ENERGY PERFORMANCE CERTIFICATION OF EXISTING BUILDINGS BASED ON ASSET RATING (EPA-ED; EPA-NR)

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ABSTRACT

The development of an Energy Performance Assessment method with supporting tools for existing buildings is specific and differs from the approach for new buildings. Although the physics are the same the context of application is quite different. Some important key-issues that relate to existing buildings are elaborated. The EPA-ED project dealt with those issues for the existing dwelling stock and produced a European assessment method including software. The project was recently completed. For non-residential buildings the EPA-NR project is currently under way. This project will also create an assessment method and software, taking into account the context of the existing building stock and its actors. The paper explores how these issues specific for the existing building stock effect the design of EP-assessment method and tools.

KEYWORDS

EPBD, Existing buildings, Energy Performance Certificate, Non-residential buildings

EPBD ASSESSMENT METHODS: EPA-ED AND EPA-NR

Focusing on issuing an Energy Performance Certificate according to the EPBD and taking into account the CEN standards as they are being developed, a new group of methodologies have emerged.

The Energy Performance Assessment for Existing Dwellings (EPA-ED) is the first project that was recently completed in the Altener research program of the EC. The EPA-ED project provides an assessment method and is accompanied by a set of tools, including software, which enables the consultants to audit and assess a dwelling or an entire residential building in a uniform way. The consultant is also supported to provide owners with specific advice for measures that can improve the energy performance of the dwelling or building. The prototype software was used for a number of pilots performed in four European countries. All final deliverables from the EPA-ED project are available from www.epa-ed.org.

The "Energy Performance Assessment for existing Non-Residential buildings" (EPA-NR) is an EIE project similar to EPA-ED and currently underway. It will also provide a method and tools, including software, to enable a consultant to generate a good quality certificate and recommendations regarding energy saving measures. Like in the EPA-ED project, the aim is to achieve an approach that can easily be adapted to local circumstances and is adequate and efficient. Up-to-date information can be found at www.epa-nr.org.

Key issues for the development of these methods are:

- The accuracy of the assessment process as a whole
- The reproducibility of the outcome of the process
- The additional value of certificates by attuning to the clients building management
- The effort and cost for issuing the certificate

The first three issues relate to effectiveness and the last one to the efficiency of the approach, where all issues are crucial for credibility of a certification scheme.

The important considerations, concerning how to balance these key issues in the development of an assessment method based on asset rating are addressed below.

THE EPBD AS A STARTING POINT

The European Directive on the energy performance of buildings (EPBD) requires that an energy performance certificate is made available to the owner or by the owner to the prospective buyer or tenant when buildings are constructed, sold or rented out. The certificate has to express the Energy Performance (EP) of the building as a numeric indicator that allows benchmarking. The certificate has to be accompanied by recommendations for the cost-effective improvement of the energy performance.
In order to facilitate the EU Member States in setting up a general framework for the calculation the European Committee for Standardisation (CEN) is working on the final elaboration of over 30 new standards to satisfy the requirements of the EPBD. These CEN standards will be the basis for standardisation on national or regional level.
The overall objective of the directive is to improve the energy performance of buildings. Issuing EP-certificates for the existing building stock is a major effort and it is a challenge to design the certificate and the assessment process in such a way that there is optimal impact in terms of taking energy saving measures.

ACCURACY AND REPRODUCIBILITY OF THE ASSESSMENT PROCESS

The assessment of the energy performance of a building based on asset rating consists of several stages. The organisation of the assessment process is not standard but depends on the specific circumstances and the type of the buildings. There are nevertheless very common stages that are relevant in the majority of assessment processes (Figure 1). Each of the stages has its specific characteristics.
The process typically starts with an intake interview with the client in order to discuss and define starting points and conditions to take into account during the assessment. This stage is a starting point for the data acquisition in order to perform energy analyses. Based on these results, the energy performance can be established together with the cost-effective energy saving measures to be advised. Finally the results have to be expressed into an Energy Performance Certificate and presented to the client. The impact of the certificate in terms of taking measures depends on the combination of the quality of the assessment and the acceptance of the advice by the actors in the market. A good quality assessment with a poor acceptance is ineffective.

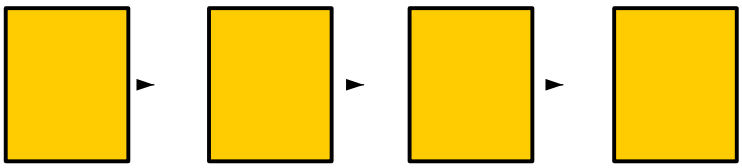


Figure 1: Stages in the assessment process

With regard to the accuracy of the whole of the assessment process three aspects are important:

- The quality of the default values in component lists or libraries linked to the calculation model;
- The quality of data acquisition especially inspection of the building;
- The quality of the calculation model itself.

The other stages in the process, “intake” and “reporting results” have a minor influence on the overall accuracy, assuming they are performed in a professional way. The inaccuracies of the relevant aspects are depicted in figure 2.

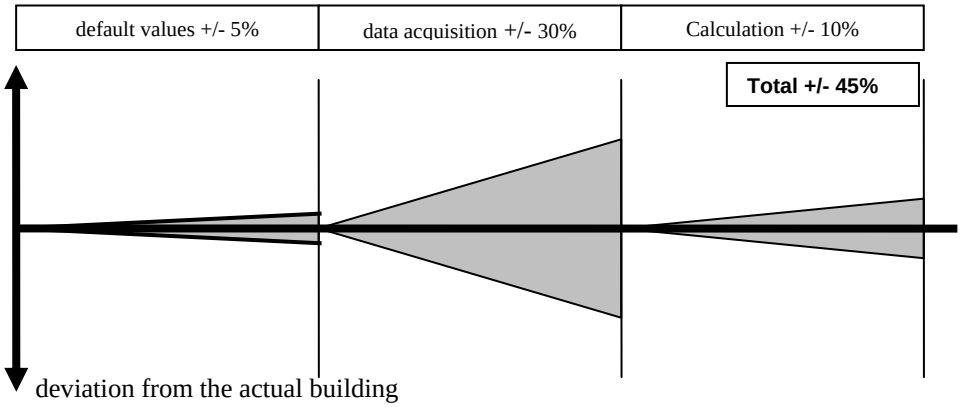


Figure 2: Inaccuracies per aspect

The accumulation of inaccuracy

The accumulating accuracy is graphically shown in the figure 3. The total inaccuracy sums up to a total of 45%. Of course this range is a worse case scenario. In practice, deviations will compensate and normally the error will be less, as illustrated by the distribution curve on the right. Nevertheless, an inaccuracy of 20 to 30% is very common.

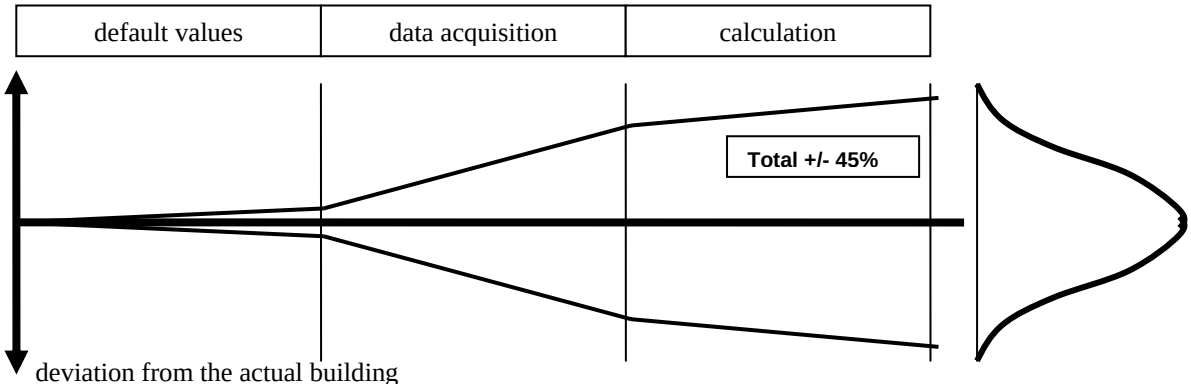


Figure 3: Accumulated inaccuracies

Reproducibility

The credibility of a certification scheme reduces dramatically if the reproducibility is poor; that is to say; if various consultants using the same method end up with different results. Especially the stage of data acquisition is very sensitive for variation in interpretation by the consultant. Describing a data acquisition procedure in an extremely explicit way is hardly possible for the divers existing building stock. Such an approach is very complex in daily practice and a source of inaccuracy in itself. The most effective approach is to simplify the data acquisition process, for instance by using default values for parameters that are susceptible to misinterpretation. A secondary advantage is that the effort for data acquisition reduces. The obvious disadvantage is that there are concessions with regard to the accuracy on the level of the building concerned. Accuracy can also be considered on the level of a building stock. By establishing the default values in such a way that they are representative on stock level, accuracy on this higher level is still served, although on the building level physical accuracy is exchanged by a better accuracy during data acquisition and a far better reproducibility.

Balancing the accuracy and reproducibility

It is important to understand that there is an interaction between the accuracy of the default values, the calculation model and data acquisition. A very advanced model with a high accuracy that requires detailed and complex input using little default values may lead to very inaccurate data acquisition. Of course the overall accuracy of the assessment process is what counts. Therefore, more simple input using default values that are not the ultimate fit for the building concerned may provide higher quality results and significantly less effort. This is even the case if a more simplified calculation model with slightly less accurate output is used.

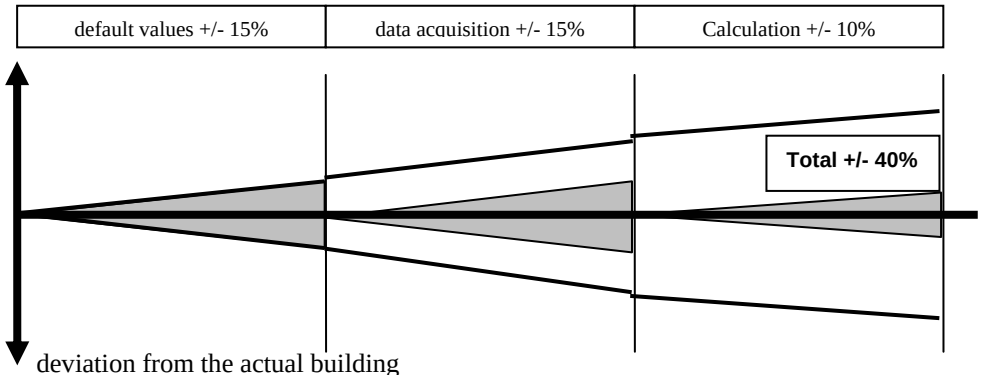


Figure 4: Inaccuracies per aspect (default values allow simple input)

This is shown in figure 4 were the total accuracy is reduced from 45% to 40% and there is a much better reproducibility of the assessment process.

LABELLING SCHEMES IN RELATION TO THE ASSESSMENT PROCESS

Labelling the energy performance of buildings is undoubtedly a high value policy measure directly facilitating the implementation of the Energy Performance in Buildings Directive. Energy labelling is a powerful communicator; it presents simple and instant communication of energy performance levels. Giving a tangible 'face' to energy performance is the first step to raising awareness about our buildings. A typical approach can be to express the rating in a classification (step wise). Also a continuous representation is an option or a combined approach of classes and a number as a continuous representation.

Designing a classification it is important to acknowledge that for credibility reasons deviations in the assessment of the same building by various skilled consultants may not differ more than one class. This implies that there is a direct connection between the number and range of classes in a labelling scheme and the reproducibility of the assessment process. This is illustrated in the figure 5; seven classes are presented in the graph together with the score of two consultants on the same building. The orange range illustrates the deviation related to reproducibility of the assessment. The presented scores show a possible mismatch in rating by a maximum of one class. Experiences indicate that such an deviation can only be expected for very well designed assessment approach in the existing building stock under the condition that it is performed by skilled personnel using good quality instruments.

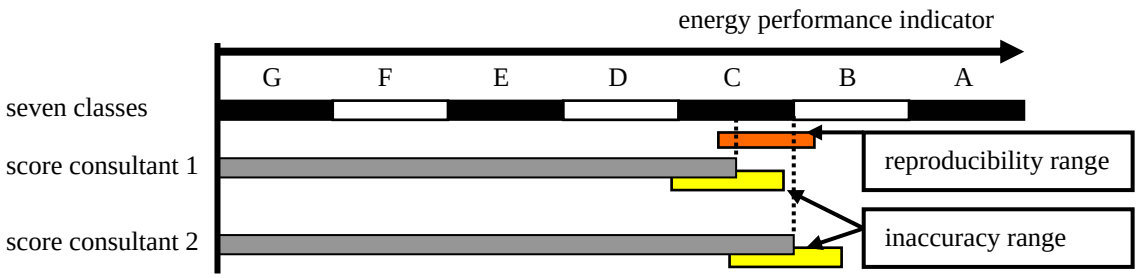


Figure 5: Labelling schemes and reproducibility/accuracy

This example based on experience shows that there is an important dependency between the classification within a labelling scheme and the accuracy of the assessment. The quality of the assessment is directly related to the cost of the assessment. A labelling scheme also sets requirements for the accuracy of the assessment method; this is depicted in the graph by the yellow bars. In fact reproducibility and accuracy are not independent aspects; accuracy plays a role in reproducibility. For the purpose of explanation both aspects are addressed separately. If the energy performance indicator is not expressed in classes but as a continuous representation, like a number the restrictions concerning accuracy are becoming less severe. In that case the bandwidth of the inaccuracy of the assessment is the only effect that counts, the jumping from one class to the next is not adding to the mismatch.

The added value of labelling

Labelling the energy performance of buildings is undoubtedly a high value policy measure directly facilitating the implementation of the Energy Performance in Buildings Directive. It can be of value for actors, from the individual building owner or tenant who wants to get an indication of the energy performance up to portfolio managers of building stocks who can use aggregated labels in order to define their policy on the energy issue. Even on municipality level policy can be formulated based on labelling schemes. Energy is not an added issue but incorporated in the common processes, like maintenance and upgrading of buildings. All these applications are locally defined and stimulate improvement of the energy performance. The consequence is that form and functionalities of the assessment method and its output should be flexible in order to meet the needs of the different actors. For instance, establishing the energy performance of a building stock is not a multiplication of the process for a single building, but a completely different process. The instruments have to allow and facilitate these different approaches.

EPA-NR OFFERS FLEXIBILITY

In order to develop an European assessment method that is effective and efficient, it is important to distinguish between common parts of the method and its tools and those parts that should be flexible in order to comply with the local context. The common parts can benefit from European harmonisation providing quality standards and uniformity.
The EPA-NR project takes these considerations into account in producing a European Assessment Method and Software for issuing an EP-certificate.
Besides practitioners being the major target group, also policy makers are facilitated with brochures and reports on the implementation aspects related to EPA-NR.

The EPA-NR method and tools

The EPA-NR method consists of a calculation model and process supporting tools like inspection protocols, checklists, building component libraries. The EPA-NR method produces an Energy Performance Certificate for non-residential buildings including recommendations for cost-effective improvements of the energy performance of existing non-residential buildings; the EPA-NR products are listed in table 1.

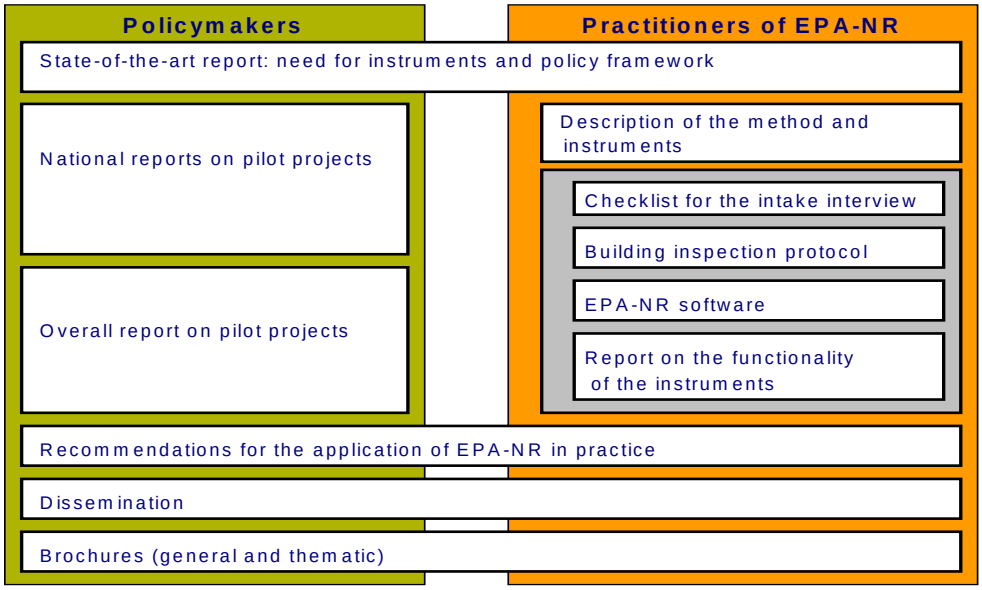
Flexible and effective

The EPA-NR method will be in line with CEN-standards and still offer much flexibility for an efficient application on a local level. The method will be easily adjustable to the national context and the diversity in the market and further development and maintenance can be low

cost due to the joint efforts. The method and instruments will be tested through pilot projects in seven EU Member States. The EPA-NR method enables to take into account the local framework with respect to legislation, technical aspects, design and building maintenance processes and acceptance by actors in the market. The flexibility of the method guarantees simple transfer to all EU Member States. The instruments will be developed in such a way that adjustment to new or modified CEN-standards will be relatively easy.

EPA-NR software has a flexible structure. It will consist of a standard calculation core which can be used internationally (independent of local context), and will fully comply with EPBD and CEN-standards. Around this infrastructure, future users will be able to build their own country or region specific interface. The calculation core makes use of local weather files, construction libraries, nationally adaptable method constants, etc. Specific project data are provided through the input interface. The input and output interfaces can be easily adapted to local needs for different languages or other user needs.

TABLE 1 - EPA-NR products



The prototype method and tools are available by January 2006. After a testing phase in pilot projects the products will be finalised by the end of 2006. Visit www.epa-nr.org .

The partners the EPA-NR and EPA-ED project teams are listed in table 2.

TABLE 2 - List of EPA-NR partners

Partner	**Country**	**City**	**EPA-ED**	**EPA-NR**
EBM-consult (co-ordinator)	The Netherlands	Arnhem	X	X
Arsenal	Austria	Viena		X
ÖÖI	Austria	Viena	X	X
SBi	Denmark	Hørsholm	X	X
Fraunhofer-IBP	Germany	Stuttgart		X
NOA	Greece	Athens	X	X
ENEA	Italy	Roma		X
OTB	The Netherlands	Delft	X	
TNO	The Netherlands	Delft		X
CSTB	France	Marne la Vallée		X