QUALICHeCK
Towards better quality and compliance

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Technology	Aspect	Country
All technologies	Compliance frameworks	Austria, Germany, Sweden, Switzerland,

ENERGY EFFICIENCY STANDARDS AS DRIVERS AND BARRIERS FOR INNOVATION IN THE BUILDING SECTOR

Compliance frameworks are important drivers for energy efficient buildings. However, sometimes they also pre-define solutions to a certain extent and therefore do not only steer but also hinder innovation in the built environment. This fact sheet compares five different energy efficiency standards from four countries and their methods for checking compliance on their implications to systemic solutions and innovation. Three standards are part of the mandatory legislative framework, and two standards are voluntary ones.

Residential buildings ☑	Non-residential buildings ☑	Specific buildings: ......
New buildings ☑	Existing buildings ☑	

Context

All EU countries have established energy performance requirements for buildings. The requirements are part of their efforts to contribute to the EU 2020, 2030 and 2050 targets under the Energy Roadmap 2050[1].

The Energy Performance of Buildings Directive (2010/31/EU) and the Energy Efficiency Directive (2012/27/EU) are the EU's main legislation when it comes to reducing the energy use of buildings[2].

While overarching targets are set on a European level, the member states are free to design the national or regional legislative framework in order to tailor the overall idea to the specific framework conditions and maximise their effect. As a result, the individual national or regional legislations differ to a certain extent.

The legal framework for energy efficient buildings has a profound impact on the approaches which are used in the building sector to realize energy efficient buildings. While some countries include also mid-point minimum requirements, e.g. for insulation of the envelope, others focus only on final energy use, a primary energy indicator, and a CO_2 indicator.

Not only requirements differ, also control and enforcement procedures differ. While some countries check EPCs only at building permit stage, other countries check whether the EPC complies for the completed building.

Besides national or regional frameworks, some private labels imposing more ambitious requirements than prescribed by legislation have gained reputation and acceptance, so that some buildings are designed according to these standards. Examples are the Passivehouse standard and the MINERGIE standard. While the parliament must pass a law to prescribe mandatory requirements, and needs the required majority to do so, voluntary schemes do not depend on the political majority but on a few or even only one committed organisation. They can be more ambitious and rigid in terms of achieving energy efficiency and CO_2-reduction targets because they do not rely on the need for political agreement.

This fact sheet compares the requirements on buildings, as well as procedures for checking and enforcing, and their implicit consequences for innovation within the building standards of Germany, the federal province of Salzburg (Austria) and Sweden (legal frameworks) as well as the MINERGIE-A ECO and the Passivehouse standard (voluntary frameworks).

[1] *https://ec.europa.eu/energy/en/topics/energy-strategy/2050-energy-strategy*
[2] *https://ec.europa.eu/energy/en/topics/energy-efficiency/buildings*

In this factsheet, innovation is defined as the process of translating an idea or invention into a good or service that creates value or for which customers will pay. In this context, it includes point innovations (single technologies) like building materials and building service technologies, or more systemic innovations such as architectural concepts and building energy concepts.

Objectives and problems addressed

The overarching goal of all energy efficiency standards is to set maximum values for energy use (final or primary) and / or carbon emissions, and to improve indoor comfort as co-benefit. They thereby aim to legally limit the environmental impact of buildings, as energy use in the usage phase is a key contributor to buildings' environmental impact over their lifespan. Compliance and enforcement frameworks serve to actually implement energy efficiency policies. They consist of:

- ✓ Requirements to be met
- ✓ Procedures to prove and check compliance with requirements
- ✓ Sanctions in case of non-compliance in order to enforce compliance

The way the framework is set up can support or block innovation, depending on the type of energy efficiency targets and / or the calculation approach.

Mid-point frameworks, end-point frameworks and combinations

With a view to the potential of supporting or hindering innovation, two types of compliance frameworks can be differentiated:

- ✓ *Mid-point framework:* a framework focusing on a check list of indicators that are of relevance for the end result in terms of energy performance (examples: minimum insulation values, minimum efficiency ratios, minimum renewable shares). The thinking behind such frameworks is that if all the mid-point requirements are fulfilled the end result will be close to the best possible option.
- ✓ *End-point framework:* a framework focusing exclusively on the energy performance result, for example a primary energy target or a carbon emission target. The thinking behind this is allowing maximum freedom in the way to achieve a target.
- ✓ Combinations of both will comprise an end-point energy performance target with some minimum mid-point indicators.

Usually, **mid-point requirements** such as insulation of the building envelope are easier to check than a complex simulation needed to prove compliance with energy performance requirements, but limit the choices of technologies. **End-point oriented approaches** offer more freedom in terms of choosing technical solutions for achieving the requirements. However, depending on the calculation method, the freedom of choice may be limited to the energy efficient technologies considered in the method. There can also be ways of using simplifications in the calculation which possibly influence the calculation result, and they are harder to control.

The EU calculation framework for energy efficiency

The need to calculate the energy performance of buildings in a way that it can be checked is addressed by norms and standards on a national and European level. Figure 1 shows EU-standards which serve to facilitate the development of energy performance calculation methods.

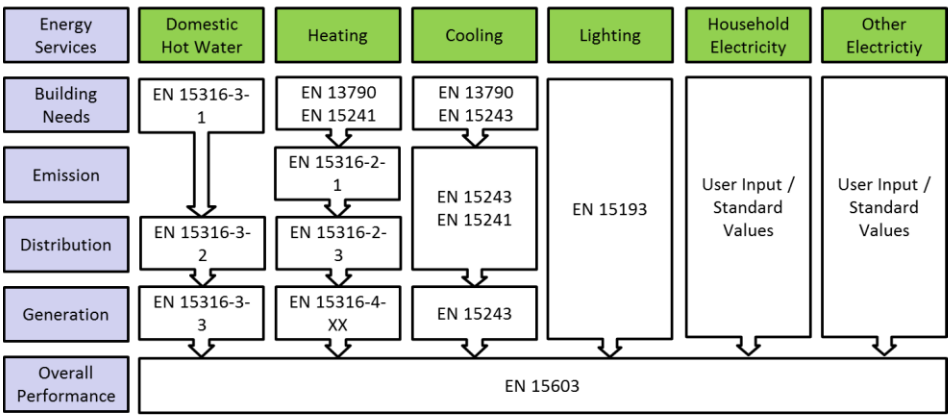

Figure 1: EU norms and standards for energy calculation in buildings

Energy performance calculation is a mandatory component of building applications in most EU countries though this is enforced to a different extent from country to country.

In line with EU legislation[3] all member countries have also established schemes to provide all buildings with energy performance certificates (EPCs), displaying the result of the energy performance calculation, that have to be provided for all rental buildings and in case of any transaction or change in occupancy.

It is evident that there is the need for a robust calculation method resulting in an EPC which can be trusted and allows comparing the energy performance of buildings.

Calculations are always a simplification of reality. As such, simplification can result in disadvantaging certain technologies and solutions while others are promoted.

- ✓ **Default values versus specific and actual values:** For calculations, input data and calculation procedures are required. For innovative technologies, real specific values are normally not available, resulting in taking reference values not describing their performance correctly.
- ✓ **Fixed demand values (normalized) versus specific and actual values:** For many aspects, calculations can use fixed demand values which cannot be changed due to the method. Examples are air exchange and domestic hot water. Actual building use can differ significantly from the fixed values. Fixed values are normally overestimated, making technologies that are related to them being ill described in their real performance.

Analysis of a selection of voluntary and legal frameworks concerning their impact on innovation

The tables below list the characteristics of two voluntary and three mandatory compliance frameworks for energy efficient buildings in regards to the framework being a driver or barrier for certain innovations in the building sector. The presentation is highly condensed and not exhaustive.

Compliance framework: MINERGIE-A, ECO (Plus-energy with ECO)[4] (Switzerland, France)

Performance requirements	Mid-point requirements	Checking compliance	Sanctions for non-compliance
✓ MINERGIE®-Indicator ≤ 0 kWh/m^2a (zero-balance)	✓ Embodied energy must be included (ECO)	✓ Air-tightness test mandatory ✓ Feasibility check on the calculation ✓ Potential site visit after completion	✓ Label not awarded / label revoked

Table 1: Minergie-A ECO

Drivers and barriers for innovation: The performance requirement is a driver for developments in the area of photovoltaic and heat pumps. Taking into account the embodied energy (energy needed to produce building products) is an incentive for the development and scaling of low carbon materials. Overall, the scheme promotes the development of systemic solutions.

Compliance framework: Passivehouse (Austria, Germany)

Performance requirements	Mid-point requirements	Checking compliance	Sanctions for non-compliance
✓ Maximum net energy demand for heating (15 kWh/m^2a) ✓ Maximum primary energy use (120 kWh/m^2a) (calculated demands)	✓ Air-tightness	✓ Air tightness test mandatory ✓ Feasibility check on the calculation	✓ Label not awarded

Table 2: Passivehouse

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[3] https://ec.europa.eu/energy/en/topics/energy-efficiency/buildings/certificates-and-inspections

[4] http://www.minergie.ch/minergie-a.html and http://www.minergie.ch/de/zertifizieren/eco/

Drivers and barriers for innovation: The label emphasises highest energy efficiency of the building envelope and strongly promotes Passivehouse labelled components. It can be seen as a barrier to innovation that the label does not promote the optimal compromise of building services systems and building fabric as achieving a very low heating demand is a condition to receive the label.

Compliance framework: German regulation

Performance requirements	Mid-point requirements	Checking compliance	Sanctions for non-compliance
✓ Primary energy use (kWh/m²a) ✓ Minimum share of renewable energy (20%) or over-performing in the other criteria by 20%	✓ Minimum H´T value (minimum average thermal quality for envelope) ✓ Air-tightness (if actual value is chosen in the calculation)	✓ Air-tightness test (if actual value is chosen in the calculation; positive impact on calculation result) ✓ Feasibility check on the calculation	✓ No building permission ✓ Completion: obligation to improve ✓ Fine

Table 3: German regulation

Drivers and barriers for innovation: Development of primary energy factors is based on Life Cycle Assessment (LCA) and scientific studies, but in actually defining them there is some margin in discretion. Thus, they can be used to promote certain products, among others wood as energy carriers or heat pumps. It is a barrier to innovation that reference values for energy performance calculation have to be used for those innovative products for which more specific compliant input data are not yet available.

Compliance framework: Swedish regulation

Performance requirements	Mid-point requirements	Checking compliance	Sanctions for non-compliance
✓ Maximum energy use allowed in kWh/m²/a (depending on climate conditions; measured values)	✓ Average thermal transmittance (average U-value, W/m²K) ✓ Functional requirement for building airtightness ✓ Installed electrical power for heating (kW)	✓ Feasibility check on the calculation in the design stage ✓	✓ No building permission

Table 4: Swedish regulation

Drivers and barriers for innovation: The boundary for the energy use is the building which means e.g. solar panels can be included. This promotes innovation because the approach is open to all technical solutions. The use of normalized values (e.g. normal use for domestic hot water) in the energy performance calculation can be a barrier for innovation. As an example, it can hinder innovative appliances to decrease domestic hot water usage, as a consequence of lack of motivation to go for such a solution.

Compliance framework: Regulation of Austrian Province Salzburg

Performance requirements	Mid-point requirements	Checking compliance	Sanctions for non-compliance
✓ TEEi (total energy efficiency indicator) (indicator based on primary energy demand and CO_2-emissions)	✓ Energy performance of building envelope ✓ Temperature of heat distribution systems ✓ Requirements for the ventilation system	✓ Checking of requirements based on submitted Energy Performance Certificates (EPC) (planning and completion EPC)	✓ No building permission in design stage ✓ Completion: obligation to improve ✓ Administrative fine

Table 5: Salzburg regulation

Drivers and barriers for innovation: TEEi limits primary energy use and CO_2-emissions. It considers the total (renewable and non-renewable) annual primary energy demand and the annual CO_2-emissions for conditioning the building. Conditioning includes space heating and cooling, ventilation, and domestic hot water. TEEi combines the primary energy demand with the quality of the energy carriers used and thus stimulates the reduction of energy demand in terms of kWh and the increased use of renewable energy sources at the same time. It is easy to communicate this indicator to building owners and it allows for a broad range of measures to meet the requirement, thus being a driver for innovation. Mid-point requirements ensure that crucial elements in terms of quality of design and quality of the works are properly taken care of.

Analysis of calculation schemes concerning their impact on innovation

Concerning calculation schemes, three aspects having an impact on innovation can be generalized. The following approaches are drivers for innovation but also barriers at the same time:

a) Giving a technology a calculation advantage that “overestimates” its effect in the calculation. Examples are primary energy factors (for example wood that was rated with a factor of 0.2 in Germany for some time) or fixed values that overestimate demand in a certain area (12.5 kWh/m^2a domestic hot water in the German legislation).
b) Having minimum requirements for mid-point indicators (insulation, renewable shares, etc.)
c) Using default values as input data.

These approaches are evaluated regarding pros and cons in the paragraphs below.

a) Overestimating effects

Pros	Cons
✓ Can promote a niche technology and trigger innovation and price reductions by market uptake	✓ Can result in concepts that cannot be massively scaled when taking away the calculation advantage
✓ Does not require subsidies for promoting market uptake of new technologies	✓ Can result in an environmentally sub-optimal concept

Table 7: Overall pros and cons of calculation advantages: overestimating effects

b) Minimum requirements for mid-point indicators

Pros	Cons
✓ Does not require subsidies for promoting market uptake of new technologies	Can make optimal and tailored solutions impossible / uneconomical
✓ Easy to control and limits the potential of abuse of the framework	

Table 8: Overall pros and cons of calculation advantages: minimum requirements for mid-point indicators

c) Default values as input data

Pros	Cons
✓ Easy to control ✓ Allows to take a measure into account also when more detailed values are not available (due to lacking standards, test methods,…)	✓ No correct description of innovative solutions

Table 9: Overall pros and cons of calculation advantages: default values as input data

Overall evaluation

Frameworks allowing for easy compliance checks can pose a barrier to innovation if they disadvantage innovative products by not describing their performance in a realistic way but by underestimating them in the energy performance calculation, or by prescribing fixed default values instead of providing the option to determine specific and actual input data. However, the way of defining energy-related requirements and the calculation method including the definition of input data can also intentionally be used to promote certain technology developments.

It is most important to bear this in mind when defining requirements and calculation methods including the determination of input data and boundaries, in order to avoid unintended effects.

References

http://www.minergie.ch/minergie-a.html

http://www.minergie.ch/de/zertifizieren/eco/

https://ec.europa.eu/energy/en/topics/energy-efficiency/buildings/certificates-and-inspections

https://ec.europa.eu/energy/en/topics/energy-strategy/2050-energy-strategy

https://ec.europa.eu/energy/en/topics/energy-efficiency/buildings

Swedish building code, Energy use:
http://www.boverket.se/globalassets/vagledningar/kunskapsbanken/bbr/bbr-22/bbr-avsnitt-9

(In Swedish)

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