

Energy consumption vs. Energy performance?

Jorma Railio
FAMBSI, Finland

Corresponding email: jorma.railio@teknologiateollisuus.fi

SUMMARY

The discussions around the implementation of the Energy Performance of Buildings Directive (EPBD) [1] – not only in national legislation but also in real practice – have revealed open questions and caused different interpretations. This paper deals with one question, and is based mainly on discussions and experiences in Finland.

Studies to prepare background material for energy calculation guidelines have been done, and several proposals for national legislation on energy performance certificates have been prepared. Proposals have been on review, with different levels of ambition, and with split views expressed in replies. The approach described here is completely independent of this legal process. It could, however, contribute as a complementary tool beyond the regulatory level.

The core of our approach is: make a clear difference between "energy performance" and "energy consumption". If this difference is vague, then a common misunderstanding of "lower energy consumption automatically means better energy performance" will stay and make an obstacle in all efforts for improved indoor environment and for more effective use of the building. The latter is valid for some building types, especially in public buildings like schools and sports facilities. Complementary tools are still to be developed to describe all elements of energy performance in parallel – suggestions for these will be discussed in the paper.

INTRODUCTION

The aim of this paper is to contribute in the "EPBD discussion" from the "Well Being Indoors" point of view: how to achieve good indoor environment with low energy consumption? This point of view is necessary, because otherwise "energy performance" is understood as "minimum energy consumption", ignoring the demand for good indoor environment. In the near future, more and more efforts in Europe and probably also globally will be put on reducing emissions and energy use, and this may become a real threat to our buildings and their indoor environment.

However, there are means already available to put together the "contradictory" demands for good indoor environment and low energy consumption. In other words, we should really aim at ENERGY PERFORMANCE, which takes into account the indoor environment and the actual usage profile of the building.

In 2003 the European Commission issued a new directive on Energy Performance of Buildings, the **EPBD**, 2002/91/EC [1]. This directive required that all member countries by January 2006 should have implemented the directive in national building legislation. By today, delays have been occurred in a number of member countries because of several reasons.

If we go back a little bit, concern has been expressed in several countries about the costs of the obligatory measures (certificates and inspections) and about lack of competent persons to perform these measures. The progress in Finland has brought up also a tendency towards simplified certificates especially for existing buildings, based on the measured consumption only. This actually does not give an "energy performance certificate". For new buildings, the certificate will be based on calculations and is much up to the reliability of the calculation method and the assumptions made in the input data.

There are two major disadvantages in the "energy consumption certificate":

-It does not properly take into account the indoor environment. Closing off the ventilation system is rewarded; aims for high-level indoor environment are punished

-it does not properly take into account the real usage profile of the building. Really efficient use of the building (e.g. using a school building for various activities during evenings and weekends) is punished, keeping the building unoccupied for exceptionally long periods are easily rewarded

Energy performance is a very complicated issue, and therefore it would take probably many years before the methods and practices are established in Member States, and even more time before they become harmonised throughout Europe. On the other hand, there is a need to start the implementation process step by step, to keep the first steps rather simple in order that the process towards a more comprehensive implementation (also in practice) goes towards the right direction from the very beginning. In this way, the "simple" obligatory measures can also provide a good basis – and also encouragement - for complementary voluntary measures.

One of the practically open questions is: how to estimate the cooling load and energy? This may sound a minor issue regarding the overall energy performance. If the cooling loads and summertime temperatures are calculated by a simple monthly basis, this may result in serious underestimation of the loads. As a consequence, the client makes a decision to skip air-conditioning, or to have big windows, and when the building is completed and during the first warm summer days the indoor temperature goes up far over 30 °C. Then it is too late to keep the temperatures in control by any reasonable combination of architectural means and air-conditioning. This has happened in reality, and this problem is increasing also in (well-insulated) residential buildings! And either the occupants will suffer and lose their productivity further, or the new building will be subject to early and expensive renovation.

To overcome contradictions in efforts for good energy performance and for good indoor environment (IEQ), a methodology is being developed on voluntary basis for guidance on technologies and design for simultaneous optimisation of energy performance and IEQ. If, like is in the case of many household appliances, everyone wants the highest energy performance, this is of course a good objective but what will happen if other key elements of a good building – architecture, and especially **indoor environment** - have to be sacrificed in

the name of energy performance. **Figure 1** gives one possible approach [2] to have these aspects in parallel in design, and this methodology can be extended further to include also the regular inspections – using the same system and product data as the basic reference.

The EPBD gives a clear justification to consider IEQ in parallel with energy performance. However, no further guidance is given how to do this in real practice.

THE METHODOLOGY

Main principles and contents

The main principles of the methodology are:

- the energy performance shall be calculated using the data that is available for the building and its building services systems and equipment.
- if, at the early design stage, there is not sufficient data available, default values shall be used for calculations.
- the calculations are revised as soon as exact data is available

Because this methodology was originally developed for other applications, the first stage to develop the procedures was to adjust the principles to fit in the EPBD implementation purposes. Testing of the methodology will take place in real practice.

The key issue is that the TARGET LEVELS for the indoor environment, as well as for energy performance, is defined in the very beginning of the design process. These target levels have to be defined in measurable quantities (indoor temperature summer – winter, energy consumption per surface area, etc.). Because in early design stages (building permit stage) the construction details and HVAC systems are not usually decided, the calculations have to be made first using default values and later on checked with real system and product data. This data should be also used as the basic data for energy performance certificate and for inspection of heating and air conditioning system. One main objective for further development of the methodology is to link together these three main elements of the EPBD.

Figure 1 presents the main flowchart of the methodology. The details will of course be different in different countries depending on how the design process proceeds, and also on the type of building. For example in residential buildings the design flow can be simplified a lot, and data from other similar building projects can be more used as a basis. In complex buildings, the process may become more complicated and contain more backcouplings.

The target level for energy performance could be specified as one figure like "xyz kWh/m²a" or as an energy performance class e.g. according to prEN 15217 [3].

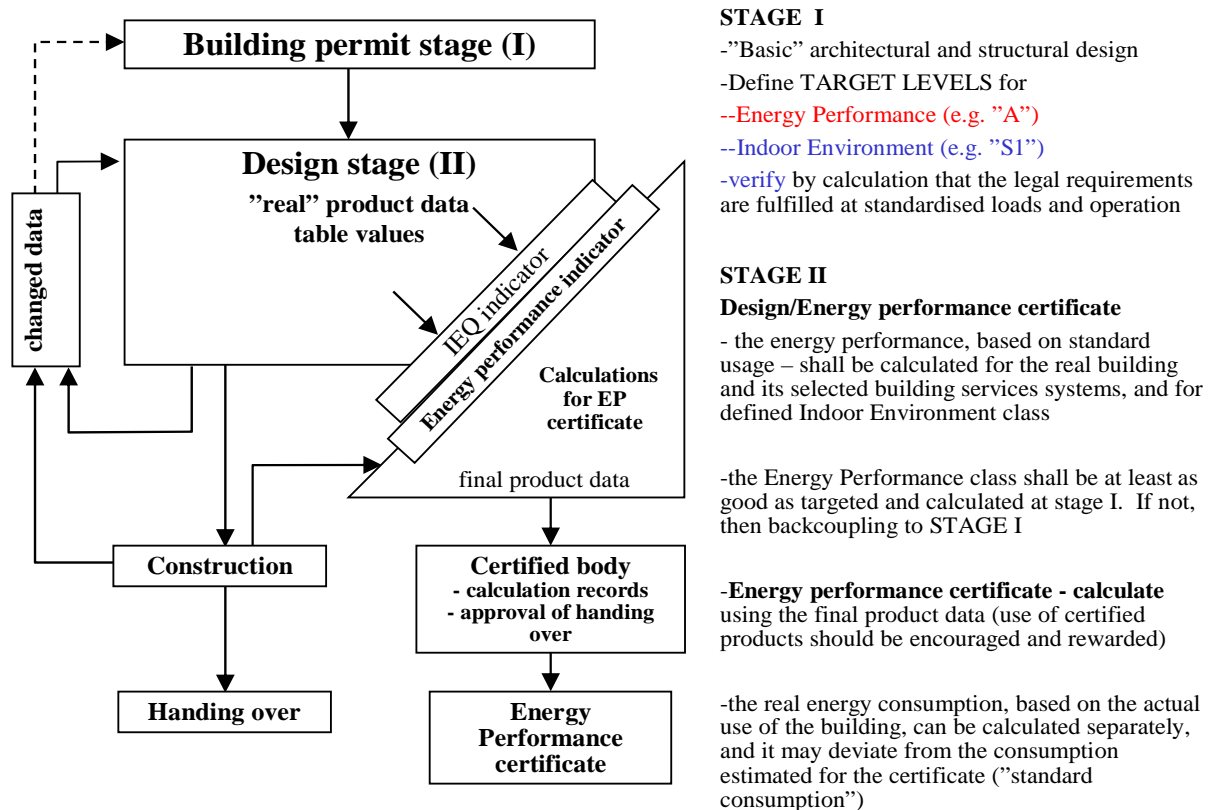


Figure 1. Principles of design methodology for good energy performance and good indoor environment.

The same system and product data can provide the basis of inspections (obligatory based on Articles 8 and 9 of the EPBD, or voluntary), too. It shall be also pointed out that Figure 1 really concentrates on the elements of design process, just giving a general connection to energy performance certificate. It should be completed with blocks for inspections.

The methodology applies also for existing buildings, but in a different way. In existing building, subject to major renovation, sale or rent, an energy performance certificate is needed. In most existing buildings the data needed for the certificate is far from sufficient. Maybe even the original documentation is incomplete, or changes in the building envelope or building services systems are not completely available. For existing buildings it is very important to encourage the owner/ end user to improve the energy performance. For example it could be stated that in order to be certified to one of the highest categories, certain elements for the indoor environment have to be validated in one way or another (e.g. measured total ventilation air flow rate, recent balancing of ventilation, plus proper documentation). If the owner/ end user has already taken care of these issues by himself, then no more validation is needed. Of course, simple measures are often not sufficient (especially in complex buildings), but in many cases these are the necessary start – and a good wake-up and helping the user to pay attention to both IEQ and energy issues in a proper and balanced way.

Key elements

The stages of the methodology consist of the following calculations. This list does not describe the construction and handing over (commissioning) stages, or how to use the final data as basic information for energy performance certificate or inspections. This list is applicable mainly for newbuildings. In buildings subject to renovation a careful study of the systems and their documentation is necessary in the very beginning. In other existing buildings a case-by-case approach is needed and the list is only partly applicable.

Stage I (building permit stage)

- basic data for calculations
- targets for energy performance and indoor environment
- weather data
- indoor environment parameters
- building envelope
- hours of operation and occupancy
- lighting and other internal loads
- ventilation and infiltration

- energy demand calculations to verify that the legal requirements are fulfilled
- heating energy demand
- indoor temperature summertime -> need for cooling
- cooling energy demand
- system energy
- building net energy

Stage II (design stage – detailed calculation)

- detailed system calculations using real system and product data as soon as available
- ventilation system
- domestic hot water
- heating system
- lighting system
- cooling system

- delivered energy: heat, electricity etc.

As an example (still just a proposal), we may apply a "star classification" – the example in Table 1 is prepared for multi-storey buildings, both new and existing ones.

OPEN QUESTIONS

The energy performance certificate has been discussed much more than the methods and inspections. But whatever the principles, final schedules and limitations are on national level in different Member States, it is of extreme importance that the certificate in new buildings is linked to the design process in one way or another, and that it based on what the building and systems really are – not only a "calculation just to satisfy the authorities". Figure 1 gives one approach to link the calculations and certificate together. In existing buildings, perhaps the most important issue is to find out the real performance of the building, in order not to sacrifice the indoor environment.

One big question is that lots of independent experts have to be trained in a relatively short time. Another question is: if, like is in the case of many household appliances, everyone wants the highest energy performance, this is of course a good objective but what will happen if other key elements of a good building – architecture, and especially indoor environment - have to be sacrificed in the name of energy performance. Figure 1 gives one possible approach to have these aspects in parallel in design, and this methodology can be extended further to include also the regular inspections – using the same system and product data as the basic reference.

DISCUSSION

In the implementation of the EPBD we should make a clear difference between **implementation in legislation** (the official implementation) and **adopting of the principles in real practice**. The latter is based on the official implementation, which should be completed by year 2009, and will probably take much more time, and require a high number of voluntary efforts in addition to the legal measures to ensure the fulfilment of the minimum requirements of the Directive.

The methodology presented in this paper is still under development, but based on elements already included in the good design and building practice. More detailed guidance and testing the methodology in real practice is needed, as well as tools to encourage the designers and clients to fix the data needed as early as possible. Testing the methodology in different types of buildings is also important to make the tools really practicable for different purposes, to fit also for use in existing buildings, and to avoid unnecessary complexity and unnecessary repetition of routine calculations in the design and construction process.

Tools for manufacturers – partly extending or revision some existing standards and product certification schemes are also needed so that certification of products will become really rewarding. The classification already applied in mandatory labelling schemes can be useful also in voluntary schemes.

It is too early to give estimates of the schedule of the "**adopting of the principles in real practice**". If we take the experiences from energy-labelling of household products, the future looks very promising: everybody wants to buy "Class A". For washing machines, people want the highest class also for other important characteristics: the washing and drying performance. So, why not to aim at the best energy performance and indoor environment simultaneously?

However, the complexity of decision-making in construction may slow down the development. Where indoor environment is clearly recognised as a key element for productivity, it is surely considered properly (or at least should be). In housing, the main target is still too often "to fulfil the minimum legal requirements with minimum investment".

The EPBD gives many opportunities. The main challenge is, however, to increase the common knowledge among our profession and among our customers, about the benefits of good energy performance and good indoor environment. The presented methodology provides one platform in this mission.

REFERENCES

1. Directive 2002/91/EC of the European Parliament and of the council of 16 December 2002 on the energy performance of buildings. European Commission
2. Railio, J., Energy Performance of Buildings Directive (EPBD). Influences on European standardization and on ventilation and air-conditioning industry. Update and follow-up 3. EUROVENT/CECOMAF Review, December 2006
3. prEN 15217 Energy performance of buildings - Methods for expressing energy performance and for energy certification of buildings (Final draft, subject to Formal Vote February-April 2007)