buildings –Ventilation for buildings

– Part 9: Calculation methods for energy requirements of cooling systems (Modules M4-1, M4-4, M4-9) – General'

[71] EN 16798–13 'Energy performance of buildings – Ventilation for buildings

– Part 13: Calculation of cooling systems (Module M4–8) – Generation'

[72] EN 16798–15 'Energy performance of buildings – Ventilation for buildings

– Part 15: Calculation of cooling systems (Module M4–7) – Storage'

'appropriate adjustment'	Adjustment refers here to the test and fine-tuning of the system under real-life conditions[73], in particular to check and possibly adjust system functions that can have an important impact on performance (e.g. control capabilities – see below).	EN 16798–17[74]
'appropriate control'	Concerns control capabilities that systems for space cooling can include in order to optimize performance, e.g. automatic adaptation of cooling output of emitters in individual rooms or spaces.	EN 15500-1[68], EN 15316-2[51], EN 15232[12]

Table 5: Possible interpretation of system requirements for space cooling

Type of requirement	**Possible interpretations for systems for ventilation**	**Useful references[75]**
'overall energy performance'	The energy performance of the ventilation system as a whole, taking into account e.g. fans energy efficiency, the characteristics of the ventilation duct network, heat recovery, etc.	EN 16798–3[76], EN 16798–5–1[77], EN 16798–5–2[78]
'appropriate dimensioning'	Dimensioning refers to the optimal sizing of the ventilation system with regard to the ventilation needs of the building and its spaces.	EN 16798–7[79], CEN/TR 14788[80], CR 1752[81]
'proper installation'	Proper installation refers to the need to ensure the system will be able to operate in accordance with design specifications. Ensuring proper installation can rely e.g. on national technical guidelines, products manufacturer documentation, certification of installers.	N/A

[73] Member States may consider ensuring a degree of alignment between the methods followed for adjusting heating systems for the purpose of compliance with the provisions of Article 8(1) on system for space cooling requirements and the methods followed to assess performance of air-conditioning systems under typical or average operating conditions, where relevant, under Article 14-15.

[74] EN 16798–17 'Energy performance of buildings – Ventilation for buildings
– Part 17: Guidelines for inspection of ventilation and air conditioning systems (Module M4–11, M5–11, M6–11, M7–11)'

[75] The references given focus on EU standards. In addition to these, Member States are invited to consult available resources at national level, e.g. in France, the NF DTU 68.3 'Installations de ventilation mécanique' standard.

[76] EN 16798–3 'Energy performance of buildings – Ventilation for buildings
– Part 3: For non-residential buildings – Performance requirements for ventilation and room-conditioning systems (Modules M5–1, M5–4)'

[77] EN 16798–5–1 'Energy performance of buildings – Ventilation for buildings
– Part 5–1: Calculation methods for energy requirements of ventilation and air conditioning systems (Modules M5–6, M5–8, M6–5, M6–8, M7–5, M7–8) – Method 1: Distribution and generation'

[78] EN 16798–5–2 | Energy performance of buildings – Ventilation for buildings
– Part 5–2: Calculation methods for energy requirements of ventilation systems (Modules M5-6, M5-8, M6-5, M6-8, M7-5, M7-8) - Method 2: Distribution and generation

[79] EN 16798–7 | Energy performance of buildings – Ventilation for buildings
– Part 7: Calculation methods for the determination of air flow rates in buildings including infiltration (Module M5–5)

[80] CEN/TR 14788:2006 'Ventilation for buildings - Design and dimensioning of residential ventilation systems'

[81] CR 1752:1998 'Ventilation for buildings - Design criteria for the indoor environment'

'appropriate adjustment'	Adjustment refers here to the test and fine-tuning of the system under real-life conditions[82], in particular to check system components and functions that can have an impact on performance (e.g. ductwork air-tightness).	EN 12599[83], EN 16798–17[74], EN 14134[84]
'appropriate control'	Concerns control capabilities that ventilation systems can include in order to optimize performance, e.g. airflow modulation.	EN 15232[12], EN 15500-1[68]

Table 6: Possible interpretation of system requirements for ventilation

4.2. Assessment and documentation of system (or altered part) performance

4.2.1. Scope of performance assessment

Section 3.3.1 gives guidance on how to interpret the scope of performance assessment (altered part vs whole system) under Article 8(9). One additional consideration is that it will be beneficial to ensure a degree of alignment between Article 8(1) and Article 8(9). This means in particular that, unless there is a justification for doing otherwise, a system upgrade under Article 8(1) should generally also be a system upgrade under Article 8(9). Member States may however wish to deviate from this approach for smaller, minor upgrades, which could lead to documenting the performance of the altered part of the system, while not triggering the application of any system requirements.

4.2.2. Assessment of overall performance

Section 3.3.2 gives guidance on how to interpret overall performance and on how to frame the assessment of overall performance. In particular, the need to ensure consistency with inspection practices under Article 14-15 is emphasized for the concerned technical building systems. An additional consideration is that, for system installation, replacement and upgrades that lead to the application of system requirements, Member States may find beneficial to ensure a degree of alignment between the tests performed for the purpose of compliance with requirements on system adjustment and those that could be required to assess overall energy performance for documentation purposes.

4.2.3. Documentation of system performance

As mentioned in section 3.3.3, Member States are free to define the form and content of the documentation (on system performance) that is passed on to building owners, provided that this documentation covers the scope of the assessment of system overall performance (section 3.3.2). An additional consideration is that it would be beneficial that this information is a provided in a way that highlights the compliance of the technical building system with applicable requirements. A checklist that would recapitulate applicable system requirements,

[82] Member States may consider ensuring a degree of alignment between the methods followed for adjusting heating systems for the purpose of compliance with the provisions of Article 8(1) ventilation system requirements and the methods followed to assess performance of combined heating / air-conditioning and ventilation systems under typical or average operating conditions, where relevant, under Article 14-15.

[83] EN 12599:2012 'Ventilation for buildings - Test procedures and measurement methods to hand over air conditioning and ventilation systems'

[84] EN 14134:2004 Ventilation for buildings - Performance testing and installation checks of residential ventilation systems

how these were assessed, and summarizing the results of the assessment (including possible tests under average or typical conditions), could fulfil this purpose.

As mentioned in section 3.3.4, it is up to Member States to decide whether a new Energy Performance Certificate (EPC) will have to be issued as a result of the assessment of the technical building system (or the altered part) energy performance. However, Member States are encouraged to require a new EPC in the case where the performance of a whole system can be affected (i.e. in case of installation, replacement or major upgrade), as in such cases it is likely that the performance of the whole building will also be affected.

Member States may also consider it beneficial to consider existing guidelines at national level[85] and outcomes from relevant EU projects[86].

[85] E.g. in Germany, the guidelines from AMEV (https://www.amev-online.de/AMEVInhalt/Infobereich/Aktuelles/technisches-monitoring-2017.docx)

[86] The QUANTUM Project (https://www.quantum-project.eu) has developed an approach for an appropriate and cost effective quality management process to assess and document building and system performance. In particular, QUANTUM aims to gives recommendations on data that shall be provided by technical building systems in order to be able to test performance.

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