QUALICHeCK
Towards better quality and compliance

Source book for improved compliance of Energy Performance Certificates (EPCs) of buildings




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François Durier (CETIAT, France), Susanne Geissler (OEGNB, Austria), Peter Wouters (BBRI, Belgium)

With contributions from: Aleksandra Arcipowska (BPIE, Belgium), Samuel Caillou (BBRI, Belgium), François Rémi Carrié (ICEE, France), Maarten De Groote (BPIE, Belgium), Pär Johansson (Chalmers, Sweden), Theoni Karlessi (University of Athens, Greece), Marina Kyprianou Dracou (CYI, Cyprus), Jose Molina (University of Seville, Spain), Eric Winnepenninckx (UEAtc, Belgium)

www.qualicheck-platform.eu

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How to read and use this source book

This source book can, of course, be read through from beginning to end. However, it has been conceived as a book that can be scanned based on the reader's interest in one particular issue or another. Its structure and clear chapter headings will allow the reader to go directly to the pages of his/her choice.

In addition, this report contains numerous references to other documentary resources, largely derived from the QUALICHeCK project. It is strongly recommended that the reader who wishes to go further in his/her reflection consults the cited reports, fact sheets, recorded webinars and slide presentations. All of these are available at www.qualicheck-platform.eu.

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Executive summary

The European Directive on the Energy Performance of Buildings (2010/31/EU), also known as EPBD, requires that Member States of the European Union establish a certification of the energy performance of buildings. An Energy Performance Certificate (EPC) must be implemented that shows the owner or tenant the energy performance of his/her new or existing building compared to reference values (Articles 11 and 12).

The energy performance certification must be carried out by independent experts (Article 17) and Member States must establish an independent control system for the EPCs that are issued (Article 18) in order to ensure compliance.

An EPC is considered compliant if it is established and used according to the procedures of the relevant legislation. Non-compliance of an EPC with the rules of the Member State that transpose the EPBD must be subject to effective, proportionate and dissuasive penalties, to be stipulated by Member States (Article 27).

In this context, this source book intends to analyse the conditions for Energy Performance Certificate compliance and the reasons for non-compliance: how to make sure that a building's EPC is compliant, and thus that the minimum energy performance requirements are met and/or that the owner or tenant is well informed?

The EPC is issued from input data that describe the building, its environment, the construction products used and their implementation, the building systems (heating, cooling, ventilation, domestic hot water, lighting, renewables, etc.) and the building's operation. EPC compliance requires that these input data are also compliant, i.e. that they have been determined according to the procedures set out in the relevant legislation. Thus, compliant input data for energy performance calculation are the foundation of a compliant EPC and are dealt with in detail in this source book.

To achieve EPC compliance, a three-step approach has been laid out:

1. To obtain compliant EPC input data and to prove that they are compliant, there should be clear procedures explaining how to determine these input data,
2. There should be clear legal procedures about how to decide on non-compliance of an EPC and EPC input data, and how to implement related actions,
3. There should be effective control and sanctioning mechanisms to be applied in case of non-compliance of an EPC and/or EPC input data.

This source book describes this three-step approach, with examples and references to other documents from the QUALICHeCK project, which provide more details.

It also explains the need for clear procedures and easy access to input data.

It describes different ways to check compliance, together with the ways to define penalties so they are effective, proportionate and dissuasive. The importance of political will and societal support is also emphasised. The source book also discusses how to handle with innovative products and systems, the economic impact of compliance, and the future role of BIM for improving compliance.

The source book provides guidance and support for compliant Energy Performance Certificates and will be useful to all stakeholders interested in improving energy performance of new and existing buildings.

1. Introduction

Within the context of the EPBD, new buildings as well as the existing building stock must become much more energy efficient. The Energy Performance Certificate (EPC) is a key element in this process and aims to provide an indication of the energy performance of a given building determined according to the national legislation. Similar identifiers exist in voluntary schemes.

This source book aims to provide guidance and support for individuals and organisations that want to know if a better EPC enforcement is needed. Moreover, if it is indeed necessary or relevant, what are the possibilities and points for attention to implement a compliant Energy Performance Certificate framework, based on compliant and easily accessible input data?

In this source book, we analyse reasons for EPC-related compliance and non-compliance to answer the following question:

How can compliance of a building's Energy Performance Certificate be ensured, and consequently that the minimum energy performance requirements are met and/or that the consumer is well informed?

In this regard, the focus of analysis is on input data for calculation, but not on the calculation method as such.

The EPBD imposes demanding energy performance requirements on the one hand, creating a need for the elimination of thermal bridges in the building envelope, for airtight construction, and for energy efficient ventilation systems, and the nearly zero energy building (nZEB) concept on the other hand, which requires the installation of systems that produce on-site renewable energy. Therefore, this source book also focuses on the technical areas mentioned above. It is important to address the quality of input data related to these technical areas (transmission characteristics, ventilation and air tightness, sustainable summer comfort technologies, renewables in multi-energy systems), in order to ensure compliance to the minimum energy performance requirements. Compliance is demonstrated by fulfilling minimum requirements defined at different levels, e.g. maximum allowed specific heat transmission losses, maximum U-values of the envelope elements, maximum annual heat demand for space heating and for cooling, maximum primary energy for operation of building systems (HVAC and lighting), with an EPC determined according to the existing rules. Compliance also requires that the energy performance declared is correct according to the agreed EPC calculation, which means there would be a compliance issue even if the legal requirements are met but the EPC is too optimistic.

In order to achieve compliance, societal support is important, meaning that stakeholders understand and accept the need for energy efficiency requirements, the need for compliance and the need to check and enforce compliance.

A three-step approach (Figure 1) has been identified in order to achieve compliance:

1. There should be clear procedures explaining what must be done in order to determine EPC input data,
2. There should be clear legal procedures about how to decide on non-compliance and related actions,
3. There should be effective control and sanctioning mechanisms to be applied in case of non-compliance.

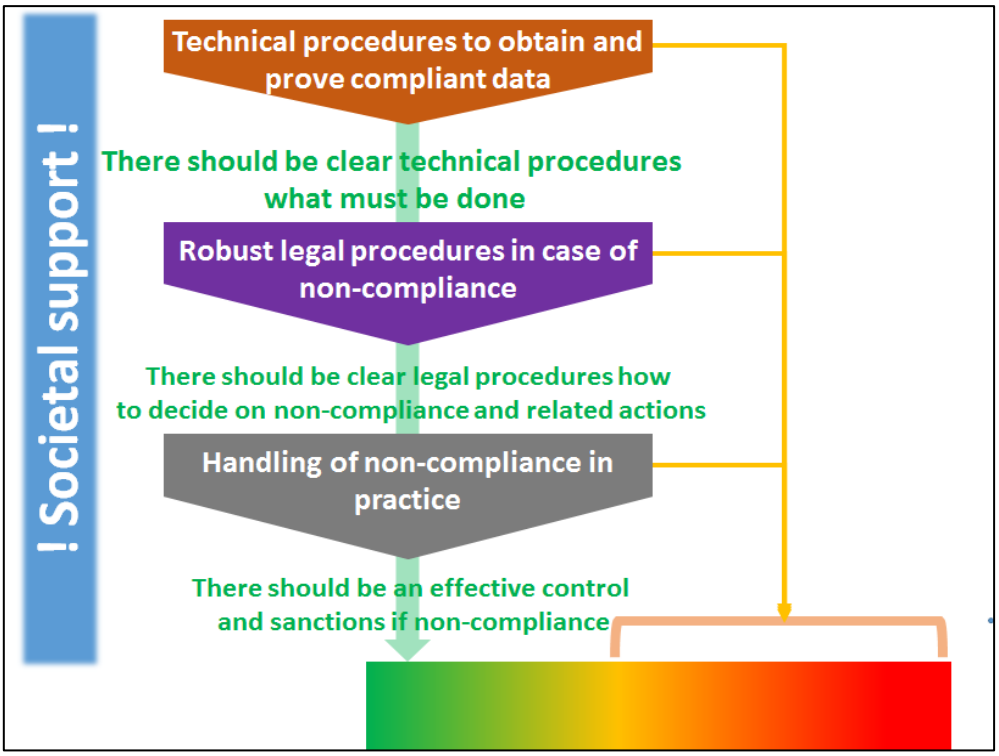

Figure 1: Overview of QUALICHeCK three-step approach

In **Chapter 2**, the context and scope of this source book is developed, with specific attention to various aspects of the EPC and its implementation.

Chapter 3 focuses on analysis of the reasons for effective/poor EPC compliance. The crucial elements for effective enforcement are briefly described in three steps.

A detailed description of these three steps (compliant input data, legal procedures in case of non-compliance, handling of non-compliance) is then discussed in **Chapters 4, 5 and 6**.

As innovation is a key element for progress, it is important that control and enforcement frameworks are not barriers to innovation. This is discussed in **Chapter 7**.

For control and enforcement schemes, it often is crucial to have societal support, and this is covered in **Chapter 8**.

Control and enforcement schemes always introduce some extra costs, but are there also benefits? This is discussed in **Chapter 9**.

In **Chapter 10**, the focus is on BIM (Building Information Modelling). To what extent can BIM be a game changer, with respect to EPC calculations and the related compliance and enforcement challenges?

Finally, the conclusions are found in **Chapter 11**.

2. Overall context

2.1. Scope of the source book

The primary focus of this source book is to provide suggestions for more effective compliance and enforcement in relation to EPC declarations in the context of the EPBD implementation. However, the suggestions provided in this source book can also be applied to a large extent to a variety of voluntary schemes related to energy performance of buildings.

2.2. Specifications in the EPBD in relation to compliance and sanctioning

There are two articles of the EPBD that are of specific relevance to the topic of compliance and enforcement: Articles 18 and 27.

Article 18 Independent control system

1. Member States shall ensure that independent control systems for energy performance certificates and reports on the inspection of heating and air-conditioning systems are established in accordance with Annex II. Member States may establish separate systems for the control of energy performance certificates and for the control of reports on the inspection of heating and air-conditioning systems.
2. The Member States may delegate the responsibilities for implementing the independent control systems. Where the Member States decide to do so, they shall ensure that the independent control systems are implemented in compliance with Annex II.
3. Member States shall require the energy performance certificates and the inspection reports referred to in paragraph 1 to be made available to the competent authorities or bodies on request.

ANNEX II Independent control systems for energy performance certificates and inspection reports

1. The competent authorities or bodies to which the competent authorities have delegated the responsibility for implementing the independent control system shall make a random selection of at least a statistically significant percentage of all the energy performance certificates issued annually and subject those certificates to verification.
   The verification shall be based on the options indicated below or on equivalent measures:
   - ✓ validity check of the input data of the building used to issue the energy performance certificate and the results stated in the certificate;
   - ✓ check of the input data and verification of the results of the energy performance certificate, including the recommendations made;
   - ✓ full check of the input data of the building used to issue the energy performance certificate,
   - ✓ verification of the results stated in the certificate, including the recommendations made, and on-site visit of the building, if possible, to check correspondence between specifications given in the energy performance certificate and the building certified.
2. The competent authorities or bodies to which the competent authorities have delegated the responsibility for implementing the independent control system shall make a random selection of at least a statistically significant percentage of all the inspection reports issued annually and subject those reports to verification.

Article 27 Penalties

Member States shall lay down the rules on penalties applicable to infringements of the national provisions adopted pursuant to this Directive and shall take all measures necessary to ensure that they are implemented. The penalties provided for must be effective, proportionate and dissuasive. Member States shall communicate those provisions to the Commission by 9 January 2013 at the latest and shall notify it without delay of any subsequent amendment affecting them.

2.3. Create appropriate boundary conditions that stimulate compliant EPC declarations

It is crucial that the EPC information is compliant with the relevant EPC regulations. In order to increase the likelihood of compliance, there are several areas of action to be considered (Figure 2).

1. TRAINING and COURSES:
   - ✓ As the cost-optimal and nZEB requirements represent new challenges for the market, it is important to evaluate whether there is a need for more and/or improved training/courses (on EPC calculation procedures, formal procedures, design approaches, execution aspects, etc.). If so, such new training/courses should be made available and, in parallel, existing training and courses should be upgraded to be in line with the new challenges.
   - ✓ The EPBD does include formal requirements towards the Member States with respect to actions in this area. Taking into account compliance and quality issues in a revised EPBD should be considered.
2. VERIFICATION or CERTIFICATION of competence
   - ✓ As part of a risk assessment, one has to evaluate if it is necessary to check that the required competence is effectively available. If so, one has to evaluate which type of checks/verification/certification is the most appropriate.
   - ✓ The EPBD has no formal requirements towards the Member States in this area.
   - ✓ The RES has a formal requirement that the Member States have a scheme for certification of installers of systems using renewable energy sources.
3. CHECKING if EPC information is compliant and related enforcement
   - ✓ These Member State activities are explicitly requested by the EPBD (Articles 18 and 27).

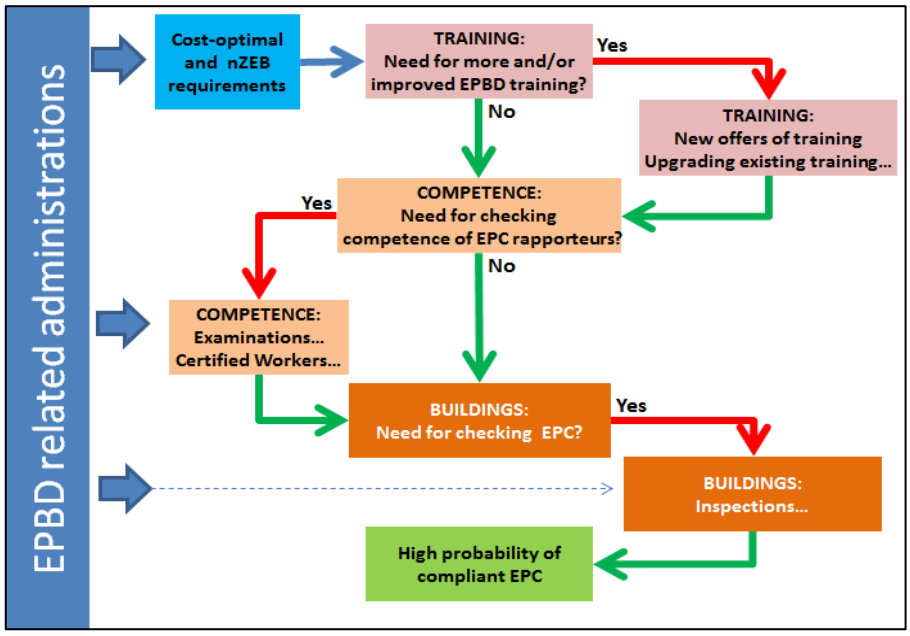

Figure 2: Possible action areas for EPC compliance

2.4. Enforcement is politically a sensitive issue

In general, enforcement of legislation is in most areas quite challenging. This is also the case for enforcement (and related sanctioning) of building regulations. In domains where non-compliance may have health effects or even be life threatening (e.g. stability, fire), societal support for strict enforcement is typically quite broad. This might be substantially lower in areas like energy efficiency. In the past, few countries had effective enforcement frameworks for energy efficiency requirements for buildings. At present, although the EPBD requires Member States to have an operational framework for penalties, few countries have such framework in operation.

For policy makers, deciding on the implementation of an enforcement framework might often not receive a lot of societal support; rather the opposite is often true. However, without societal support, there is no long-term future for enforcement and penalties.

The fact that there is a growing international consensus and will to act against climate change (as highlighted by the Paris COP 21 in December 2015) might help to increase societal support.

The issue of societal support is further developed in §8.

2.5. Current situation in Europe on compliance and enforcement

Enforcement is a key aspect to ensure effective compliance with rules and regulations related to energy performance. Articles 4, 6 and 7 of Directive 2010/31/EU on the energy performance requirements for new and renovated buildings are essential to compliance checks. The Core Theme *Compliance of Regulations* established in the third phase of the Concerted Action EPBD (from 2011 to 2015) investigated the implementation of compliance and enforcement procedures as required by Article 18 on Independent Control Systems and Article 27 on Penalties.

The respective report[1] provides an overview of the present situation in Europe and makes clear that there is much room for improvement on checking compliance with the EPBD requirements in most Member States, as well as on issuing sanctions. For example, about half of the countries have an idea about the building's compliance rates, while about half do not (Figure 3).

Figure 4 shows that in 2014 most countries checked the compliance of energy performance requirements at the design stage as part of the building permit procedure. However, since it is normal that design changes occur, another check is necessary after construction or as part of the procedure of issuing the permit for use. Bearing the intention of the Directive 2010/31/EU to transform the building sector towards energy efficiency, the as-built situation needs to be checked and controlled. In 2014, twenty-one MSs asked for proof of compliance at a certain point after construction was complete while the other countries check compliance at different phases or even only through random checks (Figure 4).

Although various sanctions are defined, practical application lags behind. Very few Member States have applied sanctions for issues related to energy performance requirements. There are many reasons for the insufficient implementation such as limited resources for checking and lack of political will for enforcement. This source book builds on the information gathered in the Concerted Action EPBD and extends the range of challenges to be addressed for better compliance.

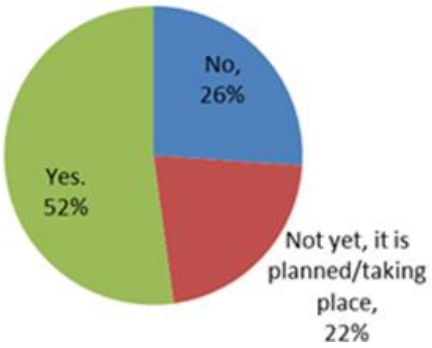

Figure 3: Countries with an idea of the compliance rates of new buildings[2]

[1]Certification: overview and outcomes - Susanne Geissler, Naghmeh Altmann-Mavaddat - Core Theme Reports of CA EPBD 2012-2015, August 2015, http://www.epbd-ca.eu/outcomes/2011-2015/CA3-CT-2015-1-Certification-web.pdf

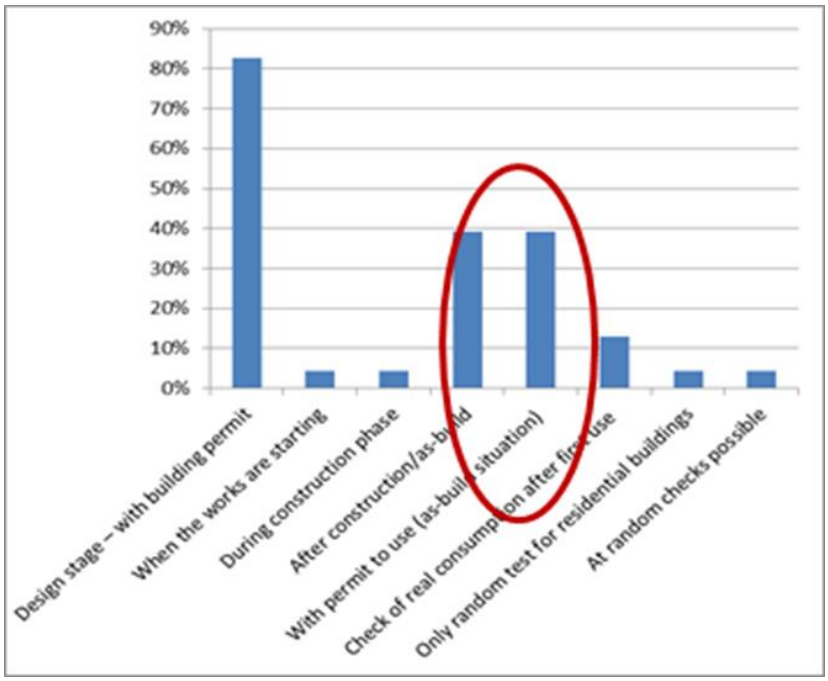

Figure 4: Timing of compliance checks[2]

The European ZEBRA2020 project (2014-2016) focused on tracking the market transition to nearly Zero-Energy Buildings (nZEBs) to derive recommendations and strategies for the building industry and policy makers and to accelerate the market uptake of nZEBs (www.zebra2020.eu).

A survey of 618 real estate agents from eight countries showed that the reliability and usefulness of EPCs is often questioned, and the related costs are considered dissuasive[3]. Many real estate professionals do not think there is a link between EPCs and the improvement of energy efficiency of buildings.

2.6. Enforcement should not be a barrier to innovation

A compliance framework, including enforcement and penalties, can be a major driver for buildings to be brought in line with the EPC declarations (e.g. enforcing the correct U-value of the components, the PV installation as declared, etc.).

An effective compliance framework supposes that procedures to determine input data are clearly defined and there is no discussion about the input data to be used. If input data are specified by the calculation method this can be problematic for systems which are not covered by the EPC calculation method, (e.g. a new heating system concept which does not meet the specifications in the EPC calculation method). Unless an alternative assessment procedure is available, there is a real risk that the compliance framework will block innovation as there is a risk for penalties when using such new concepts.

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[2] Compliance and control of the EPBD in EU – Wina Roelens - Presentation at the event on 2nd February 2016 (Revamped BUILD UP and findings from Concerted Action EPBD, http://www.buildup.eu/sites/default/files/content/06_roelens.pdf

[3] The impact of energy performance certificates on property values and nearly zero-energy buildings: An analysis for market professionals, owners and tenants – Jose Santos, Andrzej Rajkiewicz, Indira de Graaf, Raphael Bointner - Report from ZEBRA2020, September 2016, http://zebra2020.eu/website/wp-content/uploads/2014/08/Final_ZEBRA2020_NEARLY-ZERO-ENERGY-BUILDING-STRATEGY-2020_05.pdf

2.7. Terminology

Compliance - Compliant

Compliance is defined as conforming with EPC procedures or to specifications of the works. Compliant is the adjective referring to something that is in accordance with EPC procedures or with specifications of the works.

The most typical cases of non-compliance are:

1. **NO REPORTING**: The reporting requirements of the EPC procedures (e.g. certificate, database transfer, test report, etc.) or specifications of the works (e.g., test report, photo archives, etc.) are not met. This type of non-compliance may occur if, for instance, there is no energy performance certificate for a new building, or there is no test report of a given system (if mandatory in that context).
2. **WRONG REPORTING**: There are substantial differences between the data reported and the correct data according to the agreed procedure or specifications of the works. This may occur for instance if the energy performance certificate assumes or the installer formally confirms that a given component or system is certified, although the installed component or system is actually not certified.
3. **NOT MEETING THE ENERGY PERFORMANCE REQUIREMENTS**: The required energy performance or specifications of the works are not achieved. This may happen for instance if:
   - ✓ the minimum building energy performance level is not met;
   - ✓ a minimum performance requirement for a system or component is not met;
   - ✓ a non-certified contractor has performed work which required certification.

Note that these cases may or may not occur simultaneously (see Table 1).

Table 1: Categorised examples of non-compliance

Type of non-compliance			Example
(a)	(b)	(c)	
X			There is no EPC but the building characteristics comply with the technical requirements.
X	X		Simultaneously: no test report of a given system; inappropriate value used in the EPC for this system; the characteristics of the installed system comply with the regulatory requirements.
X	X	X	Simultaneously: no test report of a given system; inappropriate value used in the EPC for this system; the characteristics of the installed system do not comply with the regulatory requirements.
	X		The value used for a characteristic of a given system in the EPC is inappropriate according to the procedures, but the characteristics of the installed system comply with the regulatory requirements.
	X	X	The value used for a characteristic of a given system in the EPC is inappropriate according to the procedures, and the characteristics of the installed system do not comply with the regulatory requirements.
		X	The value used for a characteristic of a given system in the EPC is correct according to the procedures, but the characteristics of the installed system do not comply with the regulatory requirements.
X		X	There is no EPC and the building characteristics do not comply with the technical requirements.

Evidence of compliance

Evidence of compliance is any type of confirmation of compliance that can be checked according to the rules.

Input data for Energy Performance Certificates (EPC)

EPC input data are data used to assess the energy performance of a building, resulting in an Energy Performance Certificate. Such data describe or can be related to the physical characteristics of the building (e.g. floor area, heat transmission of building materials and components), its environment (e.g. climate and orientation), its systems (e.g. efficiency of heating system and/or individual components) and its operation (e.g. occupant schedule).

Agreed procedures for determining EPC input data

Agreed procedures for determining EPC input data are publicly available documents produced at a national or regional level in the EPC regulations that explain how to derive the proper values for the input data. These documents have a legal status. They may refer to standards, professional rules, etc.

Ideally, these procedures should include:

1. Technical procedures explaining how to determine the value of EPC input data (e.g. calculation of thermal transmittance of walls, calculation of solar shading coefficients[4]);
2. Organisational procedures stating requirements in order for the input value to comply with the rules (e.g. control by an independent third-party, product or system certified data, product manufacturer or distributor declaration, competence of the expert in charge of assessing the data, competence of the expert issuing the certificate if he/she himself/herself assesses the value of the input data);
3. Requirements for evidence of compliance, i.e. a set of elements considered as evidence that the EPC input data has been correctly determined (examples of elements include: an electronic file including all input values uploaded in a national database, test report issued by an accredited laboratory, certificate proving the certification or qualification of persons or companies, certificate issued by a competent person that the calculation is consistent).

Compliant EPC input data

A quantity used as input data for:

- ✓ the calculation or the assessment of the energy performance of a building and/or
- ✓ the declaration of its energy performance in the Energy Performance Certificate (EPC)

is "compliant" in EPC context if this data has been established in line with the procedures in force in the context of the relevant legislation. For brevity, this term is sometimes shortened to "compliant input data" or "compliant data".

Easily accessible input data

A quantity used as input data for:

- ✓ the calculation or the assessment of the energy performance of a building, and/or
- ✓ the declaration of its energy performance in the Energy Performance Certificate (EPC)

is "easily accessible" if it can be found, seen and used with "reasonable time, effort or expense". The notion of "reasonable time, effort and expense" is understood in the context of the modern information technologies and media required to obtain the information.

The reference situation for easy access to data is information available on an Internet page, preferably with free access. Input data will be considered more or less accessible depending on the effort needed to obtain the data compared to this reference situation.

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[4] Some of these examples may or may not be relevant depending on the regulatory context.

2.8. This source book and the other QUALICHeCK deliverables

This report builds on the outcomes of QUALICHeCK, namely:

1. The **status on the ground report**, which includes the analysis of 31 specific studies addressing specific concerns on performance data from the field, the compliance of input data, the quality of the works, as well as feed-back from compliance frameworks.
2. The **reports of each of the 10 field studies** conducted within QUALICHeCK in the nine focus countries. These studies aimed to enrich the literature on quality and compliance issues with clear data. Each study investigated a sample of at least 25 buildings.
3. The **report on existing approaches on compliant and accessible input data** that describes nine interesting approaches.
4. **58 factsheets** produced in total within QUALICHeCK, including 23 with a specific focus on EPC input data and compliance aspects.

All these deliverables are available on the QUALICHeCK website (http://qualicheck-platform.eu).

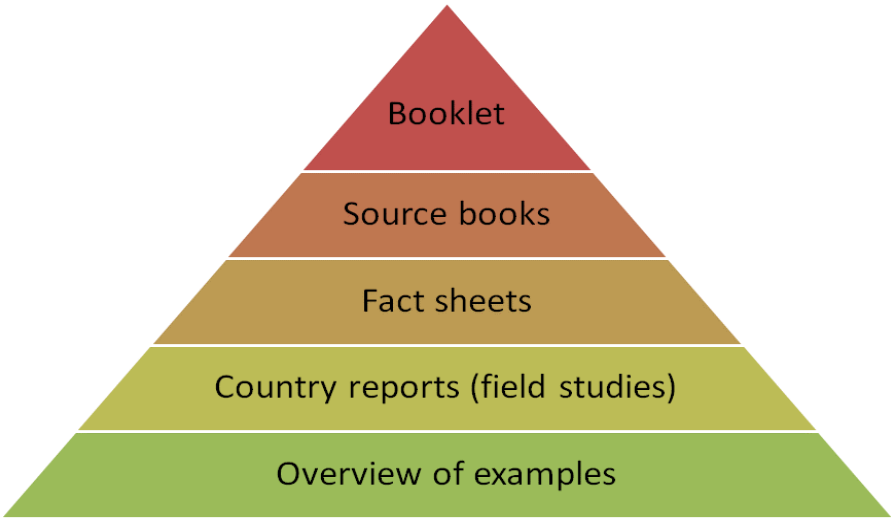

Figure 5: QUALICHeCK deliverables

3. Analysis of reasons for compliance/non-compliance of EPC

3.1. Introduction

EPC-related compliance refers to the following EPBD requirements:

- ✓ Energy performance minimum requirements for new buildings and major renovations;
- ✓ Presenting and handing over the EPC including recommendations for improvement in case of sale or rent of a building or a building unit;
- ✓ Publication of the energy performance indicators in the commercial media when advertising a building or a building unit for sale or rent.

In this report, we focus on compliance aspects related to the first bullet point *Energy performance minimum requirements for new buildings and major renovations*.

We analyse reasons for EPC-related compliance and non-compliance to answer the following question: *How can compliance of the Energy Performance Certificate of a building be ensured, and consequently that the minimum energy performance requirements are met and/or that the consumer is well informed?*

The analysis covers new buildings, existing buildings that undergo a major renovation and existing buildings that are sold or rented out. It focuses on input data for calculation of energy performance, but not on the calculation method as such. It also covers the EPC compliance, which is established by using the result of this calculation. The analysis does not cover the direct measurement of energy use of a recently built or an existing building.

Because of demanding energy performance requirements and to prepare for the development of nearly-zero energy buildings, as required by the EPBD, it is important to address the quality of input data related to four technologies, which are essential in this context:

- ✓ technologies to eliminate thermal bridges in the building envelope and to get low energy transmission characteristics;
- ✓ technologies for airtight construction and good building ventilation;
- ✓ technologies for sustainable summer comfort (solar control, cool roofs, ventilative cooling, etc.);
- ✓ technologies using renewable energy sources in multi-energy systems.

These technical areas will be explored in detail, in order to ensure compliance at the level of energy performance minimum requirements. Compliance is demonstrated by fulfilling minimum requirements defined according to national and European frameworks at different levels, e.g. maximum allowed specific heat transmission losses, maximum U-values of the envelope elements, maximum annual heat demand for space heating and for cooling, maximum primary energy for operation of building systems (HVAC and lighting).

There are three crucial aspects influencing the level of EPC-compliance achieved in practice:

1. Clarity of procedures on what must be done;
2. Clarity of procedures on how to decide on non-compliance and related actions;
3. Effectiveness of control and sanctioning mechanisms in case of non-compliance

3.2. Overall approach

In order to achieve compliance, societal support is important, meaning that stakeholders understand and accept the need for energy efficiency requirements, the need for compliance and the need to check and enforce compliance.

A three-step approach has been identified in order to achieve compliance (Figure 1):

1. There should be clear procedures on what must be done in order to determine EPC input data (Step 1),
2. There should be clear legal procedures on how to decide on non-compliance and related actions (Step 2),
3. There should be effective control and sanctioning mechanisms in case of non-compliance (Step 3).

The chapters below present the analysis of reasons for effective and poor EPC compliance allocated at each of the three steps.

3.3. Step 1: Issues related to procedures for determining EPC input data

3.3.1. Different types of EPC input data

The data used to assess the energy performance of a building, which is used to create an Energy Performance Certificate (EPC) (Figure 6), may be classified as follows:

- Data **describing the physical characteristics of the building:**
  - ✓ areas of floors, walls, facades, ceilings, roofs, windows, doors, etc.;
  - ✓ nature and characteristics of the construction products used (quantities, thermal properties);
  - ✓ information about the implementation of these construction products (e.g. the materials and thicknesses of the various layers of thermal insulation) and how they are positioned, especially at their interfaces (in order to identify junctions – thermal bridges - where insulation is not continuous and causes heat loss);
  - ✓ airtightness of the building envelope;
  - ✓ etc.
- Data **describing the environment of the building:**
  - ✓ location;
  - ✓ climatic conditions at this location (temperature, humidity, wind);
  - ✓ geographical orientation, obstacles to solar radiation;
  - ✓ etc.
- Data **describing the building systems** (heating, cooling, ventilation, domestic hot water production, lighting, etc.):
  - ✓ types of energy sources used;
  - ✓ energy efficiencies;
  - ✓ power or capacity;
  - ✓ energy input, energy output;
  - ✓ flow rates;
  - ✓ operating temperatures;
  - ✓ type of controls;
  - ✓ etc.
- Data **describing the building operation**:
  - ✓ occupancy schedule;
  - ✓ etc.

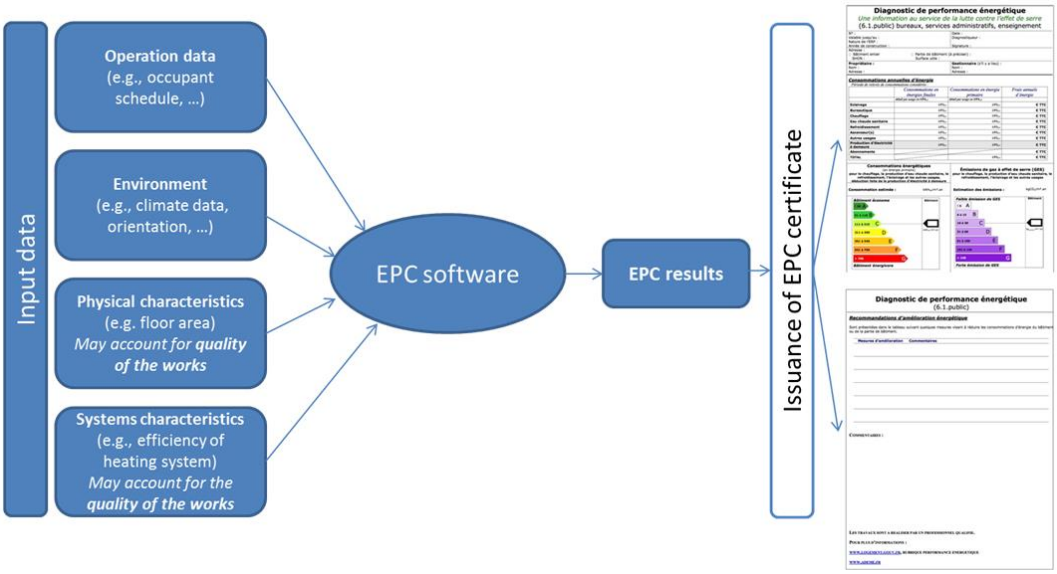

Figure 6: EPC issuance mechanism

Classification of the input data can be refined by distinguishing data that are independent from the building (construction product data, system data) from data linked to the building and its execution (and its occupancy, if necessary):

- Data **independent from the building**:
  - ✓ Construction product data (only linked to the products, independent from the building in which they will be placed);
  - ✓ System data (only linked to the systems, independent from the building in which they will be installed).
- Data **linked to the building**:
  - ✓ Building basic data (location, climate, orientation, surfaces, etc.), assessed from architectural plans and/or basic measurements on-site;
  - ✓ Execution related data:
  - ✓ Data for installed systems (ventilation airflows, ductwork airtightness, etc.);
  - ✓ Data for the whole building (building airtightness, etc.);

1. Occupancy related data (number of occupants, internal gains, room temperature set value, etc.).

EPC input data may also be classified according to how they are made available:

- Data **made available** by a manufacturer:
  - ✓ This applies to construction products and to systems.
  - ✓ Data describe the characteristics of the product/system. They are made available by the manufacturer or by an importer, a distributor or an authorized representative.
  - ✓ This also applies to innovative products and systems, for which a calculation method does not always exist; in this case, the announced values may be used to create a dedicated calculation method.
  - ✓ Examples: heat transfer coefficient of an insulation material, energy efficiency of a boiler, etc.
- Data **published** in a database:
  - ✓ This applies to data that are not only made available by the manufacturer but can also be found in common database.

- ✓ Such databases may be implemented and operated under the control of public authorities or result from private initiatives; the reliability of the content can be checked by a third party or rely on those who fill in the data
- ✓ The database includes the characteristics of construction products and systems

- ✓ Examples: properties of building materials (wall thermal transmittances, resistance or conductivity of insulation products) or system components (efficiency of systems, part load equipment efficiency as a function of outdoor temperatures, etc.)

- ➢ Data **recorded** by an expert:
  - ✓ This applies to data that may be specific to the building, or depending on the way the construction products and the systems have been implemented.
  - ✓ The data are derived from the plans or description of the building, or from on-site observations or measurements provided that these measurements do not require dedicated know-how and specific measuring devices; they may also result from simple calculations.
  - ✓ These data may be descriptive (e.g. type of controls for the heat emitters) or quantitative (e.g. nominal set value of the summer indoor temperature).
  - ✓ The expert who finds and notes these data is usually the one who will make the EPC rating calculation; it may also be the building designer.
  - ✓ The determination of these data may rely on the experience of the expert, as some values may be based on previous knowledge.
  - ✓ Examples (depending on the data required by the national EPC calculation method): building location, building orientation, floor area, volume of the heated zones, windows area, presence of thermal bridge breakers, length and size of the ductwork outside heated zones, energy efficiency of the air conditioning system according to the regular inspection report, etc.
- ➢ Data **measured** on-site:
  - ✓ This applies to data that need to take into account the actual implementation of the construction products or systems, and that are determined by an on-site measurement.
  - ✓ The measurement requires a dedicated know-how and specific measuring devices.
  - ✓ The measurement may, in some cases, be performed by the expert who will make the EPC rating calculation, but it is usually performed by another expert (for example, an energyperformance auditor).
  - ✓ Examples (depending on the data required by the national EPC calculation method): airtightness of the building envelope, airtightness of the ductwork, flue gas temperature at the boiler outlet, etc.
- ➢ Data **set** by the relevant legislation:
  - ✓ These data can be default values, i.e. relatively disadvantageous values fixed by legislation when no actual value is used or no detailed measurement or calculation is undertaken. They can also be fixed average or pre-calculated values when no actual value can be determined (for example, because no assessment or testing method exists).
  - ✓ Example: a national EPC calculation method may require using a conventional standard value of 0.5 for the solar shading coefficient, used in the calculation for all buildings.

In summary:
Three ways to classify EPC input data:

- ✓ Data describing the building / data describing the systems
- ✓ Data independent of the specific building considered / data that depend on the specific building
- ✓ Data classified by their availability (from the manufacturer information, in a database, recorded by an expert, measured on-site, set by legislation, etc.)

These three classifications will be used to analyse the best practice to obtain and prove compliant EPC input data (see Chapter 4).

Whatever the classification used, EPC input data should ideally be determined with the following procedures:

1. Clear technical procedures explaining how to determine the value of the EPC input data;
2. Clear organisational procedures stating requirements for the input data to comply with the rules;
3. Clear requirements for evidence of compliance, i.e. a set of elements considered as evidence that the EPC input data has been correctly determined.

These procedures for determining EPC input data should be publicly available documents prepared at a national or regional level as part of the EPC regulation, explaining how to derive the proper

values for the input data. These documents have a legal status. They may refer to standards, professional rules, etc.

EPC input data is "compliant" in an EPC context if this data has been established in line with the procedures laid out in the relevant legislation.

In addition, easy access to the EPC input data should also be possible.

These points are detailed in Chapters 3.3.2 to 3.3.5.

Chapter 3.3.6 explains how innovative products or systems may be dealt with.

Chapter 3.3.7 shows the necessity for the procedures for determining EPC input data to remain in line with other EU or national legislations.

3.3.2. Clear technical procedures

It is essential that clear procedures exist that explain how to determine the value of EPC input data.

These procedures should define:

- the quantity concerned;
- the unit to be used;
- the method of determination:
  - ✓ for data made available by manufacturers: clear reference to a testing and/or measurement method;
  - ✓ for data published in a database: clear reference to the database and where to find the data in the database,
  - ✓ for data recorded by an expert: clear methods for recording data from the plans or description of the building, or clear methods for recording data from on-site observations or simple measurements, or clear methods for calculating the data;
  - ✓ for data measured on-site: clear reference to a measurement method, describing how to operate and the measuring device to be used;
  - ✓ for data set by the relevant legislation: clear description of the data and the value to be used.

When the definitions and the procedures for obtaining the data are unambiguous and robust (i.e. with very high insensitivity to changing external parameters), it can be expected that assessment of the EPC input data is repeatable (i.e. by the same expert issuing the certificate or inspector) and reproducible (i.e. by different experts issuing the certificate or inspectors).

When input data for the energy performance calculation are wrong (even due to unintentional mistakes) or misunderstood, there is a risk that the assessment of the energy performance of the building will be wrong. This may imply that the minimum energy performance requirements seem to be fulfilled, when this is not actually the case.

Though the performance characteristics of several construction products and systems are defined in the CEN standards, there can be different interpretations of the product data in a number of cases. There are still some products and systems for which an unambiguous definition of data is not obvious. This is particularly the case for some of the most innovative technologies.

Concerning data linked to the building (building basic data, execution related data, occupancy related data), it is also crucial that procedures define how to determine them (see also 4.6).

It is essential that the procedures take into account the specificities of the EPC input data for existing buildings (more data to be recorded or measured on site, some data difficult to find, etc. - see also 4.12).

It has to be noted that compliant input data may sometimes be far from real values. For example, a default value used as input data according to the existing definitions and procedures may be too pessimistic or too optimistic compared to the real value. Nevertheless, it would meet the definition of compliant data.

More information about how to implement clear technical procedures can be found in Chapters 4.1, 4.6 and 4.12.

3.3.3. Clear organisational procedures

These organisational procedures define requirements such as:

- ✓ the need for input data to be controlled by an independent third-party,
- ✓ the need for the data to be certified,
- ✓ the way the data must be declared by the manufacturer or distributor,
- ✓ the need for a specific competence for the expert in charge of assessing the data,
- ✓ the need for a specific competence for the expert issuing the certificate, if he/she himself/herself assesses the value of the input data,
- ✓ etc.

Such procedures must be very clearly formulated: which type of control? Which certification? Which declaration? Which competence?

More information about how to implement clear organisational procedures can be found in Chapters 4.2 and 4.12.

3.3.4. Clear procedures for evidence of compliance

Procedures should clearly define the set of elements considered as evidence that EPC input data has been correctly determined, and which can be provided to prove compliance.

Such elements could be for example:

- ✓ the fact that the data has been uploaded into a national database,
- ✓ a test report showing the input data that has been issued by an accredited laboratory,
- ✓ a certificate of certification or qualification of persons or companies for those having determined the input data,
- ✓ a certificate issued by a competent person that the determination of the input data is consistent,
- ✓ etc.

More information about how to implement clear procedures for evidence of compliance can be found in Chapter 4.2.

In summary:

Three very clear procedures are necessary to address:

- ✓ How to determine the value of EPC input data (clear technical procedures),
- ✓ What are the organizational requirements linked to determining EPC input data (clear organizational procedures)?
- ✓ How to prove compliance of EPC input data (clear procedures for evidence of compliance)?

3.3.5. Easy access to compliant data

There is often a problem of easy access to the required and, most importantly, to the compliant input data. For certain aspects or technology areas, this may require a very substantial effort (e.g. the estimation of the thermal bridge effects).

Where input data for the energy performance calculation are difficult to find, the risk is that the expert in charge of the energy performance calculation uses default or estimated values that could be far from the actual data or from the data that are considered as "conventionally true". This also may lead to the conclusion that the minimum energy performance requirements are fulfilled, when this is not the case.

In Europe, data is considered easily accessible if it can be found with similar time, effort and expense as information available on an Internet page, preferably with free access and possibly

requiring a password. All data that requires more time, effort or expense than this "standard" information will probably be considered not easily accessible.

More information about how to implement easy access to compliant data can be found in Chapters 4.3 and 4.10.

3.3.6. EPC input data for innovative systems

This applies to innovative construction products and systems, i.e. new or advanced construction products and systems that are highly energy efficient in comparison to similar compatible ones; these are, in most cases, not properly accounted for in the regulatory calculation method.

The EPC input data must describe the characteristics of the innovative product/system. They can be determined using equivalence rules defined in the procedures. These EPC input data can be made available by the manufacturer or by an importer, a distributor or an authorized representative. They can also be recorded by an expert if the input data need to take into account the performance of the installed product or system.

This can, for example, be the case for the equivalent airflow rate of demand-controlled ventilation systems. More information about how to handle with innovative systems can be found in Chapters 4.8 and 4.9.

3.3.7. Procedures in line with EU or national legislation

Articles 34 and 35 of the Treaty on the functioning of the European Union (Consolidated version – 2010) prohibit quantitative restrictions on imports and exports, and all measures with equivalent effect, between Member States.

Some products are covered by harmonisation measures adopted by the European Parliament and the Council, by the Council or by the Commission. Such harmonization measures (Article 115 of the Treaty) are, among others, the European Regulation on construction products (Regulation (EU) N° 305/2011) and the European Directive on the Ecodesign of energy related products (Directive 2009/125/EC).

They define requirements and manufacturers may demonstrate compliance with these requirements either directly or by using harmonised standards to this effect; manufacturers issue a declaration of conformity and affix CE marking on their product.

It is essential that the procedures (technical, organisational, to show compliance) defined to determine the EPC input data (see 3.3.2, 3.3.3 and 3.3.4) are not in contradiction with the Treaty and/or Directives or European Regulations.

Declaration of performance of a construction product (and its CE marking) must be based on the Construction Product Regulation ((EU) N° 305-2011) as soon as harmonized European standards apply to this product. It is therefore important that the procedures for determining and making available EPC input data are not in contradiction with this requirement.

Member States may specify national requirements for construction products only if no harmonised standard exists and if performances may not (or may not fully) be assessed on the basis of an existing harmonized standard. In such cases, they need to foresee an equivalence clause, allowing products that have already demonstrated compliance with the national regulatory requirement through an equivalent system in another country. More information about how to handle with innovative systems can be found in Chapter 4.7.

In summary:

It is crucial that:

- ✓ EPC input data are easily accessible,
- ✓ Innovative systems are not too much limited in terms of finding compliant EPC input data,
- ✓ The procedures linked to EPC input data fulfil the requirements of other EU or national legislations.

3.4. Step 2: Legal framework related issues

A clear legal framework on **how to detect and decide on non-compliance** is absolutely necessary.

Non-compliance in the EPBD context refers to all obligations imposed by the EPBD: Meeting energy performance minimum requirements, presenting and handing-over the EPC including recommendations for improvements in case of sale or rent of a building or a building unit, publicising the energy-related information in real estate advertisements, displaying the EPC in buildings occupied by the public or frequently visited by the public, and carrying out inspections of heating and air-conditioning systems in existing buildings.

Performance requirements mainly refer to final and primary energy consumption indicators, and the achieved performance must be shown in the EPC. Although the EPBD does not specify the point in time when the EPC must be available, several countries introduced the procedure that EPCs submitted as a condition to receive the building permit must be updated to the as-built situation and only then will they be valid for 10 years. Here "quality of the works" comes into play: mistakes at the construction on-site could result in an energy performance that does not meet the requirements, and then sanctioning according to EPBD will be necessary.

With regard to the EPC, non-compliance can occur at different levels:

- ✓ input data needed for calculating the EPC can be non-compliant (i.e. they have not been established in line with the procedures in force in the context of the relevant legislation), or
- ✓ the method used to calculate the energy performance rating of the building can be non-compliant (i.e. the calculation has not been conducted in line with the procedures in force in the relevant legislation), or
- ✓ the energy performance rating of the building mentioned in the EPC, which is used to check whether energy performance minimum requirements are met or not, can be non-compliant.

Non-compliance of the input data results in non-compliance of the EPC.

Non-compliance of the energy performance calculation of the building results in non-compliance of the EPC.

In this source book, we shall not discuss non-compliance of the way to calculate the energy performance of the building.

Regarding input data, there are mainly three types of non-compliance:

- ✓ *Procedures not followed*: the technical or organizational procedures (see 3.3.2 and 3.3.3) or the procedures to prove compliance of the input data (see 3.3.4) are not followed,
- ✓ *Incorrect value:* the input data is wrong (a check shows another value),
- ✓ *No information about the compliance of the input data (no reporting):* there is no evidence of compliance of the input data (see 3.3.4), or there is no traceability showing that the procedures have been followed.

An incorrect value in the input data can result from errors or be intentional in case of fraud. It can arise because procedures have not been followed. Non-compliant input data can also result from unintentional errors when following the procedures: to limit this risk, the procedures have to be very clear (see 3.3.2, 3.3.3 and 3.3.4).

Regarding the EPC, there are mainly two types of non-compliance:

- ✓ *Incorrect value*: the energy performance presented in the EPC is wrong;
- ✓ *Not meeting the requirements*: the energy performance presented in the EPC does not fulfil the minimum requirements of the relevant legislation.

An incorrect energy performance value can result from errors or be intentional in case of fraud. It does not necessarily mean that the minimum energy performance requirements are not met. It can be due to non-compliant input data, among other reasons.

Not meeting the requirements does not necessarily mean that the value of the energy performance is wrong.

Another type of EPC non-compliance (*no reporting*) can occur regarding the availability and presentation of EPC energy indicators in the commercial media and the EPC as such when selling or renting a property, or regarding the availability of the EPC in public buildings and buildings frequently visited by the public.

In order to achieve compliance, laws transposing the EPBD must be unambiguous and include methods (e.g. full automatic checks and in-depth random control of statistical samples) and responsibilities for checking compliance (e.g. third party control and/or carried out by public bodies) as well as penalties to be applied in case non-compliance is detected. Well-designed compliance frameworks are effective and simplify implementation for administrations as well as for the construction and real estate sector.

3.4.1. A transparent compliance framework focusing on key aspects

A feasible compliance framework focuses on few key aspects that are crucial for building energy performance, such as transmission characteristics, ventilation and airtight construction, summer thermal comfort, and renewable energy systems. These are areas where clients expect substantial extra cost and/or normal users cannot detect extra energy losses during building operation. Therefore it is important to have a transparent compliance framework in place to handle non-compliance issues effectively. The following examples concerning thermal bridges and designing high-performance ventilation systems highlight what has been said above:

- ✓ Often, building details avoiding thermal bridges are more expensive and/or require more labour time. In practice, it is very difficult (almost impossible) for normal users to detect extra energy losses due to thermal bridges. (BUS/Belgium)
- ✓ Airtight constructions require ventilation systems in order to ensure the required exchange of air volume. Practice shows that there are concerns about the performances of installed ventilation systems (correct air flow rates, acoustics, etc.) in many countries. Also in this case, it is very difficult for normal users to detect inefficiencies due to poor planning and installation. (BUS/Belgium)

Thus, checking compliance of critical aspects ensures that the client actually receives the specific quality advertised by the EPC.

3.4.2. Checking compliance of input data for EPC calculation

Checking compliance is a means of quality assurance. In the context of this project, quality is defined by the procedures on how to determine input data and by minimum requirements imposed by EPBD-related legislation. Clear technical and organisational procedures are a precondition for checking compliance. Checking compliance can be done on a full scale basis, for example by means of automatic checks during EPC-database upload or by means of random sample checks, for example based on cross checks with other buildings' documents, checks of authorized experts issuing certificates, and checks of supporting documents submitted as a proof of compliant measurement data. It is necessary to check input data for calculating the design EPC as well as for calculating the updated EPC representing the as-built situation. Compliance frameworks can demand input data resulting from specific measurements to update the EPC according to the as-built situation.

3.4.3. Checking compliance using the EPC-database

In most European Member States an EPC-database has been established as a means of ensuring compliance with EPBD requirements. The way the EPC database has been set up is crucial for how the EPC-database can be used and at what cost. Automatic checks of selected input data and automatic checks of energy indicators and whether they meet energy performance minimum requirements or not can be carried out during uploading of the EPC and related information into the EPC database.

Publicly accessible parts of the EPC database are essential for bottom-up control of publicised energy indicators by potential buyers and tenants (e.g. partly publicly accessible EPC database the UK, automatic compliance checks of energy minimum requirements during EPC upload into the EPC database in Portugal).

Table 2: Checking compliance of selected input data and minimum energy requirements

Element	How to enable compliance checks	What hinders compliance checks
✓ *Connection between EPC software and EPC database*	✓ *Defined input data, calculation results and the EPC are uploaded into the database and checked against requirements during upload*	✓ *Only EPC and selected EPC indicators are uploaded into the EPC database and checked during upload*
✓ *Concept of EPC database*	✓ *The EPC database is linked with other databases containing building specific information, allowing for cross-checking of information*	✓ *The EPC database is a single unit without links to other databases*
✓ *Accessibility of EPC database*	✓ *Publicly accessible parts of the database allow for bottom-up checks of published energy indicators by interested buyers or tenants*	✓ *If access is only for public bodies, checking published indicators would be done top-down, which is either costly or only possible on a small scale*

3.4.4. Checking compliance of availability of EPC indicators and EPC

The legal framework has to consider the following elements including the definition of procedures in order to be able to check compliance:

- ✓ Presenting energy indicators in advertisements in commercial media (e.g. mandatory guidelines on how to present indicators in the media, Ireland; partly publicly accessible EPC database to check published indicator values, UK);
- ✓ Presenting and handing over the EPC, including recommendations for improvement when renting or selling (e.g. transaction through notary, the Netherlands; partly publicly accessible EPC database to check published indicator values, UK);
  Display of EPC in buildings owned by the public and/or visited by the public (e.g. unambiguous definitions, inspection procedure, Slovenia)

Table 3: Checking compliance of availability of EPC indicators and EPC

Element	How to enable check of compliance	What hinders check of compliance
✓ *Presenting energy indicators in advertisements in commercial media*	✓ *Specification of how to present which type of energy-related information in commercial media;* ✓ *Publicly accessible parts of the EPC database where information can easily be identified and checked by interested parties*	✓ *Information published in commercial media cannot be easily found in the EPC database;* ✓ *EPC database is not publicly accessible at all*
✓ *Presenting the EPC when renting or selling*	✓ *Specification of procedure, involved parties and their roles and obligations*	✓ *No specification of procedure, roles and obligations; many exemptions*
✓ *Display of EPC in buildings owned by the public and/or visited by the public*	✓ *Simple definition of relevant buildings: e.g. all non-residential buildings > 1000 m^2*	✓ *Definitions with many exemptions and unclear terminology such as "frequently visited"*

3.4.5. Checking EPC-compliance at the right point in time

The EPBD targets actual energy savings, and therefore it is not sufficient to declare the design status at the beginning of the process when applying for the building permit. In fact, it is necessary to update the EPC by taking into account design changes and declare the as-built situation after completion of the building. While some Member States have already adopted a two-step approach, others have not yet implemented such procedures.

3.4.6. Regional or central implementation influences economic feasibility

Setting up and running the enforcement and sanctioning framework requires respective budget allocations. Regional or central implementation impacts the cost of the enforcement framework and thus its economic feasibility. Member States following regional EPBD implementation should investigate which elements of the enforcement and sanctioning framework could be used together to avoid multiplication of effort and cost and to increase the possibility of creating an economically feasible and effective framework. In this regard, there are some examples to learn from in European Member States (e.g. database of product characteristics in Belgium, France, and UK).

3.4.7. Interaction with other legislations: avoiding potentially negative impact of EPBD compliance

The obligation to publicise energy indicators in advertisements in the commercial media will be less effective if this is regulated in an isolated way, and being limited to energy related information. If there is no regulation concerning all mandatory elements of a real estate advertisement, comparability of buildings and building units could be affected. Energy-related information will be presented in order to be compliant, but other important parameters such as number or rooms or location could be left out due to the fact that space for publication in print media is expensive. This is an unwanted development, resulting in difficulties regarding the assessment of the EPBD impact on the real estate market (e.g. as in Austria). In fact, it is recommended that advertisements published in print media be evaluated because it is nearly impossible to extract a meaningful sample from the internet, due to the frequent updating procedures practised by real estate agents to achieve a better rank in the listing.

3.5. Step 3: Compliance enforcement in practice related issues

The type of **reactions (or no reaction at all) in case of non-compliance** influence the level of EPC related compliance. Stakeholders respect clear enforcement procedures resulting in appropriately severe sanctions that are effective in case of non-compliance. Legal obligations without clear procedures in case of non-compliance lack practical implementation. Threat of penalties and other sanctions tend to be less effective if sanctioning procedures are not clear.

First of all, sanctions should address the potential for improvement detected during the compliance check, not only to ensure compliance but also to assure the quality of EPCs in general.

Thus, apart from financial sanctions such as penalties and withdrawal of grants, there are other types of sanctions, such as mandatory training for EPC experts, to improve EPC quality.

In order to achieve good compliance, handling of non-compliance in practice must be effective, cost-efficient and affordable and should not be compromised by conflicting legislation. There is clearly a societal wish to limit the administrative burden and cost.

3.5.1. Clear enforcement procedures facilitate exploitation of potential for improvement

Clear enforcement procedures also address the potential for improvement in terms of quality assurance. For example, the EPC database does not only facilitate automatic checks of input data and energy indicators but also helps track the energy experts and the mistakes they make in EPC calculation. If minimum energy efficiency requirements are not met, the EPC will be rejected and the energy expert has to recalculate the EPC and re-submit it again at his own expense, in order to receive the building permit (e.g. as in Denmark).

Energy experts face a step-based penalty system, depending on the frequency of submitting faulty EPCs, , beginning with the obligation of re-calculation, attending trainings, paying a fine and ending with the withdrawal of the licence (e.g. as in Portugal). Frequent mistakes will be detected and used to re-design training courses or to offer additional training modules to supplement existing ones.

3.5.2. Clear enforcement procedures and adequately severe penalties

Effective enforcement frameworks stipulate clear procedures and adequately severe penalties. If there is no clear procedure on how to react in case of non-compliance, enforcement will be difficult and costly, because the usual model would be to approach the court based on Civil Law, which is often a lengthy and also costly process. As a consequence, this rarely happens. Therefore, clear penalty procedures are essential.

Penalties must be adequate to be effective. Comparing the cost of compliance with the cost of non-compliance must always result in the conclusion that non-compliance does not pay.

3.5.3. Conflicting legislation could weaken the political will of enforcing EPBD compliance

The availability of affordable housing is very important for the peaceful development of society. In some Member States, tenants' protection and a cap on rent amounts could compromise activities (such as compliance checks and handing out punishment) with the potential result of higher costs for the building owners (and, as a consequence, for the tenants) (e.g. as in Austria).

In some Member States, data privacy legislation prevents public access to the EPC database. Interested tenants or buyers are not allowed to enter the EPC database to check the published energy indicator against the original one in the EPC database. Check of published EPC indicators is carried out either by the public administration or not at all.

3.6. Examples for transmission characteristics

The following QUALICHeCK fact sheets or presentations at QUALICHeCK events provide examples for one of the main technologies covered, i.e. transmission characteristics:

- ✓ Performance of thermal insulation in low energy buildings and advanced building renovation projects - Presentations at QUALICHeCK Workshop in Brussels, Belgium, 15 December 2016
- ✓ Voluntary scheme and database for compliant and easily accessible EPC product input data in Belgium - Samuel Caillou - QUALICHeCK Fact Sheet #05, October 2015
- ✓ Procedures for determining input data for the Energy Performance Certificate (EPC) of existing residential buildings in Belgium - Xavier Loncour, Nicolas Heijmans, Clarisse Mees - QUALICHeCK Fact Sheet #23, June 2016
- ✓ baubook – Easily accessible product information for EPC calculation provided by the Austrian database - Christoph Sutter, Susanne Geissler - QUALICHeCK Factsheet #43, June 2016
- ✓ Views from the thermal insulation industry on quality of the works and data compliance – Caterina Rocca - Presentation at 1st QUALICHeCK Conference, Brussels, September 2014
- ✓ Quality frameworks for cavity insulation of existing walls – Jan Coumans - Presentation at 1st QUALICHeCK Conference, Brussels, September 2014
- ✓ Views from the aluminium window profiles industry on quality and compliance issues – Cyriel Clauwaert - Presentation at 1st QUALICHeCK Conference, Brussels, September 2014

3.7. Examples for ventilation and airtightness

The following QUALICHeCK fact sheets or presentations at QUALICHeCK events provide examples for one of the main technologies covered, i.e. ventilation and airtightness:

- ✓ Voluntary and regulatory frameworks to improve quality and compliance of ventilation and airtightness – Presentations at QUALICHeCK Workshop in Lund, Sweden, 16-17 March 2015
- ✓ French voluntary scheme for harmonised publication of ventilation product data - François Durier, Laure Mouradian, Fabrice Lamarre - QUALICHeCK Fact Sheet #03, April 2015
- ✓ Voluntary scheme and database for compliant and easily accessible EPC product input data in Belgium - Samuel Caillou - QUALICHeCK Fact Sheet #05, October 2015
- ✓ Regulatory compliance checks of residential ventilation systems in France - François Rémi Carrié, Sandrine Charrier, Adeline Bailly - QUALICHeCK Fact Sheet #06, November 2015
- ✓ Building airtightness in France: regulatory context, control procedures, results - Sandrine Charrier, Adeline Bailly, François Rémi Carrié - QUALICHeCK Fact Sheet #07, December 2015
- ✓ Quality framework for reliable fan pressurisation tests - Clarisse Mees, Xavier Loncour – QUALICHeCK Fact Sheet #21, June 2016
- ✓ The Effinergie approach to ease transitions to new regulatory requirements - François Rémi Carrié, Yann Dervyn - QUALICHeCK Factsheet #45, January 2017
- ✓ Ductwork airtightness in France: regulatory context, control procedures, results – Sandrine Charrier, Adeline Bailly Mélois, François Rémi Carrié - QUALICHeCK Factsheet #54, February 2017
- ✓ Belgian/Flemish evaluation scheme for ventilation systems - Samuel Caillou, Paul Van den Bossche - QUALICHeCK Factsheet #55, February 2017
- ✓ Building and ductwork airtightness : Issues with the reliability of EPC input data and with the quality of the works – François Rémi Carrié, Peter Wouters - Presentation at 1st QUALICHeCK Conference, Brussels, September 2014
- ✓ Challenges for ventilation systems in Nearly Zero-Energy Buildings (NZEB) – Jelmer de Jong - Presentation at 1st QUALICHeCK Conference, Brussels, September 2014
- ✓ Lessons learned from QUALICHeCK Lund workshop on ventilation and airtightness – François Rémi Carrié - Presentation at 2nd QUALICHeCK Conference, Brussels, September 2015

3.8. Examples for sustainable summer comfort technologies

The following QUALICHeCK fact sheets or presentations at QUALICHeCK events provide examples for one of the main technologies covered, i.e. sustainable summer comfort technologies:

- ✓ Voluntary and regulatory frameworks to improve quality and compliance of solar control, cool roofs and ventilative cooling – Presentations at QUALICHeCK Workshop in Athens, Greece, 9-10 March 2016
- ✓ European solar-shading database, ES-SDA - Ann Van Eycken - QUALICHeCK Fact Sheet #53, February 2017
- ✓ Solar shading reliability of EPB input data and the quality of works – Peter Winters - Presentation at 1st QUALICHeCK Conference, Brussels, September 2014
- ✓ Ventilative cooling - Industry view on quality and compliance issues – Karsten Duer - Presentation at 1st QUALICHeCK Conference, Brussels, September 2014
- ✓ Outcomes of Athens QUALICHeCK workshop on sustainable summer comfort – François Rémi Carrié, Maria Kapasalaki - Presentation at 3rd QUALICHeCK Conference, Brussels, May 2016
- ✓ European voluntary rating programme of cool roofing products, Theoni Karlessi, Chrysanthi Efthymiou (NKUA, Greece), QUALICHeCK Fact Sheet #04, September 2015

3.9. Examples for renewables in multi-energy systems

The following QUALICHeCK fact sheets or presentations at QUALICHeCK events provide examples for one of the main technologies covered, i.e. renewables in multi-energy systems:

- ✓ Renewable heating and cooling systems for buildings – Presentations at QUALICHeCK Workshop in Lyon, France, 17 January 2017
- ✓ Voluntary control scheme developed by the province of Salzburg: building services systems declaration based on as-built characteristics - Susanne Geissler - QUALICHeCK Factsheet #34, December 2016
- ✓ Voluntary schemes as a pool of ideas for designing and improving EPC compliance frameworks: the Boileff quality assurance scheme – Susanne Geissler - QUALICHeCK Fact Sheet #40, January 2017
- ✓ Selecting EPC input data for HVAC systems: a series of French guidance sheets - Dominique Hantz, François Durier, Valérie Laplagne - QUALICHeCK Fact Sheet #42, January 2017
- ✓ baubook – Easily accessible product information for EPC calculation provided by the Austrian database - Christoph Sutter, Susanne Geissler - QUALICHeCK Factsheet #43, June 2016
- ✓ European certification of HVAC products can provide EPC input data - Michèle Mondot, Sandrine Marinhas - QUALICHeCK Fact Sheet #50, February 2017
- ✓ Views from the heat pump industry on quality and compliance issues – Thomas Nowak - Presentation at 1st QUALICHeCK Conference, Brussels, September 2014

4. Best practices for Step 1: Procedures to obtain and prove compliant data

4.1. Clear technical procedures for determining EPC input data

Context and motivation

Effective compliance is far from evident if the technical procedures are not clear and/or a source of discussion and interpretation. It is important to minimise such sources of uncertainties.

Examples of problematic situations

- ✓ For the calculation of the thermal bridges, it is only specified that thermal bridges have to be analysed by 2D- and 3D simulations as specified in CEN standards. Without additional specifications, such description is too vague for subsequent compliance control and related sanctions.
- ✓ In the national calculation method for heat loss to the ground, depth of the ground water layer is an input variable. The value of this input data is not easy to identify and, moreover, might lead to discussions.
- ✓ A national EPC method allows specification of the required ventilation air flow rates as a function of the number of occupants, whereby this number can be chosen by the design team. There is a high probability that one will choose the number that gives the best EPC result, while a controlling body will have nearly no way to question the choice.
- ✓ There can be ambiguities on how to determine the floor or wall surfaces: internal or external areas, floor area in case of an inclined roof, floor area in case of an atrium in the house, etc.?
- ✓ It can be unclear how to prepare a building before an airtightness measurement

Considerations on procedural aspects

It is essential that clear procedures exist that explain how to determine the value of the EPC input data.

These procedures should very precisely define:

- ➢ the quantity;
- ➢ the unit of expression;
- ➢ the method of determination:
  - ✓ for data made available by manufacturers: clear reference to a testing and/or measurement method,
  - ✓ for data published into a database: clear reference to the database and where to find the data in the database,
  - ✓ for data recorded by an expert: clear methods for recording data from the plans or description of the building, or clear methods for recording data from on-site observations or simple measurements, or clear method for calculating the data,
  - ✓ for data measured on-site: clear reference to a measurement method, describing how to operate and the measuring device to be used,
  - ✓ for data fixed by the relevant legislation (default values, for example): clear description of the data and the value to be used.

Relevant approaches for this topic

- ✓ Germany: handling thermal bridges by allowing various procedures, including use of a thermal bridge atlas;
- ✓ France: to avoid misunderstandings in determining EPC input data for HVAC systems, the manufacturer association Uniclima, together with CETIAT, published a total of 23 guidance sheets for heat pumps, boilers, radiators, water heaters, hot water storage, solar thermal systems, ventilation fan boxes and air handling units;
- ✓ Belgium: for existing residential buildings, procedures have been implemented for determining EPC input data (see 4.12);

- ✓ Procedures can provide default values that can be assigned to EPC input data: a QUALICHeCK fact sheet clarifies which types of default values can be found in calculation methods, how they are
- ✓ introduced in European standards supporting the implementation of the EPBD as well as the precautions to take when defining and using default values.

References

- ✓ How to get compliant and accessible data for the energy rating calculation of a building? - Overview of some existing approaches - François Durier, Susanne Geissler et al. - QUALICHeCK report, March 2016
- ✓ Selecting EPC input data for HVAC systems: a series of French guidance sheets - Dominique Hantz, François Durier, Valérie Laplagne - QUALICHeCK Fact Sheet #42, January 2017
- ✓ Procedures for determining input data for the Energy Performance Certificate (EPC) of existing residential buildings in Belgium - Xavier Loncour, Nicolas Heijmans, Clarisse Mees - QUALICHeCK Fact Sheet #23, June 2016
- ✓ Default values in energy performance of buildings standards - François Rémi Carrié - QUALICHeCK Fact Sheet #46, January 2017

Some questions to address this topic

- ✓ Are there complaints that the information required is unclear?

4.2. Clear procedures for evidence of compliance

Context and motivation

EPC input data is compliant if this data has been established in line with the procedures in force in the context of the relevant legislation.

Evidence of compliance may be shown in different ways, such as:

- ✓ Control of the data by a third party
- ✓ A declaration by a manufacturer, distributor, architect, expert, installer, etc.
- ✓ Proven competence of persons or companies previously recognised by a third party
- ✓ Etc.

Examples of problematic situations

- ✓ Product data is available but there is no clear evidence that it has been established in line with the procedures.
- ✓ An expert has recorded data describing the building or its systems, but there is no evidence that he has followed the procedures, or that he has the competence to determine this data.
- ✓ Data has been measured on-site but there is no evidence that the measurement has been performed by a competent person.
- ✓ Data has to be chosen as a pre-calculated value, for example in a thermal bridges atlas, or in a building airtightness atlas, but there is no clear evidence that this choice has been made correctly.

Considerations on procedural aspects

Third party controls:

- ✓ A third party checks that the data have been determined according to the relevant rules (e.g. a standard, a professional rule, a written methodology, etc.).
- ✓ This third party is independent from the one involved in manufacturing the product or system, or in determining the data; this third party may be, for example, a notified body, a certification body, an independent control body, etc.
- ✓ A third-party control may apply to individual data, or check a significant sample of all the data.
- ✓ A control can be operated within a quality management scheme (which is preferable) or not.
- ✓ This control results in a certificate produced by the third party, as evidence of compliance.

- ✓ This certificate and/or the corresponding data may be made available on a case-by-case basis, or published in a central database if appropriate.
- ✓ Examples: certification of the characteristics of a product or a system by a notified body or a certification body, compliance control of the finished building by an independent body, etc.

Declarations

A declaration may be provided by a product or system manufacturer, a product or system distributor, an architect, expert, installer, etc., who has been involved in determining the data.

- ✓ The declaration states that the relevant procedure has been followed to determine the EPC input data.
- ✓ The declaration may rely on the honour of the one who claims to have followed the procedure (declaration on honour), on a self-checking procedure, on a final verification, on a quality assurance scheme, etc.
- ✓ Usually, it is necessary to ensure that the procedure can be traced, in order to show the evidence of the declaration in cases of checks or contestation.
- ✓ Example: certificate of conformity with professional rules signed by the installer, based on a check-list filled-in during installation.

Proven competence of persons or companies

- ✓ The competence of the expert and/or of the company in charge of assessing the EPC input data has been previously evaluated and recognized by a third party.
- ✓ This evaluation and recognition may rely on a certification, a qualification, an accreditation, a label, etc.
- ✓ The proven competence may also include an evaluation of the measuring equipment and its capabilities.
- ✓ Competence recognized by a third party is shown by a certificate that provides evidence that the EPC input data determined by these persons or companies are compliant.
- ✓ Examples: qualification by a third-party of the experts who will measure the airtightness of a building envelope, etc.

Relevant approaches for this topic

Table 3 identifies methods to obtain evidence of compliance relevant to the different types of input data. They can be used only if the relevant legislation permits it.

Table 3: Methods to obtain evidence of input data compliance

		Possible methods for evidence of compliance		
Methods of obtaining input data	Additional information	*Third-party control*	*Declaration*	*Proven competence of persons or companies*
Made available by a manufacturer	*Applies to construction products and systems*	*Control of the data by a notified body, a certification body, an independent control body*	*Declaration by the manufacturer that the data made available are compliant*	*Certified or accredited quality control system of the manufacturer, or/and its laboratory*
Found into a database	*Applies to construction products and systems*	*Control of the data by the operator of the database*	*Declaration by persons or companies that have filled in the database that the data are compliant*	*Qualification scheme for persons or companies who will fill in the database*
Recorded by an expert	*Covers data derived from plans or description of the building, on-site observations, simple measurements, simple calculations*	*Control of the recorded data by a third party, probably on a representative or random sample*	*Declaration by persons or companies that they have recorded compliant data*	*Qualification scheme for persons or companies who will record the data*
Measured on-site	*Covers data whose measurement requires dedicated know-how and specific measuring tools*	*Control of the measured data by a third party, probably by repeating some or all measurements*	*Declaration by persons or companies that they have measured compliant data*	*Qualification scheme for persons or companies who will undertake measurements*
Set by the relevant legislation	*Covers default values, fixed average values, pre-calculated values*	*Control by a third party checking that the data have been determined according to procedure*	*Declaration by persons or companies that they have selected compliant data*	*Qualification scheme for persons or companies who will select data*

References

- ✓ How to get compliant and accessible data for the energy rating calculation of a building? - Overview of some existing approaches - François Durier, Susanne Geissler et al.- QUALICHeCK report, March 2016
- ✓ European certification of HVAC products can provide EPC input data - Michèle Mondot, Sandrine Marinhas - QUALICHeCK Fact Sheet #50, February 2017
- ✓ The role certification can play to improve the reliability of input data: Eurovent certification example – Sylvain Courtey - Presentation at QUALICHeCK Workshop, Lund, March 2015
- ✓ Certified Performance Database: tool for quality and compliance - Sylvain Courtey - REHVA Journal, Volume 52, Issue 4, pp. 28-29, August 2015
- ✓ baubook – Easily accessible product information for EPC calculation provided by the Austrian database - Christoph Sutter, Susanne Geissler - QUALICHeCK Factsheet #43, June 2016
- ✓ The French product characteristics database for boilers, heat pumps and solar thermal systems – Jean-Paul Ouin - Presentation at QUALICHeCK Workshop, Lyon, January 2017
- ✓ EPC and compliant input data: which role for the databases? – Xavier Loncour - Presentation at 3rd QUALICHeCK Conference, Brussels, May 2016
- ✓ Overview of competent tester schemes for building airtightness - François Rémi Carrié - Presentation at QUALICHeCK Workshop, Lund, March 2015
- ✓ Competent tester schemes for building airtightness - Valérie Leprince, François Rémi Carrié - REHVA Journal, Volume 52, Issue 4, , pp. 16-17, August 2015
- ✓ Belgian/Flemish evaluation scheme for ventilation systems - Samuel Caillou, Paul Van den Bossche - QUALICHeCK Factsheet #55, February 2017
- ✓ Ventilation: steps towards framework for reliable EPC input data and improved quality/compliance - Samuel Caillou - Presentation at QUALICHeCK Workshop, Lund, March 2015
- ✓ Default values in energy performance of buildings standards - François Rémi Carrié - QUALICHeCK Fact Sheet #46, January 2017
- ✓ Voluntary control scheme developed by the province of Salzburg: building services systems declaration based on as-built characteristics - Susanne Geissler - QUALICHeCK Factsheet #34, December 2016

Some questions relevant to this topic

- ✓ Are there other sources of evidence of compliance other than a third party control, a declaration or proven competence?
- ✓ According to the table, all methods for evidence of compliance can be relevant to all types of input data. Do you agree?
- ✓ Should all the methods for evidence of compliance be used under accredited or certified quality management systems?

4.3. Easy access to compliant data

Context and motivation

A quantity used as input data for:

- ✓ the calculation or assessment of the energy performance of a building; and/or
- ✓ the declaration of its energy performance in the Energy Performance Certificate (EPC) is "easily accessible" if it can be found, seen and used with "reasonable time, effort or expense".

The notion of "reasonable time, effort and expense" is understood in the context of the modern information technologies and media required to obtain the information. A reference for easy access data is information available on an Internet page, preferably with free access. Input data will be considered more or less accessible depending on the effort needed to obtain it, compared to this reference.

There are several reasons why it is important to pay specific attention to easy access to EPC input data:

- ✓ it minimises the time needed to find correct and compliant data,
- ✓ it minimises the risk that the expert in charge of the calculation uses incorrect data,
- ✓ it minimises the risk of discussions about which data is to be used,
- ✓ etc.

Examples of problematic situations

- ✓ Difficulty finding the characteristics of a construction product,
- ✓ Difficulty finding the characteristics of a system,
- ✓ Difficulty finding the result of an on-site measurement.
- ✓ …

Considerations on procedural aspects

Possible approaches for easier access to EPC input data may relate to:

- ✓ easy access to the description of the building and the systems,
- ✓ easy-to-access documentation about products and systems,
- ✓ publicly available databases of products' and systems' characteristics,
- ✓ databases of products' and systems' characteristics embedded in an EPC calculation tool,
- ✓ easy access to on-site measurement results,
- ✓ easier access to the actual energy consumption of the building.

If a database is referred to in a national regulation, precautions should be taken that there is no contradiction with the Treaty (that prohibits restrictions on imports and exports, and all measures having equivalent effect, between Member States) and/or with Directives or European Regulations (such as, for example, the Construction Product Regulation).

Ideally, the issue of easy access to compliant input data for products and systems should be handled at the European level. This is rather difficult, as products and systems are not always the same in different national markets. In addition, the input data required at the national level may differ from one country to another. This means that there is a likely need for national and/or industry-led initiatives.

Relevant approaches for this topic

- ✓ Information and communication technologies are a key contributing element for easy access to EPC input data. The use of a standard format for data sharing is a crucial issue.
- ✓ The development of the use of the Building Information Model (BIM) should help with easy access to the data related to a building and its systems.
- ✓ Most of the manufacturers of products and systems provide easy access to their products' characteristics.
- ✓ Databases at a European or national level provide easy access to product or system data; they are sometimes embedded in EPC calculation tools.
- ✓ A link to digital cadastral databases can be useful to find information about existing buildings (dimensions, orientation, etc.) or about the environment of new buildings (shading masks, for example, that block part of the sky dome from view).
- ✓ Easy access to on-site measurement results could be improved by relevant procedures, including building commissioning, building log books and, in the future, BIM.
- ✓ Privacy issues for sharing sensitive data (e.g. energy consumption) must be taken into account.

References

- ✓ How to get compliant and accessible data for the energy rating calculation of a building? - Overview of some existing approaches - François Durier, Susanne Geissler et al. - QUALICHeCK report, March 2016
- ✓ European certification of HVAC products can provide EPC input data - Michèle Mondot, Sandrine Marinhas - QUALICHeCK Fact Sheet #50, February 2017
- ✓ Eurovent certification for heating and air-conditioning products – Sandrine Marinhas - Presentation at QUALICHeCK Workshop, Lyon, January 2017
- ✓ The role certification can play to improve the reliability of input data: Eurovent certification example – Sylvain Courtey - Presentation at QUALICHeCK Workshop, Lund, March 2015

- ✓ Certified Performance Database: tool for quality and compliance – Sylvain Courtey - REHVA Journal, Volume 52, Issue 4, pp. 28-29, August 2015
- ✓ Keymark: the key to the European market – Katharina Meyer - Presentation at QUALICHeCK Workshop, Lyon, January 2017
- ✓ baubook – Easily accessible product information for EPC calculation provided by the Austrian database – Christoph Sutter, Susanne Geissler - QUALICHeCK Factsheet #43, June 2016
- ✓ The French product characteristics database for boilers, heat pumps and solar thermal systems – Jean-Paul Ouin - Presentation at QUALICHeCK Workshop, Lyon, January 2017
- ✓ European solar-shading database, ES-SDA - Ann Van Eycken - QUALICHeCK Fact Sheet #53, February 2017
- ✓ European voluntary rating programme of cool roofing products, Theoni Karlessi, Chrysanthi Efthymiou (NKUA, Greece), QUALICHeCK Fact Sheet #04, September 2015
- ✓ Voluntary scheme and database for compliant and easily accessible EPC product input data in Belgium - Samuel Caillou - QUALICHeCK Fact Sheet #05, October 2015
- ✓ Energy Performance of buildings regulations in Belgium – The key puzzle pieces for an effective regulation – Xavier Loncour - Presentation at QUALICHeCK Workshop, Lund, March 2015
- ✓ French voluntary scheme for harmonised publication of ventilation product data - François Durier, Laure Mouradian, Fabrice Lamarre - QUALICHeCK Fact Sheet #03, April 2015
- ✓ Labelling schemes and their role in building related compliance frameworks – Susanne Geissler - QUALICHeCK Fact Sheet #37, April 2015

Some questions relevant to this topic

- ✓ Could there be a central European database and/or guidance, where appropriate data can be found?
- ✓ Is there a risk that a database referred to by a national regulation could restrict the imports and exports between Member States? How can this risk be overcome?

4.4. Availability of various paths for compliance – trade-off between accuracy and effort

Context and motivation

For various types of EPC input data, there are quite accurate determination procedures which are well described. In principle, one could impose such detailed methods on all EPC calculations. In practice, some of these determination methods require a substantial amount of time and/or expert knowledge. For the determination of on-site related performance, such as building airtightness, a specific measurement may be necessary.

More simplified methods and/or use of default values might make the determination of EPC input data easier, but typically result in less accurate results.

Allowing the choice between accurate determination methods (with typically better results) and simpler methods (with typically less accurate results) can contribute to broader societal support. Depending on the context, one might choose the more accurate or the simpler approach. With increasing performance requirements moving toward nZEB, the more accurate determination methods will probably be used more than the simpler determination methods.

Examples of problematic situations

EPC methods which only allow complex approaches to determine EPC input data may require major efforts and result in a lack of societal support. For example, one could for ask to calculate the U-value of each window exactly according the CEN/ISO procedure, which is rather complex and time consuming. Moreover, it would require extensive databases with input data for all window profiles available on the market.

- ✓ The use of default values for the efficiency of heat pumps, heat exchangers, etc. is in principle very easy for whoever determines the EPC input data, but this approach does not give any kind of stimulus for using products with higher performance. If one decides to allow only default

values, the EPC would become a major barrier for innovation as there would be no stimulus at all for using better performing products and systems.

Considerations on procedural aspects

- ✓ More accurate methods should typically yield better results regarding energy performance in comparison with the use of simpler methods. It means that simpler methods should be on the safe side, i.e. resulting in a value which is likely to be worse than the actual value, in order to make sure that energy minimum requirements are met.
- ✓ Default values are input data which can be used in all cases without any requirement for proof. Default values are typically conservative estimations whereby the real values might be better. By using a more detailed method, one should in most cases be able to obtain a better EPC. In practice, there might be cases where the real building has components or systems with performances worse than the default value. However, the default value can still be used.
- ✓ In case the EPC input data determination method allows simpler and more detailed approaches, it will result in different EPC levels. All results can be compliant, e.g. respecting the procedures. However, the degree of 'accuracy' can vary substantially.

Relevant approaches for this topic

- ➢ Lighting:
  - ✓ There is a whole range of possibilities for modifying the energy performances of lighting systems, e.g. the use of more efficient lamps, better luminaires, presence detection, daylight compensation, etc.).
  - ✓ The use of a default value in office buildings (e.g. 20 W/m²) is in most cases a conservative estimation, but might in some rooms be less than what is effectively installed. When using an extremely negative default value, such value loses its relevance as one will, in practice, be obliged to use a more detailed determination method. In practice, the use of such a default value will not be evident when moving to nZEB requirements. More refined methods then become important (probably in combination with a smart lighting strategy).
- ➢ Thermal bridges:
  - ✓ An accurate assessment of thermal bridges can be done according to 2-dimensional and 3-dimensional calculation methods as foreseen in the CEN standards. However, the collection of all required input data and the related analysis is very time consuming. The use of simpler methods (e.g. default values, use of standard details or standard rules in combination with a better default value) might be necessary as an alternative compliant procedure.
- ➢ Air to air heat exchangers for ventilation systems:
  - ✓ A default value for various types of heat exchangers (cross flow, counter flow, etc.) might be relevant. In the case of the Belgian calculation method, it was agreed in consultation with the stakeholders to have as default value 0%. The motivation was to avoid unwanted product developments (e.g. supply and exhaust metal ducts which are in contact with each other can theoretically comply with the definition of counter-flow heat exchanger). In the meantime, all products on the market have product data in line with the agreed procedures (see www.epbd.be).
- ➢ Windows:

  Possible approaches are found in the market, e.g.:
  - ✓ Default values per type of window profile (wood, PVC, aluminium, etc.), whereby typically a fixed percentage for glazing and window profile is assumed.
  - ✓ Calculation of the U-value of the window by taking the U-value of the profile with the highest U-value for all profiles and with fixed or correct percentages for glazing/profile sections.
  - ✓ Detailed calculation, whereby each profile has a different U-value.
- ➢ Building airtightness
  - ✓ Various approaches exist:
  - ✓ There are countries with a maximum acceptable airtightness level. In such cases, a default value has no relevance.
  - ✓ There are countries that assess the airtightness based on a catalogue of building details.

- ✓ Most countries allow the measured airtightness result to be used as input data for the EPC calculation method.
  In France, there is an alternative procedure whereby default values can be used if the building firm follows a set of procedures and it can be shown that a system is in place which should guarantee that the specifications will be met in most cases.

References

- ✓ Default values in energy performance of buildings standards - François Rémi Carrié - QUALICHeCK Fact Sheet #46, January 2017
- ✓ Building air leakage rate in energy calculation and compliant procedures – Kalle Kuusk – QUALICHeCK Fact Sheet #33, December 2016
- ✓ Building regulations can foster quality management: the French example on building airtightness – François Rémi Carrié, Sandrine Charrier - QUALICHeCK Fact Sheet #01, January 2015
- ✓ Building airtightness in France: regulatory context, control procedures, results - Sandrine Charrier, Adeline Bailly, François Rémi Carrié - QUALICHeCK Fact Sheet #07, December 2015
- ✓ Belgium – Compliance of EPC input data for window thermal performance of new buildings – Lien De Backer, Arnold Janssens - QUALICHeCK report, 2016

Some questions relevant to this topic

- ✓ Are there products and/or systems for which only default values exist? If so, is this seen by the market as a barrier for product and/or system innovation?
- ✓ Are there complaints from stakeholders about the complexity/required effort for obtaining certain types of input data?

4.5. Delicate balance between accuracy of calculation model and number/complexity of input data

Context and motivation

The issue is not the scientific and methodological aspects of calculation methods, but considerations regarding input data and compliance.

- ✓ From a scientific point of view, it is clear that a multi-zone, non-steady state calculation tool gives the highest potential for accurate predictions of energy consumption and indoor climate conditions.
- ✓ However, such detailed calculation methods may be more challenging to a robust and efficient compliance framework as there will be a large amount of data, which might be easy to unambiguously define.

Moreover, more detailed calculation models typically require more effort to provide the input data.

Examples of problematic situations

- ✓ An hourly calculation method is potentially able to better assess the risks of overheating. In case a residential building is still modelled as one single zone, the gain in accuracy/reliability by performing hourly calculations instead of monthly calculations might be limited. If a multi-zone modelling is considered, it will require much more input data (room volumes, internal walls). Moreover, one has to define occupancy profiles, internal gains, etc. with a room by room approach.
- ✓ The situation would of course become much different in case technologies like BIM (see §10) become mainstream and compatible with EPC calculations.

Considerations on procedural aspects

- ✓ Monthly versus hourly method
  An hourly calculation method allows a more accurate prediction of system performances, overheating risks, indoor air quality, etc. At the same time, it often needs more input data and

more time for calculation. One might expect that the calculation time gradually becomes less of a problem, although very detailed modelling might still remain time consuming.

- ✓ Single zone versus multi zone
  Multi-zone modelling has several advantages, particularly in terms of accuracy. However, there are also risks and drawbacks, e.g. the need to introduce significantly more input data.
- ✓ Standard tools versus commercial calculation packages
  There are several very powerful calculation tools on the market. Some of these tools are highly standardised, others have modules which can be modified/adapted by users. There are procedures to check the accuracy of these calculations tools (e.g. BESTEST, etc.).
- ✓ Potential advantages of BIM (Building Information Modelling)
  The use of BIM might strongly reduce the efforts necessary to create an EPC compliant building model and to provide input data. This topic is further developed in §10.

References

- ✓ Procedures for determining input data for the Energy Performance Certificate (EPC) of existing residential buildings in Belgium - Xavier Loncour, Nicolas Heijmans, Clarisse Mees - QUALICHeCK Fact Sheet #23, June 2016

Some questions relevant to topic

- ✓ Has the calculation method been assessed in terms of complexity and/or efforts required for determining the EPC of a building? In particular for simple and small projects, is the effort considered reasonable?
- ✓ Are there sufficient options for carrying out more detailed calculations, offering the possibility of a better result?

4.6. Specific attention for procedures regarding execution-related input data

Context and motivation

Some EPC input data depend on the execution of the building site. This is particularly the case for:

- ✓ building airtightness, depending on the construction works;
- ✓ ductwork airtightness, mechanical ventilation air flow rates, electrical fan power, etc. , depending on the installation works;
- ✓ mechanical ventilation air flow rates, heat input, heat output and combustion parameters of heating systems, water flow rates, fan or pump speed/stage, etc., depending on the adjustment of systems' operation parameters at commissioning.

For some of these input data, national regulations may not require the actual value. Reasons for this choice can be that:

- ✓ the actual variations of the input data value on either side of a nominal (or normal) value are in practice small and/or they do not have much influence on the whole building's energy performance assessment (for example combustion parameters),
- ✓ the value is fixed by other regulations or professional rules.

For other input data, either because they may vary within a wide range depending on the construction, installation or commissioning works, or because their variations have a significant influence on the assessment of the building's energy performance, national regulations can require that the actual value be known and used. This may be the case, for example, for building airtightness, ductwork airtightness, ventilation air flow rates, etc.

In this case, construction product or system data as supplied by the manufacturers are not sufficient, and in most cases on-site records or measurements are necessary.

In some cases, the lack of on-site measured data is allowed but then default values have to be used, resulting in a disadvantage when issuing the EPC (see 3.3.1 and 4.4).

Examples of problematic situations

Data has to be recorded on-site (see 3.3.1 and 4.2) but there is no procedure or the procedure is not clear.

- ✓ Data has to be measured on-site (see 3.3.1 and 4.2) but there is no procedure or the procedure is not clear.
- ✓ Data should be recorded or measured on-site but this requires too much time, competent persons or companies, expense, etc., making it unrealistic

Considerations on procedural aspects

For on-site records or measurements:

1. As for all EPC input data, three very clear procedures are necessary:
   - ✓ Clear technical procedures explaining how to record or measure on-site data (see 4.1),
   - ✓ Clear organisational procedures giving the organisational requirements linked to on-site data determination (see 3.3.3),
   - ✓ Clear procedures for evidence of compliance (see 4.2).
2. These procedures should especially describe how the resulting record or measurement is then made available to the person or company who will use it as input data for the energy performance calculation of the building.

For limiting or avoiding on-site records or measurements by a third party:

A specific framework for quality control of construction, installation or commissioning works (proven competence of persons or companies) can, in some cases, limit (or even prevent) on-site records or measurements.

Relevant approaches for this topic

- ✓ In Sweden, clear procedures exist for regulatory checks of ductwork airtightness in new buildings (AMA).
- ✓ Clear procedures under a quality framework have been defined and implemented in Belgium for building airtightness measurements. A scheme has been developed in the Flemish Region by which authorized persons control ventilation systems on the basis of a reference document describing performance criteria.
- ✓ In the United-Kingdom, all building airtightness measurement results have to be uploaded into a specific database in which the person in charge of the building energy performance calculation can find the result.
- ✓ In France, a certification of construction companies' quality management system for airtightness of buildings has been implemented. A systematic measurement of building airtightness is not required for certified companies. In addition, the ductwork airtightness class must be justified if input data different from the default value is used, derived either from a measurement performed by a certified tester or from the application of a certified quality management approach.
- ✓ In the Netherlands, three methodologies can be used to determine building airtightness: 1. Calculate a fixed value according to NEN 8088 based on building year and type, 2. Measure airtightness, 3. Calculate airtightness based on reference details: if this outperforms the fixed value according to NEN 8088, a measurement is necessary.

References

- ✓ Background on Swedish regulation BBR – Ventilation and airtightness – Wanda Rydholm - Presentation at QUALICHeCK Workshop, Lund, March 2015
- ✓ Belgian/Flemish evaluation scheme for ventilation systems – Samuel Caillou, Paul Van den Bossche - QUALICHeCK Factsheet #55, February 2017
- ✓ Building airtightness: towards improved and reliable declared performance – Clarisse Mees - Presentation at QUALICHeCK Workshop, Lund, March 2015
- ✓ Air-permeability testing of new dwellings & buildings in the UK: challenges to maintaining standards – Barry Cope - Presentation at QUALICHeCK Workshop, Lund, March 2015
- ✓ Building regulations can foster quality management: the French example on building airtightness – François Rémi Carrié, Sandrine Charrier - QUALICHeCK Fact Sheet #01, January 2015

- ✓ Ductwork airtightness in France: regulatory context, control procedures, results – Sandrine Charrier, Adeline Bailly Mélois, François Rémi Carrié - QUALICHeCK Factsheet #54, February 2017
- ✓ Overview of competent tester schemes for building airtightness – François Rémi Carrié - Presentation at QUALICHeCK Workshop, Lund, March 2015
- ✓ The Effinergie approach to ease transitions to new regulatory requirements - François Rémi Carrié, Yann Dervyn - QUALICHeCK Factsheet #45 , January 2017
- ✓ Quality and compliance on building ventilation and airtightness in the Dutch context – Wouter Borsboom - Presentation at QUALICHeCK Workshop, Lund, March 2015

Some questions relevant to this topic

- ✓ Are there other ways to get input data that depend on construction, installation or commissioning, besides systematic recording or measurement by a third-party?

4.7. Procedures in line with EU or national legislation

Context and motivation

Articles 34 and 35 of the Treaty on the functioning of the European Union (Consolidated version – 2010) prohibit quantitative restrictions on imports and exports, and all measures with equivalent effect, between Member States.

Some products are covered by harmonisation measures adopted by the European Parliament and the Council, by the Council or by the Commission. Such harmonization measures (Article 115 of the Treaty) are, among others, the European Regulation on construction products (Regulation (EU) N° 305/2011) and the European Directive on the Ecodesign of energy related products (Directive 2009/125/EC).

These regulations define requirements; manufacturers may demonstrate compliance with these requirements either directly or by using harmonised standards to this effect; manufacturers issue a declaration of conformity and affix CE marking on their product.

Other Directives on renewable energy sources (2009/28/EC) and on energy services (2006/32/EC) are also relevant to some of the EPC input data.

Examples of problematic situations:

- ✓ It is essential that the procedures (technical, organisational, for evidence of compliance) to determine EPC input data are not in contradiction with the Treaty and/or Directives or European Regulations.
- ✓ The following paragraph gives a summary of the main requirements of these regulations when they may influence methods to define, determine and show evidence of compliance of EPC input data.

Considerations on procedural aspects

European regulation on construction products (Regulation (EU) N° 305/2011)

Declaration of performance of a construction product (and its CE marking) must be based on the Construction Product Regulation ((EU) N° 305-2011), as soon as harmonized European standards cover this product. It is therefore important that the procedures for determining and making EPC input data available are not in contradiction with this requirement.

Member States may specify national requirements for construction products only if no harmonised standard already exists and if performance may not (or may not fully) be assessed on the basis of an existing harmonized standard. In such cases, they need to foresee an equivalence clause, allowing products that have already demonstrated compliance with the national regulatory requirement through an equivalent system in another country. (See also 5.3).

European Directives about the Ecodesign of energy related products (Directive 2009/125/EC) and energy labelling of energy related products (Directive 2010/30/UE)

The European Directive 2009/125/EC (sometimes called ErP Directive or Ecodesign Directive) requires that energy-related products fulfil Ecodesign requirements as defined in specific implementing measures, usually Commission Regulations, for the different products. Such regulations cover or will cover space heating and domestic hot water systems, air conditioners and air to air heat pumps, ventilation units, as well as some of their components (fans, pumps, electric motors), chillers, fan coil units, condensing units, solid fuel boilers, local room heating products, etc. The regulations include requirements on energy performance levels and how to assess energy efficiency, based on harmonised standards. Often, the regulations establish requirements with thresholds becoming stricter over time. The regulations also list which information and data must be published in systems' technical documentation. The directive requires that the manufacturer keeps and makes available an EC declaration of conformity, and affixes the CE marking.

The European Directive 2010/30/UE (sometimes called Energy Labelling Directive) relates to the indication of the consumption of energy and other resources by energy-related products through labelling and information to end-users. Commission Delegated Regulations have already been published for household air conditioners, space heaters and water heaters and residential ventilation units, defining energy efficiency classes, contents of the label and product information to be made available to consumers.

It can be noted that the parameters and methods used in the regulations linked to these two Directives are generally very different from those used to take into account the performance of HVAC products in the calculation of the energy performance of buildings (national transpositions of the EPBD).

European Directive 2009/28/EC on the promotion of the use of energy from renewable sources

This directive requires, among other things, that Member States promote the use of renewable energy sources in buildings. Member States must have defined specifications for renewable energy systems to benefit from support schemes, based on European standards if they exist (Article 13). Such technical specifications must not prescribe where the systems are to be certified and should not impede the operation of the internal market.

For biomass, Member States are required to promote technologies that achieve a conversion efficiency of at least 85 % for residential and commercial applications and 70 % for industrial applications. Member States are required to promote heat pumps that fulfil the minimum requirements of the European eco-label and to promote certified solar thermal systems based on European standards if they exist.

Member States were also obliged to ensure that certification or qualification schemes were available by the end of 2012 for installers of small-scale biomass boilers and stoves, solar photovoltaic and solar thermal systems, shallow geothermal systems and heat pumps, with a mutual recognition of these certifications or qualifications between Member States (Article 14).

Finally, Article 5 defines how Member States must include heat pumps in the calculation of their share of renewable energy sources. The heat energy captured by heat pumps shall be taken into account for this calculation if the final energy output significantly exceeds the primary energy input required to drive the heat pumps. This is described by a formula (Annex VII) using a seasonal performance factor and requiring that only heat pumps for which this factor is higher than a given limit be taken into account, depending on the national ratio between gross production of electricity and the primary energy needed for this electricity production.

European directive 2012/27/EU on energy efficiency

This Directive includes a requirement that Member States promote the availability of high-quality energy and cost-effective audit schemes for all final customers, aimed at identifying and quantifying cost-effective energy savings opportunities, which are carried out in an independent manner by qualified and/or accredited experts (Article 8).

References

- ✓ Consolidated version of the Treaty on the Functioning of the European Union (2010/C 083/01)
- ✓ Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products
- ✓ Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of Ecodesign requirements for energy-related products
- ✓ Directive 2010/30/UE of the European Parliament and of the Council of 19 May 2010 on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products
- ✓ Impact of the Ecodesign and Energy Labelling Directives on HVAC products – François Durier, Michèle Mondot –BUILD UP website, April 2015, www.buildup.eu/news/43913
- ✓ Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources
- ✓ Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency
- ✓ Legal issues when developing compliance frameworks - Eric Winnepenninckx - Presentation at QUALICHeCK Workshop, Lund, March 2015
- ✓ Default values in energy performance of buildings standards - François Rémi Carrié - QUALICHeCK Fact Sheet #46, January 2017
- ✓ Labelling schemes and their role in building related compliance frameworks – Susanne Geissler - QUALICHeCK Fact Sheet #37, April 2015

Some questions relevant to this topic

- ✓ Would it be possible to move towards a harmonisation of the quantities defined and used by all these directives and regulations and the quantities used as input data by the various national regulations implementing the EPBD

4.8. Robust technical handling of project independent innovative systems

Context and motivation

In principle, QUALICHeCK does not deal with aspects of calculation methods. However, in order to arrive at an effective compliance framework, societal support is important. It is clear that new innovative concepts may result in better energy performances and/or a better indoor climate and/or a better cost-benefit ratio.

As indicated in §0, a compliance and enforcement framework should not be a barrier to innovation. Therefore, the issue of innovation is included in this source book.

Technologies not covered by a calculation method

In general, but in particular in a context with effective compliance control, it is not possible to take into account technologies in the EPC calculation if these technologies are not covered by the calculation method.

Technologies only covered by a very simple and/or conservative input value

In some cases, a technology is considered in the calculation method but with a conservative default value. If there is no procedure for proving a better performance, there is no drive for innovation.

In both cases, it is clear that the market uptake of innovative technologies can be blocked or seriously limited. In particular with demanding EPC requirements (such as nZEB) it may mean in practice that such technologies are not used.

In case there is not an effective compliance and enforcement framework, this issue is less critical. However, with an effective compliance and enforcement framework, there is no market for such technologies if there it is not possible to accurately assess their performance.

Examples of problematic situations

- ✓ A national calculation method that does not take into account the absorption and emission characteristics of the external layer of opaque components does not address cool roof products.
- ✓ A national calculation method that does not take a specific type of heat pump technology into account means in practice that this type of heat pump cannot be used in that country for EPC calculations.
- ✓ A national calculation method that does not take into account advanced natural ventilation strategies for summer comfort control.
- ✓ A national calculation method that has a conservative value for demand controlled ventilation, while substantially better products are available on the market. However, there is no procedure foreseen for obtaining a better result.

Considerations on procedural aspects

The following aspects are important when developing an procedural approach:

- ✓ Transparency in the assessment procedure for project-independent innovative technologies:
- ✓ It is very important that the procedure to be followed is clearly communicated in the market.
- ✓ Predictability of the possible outcome:
- ✓ Although not always easy and in cases of very innovative technologies likely not even possible, it is important that the market is informed about the assessment methodology in order to allow optimisation of product development.
- ✓ Developing an equivalent assessment methodology can be very challenging because such methodology usually does not exist in the literature or in foreign EPC methods.
- ✓ Integration into standard procedure at a later phase:
- ✓ Once there is enough experience in the market with a given technology, it could be useful to integrate the assessment method into the standard calculation method, with the possibility to improve the assessment method (potentially toward less favourable assessment) based on the experiences.
- ✓ Legal aspects:
- ✓ It is important to respect all national and EU legislation, in particular the criteria for the persons and organisations which make such assessments.
- ✓ Time and costs:
- ✓ In order to stimulate innovation and or at least to not hinder innovation, it is important that the duration of the assessment can be short and be carried out at a reasonable cost.

Relevant approaches for this topic

- ✓ Several countries already have a procedure in place for handling such technologies, i.e. Belgium, France and the Netherlands.
- ✓ The overall approach of these national procedures is rather similar, but in practice there are differences in approaches, as well in terms of legal framework, the kind of technologies to be covered, financial aspects, etc.

References

- ✓ The final recommendations of the ASIEPI project: How to make EPB-regulations more effective?, March 2010, Summary report
- ✓ Assessment of demand-controlled ventilation in various countries and compliance frameworks: practical experience and difficulties encountered by a manufacturer – Yves Lambert - Presentation at QUALICHeCK Workshop, Lund, March 2015

Some questions relevant to this topic

- ✓ Is there a procedure for handling such innovative technologies in your country of interest?
- ✓ Do you know manufacturers who are confronted with such an obstacle?

4.9. Handling project specific technologies in a robust way

Context and motivation

As already indicated in §4.8, the need for a robust framework for handling technologies not covered by the standard EPC procedure is more important if there is a strict compliance framework. If such framework does not exist, there is basically no market for such technologies.

In §4.8, the focus is on products and systems that can be installed in any building, and for which it is possible to have a project-independent assessment. However, there can be also cases where the technology is so project-specific that the analysis should be done at a project level. An example could be a large office building that uses a nearby river as source for a heat pump, when this technology is not integrated in the standard EPC method.

As is the case for §4.8, this aspect is important within the scope of QUALICHeCK as the lack of such procedures might be very problematic in a legal framework where there is effective compliance and enforcement. In case of no compliance and enforcement, it is of less concern if innovative concepts are supported are not.

Example of problematic situations

One wants to realise a big office building project, with the nearby river as cooling source for a heat pump-based heating system. The legal calculation procedure does not foresee the possibility of using a river as a cooling source for a heat pump. In case of a strict compliance framework, it is clear that such technology cannot be considered.

Considerations on procedural aspects

- ✓ This kind of challenge is more typical for larger projects.
- ✓ It is very important that the assessment time is reasonable; if not there is, in practice, no market for such assessment.
- ✓ Assessment of the applied methodology by the government or by organisations designated by the government typically requires expert knowledge. It might be useful to consider a panel of competent experts. In small countries, it might be challenging to find such a panel that guarantees a sufficient degree of independence from the submitters of proposals.

Relevant approaches for this topic

In Belgium, the legislation by the Regions foresees an assessment of innovative systems at a building level.

Some questions relevant to this topic

- ✓ Are there possibilities in the EPC procedure to assess specific design solutions and/or technologies at a project level that are not covered by the official EPC procedure? If so, is this covered in the legislation? Is there experience in practice? Are there practical limitations (e.g. only technologies or concepts with minimum improvement)?

4.10. IT can help to minimise the risk of non-compliant EPC input data

Context and motivation

There can be several reasons for non-compliant EPC input data. This can be a lack of understanding of certain aspects of the procedures for determining the data, an error when entering the data into the EPC calculation tool, etc.

In principle, this kind of problem is fully the responsibility of those in charge of the calculation. However, a good IT environment can help to minimise the risk of such errors and related non-compliant input data. Such functionalities can also help to increase societal support in case of strict sanctions for non-compliance.

BIM (Building Information Modelling) might in the future substantially contribute to the availability of compliant data (see §10).

Examples of problematic situations

- ✓ The efficiency of a heat exchanger must be introduced as a percentage. For a heat exchanger with an efficiency of 78%, one introduces 0.78, whereas the software assumes that the input value is a percentage. An automatic check by the software (e.g. a warning if the efficiency is below 1%) can avoid such errors.
- ✓ There are 12 PV panels, each with a nominal power of 250 W, i.e. a total power of 3 kW. In the software, 12 panels are introduced with each a nominal power of 3 kW. This results in a far too optimistic EPC result.
- ✓ The thermal conductivity of an insulation material is incorrectly introduced, e.g. 0.32 W/m.K instead of 0.032 W/m.K (resulting in a result that is too negative). As long as the building energy performance requirements are met, this should not result in a sanction, but such errors should be avoided.

Considerations on procedural aspects

- ➢ It can be useful to associate conditions resulting in a warning and conditions resulting in rejection of the introduced value with the various input parameters:
  - ✓ **Rejection:** if the submitted data is impossible, e.g. an efficiency of an air to air heat exchanger of more than 100%, a negative lambda value, etc.
  - ✓ **Warning:** in case a value is outside a reasonable range, e.g. a nominal power of a PV panel of more than 500 W, an efficiency of an air to air heat exchanger of less than 1%.

Relevant approaches for this topic

- ✓ The availability of databases of input data, which are paired with the software for calculating the EPC can avoid the risk of such errors.
- ✓ The use of files giving product characteristics in the context of BIM should help to avoid such errors (see Chapter 10).

References

- ✓ How to get compliant and accessible data for the energy rating calculation of a building? - Overview of some existing approaches - François Durier, Susanne Geissler et al. - QUALICHeCK report, March 2016
- ✓ European certification of HVAC products can provide EPC input data - Michèle Mondot, Sandrine Marinhas - QUALICHeCK Fact Sheet #50, February 2017
- ✓ baubook – Easily accessible product information for EPC calculation provided by the Austrian database – Christoph Sutter, Susanne Geissler - QUALICHeCK Factsheet #43, June 2016
- ✓ EPC database and control system for compliant EPC input data in Sweden - Pär Johansson - QUALICHeCK Fact Sheet #24, August 2016
- ✓ Easy access, compliance of EPC input data and quality assurance of EPCs, Theoni Karlessi, Nikos Papadopoulos, Chrysanthi Efthymiou, QUALICHeCK Fact Sheet #49, February 2017

Some questions relevant to this topic

- ✓ Does the EPC calculation tool include automatic checks regarding correctness of input data? (see examples above)

4.11. Recognition of the competence of persons or companies for specific aspects

Context and motivation

To improve compliance and to help to show evidence of EPC input data compliance, previously-recognised competence of persons or companies may be useful:

- ✓ EPC input data made available by a manufacturer or found in a database may result from measurements carried out by an accredited laboratory.
- ✓ Data recorded by an expert or measured on-site may be determined by a certified or qualified person or company.
- ✓ Choosing the relevant data fixed in legislation (for example, finding the correct value in a thermal bridges atlas) may be done by a certified or qualified person or company.

Examples of problematic situations

- ✓ Without previous recognition of a testing laboratory, it may be necessary for the procedures to require that EPC input data for construction products and systems are provided along with a report showing that all aspects of the technical procedures have been fulfilled (detailed description of the testing installation, of the measuring appliances used, of their calibration, of the corrections brought to the measured values to take into account the calibration certificate, etc.);
- ✓ Without previous recognition of experts that record data describing the building or its systems, it may be necessary for the procedures to require that all the data used for the EPC calculation are provided together with detailed information about how they have been determined;
- ✓ Without previous recognition of experts that measure data on-site, it may be necessary for the procedures to require that the measured data are provided together with a report showing that all aspects of the technical procedures have been fulfilled (detailed description of the preparation of the measurement, of the conditions of measurement, of the measuring appliances used, of their calibration, of the corrections brought to the measured values to take into account the calibration certificate, etc.).

Considerations on procedural aspects

According to the particular needs, procedures may require either qualification, certification or accreditation:

- ✓ Qualification is the recognition by a third party that a person or a company has the ability, qualities, or attributes to perform a particular job or task, after successful completion of a course or training or passing of an exam or an audit.
- ✓ Certification is the procedure by which a third party gives written assurance that a product, a process, a system or a person conforms to specified requirements mentioned in the rules of the relevant certification scheme.
- ✓ Accreditation is the recognition by a third party of the competence of a conformity assessment body to carry out specific conformity assessment tasks. Accreditation only applies to conformity assessment activities, such as tests and inspections. Accreditation also applies to certification bodies for their activity of certifying a product, a process, a system or a person.

With such definitions, it may be interesting that the organisational procedures for the determination of the EPC input data, and/or the procedures for the evidence of compliance of these data make reference to:

- ✓ Qualification of persons (for example: qualification of experts to establish the EPC of an existing residential building, relying on training followed by a successful exam),

- ✓ Qualification of companies (for example: qualification of a company to measure building airtightness, relying on employee training, examination of the measuring devices and a relevant quality insurance system),
- ✓ Accreditation of testing laboratories according to EN ISO/IEC 17025, for the measurement of product data, and if appropriate of certain data measured on-site,
- ✓ Accreditation of inspection bodies according to EN ISO/IEC 17020 (for example: accreditation of the body that checks the compliance of the EPC input data),
- ✓ Certification of management systems implemented by companies, inspection bodies or certification bodies (for example: certification of the management system of a building company for the construction of airtight buildings, allowing for non-systematic measurement of building airtightness),
- ✓ Certification of services (seen as a process) provided by companies or inspection bodies (for example: certification of the service of establishing an Energy Performance Certificate),
- ✓ Certification of persons (for example: certification of experts to establish Energy Performance Certificates for all types of non-residential buildings).

It may also be required that such certifications of management systems, services or persons are managed by certification bodies that are themselves accredited:

- ✓ According EN ISO/IEC 17065 for certification of services and processes,
- ✓ According to EN ISO/IEC 17021 for certification of systems,
- ✓ According to EN ISO/IEC 17024 for certification of persons.

Relevant approaches for this topic:

- ✓ Schemes for the recognition of the competence of building airtightness testers have been implemented in the Czech Republic, Denmark, France, Germany, Ireland, Sweden, and the United Kingdom.
- ✓ In France, systematic measurement of building airtightness is not required for construction companies with a certified quality management system regarding building airtightness.
- ✓ In Sweden, experts that issue EPCs must be certified.

References

- ✓ How to get compliant and accessible data for the energy rating calculation of a building? - Overview of some existing approaches - François Durier, Susanne Geissler et al. - QUALICHeCK report, March 2016
- ✓ Building regulations can foster quality management: the French example on building airtightness – François Rémi Carrié, Sandrine Charrier - QUALICHeCK Fact Sheet #01, January 2015
- ✓ Competent tester schemes for building airtightness - Valérie Leprince, François Rémi Carrié - REHVA Journal, Volume 52, Issue 4, pp. 16-17, August 2015
- ✓ Air-permeability testing of new dwellings & buildings in the UK: challenges to maintaining standards – Barry Cope - Presentation at QUALICHeCK Workshop, Lund, March 2015
- ✓ Certification of persons issuing OVK and energy performance certificates - Magnus Jerlmark - Presentation at QUALICHeCK Workshop, Lund, March 2015
- ✓ Qualification of airtightness testers - Paula Wahlgren, Magnus Hansén - Presentation at QUALICHeCK Workshop, Lund, March 2015
- ✓ Building airtightness: towards improved and reliable declared performance – Clarisse Mees - Presentation at QUALICHeCK Workshop, Lund, March 2015
- ✓ Overview of competent tester schemes for building airtightness – François Rémi Carrié - Presentation at QUALICHeCK Workshop, Lund, March 2015
- ✓ Certification of experts for the issuance of EPCs in Sweden – Paula Wahlgren – QUALICHeCK Fact Sheet #56 – February 2017

Some questions relevant to this topic

- ✓ The cost of recognition of competence is usually paid by persons or companies that request it. Is the cost always covered by simplifications in the procedures or is it sometimes an additional cost?

- ✓ Are there clear criteria to decide about the level of requirements to obtain a qualification or a certification?
- ✓ Does the level of requirements to obtain a qualification or certification always result from a compromise between professionals that would like fewer requirements and administration that would like more requirements?

4.12. Specific issues regarding existing buildings

Context and motivation

The EPBD (Directive 2010/31/EU) requires that Member States ensure that an EPC (energy performance certificate) is issued for:

(a) buildings subject to major renovation;

(b) buildings or building units which are constructed, sold or rented out to a new tenant; and

(b) buildings where a total useful floor area over 250 m^2 is occupied by a public authority and frequently visited by the public.

This means that EPC input data have to be determined not only for new buildings but also for existing buildings.

While data availability and quality of input data might be better in case of major renovations due to the simple fact that they are needed for planning renovation measures, data availability and thus also EPC compliance may be problematic in the two other cases.

Examples of problematic situations

- ✓ In existing buildings, it may be difficult or even impossible to get all the information required by the procedures. The procedures for determining EPC input data may be not adapted to the specific case of existing buildings, where information about the construction products used, their characteristics, the way they have been implemented, the performance of the systems, etc., may be not available.
- ✓ In most cases, determination of EPC input data for existing buildings relies on observations, records or measurements made on-site: the procedures may not be adapted to this specificity.

Considerations on procedural aspects

- ➢ As for all EPC input data, three very clear procedures are required:
  - ✓ Clear technical procedures explaining how to record or measure data on-site (see 4.1),
  - ✓ Clear organisational procedures giving the organisational requirements linked to the on-site determination of the data (see 3.3.3),
  - ✓ Clear procedure for evidence of compliance (see 4.2).
- ➢ These procedures should be adapted for existing buildings, taking into account that some required information may be not easily accessible or even impossible to find, record or measure. They should use default values as necessary (see 4.4 and 5.22).

Relevant approaches for this topic

For existing residential buildings, detailed procedures have been implemented for determining EPC input data.

References

- ✓ Procedures for determining input data for the Energy Performance Certificate (EPC) of existing residential buildings in Belgium - Xavier Loncour, Nicolas Heijmans, Clarisse Mees - QUALICHeCK Fact Sheet #23, June 2016

5. Best practices for Step 2: Legal frameworks for better enforcement and effective penalties

It is important to have an effective enforcement and sanctioning framework in place in order to drive the market towards better energy efficiency performance.

In the current EPBD version,

Article 18 "Independent control system" requires:

- ✓ The implementation of an independent control system for energy performance certificates and reports on the inspection of heating and air-conditioning systems in accordance with Annex II.
- ✓ The Member States may delegate the responsibilities for implementing the independent control systems in compliance with Annex II and shall require the energy performance certificates and the inspection reports referred to in paragraph 1 to be made available to the competent authorities or bodies on request.

Article 27 "Penalties" requires that

- ✓ Member States shall lay down the rules on penalties applicable to infringements of the national provisions adopted pursuant to this Directive, and
- ✓ Shall take all measures necessary to ensure that they are implemented. The penalties provided for must be effective, proportionate, and dissuasive.

In this chapter, the focus is on the rules and formal procedures (i.e. "Member States shall lay down the rules on penalties applicable to infringements of the national provisions"), whereas Chapter 6 focuses on the application in practice (i.e. "Shall take all measures necessary to ensure that they are implemented")

Societal support for EPBD implementation is important (for more information see Chapter 8) as well as an effective framework for enforcing compliance. In this chapter, the focus is on the legal boundary conditions.

Legal obligations imposed by the EPBD are as follows:

New buildings and major renovations:

- ✓ The availability of the EPC
- ✓ Meeting minimum energy requirements for specific systems and building components,
- ✓ Meeting minimum energy requirements for energy performance indicators.

All buildings and building units:

- ✓ The availability of the EPC in case of construction, sale or rent,
- ✓ EPC to be presented and handed over to buyers and tenants,
- ✓ EPC indicators to be published in the media when selling or renting,
- ✓ EPC to be displayed in public buildings and buildings frequently visited by the public.

With regard to the EPC, non-compliance can occur at different levels (for more information see Chapter 3.4):

- ✓ input data needed for calculating the EPC can be non-compliant (i.e. they have not been established in line with the procedures in force in the context of the relevant legislation), or
- ✓ the methods to calculate the energy performance rating of the building can be non-compliant (i.e. the calculation has not been undertaken in line with the procedures in force in the context of the relevant legislation), or
- ✓ the energy performance rating of the building mentioned in the EPC, which is used to check whether energy performance minimum requirements are met or not, can be non-compliant.

In all cases it is important to have an enforcement framework in place in order to drive the market towards better energy efficiency performances.

In the following paragraphs, various aspects related to the legal framework are identified, and examples of best practice are provided. This list is quite long and it reflects the many aspects to be taken into account in order to be able to come to an appropriate legal framework.

5.1. Clear procedures regarding communication with authorities

Context and motivation

It is crucial that the legal framework specifies WHEN and WHICH TYPE of information has to be communicated, e.g.:

- ✓ At which point in the building process is communication with the authorities necessary?
- ✓ What type of information needs to be communicated?
- ✓ Which procedures exist regarding confirmation of information?

Examples of problematic situations

- ✓ In case the legislation does not clearly specify the last point to submit the EPC, it is not possible to have an enforcement/penalty if no EPC is submitted.
- ✓ In case the legislation does not clearly specify the practical procedure for submitting the EPC (by post, registered mail, by web application, etc.), it will not be possible to apply enforcement/penalties due to non-submission of the EPC.

Considerations on procedural aspects

- ✓ It is important to check systematically if all aspects of communication with the public authorities are precisely described in the legislation.
- ✓ A well-developed web application can substantially contribute to efficient communication with the public authorities.

Relevant approaches for this topic

In Ireland, the provisional energy performance certificate (called BER – Building Energy Rating) issued in the design stage must be substituted by the updated final EPC for the completed building within a specified period of time. The process is supported by the electronic database and a web application. The authority can easily check whether the legal obligation is fulfilled or not.

References

- ✓ Sustainable Energy Authority of Ireland (SEAI) - How will BER of new dwellings be carried out? – Page on the SEAI website
- ✓ Sustainable Energy Authority of Ireland (SEAI) - Building Energy Rating - Assessors - Page on the SEAI website
- ✓ Sustainable Energy Authority of Ireland (SEAI) - Building Energy Rating - Display Energy Certificates (Decs) - Page on the SEAI website
- ✓ Building Energy Rating (BER) assessors and Display Energy Certificates (DEC) assessors - Code of Practice - Sustainable Energy Authority of Ireland (SEAI) - www.seai.ie, August 2016
- ✓ 2016 Implementing the Energy Performance of Buildings Directive (EPBD), featuring country reports – Concerted Action EPBD - www.epbd-ca.eu/ca-outcomes/2011-2015, September 2015

Some questions relevant to this topic

- ✓ Is your legislation clear in terms of how information exchange has with the governmental Services in charge of EPC implementation should be carried out?

5.2. Philosophy on type of requirements and requirement levels

Context and motivation:

Most countries have, in addition to a requirement in terms of primary energy consumption, additional requirements:

- Related to energy use, e.g.:
  - ✓ Minimum component requirements,
  - ✓ Net heating and/or cooling demand,
  - ✓ Building airtightness,
  - ✓ Minimum contribution of renewable energy sources.
- Related to indoor climate, e.g.:
  - ✓ Summer comfort,
  - ✓ Indoor climate and indoor air quality,
  - ✓ Daylight availability.
- Related to energy flexibility, smart grid, etc.

It is important in all circumstances to critically evaluate if such a requirement is necessary and/or whether it is better to consider another type of requirement.

Additional requirements can support control procedures. They can help to improve specific aspects by addressing specific problems identified in evaluation studies. However, they can also lead to problematic situations (see below).

Once a type of requirement has been decided on, there are also various requirement levels to select.

Examples of problematic situations

Additional requirements can lead to problematic situations or may create unnecessary burdens in terms of design process and building costs.

Examples:

- ✓ Imposing severe airtightness requirements,
- ✓ Imposing very low U-value for windows,
- ✓ Imposing very low U-value requirements for common walls,
- ✓ Imposing heat recovery with a very high minimum efficiency.

Considerations on procedural aspects

For each of the potential requirements, there are at least two key issues of concern:

- Making objectives the motivation for imposing such a requirement.
  - ✓ There can be more than one objective for imposing such requirements.
  - ✓ It is important to evaluate whether the requirement is necessary for meeting the objective. It is not always certain that the requirement is effective and necessary for meeting the objective. Moreover, a requirement may have made sense in the past, but is less necessary today for a given objective (see below example on glazing).
- Critically analysing and motivate the requirement level.

Relevant approaches for this topic

U-value glazing

- ✓ In the past, a major motivation to impose maximum U-values was because of thermal comfort considerations (motivation: comfort).
- ✓ In the case of specific voluntary schemes (e.g. as in the case for Passive houses - a specific construction standard accompanied by a voluntary quality assurance scheme), whereby the aim is to avoid a classical heating system, imposing a very low U-value (corresponding with triple glazing) can be a good approach (motivation: limited peak power by ventilation supply system requires minimisation of transmission losses).

- ✓ In most countries and in order to avoid unreasonable choices, one can impose a maximum U-value of 1.1 W/m²K (corresponding with low-e, argon filled double glazing) as such glazing is currently at a quite similar price level as ordinary double glazing (motivation: cost-optimal choice in ALL cases).

Building airtightness

- ✓ In the case of specific voluntary schemes (e.g. as is the case for Passive houses - a specific construction standard accompanied by a voluntary quality assurance scheme) it is a logical choice to impose a severe airtightness requirement (motivation: limited peak power by ventilation supply system requires minimisation of transmission losses).
- ✓ In general: imposing an ambitious airtightness requirement calls for a test to verify compliance and thus results in additional costs for testing.
- ✓ Testing procedures will be only effective if qualified experts and compliance frameworks are available.

References:

- ✓ Quality framework for reliable fan pressurisation tests - Clarisse Mees, Xavier Loncour – QUALICHeCK Fact Sheet #21, June 2016
- ✓ Passive house Institute, passive house standard, passive house certification, http://passivehouse.com/

Some questions relevant to this topic

- ✓ Do you have a solid justification for imposing a certain type of requirement?

5.3. Conformity with EU legislation

Context and motivation

There are several EU legislations (construction product regulation, workers' rights to free movement, EU rules governing State Aid and Competition, etc.) containing specifications which have to be respected when developing legal procedures in relation to EPBD compliance handling.

- ✓ In the context of the EPBD, the Construction Product Regulation (EU) No 305/2011 is especially important, ensuring the free circulation of construction products in the EU's Single Market, meaning that products only have to be tested once according to a harmonised European standard or European Assessment Document. This has to be taken into account when setting rules on how to check compliance.
- ✓ Regulation (EU) No 492/2011 and Directive 2014/54/EU are crucial in the context of freedom of movement for workers, meaning that qualification requirements targeting the workforce establishing the EPC must be set without excluding workforces from abroad. This has to be taken into account when setting rules on how to ensure compliance of the EPC and how to check compliance.
- ✓ EU rules governing State Aid and Competition have to be respected when it comes to offering incentives for better compliance instead of punishing lack of compliance.

Looking at EED 2012/27/EU and EPBD implementation, some potential overlaps can be identified: implementation of Article 5 EED "Exemplary role of public bodies' buildings" will be facilitated if it is possible to build on the compliant implementation of the EPBD. However, if the responsibility for transposition is with different public entities, it will be difficult if not impossible to tap the full potential of synergies and information exchanges about non-conformity and the respective consequences regarding enforcement and sanctions. Usually, timelines of transposition and implementation are different and can hardly be harmonized. In countries, where the same public body is in charge of both Directives, synergies can be generated, e.g. regarding legal framework for data collection, inspection procedures, database implementation, certification of experts, and sanctions.

Examples of problematic situations

- Examples of procedures clearly not in line with the requirements of the Construction Product Regulation are as follows:
  - ✓ For construction products covered by a harmonised European standard, a country mandates that some data have to be included in its national product database used for EPC calculations, in contradiction with the requirement that the performance of these products must be declared according to the rules of the Construction Product Regulation.
  - ✓ A country imposes additional national assessments on CE marked construction products.
  - ✓ For a construction product for which no harmonised standard exist and whose performances may not (or may not fully) be assessed on the basis of an existing harmonized standard, a country imposes an assessment according a national scheme without allowing the equivalence of foreign equivalent schemes.
- Regarding freedom of movement for workers, it would violate EU legislation if qualification specifications are limited to having passed a defined course or training programme, instead of determining requirements to be met, for example according to qualified tester schemes which have started to spread in Member States.
- no plan to tap the potential of synergies and exchange of non-conformities.

Considerations on procedural aspects

Other EU legislation has to be observed to keep up with latest developments and avoid potential conflicts. Also in this regard stakeholders' involvement is crucial because it allows for making use of their expertise in various special fields relevant for EPBD implementation.

Relevant approaches for this topic

- ✓ **EPBD products database in Belgium**: The EPBD database was developed in close collaboration with the stakeholders involved. Inclusion in the database is not mandatory, but only aims to simplify the work for the building sector and in case of compliance checks. The only guarantee given by the database is that the values in the database will never be questioned in case of EPC compliance checks, but no guarantee is given in case the data are used outside the context of the EPC calculations.
- ✓ **Qualified tester scheme:** Mandatory building airtightness testing is considered in many European countries because of the increasing weight of the building leakage on the overall energy performance of low-energy buildings. The reference testing protocol in Europe is described in EN 13829. In addition, many countries have developed specific guidelines to detail or adapt EN 13829 requirements, also regarding the tester's knowledge and know-how.

References

- ✓ How to get compliant and accessible data for the energy rating calculation of a building? - Overview of some existing approaches - François Durier, Susanne Geissler et al. - QUALICHeCK report, march 2016
- ✓ Voluntary scheme and database for compliant and easily accessible EPC product input data in Belgium - Samuel Caillou - QUALICHeCK Fact Sheet #05, October 2015
- ✓ Reasons behind and lessons learnt with the development of airtightness tester's schemes in 11 European countries - Valérie Leprince, François Rémi Carrié - AIVC workshop on Quality of Methods for Measuring Ventilation and Air Infiltration in Buildings, March 18-19, 2014, Brussels, Belgium
- ✓ Legal issues when developing compliance frameworks - Eric Winnepenninckx - Presentation at QUALICHeCK Workshop, Lund, March 2015
- ✓ Concerted Action EPBD, www.epbd-ca.eu

Some questions relevant to this topic

- ✓ Do you have any experience with other EU legislation hindering EPBD compliance in your country?
- ✓ Are there any problematic elements in EU rules governing State Aid and Competition in this regard?

- ✓ Do you have good examples to report on how other EU legislation helps EPBD compliance in your country?

5.4. Philosophy on timeline for evolution of requirements

Context and motivation

The timing for imposing EPC related requirements is a crucial aspect, in particular if there is an effective compliance framework. Timing has two dimensions:

- ✓ the time between the decision on the requirement (level) and the date of entering into force;
- ✓ the speed of evolution of the requirements.

Minimum interval before announcing the requirement and coming into effect

In case of no or light enforcement, it might be acceptable and not so critical if in the first year there is not total fulfilment of the requirement, as there are no severe penalties such as fines or loss of license. In such context, one can focus on a progressive move to meeting the requirement.

In case of a legal framework with strict compliance and enforcement, this is not evident. One has to meet the requirements from the start. Therefore, an appropriate timing for imposing requirements is crucial for a societally supported enforcement.

Intervals between increasing requirements

A building project from conception until occupation typically requires several years. Moreover, most of the building projects are in many countries undertaken by (small) PMEs. It is important that the building sector has time to become accustomed to a certain requirement level before another increase is imposed.

With respect to the tightening the requirements, early communication is important as well as an in-depth check of the feasibility of increasing requirements.

Examples of problematic situation

- ✓ There is a very short interval between decision and date of implementation, e.g. a governmental decision on November 15 to impose new requirements for building permits from January 1 onwards.
- ✓ Strengthening of requirements with very short time intervals, for example every two years, without presenting the long-term strategy of tightening the requirements, makes it difficult for all actors involved in building projects to keep pace with the development in terms of availability of qualified staff and products.

Considerations on procedural aspects

- ✓ The design process for setting up a new building often starts quite a long time before the building permit is submitted. In particular for larger apartment buildings, office buildings and schools, this can take several years. This can delay progress towards (nearly) zero energy buildings, especially if the long-term strategy for tightening the requirements is not available or not communicated.
- ✓ In case architect competitions are organised, the whole process can take quite some time before announcing the competition and the start of the work. It is crucial that the requirements that will be in force at the moment of the request for building permit are known at the start of the competition.

Relevant approaches for this topic

Voluntary certification schemes can be useful in preparing the public for requirements to come and to test new methods of quality control. Usually, they set more ambitious requirements than prescribed by law and reward compliance with the requirements with a label or a grant. In this way, an outlook on the possible future evolution of requirements is provided and companies have the chance to adjust early to future frameworks.

Example

- ✓ The Effinergie certification operated in France has served as a laboratory for setting the overall primary energy minimum requirements or for the mandatory justification of an envelope airtightness level applied in the current regulation. Presently it experiments with new requirements and methods, which will be used for the 2020 revision of the energy regulation.
- ✓ In Austria, the housing subsidy scheme has a long tradition in supporting energy efficient buildings: from 1993 to 2006, requirements addressing energy efficiency and renewable energy technologies more ambitious than what was prescribed by the building legislation had to be met to receive an additional amount of housing subsidy. In 2006, these criteria that had been tightened over the years were made mandatory for receiving a housing subsidy: since then, it is no longer possible to receive a housing subsidy without complying with more ambitious energy related requirements than prescribed by the building legislation, and the EPC has served as proof.

References

- ✓ The Effinergie approach to ease transitions to new regulatory requirements - François Rémi Carrié, Yann Dervyn - QUALICHeCK Fact Sheet #45 , January 2017
- ✓ Voluntary control scheme developed by the province of Salzburg: building services systems declaration based on as-built characteristics – Susanne Geissler - QUALICHeCK Fact Sheet #34, December 2016

Some questions relevant to this topic

- ✓ In case of envisaging a strict compliance framework, is there enough time foreseen between the time of adoption the legislation and the time of it coming into effect ?
- ✓ Is there a strict compliance framework from the start of the legislation or is there a possibility for a transition period?

5.5. Timing for proof of EPC compliance

Context and motivation

In the past, most EU countries required that compliance with the building regulations be demonstrated when the building permit was submitted. In practice, it often happens that modifications occur after the building permit. These modifications can be at the building layout level, component areas (windows), materials, use of technology, etc. From a societal and economic point of view, most of these changes can be justified due to changing specifications of the owners, more economic solutions, and new technologies.

However, it is important that such changes are included in a transparent way in the EPC calculations. If not, implementing an effective compliance framework will be very difficult and risks failing to garner the necessary societal support.

In contrast to other European countries, the Swedish EPC is based on the operational (measured) energy use of the building. It has to be measured during a period of 12 consecutive months and entered into the database by an independent certified energy expert. The energy use is then corrected for the climate variability and for non-normal use. The corrected value determines the energy class level of the EPC.

EPCs have to be issued at the latest when the building is sold and within two years after commissioning of a new building.

Examples of problematic situations

Basically, all cases where updating the EPC calculation after submission of the building permit is not clearly required.

Considerations on procedural aspects

- ✓ It is strongly recommended to impose proof of compliance at the end of the works, i.e. the EPC declaration describes what has been effectively constructed. In case of control, there is then less risk for disagreement.
- ✓ In addition to the EPC calculation at the end of the works, it might also be useful to require the EPC be made available at another time, e.g. when the building permit is submitted. This additional requirement can help reduce the risk that the requirements will not be met, inform the investor of the type of measurements to be taken, etc.
- ✓ It is very important that there is clarity about who is responsible for submitting the EPC.

Relevant approaches for this topic

- ➢ In Belgium/Flemish region, the compliance check is no longer done at the building permit stage but at the as-built stage when the construction works are finished and all reliable compliant input data for the calculation are available. The inspector checks whether the as-built condition complies with what is stated in the final energy performance declaration.
- ➢ There are voluntary quality control frameworks available that target as-built quality with regard to energy-related aspects. These voluntary approaches can serve as a pool of ideas for designing and improving compliance frameworks:
  - ✓ The SQUARE approach for retrofit of residential buildings emphasises requirements that can be verified, and measures specific parameters in critical stages of the works in order to ensure compliance with the requirements that the organisation committed itself to achieving.
  - ✓ The BOILEFF quality assurance scheme specifically targets the installation of condensing boilers in residential buildings and was developed to guarantee the efficient operation of the boiler based on the proven high quality installation of all elements the heating system consists of.

References

- ✓ Belgium/Flemish region control and penalty scheme of the energy performance legislation: checking procedure and fines – Clarisse Mees - QUALICHeCK Fact Sheet #48, February 2017
- ✓ QUALICHeCK Study Sweden – Compliance of Energy Performance Certificates (EPCs): differences between measured and calculated energy use in EPCs versus building permits - Pär Johansson - QUALICHeCK Fact Sheet #20, June 2016
- ✓ EPC database and control system for compliant EPC input data in Sweden - Pär Johansson - QUALICHeCK Fact Sheet #24, August 2016
- ✓ Voluntary quality assurance system for retrofitting multiunit residential buildings based on self-commitment – Susanne Geissler - QUALICHeCK Fact Sheet #39, January 2017
- ✓ Voluntary schemes as a pool of ideas for designing and improving EPC compliance frameworks: the Boileff quality assurance scheme – Susanne Geissler - QUALICHeCK Fact Sheet #40, January 2017

Some questions relevant to this topic

- ✓ At which steps are mandatory reports to the government required (building permit, start of the works, end of the works, a certain period after the end of the works, etc.)?
- ✓ Is it possible or required to make the EPC declaration at the end of the works? If not, why is this not possible?

5.6. Availability of legal procedures for penalising different types of non-compliance

Context and motivation

The availability of operational legal procedures for handling (detecting and punishing) different types of non-compliance is essential if one wants to take effective measures. Within such a context, it is important to check whether such legal procedures exist for the following types of non-compliances:

- ✓ Non-submission of required documents or not completed in due time,
- ✓ EPC declarations not made according the legal specifications (e.g. specifications regarding individuals who can make the declarations) or using an incorrect energy performance value,
- ✓ EPC declaration not meeting one or more performance requirements,
- ✓ Non-compliant input data used in the EPC calculation,
- ✓ EPC indicators not published in real estate advertisements or not made available when selling or renting a property,
- ✓ EPC not displayed in public buildings and buildings frequently visited by the public.

Examples of problematic situations

- ✓ Legislation without specification related to penalties in case of non-compliance. Without such specifications, it is probably impossible to implement penalties.
- ✓ Different authorities in charge of imposing and executing different types of penalties (e.g. EPC indicators not published in real estate advertisements regulated at the federal level, EPC declaration not meeting one or more performance requirements regulated at the regional level) resulting in a scattered picture and incomplete feedback.
- ✓ Legislation with specifications of penalties in case of non-compliance, but without clear rules on how to proceed.

Considerations on procedural aspects

- ✓ It is important to have specifications regarding the various potential types of non-compliance (as listed above).
- ✓ It is important to clearly specify the authorities who are authorised to deal with sanctioning in case of non-compliance. This issue is further discussed in §5.15.
- ✓ It is important to clearly specify the type and level of possible sanctions in case of non-compliance. This issue is further discussed in §5.7, §5.8 and §5.9.
- ✓ In order to minimise potential disputes, it is very important that the legislation clearly identifies who will be penalised in case of non-compliance. This issue is further discussed in §5.9.

Relevant approaches for this topic

- ✓ Checking compliance with energy performance minimum requirements in new constructions and major renovations: automatic checks based on central the EPC database and detailed specific checks; e.g. as in Belgium, Portugal, Denmark, Ireland,
- ✓ Checking energy indicators in advertisements in commercial media: mandatory guidelines on how to present indicators in the media, as in Ireland; a partly publicly accessible EPC database to check published indicator values, as in the UK,
- ✓ Checking the transfer of the EPC, including recommendations for improvement when renting or selling: e.g. transaction through a notary, as in the Netherlands,
- ✓ Checking the display of EPCs in buildings owned by the public and/or visited by the public: e.g. unambiguous definitions, inspection procedure, as in Slovenia.

References

- ✓ Belgium/Flemish region control and penalty scheme of the energy performance legislation: checking procedure and fines – Clarisse Mees - QUALICHeCK Fact Sheet #48, February 2017
- ✓ 2016 Implementing the Energy Performance of Buildings Directive (EPBD), featuring country reports – Concerted Action EPBD – www.epbd-ca.eu/ca-outcomes/2011-2015, September 2015

- ✓ Compliance and control: overview and outcomes - Wina Roelens, Xavier Loncour, Marcello Antinucci - Core theme report of the third Concerted Action EPBD, www.epbd-ca.eu/ca-outcomes/2011-2015, August 2015
- ✓ Certification: overview and outcomes - Susanne Geissler, Naghmeh Altmann-Mavaddat - Core theme report of the third Concerted Action EPBD, www.epbd-ca.eu/ca-outcomes/2011-2015, August 2015,
- ✓ How to make the best use of EPCs – Susanne Geissler, Naghmeh Altmann-Mavaddat – Report of the third Concerted Action EPBD, www.epbd-ca.eu/ca-outcomes/2011-2015, September 2015

Some questions relevant to this topic

- ✓ Are you aware of specifications regarding the various potential types of non-compliance in your country?
- ✓ Is it clearly stated who is the authority responsible for penalising in case of different types of non-compliance?

5.7. Types of penalties in case of non-compliance

Context and motivation

In case of non-compliance, there should be a consequence. A whole range of actions is possible. It is important to identify the responsible entities and most appropriate measure(s) to enforce compliance. An effective enforcement framework specifies penalties in case of non-compliance and whom they address.

- ✓ Typical penalties for EPC experts are (applied in a system of steps):
- ✓ Free re-issue of EPC ▫ Warning ▫ Attendance at extra training and examination ▫ Suspension of license ▫ Loss of license ▫ Fines ▫ Prison
- ✓ Typical penalties for building owners are: No issue of building permit, loss of building permit, no issue of permit to use, loss of financial support, entry in land registry, lower maximum rental price, fines, prison
- ✓ Typical penalties for real estate agents are (applied in a system of steps): Warning ▫ Suspension of license ▫ Loss of license ▫ Fines ▫ Prison

The work of the leader of the design team and the leader of the construction workforce is usually covered by warranty/liability clauses. If they do not comply with the specifications, they will have to improve until they achieve the quality defined by the contract. Other requirements imposed by quality frameworks addressing the quality of the works are covered in the Source book on guidelines for better enforcement of quality of the works.

Examples of problematic situations

- ✓ The leader of the design team and the leader of the construction workforce are responsible for achieving the energy performance minimum requirements imposed by the building legislation. However, a procedure to check whether results comply with the specification is often not available, and warranty clauses are not applied.
- ✓ Penalties are not proportionate, for example the building owner decides to pay the fine as this is cheaper than to comply with the legislation.

Considerations on procedural aspects

- ✓ Analyse which types of penalties are most likely to be effectively implemented and controlled (see also Chapter 6).
- ✓ The choice of the type of penalty may take into account the approaches in other sectors in the country.
- ✓ Punishment is always very sensitive because it might have very serious consequences for the economic activity of an individual/company. Therefore, societal support is crucial and it might be preferential to decide on the type of penalties after (intense) consultation with the stakeholders.

- ✓ In some countries such as Austria, financial support (grants and subsidised loans) is very important for improving energy efficiency of new buildings as well as of existing buildings. Therefore, withdrawal of financial support is an important penalty, however difficult to implement due to political reasons.

Relevant approaches for this topic

- ✓ Portugal: Step by step penalty system for EPC experts;
- ✓ Belgium: Step by step penalty system for real estate agents;
- ✓ Austria: Financial support scheme for building owners;
- ✓ Greece: penalties are administrative sanctions and/or fines for the energy auditor responsible for issuing the EPC.

References

- ✓ Belgium/Flemish region control and penalty scheme of the energy performance legislation: checking procedure and fines – Clarisse Mees - QUALICHeCK Fact Sheet #48, February 2017
- ✓ Voluntary control scheme developed by the province of Salzburg: building services systems declaration based on as-built characteristics – Susanne Geissler - QUALICHeCK Factsheet #34, December 2016
- ✓ How to get compliant and accessible data for the energy rating calculation of a building? - Overview of some existing approaches - François Durier, Susanne Geissler et al. - QUALICHeCK report, March 2016
- ✓ 2016 Implementing the Energy Performance of Buildings Directive (EPBD), featuring country reports – Concerted Action EPBD – www.epbd-ca.eu/ca-outcomes/2011-2015, September 2015
- ✓ Compliance and control: overview and outcomes - Wina Roelens, Xavier Loncour, Marcello Antinucci - Core theme report of the third Concerted Action EPBD, www.epbd-ca.eu/ca-outcomes/2011-2015, August 2015
- ✓ Certification: overview and outcomes - Susanne Geissler, Naghmeh Altmann-Mavaddat - Core theme report of the third Concerted Action EPBD, www.epbd-ca.eu/ca-outcomes/2011-2015, August 2015,
- ✓ How to make the best use of EPCs – Susanne Geissler, Naghmeh Altmann-Mavaddat – Report of the third Concerted Action EPBD, www.epbd-ca.eu/ca-outcomes/2011-2015, September 2015
- ✓ Easy access, Compliance of EPC input data and Quality Assurance of EPCs in Greece - Theoni Karlessi, Nikos Papadopoulos, Chrysanthi Efthymiou - QUALICHeCK Fact Sheet #49, February 2017

Some questions relevant to this topic

- ✓ What are typical penalties for EPC experts, building owners, and real estate agents in your country?

5.8. Clarity in scale of penalties

Context and motivation

Imposing penalties is a sensitive issue. In cases of financial penalties, for example, it is very important that the rules for these penalties are as transparent as possible and derive from consultation with the stakeholders.

Examples of problematic situations

- ✓ The legislation does not contain information about the principles for penalties.
- ✓ The legislation only specifies a maximum financial amount for the penalty but no precise rules. On the one hand, this gives a large degree of freedom to the person/organisation in charge of the penalties, but discretion can also result in arbitrariness and lead to a higher risk of legal disputes.

Considerations on procedural aspects

- ✓ One possibility is to make financial penalties proportional to the degree of non-compliance. This will simplifies the decision-making process for the individuals in charge of the penalties and it also minimises the risks of legal disputes.
- ✓ One might exclude certain aspects from penalties in the EPC context, in case there are other possibilities for compliance stimuli or if the requirement is too strict in some cases. If so, one can consider requirements as guidance values instead.
- ✓ In case of financial penalties and in order to limit the number of dossiers with penalties, it might be useful to consider a minimum amount for penalties, whereby penalties below this threshold are not implemented.

Relevant approaches for this topic

- ✓ Energy performance in Belgium: The compliance and enforcement approach for new buildings is based on fines in the three Regions. These fines are all laid out in the legislation. In case of non-compliance regarding the U-value, the fine is 60 € per W/K. If the total amount of the penalties is less than 250 €, payment is not required. The software for EPC calculation for new buildings automatically calculates the penalty in case of non-compliance.
- ✓ Building airtightness and ventilation in France: Non-compliance with regulations is an offense and controllers' reports are sent to national authorities. By law, the building owner is liable for the compliance of his building with the regulation; however, in turn, the responsibility usually falls on the individuals "skilled in the art" (architects, contractors, etc.). In case of non-compliance, the attorney general can give financial penalties up to 45.000 €, and, in case of repeat offence, up to 75.000 € with 6 months imprisonment, or ban professionals from practicing. In reality, penalties are very rarely applied; however, the owner is compelled to apply remedial actions to comply with the regulation.
- ✓ In Greece, controls are carried out by the special service of energy auditors (EYEPEN). In case of non-compliance, including the submission of inaccurate and invalid data or violation of confidentiality issues, the following sanctions are imposed according to the severity of the problematic issue and the area of the building: exclusion of the energy auditor from the registry for 1-3 years, payment of fines ranging from 500 to 20000 €, permanent removal of the auditor from the registry. Payment of the fine can be in addition to the administrative sanctions.

References

- ✓ Belgium/Flemish region control and penalty scheme of the energy performance legislation: checking procedure and fines – Clarisse Mees - QUALICHeCK Fact Sheet #48, February 2017
- ✓ Regulatory compliance checks of residential ventilation systems in France - François Rémi Carrié, Sandrine Charrier, Adeline Bailly - QUALICHeCK Fact Sheet #06, November 2015
- ✓ Building airtightness in France: regulatory context, control procedures, results - Sandrine Charrier, Adeline Bailly, François Rémi Carrié - QUALICHeCK Fact Sheet #07, December 2015
- ✓ Easy access, Compliance of EPC input data and Quality Assurance of EPCs in Greece - Theoni Karlessi, Nikos Papadopoulos, Chrysanthi Efthymiou - QUALICHeCK Fact Sheet #49, February 2017

Some questions relevant to this topic

- ✓ Does the EPC legislation specify the principles for sanctioning?
- ✓ Does the EPC calculation allow advance estimation of the penalty that results from non-compliance?

5.9. Clear procedures about who is sanctioned in case of non-compliance

Context and motivation

Penalties in case of non-compliance often occur in the building sector. If handled by a judge, an important part of the process is to identify the individuals/organisations with liability. It regularly happens that several parties are liable for part of the damage, whereby the judge identifies these percentages.

In cases of EPBD related non-compliance, it is sometimes very clear who is liable (e.g. when no EPC is submitted). However, for various types of non-compliance (not compliant calculations, not meeting the requirements, etc.), the responsibility might be spread over various parties (see examples below). In such cases, it might not be easy to identify the specific liabilities and the related penalties.

An approach where liabilities are always attributed to specific parties in the governmental context might be an interesting option.

Examples of problematic situations

- The EPC declaration specifies that the U-value of the window is 1.58 W/m²K. In practice, it proves that according to the foreseen calculation procedures, the best possible U-value to be used is 2.67 W/m²K. The relevant legislation specifies that the energy administration must sanction the organisation(s) in charge of this error. The analysis of this case leads to the following findings:
  - ✓ The person who made the EPC calculations states that he got this value from the contractor.
  - ✓ The contractor states that he got this value from the manufacturer. Moreover, he states that the owner had asked for another window type than originally planned.
  - ✓ The situation is problematic, especially if there is no proof to support the statements.
- If energy performance is part of the building legislation, penalties for non-compliance can be the responsibility of the building authority. Non-compliance with energy performance requirements can be dealt with under the rule for penalties stipulated for violating the building law. If the building authority is represented by the mayor of the municipality, penalties might not be executed due to political reasons.

Considerations on procedural aspects

- A major choice to be made in the legislation is to identify which governmental entity is in charge of sanctioning. This issue is discussed in §5.15.
- In general, but particularly in the case of sanctioning by governmental administrations, it is important to avoid civil servants needing to become a kind of detective to identify who is involved in the non-compliance act and their relative contribution.
- It might be useful to make a distinction between:
  - ✓ Dealing with non-compliance and penalties in the relationship between the government and the building project,
  - ✓ Dealing with non-compliance and penalties within the building project itself.
- An example of such approach is found in the Flemish legislation (see below).
- This aspect of sanctioning is highly sensitive for the stakeholders. It is certainly important to allow active involvement of the stakeholders in the process leading to the legislation, in order to ensure societal support.

Relevant approaches for this topic

- **Flemish approach.** The legislation specifies that:
  - ✓ The Flemish Energy Agency is in charge of compliance checks and related sanctioning.
  - ✓ Depending on the type of non-compliance, it is clearly specified who will be sanctioned. It means that the energy administration does not have to analyse who is responsible for non-compliance.
  - ✓ Moreover, the amount of sanctions is fully specified in the legislation.
- **Greek approach:** the legislation specifies that:

- ✓ The Special Service for Energy Audits (EYEPEN) operating within the framework of the Ministry of Energy, Environment and Climate Change (YPEKA) is in charge of EPC compliance checks and related sanctioning.
- ✓ The responsibility of non-compliance lies with the energy auditor who issued the EPC.
- ✓ Sanctioning, administrative and/or financial, is fully specified by the legislation.

References

- ✓ Belgium/Flemish region control and penalty scheme of the energy performance legislation: checking procedure and fines – Clarisse Mees - QUALICHeCK Fact Sheet #48, February 2017
- ✓ Regulatory compliance checks of residential ventilation systems in France - François Rémi Carrié, Sandrine Charrier, Adeline Bailly - QUALICHeCK Fact Sheet #06, November 2015
- ✓ Building airtightness in France: regulatory context, control procedures, results - Sandrine Charrier, Adeline Bailly, François Rémi Carrié - QUALICHeCK Fact Sheet #07, December 2015
- ✓ Easy access, Compliance of EPC input data and Quality Assurance of EPCs in Greece - Theoni Karlessi, Nikos Papadopoulos, Chrysanthi Efthymiou - QUALICHeCK Fact Sheet #49, February 2017

Some questions relevant to this topic

- ✓ In case non-compliance is observed, is it automatically clear which party/parties in the process are liable for this non-compliance? If not, is there not a large risk that the identification of liabilities may require significant effort for the controlling organisation and/or high potential for legal disputes over liabilities?

5.10. Penalties should be proportional to the degree of non-compliance

Context and motivation

It is important that sanctions are proportional to the degree of non-compliance. If not, societal support might not be secured at all or be quickly lost.

Penalties are not only a means of enforcing energy efficiency legislation but are above all a means of improving actual energy efficiency in buildings. Therefore, it is important to have proportional sanctions in place to achieve actual progress, because:

- ✓ Inappropriately severe penalties might result in developing strategies on how to avoid audits or checks;
- ✓ Inappropriately light penalties might result in accepting the sanctions rather than complying with the legislation.

Examples of problematic situations

- ✓ Penalties are not proportionate, e.g. not aligned with the impact of the error.
- ✓ Penalties are exaggerated, e.g. in case of a faulty EPC, they are unjustifiably higher than EPC cost.

Considerations on procedural aspects

- ➢ It might be useful to have a sanctioning scheme, which is proportional to the importance of non-compliance, e.g.:
  - ✓ A sanction proportional to the building size in case an EPC declaration is not delivered,
  - ✓ A sanction proportional to the difference in kWh/year in case of non-compliance with the EPC requirement.
- ➢ Definitions must be unambiguous in order to avoid objections and associated procedures putting additional administrative burden on the authority.
- ➢ Penalties will only be effective if a control system is also in place (clear procedures on how to detect non-compliance and how to react in case of non-compliance).

Relevant approaches for this topic

Non-compliance with EPC requirement: In Belgium / Flemish region the Energy Decree imposes a fine in case the EPC and supporting calculations do not comply with reality, and the severity depends on the degree of non-compliance:

Fine = x * Δy

Δy = difference between performance in calculation and performance as-built, according to VEA

X = depending on how severe the error is

If the Flemish Energy Agency (VEA) detects a difference between the EPC and the as-built situation, the authority will be entitled to ask for a new EPC and to impose the relevant fine. 'Major errors' result in fines beyond 250 €.

Non-delivery of EPC declaration: In Belgium / Flemish region, the legislation allows penalties from 500 to 5000 €. However, in practice the usual fee is 500 €. If there is an agent involved, the fine will be imposed on the real estate agent and not on the building owner.

Incorrect declaration: In Italy / Lombardy region an innovative strategy to discourage experts from declaring EPC classes higher than reality has been put in place: an extra fine is calculated proportional to the building area; this fine is added to the administrative sanction.

References

- ✓ Belgium/Flemish region control and penalty scheme of the energy performance legislation: checking procedure and fines – Clarisse Mees - QUALICHeCK Fact Sheet #48, February 2017
- ✓ Concerted Action EPBD - www.epbd-ca.eu/

Some questions relevant to this topic

- ✓ How do you assess the attitude towards penalties in your country?
- ✓ Are you aware of effective proportionate penalties in your country you would recommend being introduced in other countries?

5.11. Rewarding instead of punishing?

Context and motivation

It seems quite logical to handle non-compliance issues with penalties. It might be good, in particular in terms of societal support, to look for means whereby compliance is awarded. There might be opportunities for the market: an example is the financial/insurance sector that could offer better conditions in case there is a framework for increased confidence in the compliance of EPC information.

Examples of problematic situations

When setting the framework, the conditions for reward are made too demanding, in terms of requested compliance checks and associated supporting documents. The result is that building owners move forward without the reward system and thus also avoid the associated control system.

Considerations on procedural aspects

The financial/insurance sector might require not only compliant EPCs but also EPCs that closely reflect reality, especially when it comes to correct installation of technical systems exposed to environmental hazards such as photovoltaic systems.

However, depending on the national legislation, compliant EPCs do not necessarily reflect the actual building situation (see also Chapter 5.5: Timing for proof of EPC compliance).

Relevant approaches for this topic

- ✓ **EPC as evidence for rewarding improved building energy performance:** In many EU countries, achieving energy performance better than the minimum requirements is rewarded, and the EPC

is used as evidence. As soon as financial incentives are involved, there is the tendency that EPC compliance is checked thoroughly in order to justify the public money spent for better energy performance. Financial incentives can be grants, loans provided at reduced interest rates, or combinations of both. In this case, the compliance framework is not the precondition to receive a financial benefit, but compliance checks are the consequence of applying for the financial benefit.

- ✓ **The European Investment Bank (EIB)** could play a unique role as it is owned by the Member States and supports the Member States in achieving the 20-20-20 targets. Projects are eligible if there is proof that they will affect a significant amount of energy savings, CO2 savings, and renewable energy. The EPC can be used as proof, but at present it is not a mandatory condition, and financing conditions are not tied to EPC compliance.

In Austria, selected banks apply an internal building rating scheme as part of assessing creditworthiness and thus financing conditions. However, this scheme is not tied to EPC compliance but based on Green Building Rating schemes.

References

- ✓ More information on energy performance related building financing schemes is available at www.buildup.eu/en/practices/financing-schemes
- ✓ Investing in building energy efficiency: the role of the EPC in economic decision-making - Susanne Geissler, Klemens Braunisch - QUALICHeCK Fact Sheet #36, December 2016
- ✓ The quality assurance system of the German reconstruction loan corporation (Kreditanstalt für Wiederaufbau, KfW) in the field of energy-efficient construction and retrofitting (residential buildings) - Linda Lyslow, Heike Erhorn-Kluttig - QUALICHeCK Factsheet #44, January 2017
- ✓ Voluntary control scheme developed by the province of Salzburg: building services systems declaration based on as-built characteristics – Susanne Geissler - QUALICHeCK Factsheet #34, December 2016

Some questions relevant to this topic

- ✓ Are you aware of a financing institution / insurance in your country rewarding compliant EPCs? In case there are no such instruments in your country due to weaknesses related to the EPC, what EPC improvements would be necessary?

5.12. Considerations regarding imposing a similar type of reporting at different points in time

Context and motivation

It is important to limit the administrative burden and in particular to avoid the need to provide redundant information. In that context, it might be sufficient to ask in the legal context for an EPC declaration at the end of the works, and no other obligatory communication at earlier stages. Of course, the organisations involved in a specific project might decide to do the EPC calculation at other moments in the process, but then on a voluntary basis.

However, it can be justified to require reporting at other points in the building process. A major reason can be the desire to limit the risk of having non-compliance problems at the end. If so, it is then very important to have:

- ✓ Convincing arguments for such extra obligation(s) on the one hand and
- ✓ Strong support (or ideally a request) from the stakeholders on the other.

Examples of problematic situations

- ✓ Imposing the calculating and communication of the EPC at different point (building permit, start of the works, end of the works, etc.) can be considered by the market as unnecessary work which increases the cost of the buildings.

Considerations on procedural aspects

- ✓ From a purely rational point of view, there is no need to have a governmental requirement to carry out EPC calculations at different point, as there is only one value which counts in the legal context.
- ✓ Although stakeholders are in general not in favour of extra obligations, they might consider it useful to have such extra duties, as it could reduce the risk of non-compliance and therefore lower risks for liabilities and penalties.
- ✓ In case the stakeholders ask for such calculations at different points and in particular if the stakeholders who have do this work are also in favour, it is probably useful for the government to consider such demands as it would increase societal acceptance of the legislation.

Relevant approaches for this topic

- ✓ In Ireland, the provisional energy performance certificate (called BER – Building Energy Rating) issued in the design stage must be substituted by the updated final EPC for the completed building within a specified period of time.
- ✓ In Spain, the EPC is required two times, once at building permit stage and once at completion stage.
- ✓ In the province of Salzburg, design EPCs and updated EPCs representing the as-built condition must be submitted to be eligible for housing subsidies. There is the intention to apply this procedure as a general rule because it is considered to limit the risk of non-compliance and facilitate actual energy efficiency.
- ✓ In the Flemish Region, there was originally only the requirement to have an EPC calculation at the end of the works. However, and mainly due to requests by the stakeholders (including the architects), the legislation now also requires an EPC calculation before the starts of the works.

References

- ✓ Sustainable Energy Authority Ireland (SEAI) - How will BER of new dwellings be carried out? – Page of SEAI web site
- ✓ QUALICHeCK Study Austria - assessment of EPC input data based on recalculation and on-site validation - Susanne Geissler, Peter Wallisch, Lukas Maul - QUALICHeCK fact sheet #12, June 2016
- ✓ Voluntary control scheme developed by the province of Salzburg: building services systems declaration based on as-built characteristics – Susanne Geissler - QUALICHeCK Factsheet #34, December 2016

Some questions relevant to this topic

- ✓ Does the EPC need to be calculated at different moments? If so, is there broad support for this approach?

5.13. Minimise discussions about who is liable towards the government

Context and motivation

In order to have an effective enforcement framework, one has to specify the principles for penalties for non-compliance and also the principles to identify the individuals/organisations to which these penalties will be addressed.

In order to limit discussions about liabilities, contracts should be set up in a way that there are clear roles between partners.

Possible roles of partners involved in the EPC context are:

- ✓ Building owner responsible for EPC availability,
- ✓ EPC expert responsible for choosing appropriate input data for EPC calculation,
- ✓ Leader of the design team and companies delivering building products responsible for providing input data for EPC calculation,

- ✓ The leader of the design team and the leader of the construction workforce responsible for achieving the energy performance minimum requirements imposed by the building legislation as well as quality frameworks,
- ✓ Third party control responsible for carrying out the agreed checks and measurements.

Without such clear procedures, it is often not evident who is liable. Moreover, it often appears that several parties involved in the works have part of the liability (poor prescriptions, incorrect execution, no appropriate control, etc.) while liabilities are designated to different parties (X % to designer, Y% to contractor A, etc.). This situation can also occur in the context of EPB compliance. In order to come to a decent decision, it can require a lot of analysis work, designation of an expert and, in case of a decision, appeals against this decision, etc.

In order to avoid such circumstances and in order to increase the probability of effective sanctioning, it might be useful to consider approaches where these types of discussions at a governmental level can be largely avoided.

Examples of problematic situations

- ✓ EPC has to be delivered when the building permit is submitted, with no possibility to modify it later.
- ✓ Legislation specifies penalties, but without rules identifying who is liable.

Considerations on procedural aspects

- ➢ The 'Dossier as built' at the end of the works can be a very good basis for a correct reporting.
- ➢ The need for clear rules about who is liable for a given non-compliance is particularly important if the decisions on non-compliance have to be made by civil servants. In the case of decisions by judges, there is typically more possibility for a judgment.
- ➢ In terms of liability, it might be useful/necessary to make a difference between
  - ✓ Public law: Liabilities in the context of EPC compliance and enforcement (relation between the government and the builders)
  - ✓ Private law: Principles and liabilities regarding contractual relations between private parties
- ➢ An example of this difference is illustrated below for the Belgian-Flemish approach
- ➢ Penalties must address the responsible actor who has caused the mistake.

Relevant approaches for this topic

Belgian/Flemish approach: The legislation foresees that compliance checks and enforcement is handled by the energy administration. The following principles are applied:

- ✓ Public law - In case the EPC contains errors, the EPC rapporteur will have to pay the fine, even if he/she can show that no error was made. The motivation for this approach is that the energy administration must not become involved in the whole analysis where errors might have been made.
- ✓ Private law - In case the EPC rapporteur receives a fine for an incorrect declaration (e.g. because the roof insulation is not in line with the description in the EPC), and in case he/she had the required evidence (invoices, etc.) from one of the parties to make the declaration, it should be quite straightforward to ask this third party to pay the fine.

References

- ✓ Belgium/Flemish region control and penalty scheme of the energy performance legislation: checking procedure and fines – Clarisse Mees - QUALICHeCK Fact Sheet #48, February 2017

Some questions relevant to this topic

- ✓ Is the EPC legislation checked in terms of practical application identifying liabilities in case of non-compliance?

5.14. Specific attention has to be paid to sanctions for private owners

Context and motivation

It is logical to assume that the one responsible for non-compliance should be punished. In the case of the building owner (and a private citizen in particular), one has to check whether it is feasible, correct and socially acceptable for the building owner to be held liable for certain non-compliance acts. If there is a broad consensus that an average owner is not capable of understanding the consequences of certain decisions in relation to the EPC, the result of sanctioning the owner might be the loss of societal support for sanctioning.

Examples of problematic situations

- ✓ A private owner accepts a proposal by a contractor to install a component/system with a lower performance than originally specified, but without being warned of risks of non-compliance. As a result, there is non-compliance and a sanction for the owner.

Considerations on procedural aspects

- ✓ It is important to carefully check if an average building owner is capable of assessing the risk of non-compliance. If this is not evident, one should evaluate the possibility of alternative procedures.
- ✓ It might be useful to consider procedures whereby professional parties in the process are allocated specific roles. See below the example of the Flemish Region.

Relevant approaches for this topic

Flemish Region (Belgium): The decree (ref) specifies 'In case the architect in charge of the control on the execution of the works observes a serious risk that the EPC requirements will not be met, he informs the parties involved…'. This specification aims to primarily protect the owner from decisions leading to non-conformity.

References

- ✓ Belgium/Flemish region control and penalty scheme of the energy performance legislation: checking procedure and fines – Clarisse Mees - QUALICHeCK Fact Sheet #48, February 2017

Some questions relevant to this topic

- ✓ Has your regulation ensured that the sanctions towards (private) owners are reasonable?

5.15. Considerations regarding the organisation who decides on penalties

Context and motivation

The choice of the organisation in charge of sanctioning can determine the effectiveness of compliance. This clearly depends on the national context.

Examples of problematic situations

- ✓ National legislation specifies that non-compliance cases have to be handled by judges. In practice, and primarily due to a very heavy workload, non-compliance of EPCs is not given priority, so there is in practice no effective compliance.
- ✓ National legislation does not specify how non-compliance is dealt with. In this case, procedures occur according to civil law. Depending on the national legislation, complaints about non-compliance will be raised or may just not be reported, for example in countries where legal proceedings are costly and time-consuming.
- ✓ National legislation specifies that non-compliance cases have to be handled by the energy administration or a similar authority. Moreover, the national legislation specifies that civil servants have no interpretation freedom, i.e. if there is no doubt of non-compliance, there must be a sanction. For example, an unintentional error has been made (e.g. calculation with 120 PV panels instead of only 12 PV panels with an extremely good EPC result) resulting in a fine of 13.000 € for an individual dwelling. The civil servant might have no way to accept it was

mistake, whereas a judge could take into account the context and perhaps implement a less severe sanction.

Considerations on procedural aspects

- If the entity responsible for sanctioning is different from the entity doing compliance checks, it will most likely compromise the effectiveness of the enforcement framework.
- Will the designated organisation give enough priority to compliance checks and sanctioning?
- Will the designated organisation have the capacity (staff, competence, etc.) to carry out these activities?
- What freedom of interpretation does the designated organisation have in case of non-compliance?
  - ✓ The legislation can specify that dealing with non-compliance cases must be done by judges. They have freedom of interpretation, but may not have the capacity to handle EPC non-compliance cases.
  - ✓ The legislation can specify that handling of non-compliance cases must be done by the energy administration. In the case of administrations, the regulation likely needs to be much more specific about the rules for handling non-compliance than if handled by judges. However, rules can also include procedural aspects (what needs to be done in which case), making this approach practically feasible. Also, there might be questions about the capacity available to handle EPC non-compliance cases.

Relevant approaches for this topic

Checking compliance and sanctioning carried out by Flemish energy administration, VEA:

VEA compares the information gathered on-site with the EPC input data. If mistakes are found, the expert will be asked to send plans and a proof of selected input data (not all). VEA calculates the impact of the mistakes on the final results. Further steps depend on the impact of the mistakes. If there are severe mistakes, the expert will receive an invitation for a meeting, and counterarguments will be evaluated before laying down a definite administrative fine. VEA collects the fine that is then used to finance the control system.

References

- ✓ Belgium/Flemish region control and penalty scheme of the energy performance legislation: checking procedure and fines – Clarisse Mees - QUALICHeCK Fact Sheet #48, February 2017
- ✓ Concerted Action EPBD - www.epbd-ca.eu/

Some questions relevant to this topic

- ✓ What is the appropriate solution for your country that results in an effective framework and societal support?

5.16. Specific attention for execution-related performances

Context and motivation

In case of execution-related performance (e.g. building airtightness, air flow rates of mechanical ventilation systems, etc.), there is always a possibility that the performance changes after measurement. This can be due to various reasons, e.g. ageing, damage to the building envelope, manipulation of orifices by third parties, etc. Therefore, it is important to have a compliance approach which does not rely on control measurements which are done weeks, months, etc., after the initial measurements.

Examples of problematic situations

- ✓ The building airtightness is checked eight months after the original test. The result appears to be (substantially) worse than the original value. From a legal point of view, it is not evident which person/organisation is liable: it can be an incorrect performance determination, but it can also be that the building envelope has been deteriorating in the period between the original

test and the control measurement. It can also be that damage has occurred to the building envelope.

Considerations on procedural aspects

- ✓ It is important to systematically identify which EPC related input data are execution-related. For these input data, it is then necessary to evaluate if there is a robust approach to assess data compliance.

Relevant approaches for this topic

- ✓ France: Airtightness measurements in the context of the law RT2012 must be undertaken by recognised testers.
- ✓ France: In the context of RT2012, there is also the possibility of a quality based approach, which does not require systematic testing, but an integral quality approach at execution level with a limited number of control tests.
- ✓ Flemish Region, Belgium: In the context of EPC for new buildings, airtightness testing can only be done by recognised testers. Moreover, in order to avoid incorrect declarations, the obtained result must be communicated to the control organisation by SMS, whereby random checks are implemented.

References

- ✓ Belgium/Flemish region control and penalty scheme of the energy performance legislation: checking procedure and fines – Clarisse Mees - QUALICHeCK Fact Sheet #48, February 2017
- ✓ Regulatory compliance checks of residential ventilation systems in France - François Rémi Carrié, Sandrine Charrier, Adeline Bailly - QUALICHeCK Fact Sheet #06, November 2015
- ✓ Building airtightness in France: regulatory context, control procedures, results - Sandrine Charrier, Adeline Bailly, François Rémi Carrié - QUALICHeCK Fact Sheet #07, December 2015

Some questions relevant to this topic

- ✓ Is there specific attention paid in the EPC procedure to compliance checks for execution-related input data?

5.17. Is complying with the EPC requirements sufficient – or should correct reporting also be imposed?

Context and motivation

It is logical to have penalties in case it is found that the building does not meet the legal requirements. One should also evaluate if there are penalties in case the building effectively meets the legal requirements, but the EPC declares a result that is too optimistic.

An argument in favour of such sanctions is that they protect individuals/organisations who want to do better than the legal requirements. In case there is no risk of penalties as long as the legal requirements are fulfilled, the compliance and enforcement framework will not be a stimulus for compliance in such circumstances.

Examples of problematic situations

- ✓ An investor wants to have a very energy efficient building. The EPC shows that this objective is met. Compliance checks highlight errors in the calculation, whereby the EPC result is worse than stated but still meets the legal requirement. There is no sanction as the legal requirement is met. However, the investor does not get the building he expected.
- ✓ In order to have a solid basis to assess if stricter requirements can be imposed in the future, a government can analyse the available EPCs. In case a substantial proportion is better than the present requirements, this can be a good argument for more stringent requirements. Of course, this conclusion is only possible if one can trust EPC declarations with (significantly) better results than the minimum requirements.

Considerations on procedural aspects

- ✓ In case a government wants to create confidence in the EPC, it seems logical to also have sanctions in case the EPC gives better results than achieved in practice, even if the corrected results are still in line with the legislation.
- ✓ An incorrect EPC can be considered a fault, the investor has been damaged and there is clearly a causal relation. However, it might not be so apparent for many owners (in particular families) to take legal measures. Therefore, it might be justified for governmental compliance frameworks to also include sanctions if the EPC is worse than what has been built.

Relevant approaches for this topic

- ✓ Belgium/Flemish region: The framework for penalties also lays out sanctions in case the EPC is worse than what is built, and this is independent of whether the legal requirement has been met or not.

References

- ✓ Belgium/Flemish region control and penalty scheme of the energy performance legislation: checking procedure and fines – Clarisse Mees - QUALICHeCK Fact Sheet #48, February 2017

Some questions relevant to this topic

- ✓ Is there a risk of a penalty in case the declared EPC result is not correct, but the legal requirement is still met?
- ✓ Is the EPC approach also considered as a possible stimulus for achieving buildings better than the legal requirements?

5.18. No possibility to make up for non-compliance in EPC calculations

Context and motivation

It is important that a compliance check can be done in an efficient manner. In order to avoid time consuming works and discussions, it can be useful to lay out in the regulation that non-compliance results in a sanction, without the possibility for one element to compensate for another.

Examples of problematic situations

- ✓ An inspector observes that the roof is less insulated than specified in the EPC. The owner declares that the floor on the ground is better insulated than reported in the EPC, resulting in the same overall performance. However, it is not apparent that the inspector should check if the floor is effectively insulated as stated by the owner.
- ✓ As part of an inspection, one finds that there is ordinary double-glazing instead of low-e double glazing. In order to defend this change, it is argued that the roof and floor are better insulated than originally planned, with the same EPC result. As it is very difficult to inspect the insulation in roofs and floors, this might take too much time and/or be ultimately impossible to come to a conclusion.

Considerations on procedural aspects

- ✓ Particularly if the legislation imposes/allows EPC reporting after the end of the works, there is no reason to allow the possibility of compensation.
- ✓ In case the EPC must be submitted with the building permit or at the start of the works, it is clear that changes may occur, where it might still be possible to adhere to the declared EPC. However, such approaches are likely more difficult for achieving an effective compliance and enforcement framework.

Relevant approaches for this topic

- ✓ In the Belgian approach (Flemish region), it is explicitly stated that no exchange of measures is allowed.
- ✓ See also §5.24

References

- ✓ Belgium/Flemish region control and penalty scheme of the energy performance legislation: checking procedure and fines – Clarisse Mees - QUALICHeCK Fact Sheet #48, February 2017

Some questions relevant to this topic

- ✓ Does your country have the possibility for non-compliance of one part of the building to be compensated by better performance for another aspect in the EPC calculations?

5.19. Interrelation with other legislation: avoiding potentially negative impacts of EPBD compliance

Context and motivation

Social policies (affordable housing) and real estate legislation (advertisements, maintenance and repair) are closely linked with EPBD implementation.

Examples of problematic situations

- ✓ Evaluating EPC impact on the real estate market and publicising energy indicators: The obligation to publicise energy indicators in advertisements in the commercial media will be less effective if regulated in an isolated way, and limited to the energy related information. If there is no regulation concerning all mandatory elements of a real estate advertisement, comparability of buildings and building units could be affected. Energy-related information will be presented in order to be compliant, but other important parameters such as number of rooms or location could be left out due to the fact that space for publication in print media is expensive. This is an unwanted development, resulting in difficulties regarding the evaluation of the EPBD impact on the real estate market (e.g. as in Austria). In fact, it is recommended that advertisements published in print media be evaluated because it is nearly impossible to extract a meaningful sample from the internet, due to the frequent updating procedures practised by real estate agents to achieve better ranking in the listings.
- ✓ Affordable housing and achieving energy performance minimum requirements in major renovations: The budget of maintenance and repair reserve does not take into account additional expenses necessary to achieve better energy performance (e.g. energy performance minimum requirements to be achieved when carrying out major renovations), but is still calculated based on the usual assumptions regarding maintenance and repair expenses. In addition, there is often a backlog of maintenance and repair, resulting in unrealistic cost estimations for energy efficiency measures. In reality, costs are much higher than projected, cannot be paid from the maintenance and repair budget and an additional loan is needed. From the investor's perspective, the investment contributes to increasing the value of the building because it will be rented at a higher price. From the user's perspective, higher rents might not be affordable although the better conditions are appreciated.

Considerations on procedural aspects

- ✓ Collaboration with real estate experts in general and specifically with experts representing the housing sector is useful for the evaluation and improvement of EPBD-related legislation.

Relevant approaches for this topic

- ✓ In Austria, there is a specific law for non-for-profit housing associations acting as developers and property managers at the same time. There are clear rules regarding maintenance and repair budgets, there is no backlog, and renovation rate in terms of energy efficiency measures is much higher than average. This is possible due to a specific tax model for this type of organisation, resulting in better energy performance of buildings without losing the advantage of affordable rents.

References

- ✓ Investing in building energy efficiency: the role of the EPC in economic decision-making - Susanne Geissler, Klemens Braunisch - QUALICHeCK Fact Sheet #36, December 2016
- ✓ QUALICHeCK Workshop held during BauZ! Conference in Vienna 13th February 2015
- ✓ Wohnungsgemeinnützigkeitsgesetz – WGG - https://www.ris.bka.gv.at/

Some questions relevant to this topic

- ✓ Are you aware of any potentially negative impact of EPBD compliance in your country?
- ✓ Are you aware of any interesting examples where problems due to conflicting legislation could be solved?

5.20. Lack of a satisfactory solution – involve stakeholders

Context and motivation

It is not always possible to find a solution that satisfies all expectations. As a result, one must sometimes make (difficult) choices. Making these choices is often subjective to a certain extent, and can depend on the relative priorities given to various expectations. In order to increase societal support, it might be a good strategy to involve the (major) stakeholders in the process, so that they understand the choices to be made and will thus hopefully also defend the selected approach.

Examples of problematic situations

- ✓ It appears that a certain aspect of the EPC procedure is considered by several stakeholder organisations too complicated and/or too time consuming. Other stakeholder organisations indicate that they want a more detailed procedure.

Considerations on procedural aspects

- ✓ In general, it is useful to find pragmatic procedures to involve stakeholders' organisations in the EPC process.
- ✓ It is not guaranteed that such involvement will lead to a satisfactory approach, but there is a higher probability that the various stakeholders will understand the reasoning behind a certain approach, including the fact that it is sometimes necessary to make non-optimal choices.
- ✓ Voluntary quality schemes can be a means for stakeholder involvement because they help to create awareness and to educate stakeholders, thus preparing the ground for useful discussions.

Relevant approaches for this topic

Voluntary quality approaches can be operated by authorities, NGOs or other organisations, and refer to the building and the overall energy performance or to a specific part of the building, such as the ventilation system. Examples:

- ✓ Effinergie (France),
- ✓ KfW Scheme (Germany),
- ✓ Housing subsidy scheme (Austria),
- ✓ TQB – Austrian Green Building Assessment Scheme (Austria),
- ✓ IBO Oekopass (Austria),
- ✓ BuildE (Sweden).

For example, criteria and requirements of the Austrian TQB scheme are discussed and revised together with stakeholders, thus creating awareness among stakeholders and also educating them.

Voluntary quality approaches can also be based on self-commitment, as demonstrated by the SQUARE project and the BOILEFF project.

References

- ✓ The Effinergie approach to ease transitions to new regulatory requirements - François Rémi Carrié, Yann Dervyn - QUALICHeCK Factsheet #45 , January 2017

- ✓ The quality assurance system of the German reconstruction loan corporation (Kreditanstalt für Wiederaufbau, KfW) in the field of energy-efficient construction and retrofitting (residential buildings) - Linda Lyslow, Heike Erhorn-Kluttig - QUALICHeCK Factsheet #44, January 2017
- ✓ Voluntary control scheme developed by the province of Salzburg: building services systems declaration based on as-built characteristics – Susanne Geissler - QUALICHeCK Factsheet #34, December 2016
- ✓ Voluntary green building assessment paves the way for better as-built quality – Susanne Geissler, Peter Wallisch - QUALICHeCK Factsheet #28, November 2016
- ✓ The Austrian building certification system IBO Oekopass – Cristina Florit, Susanne Geissler - QUALICHeCK Factsheet #27, October 2016
- ✓ BuildE - A method for quality assurance of energy efficient buildings – Paula Wahlgren - QUALICHeCK Factsheet #26, September 2016
- ✓ Voluntary quality assurance system for retrofitting multiunit residential buildings based on self-commitment – Susanne Geissler - QUALICHeCK Factsheet #39, January 2017
- ✓ Voluntary schemes as a pool of ideas for designing and improving EPC compliance frameworks: the Boileff quality assurance scheme – Susuanne Geissler - QUALICHeCK Factsheet #40, January 2017

Some questions relevant to this topic

- ✓ To what extent are stakeholders (organisations) systematically involved? During the preparation phase? During the implementation phase? Is there a formal framework for consultation?

5.21. Global compliance and enforcement approach OR a focus on specific areas of concern?

Context and motivation

The development of an overall compliance and enforcement approach requires significant effort, in particular if there is not currently significant attention paid to compliance and enforcement measures. If the resources (staff, financial means, etc.) are available for the development and implementation of an overall compliance and enforcement approach, this is of course the best strategy. If these resources are not evident, it might be a pragmatic strategy to advance step by step and focus on specific issues, e.g. create easy access to reliable data.

Considerations on procedural aspects

- ✓ In case there is a clear consensus that a better framework for compliance and enforcement is a priority, it might be very useful to start with an in-depth inventory of the shortcoming of the existing approach. This source book can be a help to identify critical areas for achieving an effective compliance and enforcement framework.
- ✓ It might be productive to evaluate such assessment at a governmental level but also with the input of stakeholders' organisations.

References

- ✓ How to get compliant and accessible data for the energy rating calculation of a building? - Overview of some existing approaches - François Durier, Susanne Geissler et al. - QUALICHeCK report, March 2016

Some questions relevant to this topic

- ✓ Has an assessment been made of all actions necessary to foster a better context for compliance and enforcement?
- ✓ If so, does it seem feasible to implement all these actions? Or is it more realistic to focus on a consistent subset of actions that might result in partial improvements?

5.22. Specific challenges for existing buildings

Context and motivation

Issuing an EPC for an existing building in case of renting or selling the building or building unit will be much more challenging in terms of determining input data than for a new construction. Documentation is often not available, data collection is costly and therefore default data are used to keep the cost of EPCs low (see 4.12), despite awareness of the trade-off between cost and reliability of EPCs. Estimation of U-values for constructions and solar transmission values for windows especially influence EPC calculation results significantly. Publication of acknowledged but unspecific standard default values can lead to compliant but unrealistic EPCs, also in terms of cost-effective recommendations for renovation.

EPBD 2010/31/EU requires that EPCs contain recommendations for improving building energy performance. Providing information about the room for improvement should motivate building owners to renovate their building. In some countries, EPCs contain specific recommendations and even the savings potential in monetary terms (e.g. England and Wales, Portugal). Issuing EPCs for existing buildings including recommendations on how to improve building energy performance raises the question whether use of building specific data is necessary or whether default input data will be still sufficient for a meaningful EPC calculation result (see 4.4).

Examples of problematic situations

- ✓ Default input data for EPC calculations are provided by national standards and other official documents, resulting in cheap and compliant but potentially unrealistic EPCs lacking market acceptability.
- ✓ EPC experts are entitled to calculate and issue EPCs based on their professional license and not based on proven qualifications, resulting in potentially faulty EPCs, especially in the field of existing buildings that requires significant experience and knowledge.

Considerations on procedural aspects

- ✓ It is important to choose the appropriate level of detail in terms of region and construction period when setting up a building typology, in order to ensure realistic default values.
- ✓ Development of building typologies at regional level must take into account the interrelation between default values.
- ✓ Determination of realistic default values as input data for the EPC calculation of existing buildings should be on the agenda of mandatory training programmes for EPC experts.

Relevant approaches for this topic

- ✓ In Germany and Luxembourg, the correct determination of U-values is supported by detailed building typologies. More accurate building typologies can provide default values that are closer to reality. In both countries, such typologies are provided at a regional level, and in Germany the document is considered an official ministry document. EPC experts choose appropriate default values depending on the building typology that corresponds to the building under assessment. There is an interrelation between various default values that has to be taken into account. Therefore, qualification of experts is crucial in order to ensure the correct determination of U-values.
- ✓ Several Member States have clearly defined qualification requirements for EPC experts. These requirements are tied to the type of formal education, practical experience, and passing targeted training courses.

References

- ✓ Concerted Action EPBD - www.epbd-ca.eu
- ✓ Building typologies in Member States – http://episcope.eu/index.php?id=97
- ✓ Default values in energy performance of buildings standards - François Rémi Carrié - QUALICHeCK Fact Sheet #46, January 2017

Some questions relevant to this topic

- ✓ Are you aware of any other specific challenges for existing buildings in your country?

5.23. Integration of information regarding non-compliance issues in EPC calculation software

Context and motivation

Integration of information regarding non-compliance issues in EPC calculation software increases transparency and helps to create awareness of sanctions that will apply if minimum requirements are not met. Use of calculation software is necessary for issuing an EPC, and therefore the software is an appropriate means to provide information about sanctioning as well. This is especially important for EPCs issued for existing buildings in the course of sale or renting. While in a new construction the obligation to meet energy performance minimum requirements is part of the building legislation and tied, for example, to the building permit approval for new buildings, there is no such evident sanction in cases where EPCs are issued in the course of selling or renting a building or a building unit.

Considerations on procedural aspects

- ✓ The procedure on how to integrate information regarding non-compliance issues in EPC calculation software will depend on the specific situation in each country: Is there one mandatory software program to be applied or are there different software products available on the market which must comply with the mandatory methodology?
- ✓ Information on sanctions should not be limited to the software program but could also appear on the EPC itself. There is a legal framework for the layout of the EPC and the elements an EPC must contain. In addition to the comparison between actual performance indicators and minimum requirements, sanctions could be presented in case minimum requirements are not met.

Relevant approaches for this topic

- ✓ In Belgium, the EPC calculation software does not only calculate performance indicators but also relevant fines in case of non-compliance. The rules are straightforward, e.g. for non-compliance in relation to transmission losses 60 € per W/K, for ventilation provisions 4 € per m3/h.

References

- ✓ Belgium/Flemish region control and penalty scheme of the energy performance legislation: checking procedure and fines – Clarisse Mees - QUALICHeCK Fact Sheet #48, February 2017
- ✓ Concerted Action EPBD – www.epbd-ca.eu

Some questions relevant to this topic

- ✓ How is information regarding non-compliance issues in EPC calculation software dealt with in your country?

5.24. Smart procedures for compliance checking and enforcement

Context and motivation

In most countries, the resources available for organising compliance checks and related sanctioning are limited. Therefore, it is important to consider smart procedures for compliance checks and enforcement, and there are several possibilities to facilitate the process.

Examples of problematic situations

- ✓ Several countries have reported in the past that they lack the required staff to implement a compliance and enforcement framework in daily practice.

Considerations on procedural aspects

- ✓ **No allowance of compensation for non-conformities**
  One should consider the possibility to include an explicit rule in the legislation that non-compliance of a certain aspect of a building cannot be compensated by a better result in

another part of the building. If so, each case of non-compliance can result in a sanction. In order to have the necessary societal support, it is important to have the possibility for the EPC declaration to be made after the end of the works, i.e. reporting what has been built, and not what the intention when the building permit was submitted. This example is further developed in §5.18.

- ✓ **Allow a sufficient period for carrying out controls**
  In order to increase the probability of detecting non-compliance, it is important to have a sufficient period for compliance checking.
- ✓ **Mandate full access to input data in order to allow third parties to undertake compliance checks**
  An increasing number of owners and renters are interested in the energy performance of their buildings. A classic EPC declaration does not contain information allowing them to check the validity of the EPC. If specific target groups (owners, renters, potential buyers, etc.) can have access to the full EPC file (including wall composition, materials, thicknesses, name and type of heating components, etc.), is it likely that some of these parties will carry out controls.
- ✓ **Recognised databases**
  The availability of a recognised database can substantially improve/simplify analysis of the EPC declarations. Moreover, it can be used for a statistical evaluation, to identify outliers, and to check for trends. Finally, it will reduce the risk of contestation of the observed non-compliances.

Relevant approaches for this topic

- ✓ See the examples listed above.

References

- ✓ A guide for policy makers to develop better frameworks for EPC compliance and enforcement, QUALICHeCK Webinar, 13 December 2016
- ✓ Databases of Energy Performance Certificates (EPCs): structure, content, operation, QUALICHeCK Webinar, 5 July 2016
- ✓ Compliance and control: overview and outcomes - Wina Roelens, Xavier Loncour, Marcello Antinucci - Core theme report of the third Concerted Action EPBD, www.epbd-ca.eu/ca-outcomes/2011-2015, August 2015
- ✓ Certification: overview and outcomes - Susanne Geissler, Naghmeh Altmann-Mavaddat - Core theme report of the third Concerted Action EPBD, www.epbd-ca.eu/ca-outcomes/2011-2015, August 2015
- ✓ How to make the best use of EPCs – Susanne Geissler, Naghmeh Altmann-Mavaddat – Report of the third Concerted Action EPBD, www.epbd-ca.eu/ca-outcomes/2011-2015, September 2015

Some questions relevant to this topic

- ✓ Does the EPC procedure include aspects that simplify/optimise the possibilities for compliance checks and enforcement?
- ✓ Has there been analysis of the most frequent difficulties that occur when implementing compliance and enforcement frameworks? Have there been discussions about possibilities for minimising these difficulties?

5.25. Specifications concerning type and frequency of verifications

Context and motivation

According to Article 18 of the EPBD and Annex II, MSs should install an independent control system to control the quality of the issued EPCs and inspection reports. According to the Annex, a random selection of at least a statistically significant percentage must be controlled every year.

In most European Member States a central EPC database has been established as a means to ensure compliance with EPBD requirements. The EPC database represents the basic element of verification by enabling automatic checks during uploading of the EPC and related information into the EPC database (100% control of selected elements during EPC upload to electronic database) and allowing for the planning of meaningful sampling procedures for specific periodic verifications.

Quality control systems include desk controls and on-site controls, random selection but also targeted selection of the EPCs to control, e.g. after having received complaints (100% control in case of complaints), and data mining methods, in order to get as much output as possible with the available resources. The more EPCs are controlled, the higher the cost will be.

EPC databases can be used to check EPCs and EPC experts. The way the EPC database has been set up is crucial how it can be used and at what cost.

Examples of problematic situations

- ✓ There is no central EPC database, and therefore the basis for setting up an effective sampling scheme is missing.
- ✓ The central EPC database was designed in isolation and it does not provide appropriate interfaces to fully exploit the potential for setting up an effective and cost-efficient sampling scheme.
- ✓ The EPC database does not contain a publicly accessible section and thus does not allow interested individuals to check basic information published in advertisements.

Considerations on procedural aspects

The legal framework has to consider the following elements:

- ➢ Which parts of the EPC database should be accessible for whom? Publicly accessible sections (while respecting data privacy rules) enhance the effectiveness of the database.
- ➢ How the EPC database should be used for control of EPC experts: during upload into the EPC database, faulty EPCs are detected and mistakes are noted; EPC experts are required to improve the quality of EPCs (step by step system from warning, additional training, fine to withdrawal of license) and in case of specific frequently detected errors, targeted trainings should be offered.
- ➢ Percentage or number of EPCs to be controlled every year: the percentage can be fixed in the legislation or it can be stated that the number to be controlled will be fixed every year, allowing for more flexibility. The Percentage can be fixed depending on the rating result, i.e. 80% of the total sample of A level EPCs.
- ➢ How to make use of data mining techniques in back-office analysis of EPC databases:
  - ✓ Sampling, for example, only buildings with PV panels,
  - ✓ Checking the validity of some input values by crosschecking with other databases,
  - ✓ Plausibility checks: areas, energy indicators against expected values in the building category, to find strange or impossible input values,
  - ✓ Performing some cross checks to identify EPCs to be controlled, i.e. buildings with some specific technologies should correlate with a certain energy performance class.

Relevant approaches for this topic

In Portugal, a step by step system based on the use of the EPC database is applied to check EPCs and EPC experts, using the following types and frequency of verifications:

- ➢ Automatic input validation when the expert fills in the EPC:
  - ✓ IT platform checks the inputs, and inconsistencies or “out of range” values are identified

  - ✓ Expert can correct the inputs
  - ✓ All certificates are checked
- ➢ Simple quality checks to evaluate the main parameters that are displayed in the EPC and other supporting documents; evaluation consists of analysing EPC, certification report, calculations, recommendations:
  - ✓ Analysis made without the involvement of the expert
  - ✓ Made exclusively by cross referencing the documents uploaded by the expert
  - ✓ About 5 to 6% of certificates are analysed
- ➢ Detailed quality checks:
  - ✓ Replicates the work performed by the expert
  - ✓ More interaction between the quality assessors and the expert
  - ✓ If severe errors were made, fines can be applicable
  - ✓ 0,5 % of the certificates are verified
- ✓ In Portugal, at the beginning of the process of implementing the control system, around 5% of the issued EPCs were controlled. This number has been reduced as experience has grown. Based on lessons learnt during the beginning of the process, a study on statistics and probability of the control procedures has been developed, in order to define what percentage could be representative, with the result that roughly 1% of the issued EPCs go through a control procedure.
- ✓ In France, the organization (private companies) in charge of control must check at least eight EPC reports for each expert. In addition, they must carry out one on-site control per expert once every five years, based on an existing EPC report.
- ✓ In the UK and Ireland, interested individuals check energy indicators published in commercial media by searching this information in the public part of the EPC database.
- ✓ In Belgium, VEA annually checks 3000 buildings on the availability of EPC when selling or renting. The compliance rate has changed from 47% in 2009 to 95% in 2012.
- ✓ In the Netherlands, a new check is being developed to enforce EP requirements and the EPC in new buildings. Evidence has to be collected from the point of design up to the moment of completion of a building. This can include design calculations, drawings, photographs, and invoices of applied materials and installations. As a last step in the process, a site visit will be carried out to determine whether the realised EPC is in accordance with EP requirements from the design phase.
- ✓ In Greece, the quality control of EPCs for the Ministry of Energy, Environment and Climate Change (YPEKA) is conducted by a special service of energy auditors (EYEPEN) operated by the Ministry, on a random sample of 5% and upon request due to specific complaints. The control includes: checks of the validity and accuracy of the input data submitted as electronic files and verification of the EPC results, checks of suggestions for improving energy performance and on-site inspections in order to verify the data used for the EPC.

References

- ✓ Belgium/Flemish region control and penalty scheme of the energy performance legislation: checking procedure and fines – Clarisse Mees - QUALICHeCK Fact Sheet #48, February 2017
- ✓ Easy access, Compliance of EPC input data and Quality Assurance of EPCs in Greece - Theoni Karlessi, Nikos Papadopoulos, Chrysanthi Efthymiou - QUALICHeCK Factsheet #49, February 2017
- ✓ Concerted Action EPBD - www.epbd-ca.eu/
- ✓ A guide for policy makers to develop better frameworks for EPC compliance and enforcement, QUALICHeCK Webinar, 13 December 2016
- ✓ Databases of Energy Performance Certificates (EPCs): structure, content, operation, QUALICHeCK Webinar, 5 July 2016
- ✓ Compliance and control: overview and outcomes - Wina Roelens, Xavier Loncour, Marcello Antinucci - Core theme report of the third Concerted Action EPBD, www.epbd-ca.eu/ca-outcomes/2011-2015, August 2015
- ✓ Certification: overview and outcomes - Susanne Geissler, Naghmeh Altmann-Mavaddat - Core theme report of the third Concerted Action EPBD, www.epbd-ca.eu/ca-outcomes/2011-2015, August 2015

Some questions relevant to this topic

- ✓ What are your lessons learnt from operating the independent control system?

5.26. Specifications regarding appeal procedures

Context and motivation

Penalties are not differentiated by the reasons for non-compliance; for example, whether unintentional mistakes have been made or whether there is a case of fraud. However, punishment schemes that are too rigid might not be supported by society. Therefore, appeal procedures are necessary to give those who have made unintentional errors the chance to correct them. Appeal procedures will be clearly regulated if non-compliance is a court matter and treated by a judge. If the administrative authority is in charge of sanctioning, the following considerations will apply.

Examples of problematic situations

- ✓ There is no discretion to deal with non-bureaucratic correction of unintentional errors or very small errors.
- ✓ There is no procedure implemented to collect information about faulty EPCs and thus there is no basis to decide which errors must be penalised and which errors can be subject to appeal.

Considerations on procedural aspects

- ✓ Appeal procedures have the tendency to increase the administrative burden. Therefore, specifications should simplify procedures, for instance by giving an order for correction without any further administrative procedure in terms of sanctioning.
- ✓ Orders for correction also increase the administrative burden, because there will be the need to check again whether mistakes have been corrected. However, fees can be charged to cover administrative costs. In this way, the joint effort to improve is still at the forefront (instead of punishment) and at the same time it prevents stakeholders from treating compliance lightly.

Relevant approaches for this topic

- ✓ Control is regarded as a service at the same time: In Austria, a two year project carried out in the province of Lower Austria, and every single EPC used as evidence to apply for an energy-related grant was checked, as was the building at the construction-site. The objective was to improve as-built situations and achieve compliance. Detecting errors raises questions on how to correct them. In this regard, the project was also a major qualification effort.
- ✓ In the Austrian province of Carinthia, the responsible authority charges a fee for re-submitting the corrected EPC, after mistakes have been detected.
- ✓ In Portugal, experts calculating energy efficiency performance and issuing the EPC are traced, and those experts repeatedly submitting faulty EPCs must face sanctions.

References

- ✓ Default values in energy performance of buildings standards - François Rémi Carrié - QUALICHeCK Fact Sheet #46, January 2017
- ✓ Belgium/Flemish region control and penalty scheme of the energy performance legislation: checking procedure and fines – Clarisse Mees - QUALICHeCK Fact Sheet #48, February 2017
- ✓ Concerted Action EPBD - www.epbd-ca.eu/

Some questions relevant to this topic

- ✓ How are appeal procedures organised in your country, and which elements would you recommend for implementation in other countries?

5.27. Are there other procedures for achieving effective compliance?

Context and motivation

In principle, the government should organise effective enforcement. In parallel with, or as an alternative to governmental enforcement, there might be other and sometimes more effective mechanisms in the market leading to enforcement. This can include specifications and control measures by insurance companies, etc.

Another alternative approach in the medium and long term can come from the market uptake of Building Information Modelling (BIM). This approach is further developed in Chapter 10.

Considerations on procedural aspects

- ✓ Private initiatives leading to effective compliance can in some cases and at least on a temporary basis be a valid alternative for general government enforcement. This can be the case if there is not yet a governmental enforcement scheme in operation, and private initiative can serve as a small scale 'testing ground'.

Relevant approaches for this topic

- ✓ The French programme RAGE developed technical reference documents and reliable practical tools and resources, resulting in installations acknowledged by insurance companies. The programme was launched in mid-2010 and closed at the end of 2014. The continuation is called PACTE. It is an ambitious national programme that aims to update (or create) energy efficiency standards for construction practices.

References

- ✓ Action Programme for Construction Quality and Energy Transition - Sylvain Mangili - Presentation at QUALICHeCK Workshop, Lyon, January 2017

Some questions relevant to this topic

- ✓ Are there procedures in your country, which in addition, in parallel or as an alternative, contribute to enforcement of energy legislation?

6. Best practices for Step 3: Practical implementation of a framework for better enforcement and effective penalties

6.1. Political will for effective compliance checking is crucial

Context and motivation

The organisation of effective compliance checks requires real political will at the governmental level. As compliance checks, and related sanctioning, is in general a politically sensitive issue, it is important to be aware if the limits of political will are reached.

A major element is stakeholders' support for an effective framework for better enforcement and effective penalties. This is less evident than many people might think and it usually requires specific efforts.

Examples of problematic situations

- ✓ In case the responsible politicians are against the introduction of penalties, there is basically no chance to achieve effective compliance and enforcement. Even if the administration is strongly motivated, it would not be effective in practice and would demotivate such administration.

Considerations on procedural aspects

- ✓ In principle, the large majority of stakeholders' organisations should not be against an effective compliance framework, on the condition that the envisaged sanctions are reasonable. However, it is logical that stakeholders organisations are cautious about supporting measures which might be used against it members. Therefore, it is crucial that the representatives of stakeholders' organisations can be convinced that the enforcement framework will be fair, proportional and reasonable. Such conviction is not likely if the stakeholders are not heavily involved in the development process of a compliance and enforcement framework. Moreover, they must be involved during the implementation process as well.
- ✓ Successful examples from other countries or other sectors might help to convince stakeholders and politicians to effectively support a compliance framework. One of the aims of the QUALICHeCK reports, webinars, etc., is to provide documented examples of successful approaches.

Relevant approaches for this topic

- ➢ AMA (General material and workmanship specifications) has been used in Sweden for more than sixty years. The different parts of AMA are used as reference documents in technical specifications. The AMA requirements are complementary to statutory rules, regulations and specified building standards laid down by the authorities. Statutory demands, that have to be followed by the building proprietor and the contractor, are based on EU requirements, laws, statutes and directions. In addition to these compulsory demands both parties also have to follow the requirements in the contract once it is signed. The contract documents include a building specification referring, by codes and headings, to specified AMA demands. The AMA requirements are made valid when they are referred to in the contract between the owner and the contractor. Between 90 and 95% of all building projects in Sweden refer to AMA in the contract documents. AMA is updated every third year. The Swedish approach for ductwork airtightness was not developed in the context of EPC declarations but proves to be extremely efficient.
- ➢ In the framework of the French RT2012 regulation, it is mandatory to assess the building airtightness. Two possibilities exist:
  - ✓ a systematic testing of the airtightness of each building; such tests must be done by certified testers and the assessment also includes leakage detection;
  - ✓ an overall quality framework at the level of the building companies involved; this approach requires the fulfilment of a series of procedures at company level, in combination with testing of about 5% of all buildings.

References

- ✓ Swedish approach to quality and Compliance, Johnny Andersson, Presentation at QUALICHeCK Workshop, Lund, March 2015, http://qualicheck-platform.eu/events/workshops/
- ✓ AMA - general material and workmanship specifications – Paula Wahlgren - QUALICHeCK Fact Sheet #09, February 2016
- ✓ Perspectives for effective compliance checks - Xavier Loncour -Presentation at QUALICHeCK Workshop, Lund, March 2015
- ✓ Lessons learnt from regulatory compliance checks on ventilation and airtightness: regulatory, context, control procedures, results - Sandrine Charrier, Adeline Bailly - Presentation at QUALICHeCK Workshop, Lund, March 2015
- ✓ Belgium/Flemish region control and penalty scheme of the energy performance legislation: checking procedure and fines – Clarisse Mees - QUALICHeCK Fact Sheet #48, February 2017
- ✓ Regulatory compliance checks of residential ventilation systems in France - François Rémi Carrié, Sandrine Charrier, Adeline Bailly - QUALICHeCK Fact Sheet #06, November 2015
- ✓ Building airtightness in France: regulatory context, control procedures, results - Sandrine Charrier, Adeline Bailly, François Rémi Carrié - QUALICHeCK Fact Sheet #07, December 2015

Some questions relevant to this topic

- ✓ In case you do not yet have a fully effective enforcement system, do you have the impression that there is, in principle, strong political will in your country for effective enforcement?
- ✓ In case you have already an effective enforcement system, do you believe that the political will to maintain such enforcement remains sufficiently strong?

6.2. Effective monitoring if reporting is happening in due time

Context and motivation

In principle, all EPC related regulations should contain requirements regarding deadlines for communication of documents (e.g. at moment of building permit, at end of works). Is this reporting happening in practice? Is there an effective control and, in case of non-compliance a sanctioning?

Considerations on procedural aspects

- ✓ It is important that there is a sufficient time allowed for submitting the required declarations, but at the same time it is important to check if the timing is respected and, if not, enforcement measures are operational.
- ✓ The use of an efficient IT platform in combination with databases can substantially simplify monitoring and enforcement of deadlines.

Relevant approaches for this topic

- ✓ In Austria, 3 provinces joined together to operate a web application called ZEUS (Zentrale Energieausweis Umgebung Salzburg) which includes also an EPC database. EPCs are submitted from the calculation tool via XML interface and are processed to all organisations involved in the process: building authority, subsidisation authority, independent control. It is always transparent with whom the EPC is and which task is pending to be completed by a certain date (e.g. check by building authority, check by independent control, revision by EPC expert due to detected errors).

References

- ✓ ZEUS (Zentrale Energieausweis Umgebung Salzburg), test environment accessible for everybody after having registered (in German only), www.energieausweise.net/testumgebungen

Some questions relevant to this topic

- ✓ Is there in your country an active monitoring of meeting deadlines in terms of reporting? Statistics?
- ✓ Is there an effective sanctioning in case of not meeting the deadlines? Statistics?

6.3. Appropriate resources to implement effective compliance checking

Context and motivation

There is clearly a societal wish to limit the administrative burden and cost. Thus, the question arises whether it is necessary to set up a whole compliance framework to verify compliance with regulations, or whether one can assume that competent individuals will apply their competence and control can be omitted.

Practice shows that it is not evident to assume that people with the required competence will apply the principles of good building details in case of non-compliance framework. Often, such details are more expensive in construction and/or require more labour time in the design and/or construction process. In practice, it is very difficult (almost impossible) for normal users to detect such extra heat losses caused by not applying the principles of good building details, and enforcement will be unfeasible. Therefore, it is important to have a governmentally organised framework for handling non-compliance issues in place, be it carried out by the public authority itself or by a private organisation commissioned by the public authority.

Examples of problematic situations

- ✓ The sampling scheme for compliance checking is not well developed and therefore not effective in terms of achieving a constant improvement of EPCs and buildings but also EPC experts.
- ✓ Compliance checks should be carried out by the public authority, but there is a lack of human resources and budget allocation is insufficient, thus resulting in isolated minimum activities with little impact on improving actual quality of EPCs and buildings.

Considerations on procedural aspects

- ➢ The development of the sampling scheme is crucial:
  - ✓ Which building related energy aspects need most attention because weaknesses are already known?
  - ✓ Which building related energy aspects should be investigated because there are hints regarding potentially problematic situations?
  - ✓ Which building related energy aspects should be investigated because little information is available?
- ➢ If financial and human resources to control are limited, solutions will have to be found how to disburden the administrative staff by improving the efficiency of administrative procedures and transferring certain tasks to market players.
- ➢ Member States following regional EPBD implementation should investigate which elements of the enforcement and sanctioning framework could be used together to avoid multiplication of effort and cost and to increase the chance of creating an economically feasible and effective framework.
- ➢ In case it is not evident to make staff from governmental agencies available for EPC compliance, it might be useful to consider subcontracting of certain parts of the work.

Relevant approaches for this topic

- ➢ Central management of decentralised tasks in Germany: The new German control system for EPCs went into force with the amendment of the Energy saving Ordinance (EnEV 2013). Though compliance and controls are in the responsibility of 16 local governments, Germany will have one centrally organised system. This is an innovative form of cooperation between the local governments and it aims at keeping the administrative burden as low as possible.
- ➢ In UK, EPC assessors (competent individuals) assist building control officers (public authority): The building regulation is checked (in principle on-site) by the building control officers (BCO). But these building control officers are no experts on energy so it is difficult to pick up all the evolutions in the energy performance regulations and to control the compliance with the regulation. They also have a high work load. Different opportunities were used to solve the problem, such as the following ones:

- ✓ The same software can be used for building regulation compliance and the EPC. The EPC assessors are accredited with a QA scheme that is checked by the government. The EPC can be used by the building control officers to check the requirements.
- ✓ BCO can also use a declaration of a competent person: top assessors can be competent individuals, so their declaration can be accepted by the BCO as complying with the regulation.

References

- ✓ Concerted Action EPBD - www.epbd-ca.eu/

Some questions relevant to this topic

- ✓ Could you provide information about the cost of compliance checking in your country (number of person month per year or amount in EUR)?

6.4. First warning, then sanctioning?

Context and motivation

The change from a situation with no or limited compliance checks to a (more) stringent compliance check can give some chocks in the market with potentially the risk that there is loss of societal support. Therefore, it might be useful to consider a stepwise approach in the effective compliance implementation. In addition, or as part of the timing at legal level (see §5.3), one could also foresee a transition in the implementation process itself, e.g.:

- ✓ A first period where only warnings are given and corrections have to be done, however without any financial or any other consequences.
- ✓ A second period where the sanctioning system is effectively in place.

Examples of problematic situations

- ✓ In case the legislation and/or the enforcement framework are substantially changed on short notice, there might be in the start-up phase frequent cases of non-compliance. If this results in frequent penalties, one might lose the societal support.

Considerations on procedural aspects

- ✓ To warn instead of sanctioning is not always possible. In case the legislation is clearly specifying the rules for enforcement, and if the enforcement is handled by civil servants, they may not have the possibility to only warn during the start-up process, unless this is specified in the respective regulation by defining a transitional period. Typically, if non-compliance is handled by a judge, the possibility to warn is much greater.
- ✓ One can in the legal framework explicitly foresee the possibility to warn during a given period before the sanctioning become effective.
- ✓ Warning and the final order to improve can be an explicit part of a stepwise penalty system.

Relevant approaches for this topic

- ✓ No examples available

References

- ✓ Concerted Action EPBD – www.epbd-ca.eu

Some questions relevant to this topic

- ✓ Do you see reasons in your specific context for considering a warning system during a start-up process?

6.5. Robust procedures in case of penalties

Context and motivation

In case of confirmed non-compliance, it is important to have a robust procedure for enforcement and penalties. Typically, there must be one or more possibilities for appeal.

Examples of problematic situations

- ✓ In case a civil servant has to decide on sanctions, without the possibility for appeal, there might be a loss of societal support in case there are frequently sanctions, whereby there might be the perception by part of the market that the sanctions are not fair.

Considerations on procedural aspects

- ✓ In case non-conformities are handled by judges, the typical procedures for appeal are applicable.
- ✓ In case non-conformities are handled by governmental administrations, it is important that there is sufficient control on the sanctioning decisions and the possibilities for (several levels of) appeal.
- ✓ In case non-conformities are sanctioned by organisations designated by the government, the situation is quite similar as in the case of governmental administrations, whereby it is important to evaluate whether civil servants should be involved in this whole process.

Relevant approaches for this topic

- ✓ In Belgium, the Flemish region has implemented a scheme for checking procedures and fines.

References

- ✓ Belgium/Flemish region control and penalty scheme of the energy performance legislation: checking procedure and fines – Clarisse Mees - QUALICHeCK Fact Sheet #48, February 2017

Some questions relevant to this topic

- ✓ Does the regulation foresee procedures for appeal?

6.6. Support by stakeholders for effective compliance is crucial

Context and motivation

As indicated in §6.1, overall support or acceptance by stakeholders for an effective compliance framework is in most cases crucial for politicians and this at different stages:

- ✓ During the preparation phase: politicians will rarely decide a strict enforcement policy unless strong support from the stakeholders
- ✓ During implementation: it is not evident for politicians to support the effective implementation of strict enforcement and sanctions, unless supported by most of the stakeholders.

Typically, most stakeholders' organisations are in principle reluctant to actively support effective enforcement frameworks with related sanctions, if there is not a quite high guarantee that this enforcement will be fair, proportional and reasonable.

Therefore, it is important to actively involve stakeholders in the implementation of compliance measures.

Examples of problematic situations

- ✓ The whole legislation has been developed with little or no stakeholder's interaction. In particular for the aspects related to compliance and enforcement, such lack of interaction can completely block the possibility for compliance and enforcement.

Considerations on procedural aspects

- ✓ Make stakeholders an effective partner in the development process of enforcement frameworks
- ✓ Try to find solutions which meet the expectations from the stakeholders

- ✓ Organise an active monitoring process involving stakeholders organisations

Relevant approaches for this topic

- ✓ The French consumer association UFC - Que Choisir operated in November 2015 a survey by visiting 1246 real estate agencies all over the country. Results show that 65% of the visited agencies systematically display the Energy Performance Certificate results for dwellings for rent or sale shown in their shop window, that 26% do not systematically display it, and that 9% do not display it at all. These values were respectively 72%, 18% and 10% during a previous survey in March 2011.
  No specific sanction is foreseen for non-displaying EPCs in the French Law, and the French Ministry of Housing indicated in January 2011 that common law applies to the default and inaccuracy of the EPC. From the point of view of the civil law, fraud can be assimilated to the concealment of a fact which, had it been known, would have led the consumer not to contract or to do it at a lower price (art 1116 of the French Civil Code): the penalty can be the nullity of the act or a price reduction. From the point of view of the criminal law, misleading advertising (art. L 121-1 of the French Consuming Code) can be subject to sanctions up to 2 years in prison and 300000 € of fine. UFC - Que Choisir says that one real estate agency was condemned in 2013 according to the civil law to pay a compensation to a tenant because the EPC was not available when the contract was signed: in this case, the fine was 2000 €.

References

- ✓ French consumer association UFC-Que Choisir - www.quechoisir.org/immobilier-logement/location/communique-acces-a-la-location-400-agences-immobilieres-mises-en-demeure, http://image.quechoisir.org/var/ezflow_site/storage/original/application/e25fd79bce390667340d89ab52b80b37.pdf

Some questions relevant to this topic

- ✓ Are most stakeholders in your country effectively involved in the process of EPBD implementation and, more specifically, in issues related to compliance and sanctioning?

6.7. Communication on outcomes of compliance activities

Context and motivation

In case of an effective compliance framework, it might be very useful to regularly inform the regional and national market of the outcomes of such compliance activities. Communication on outcomes of compliance activities serves awareness creation among stakeholders that improvements are necessary and thus also raises acceptance and societal support for compliance activities.

This can include various types of information, e.g.:

- ✓ What kinds of non-compliance issues are observed?
- ✓ Frequency of non-compliances
- ✓ Consequences of non-compliance in terms of sanctions
- ✓ Recommendations for reducing risks for non-compliances
- ✓ …

Examples of problematic situations::

- ✓ Information about compliance is not available at all because the independent control system required by the EPBD is not in place.
- ✓ The independent control system required by the EPBD is in place, but there is no follow-up on the information gathered.
- ✓ Feedback on non-compliance is only provided to the concerned person, and feedback targeting a larger group does not take place.

- ✓ The independent control system required by the EPBD is in place and there is a follow-up on the information gathered, but no communication takes place on evaluation results, and no activities take-off to target constant improvement.

Considerations on procedural aspects

- ✓ Which organisation has access to relevant information?
- ✓ Is there a responsibility and a budget to collect, evaluate and distribute information on outcomes of compliance activities?
- ✓ Who are the relevant target groups?
- ✓ What is the best way of distributing information to which target group (conference contribution, journal article, newsletter via e-mail)?

Relevant approaches for this topic

- ✓ In Belgium and other Member States, the central EPC-database is used to evaluate compliance. In Belgium, efforts in communication and presence control carried out by the authority resulted in an increase in EPC availability from 46% in the year before the measure to 80% in the year after.
- ✓ In Portugal and other Member States, evaluation of mistakes is used to update training programs addressing EPC experts.
- ✓ In Ireland and other Member States, statistics are published about the energy performance stated in EPCs.

References

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- ✓ Certification: overview and outcomes - Susanne Geissler, Naghmeh Altmann-Mavaddat - Core theme report of the third Concerted Action EPBD, www.epbd-ca.eu/ca-outcomes/2011-2015, August 2015
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- ✓ How to get compliant and accessible data for the energy rating calculation of a building? - Overview of some existing approaches - François Durier, Susanne Geissler et al. - QUALICHeCK report, March 2016
- ✓ SEAI – Sustainable Energy Authority of Ireland, BER Statistics, www.seai.ie/Your_Building/BER/BER_FAQ/FAQ_BER/General/BER_Statistics.html
- ✓ Province of Salzburg: EPC Statistics - Energieausweis-Statistik (Wohnbauförderung), https://www.energieausweise.net/statistik-salzburg
- ✓ Concerted Action EPBD - www.epbd-ca.eu

Some questions relevant to this topic

- ✓ How is communication on outcomes of compliance activities organised in your country?

7. About innovation

7.1. Introduction

Over the last decade, substantial progress has been achieved for many products and systems in terms of product and system performances regarding energy efficiency and renewable energies. The type of progress can take different forms, e.g.:

- ✓ Better energy efficiency of systems (e.g. heat recovery, efficiency of heat pumps, …)
- ✓ New technologies (e.g. vacuum insulation panels, LED lighting, deep geothermal energy, …)
- ✓ Cost reductions for various types of energy efficient technologies and renewable energies
- ✓ Better durability of systems and products, e.g. for building and ductwork airtightness

Energy performance regulations should correctly assess all kind of technologies and, as a result, also stimulate and/or allow the market uptake of innovative technologies.

It is important to underline that the market introduction of innovative technologies is not by definition a difficulty for an EPC calculation method. In many cases, the calculation method can perfectly handle many new technologies. A few examples to illustrate:

- ✓ A heat pump with a much better efficiency but whereby the technology is covered by the calculation method and where system data can be introduced, is no issues of concern.
- ✓ An insulation material with a much better thermal conductivity, a window profile with a much lower U-value then available in the past … is not a problem for the EPC calculation method if the method allows using the measured/calculated value.

7.2. Simplified procedures are important but should not be a barrier for innovation

The availability of simplified procedures is often considered as a major element for market acceptance. At the same time, it is important that innovation is not blocked due to oversimplification in the EPBD calculation methods.

In practice, there are various possibilities for dealing correctly with better performing products and it is crucial to foresee at least one of these possibilities.

Examples

- ➢ Existing technology: condensing boiler
  - ✓ The use of a fixed value for the efficiency of condensing boilers is not stimulating the use of more energy efficient condensing boilers. A possibility to stimulate innovation is to allow to use specific product data, whereby it still is possible to have a default value when using a condensing boiler
- ➢ New technology not covered by the standard procedure: shower with heat recovery
  - ✓ In case such technology is not covered in a given country, and if considered a relevant technology, it is important that the legislation foresees a procedure for handling such technologies. See also §4.8.
- ➢ Very innovative building designs
  - ✓ In case specific and rather unique design concepts are implemented, it might be necessary to foresee the possibility of a project specific assessment method, if not innovation will be blocked. See also §4.9.

7.3. Important to have a robust framework for assessing technologies not covered by the normal procedures

7.3.1. Points of attention

In order to have legislation which allows compliance checks and an effective enforcement, it is important that there are robust legal and technical procedures for assessing concepts and technologies not covered in the standard procedure.

There are a whole range of points of attention, i.e.:

- Technical assessment
  - ✓ It is important that there is a sufficient amount of transparency in the magnitude of the impact to be expected by an innovative technology in the EPC context.
  - ✓ This is in some cases far from evident (is the expected savings large or marginal?) and it might require a substantial effort and time to come to a robust procedure.
  - ✓ In case the procedure is not transparent, it is for industry not evident to develop and optimise innovative technologies
- Legal procedures
  - ✓ It is important that the legislation foresees a framework for assessing innovative products and concepts.
  - ✓ It is important that the legislation is in line with the various EU legislations.
- Consistency between the assessment of technologies
  - ✓ It is important that there is consistency between the assessments of different types of technologies. This seems evident, in practice it is sometimes very difficult to find a straightforward method for comparing, in particular when the assumptions to be made for various systems are in different areas.
- Time for assessment
  - ✓ It is important that the time effort for assessing an innovative concept is still moderate, if not there is no market for an innovative approach. This aspect becomes the more important in case there is a strict compliance and enforcement framework.
- Costs of assessment
  - ✓ It is important to pay attention to the costs for the industry for the assessment of the innovative approaches.

7.3.2. Possible solutions

In general terms, the solution is to foresee in the legislation one or more alternative roads for dealing with systems and projects which are not covered by the standard calculation procedure.

In practice, one finds approaches allowing to assess specific technologies and this independent of the building in which it is applied. For more information, see §4.8.

Other approaches are focusing on the application of a specific technology (or combination of technologies. For more information, see §4.9.

8. Importance of societal support for compliance and forcement

8.1. Effective enforcement not evident without strong societal support

As already indicated before, it is in most countries for governments not evident to have (strict) enforcement schemes regarding EPC compliance (including penalties) if such enforcement is criticised by a (substantial) part of the market. The political motivation for setting strict enforcement rules might be weak without societal support. In case there are enforcement rules, there is a very large risk that enforcement measures will be diminished or stopped once there is strong market opposition against enforcement and penalties.

Therefore, it is very important to work on the required societal support, which involves various activities, including:

- ✓ Active involvement of stakeholders in the development phase of the procedures, whereby they have a good understanding of the pro and cons with various approaches and whereby they hopefully support the choices which are made
- ✓ Involvement and/or dialogue in the implementation and enforcement phase, whereby it is important that they understanding the reasoning behind the enforcement measures and whereby they can provide inputs in case of criticism from the market.

8.2. Raising societal awareness regarding an EPC which can be trusted

In general, and this is not surprising, there often are negative reactions in case someone or a part of the market is sanctioned in case of non-compliance. The reactions might be e.g. “This is not fair”, “The procedure is too heavy and/or too costly”, “the procedures are not clear”…

Therefore, it is very important that all relevant stakeholders’ organisations have the opportunity to be involved in the preparation process of compliance and enforcement procedure.

What can be the objectives for such stakeholders’ involvement?

- ➢ **Before implementation:**
  - ✓ To inform them about the motivations for an enforcement framework, e.g. by sharing experiences of problems with the EPC (EPC is not available, wrong information in the EPC, …)
  - ✓ To discuss the procedures for determining the EPC (Step 1 – See chapter 4), which will allow them to assess the complexity, the type of technologies covered/not covered, …
  - ✓ To discuss the principles of the legal framework for compliance and enforcement (Step 2 – See chapter 5)
  - ✓ To discuss the principles for practical implementation for the enforcement (Step 3 – See chapter 6)
- ➢ **During implementation:** regular evaluation if the procedure is well balanced and/or if improvements are needed, e.g.
  - ✓ Is there a need for a modification in the procedures for determining the EPC (Step 1 – See chapter 4);
  - ✓ Is there a need for a modification of the principles of the legal framework for compliance and enforcement (Step 2 – See chapter 5)
  - ✓ Is there a need for a modification of the principles for practical implementation for the enforcement (Step 3 – See chapter 6)

Practice shows that it requires substantial efforts for the stakeholders to obtain the overall picture and therefore it often is time consuming for reaching the required support. Moreover, it is important to acknowledge that many stakeholders’ organisations have a multi-layer approach, whereby it is for issues as compliance and enforcement often important that there is a broad support at different levels:

- ✓ Individual members
- ✓ One or more committees dealing with EPC issues

- ✓ Some organisations have a permanent staff which is assumed to represent the views of the stakeholders

A strong interaction requires time but can have various substantial advantages:

- ✓ Identification of opportunities for improvement
- ✓ Increased credibility of the overall approach in case there is support from the stakeholders
- ✓ Better understanding by the stakeholders of the reasons for certain choices and therefore more support in case of negative reactions from market players

In the Flemish Region a comprehensive evaluation of the EPB-regulation is foreseen every 2 years. Stakeholders participate on this process, and quality issues are brought up. If necessary legislation is adapted or actions such as communication, adaptation financial incentives are foreseen.

Real estate agents belong to a crucial stakeholder group because they are the ones presenting the energy performance of a building to customers interested in buying or renting a building or a building unit. It is paramount that they promote the EPC as a useful tool and not as an additional burden

In this regard, there must be a clear communication about the EPC based on default values serving to provide orientation on the market and to compare buildings, and the EPC based on specific building data serving to provide specific information about the building. As a result, the EPC will be regarded as a reliable source of information for potential buyers and renters during the decision making process.

9. Economics of control and enforcement

The cost issue is often a potentially critical issue in the context of 2nd and in particular 3rd party control and enforcement schemes. The cost debate has various dimensions and this is further discussed in this chapter.

9.1. An effective second or third party control and enforcement framework requires efforts

Organising control and, in case of non-compliance, set up enforcement actions requires various investment and staffing costs. These costs will depend on various elements, e.g.:

- ✓ The type of control: desktop, on-site …
- ✓ The frequency of control
- ✓ The intensity of control
- ✓ The frequency of non-compliance and the number of enforcement actions
- ✓ IT environment
- ✓ Consultation process, legal advices, …

9.2. Who pays the costs for control and enforcement schemes?

Overall scheme

In case of second party control and enforcement frameworks, the costs have to be covered by the parties involved and, at the end, by the client.

In case of third party control and enforcement schemes, this remains the same if the initiative is taken by the client. In case it is linked to a governmental initiative (EPC, incentives…), it is a decision of the initiator (government, organization which is setting up incentive scheme…) to decide who has to pay for the overall costs.

In case of governmental schemes, the cost of control and enforcement is covered by the budget for public administration. Specific taxes related with energy efficiency or fines due to violation of regulations can be used to sustain the budget. In the end, it is the public who pays and especially those, not complying with the regulations.

Additional costs in case of non-compliance

In case of non-compliances and the need for additional controls, corrective measures…, these extra costs have also to be covered by one or more parties involved in the process.

9.3. Are there no costs in case of no second or third party control and compliance framework?

There is no doubt that the installation and operation of a second or third party control framework induces costs. Is the alternative, i.e. no control and enforcement framework therefore cheaper?

The absence of a second or third party control and enforcement framework might result in a (much) higher degree of non-compliances. If this is the case, this can result in various types of direct or indirect costs, e.g.:

- **At individual level:**
  - ✓ Too positive EPC declarations will result in wrong information about the building energy performance and typically higher costs for operation and improvement, thus misleading potential buyers and tenants during the decision making process, but also building owners if they plan to use the building themselves.
  - ✓ A compliant EPC will act as a level playing field for investors, designer, contractors and supply industry and will allow a fair competition. In case it is easy to use wrong data in the EPC, the risk of fraud will substantially increase.
- **At member state level:**
  - ✓ Not meeting the energy requirements as imposed by Energy Efficiency Directive (EED) and Renewable Energy Directive might cause infringement procedures due to violating the European legal framework, resulting in additional workload for civil servants and fines. It will probably have a negative impact on climate protection obligations, because usually energy efficiency in buildings is a condition for achieving CO2-reduction targets. Missing CO2-reduction targets causes penalties, as well.
  - ✓ No reporting will cause additional efforts in substituting information otherwise provided by EPCs, e.g. for reporting according to Article 5 EED or to meet other reporting obligations. If EPCs are not available, data collection studies will have to be carried out to provide the necessary information. In the long run, expenses for these studies might be higher than cost of implementing and running a successful compliance scheme.
- **At world level**
  - ✓ CO2-emissions from fossil fuels cause external cost related with climate change.. These are cost paid by the society instead by the polluter. CO2-emissions contribute to climate change, and damages caused by climate change are enormous: floods and droughts, and as a consequence destroyed infrastructure and crop failures, fight for resources, migration, etc. These costs must be avoided. Therefore, when striving for cost transparency, it is necessary to declare correct CO2-emissions on building level, to develop targeted policy instruments for a reduction of CO2-emissions.

9.4. Lower total cost?

Often, energy efficiency in buildings is motivated by lower Life Cycle Costs (LCC). However, in practice, this is often not true. The reason is that the Standard on LCC (ISO 15686-5:2008) allows a broad range of interpretation: Similar to Life Cycle Assessment (LCA, ISO 14044:2006), also LCC starts with the scoping and definition of objectives. Crucial parameters dominating the calculation result such as interest rate, intensity of maintenance and repair, and lifespan of products and systems can be defined by the person carrying out the analysis.

Apart from these crucial parameters the following choices for calculation may lead to unrealistic results:

- ✓ Additional cost for energy efficiency is calculated instead of total renovation cost;
- ✓ Cleaning cost is neglected although important in energy efficient buildings due to extensive application of glass in order to making use of solar gains;
- ✓ Assumed energy consumption used for calculation is not realistic due to prebound and rebound effect;
- ✓ User needs and user behaviour might change over time and is not taken into account.

However, being aware of the possible traps, the Life Cycle Cost approach can facilitate new forms of cooperation (e.g. based on alliance contract models) and new business models (e.g. total cost of ownership), offering great potential for increasing energy efficiency in buildings.

In any case, it is crucial to start discussions at the same level of information, and thus to avoid troubles resulting from the utilisation of wrong terms. In this regard it is useful to refer to ISO 15686-5:2008, defining the terms as follows:

- ✓ Life Cycle Cost (LCC) comprise of construction cost, maintenance cost, operation cost, occupancy cost, and end of life cost.

- ✓ Whole Life Cost (WLC) comprise of Life Cycle Cost, non-construction cost, income, and externalities.

9.5. Compliance checks and enforcement as means against unfair competition?

Compliance checks and effective enforcement creates a level playing field for all actors involved in the project. This can substantially contribute to avoid unfair competition.

9.6. Cheap financing of stimuli for innovation?

An EPC legislation with possibilities for market uptake of innovative systems in combination with compliance checks and an effective enforcement can be a major driver for product and system innovation. If industry achieves cost effective energy efficient systems, there is in such context a very good chance for market uptake.

10. Can BIM be a game changer?

According to ISO 29481-1:2016(en), building information modelling (BIM) is “use of a shared digital representation of a built object (including buildings, bridges, roads, process plants, etc.) to facilitate design, construction and operation processes to form a reliable basis for decisions”.

10.1. Why the emergence of the BIM?

One can find an explanation for the recent worldwide acceleration of the digital transition, especially in the new awareness of the environmental deterioration caused by our ways of living and building. Indeed, the real estate, which is responsible for a large share of global consumption of non-renewable energy resources, is increasingly being subjected to systemic analysis by construction actors.

If such studies ensure a more mature and sustainable decision-making (related to design, construction, management …), they necessarily involve considerable information needs in terms of volume and frequency in all areas of expertise involved in the construction. Besides, the new products and services (e.g. IoT) introduce more and more information contents. In this context, it has become extremely complicated for humans as information processing systems with limited cognitive capacity to make justified and justifiable choices based on those data volumes. This problem of mass information processing for decision-making is at the origin of the research carried out on the Information Systems, a family the building digital mock-up is part of.

It’s been decades now since the digital mock-up has proved its worth in aerospace and automotive fields. Nowadays, it offers new opportunities to the construction sector, and it even starts to be considered as a privileged support for urban planning policy. Among the new technologies emerging in the construction sector, the BIM digital model is distinguishable by a high level of maturity and a very predictable impact on building management and compliance.

If the current term of BIM appears only in 1986 in the article of the engineer and computer researcher Robert Aish, the reflection on this process is more than fifty years old! However, computer technology was still unable to provide sufficient memory and quality of representation to materialize this idea. The combination of powerful performance software and a common language finally made possible the BIM, which tends to become a norm in building design all over the world.

10.2. BIM developments in Europe

The future market uptake of BIM is difficult to predict with great accuracy, but it clearly is a development with great potential.

In terms of requirements, an increased number of countries impose the use of BIM for certain types of projects, e.g.:

- ✓ Since 2007, obligatory in Norway for public buildings, in Finland for any project above 2 M€ and in the USA for any major project
- ✓ Since 2012 mandatory in the Netherlands for any major public project
- ✓ Since 2014 mandatory in Hong Kong for any public project
- ✓ Since 2016 mandatory in South Korea for any project above 50 M$ and in the UK for public projects

In a 2016 report ‘Shaping the Future of Construction – A breakthrough in mindset and technology’ by the World Economic Forum, prepared in collaboration with the Boston Consulting Group, the market view on a whole range of new technologies has been collected. From this survey, it appears that integrated BIM has the highest likelihood AND the highest expected impact on the construction sector in the future compared to thirteen other new technologies (such as advanced building materials, augmented reality, 3D printing of components, big data analytics…).

10.3. What can BIM mean for EPC calculations?

At present, the calculation of the EPC of a building is an activity on its own. One has to collect all input data (surfaces, volumes, product and system data, …) and enter them into the software tool.

This can be very time consuming. Reducing the effort to collect and enter input data can rely on either simplified calculation procedures (for e.g. dwelling treated as a single zone, default values for various systems, simplified description of thermal bridges) or on calculation software with embedded product characteristics databases.

With BIM, and of course depending on the level of maturity (LoM – see further) level of development (**LoD** – see further) of the BIM approach, all the input data for EPC calculations are part of the BIM model. Of course, specific tools have to be developed for the EPC calculations, with the ability to use BIM files for input data, and to generate results that are integrated into the BIM. Such BIM approach can very substantially reduce the required efforts for producing an EPC. As such it will be easier to generate and evaluate variations to optimize the overall performance. In the "as built" stage, it will again be relatively easy to verify if the requirements are met.

What can be the impact on the calculation procedures themselves? An interesting example are **thermal bridges**: with a detailed description of the building envelope through BIM, and given the calculation power or modern computers, it becomes possible to have a 3-dimensional transmission analysis of the building shell, meaning that there is no need any more to have a specific analysis of thermal bridges.

Another example is the **assessment of overheating risks**. At present, most countries use simplified procedures which only give a rough indication of the risk of overheating and/or the related energy consumption for achieving appropriate thermal comfort. With a detailed BIM model, much more refined assessment methods can be used without requiring specific efforts for collecting input data.

Most countries have at present (very) simplified procedures to assess the energy performance of **HVAC systems**. With BIM, a more refined assessment becomes possible as the actual characteristics of the systems are easily available.

10.4. Level of Maturity (LoM)

The English standard BSI PAS 1192-2: 2013 defines the BIM maturity levels that are now the world's benchmark. These levels of maturity make it possible to define the level of integration observed or requested in a project thanks to BIM digital models. These levels are:

- ✓ **Level 0: no digital mockup**
  The tools used only assemble straight or curved lines or texts, without logic between them (as AotoCAD does).
- ✓ **Level 1: Isolated BIM**
  Each actor works on a model specific to his needs but there is no exchange of information.
- ✓ **Level 2: Federated BIM**
  The digital model is collaborative: each actor works on a copy of the model then the BIM manager (internal or external intervener) summarizes it in a global model. This level is mandatory in the United Kingdom since January 2016 for all public contracts> £ 5m.
- ✓ **Level 3: Integrated BIM**
  The digital mock-up is integrated "iBIM". Real collaborative work tool, the actors work at the same time on the same model.

10.5. Level of Development (LoD) of BIM

In the definition used by the American Institute of Architects [9] there are 5 basic Levels of Development which do not reflect specific modelling guidelines for any particular software, rather a generic definition of model content and, more importantly, authorized uses of the model for the respective LoD:

- ✓ **LoD 100** - Essentially the equivalent of conceptual design, the model would consist of overall building massing and the downstream users are authorized to perform whole building types of analysis (volume, building orientation, cost per square foot, etc.)
- ✓ **LoD 200** - Similar to schematic design, the model would consist of "generalized systems or assemblies with approximate quantities, size, shape, location and orientation." Authorized uses would include "analysis of selected systems by application of generalized performance criteria."

- ✓ **LoD 300** - Model elements are suitable for the generation of traditional construction documents and shop drawings. As such, analysis and simulation is authorised for detailed elements and systems.
- ✓ **LoD 400** - This level of development is considered to be suitable for fabrication and assembly. The Model Element Author (MEA) for this LOD is most likely to be the trade contractor or fabricator.
- ✓ **LoD 500** - The final level of development represents the project as it has been constructed - the as-built conditions. The model is suitable for maintenance and operations of the facility.

10.6. BIM and standardisation

In order to accelerate the market uptake of BIM, standardisation of protocols is important. Within CEN, Technical Committee 442 (Building Information Modelling) was created in September 2015. In ISO, Technical Committee 59 (Buildings and civil engineering works) is also dealing with BIM.

With the market uptake of BIM, and assuming that BIM models will be used for EPC calculations, there might be also new tasks for standardisation in relation to EPBD related standards. BIM offers the possibility to have a better physical modelling of energy processes (see examples mentioned ahead for thermal bridges, overheating assessment, HVAC modelling). It is important that the (CEN and ISO) standards reflect such development. A liaison officer between CEN TC 442 and the energy related CEN TC's has been nominated.

10.7. BIM and convergence of national EPC calculation procedures

At present, there are still major differences in the national EPC calculation methods. With the new set of CEN standards, one can expect more convergence in the EPC calculation procedures. However, one observes sometimes very big differences in the visions on the need for simplification and this is often a barrier for further convergence.

With BIM, there is the possibility to come with limited or no efforts for the user to a more accurate physical modelling of the energy performances and therefore the possibility of nearly no differences in views between member states. If the thermal bridges are automatically calculated due to the fact that the BIM model has all relevant information, why should countries have different procedures?

10.8. BIM and EPC compliance

At present, data collection for calculating the EPC of a building is in most cases an autonomous activity not linked to other design and execution processes. This might fundamentally change if BIM becomes mainstream. All relevant product and system data can then be directly integrated into the BIM objects (brick, thermal insulation, fan, heat pump, …), together with an information about their compliance to the national procedures for determining input data. Moreover, an integrated BIM model will be updated according to design or execution modifications, making that it will effectively represent what is constructed. Therefore, the energy performance calculation can be made for the as-built building.

As a result, it might mean that, once the BIM approach has become mature, there is nearly no need for specific compliance efforts related to the compliance of EPC and its input data.

10.9. BIM and quality of the works

Another potential advantage of the market uptake of BIM is the possibility to come to a better quality of the works. This can be illustrated for ventilation systems. If the BIM model of the installation includes all components, it will be easily possible thanks to dedicated software to assess if the required air flow rates can be achieved, if the acoustical performances can be reached.

10.10. BIM and smartness indicator

The issue of the smartness indicator proposed by the EC for the amendment of the EPBD is the topic of another article in this journal. With the expected market uptake of BIM, it probably becomes also possible to set up in a cost effective manner more refined assessment methods for the smartness indicator of a buildings.

10.11. Conclusions

It is at present not clear how quickly BIM will become mainstream for new and existing building projects, but there is no doubt that its importance will substantially grow in the coming decade. BIM can offer major opportunities in relation to the energy performance assessment of buildings, including compliance and enforcement. Moreover, it can at the same time contribute to better quality of the construction and of the installed energy systems, as well as to the market uptake of smart building systems.

References

- ✓ The potential impact of BIM uptake regarding EPC calculations – Bart Ingelaere - Presentation at 3rd QUALICHeCK Conference, Brussels, May 2016
- ✓ Can BIM be a disruptive technology for EPC assessment?- Peter Wouters, François Durier, Bart Ingelaere - REHVA Journal, Volume 54, Issue 2, 2017
- ✓ Can the smart grid and BIM be a major game changer for indoor climate control? - Peter Wouters - Presentation at QUALICHeCK workshop Athens, March 2016

11. Conclusions

The energy performance of buildings has become a major boundary condition for new buildings but, more and more, also for existing buildings. At European level, the EPBD has been the major driver. Whereas the original EPBD was not imposing to the Member States a requirement level to be achieved, the EPBD recast imposes cost-optimal requirements and for new buildings from 2019/2021 onwards the level nearly-zero energy buildings (nZEB).

The proof of energy performance is the Energy Performance Certificate (EPC), which is mandatory for new buildings, as well as for existing buildings when sold or rented. For new buildings, the EPC acts as proof of evidence that the building is meeting the requirement or that its performances might even better than the minimum requirements. For existing buildings, it is information for the potential buyer or renter and it should be a driver for better performing buildings.

In practice, various studies, including studies carried out in the framework of QUALICHeCK have highlighted that it is not evident to assume that the EPC information is compliant with the regulatory procedures, whereby often the declared EPC is better than what is achieved in reality. This is of course very problematic. At the same time, there are various experiences which show that compliant EPC input data and compliant EPC declarations are possible when certain conditions are met. The QUALICHeCK reports and factsheets describe such experiences.

From the analysis of good and bad experiences in terms of EPC compliance, it has become clear that in most cases compliant EPC declarations require controls and the possibilities of sanctions. The EPBD recast itself in article 27 imposes Member States to have a framework for penalties which are “effective, proportionate and dissuasive”.

In order to come to an effective compliance and enforcement framework, QUALICHeCK has identified 3 major steps. First of all, the technical procedures for calculating a compliant EPC level must meet a number of requirements. A kind of checklist with explanations is found in §4. Secondly, there must be a robust legal framework for action in case of non-compliance (see §5) and, finally, there are the application in practice with also a set of challenges (see §6).

Practice shows that it is possible to develop frameworks with adequate answers to these 3 parts of an effective compliance and enforcement framework. However, there might be substantial differences in the details of implementation and this is not a problem. One has to take into account the starting point in a given country, the building tradition and culture, etc.

A crucial element for an effective compliance and enforcement framework is societal support. It is not necessarily evident that politicians should impose sanctions for non-compliance with the regulations if stakeholders strongly criticise such a sanction scheme. If developed in close consultation with stakeholders, an effective compliance and enforcement framework can be for the various partners involved in the process (owners, architects, consultants, supply industry, contractors,..) an opportunity instead of a threat.

The move to nearly-zero energy buildings is, in principle, a clear driver for innovation. It is essential that the EPC calculation methods support and stimulate market uptake of innovative systems (see §7).

Is a compliance and enforcement framework justified if it introduces extra costs? In case the EPC requirements meet cost-optimal criteria and if the compliance and enforcement framework is well developed, we believe that the benefits are much greater than the costs (see §9).

Finally, the issue of BIM (Building Information Modelling) is discussed, as it might be a game changer, as well in terms of achieving better EPC with effective compliance and as it might also contribute to better quality of the works.

12. Annex: List of factsheets

- ✓ French voluntary scheme for harmonised publication of ventilation product data - François Durier, Laure Mouradian, Fabrice Lamarre - QUALICHeCK Fact Sheet #03, April 2015
- ✓ European voluntary rating programme of cool roofing products, Theoni Karlessi, Chrysanthi Efthymiou (NKUA, Greece), QUALICHeCK Fact Sheet #04, September 2015
- ✓ Voluntary scheme and database for compliant and easily accessible EPC product input data in Belgium - Samuel Caillou - QUALICHeCK Fact Sheet #05, October 2015
- ✓ Regulatory compliance checks of residential ventilation systems in France - François Rémi Carrié, Sandrine Charrier, Adeline Bailly - QUALICHeCK Fact Sheet #06, November 2015
- ✓ Building airtightness in France: regulatory context, control procedures, results - Sandrine Charrier, Adeline Bailly, François Rémi Carrié - QUALICHeCK Fact Sheet #07, December 2015
- ✓ Quality framework for reliable fan pressurisation tests - Clarisse Mees, Xavier Loncour – QUALICHeCK Fact Sheet #21, June 2016
- ✓ Procedures for determining input data for the Energy Performance Certificate (EPC) of existing residential buildings in Belgium - Xavier Loncour, Nicolas Heijmans, Clarisse Mees - QUALICHeCK Fact Sheet #23, June 2016
- ✓ EPC database and control system for compliant EPC input data in Sweden - Pär Johansson - QUALICHeCK Fact Sheet #24, August 2016
- ✓ Voluntary control scheme developed by the province of Salzburg: building services systems declaration based on as-built characteristics - Susanne Geissler - QUALICHeCK Factsheet #34, December 2016
- ✓ Investing in building energy efficiency: the role of the EPC in economic decision-making - Susanne Geissler, Klemens Braunisch - QUALICHeCK Fact Sheet #36, December 2016
- ✓ Labelling schemes and their role in building related compliance frameworks – Susanne Geissler - QUALICHeCK Fact Sheet #37, April 2015
- ✓ Voluntary schemes as a pool of ideas for designing and improving EPC compliance frameworks: the Boileff quality assurance scheme – Susanne Geissler - QUALICHeCK Fact Sheet #40, January 2017
- ✓ Selecting EPC input data for HVAC systems: a series of French guidance sheets - Dominique Hantz, François Durier, Valérie Laplagne - QUALICHeCK Fact Sheet #42, January 2017
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