[European projects]

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Energy performance certification for new and existing buildings

Differences in approach, the role of choice in CEN standards application.

This paper gives information about the difference between preparing an energy performance certificate for new and for existing buildings, the impact of this on the development of a national or regional procedure for energy performance certificates and how this may affect the procedures laid down in the CEN standards to support the EPBD and their implementation at national/regional level.

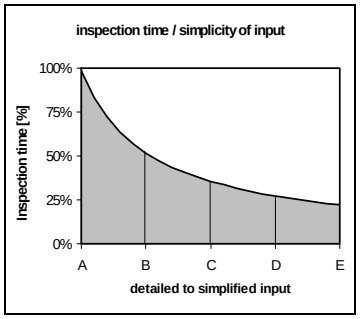
1 > Introduction

There is a difference between preparing an energy performance certificate for a new building or for an existing building. For new buildings it is normally easy to obtain the building and system characteristics. For existing buildings, especially older ones, this is potentially labour-intensive. In this case an energy-expert may to be engaged to discover the building and system characteristics and, even then, for some characteristics a non-destructive and acceptably labour-intensive inspection will yield only approximate information.

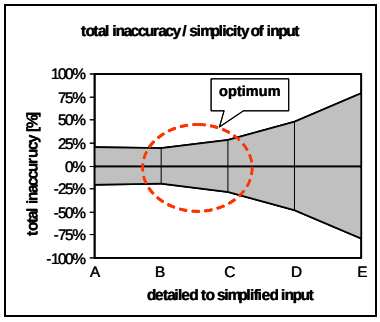
Following the EU's Energy Performance of Buildings Directive (EPBD), energy performance certificates shall be available when buildings are constructed, sold or rented and shall be displayed in public buildings. European standards have been developed to help the Member States to draw up procedures for the preparation of these energy performance certificates. The standard defining the certificate is EN 15217; more information on this can be found in IP 155. It refers to an either measured or calculated performance indicator according to EN 15603 which is described in IP 088, and which again refers to other calculation standards.

These standards generally contain different approaches to calculate the energy performance of the different elements of a building and its technical systems, either detailed methods or simplified procedure. The choice may have an impact on the amount of input data that has to be collected and on the accuracy and reproducibility of the result. In this paper we show that it is important to understand the sometimes conflicting demands which influence these choices; and that they are typically different between new and existing buildings.

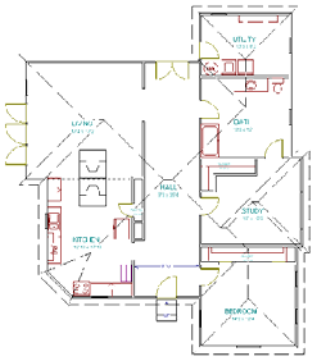
Intelligent Energy Europe



The inspection time can be drasticly reduced by simplified input, at the cost of accuracy and distinctivity
Source: Builddesk study for Dutch government (NL)



But more detailed input leads also to increase of likelihood to make errors (guesses, mistakes) ➔ Optimum somewhere in between
Source: Builddesk study for Dutch government (NL)



New building: detailed characteristics from a drawing

New building: With certified product data

To courage energy conservation measures when required the rating should clearly distinguish between new and existing buildings, for several reasons (e.g. the cost effectiveness of measures for new buildings differs from that of measures for existing buildings; for both new and existing buildings a perspective that encourages appropriate energy conservation measures should be taken). For the purpose of informing the consumer about expected energy consumption however it may be desirable that the energy performance rating for new building is not suddenly different when the same building later becomes an existing building.

2 > The EPBD requirements

Article 7 of the EPBD sets the requirements for the energy performance certificate.

> *Member States shall ensure that, when buildings are constructed, sold or rented out, an energy performance certificate is made available to the owner or by the owner to the prospective buyer or tenant, as the case might be. The validity of the certificate shall not exceed 10 years.*

3 > Quality aspects

There are several quality aspects associated with drawing up the procedures for an energy performance certificate at the national or regional level (see [1] and [2]):

- Robustness
- Transparency
- Reproducibility
- Sufficient accuracy
- Cost-effectiveness

Robustness means that the method can handle a wide variety of situations, with some loss of accuracy, but without going out of control.

Transparent means that the market parties, the users and the authorities should be able to understand the overall result and the results at the components level, to understand and accept the effect of choices (input) on the calculation result.

Reproducibility means that for a specific case the method leads to the same result; independent of subjective or arbitrary choices and independent of the user.

Sufficient accuracy means that the method must be sufficiently 'distinctive'.

Cost-effectiveness means that obtaining the building data needed for an energy performance certificate must not take too much time compared to their impact on the energy performance.

4 > Building characteristics for energy perfomance certification

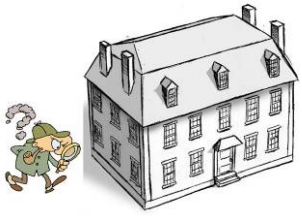
To prepare an energy performance certificate one has to obtain a number of building and system characteristics. For a new or an existing building one needs, for example, information about:

- The building envelope.
  Thermal, solar and daylight properties and the area and air leakage properties of the building envelope.
- Heating and cooling system
  The type and properties of the heating and cooling sources and the type and properties of the distribution system.
- Ventilation

Type and properties of ventilation system, heat recovery.

› Hot water system
The type and properties of the hot water heater for the building.

› Lighting
Type and properties of the lighting system and the control systems.



Gathering characteristics of the building envelope

In particular, in case of inspection of 'old' existing buildings, where obtaining all of required input would be so labour-intensive for the purpose, related to cost-effectiveness, national default values (or default simplified procedures) have been and in some cases may need to be defined. For instance: for the *U*-values and thermal bridges of old walls and roofs, the efficiency of (old and old types of) boilers. On the other hand, the input should be sufficiently distinctive for the effect of improvements in the energy performance to become clear (see previous chapter on quality aspects).

For a new building it is normally quite simple to obtain the building characteristics from the design specifications, or from inspection at the building site.

Gathering characteristics of the heating system

5 > How to obtain information about the building characteristics

The following table shows the differences between how building characteristics are obtained for new and old existing buildings.

Building characteristics	**How to obtain them**	
	New buildings	**Old existing building**
Thermal/solar/daylight properties of the building envelope	Building specifications and drawings of the building	Non-destructive Inspection in the building
Heating and cooling system	Description of the heating and cooling system specifications	Non-destructive Inspection in the building
Ventilation	Description of the ventilation system specifications	Non-destructive Inspection in the building
Hot water system	Description of the hot water system specifications	Non-destructive Inspection in the building
Lighting	Description and specifications of the lighting system and lighting plan	Non-destructive Inspection in the building

6 > Reproducibility for the energy perfomance certification

Most CEN-EPBD standards contain different approaches, such as calculating the properties of a building component in detail, or a less detailed approach such as providing default values.

If the more detailed approach is used, more detailed information about the building component may be needed.

For example EN ISO 10211 gives the detailed method for calculating the influence of thermal bridges on the resulting heat transfer. EN-ISO 14683 gives the simplified method and default values for thermal bridges.

In the case of a new building, one can see in the drawing how and where the thermal bridges are located, so the standard EN ISO 10211 can be applied. However, in the case of an old existing building where no drawings are available, it is not possible either to locate or obtain the details of the thermal bridges. In this case one must use the default values according to the standard EN ISO 14683, but these may be too conservative, depending on the national/regional building style and thermal insulation levels.

Another example is the area of a sloping roof, which is needed when assessing thermal transmission properties: in an 'old' existing building, part of the roof may be hidden behind panels, allowing only a rough estimate of the area. It is also difficult to determine the thermal resistance of an old existing wall or roof without destroying the vapour barrier in the process.

A third example is how to calculate the energy impact of ventilation heat recovery units. One can either calculate the energy efficiency of the heat exchanger in detail or use results from an accepted test method, or one can use the default value (Class H3) for energy efficiency according EN 13053.

Comparison of two identical buildings, but with different information: a dilemma

Imagine two identical buildings and two different inspectors. For one of these building there is no drawing or other detailed information available. For the building without detailed information only the less detailed method of the standards can be used, while for the other building the detailed information could be used.

It must be clear that the different approaches generally lead to a different energy performance of the building and possibly to a different rating.

Note that due to the difference in available information we do not know for sure whether the two buildings are the same. In the following the possibility that they are in fact different is one of the considerations.

For a new building, it is normal that less information leads to a more conservative energy performance rating. However, for existing buildings this is not self-evident. The (policy related) question is: is it fair to punish the building by giving it a worse energy rating simply because less information is available than in a similar building?

Option 1 For existing buildings. Available information is accepted as input

	
No extra information for the thermal properties available	*Extra information for the thermal properties available and rewarded*
EP = 450 MJ/m²	*EP = 400 MJ/m²*

Option 2 For existing buildings. Only selected information is accepted and conservative values are assigned to these

	
No extra information for the thermal properties available: punished by conservative input	*Extra information for the thermal properties available; but not rewarded*
EP = 450 MJ/m²	*EP = 450 MJ/m²*

Option 3 For existing buildings. Only selected information is accepted and moderate values are assigned to these

	
No extra information for the thermal properties available; but not punished	*Extra information for the thermal properties available; but not rewarded*
EP = 400 MJ/m²	*EP = 400 MJ/m²*

Other example of option 2 Difference between new and existing building: for the new building the available detailed information is accepted, while for the existing building only selected information is accepted and conservative values are assigned to these

	
New bldng:extra information for the thermal proper-ties available and rewarded	*Same bldng, but existing: Extra infor-mation for the thermal proper-ties available; but not rewarded*
EP = 400 MJ/m²	*EP = 450 MJ/m²*

There are three options:

1. Accept that the rating result depends on the information available.
   Disadvantages:
   - it is in general more labour-intensive to gather more detailed information, which will add to the cost of the label; if having more detailed information is rewarded, there is an incentive to obtain access to these data even if they are hard to obtain;
   - the reproducibility decreases, because the result will depend on the knowledge of the energy-expert;
   - it is labour intensive and thus it adds to the cost of inspection to discuss and defend the validity of the source of information;
   - if the two buildings are the same (although we will never know…), the label will express the difference in input data and not the difference between the two buildings.

2. Ignore any information which would typically not be available in an existing building (e.g. depending on some general characteristics of the building) and use conservative values, to obtain the same results for the two buildings.
   Disadvantages:
   - the owner of the building with extra information is not rewarded for making the extra information available;
   - if for the majority of buildings types of comparable type and age, no extra information is available, they would all obtain a conservative rating. With moderate default values (option 3) these ratings would be more representative;
   - the purpose of the energy performance certificate is to show the result of a renovation the best available technologies will not be rewarded and thus may not be applied (in particular if the improvement in rating would qualify for subsidies);
   - If the certificate is the basis for planning a renovation, the conservative values may lead to too exaggerated expectations of the improvement in energy performance rating.

3. Again, ignore any information which would typically not be available in an existing building (e.g. depending on some general characteristics of the building), but use moderate (not too conservative) default values (e.g. depending on the building's age), to obtain the same results for the two buildings.
   Disadvantages:
   - If the moderate value is too optimistic for the building without information, it may lead to an underestimation of the potential to improve the energy performance rating (note that sometimes subsidies depend on the predicted improvement in energy performance rating).
   - The same disadvantages, but less marked, are valid for the building with more available information;
   - If the moderate value is too optimistic for the building with detailed information, this leads to a moral conflict: should the information be used or ignored?

Comparison of two identical buildings, one new, the other existing: a dilemma

The afore mentioned choice also has an effect on the (dis-)continuity of the energy performance rating of new and existing buildings.

In the case of Option 1 there is a maximum of continuity between the rating issued for the building as a new building and the rating issued later for the same building, which is now an existing building. Obviously, differences may still occur, e.g. if the former is based on input values from the design stage, while the latter is based on the as-built data.

In the case of Option 2 or Option 3 a discontinuity will occur.

A possible solution would be the adoption of Option 1 for levels of techniques that are more likely to be used in new buildings and major renovations, while Option 3 (use of moderate default values) is used for levels of techniques that can more often be found in old existing buildings.

To add another dimension to the discussion: in the case of a tailored rating, intended for energy conservation recommendations that are tailored to the actual use of the building (which is different from the certificate which is used in building transactions) as much of the available information as possible should be used, including empirical data on the operating conditions. For the (standard) energy performance rating standard values should be assigned to the operating conditions to avoid a rating that is dependent on the occupants and the weather conditions instead of rating the building and it's systems.

7 > Conclusions

For the national standard organisations or building regulations writers it is good to be aware of the effect of the choices they make in using the CEN-EPBD standards for the energy performance certification for new and existing buildings.

Different (policy related) options are possible for the choice between detailed or simple methods for specific components, each with advantages and disadvantages with in terms of their reproducibility, cost-effectiveness, consistency and accuracy. The optimum choice may be a delicate process and should depend on national/regional building styles and energy saving techniques and on the specific purpose for which the rating is required.

8 > References

1. P025, *Energy performance calculation procedures for the EPBD (1). Introduction*, EPBD Buildings Platform Information Paper, Dick van Dijk (TNO, NL), February 6, 2007
2. P026, *Energy performance calculation procedures for the EPBD (2). Quality for purpose*, EPBD Buildings Platform Information Paper, Dick van Dijk (TNO, NL), February 6, 2007

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