Analysis of EPBD 2018 regarding requirements for building automation

1. Introduction

The EU is getting serious and tightening the thumbscrews: European buildings are to be CO_2-neutral by 2050, and this is already leading to a number of stricter requirements in the coming years. The main focus lies on strengthening building automation – whether directly or indirectly, through the intelligent integration of e-mobility charging stations or the continuous electronic monitoring of the efficiency of heating and air-conditioning systems.

Corresponding requirements for buildings are centrally regulated in the European Union. Although the member states must enact the actual, binding requirements as national law or regulation, the basics are predefined by the EU in the form of the EPBD (Energy Performance of Buildings Directive).

The first EPBD was published in 2002. It comprised a mere seven pages and made absolutely no reference to requirements for automation or control equipment.

In 2010, the EPBD was revised and expanded to 23 pages. Once again, there were no mandatory requirements regarding building automation, but Article 8 did contain preliminary recommendations for the introduction of *intelligent metering systems*, *active control systems*, and *automation, control and monitoring systems*. Thus, it appeared that the EU Commission in charge was beginning to realize that a completely energy-efficient building is not possible without building automation.

In 2018, the EPBD was again revised and expanded, resulting in a 29-page consolidated version. In this version, direct requirements for building automation were inserted in many places. Paragraph 15 explicitly states that *it is important to ensure that measures to improve the energy performance of buildings do not focus only on the building envelope*. Terms such as "self-regulating devices," "smart

charging of electric vehicles," "digitalization of the energy system," "electronic monitoring," and "connected buildings" appear several times. The term "building automation" is clearly emphasized nine times. There is also a demand to make buildings "smart-ready" and to make their smart readiness measurable and verifiable. This is to be based on a "smart readiness indicator" that is yet to be defined. The word "smart" appears 19 times. The importance of building automation is definitely growing!

2. Basic Content of EPBD 2018

This document examines the requirements for building automation in EPBD 2018 in more detail.

2.1 Background and framework data

This revision of the EPBD is based on the EU's goal of developing *sustainable, competitive, secure and decarbonized energy systems*. The purpose is to reduce greenhouse gas emissions by at least 40% compared to 1990 levels by 2030. Buildings are a particular focus because the EU considers them to be responsible for approximately 36% of CO_2 emissions.

One new aspect of EPBD 2018 is a cross-reference to the 2015 Paris Agreement on climate change and mention of the endeavor to contribute to the agreements reached in Paris through the current EPBD.

In addition to the climate policy framework conditions, the EPBD cites dependence on energy imports. It claims that for every one-percent increase in energy savings, gas imports can be reduced by 2.6%. Consequently, a reduction in the energy needs of buildings is extremely important for the EU's energy independence, as well as having tremendous job creation potential.

EPBD 2010 already suggested that the experience gained and progress made during its application be reviewed and, if appropriate, that proposals be made. This review was conducted, with the result that a number of changes were needed to strengthen the provisions in the EPBD.

2.2 Requirements for automation

As was already mentioned in the introduction, EPBD 2018 clearly stresses that measures to improve the energy performance of buildings should not focus solely on the building envelope. It recognizes that excellent progress has already been made in terms of building physics and that catch-up measures need to be taken in other areas.

In this context, it strongly recommends the installation of *self-regulating devices* for individual room temperature control. One interesting recommendation states that an economical use becomes probable when costs are less than 10% of the total costs of the discipline affected (wording in the EPBD: "of the replaced heat generator").

In the broader context, EPBD 2018 emphasizes the digitalization of energy systems and thus also the digitalization of the building industry. It is assumed that the further expansion of communication networks will result in an increased connection of building technology to these networks. The resulting requirement is that automation be "smarter" and more communication-capable. This is the only way that exact information on the energy consumption of individual disciplines or systems can be provided and observed. These requirements in the EPBD strongly reinforce the aspect of monitoring, which is in turn possible only through an extensive use of sensors and connection to higher-level controllers and monitoring systems.

For heating, air-conditioning and ventilation systems in particular, the directive emphasizes that actual energy efficiency can be assessed only on the basis of regular monitoring values, because operating conditions vary dynamically. Systems with an output of over 290 kW must be equipped with appropriate building automation systems by 2025. The directive also states that the introduction of building automation and electronic monitoring has proven to be an effective and, in larger buildings, the most cost-efficient replacement for inspections, and offers great potential for providing significant energy savings for both consumers and businesses. In order to encourage electronic

monitoring in smaller systems, the lower limit for mandatory inspections was raised from 12 kW to 70 kW. As a benchmark, the directive states that the corresponding investments can be paid back in less than three years.

At a higher level, EPBD 2018 calls for using a "smart readiness indicator" to measure buildings' capacity to use information and communication technologies as well as electronic systems to adapt building operation to the needs of the occupants/users. This will in turn improve the overall energy efficiency of buildings. In this context, EPBD 2018 clearly emphasizes the advantages of using building automation.

The method for calculating this smart readiness indicator must first be created. The EU Commission is expected to adopt an act to this effect by the end of 2019 as a supplement to the EPBD. The supplement will then contain the technical modalities for implementation and a timeline for an initially non-committal test phase at a national level.

2.3 Requirements for the charging infrastructure for electromobility

In addition to automation, buildings are also expected to meet several requirements in terms of the charging infrastructure for electric vehicles. Whereas the term "e-mobility" was never used in EPBD 2010, EPBD 2018 contains a number of requirements relating to it.

The foundation is reasonable: It must be possible to regularly recharge e-vehicles. For obvious reasons, this is best done where the e-vehicles are parked for longer periods of time – in garages or carports/parking spaces attached to private buildings or in company parking garages. In addition, there must be possibilities for "opportunity charging," meaning short-term but much more intensive charging while parked, for example, in supermarket parking lots or in city centers.

The biggest problem in this context isn't the specific power output but its delivery. Most of the electric grids currently installed are not designed for the

high charging power required by e-vehicles. Especially in places where multiple charging stations are available in a limited space – for example, in parking garages – the available charging power must be dynamically distributed to the active charging stations. This is possible only with load management – implemented either as a separate IT system or as an additional feature of a BMS (building management system). Either way, there is clearly a need for corresponding controllers and the provision of the necessary smart charging infrastructure. The EPBD 2018 pays particular attention to this aspect.

It states that buildings can be "leveraged" for the development of the infrastructure necessary for the smart charging of electric vehicles. E-vehicles also constitute an important component of a clean energy transition and thus contribute to important goals relating to climate policy and energy independence.

2.4 Requirements for member states

Although the EPBD defines guidelines for the requirements placed on buildings, only the particular member states can implement the measures. That's why the EPBD includes a number of recommendations regarding how these measures can and must be implemented.

Many measures are aimed at the further introduction of automation equipment. There are also measures for simplifying the provision of charging infrastructure for e-vehicles and the minimum number of charging points.

Member states are called upon to define clear guidelines and a mandatory design for measurable, targeted actions. It is also clearly recommended that they guarantee equal access to financing – meaning, for example, the creation of appropriate funding programs. Especially interesting is the recommendation that these actions and financing also be created for existing buildings and, very explicitly, for rental homes.

At the same time, the member states are required to implement initiatives that promote skills development and thus take into account the need for education in the construction and energy efficiency sectors.

3. Reconciliation of EPBD requirements with requirements for sensors and actuators in building automation

Requirements for building automation components can also be derived from the EPBD requirements.

EPBD requirements	Requirements for sensors/actuators in building automation
"Communication capability"	This requirement demands flexible yet powerful protocols for communication between sensors, actuators and controllers. To avoid unnecessary complexity, the number of protocols should be reduced as much as possible. On this basis, the requirement is for protocols that are as standardized as possible and highly versatile in terms of application (e.g. heating, cooling, ventilation, shading, lighting, monitoring and visualizing).
"Installation of self-regulating devices"	Control circuits require sensors. These sensors have to be installed in the best places for recording the desired data – and not where they can most easily be wired. In addition to wired sensors, radio-based sensors also have their benefits, but they must transmit securely and reliably and be low-maintenance or even maintenance-free. Even when deploying wired components, however, it still makes sense to use communication-capable components.
"Smart charging of electric vehicles"	The biggest problem with charging stations for e-mobility is the distribution of available charging power to the active charging stations. Add to this the requirements for using as much in-home PV current as possible. Truly smart load management takes into account patterns of charging station usage, the number of peo-

	ple in the building and charging station occupancy, among other things. In this case as well, a large number of sensors need to be flexibly positioned, low-maintenance or completely maintenance-free and able to communicate via protocols that are as standardized as possible.
"Smart readiness indicator"	Buildings need to become smarter. The trend is toward recording far more measured values than before. Whereas the traditional method is to install pushbuttons, temperature sensors and motion detectors, in the near future chair sensors will provide information on occupancy, and iBeacons will permit pinpoint locating in buildings and support location-based services. This transformation from traditional buildings to IoT buildings is currently just beginning and clear requirements on the type and position of sensors do not yet exist. Flexibility and the ability to change locations are thus key criteria on the way to genuinely smart buildings.

4. Implementation in EU states

The EPBD requires member states to establish clear guidelines, come up with measurable actions and (extremely important!) provide subsidies. It emphasizes that the actions also apply to existing rental homes.

When it comes to implementation, the member states are called upon to adopt the legal and administrative regulations needed to comply with the EPBD by March 10, 2020. For Germany, this could be quite a stretch, because the GEG (Building Energy Act) is currently in preparation.

The GEG is a combination of the existing EnEV (Energy Conservation Regulation), EnEG (Energy Conservation Act), and EEWärmeG (Renewable Energies Heat Act). In the current government's coalition agreement, it was decided that this combination would not result in stricter requirements. This makes adopting the required aspects in EPBD 2018 seem unrealistic. Soon, however, the German federal government will also have to clarify and define how it will meet the requirements of the EPBD, i.e. European law.

5. Summary

The EPBD (Energy Performance of Buildings Directive) establishes requirements for buildings, which are to be implemented by EU member states under their national laws. In Germany, for example, this is the most recent EnEV (Energy Conservation Regulation) and the GEG (Building Energy Act) currently in preparation. The latest EPBD amendment took effect on May 30, 2018. It requires the CO_2-neutral operation of buildings by 2050, with interim goals set for 2030 and 2040. For example, greenhouse gas emissions are supposed to be cut by 40% compared to the 1990 level as early as 2030.

This strict requirement is based on the view expressed in the EPBD that existing buildings in the EU are responsible for 36% of all CO_2 emissions. This means that buildings can't be exempted from the EU's overriding objectives regarding climate change.

5.1 "Smart-ready buildings"

The EPBD focuses explicitly on technical installations and on their regulation and control. While the focus in recent years has been primarily on the building envelope and optimizing the building physics (insulation, heat bridges, etc.), there is clearly a lot of catching up to do in the area of the regulation and control of technical building equipment. The EPBD thus imposes a series of stipulations on "self-regulating devices," "smart charging of electric vehicles," "digitalization of the energy system," "smart-ready buildings" (!), "electronic monitoring," and "connected buildings." The term "building automation" is clearly emphasized several times in this context.

The EPBD also covers a "smart readiness indicator," which is yet to be defined. This indicator should take into account aspects such as smart meters, the degree of distribution of building automation systems, self-regulating devices, etc. Although the specific definition and calculation of this factor are still to be established, just the fact that it has been officially determined specifically for buildings greatly strengthens the building automation discipline.

Last but not least, the directive cites a possible payback period of less than three years for the automated collection of consumer data.

5.2 Building automation is gaining ground

The EPBD imposes explicit requirements on building automation:

- "Installation of self-regulating devices": Experts in the field know that control circuits require sensors, actuators and control equipment (usually in the form of controllers). These requirements can thus be implemented only with building automation components.
- "Smart charging of electric vehicles" and "minimum number of recharging points" in non-residential buildings or multi-party residential buildings: The biggest problem with charging stations for e-mobility is the distribution of potential charging power to the active charging stations. This is possible only by introducing load management practices and thus intelligently coupling the charging stations with a superordinate controller. Once smart BMS systems (building management systems) control the technical equipment within the building, it is conceivable that e-mobility charging stations will also be connected to the BMS systems in the building in the near future. This means that, in the future, the building automation discipline will also be responsible for the load management of e-mobility charging poles.
- "Logging the actual energy performance" of heating and air-conditioning systems: The recording of actual consumption and energy efficiency values is extremely inadequate. This is mentioned multiple times in the EPBD. The actual values can be reliably and continuously recorded only with a monitoring system that sensibly forms part of the overall building automation

system. Finally, the measured values must not only be recorded but, according to the EPBD, continuously analyzed.

5.3 Conclusion

The new EPBD significantly increases the importance of building automation. It has now been recognized that completely energy-efficient operation also imposes additional requirements on monitoring and automation. Since these aspects were previously neglected at the expense of insulation and building systems, there is still a lot of catching up to do in the area of automation. The blueprint is in place, and this template must now be immediately turned into national laws and regulations.

6. Source

Analysis of EPBD 2018 regarding requirements for building automation, IGT – Institut für Gebäudetechnologie, 2019.