

Need for uniform energy efficiency evaluation methods for heating and cooling systems



Johann Zirngibl
Senior Scientist
Centre Scientifique et Technique du Bâtiment / France
Convenor CEN TC 228/WG4
Convenor ISO TC 205/WG9
Johann.zirngibl@cstb.fr

Heating and cooling systems play a significant role in the increase the energy efficiency in buildings by using innovative technologies and renewable energy systems. The European Commission underlines the contribution of the heating and cooling systems in the recast EPBD and prepares a new mandate to update the CEN standards linked to EPBD.

To design energy efficient buildings and systems, professionals need sophisticated tools. Tools able to show the positive impact on the energy efficiency of heating and cooling systems and based on verified performance data. No “details” can be neglected in low energy or nearly net zero energy houses or buildings.

This article underlines the need for uniform evaluation methods as a necessary basis for the development of such tools. The complementarity of standardization and regulation is described. The integration of the heating and cooling systems in the evaluation of overall energy use of buildings is presented.

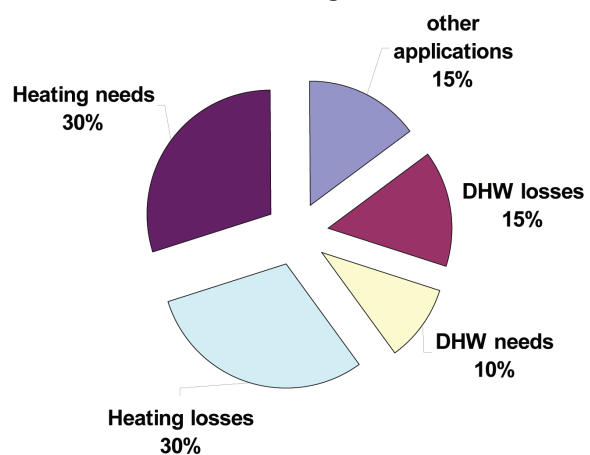
European standards to evaluate and demonstrate correctly the energy efficiency of heating and cooling systems

The European Directive “Energy Performance of Buildings” (EPBD) requires the EU Member States to have building regulation to control the energy efficiency of existing and new buildings. This affects the market of technical building systems by the requirements set (minimum requirements, inspection, certification) and by the energy

efficiency evaluation method based on a holistic approach. In the EPBD the product is not longer evaluated as a product but as a part of a system. The specific operation conditions of the installation are taken into account (system approach).

The EPBD leaves the concrete transposition of this directive to the Member States. This situation creates a non-levelled playing field for the EU market for heating and cooling systems. The level of the national implementation is quite variable. Innovative techniques, as micro cogeneration, and basic aspects as hydraulic balancing, are sometimes not taken into account in national methods. The contribution of the innovative techniques to the overall energy use of the building cannot always be demonstrated in the same way.

The overall energy consumption of a single family house in the French building stock is about



Breakdown of energy applications in buildings (final energy 200 kWh/m²a)

200 kWh per m² and year (delivered energy). The losses of the technical building systems are representing about the half of the consumption. This example shows that reducing the energy losses due to poorly design and operation of technical building systems contribute will have an very important effect on the improvement of the overall energy efficiency of buildings. For existing building this means modernization of installation with innovative technology.

This positive contribution must be made “visible” for the regulator responsible for the national building regulation and also for the consumer by a uniform, transparent evaluation of building technical systems based on standardised product and system characteristic.

European standards as an international reference to support export

The European heating and cooling industry did pioneer work and is among the leaders in the area of the energy efficiency. The European products (boiler, heat pumps, distribution systems, radiators, regulations, ventilation systems, etc.) and services (planning, execution inspection and maintenance) are world-wide known as high end quality products. These economic activities create jobs in Europe especially in small and medium-size enterprises.

For an export-oriented economy it is essential to create a global market with transparent rules. The EPBD contributes to this by pushing forward uniform concepts and methods.

World-wide accepted standards help to reduce and avoid trade barriers and additional costs of multiple testing. It is clear for the EU that 27 different national methods will not create a strong export position.. Creating already at the European level uniform evaluation methods, where also third countries can refer to, is one of the objectives of the second mandate the European Commission will give to CEN.

European standards and national building regulations

The reference in the national regulations to European standards works satisfactorily in several countries. Standardization completes the national

regulations by the following task sharing:

- ▶ Standardization takes over the technical part (creation of a uniform evaluation method);
- ▶ National regulations set requirement levels.

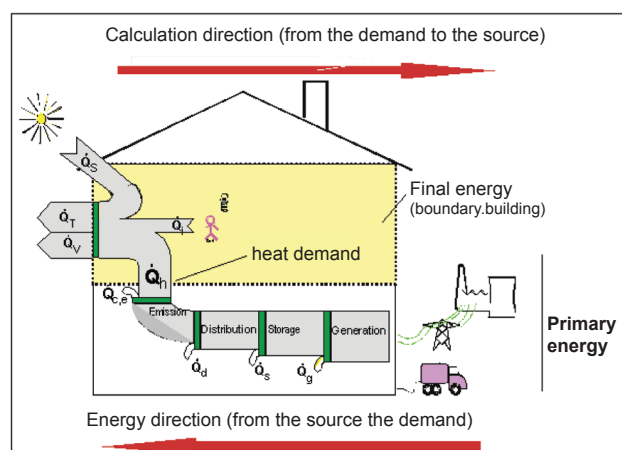
The standards should be directly referenced in the national regulation. No additions or changes should be made to the standards. Only in this way uniform evaluation methods and tools (software) can be created.

The recast EPBD (2010) requires in article 8 that the Member States shall set requirements in respect of the overall energy performance for technical building systems. As the systems requirements shall be set for new, replacement and upgrading they will have an important impact on the market of heating and cooling systems. It is very important that the definition and calculation of the system requirements is uniform in Europe in order to avoid distortion in competition. International standardisation of these procedures is essential. Based on these standards national regulations will then set the level of the system requirements.

How the heating and cooling systems are integrated in the evaluation of the overall energy use?

The general structure is defined in standard EN 15603 “Energy performance of buildings - Overall energy use and definition of energy ratings”. The calculation direction goes from the needs to the source, from the building energy needs to the primary energy.

The energy efficiency of heating and cooling systems is determined by calculating the thermal systems losses and the auxiliary consumption.



articles

The heating standards are structured by modules:

- ▶ Generation;
- ▶ Storage;
- ▶ Distribution;
- ▶ Emission.

This structure is following the real structure of a technical building system.

For each module, simplified (e.g. tabulated values) or detailed methods may be applied according to the accuracy required. However, it is essential that the results correspond to the defined output of the module in order to ensure proper links to calculations for the following module.

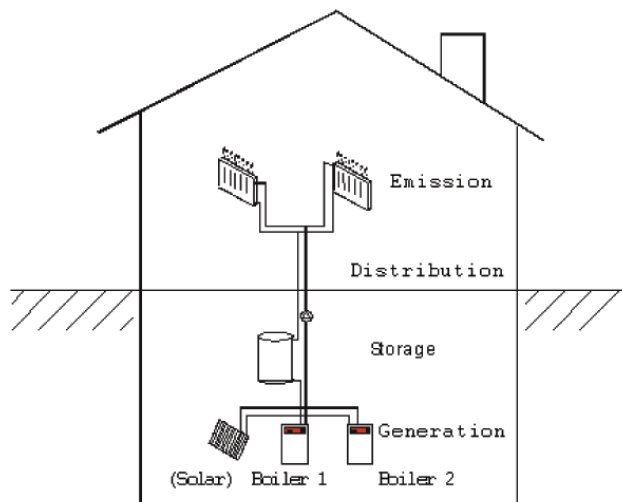
From the methods to the tools – heating and cooling systems needs high quality and easy to use software tools

Technical building systems have the reputation to be complicated in data acquisition and in the evaluation of the performance. The assumption that the influence of technical building systems on the total energy use is secondary compared with other improvements, especially in low energy houses is false. The new standards evaluating in a more detailed way the contribution of heating and cooling systems to the overall energy use will show this!.. Based on these standards, software tools have to be developed for easy computation and data acquisition of technical building systems.

Software tools needed:

A workshop on software for building energy performance was organized in Brussels - CEN Meeting Centre, on June 2009. The main objective of the event was to identify the interest for an uniform European framework for building energy performance software. The subject of the workshop was considered to be of high priority. Participants from 17 countries attended the workshop. The majority of the participants were representing the main European software companies in this field.

The importance of the software developers, as the linking element between the standard writers and the standard users (designers, installers, certifiers) in the field of energy performance of buildings was recognized. Mainly software developers will read the standards and apply them in the development of software tools for building professionals. The content of the second



generation of EPBD standards has to be adapted to the needs of software developers.

When revising the heating and cooling system standards during the second mandate, the following items are important to be considered:

- ▶ how “detailed” the standards should be;
- ▶ the data acquisition and data bases.

The comment “the standards are too detailed” is an argument of the past. Low energy houses (high quality buildings) require high quality calculation models and software. Especially for heating and cooling systems, where the energy efficiency depends strongly on the running conditions, for examples for heat pumps, a detailed calculation (hourly calculation) is needed.

Also compared to the capacities of the calculation engines, the question of hourly or monthly method is a wrong debate. The future standards should develop a very detailed calculation method as a basis.

Simplification of input data not of the calculation method

The simplification will not be on the calculation method but on the user interfaces which are as important as the content.

The user interfaces are linked to required input data. The biggest uncertainty in the model, and also the most time consuming parameter in calculation, is in the input data. Detailed methods often leave to the user the problem of finding the right data. This has a tremendous impact on the

reliability of the calculation. To lose time in detailed calculations when looking for small losses, is a waste of time and a risk for mistakes.

For example, calculating the emission losses due to stratification losses in well insulated buildings with limited room height seems not productive. Nevertheless, a detailed calculation shall be left open in the case of high ceilings and where stratification may cause dramatic increases in losses.

When updating the standards linked to the EPBD the input data have to be structured by an approach based on typology. The expert will decide to go deeper in details or not depending on the cases he is working on. Knowing the right simplification according to the context is one of the most precious expert knowledge.

Easy access to database, to find the right performance of the products, is another important factor in energy certification and building optimization.

The databases are often closely linked to the national calculation methods (e.g. UK, France). The result is a patchwork of databases corresponding to the patchwork of national methods.

The proliferation of different databases (i.e. product characteristics, weather data) is a strong argument in favour of a unified European framework. If the national market is not so important, manufacturers will often be unwilling to make the effort to provide data. National databases sometimes require additional testing or precalculation. This creates new barriers for trade within Europe.

Integrated tools for new and existing buildings should be created to facilitate the daily work of certifiers and design engineers. The experts in all European Member States should have access to these tools and be allowed to use them to show compliance with national regulation. Especially for the experts of small European Member States the access and the use to these integrated tools are important because very often they do not exist for small markets. If experts have not access to high quality tools, important energy-saving potentials would not be used.

Conclusions

The second mandate for CEN standards linked to the EPBD is very important for the heating and cooling systems in order to:

- ▶ develop harmonized characterization of the product energy efficiencies;
- ▶ provide a uniform energy efficiency evaluation method based on verified performance data, where the innovative heating and cooling system technologies are correctly taken into account;
- ▶ show the energy efficiency of heating and cooling systems and their positive contribution to the overall energy use, energy efficiency and their impact on the environment;
- ▶ promote the use of European experience on an international standardisation level.

If Europe wants to create a normative reference based on CEN standards other third countries can refer to, this reference has to be created and applied in Europe first.

It is unlikely that national methods will be replaced immediately by a common European methodology. Therefore the use of a European methodology should be admitted as an alternative to fulfil the national building code requirements.

References

- ▶ *CENSE Information Paper P87, How to integrate the CEN-EPBD standards in national building regulations? The use of EN 15603 to adopt the same structure as starting point for coordination of Member States regulations*, Johann Zirngibl, February 2009 (available at www.iee-cense.eu)
- ▶ *CENSE Information Paper P88, Energy performance of buildings – Overall energy use and definition of energy ratings – Calculated energy rating EN 15603 (Overall energy use)*, Johann Zirngibl, September 2008 (available at www.iee-cense.eu)
- ▶ *CENSE Information Paper P161, Towards Pan-European Software for Building Energy Performance; Report from a workshop organized by CENSE on June 29, 2009 in Brussels*, Johann Zirngibl, August 2009 (available at www.iee-cense.eu)
- ▶ *EN 15603 "Energy performance of buildings - Overall energy use and definition of energy ratings"*.