eu.bac
GUIDELINES FOR THE TRANSPOSITION

of the 2024 Energy Performance of Buildings Directive (EPBD) in Member States

eu.bac european building automation controls association

Content

Foreword

[redacted]

[redacted], President of eu.bac

As President of eu.bac and a representative of Europe's building automation industry, I am excited by the **tremendous opportunities the revised EPBD creates for smarter and more flexible buildings**. In 2050, large majority of today's buildings will still be standing. That means renovation is a necessity — not a choice — and it must deliver four things at once: efficiency, resilience, flexibility, and sustainability. The good news: the technology exists today. Our industry already produces systems that can make those buildings measurably cleaner, safer, and smarter. The updated directive firmly acknowledges the potential of these technologies to drastically cut energy use while enhancing comfort and health for occupants. **With the EU setting these legal requirements, the market for smart building solutions will expand rapidly**, accelerating innovation and deployment. I applaud the **unprecedented collaboration across our industry** in agreeing on key provisions and presenting a united front to policymakers – this collective effort was essential to embed practical, impactful measures in the EPBD. The new rules not only align with the EU's climate neutrality targets but also validate eu.bac's mission to promote technologies that make buildings better for both people and the planet. We stand ready to support the EPBD implementation at the national level.

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[redacted], Managing Director of eu.bac

I am proud of our industry's pivotal role in shaping the revisions to the Energy Performance of Buildings Directive (EPBD). Through active advocacy and close collaboration with EU policymakers, **eu.bac led the push for crucial amendments** that recognize the value of Building Automation and Control Systems (BACS) and indoor environmental quality (IEQ) in improving building performance. We worked hand-in-hand with legislators and partners across the industry to ensure the **EPBD's new provisions align with Europe's climate and digitalization goals**, from mandating smart controls and IEQ standards to strengthening requirements for energy efficiency. These achievements underscore eu.bac's commitment to public policy leadership – demonstrating how our sector's expertise can help deliver the EU's Green Deal objectives. The revised EPBD is a milestone on the path to decarbonising Europe's buildings, and eu.bac will continue to support Member States in **transposing these ambitious measures** into effective national regulations.

Introduction

The revised *Energy Performance of Buildings Directive* (EPBD) – Directive (EU) 2024/1275 – is a pivotal framework for enhancing the sustainability and energy efficiency of Europe's building stock. It introduces a comprehensive set of provisions focused on advanced building technologies to **optimise energy use**, improve **indoor environmental quality (IEQ)**, and support the EU's climate objectives. Central to the recast EPBD is the integration of smart building solutions, including **Building Automation and Control Systems (BACS)**, hydronic balancing, and self-regulating devices.

This guideline document provides an industry perspective on these provisions, offering insights to support effective transposition and implementation across Member States. It addresses key areas such as mandatory BACS in non-residential buildings, the Smart Readiness Indicator (SRI), and prioritisation of IEQ to ensure occupant well-being. The guidelines emphasise optimising energy performance through technical building systems while minimising operational costs and enhancing sustainability.

By promoting smart technologies and automated controls, the EPBD aims to drive a more efficient, resilient built environment. This document serves as a resource for policymakers and national authorities, providing the technical context required to achieve compliance and leverage the benefits of these innovations.

Executive Summary

The revised EPBD sets ambitious goals to improve building energy performance, in line with the EU's climate neutrality targets. These guidelines offer a framework to assist policymakers, building owners, developers, and professionals in implementing the directive's provisions on smart building solutions across Member States. The focus is on actionable strategies that promote energy efficiency, improve IEQ, and ensure long-term compliance with the directive.

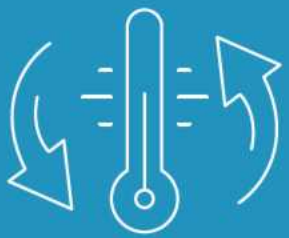
Key Provisions and Targets

Building Automation and Control Systems (BACS)

These systems are mandatory for new and existing non-residential buildings with an effective rated output of heating, cooling, and/or ventilation systems over 290 kW (by the end of 2024) and over 70 kW (by the end of 2029) **(EPBD Article 13(9)-(10))**. BACS ensure continuous monitoring, control, and optimisation of energy use. Additionally, the BACS mandatory functionalities have been extended with capability **(d)** requiring indoor environmental quality monitoring **(EPBD Article 13(10)(d))**.

Smart Readiness Indicator (SRI)

Under the recast EPBD, the Commission will establish a common Union SRI scheme by delegated act by **30 June 2027**, making SRI mandatory for large non-residential buildings >290 kW HVAC capacity **(EPBD Article 15)** This will build on the ongoing voluntary SRI framework. Affected buildings will be required to undergo an SRI assessment, which will rate the building's smart capabilities in improving energy efficiency and overall performance.



Hydronic Balancing and Self-regulating Devices

Article 13(3) requires that **new buildings** be equipped with self-regulating devices for separate room-level temperature control, and (where applicable) hydronic balancing of heating/cooling distribution systems, whenever feasible. In **existing buildings**, the installation of such **thermostatic controls and balancing valves** must be required when heat generators or cooling generators are replaced (if feasible). These technologies are critical for optimising heating and cooling efficiency, minimising energy losses, and enhancing thermal comfort.

Indoor Environmental Quality (IEQ) Provisions

+ **Monitoring and Control: Article 13(5**) requires **non-residential zero-emission buildings (ZEB)** to be equipped with measuring and control devices for monitoring and regulating **indoor air quality (IAQ)**. This applies to new public buildings from 2028 and all new non-residential buildings from 2030 (as those must be ZEBs under EPBD Article 7). In addition, whenever an existing non-residential building undergoes a *major renovation* to ZEB level, IAQ monitoring devices must be installed if feasible. Member States may also extend this requirement to residential buildings. Notably, compliance with the BACS functionality requirements in **Article 13(10)** – which now include IEQ monitoring – will inherently satisfy much of this IAQ monitoring obligation. In other words, a large non-residential building that installs a Class B BACS with IEQ sensors by 2026 will fulfil the EPBD's IAQ device mandate ahead of the ZEB deadlines. Member States should ensure their transposition aligns these provisions and avoids duplication.
+ **Mandatory IEQ Standards: Article 13(4)** obliges Member States to **set requirements for adequate indoor environmental quality standards** in buildings to maintain a healthy indoor climate. In practice, national regulations should establish performance thresholds or design criteria for key IEQ parameters (at least temperature, humidity, ventilation rate, and presence of air contaminants per the EPBD definition of IEQ.

Strategic Importance of BACS

Building Automation and Control Systems are central to the EPBD's goals. By enabling real-time optimization of building operations, BACS can deliver substantial energy savings and improve overall performance. Studies show installing BACS in inefficient buildings can raise their EPC rating by at least one class while paying back within a few years. Moreover, BACS often cost less than €20/m^2, making them one of the most affordable upgrade measures. Member States should therefore consider policies (incentives, training, etc.) to accelerate BACS deployment, particularly in the worst-performing buildings targeted by MEPS.

Challenges and Recommendations

Complexity of Compliance

Implementing the full range of EPBD measures will require clear guidance from national authorities. Older buildings may face technical hurdles; phased approaches or targeted investments in high-impact areas (such as energy management systems and IEQ upgrades) may be necessary to ensure feasibility. Member States should develop toolkits (e.g. compliance checklists, templates) to assist building owners and professionals in meeting new requirements, especially for BACS capabilities.

Harmonization Across Member States

While the directive sets EU-wide objectives, national transposition will vary. Stakeholders should engage early with local regulators during the transposition process to ensure clarity. Consistency is crucial for industry; divergent national interpretations (for instance on what constitutes adequate IEQ or how BACS requirements are implemented) could complicate technology deployment.

Conclusion

In conclusion, the revised EPBD emphasises the integration of smart building technologies and IEQ measures as foundational to transforming Europe's building sector. Adopting BACS, hydronic balancing, self-regulating devices, and IAQ monitoring systems will not only improve energy efficiency but also create healthier, more comfortable indoor environments. These guidelines provide stakeholders with the tools and insights needed to achieve compliance, reduce operational costs, and contribute to the EU's broader climate and energy goals.

Article 2

Relevant Definitions

§6 What Are Technical Building Systems?

'Technical building system' means technical equipment for space heating, space cooling, ventilation, domestic hot water, built-in lighting, building automation and control, on-site renewable energy generation and energy storage, or a combination thereof, including those systems using energy from renewable sources, of a building or building unit.

> Practical Context

BACS have been part of this definition since the 2018 EPBD amendment, meaning a building's automation/control system is to be treated as any other technical system when applying requirements (e.g. for renovations, energy performance optimization, etc.). In practice, this implies that when technical systems are renovated or upgraded, the BACS should also be upgraded or installed to meet the new standards (see Article 13(6) on optimising TBS upon retrofit). We also note that **electrical installations** (e.g. power distribution, wiring infrastructure) play a critical role in enabling efficient operation of all technical systems and integration of on-site renewables or EV chargers. While not explicitly listed in the EPBD definition, Member States are encouraged to consider a building's electrical installation as part of the overall technical system ecosystem, since an inadequate electrical system can hinder the performance of HVAC, BACS, solar PV, storage, etc.

§7 What is a Building Automation and Control System?

'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.

> Practical Context

The definition of BACS has remained constant since the last revision of the EPBD and adheres to the relevant standards of EN ISO 52120[1] and EN ISO 16484[2]. This broad definition should already be transposed into national law. It is important for Member States to distinguish between BACS in general (any such system as defined above) and the specific mandatory BACS capabilities outlined in Article 13(9) and 13(10) for certain buildings. In short, all BACS meeting the Article 2(7) definition are considered "technical building systems." However, only certain buildings (large non-residential ones over the stated capacity thresholds) are required to have BACS that fulfil the capabilities listed in Article 13(10) (monitoring, benchmarking, interoperable control, and IEQ sensing). If those requirements are met, the building is exempted from routine inspections (see Article 23(7) in EPBD 2024) – a significant incentive to comply. Member States should ensure this linkage is clear: installing a compliant BACS not only reduces energy use but also regulatory burden.

[1] EN ISO 52120 is an international standard concerning the Energy performance of buildings — Contribution of building automation, controls and building management. It specifies a structured list of control, building automation and technical building management functions which contribute to the energy performance of buildings; a method to define minimum requirements or any specification regarding the control, building automation and technical building management functions contributing to energy efficiency of a building; a factor-based method to get a first estimation of the effect of these functions; detailed methods to assess the effect of these functions on a given building.
[2] EN ISO 16484 is an international standard concerning Building automation and control systems (BACS). This document specifies guiding principles for project design and implementation and for the integration of other systems into the building automation and control systems (BACS).

§42 The Role of Air-conditioning on Relative Humidity

'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.

> Note

Although this definition (Article 2(42)) focuses on temperature control, air-conditioning systems inherently affect humidity and air quality as well. In implementing EPBD provisions, national authorities should recognize that maintaining thermal comfort includes humidity control. This is especially relevant given the new EPBD focus on IEQ. For example, a building with a BACS that manages an HVAC system can leverage the AC's cooling and dehumidification functions to ensure comfort and health (preventing mold, etc.). We recommend referring to EN 16798[3] for guidance on acceptable humidity ranges, even if "humidity" is not explicitly mentioned in the AC system definition.

[3]EN 16798 is a European standard, which specifies indoor climate input data for the design and assessment of energy performance of buildings with regard to indoor air quality, indoor thermal climate, lighting and acoustics

§66 What is Indoor Environmental Quality?

'Indoor environmental quality' means the result of an assessment of the conditions inside a building that influence the health and well-being of its occupants, based upon parameters such as those relating to the temperature, humidity, ventilation rate and presence of contaminants.

> Practical Context

The definition of indoor environmental quality (IEQ) is being introduced for the very first time. It holds particular significance in the context of Article 13, Paragraph 10, capability (d) of the Building Automation and Controls capabilities listed, as well as Article 13, Paragraphs 4 & 5, which requires Member States to establish optimal Indoor Environmental Quality Standards and require monitoring and regulation of parameters in buildings. The definition outlines several parameters that impact IEQ and can serve as the basis for minimum national monitoring or standard requirements. However, these parameters are not exhaustive and the definition needs to be strengthened by the Commission's guidelines. eu.bac, in its checklist, **sets out temperature (T), relative humidity (RH), and CO_2 levels as the minimum** list of parameters to be monitored in order to meet the Directive's definition. Nevertheless, we also believe that **Volatile Organic Compounds (VOC), Particulate Matter (PM2.5) as well as Daylight Illuminance Level (DIL)** should be monitored to ensure optimum Indoor Environmental Quality with reference to EN 16798, the ALDREN TAIL index and Level(s) European framework for sustainable buildings objective 4 for construction companies and contractors, manufacturers, asset managers, facilities managers, and occupants on Healthy and Comfortable spaces.

Article 13

PARAGRAPHS 9 AND 10

Mandatory Requirements for BACS in Non-residential Buildings

Article 13 of the recast EPBD contains multiple new or strengthened requirements for technical building systems. These span from general obligations to maintain and improve system performance, to specific mandates on automation, controls, and IEQ. This section provides guidance on each relevant paragraph of Article 13 and how national authorities can implement them.

Member States shall lay down requirements to ensure that, where technically and economically feasible, non-residential buildings are equipped with building automation and control systems, as follows:

(a) by 31 December 2024, non-residential buildings with an effective rated output for heating systems, air-conditioning systems, systems for combined space heating and ventilation, or systems for combined air conditioning and ventilation of over 290 kW;

(b) by 31 December 2029, non-residential buildings should have an effective rated output for heating systems, air-conditioning systems, combined space heating and ventilation, or systems for combined air conditioning and ventilation of over 70 kW.

These paragraphs are among the most impactful new provisions, essentially mandating **Building Automation and Control Systems** for large non-residential buildings, with staged compliance deadlines, and specifying the minimum functionalities those BACS must have.

How to Establish the Effective Rated Output and **Decide Which Buildings Are in the Scope?**

Firstly, the European Commission, in its guidelines, clarifies that the 290 kW and 70 kW thresholds apply to each system individually, i.e. the obligations will apply in all of the following cases:

+ When the effective rated output of the heating system is above 290 kW/70 kW;
+ When the effective rated output of the combined heating and ventilation system is above 290 kW/ 70 kW;
+ When the effective rated output of the air-conditioning system is above 290 kW/70 kW;
+ When the effective rated output of the combined air-conditioning and ventilation system is above 290 kW/70 kW.

The effective rated output is the maximum output (in kW) during operation, as stated by the system manufacturer. It is the responsibility of the building owner to determine whether their building falls within the scope of the guidelines. However, Member States should provide clear guidance on this matter when transposing the Directive.

In cases where a building is used for mixed purposes, it may not be immediately apparent whether the building should be classified as residential or non-residential. To address this, it is recommended to consider the effective rated output of the entire building and:

IF MORE THAN 290 kW/70 kW and most (>50%) of the useful building floor area is used for non-residential purposes, apply the mandatory requirements for BACS only to the non-residential part of the building; for the residential part of the buildings, the relative provisions will apply (see pages 11, 12 on Mandatory Functionality Requirements for Residential Buildings).

IF LESS THAN 290 kW/70 kW, these mandatory requirements will not apply unless decided differently by the Member States.

Where is it **Technically and Economically Feasible?**

The European Commission, in its guidelines, firstly clarifies how to interpret these terms:

Technical feasibility generally refers to possible technical barriers that can prevent or make technically irrelevant the obligations.

Economic feasibility generally relates to the upfront price (including installation) and the running costs of BACS and to how these costs compare to the expected benefits and other costs borne by the investor.

Instances, where the installation of BACS is not technically and/or economically feasible, are uncommon, and the European Commission's guidance document stipulates that such cases must be clearly identified and justified. It is important to note that owners or installers **cannot self-declare** a BACS as infeasible without justification, and each Member State must provide specific details on this in their legislation, transposing the Directive into national law. Labour laws and environmental, social and governance reporting (ESG) should not be ignored. The Commission's guidance also indicates that for new buildings, technical and economic feasibility will typically not be a concern, as:

1. The design of buildings and systems can ensure that there is no technical barrier to the installation of BACS;
2. The design of buildings and systems can ensure that the costs for the installation and use of BACS will correspond to the building owner's requirements, and the cost-benefit analysis is conducted;
3. BACS are already part of common practices for new large non-residential buildings.

When it comes to existing buildings, there may be instances where installing BACS proves difficult from a technical standpoint because the building technology systems are not equipped accordingly. This could be due to a subsystem lacking local controls or local controls not providing input/output signal capabilities. In these cases, it's likely that the existing systems are outdated and energy-inefficient, making a new, state-of-the-art system a priority. Additionally, according to the European Commission, when considering economic feasibility, the upfront and running costs, as well as the payback period, should be taken into account. Not to mention the cost of collecting data for ESG reporting and verifying labour compliance. . The average payback period for BACS is below three years, as demonstrated by the Waide study and almost always below ten years regardless of the application. Therefore, for economic feasibility to be a concern, a building would need to have exceptional circumstances that significantly increase costs or reduce benefits. Moreover, there are Energy Service Contract-based business models that do not require any upfront costs.

If we take a look at existing legislation, a possible relevant example could be Décret n° 2023-259 from France, where economic feasibility exemption for BACS systems is allowed only where the owner presents a study demonstrating that the installation of such a system or its connection with the technical systems of the site to be connected, is not feasible with a return on investment time of more than ten years, after deduction of public financial aid. Meanwhile, in Germany, under the GEG 2024 § 71a Gebäudeautomation, the economic feasibility exemption is not included at all, meaning that BACS systems are always considered feasible in buildings falling under the scope.

Functionalities of the **Mandatory BACS**

"The building automation and control systems shall be capable of:

(a) continuously monitoring, logging, analysing and allowing for adjusting energy use;

(b) benchmarking the building's energy efficiency, detecting losses in the efficiency of technical building systems, and informing the person responsible for the facilities or technical building management about opportunities for energy efficiency improvement;

(c) allowing communication with connected technical building systems and other appliances inside the building and being interoperable with technical building systems across different types of proprietary technologies, devices and manufacturers;

(d) by 29 May 2026 monitoring of indoor environmental quality."

How to Define if a BACS Fulfils **These Functionality Requirements?**

The capabilities listed under Article 13, Paragraph 10 apply only to the BACS in scope that are able to deliver relevant functions. If a building's technical building systems (TBS) do not support these BACS functionalities, the TBS must first be upgraded to enable them. It is, therefore, key to find a method to distinguish the BACS that can deliver the above-listed functions from those that cannot. To aid Member States in implementing the EPBD, eu.bac has created an updated **compliance checklist for BACS requirements** related to mandatory capabilities. This checklist serves as a necessary reference for Member States and other stakeholders to ensure compliance with the Directive.

Furthermore, the International Standard ISO 52120 provides a list of functions with energy efficiency classes from A to D for each of the functions. In general, a BACS with class B or above functions will meet the requirement for mandatory BACS. Rooms that are designed for continuous occupancy during operating hours shall have control equipment that meets at least Class B, according to ISO 52120, while other rooms shall meet at least Level C. Level B classes and higher can communicate with primary or "generation and distribution" systems, ensuring efficient energy flows. Systems such as boilers, chillers, and air handlers supporting rooms with Class B requirements (or mixed classes) must meet the same class of controls. A building is considered occupied if at least one room/zone falls in the "occupied" category. Additionally, only Level B classes and higher imply that local adjustments in rooms, such as temperature, airflow can be reset by the system, usually once or twice a day.

To avoid situations where heating and cooling are fighting against each other in the same room, all installed BACS must be designed to prevent such conflicts. For benchmarking the energy efficiency of the building, BACS require access to monitored consumption data to adjust energy usage and optimise energy performance, representing at least 80% of HVAC systems in the building. Finally, hydronic heating and cooling systems must be dynamically balanced at the heat/cool emitter/zone level. This is a crucial condition for optimising the performance of hydronic systems under typical or average operating conditions.

Remarks on functionalities under:

a

"Continuously monitoring, logging, analysing and allowing for adjusting energy use."

The functionality is defined in EN ISO 52120 group 7. It is assumed that the requirements meet at least the functionality class that the rest of the building is required to meet. An installed BACS can determine those parameters at any place within the architecture (even in the cloud). The priority is to secure a way to have data available over time.

b

"Benchmarking the building's energy efficiency."

EN ISO 52120 functions 7.3 and 7.4 in Tables 5 and 6 address the detection of efficiency. It is vital that an installed BACS supports both functions.

"Detecting losses in the efficiency of technical building systems."

This functionality is strictly related to benchmarking, as comparing values and developments over time of the acquired/calculated data allows the detection of drifts in performances.

The following mechanisms are examples of how a building's energy efficiency can be benchmarked and losses in efficiency can be detected:

Heat emission and (domestic) hot water distribution

Measure the supply and return water temperature of a heat emitter, e.g. a fan-coil unit, and compare the actual with the design temperature difference. Alternatively, actual vs. design pressure characteristics can be used. Significant deviation indicates a loss of efficiency.

Heat/cool generator

Compare actual efficiency, expressed e.g. as "coefficient of performance," with designed efficiency. Allow for a tolerance and detect whether the difference exceeds the acceptable deviation.

Air handler (VAV)

Pressure reset. Having the main fan maintain accurate pressure controls. During unoccupied periods, a test procedure runs to determine the pressure while all dampers are fully open and then while all are closed. The two measures are the new control points for the valve, which are to become the ramp ends of the pressure control sequence.

Room IAQ

The IAQ value (design) shall be tracked during occupancy time, and if the values fall below the outside air values, then the room is likely to be overventilated. Only with Class A possible.

Efficiency in function

Similar to the air pressure or flow in the ducts (static), heating and cooling capability could be determined during non-occupied times by heating or cooling rooms and watching out for temperature changes. With such a test, the general function of a system, including controls, could be detected.

The above functions mentioned under classes a) and b) allow – while data can be determined at a plant level or a group of similar plants (e.g. air handlers) – to detect efficiency drifts that indicate to operators upcoming or existing issues in the plant operation. A proper reaction to this is plant maintenance. Consumptions that allow "normalisation," e.g., HDD (heating degree days), shall also be determined and reported.

Remarks on functionalities under:

c

"Allowing communication with connected technical building systems and other appliances inside the building, and being interoperable with technical building systems across different types of proprietary technologies, devices and manufacturers."

"Interoperability" ensures that the required functions, as defined by mandatory BACS requirements, are both installed and operational—particularly for the integration of Technical Building Systems (TBS) and appliances within the BACS framework. For instance, devices such as room thermostats must be integrated into the BACS to meet the requirements for class B functionality. Example: A stand-alone fan coil unit in an occupied room must be functionally incorporated into the BACS to support class B-level performance.

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d

"Monitoring of indoor environmental quality."

This is a new capability added through the 2024 revision of the EPBD and shall apply by 29 May 2026. It needs to be considered in relation to the Article 2 Paragraph 66 definition outlining several parameters that impact IEQ and can serve as the basis for minimum monitoring requirements: temperature, humidity, ventilation rate and presence of contaminants. However, these parameters are not exhaustive and can be supplemented by Member States as deemed necessary. eu.bac in its checklist **sets out temperature (T), relative humidity (RH), and CO_2 levels** as the minimum list of parameters to be monitored in order to meet the capability (d) functionality in spaces designed for human occupancy, such as classrooms, offices, meeting rooms, restaurants, kitchens, shops, gyms, etc., at the relevant unit level. As a recommendation, we also believe that Volatile Organic Compounds (VOC), Particulate Matter (PM2.5) as well as Daylight Illuminance Level (DIL) should be monitored to ensure optimum Indoor Environmental Quality with reference to EN 16798-1:2019 and Level(s) European framework for sustainable buildings objective 4 on Healthy and Comfortable spaces.

Article 13

PARAGRAPH 11

Mandatory Functionality Requirements for Residential Buildings

Member States shall lay down requirements to ensure that, where technically, economically and functionally feasible, from 29 May 2026, new residential buildings and residential buildings undergoing major renovations are equipped with the following:

(a) the functionality of continuous electronic monitoring that measures systems' efficiency and informs building owners or managers in the case of a significant variation and when system servicing is necessary;

(b) effective control functionalities to ensure optimum generation, distribution, storage, use of energy and, where applicable, hydronic balance;

(c) a capacity to react to external signals and adjust the energy consumption.

This provision makes what was optional under the 2018 EPBD into a **mandatory requirement for residential buildings** (for new builds and major retrofits, by the transposition date). Unlike the non-residential BACS clause, there is **no size threshold** – it applies to residential buildings of any size, unless an explicit exclusion is invoked. However, Article 13(11) allows Member States to **exclude single-family houses undergoing major renovation** if the cost of installing these functionalities exceeds the benefits. Such an exclusion must be justified and notified (the Member State should demonstrate how they determined the cost outweighed the benefit). Apart from that narrow case, all multi-family residential buildings and new single-family homes are in scope.

The required functionalities are essentially "light" BACS capabilities tailored to the residential context:

Continuous electronic monitoring:

a

This means the heating/cooling/DHW system should have a means to measure its energy use and performance, and automatically notify the homeowner or manager if efficiency drops significantly or if maintenance is needed. For example, a smart thermostat or boiler control that tracks the boiler's efficiency or fuel consumption and flags when it falls below a threshold would fulfill this. The monitoring should be **continuous** (ongoing, not just occasional checks). A practical interpretation is that data logging at least daily (and analysis of trends) is expected, rather than, say, a quarterly manual reading. If performance falls "significantly could be defined as a percentage drop or absolute efficiency loss, an alert must be sent to the building owner/manager. Member States could tie this to existing boiler control standards or smart thermostat functions.

Effective controls for optimal operation (and hydronic balancing):

b

This requires that residential heating/cooling systems have appropriate controls to ensure they operate efficiently under partial loads and varying conditions. In practice, for a typical central heating system in a block of flats or a house, the following features would be expected: individual room temperature control (e.g. TRVs or zone thermostats), **weather-compensated** flow temperature control, scheduling (time-of-use programming), and hot water temperature and circulation control. These are common functionalities that together optimise generation (boiler modulation based on weather), distribution (pump control, **dynamic hydronic balancing** to adjust flows – explicitly required *"where applicable, hydronic balance"*), and storage/use (e.g. avoiding overheating or over-circulation). Article 13(11)(b) essentially embeds the requirement for **self-regulating devices and balancing** into the residential context for new/renovated buildings, linking to the Article 13(3) obligations. Member States should ensure that their regulations for residential technical systems include provisions for **dynamic hydronic balancing** (using automatic balancing valves or equivalent in multi-family buildings) and for the control systems to maintain optimal performance as conditions change. Commission guidance notes that if Member States had already transposed the voluntary 2018 provisions, they now need to **add hydronic balancing** to the list of required controls. In summary, (b) implies a *package of control functions* that work together to minimise energy waste – from generation to emission.

Demand-response capability:

c

The system should be able to adjust energy consumption in response to external signals (e.g. from the electric grid or a demand response program). In practice, a building automation and control system (BACS) typically provides the functions to interpret such signals and coordinate heat pumps, ventilation and DHW, as well as on-site storage, PV and EV charging, so that load can be shifted or limited while maintaining IEQ. Interoperable interfaces and fair access to building systems data further facilitate third-party flexibility services and market participation. Electrified systems (e.g., heat pumps) tend to offer greater responsiveness then fossil fuel-based ones, including pre-heating and off-peak charging strategies [Annex 7, Section 7]. If external signals (such as dynamic tariffs) are not yet available locally, installing the capability helps future-proof the building; in the meantime, BACS can still provide value through internal scheduling, peak-limiting and optimisation. The *functional feasibility* aspect implies that if a building isn't connected in any way to an external signal (e.g. no smart meter or no dynamic tariffs available), this function might not be immediately utilized.

How to Define if a **Building Has These Functions?**

The following mechanisms are examples of how the systems' efficiency can be monitored, and deterioration can be detected:

Building

Compare the actual HVAC and domestic hot water heating performance with the designed performance or, if unavailable, the performance during the last 2-3 years.

Heat/cool distribution

Measure supply and return water temperature, or pressure characteristics, at suitably chosen parts of the system, such as heat source or riser. Compare the actual with the design temperature difference. Significant deviation indicates a loss of efficiency. Measure domestic hot water temperatures to indicate too high/low value.

Upon significant deviation, e.g. a deviation by more than 30% of designed performance, building owners should receive a 'push' notification.

Effective control functionalities are those optimising building performance under actual part load operating conditions. For a typical multifamily building with central heating and a domestic hot water system, the relevant functionalities are:

+ Individual room temperature control
+ Dynamic balancing, as defined in EN 15316 and EN ISO 52120
+ Weather compensation
+ Scheduling
+ Domestic hot water control (temperature, circulation)
+ A capacity to react and adjust consumption following external signals from the grid

Compliance and standards: To aid implementation, **EN ISO 52120-1** provides a list of recommended capabilities for residential buildings (see especially **Part 7** of the standard). The Commission suggests Member States could require systems to meet **Class B for Part 7 (Technical Home and Building Management)**. Using the standard can provide a structured way to verify that the required functions are present. Member States should also integrate this requirement with existing national building codes. Some countries already mandate, for instance, thermostatic valves and programmable controls in new heating systems – those should now be expanded to include the **monitoring and notification** aspect and **demand-response readiness**.

Article 13

PARAGRAPH 12

Automatic Lighting Control

Member States shall lay down requirements to ensure that, where technically and economically feasible, non-residential buildings with an effective rated output for heating systems, air-conditioning systems, systems for combined space heating and ventilation, or systems for combined air conditioning and ventilation of:

(a) over 290 kW are equipped with automatic lighting controls by 31 December 2027;

(b) over 70 kW are equipped with automatic lighting controls by 31 December 2029.

The automatic lighting controls shall be suitably zoned and capable of occupancy detection.

This provision, in Article 13(12), adds a new requirement for **automatic lighting control** in large non-residential buildings, on a timeline slightly behind the BACS requirements.

Alignment with BACS: The EPBD mandates BACS installation in certain non-residential buildings. EN ISO 52120, the relevant standard for BACS, already defines automatic lighting control functionalities for Class B and Class A systems, which are also the recommended BACS classes for achieving the capabilities outlined in Article 13, paragraph 10 of the EPBD. This standard should also clarify the automatic lighting control requirement.

Occupancy Detection and BACS Integration: Occupancy detection, a key component of automatic lighting control, is also relevant for optimising other building systems, as outlined in EN ISO 52120. Integrating these functionalities within a unified framework can improve efficiency and avoid unnecessary device duplication.

Recognition of natural lighting controls through solar shading: Automatic solar shading solutions, as recognised under EN 52120 (Blind Control), play an essential role in creating energy-efficient buildings. These systems should be considered when implementing automated lighting controls. Blind control has two main purposes: protection from solar heat to prevent overheating and reducing glare. Solar shading allows for the optimal management of daylight, harnessing natural light while supporting occupant well-being. Additionally, it contributes to significant energy savings in heating, lighting, and cooling.

A clearer connection between these requirements would:

- **Promote Efficient Implementation of both BACS and automatic lighting control:**
  Encourage building owners to leverage BACS capabilities for automatic lighting control, aligning with existing standards and best practices.
- **Optimize Building Performance:**
  Foster a holistic approach to BACS utilisation, optimising not just lighting but also other building systems based on occupancy data.

By strengthening this connection, the EPBD can ensure that automatic lighting control contributes to a more efficient and integrated building automation system.

Article 13

PARAGRAPH 4

Member State's Responsibility to Set Indoor Environmental Quality Monitoring Requirements

Member States shall set requirements for the implementation of adequate indoor environmental quality standards in buildings in order to maintain a healthy indoor climate.

This clause places the onus on Member States to incorporate **minimum IEQ standards** into their building regulations. In practice, upon transposition, each country should have a defined set of IEQ criteria that new buildings (and possibly existing buildings in operation) must meet. Key points for transposition and implementation include:

Parameters to cover:

At a minimum, the standards should address the parameters named in the IEQ definition (Article 2(66)) – **air temperature, humidity, ventilation (fresh air rates), and airborne contaminants**. A “healthy indoor climate” implies thresholds for these factors that protect occupant health and comfort.

Use of standards and guidance:

Member States should reference **EN 16798-1** for thermal and air quality categories (which provide recommended temperature ranges and CO_2 levels for Category I, II, III environments). For example, maintaining a “healthy indoor climate” might be interpreted as meeting at least **Category III** conditions for existing buildings in use (moderate expectation, acceptable for most occupants), while new buildings might be expected to meet Category II (higher comfort level). The **Level(s) framework** and indices like ALDREN TAIL can also supplement these standards by providing additional IEQ metrics or targets (e.g. TAIL addresses Thermal, Acoustic, Indoor Air, Luminance comfort). Member States might set different IEQ targets for different building types (hospitals might have stricter IAQ requirements, for instance).

Integration with EPCs and renovations:

The EPBD makes IEQ part of the picture for building performance. Article 8(3) ensures **major renovations must consider IEQ**; Article 19(5) will have EPC recommendations include IEQ improvements. Member States should therefore align their IEQ standards with these – for instance, if during an EPC assessment it's found that a building doesn't meet the national IEQ standard (poor ventilation, etc.), the EPC should recommend upgrades, and possibly legal mechanisms could require action for very poor IEQ. Some countries might incorporate IEQ compliance checks in occupancy permits or health & safety regulations.

Enforcement and monitoring:

Setting the requirements is one step – ensuring they are followed is another. Member States should require that *designs* for new buildings demonstrate compliance with IEQ standards. For existing buildings, periodic inspections (Article 23, for HVAC systems) will now also touch on IEQ aspects – e.g. inspectors will check if ventilation systems are providing adequate airflow and if hydronic balancing is done to ensure even temperatures. The output of these inspections could feed into enforcement of IEQ standards. Some countries might choose to introduce an **IEQ certificate** or integrate IEQ into the EPC rating.

✓ Summary

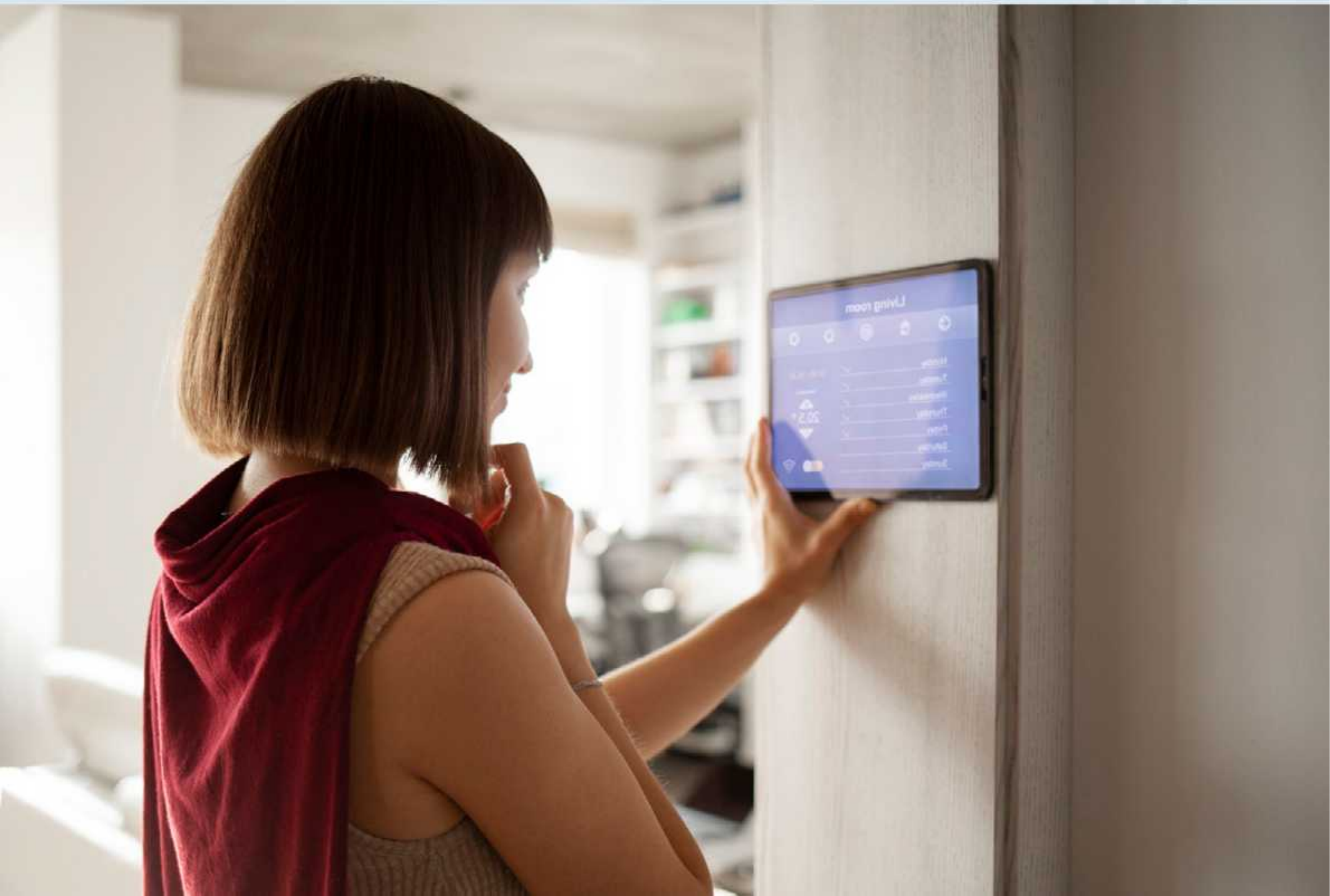
In summary, transposition of Article 13(4) should result in a clear set of IEQ benchmarks in national law, applicable to building design and operation. By focusing on **performance levels for key IEQ factors**, Member States can maintain flexibility and encourage the use of best-practice standards to achieve healthy indoor environments.

Article 13

PARAGRAPH 5

Monitoring and Regulation of Indoor Environmental Quality

Member States shall require non-residential zero-emission buildings to be equipped with measuring and control devices for the monitoring and regulation of indoor air quality. In existing non-residential buildings, the installation of such devices shall be required, where technically and economically feasible, when a building undergoes a major renovation. Member States may require the installation of such devices in residential buildings.



This clause expands on the IEQ monitoring theme by making it a requirement in **non-residential ZEBs** and certain renovations, complementing the BACS-based IEQ functionality (which only applies to larger buildings). Key interpretation points:

- **Non-residential ZEBs:** From 1 January 2030, all new non-residential buildings must be **zero-emission buildings** (Article 7). Thus, effectively, as of 2030 all new non-res buildings will need IAQ monitoring. Even earlier, from 2028 new public buildings must be ZEBs, triggering this requirement. The wording "zero-emission buildings" also includes buildings that have been renovated to ZEB level (deep renovations). So, *all* ZEB-compliant non-residential buildings, new or renovated, must have IAQ monitors and controls installed.

- **Major renovations of existing non-residential buildings**: If a building isn't necessarily reaching ZEB level but undergoes a major renovation (as defined in Article 2(30)), Member States must require IAQ devices *if feasible*. Many major renovations involve HVAC upgrades or changes in use, which present an opportunity to add IAQ monitoring. Technical feasibility here is usually not a barrier (sensors can be added to almost any system), and cost is relatively low in the scope of a renovation. So, we expect few exemptions on this basis.

- **Residential buildings**: Optional for Member States. Given the importance of indoor air quality in homes (for health and to manage ventilation energy), Member States are **encouraged** to extend this requirement at least to large residential buildings or those accommodating vulnerable occupants. Some may choose to mandate CO_2 sensors in new apartments or require provision for future installation. This is at their discretion but should be considered in national plans.

- **Scope of "measuring and control devices"**: This implies not just passive sensors, but integrated devices that can both monitor IAQ and control ventilation/airing systems to maintain it. For example, a CO_2 sensor integrated into a BACS system that increases flow as CO_2 rises would fulfil "monitoring and regulation". In simpler terms, a demand-controlled ventilation (DCV) system. Temperature and humidity might also be included if we interpret IAQ broadly (the definition of IEQ includes humidity, and excessive humidity can relate to IAQ in terms of mold risk). The **minimum** parameters to monitor and regulate should be **temperature, humidity, and CO_2** as recommended earlier. Additional pollutants (VOC, PM2.5) can be added by national choice if deemed necessary for certain building types.

+ **Relationship to BACS IEQ functionality:** There is overlap. Buildings that have installed a BACS under Article 13(10) will have IEQ monitoring (capability d) anyway, which would cover this requirement for IAQ. Article 13(5) captures some buildings that Article 13(10) does not: for example, a small school building (60 kW boiler) – not required to have full BACS under 13(9), but if it's newly built in 2030 as a ZEB, it *does* need IAQ monitoring under 13(5). Conversely, a large office with BACS will automatically meet 13(5). Member States should ensure that compliance with Article 13(10) BACS (with IEQ sensors) is recognized as fulfilling Article 13(5) for those buildings.
+ **Enforcement:** Similar to the BACS requirement, documentation will be key. For new ZEBs, obtaining an occupancy permit could be conditional on having the IAQ system installed and operational. For major renovations, building code sign-off should include the IAQ devices if applicable. Integration with EPCs: after renovation, the EPC could note the presence of IAQ control systems. For existing buildings not undergoing works, Article 13(5) doesn't directly mandate retrofit except at major reno, but public awareness and possibly voluntary programs could encourage it.

Summary

To summarize, Article 13(5) ensures that the push toward very high energy performance buildings does not come at the expense of indoor air quality – in fact, it ensures IAQ is actively monitored and managed in the newest and most efficient buildings. Member States' transposition should clearly state that **all new non-residential buildings from 2030 onward must include IAQ monitoring/control** and set criteria for major renovation triggers. It should also consider extending the requirement to residential buildings or specific residential settings (e.g. nursing homes, dormitories) as appropriate.

Article 13

PARAGRAPH 3

Self-regulating Devices and Hydronic Balancing

Member States shall require new buildings, where technically and economically feasible, to be equipped with self-regulating devices for the separate regulation of the temperature in each room or, where justified, in a designated heated or cooled zone of the building unit and, where appropriate, with hydronic balancing. The installation of such self-regulating devices and, where appropriate, hydronic balancing in existing buildings shall be required when heat generators or cooling generators are replaced, where technically and economically feasible.

This provision carries forward and strengthens the requirements from the previous EPBD (Article 8(1) of Directive 2010/31/EU as amended by 2018/844) regarding room-level temperature controls (e.g. TRVs) and adds an explicit mention of **hydronic balancing**.

What Devices Fall Under the Definition of **"Self-regulating Devices for the Separate Regulation of the Temperature"?**

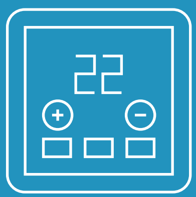
All temperature control devices are 'self-regulating' in that they will sense the temperature and, in response, automatically adjust the heating output to maintain the desired temperature. The key aspect of this requirement is that it needs to be done on a room-by-room basis, and therefore, the control must both monitor temperature and adjust heating output in each room. This means, in particular, that, as explained by the European Commission in its guidelines:

- Any solution based on the manual regulation of heating output would not fulfil the requirements, even if the adjustment can be performed at room (or zone) level.
- Any solution that allows for the automatic regulation of temperature but not at room (or zone) level, e.g. automatic regulation at dwelling level, would not fulfil the requirements.

Typical devices for individual room temperature control will depend upon the type of emitter in the room, but the following would be the most common:

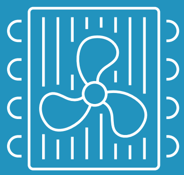
THERMOSTATIC RADIATOR VALVES (TRVS)

for rooms heated by radiators as part of a hydronic system. These are fitted to a radiator where it connects to the pipework, replacing the unregulated manual valves unable to react to room temperature changes, that would otherwise be used to set up the system. They have a sensor to monitor the temperature of the room they are in and then automatically adjust the heat output of the radiator in response to this by opening or closing the valve.



ROOM THERMOSTAT

for rooms heated by surface heating as part of a hydronic system. These will connect to the mixing valve for each room to adjust the flow temperature to the surface heating for that room, therefore automatically adjusting heat output into the room to maintain the setpoint temperature.



FAN COIL UNIT REGULATING DEVICES

that control water and airflows automatically to maintain/achieve the desired room temperature.

INDIVIDUAL DEVICE CONTROLS

for stand-alone heaters. Where rooms are heated by individual heaters that are not connected to a heat generator serving multiple rooms, it is likely that these heaters would have built-in controls to maintain a set-point temperature in the room. Ecodesign requirements for local space heaters should ensure that all replacement electric panel heaters, for example, will incorporate such controls. However, in some circumstances, it may be necessary to install a room thermostat wired into a local space heater to provide self-regulating room temperature control.

What Devices Fall Under the **Definition of "Hydronic Balancing"?**

The guideline describes hydronic balancing as ensuring the water flow in heating/cooling networks is properly distributed, which improves comfort and reduces energy use. Unbalanced systems often overheat some areas and underheat others, and pump energy is wasted pushing water through easier paths. Static balancing involves fixed valve settings to achieve design flows, but it only holds for the design condition (full load). Dynamic balancing uses special valves that automatically adjust to maintain flow as other valves open/close, ensuring balance at all loads. Modern best practice leans toward dynamic balancing for its ease and accuracy. Member States could thus require dynamic balancing devices for new systems and encourage their use in existing system retrofits. Given the growing demand for low-carbon heating systems, such as heat pumps, hydronic balancing is becoming increasingly important to maintain high coefficient performance.

Where is It Technically **and Economically Feasible?**

The European Commission, in its guidelines (EU 2019/1019), firstly clarifies how to interpret these terms:

+ Technical feasibility generally refers to possible technical barriers that can prevent or make technically irrelevant the obligations,
+ Economic feasibility generally relates to the upfront price (including installation) and the running costs of self-regulating devices and hydronic balancing, as well as how these costs compare to the expected benefits and other costs borne by the investor. In the context of these provisions, only the upfront price is relevant, as running costs of self-regulating devices and hydronic balancing will be negligible.

Furthermore, the EC also adds that "In the vast majority of cases, the question of technical and economic feasibility will not apply for new buildings, as the need for temperature self-regulation at room (or zone) level and hydronic balancing can be addressed in the design phase (preventing any technical barrier in the subsequent steps and ensuring related costs are optimal)."

With regard to existing buildings, the technical feasibility is strictly related to the economic feasibility. It is always technically feasible but in limited cases the amount of substantial alteration to make it feasible can lead to prohibitive costs, according to the European Commission.

In this respect, the European Commission makes it very clear that each Member State "must clarify how the costs are calculated and how they are compared" these parameters must be clearly identified in the regulation, transposing the EPBD into national legislation.

The preferable approach to do this, in the view of the European Commission, is "Comparing the upfront costs of self-regulating devices and hydronic balancing to the expected energy cost savings resulting from the installation of these solutions and setting a threshold on a maximum payback period (e.g. five years)".

This is the most effective option in the pursuit of the aims of this amendment, as it would ensure the installation of technologies (whose payback is 2-3 years) that are able to maximise the health and comfort of the occupants while at the same time securing energy and costs savings.

Where is It Justified to **Use A Designated Heated Zone of the Building Unit Instead of Individual Rooms?**

The concept of a 'heated zone' is less effective than 'individual room control,' as the significant benefits, particularly the potential for substantial energy savings, are tied to managing individual rooms. Without this level of control, optimizing energy consumption and comfort becomes impossible. Just as an indication, each degree of room temperature corresponds to an energy use difference of about 6%-7%. Therefore, in residential buildings, installing equipment controlling designated heated zones instead of single rooms is not justified from a financial or technical perspective. The application of "designated heated zone" should be, therefore, limited only to net-zero and non-residential buildings for rooms of equivalent type and usage when no additional energy savings can be achieved in a "room by room – zoning".

Article 13

PARAGRAPHS 1 AND 6

The Optimised Energy Performance of Technical Building Systems

§1 *Member States shall, for the purpose of optimising the energy use of technical building systems, set system requirements, using energy-saving technologies with respect to the overall energy performance, the proper installation, the appropriate dimensioning, adjustment and control and, where appropriate, the hydronic balancing of the technical building systems which are installed in new or existing buildings. When setting up the requirements, Member States shall take account of design conditions and typical or average operating conditions.*

§6 *Member States shall ensure that, when a technical building system is installed, the overall energy performance of the altered part and, where relevant, of the complete altered system is assessed. The results shall be documented and passed on to the building owner so that they remain available and can be used for the verification of compliance with the minimum requirements laid down pursuant to paragraph 1 and the* ***issue of energy performance certificates. Member States shall take the necessary measures to ensure that the energy performance of technical building systems is optimised where they are retrofitted or replaced.***

Overall system optimization under dynamically varying typical operating conditions is fundamental for a successful energy transition in buildings. In order to facilitate the transposition and implementation of this article, the European Commission, in its Guidance Document, included a table with possible interpretations of how these requirements can be concretely achieved in the BACS field.

eu.bac has compiled a list of essential capabilities necessary to ensure system optimization under dynamically varying typical operating conditions:

1. Capability of the heat or cool generator system, or ventilation air handling unit, to vary the heating/cooling power or fresh air output upon signals from the control system / demand signals from the emission spaces – so-called "modulation" of the output.

2. Capability of the HVAC system to vary energy distribution according to actual demand (e.g. capability of the pumps, compressors and fans to adjust water/refrigerant/air flows and temperatures to actual needs).

3. Capability of the control system to automatically modulate and adapt the output of heat or cool emitters – e.g. radiators or a fan coil unit – to match actual and desired room temperature in individual rooms of the building – so-called individual room temperature control based on various parameters such as room temperature/occupancy.

4. Capability of the control system to adapt space heating and cooling energy output to outdoor temperatures – so-called weather compensation.

5. Capability of the control system to automatically adjust humidity level – so-called humidification or de-humidification.

6. Capability of the control system to manage automated solar protection to ensure the correct level of HVAC / avoid unnecessary cooling and glare protection depending on natural solar gains or overheating depending on seasons.

7. Capability of the control system to manage artificial lighting levels depending on natural light through automated solar protection.

8. Capability of the control system to coordinate systems that are integrated in order to facilitate energy efficiency and smooth operation (e.g. scheduler and setpoint manager for rooms covering all installed services (e.g. heating, cooling, ventilation, light and sun protection)).

9. Capability of the control system to avoid simultaneous heating and cooling at the same time in the same room/space through any installed system (e.g. ventilation and heating).

10 Capability of the HVAC / hydronic system to ensure smooth distribution of energy across the building in water-based heating, air conditioning and cooling systems – so-called dynamic hydronic balancing.

11 Capability of the control system to support monitoring operation and changes in the system – in particular setpoints and schedules of room systems and equipment.

These capabilities optimize the HVAC system's energy and comfort performance under actual building use conditions by ensuring that each part/room of the building uses only the minimum amount of energy at the right time and at the right place to provide the indoor conditions chosen by the occupants and in accordance with legal requirements. (Labour Law). The system capabilities above ensure that actual operating conditions are close to assumed test conditions so that expected energy performance improvements are achieved in practice.

When is It Limited to the Altered Part and When Should It Be Extended to the Complete Altered System? **What Does "Complete Altered System" Mean?**

§6 *Member States shall ensure that, when a technical building system is installed, the overall energy performance of the altered part and, where relevant, of the complete altered system is assessed.*

In all cases when a technical building system is installed, replaced or upgraded, the performance of the altered part must be assessed and documented. In addition to this - "where relevant" – the scope of the assessment must be not only that of the altered part but that of the complete altered system.

There are certain cases in which the new TBS has such an important impact on the system that it is worth assessing its impact on the overall energy system, such as:

1. Additions of technical systems service full or for a part of a building (e.g. cooling system).
2. Changes/upgrades of the building envelope of above 5% of the surface of the envelope.
3. Addition of a building service (e.g. cooling, ventilation) in, for example, at least 5% of the volume of the conditioned building.
4. Changes in the TBS service (e.g. hydronic system) that affect, for example, more than 5% of the volume of the conditioned building.
5. Changes in the control subsystem of a service that affects scheduling, set point management or hard-wired interconnection with BACS (e.g. using dry contact(s)).

The Commission in its guidelines in the past (EU 2019/1019), has set out these trigger points for assessment:

1. 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;
2. 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;
3. Any upgrade or alteration that affects the balance of the system.

How Should This Assessment Be Documented **in Order to Make It Work?**

Article 13 Paragraphs 1 and 6 have the potential to trigger significant energy and cost savings via optimising the energy performance of technical building systems. To ensure the provision's effectiveness, it should be clarified that the documentation must be provided independently from the EPC, as the scope of the application and content are different. This could be realized through the inclusion of this information "as a separate entry" in the national energy performance database.

Article 13

How to Ensure the Compliance With the Mandatory Requirements Under Article 13?

Many Article 13 provisions introduce **new obligations** that require verification and enforcement mechanisms. Ensuring compliance, particularly for existing buildings, is a key implementation challenge. Member States should consider the following strategies:

+ **Building Code and Commissioning (for new buildings):** For new constructions and major renovations, compliance with Article 13 requirements (BACS, controls, IEQ, etc.) can be ensured through the building permitting process. National building codes should incorporate these requirements (e.g. a new non-residential building must include a compliant BACS if over threshold, new buildings must have TRVs, etc.). Inspectors or certified commissioning agents should verify the installation and proper functioning of required systems before final occupancy approval. The documentation mandated by Article 13(6) – an assessment of the energy performance of the altered system after installation – should be submitted and recorded, separate from the EPC, to serve as evidence of compliance. This info could be stored in the national EPC database for future reference.

+ **Documentation and Databases:** Article 13(6) requires that whenever a technical building system is installed, replaced or upgraded, its performance must be **assessed and documented**, and given to the owner. This documentation (sometimes called a "system performance report" or similar) is crucial. It not only verifies that the system meets minimum requirements but also can be used to check compliance with the specific mandates of Article 13. For example, if a BACS is installed,

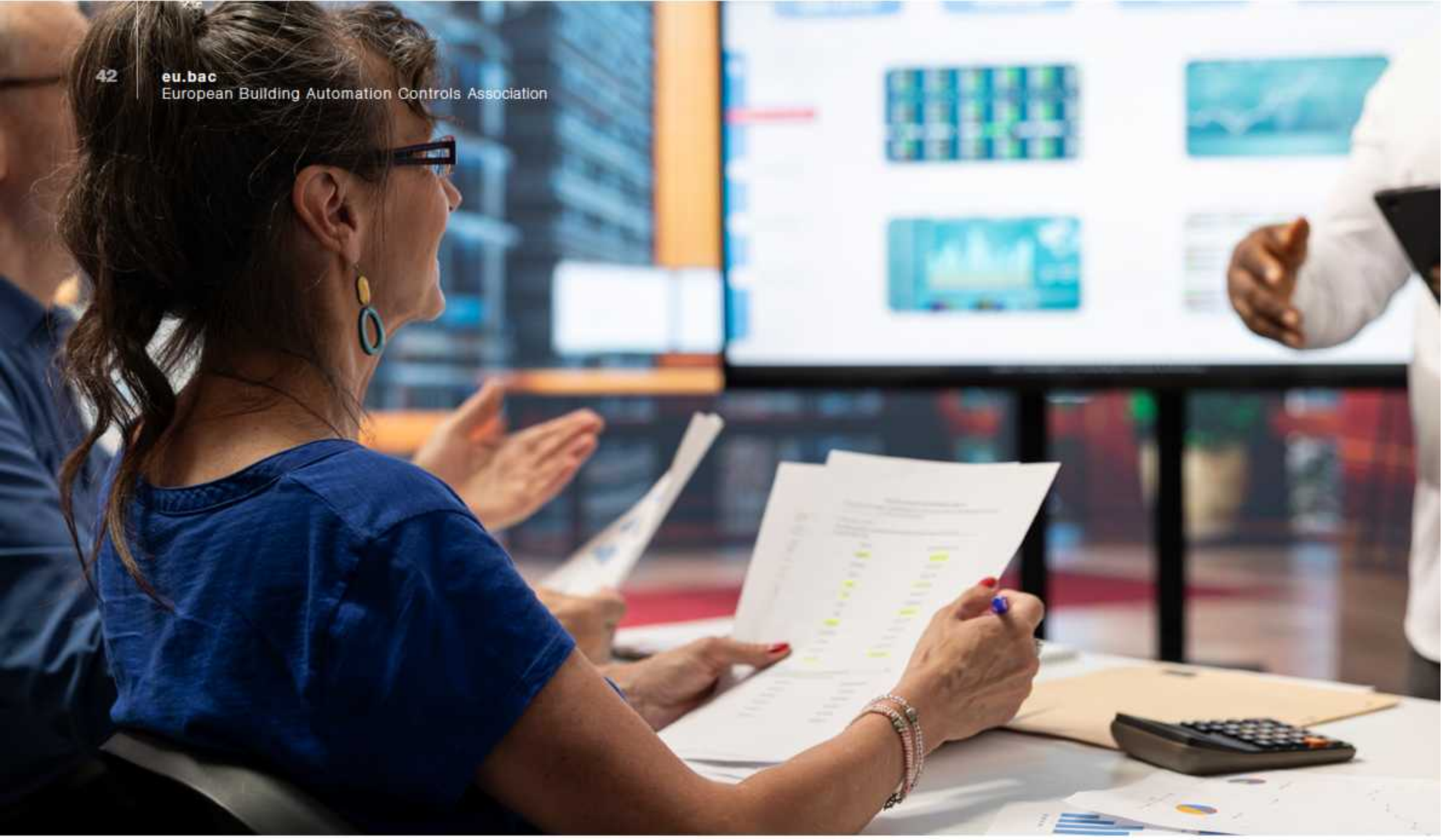
the documentation should note that it has functionalities (a)–(d). If a boiler is replaced, the report should confirm TRVs were added. Member States should require that this documentation be uploaded to a central registry (like an EPC database or a building renovation database). This ensures regulators have a record.

+ **Inspections and control systems (for existing buildings):** The EPBD's inspection regime (Article 23 and 24 in the recast) can be leveraged to enforce the new requirements. For instance, *inspections of heating and AC systems must now check hydronic balancing and control functionality*. If an inspector finds a large building without the required BACS or a renovated building lacking IAQ sensors, they would flag non-compliance. The independent control system for EPCs and inspections (Article 27 in EPBD) could be expanded to include verifying Article 13 measures. However, not all buildings will be inspected frequently (inspections can be up to 5 years apart for smaller systems).

+ **Random sampling approach:** As suggested, Member States can institute a **spot-check system** for buildings that fall under Article 13 obligations but might not otherwise be checked. This could mirror EPC/inspection control systems: competent authorities randomly select a statistically significant sample of buildings that should have, say, installed BACS by 2024, and **verify** that they indeed have. This might involve on-site visits or requiring owners to submit proof. It could be done in conjunction with EPC issuance – e.g. whenever an EPC is issued for a large non-res building after 2024, also check if BACS is present. Non-compliance can then be addressed.

+ **Penalties and incentives:** Member States are required by the directive to lay down penalties for non-compliance (Article 32 of the recast). For Article 13, penalties could include fines or withholding of certificates if owners don't implement required upgrades by deadlines. On the flip side, incentives can encourage early compliance – for example, subsidies for installing BACS or smart controls before the deadline. The guidelines suggest notifying building owners well in advance of the obligations and considering **financial incentives for early adopters**, as well as penalties for laggards. For instance, a grant program in 2023–2024 could help owners of >290 kW buildings install BACS before the end of 2024.

+ **Compliance checklists and digital tools:** eu.bac's compliance checklist **for BACS requirements** can serve as a reference for what needs to be checked. Member States can adapt this into a **standardized form** that installers or inspectors fill out, confirming each required capability. The guidelines note this can be digitised for ease of use. Some countries may integrate it into existing energy performance software or commissioning protocols.



+ **Synergies with SRI and EPC:** The Smart Readiness Indicator, once mandatory, will actually assess some of these capabilities (BACS functionality is directly tied to SRI scoring). Likewise, EPCs now include an indication if certain features like automatic controls are present. Member States can use SRI assessments or EPC data to identify buildings that have or lack compliance. For example, if an EPC database shows a large office building has no automatic control class, that could flag non-compliance with BACS requirement post-2024.

+ **Exemptions clarity:** Ensure that where the directive allows exemptions (feasibility issues, single-family exclusion, etc.), the national law clearly delineates how those are determined and by whom. Possibly require that an application for exemption must be filed by the owner with evidence (so it's not just assumed). This will tighten compliance.

Conclusion

In conclusion, **new buildings** will mostly be handled through building code enforcement at construction, whereas **existing buildings** need a combination of documentation at trigger events (system replacements), periodic inspections, and random audits to ensure they retrofit the required features. Member States should aim to integrate Article 13 checks into existing administrative processes to minimize burden (for instance, linking it with HVAC inspections and EPC issuance as mentioned). The overarching goal is that by the final compliance dates (2024, 2026, 2027, 2029, etc.), the vast majority of buildings have actually implemented these improvements, thereby delivering the expected energy savings and comfort benefits.

Article 15

Smart Readiness of Buildings

§2 *By 30 June 2026, the Commission shall submit a report to the European Parliament and the Council on the testing and implementation of the smart readiness indicator on the basis of the available results of the national test phases and other relevant projects.*

Taking into account the outcome of that report, ***the Commission shall, by 30 June 2027, adopt a delegated act*** *in accordance with Article 32, supplementing this Directive by requiring the* ***application of the common Union scheme for rating the smart readiness of buildings****, in accordance with Annex IV,* ***to non-residential buildings*** *with an effective rated output for heating systems, air-conditioning systems, systems for combined space heating and ventilation, or systems for combined air-conditioning and ventilation* ***of over 290 kW****.*

Overview: Article 15 of the recast EPBD is dedicated to the **Smart Readiness Indicator (SRI)**, a mechanism to assess the technological capability of buildings to interact with occupants and the energy grid, and to operate efficiently. In the recast, the SRI, which has so far been a voluntary scheme, is set to become more prominent and eventually mandatory for certain buildings.

Key provisions of Article 15:

+ The European Commission is empowered to **adopt a delegated act by 30 June 2027 to establish an EU-wide SRI scheme** (common methodology, parameters, rating system). This means by that date, the currently voluntary framework (piloted through Commission Delegated Regulation (EU) 2020/2155) will be updated or replaced with a binding one.
+ Once the common scheme is in place, **Member States must implement SRI for large non-residential buildings with HVAC over 290 kW**. The EPBD indicates that from a certain date, carrying out an SRI assessment will be *mandatory* for those buildings (the exact date will likely be set by the delegated act, but it's expected shortly after 2027). This aligns with the thresholds for mandatory BACS – essentially the largest buildings must also obtain a smart readiness score.
+ For other buildings (smaller or residential), SRI remains optional unless a Member State decides to mandate it nationally. The directive continues to allow SRI to be used on a voluntary basis elsewhere.
+ Article 15 also stipulates that the SRI scheme will be **aligned with other building assessment schemes** and should not create undue burden. It may involve displaying the SRI on the energy performance certificate or a similar public display for buildings open to the public, etc.

Transposition actions:

For now (before the delegated act), Member States should prepare the ground by: participating in the testing and refinement of the SRI methodology; raising awareness among building owners and professionals about SRI; and considering how to integrate SRI with EPC processes.

The SRI is intended as a **"key tool for measuring building smart performance and raising awareness"**. Its successful implementation relies on synergy with other provisions:

+ **Link with BACS requirements:** Buildings that have advanced BACS (Article 13(10) for non-res, 13(11) for res) will inherently score higher on SRI. Indeed, ambitious implementation of those BACS requirements will help achieve better SRI results. Conversely, an SRI assessment can also verify if a building has the mandated BACS functionalities. Member States should ensure that when they adopt SRI, **data from BACS compliance can feed into SRI scoring** and vice versa. They should streamline the assessment so that one survey covers both needs.
+ **Procedures:** The SRI could be integrated with EPC processes or done alongside them to reduce administrative load. The Commission has suggested to avoid duplication (for example, if an EPC assessor already collects info on controls and automation, that can serve the SRI). Member States might consider having the same experts handle EPC and SRI if qualified, or scheduling SRI assessments at similar intervals as EPCs.
+ **Standards:** The SRI scheme is being developed with open standards in mind. Member States should follow the **common methodology** provided by the Commission (likely via the delegated act or accompanying guidance). Ensuring consistency across the EU is important – fragmentation into national SRI approaches would undermine its value, so all Member States should adhere to the unified method and weighting for SRI.
+ **Communication to owners:** Once mandatory, building owners and developers need to be informed about SRI obligations. SRI should be presented as beneficial: it showcases the added value of smart features (improving comfort, flexibility, etc.). High SRI could even enhance property value or marketability. Member States should promote SRI through awareness campaigns, possibly linking it to green building certifications or financial incentives (e.g. banks might consider SRI in green mortgages).
+ **SRI and other directives:** Note that the EPBD SRI links with broader EU digitalisation initiatives. The Data Exchange (Article 16) will feed into SRI. Also, interactions with the Electricity Market Directive (on demand response readiness) and the Energy Efficiency Directive (on building energy management) exist.

Summary

In summary, **Article 15 and Annex IV set the stage for SRI to become mandatory for large buildings after 2027.** Member States' current focus should be on preparation: participating in the development of the SRI scheme, running or continuing pilots to gather experience (if not already), and preparing the infrastructure (legal and technical) to perform SRI assessments widely. Transposition at this stage might simply reference that the SRI *may be used* and that national authorities will support its implementation, with a commitment to adopt the delegated act's provisions when they come.

Overall, the SRI aims to drive smarter buildings by highlighting their capabilities in a standardized way. Aligning BACS, data exchange, and occupant-centric outcomes (comfort, convenience) through the SRI will support the EPBD's digital and decarbonised building stock goals.

Article 16

Data Exchange

§7 *By 31 December 2025, the Commission shall adopt implementing acts detailing interoperability requirements and non-discriminatory and transparent procedures for access to the data.*

Those implementing acts shall be adopted in accordance with the advisory procedure referred to in Article 33(2).

The Commission shall issue a consultation strategy, setting out consultation objectives, targeted stakeholders and the consultation activities for the development of the implementing acts.

What is "building systems data"? At a minimum, Article 16 covers readily available data relating to: (i) energy performance of building elements; (ii) energy performance of building services; (iii) projected remaining lifespan of heating systems (where available); (iv) building automation and control systems (BACS); (v) meters; (vi) measuring and control devices; and (vii) EV recharging points. It explicitly includes data about non-connected products and basic/static data about connected products (e.g., presence/type of BACS, sensors, number/type of EV charge points) [Annex 6, Section 3.1].

Covered:

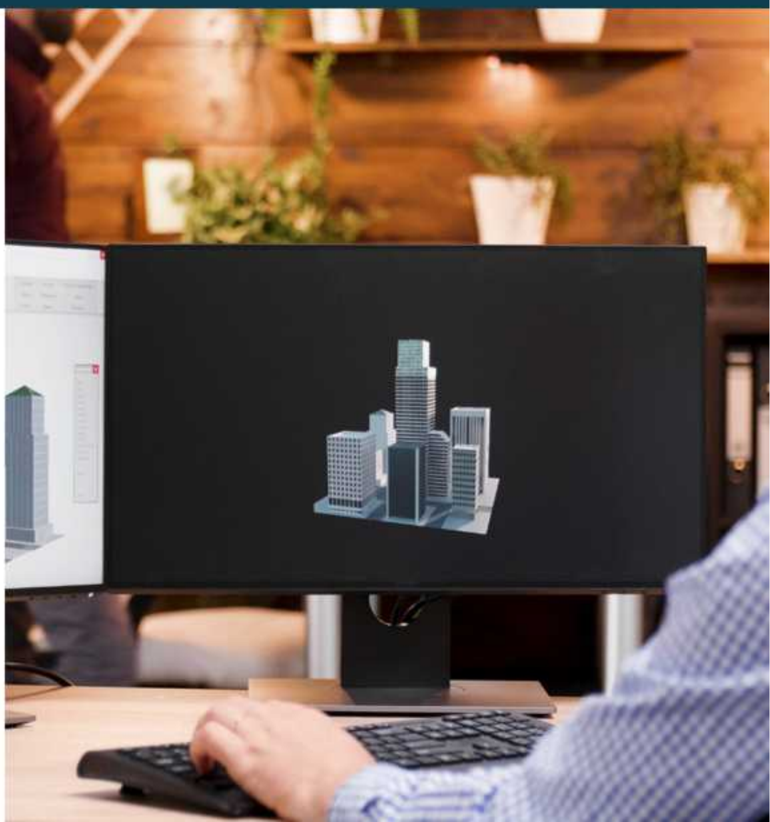
Data about building systems (non-connected and basic/static data about connected products): Static/characterisation data that describe the building and its systems as they are and that change only when works occur (e.g., renovation, system replacement). Examples: envelope U-values, installed on-site renewable capacity (e.g., PV kWp), number/characteristics of EV recharging points, presence/type of BACS and sensors, and other static descriptors. Article 16 can also encompass static building information stored in national databases such as EPCs, inspection reports, SRI certificates, renovation passports and digital building logbooks [Annex 6, Sections 3.1 and 4.1.3].

Not Covered:

+ **Dynamic/operational data from connected products** (e.g., time-series from smart heating systems, setpoints, IAQ sensor readings, on-site renewable production profiles) fall under the **Data Act**, not Article 16 [Annex 6, Section 3.1].

+ **Metering and consumption data from regulated meters** used for energy billing are outside Article 16 and governed by the **Electricity** and **Gas** Directives. Article 16 may still cover static information about the presence/type of non-billing sub-meters [Annex 6, Section 3.1].

The Data Act (Regulation (EU) 2023/2854) is cross-sector and applies to building-deployed connected products (an item that obtains/generates/collects data about its use or environment and can communicate that data). It requires product and related service data to be made available to the user and, upon request, to authorised third parties, and clarifies limits (e.g., highly processed/enriched data aren't covered).



Article 9

Minimum Energy Performance Standards and Trajectories for Progressive Renovation

To accelerate the renovation of worst-performing buildings. Member States must set **minimum energy performance standards** for existing buildings, including specific targets for upgrading the lowest-performing segments of the stock[55]. For example, for **non-residential buildings**, the Commission's guidance suggests targets such as renovating the worst-performing 15%–16% of floor area to higher ratings by 2030 (e.g. to at least EPC class F) and ~25% by 2033 (to at least class E). In the **residential sector**, Member States must establish a **national trajectory** for reducing average primary energy use – e.g. by ~16% by 2030 and ~20% (up to 22%) by 2035 – with a substantial portion of savings coming from upgrading worst-performing homes. These targets are to be integrated into National Building Renovation Plans and reported to the Commission.

Cost-Effective solutions: A key element in meeting these targets is the adoption of cost-effective energy-saving technologies. Recent research by Politecnico di Milano, highlights Building Automation and Control Systems (BACS) as a highly efficient and economical solution for improving building energy performance. The study demonstrates that implementing BACS, particularly in poorly performing buildings, can result in significant energy savings, leading to an upgrade of at least one Energy Performance Certificate (EPC) class. This is especially important as EPC ratings are central to compliance with MEPS.

The study shows that BACS can achieve these performance improvements at a relatively low cost, averaging below €20 per square meter. This makes them one of the most affordable solutions available, particularly when compared to other renovation options, such as installing thermal insulation or replacing windows. For instance, BACS focusing on heating and cooling can deliver up to 26% energy savings with a minimal investment, significantly contributing to MEPS compliance. In the non-residential sector, equipping the worst-performing 16% of buildings with BACS could save substantial amounts of energy while requiring an estimated investment of only €4.1 billion by 2030, rising to €7.2 billion by 2033 for further upgrades.

For the residential sector, the study estimates that achieving the 16% reduction in primary energy demand by 2030 would require the implementation of BACS in approximately 25 million buildings, with an investment of around €34 billion. Adopting slightly less efficient BACS class B systems could lower costs to €29 billion, although more buildings would need to be involved to reach the same energy reduction targets.

✓ Summary

In summary, the adoption of BACS represents a strategic and cost-effective approach to meeting MEPS. Their ease of installation, low cost, and significant impact on energy performance make BACS a crucial technology for achieving the EPBD's energy efficiency goals, particularly for the worst-performing buildings that are the focus of progressive renovation plans.

Article 23

Exemptions From Inspection of Heating, Ventilation, and Air-conditioning Systems and Checklists

§7 *Buildings that comply with Article 13(10) or (11) shall be exempt from the requirements laid down in paragraph 1 of this Article.*

All buildings equipped with BACS functionalities according to Article 13, paragraphs 10 and 11, both in non-residential and residential sectors, despite their dimensions (below or above effective rated output of over 290 kW), should be exempt from physical inspections of heating and air-conditioning systems, as these systems are able to provide the buildings with the same functionalities ensured by the inspections. Member States need to transpose this principle correctly in their legislation and ensure that all owners are informed about this possibility. It is in the best interest of the Member State to speed up the deployment of BACS, which are able to continuously monitor the performance and detect malfunctions, providing 24/7 control on the efficiency of the systems in a cost-effective manner.

§8 *Member States shall put in place inspection schemes or alternative measures such as digital tools and checklists to certify that the delivered construction and renovation works meet the designed energy performance and are compliant with the minimum energy performance requirements laid down in the building codes or equivalent regulations.*

After a new building is built or a major renovation is completed, there should be an inspection or at least a formal check to **certify that the building as built achieves its intended energy performance**. Member States must transpose this by: - Establishing either a formal "inspection" (which could mean an on-site verification by an expert) or **alternative measures** (which could be requiring submission of a commissioning report, digital compliance checklists, etc.) for new buildings and renovations. - The goal is to catch discrepancies between design and construction – for example, if a builder deviated from plans and the building is less efficient than promised, or if systems are not properly tuned. This ensures compliance with building code energy requirements in practice, not just on paper.

As proposed by the ITRE EPBD implementation report, recommendation 46, the industry has developed a useful **compliance checklist for BACS requirements** to aid Member States. The BACS checklist could be part of the broader post-work compliance checks (ensuring all systems, not just BACS, are properly commissioned). Digitising such tools can make it easier to aggregate results and identify common problems.

Member States should integrate this requirement with occupancy permitting or final inspections; basically, you should not get a final sign-off for a new building until this energy performance verification is done. Alternatively, it could be tied to the EPC: perhaps require a "as-built EPC" or a specific check right after construction that the EPC assumptions were met.

Annex I

Inclusion of EN ISO 52120-1 and Integration of BACS Into Energy Performance Calculation

Finally, it's noteworthy that **Annex I of the EPBD** (the framework for calculating building energy performance) has been updated to explicitly include the effects of building automation and controls. In Annex I, Paragraph 4(k) states that the **positive influence of building automation and control systems on energy performance and IEQ** must be reflected in the calculation methodology. Additionally, **EN ISO 52120-1** (the standard for BACS energy performance impact, successor to EN 15232) is now listed among the standards that Member States can use for their calculations.

This means: - When Member States update their national calculation software or methods (for EPCs or code compliance), they should incorporate algorithms or factors that give credit for BACS. For example, a building with a Class B BACS might reduce heating energy use by a certain percentage (as per EN 52120-1 tables). - It formally recognizes that deploying BACS improves a building's performance (and IEQ) and that should be quantified. EPC assessors will need to account for any installed automation – e.g. using the standard's factors for lighting control, HVAC control, etc., raising the EPC rating accordingly. Member States must describe in their EPC methodology documentation how they account for BACS and controls, per Annex I(1) and (4).

Including BACS in Annex I is a strong signal: it ensures BACS aren't seen as just "bonus" but integral to building performance evaluation. Transposition wise, if not already done, Member States should update technical definitions and EPC input forms to capture presence of BACS (many already do after 2018 EPBD, e.g. requiring to indicate if automation is present). They should also align with EN ISO 52120-1 to quantify contributions.

✓ Summary

In summary, by embedding BACS in Annex I, the EPBD ensures that all the effort to install BACS and smart controls is acknowledged in the official performance metrics. Member States must operationalize this by updating calculation methods promptly. They should also ensure assessors and software can handle this new parameter smoothly by 2026 at the latest. This will make EPCs more reflective of a building's true efficiency potential and promote smarter buildings through better scores.

References

1. Directive (EU) 2024/1275 of the European Parliament and of the Council of 24 April 2024 on the energy performance of buildings (recast) – *Official Journal L 1275, 8.5.2024*. [EPBD Recast 2024]
2. European Commission Guidance (2025) – Commission Notice on implementing the recast EPBD, with 13 Annexes covering specific provisions (Annex 1: MEPS, Annex 6: Data exchange, Annex 7: ZEB, *Annex 10 – Technical building systems, indoor environmental quality and inspections*, Annex 12: Calculation framework, etc.)
3. eu.bac BACS Compliance Checklist (2024) – An industry-developed checklist to verify compliance of installed BACS with EPBD Article 13(10) functionalities
4. EN ISO 52120-1:2022 – *Energy performance of buildings – Contribution of building automation, controls and building management – Part 1: General framework and procedures*. (This standard replaced EN 15232 and provides factors for the impact of BACS on energy performance)
5. *"Building Automation and Control Systems' Impact on EPC Classes in Europe"* (Politecnico di Milano, 2024)
6. EN 16798 series – *Energy performance of buildings – Ventilation for buildings – Modules M1-...* (Provides guidelines on indoor environmental input parameters, ventilation rates, and IEQ for design and assessment).
7. European Commission Recommendation (EU) 2019/1019 (on building modernisation)
8. France Décret n°2023-259 (March 2023) – France's regulation requiring BACS in large buildings, allowing economic feasibility exemption only if ROI > 10 years (with evidence)
9. Germany Gebäudeenergiegesetz 2024 (§71a) – Germany's building energy law mandating BACS in large non-residential buildings without any economic exemption
10. EU Data Act (Regulation (EU) 2023/2854)

About eu.bac

European Building Automation and Controls Association represents industry's leading manufacturers and service providers in Europe. Our vision is a world where everyone lives in smart, decarbonized, and efficient buildings. We work with EU and national authorities to translate policy into practice–reducing greenhouse-gas emissions in line with climate goals, accelerating the digital transformation of building infrastructure to drive growth and jobs, and empowering occupants, owners and operators to cut energy costs while improving comfort and well-being. We also help tackle energy poverty by fostering access to affordable, reliable and sustainable technology.

Learn more at **www.eubac.org**

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