

**IMPACT
NATIONAL ENERGY PERFORMANCE
CERTIFICATION TEST**

Compilation of national test reports

October 2006

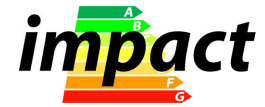
IMPACT

Improving energy performance assessment and certification schemes by tests

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Author(s):

Christina Sager
dena, Berlin, Germany
sager@dena.de

Felicitas Kraus
dena, Berlin, Germany
kraus@dena.de

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Project co-ordinator

Ecofys BV
Utrecht, The Netherlands

Mr. F.T.S. (Frank) Zegers
f.zegers@ecofys.nl

Supported by:



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Project description

The background of the IMPACT project, which is conducted in the framework of the Intelligent Energy Europe Programme, is the implementation of the Directive on the Energy Performance of Buildings (EPBD) in 2006. In existing building certification schemes barriers have been reported regarding quality, communication aspects, certification of apartment buildings and lack of expert (auditor) capacity. To have an impact on the energy consumption of buildings all aspects in the certification process need to be addressed. In order to contribute to tackling these barriers IMPACT has the objective to:

- 1) test energy performance certification for existing buildings in practice in 6 country pilots,
- 2) exchange experiences and success factors,
- 3) derive recommendations for improvement of tools, certification schemes, training of experts and communication,
- 4) support the EPBD implementation process in 6 countries,
- 5) disseminate project results on a national and EU wide scale.

The tests are conducted in: Belgium, Denmark, France, Germany, The Netherlands and Spain.






Target groups for IMPACT are:

- National stakeholders responsible for EPBD implementation (ministries, building research institutes, national energy agencies)
- Market actors (experts, building owners, intermediary organisations like real estate agents or municipalities).

The project is divided in work packages with the following main deliverables:

WP1	Test preparation	Overall report on national test approaches
WP2	National tests	National test reports (6) Overall report on national tests
WP3	Evaluation and synthesis	Synthesis report with best-practice approaches and guidelines as basis for dissemination activities
WP4	Dissemination	EU newsletter National newsletters National workshops for implementation stakeholders National workshops for markets actors

Project partners

<p>Ecofys Netherlands</p>	
<p>SenterNovem Netherlands</p>	
<p>Deutsche Energie-Agentur GmbH (dena) Germany</p>	
<p>Tribu-energie France</p>	
<p>Danish Building Research Institute (SBI) Denmark</p>	
<p>Belgian Building Research Institute BBRI / WCTB Belgium</p>	
<p>3E N.V. Belgium</p>	
<p>Ecofys S.L. in cooperation with Generalitat de Catalunya and ADIGSA Spain</p>	  

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Executive summary

The progress of the IMPACT project was strongly interconnected with the national implementation process of the EPBD. In all countries this process was delayed to some extent. The target date for implementation January 1st 2006 wasn't realised by any country with a full implementation of all aspects of the EPBD. All countries in the IMPACT project therefore faced some difficulties in the time schedule of the tests. Mainly the delayed or missing documents and guidelines caused problems, because in some cases the tests had to be performed with preliminary documents and calculation procedures and tools.

Nevertheless the tests were completed in all countries with significant results. The total target number of issued certificates was achieved. In all countries the IMPACT results influenced the national implementation process and contributed to the solution of specific problems.

The targets of the IMPACT tests were focussed on different aspects in the partner countries. This way a large variety of different questions could be considered and different approaches were developed. All building types (small and large residential buildings, flats, non-residential-buildings) were covered in the project albeit not in all tests. The Danish field test was focussed specifically on the certification of flats. The test in Spain were focussed on two different calculation tools. The other tests had a broader scope but also with specific key issues, such as the qualification of "laymen" in France, simplified procedures in Germany and Belgium and data collection by building owners in The Netherlands. These stand-alone topics together with the large number of comparable issues give a good outline of the perspectives and problems of energy certification in buildings.

A number of issues were discussed intensely among the partners in the course of the project. The number of auditors needed for full implementation, the qualification and training needs of the auditors and the correlation between the method used and the costs for certification were covered in all tests. The results can serve as inspiration for other countries who face similar boundary conditions.

The aim of this document is to give an overview on the different approaches and the evaluation results in the countries. A detailed compilation of results can be found in the national evaluation reports. The conclusions towards "best-practice" approaches that can be derived from the results of the tests will be covered in WP 3.

1 Introduction

1.1 Introduction

The final evaluation reports of all national field tests follow the same structure, regardless of the specific focus of in the countries. This has been agreed upon by the national partners to facilitate cross country evaluation and to pinpoint recommendations for other countries. The report follows the certification steps and brings the field test results in context to the current legal status of implementation. The specific impact of the tests for the legal implementation process are emphasized.

1.2 Terms and Definitions

Single-family-house: Ground-level single family dwelling (free standing, attached or in rows).

Apartment / flat: Single unit within a multi-family-house.

Multi-family-house: Large residential building containing several apartments / flats occupied by different tenants / owners.

Dwelling: Generic definition of for a house, either one single family house or one apartment/flat.

Certification scheme: by the regulation defined procedure for building analysis for the purpose of delivering energy rating and certificate of buildings. The schemes are country specific. Some voluntary schemes (thus no certification scheme) have similar application fields : e.g. EAP-audit (BE), energy audit (NL).

Expert: person who performs the energy certification as defined by the regulation. Synonymous for energy consultant (BE, DK, FR), issuer (DE), energy auditor (NL). The qualification requirements differ in the countries.

Sensitivity analysis: Method to analyse the impact of variations of input data for the results of complex calculations. By varying the single-input parameters the deviation of results is determined, e.g. for setting of default values.

Building inspection: inspection of a building with the goal to collect all the required input data necessary for making a legal energy certificate.

Energy certificate: result of the analysis and calculation procedure which contains the energy rating and essential building information to present to the building owner. All Impact-countries are preparing a national standardised legal format for the energy certificate.

Energy audit: Procedure for analysing the efficiency of a building, often performed in the voluntary context of an energy advice procedure.

Advice report: more elaborate report explaining the energy efficiency of a building and a building specific advice on improvement measures covering building physics as well as financial aspects (investment costs, pay back time).

Simplified method: more simple approach for energy certification in order to save costs. Two general approaches of simplified procedures can be identified in the countries:

- **simplified procedure**, the calculation procedure is simplified / shortened or substituted by a standardised data base,
- **simplified input**, the calculation procedure remains the same but the experts may use default values instead of on-site data.

Energy Label: In the energy label the energy indicator is displayed in a comprehensible (graphic) manner. As energy labels both classifications and colour gradients can be used. The energy label is usually part of a standardised energy certificate format.

2 EPBD implementation and role of Impact

2.1 EPBD Implementation in the countries

In all countries the national implementation of the EPBD was delayed to some extent, leading to more or less severe delays in the progress of the IMPACT tests. None of the partners was able to use the final certification procedures and certificate formats as implemented in national legislation. Thus meaning that all the IMPACT tests were performed with draft procedures and certificates. On the other hand the IMPACT partners were all in close contact with the relevant decision makers responsible for the national implementation, leading to a significant feedback of the test results into the preparation of the legal documents.

In most countries the EPBD implementation is set into force on a national level. Only Belgium faces a regional implementation with maybe different regional approaches. For the full implementation of the EPBD requirements most countries could base on existing regulations and extend or amend these to the EPBD requirements. Since the EPBD sets requirements on several aspects concerning the energy efficiency of buildings some countries have already implemented large parts of the Directive and are only missing single aspects (e.g. certification for existing buildings, extension of calculation method, adjustment of area limits etc.) whereas for others the topic is entirely new. The preconditions therefore are very different in the countries leading to different national test approaches.

		in force (for building of type..)
Belgium	regional	Flanders: 1.1.2006 (new)
Denmark	national	1. April 2006 (regulation, all new buildings), 1 September 2006 (certification, all buildings)
France	national	Autumn of 2006 (existing for sale) middle of 2007 (new) middle of 2007 (existing for rent)
Germany	national	since 2002 (new) beginning of 2007 (all existing)
The Netherlands	national	beginning of 2007 (all)
Spain	national	decree notified but not published (new)

Tab. 2.1: legal implementation of energy certification in the countries.

2.2 IMPACT tests in countries

2.2.1 Purpose of tests

The purpose of the IMPACT tests in the countries is highly dependent on the national implementation context. In summary it can be stated that four countries followed very similar evaluation criteria, whereas the national emphasis in two countries differed significantly from the others. The Danish field test was solely focused on the certification of flats, since this topic has been generally revised for the new certification scheme in Denmark. The Spanish implementation process was delayed in many central aspects, leading to severe deficits in the availability of material for the Spanish test. The Spanish colleagues therefore focussed mainly on the comparison of the planned legal calculation procedure software (LIDER-CALENER VYP) and the EPA-ED /-NR software of the EU-Save Project.

Regarding the building types represented in the IMPACT tests, the national focus was distributed the following way:

	single family houses (detached)	duplex houses (semi-detached)	terraced houses (row-houses)	multi-family houses	apartments / flats (as single units)	non-residential buildings (including public)
Belgium	X	X	X			
Denmark				X	X	
France	X	X	X	X		
Germany	X	X	X	X		X
The Netherlands	X	X	X			
Spain				X		X

Tab 2.2: Building types represented in the IMPACT tests.

The procedures used for the tests were mainly draft versions of the planned legal procedures for certification. In Belgium a more elaborate existing Energy Advice Procedure was tested. In The Netherlands the voluntary elaborate tailored Energy Advice was tested in addition to a cost-effective simple and concise (draft) legal certificate. In both the Belgian and the German tests simplified methods (default values for calculation) played a major role. The French test was strongly focussed on the qualification of experts not primarily qualified in the building field.

	comparison of different calculation procedures	simplified methods (use of default values)	comparison of different label/certificate types	certification of single apartments	building assessment by the building owner	improvement of expert training
Belgium	X	X	X			
Denmark				X		
France						X
Germany		X	X			
The Netherlands			X		X	
Spain	X					

Tab 2.3: "Stand-alone" aspects in the IMPACT tests.

All countries collected expert feedback on the following topics:

- certification procedure
- time needed for certification

In countries where special training courses were held for the experts in the IMPACT tests, also feedback on the training course was collected, also feedback on the calculation procedure(s) was gathered in several tests.

Regarding the end-user feedback all countries (except Spain, who hasn't performed an end-user inquiry) analysed the end-user feedback on the certificate including different aspects and possible impacts on taking renovation measures. The Danish end-user inquiry was solely focussed on aspects of the certificate's appearance and understandability, whereas Belgium, France, Germany and The Netherlands also included the following topics into their end-user inquiries:

- feedback on the certification procedure
- acceptable price for the certificate
- effect on the building's value

The findings of the national evaluation will be compared in detail in the following chapters.

3 Information strategies for EPBD

3.1 EPBD information strategies in the countries

In most countries the national promotion strategies of building certification are not the predominant focus at the moment. It can be expected that the work on promotion strategies will be enforced after the legal implementation process has been completed or has advanced further. In Denmark the existing mandatory certification scheme has not been promoted much, which is regarded one reason for the limited success in the past.

All countries are planning to provide information leaflets or brochures on the topic. Broad promotion campaigns are planned in Denmark, Germany and The Netherlands after the implementation has come into force. A direct subsidy for certification is not foreseen in any of the countries. In Denmark the maximum price for certificates for buildings smaller than 500 m² will be limited. In Germany a more elaborate Energy Advice Procedure, not interconnected with certification, is currently being subsidised. In The Netherlands the existing elaborate Energy Performance Advice has been subsidised previously leading to a high penetration in a short time. In Spain there are several promotion campaigns and subsidy programmes running for the replacement of inefficient appliances.

All countries already offer information on the implementation on several websites. In France and in Germany a national hotline service offers information on the topic.

3.2 Promotion strategies in the IMPACT project

For participation in the IMPACT test end-users and / or experts were offered different types of incentives by the partners. In Belgium and The Netherlands the home owners were offered a free audit / certification for their cooperation. In Belgium, France, Germany and The Netherlands home owners were asked to apply for participation by regional campaigns, newsletters or tenders (in newspapers). In the German test regional authorities or partners served as intermediaries for home owners and experts. In France the experts were offered a free training day for their participation. A free training course in the new calculation procedure also played a role in the acquisition of experts for the non-residential buildings in Germany. In the Danish and the Spanish test the buildings and the building inspectors were selected directly by the partners.

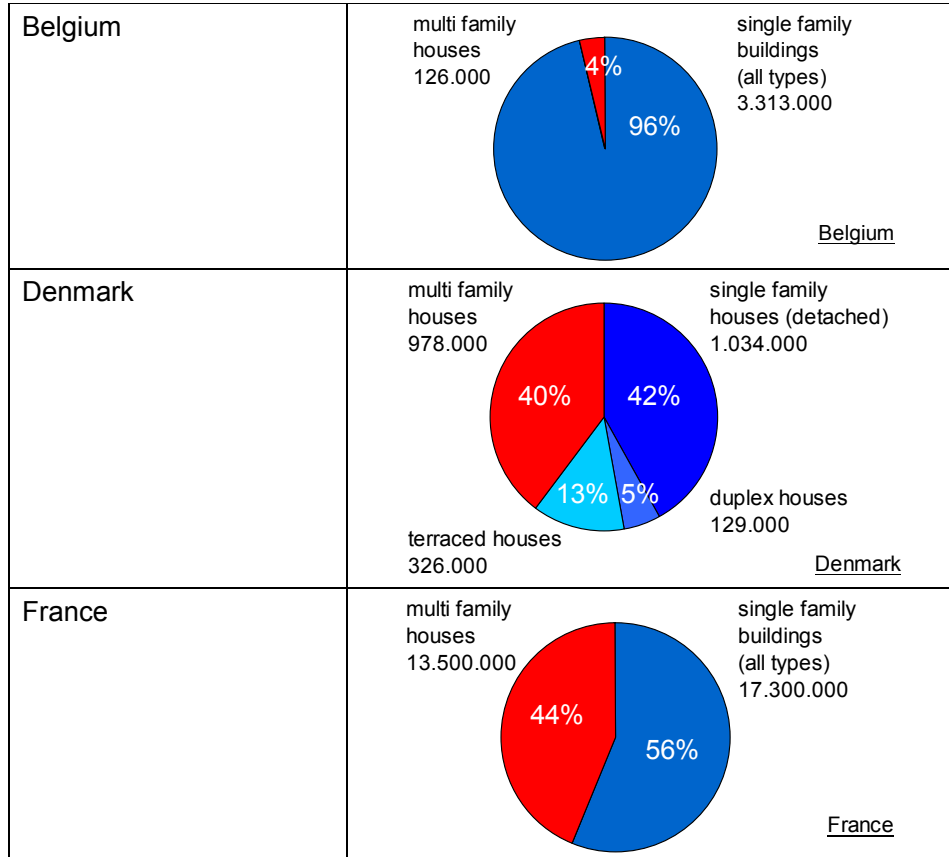
	public tender, national or regional campaign	advertisements (news-papers, magazines)	incentives for owners or experts	brochures, leaflets (for promotion)	newsletters, website (for promotion)	buildings/experts directly selected by partners
Belgium		X	X		X	
Denmark						X
France				X	X	
Germany	X		X			
The Netherlands	X		X		X	
Spain						X

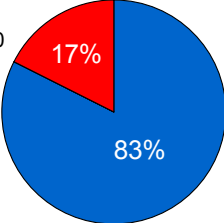
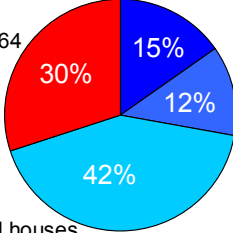
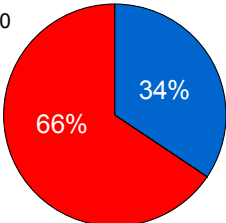
Tab 2.4: Promotion strategies to engage home owners and experts in the IMPACT tests.

4 Building structure

4.1 National building structure

The national building structure is a relevant factor for the anticipated demand for certificates and the expert capacity needed in the coming years. In all countries statistics on the existing residential building stock were available, whereas the number of non-residential buildings could only be estimated by most partners. Figures for the exististing non-residential buildings were only given by Spain and Germany, since all other tests were solely focussed on residential buildings.



<p>Germany</p> <p>non-residential: approx. 1.660.000</p>	<p>multi family houses 3.036.000</p> <p>single family buildings (all types) 14.423.000</p>  <p>Germany</p>
<p>The Netherlands</p>	<p>multi family houses 1.972.364</p> <p>single family houses (detached) 1.011.065</p> <p>duplex houses (semi-detached) 819.257</p> <p>terraced houses 2.785.384</p>  <p>The Netherlands</p>
<p>Spain</p> <p>non-residential: approx. 300.000</p>	<p>multi family houses 9.250.000</p> <p>single family buildings (all types) 4.870.000</p>  <p>Spain</p>

Tab 2.5: Distribution of the existing building stock in the countries.

The distribution of building ages in the existing residential building stock in the countries is quite similar. Quite old buildings (built before 1970) represent between 52% and 68% of the total building stock with The Netherlands and Spain with the youngest, Denmark and Germany with the oldest building stock. Very old buildings (built before 1900) are represented with 4% to 11%, new buildings (built after 1991) represent between 6% and 14% of the total building stock in the countries¹.

4.2 Required expert capacity in the impact countries

An estimate of certificates needed because of the different occasions for certification were given by the countries. The number of certificates needed can be used as an indicator for an estimate on the necessary expert capacity for the countries. Only Denmark has previous experiences with certification experts and an existing pool of certification experts. For all other countries the given figures can only represent a rough estimate of the expected certification demand. In the

¹ Some statistics differed a little in the reference periods. The figures given therefore represent only a rough comparison.

first year after implementation there will be a very high demand for certificates, later decreasing to an average yearly demand. To reduce the initial demand, most countries are planning transition periods. The average demand depends on the validity of the issued certificates. In all countries but in Denmark the validity will be 10 years. Denmark will limit the validity to 5 years.

	new buildings	tenancy changeover	selling	public buildings (display)	number of 1/1 auditors ²
Belgium	24.900				
Denmark		110.000			500-600
France	400.000	1.400.000	400.000		>6.000
Germany ³	148.500	429.000	264.000	55.000 ⁴	5.500
The Netherlands	66.700	291.500	260.000		≥1.000
Spain	548.000				1.400

Tab 2.6: Initial number of certificates needed per year and necessary experts for certification.

4.3 Buildings in IMPACT test

The building structure in the field-tests differed from the national building statistics in all countries. Nevertheless the partners selected the buildings for the test with regard to building type and building age to get a large variety of different examples in the tests. Due to the limited number of buildings in the IMPACT tests the achievement of thoroughly representative results in respect to the building typology couldn't be the primary goal of the tests.

² Because of the lacking experience in most countries the number of experts can only be a rough estimate. The number may be much higher in the case that most experts will not work full-time in the field of certification.

³ Including non-residential buildings.

⁴ Certificates for public buildings only needed in the first year and then every ten years.

	single family houses (detached)	duplex houses (semi- detached)	terraced houses (row- houses)	multi family houses	apartments / flats (as single units)	non-residential buildings (including public)
Belgium	20 (sensitivity analysis on 131 dwellings)					
Denmark				6	240	
France	102			70		
Germany	1374			2551		38
The Netherlands	11	18	71			
Spain				11		5

Tab 2.7: number of buildings represented in the IMPACT tests.

5 Building inspection

5.1 National overview building inspection

The qualification requirements for experts are an intensely discussed issue in most countries. The preconditions vary significantly in the countries. In Belgium and in Spain the requirements for auditors are not decided upon yet. In Denmark and in France the auditor has to have a national accreditation. In The Netherlands a national accreditation will be given to the auditor's company, requiring at least one qualified expert in the company to meet the requirement. In Germany the regional accreditation for submitting audits regarding the legal requirements on energy efficiency automatically qualifies for submitting certificates. In all countries architects and building engineers are regarded the favoured qualifications for certification. In some countries the qualification spectrum is enlarged to meet the required number of experts.

	architects	engineers	craftsmen	energy advisors (listed for existing programs)	"laymen" (advisors not primarily educated in the building field)	additional requirements
Belgium	(yes)	(yes)				
Denmark	yes	yes				X
France ⁵	yes	yes	yes	yes	yes	X
Germany	yes	yes	yes	yes		X
The Netherlands ⁶	yes	yes		yes		X
Spain	(yes)	(yes)				

Tab 2.8: qualification of consultants to supply energy certificates

To ensure the quality of the auditors, the countries who have already defined requirements for certification, usually link the initial "formal" qualification of the experts to several additional requirements. Only France it is foreseen to abstain

⁵ In France the requirements for accreditation will be defined by an exam the expert has to pass, no „formal“ qualification is checked.

⁶ In The Netherlands not the auditor is accredited but the auditing company which needs at least one qualified and trained expert as process quality manager.

from a formal qualification and guarantee quality by additional requirements. In Germany the qualification requirements are different for the different building types. New buildings can only be certified by accredited architects or engineers (jurisdiction of Fed. States), existing non-residential buildings can be certified by architects and engineers and existing residential building can as well be certified by craftsmen if they provide the additional requirements. In The Netherlands not the auditor is certified but the auditing company which has to guarantee at least one qualified and trained expert as proces quality manager.

	special training + exam	special university key course	practical experience	national or regional accreditation of expert	national accreditation of company	liability insurance
Belgium	(X)					(X)
Denmark	X		X	X		X
France	X			X		X
Germany	X	(X)	(X)	(X)		X
The Netherlands ⁷	X		X		X	X
Spain ⁸						

Tab 2.9: additional requirements for accreditation of auditors for building certification.

In all countries with a national accreditation the auditors / auditing companies loose their accreditation if they don't comply with the standards or attract attention in the quality assurance systems. In all countries the auditors are held responsible for the correctness of the data in the certificate, even if the data assessment is performed by the owner. All auditors / auditing companies have to provide liability insurance.

5.2 Building inspection in IMPACT test

5.2.1 Approach

In many countries the final decision on the accreditation procedure was not available at the beginning of the tests. Therefore most of the tests were performed with "potential" auditors, meaning persons who were probably complying with the coming legal requirements. In most countries the auditors for the IMPACT tests were specially trained for the new tasks of certification. Only

⁷ There will not be a mandatory exam in The Netherlands

⁸ additional legal requirements are not yet known.

Denmark performed the test with eight experts fully trained in the entire scheme, this was possible mainly because the scope of the test was focussed on the certification of flats in a limited number of buildings. A similar approach was chosen in Spain and Belgium, where a small number of experts, directly engaged with the IMPACT team performed the tests. These experts received a tailored training on the scope of the tests. In The Netherlands five accredited experts for the existing energy advice scheme performed the assessments. A larger number of experts were involved and trained in the tests in France and in Germany.

In all tests the building data was assessed on-site by the auditors. In The Netherlands the building owners additionally performed an assessment themselves. The results of both assessments were later compared.

The inspection procedure was evaluated by auditor inquiries. All partners except Spain also performed an end-user inquiry. All partners received sufficient feedback from the inquiries to base the evaluation on the answers. In Belgium the number of questioned experts was extended to all experts experienced with the existing energy advice procedure in the Flemish region to gain a broader data base.

5.2.2 Results of Evaluation

In the following, some results from the national evaluations are stated that either cover comparable topics or state “stand-alone” aspects of the countries tests.

Time needed and costs

All countries evaluated the necessary timely effort for the procedure. The large majority of certificates was delivered with an effort of 2 to 8 hours. The simplified tool in France certainly has contributed to a rather low number of 2 to 3 hours, whereas the additional elaborate procedure in Belgium has led to higher numbers of up to 16 hours. The results of the Danish, the German and the Dutch test end up with figures somewhere inbetween. It can be stated that the certification of non-residential buildings and the use of uncomfortable or new software tools has led to very high time consumption in the German non-residential test and the Spanish test, which both state a necessary effort of up to 50 hours for the full certification scheme.

In the **Belgium** test 75% of the audits cost between € 250 and € 500, of which 40% was subsidised. A market survey however came to the conclusion that 85% of the end-users would not be willing to pay more than € 200 on the mandatory certification. The results of the IMPACT survey produced a maximum price of € 200 to € 400 that 28% of those questioned would be willing to pay. About as many said they would be willing to pay less than € 50.

In the **German** residential test 65% of the certificates cost less than € 300, 32% were below € 200. The majority of the end-users stated that a price up to € 500 would be reasonable for the certificate. A price higher than that was regarded too high by almost half of those questioned, but 5% considered more than € 500 to be favorable.

In the **Netherlands** the certificates were issued for € 100 each. In **France** the costs have been estimated between € 150 and € 220. Only in **Denmark** a maximum price for certification is legally defined for buildings smaller than 500 m². Minimum wages or honorarium scales are recommended for the legal implementation by the **Belgian** partners.

Procedure

The experts involved in the tests mostly viewed the procedures positively.

66% of the experts in the **Belgium** test stated that the tested energy advice procedure would be an interesting method for the mandatory certification.

Only 10% of the auditors in **France** have difficulties with the procedure, the actual model seems to be understood.

The large majority of the experts in the **German** residential test considers the tested procedure an easily manageable instrument. For the new procedures of the non-residential certification an additional training is regarded necessary.

The handbook for consultants is viewed as the essential factor for high quality results in **Denmark**.

Generally good documentation, tools / guidelines, training and some sort of helpdesk are regarded absolutely necessary in all countries. There were no statements made that the sole legal requirements were found sufficient for the practical work. The majority of experts stated that they were content with the available information and the offered training.

The experts in **France** stated that a 2 or 3 days training workshop would be sufficient. The longest training courses with 45 hours of training were held in the context of the **Spanish** test. It was stated that in contrast to the planned legal tool the use of the EPA tool was more or less self-explanatory for higher educated experts like architects and energy engineers and didn't produce many application problems.

Improvement measures

For the end-users the most significant elements of the certificate are the improvement measures. To this conclusion came the end-user inquiries in

Belgium, Germany and The Netherlands. The recommendations are regarded an added value. Nevertheless it has to be stated that there were mainly own-property users involved in the IMPACT tests, who do not represent the typical target group for the legal certificates.

In France and in The Netherlands some concerns were stated on the quality of the given improvement measures. In France the majority of “diagnostic experts”, who represent the auditor group without previous experience in the field of energy efficiency in buildings did not provide recommendations with the certificates. 37 out of 64 certificates for individual houses were returned without recommendations. The rate for flats was even lower. This has led to the conclusion that some additional effort should be concentrated on the training (and possibly software tools) on this issue. In The Netherlands the auditors spent approximately 10 minutes on compiling the recommendations and another 10 minutes on reporting. This has led to the conclusion that the reports were often produced automatically by the software and not tailored to the specific building characteristics afterwards. In some cases the recommendations showed inconsistencies in terms of building physics and the chosen sets of measures. The Dutch report states that the advisors could be assisted better in the process of composing sets of measures by the software, help files and a manual with clear instructions.

The results on the potential impact of the given renovation measures are given in Chapt. 7.

Self-assessment by home-owners in The Netherlands

The test showed that the information on surface areas and levels of insulation supplied by the home owners deviated considerably from those assessed by the EPA advisors. On the other hand, owners were able to supply accurate information on characteristics like the type of house, date of construction, number of residents and number of floors and installations, and to provide construction drawings and user manuals for central heating boilers, as well as tenders for previously implemented insulation measures. This information can help reduce the advisors' assessment time and thus reduce costs. Almost 80% of the home owners would be prepared to invest up to two hours of their time to collect data for the building assessment in exchange for a 20% discount of the assessment. These data could well be supplied on a simplified assessment form, together with construction drawings, user manuals of central heating boilers and tenders for insulation measures implemented in the past. EPA advisors report that it would save an hour of their time if home owners supply these data and confirm the possibility of a 20% discount in this case.

6 Calculation of energy performance

6.1 National overview calculation methodologies

The strategies of the definition of the calculation procedures differ slightly in the countries. There can be pointed out three different options for the legal procedures:

Germany and probably The Netherlands: Calculation method defined in national and/or European standards: In the legal decrees reference is given to the calculation methods in the standards. The transposition of the method into software tools is left to the market.

Denmark: Calculation method based on national and/or European standards implemented in a national certification tool: All certificates are produced with the same mandatory certification tool (calculation engine) which is based on standards.

Belgium, France, Spain: Mandatory national software tool for certification: The calculation methods are fully implemented into the software, which is tailored for the mandatory certification. All certificates are produced with the same mandatory certification tool.

6.2 Calculation methodology used for Impact test

6.2.1 Approach

In most IMPACT partner countries the calculation tools weren't fully developed at the beginning of the project. This circumstance was mainly responsible for the delays in the IMPACT time schedule.

In **Belgium** mainly the existing Energy Advice Procedure has been used for the tests, which was compared to the available legal procedure for new buildings in the Flemish region. To reduce the timely effort for building assessment the possibilities of using default values were analysed in the IMPACT test.

The existing calculation tool for certification in **Denmark** was revised in the context of the EPBD implementation and released on January 1st 2006. In the IMPACT tests this tool was used even though the interfaces for certification were still under development. In the IMPACT project the different energy billing

approaches in Denmark were analysed in order to improve the distribution of costs in a common system. For the certification of flats a detailed model and a simplified model were developed and applied.

In **France** a simplified tool containing less than 50 questions will be used for building certification. Being the official simplified method the 3CL tool was tested in the IMPACT project.

The calculation procedure for existing residential buildings in **Germany** is based on existing regulations. For the test some additional guidelines (default values and simplification rules et.al.) were released and implemented in several software solutions. For the non-residential test the calculation method was available as national standard and additional guidelines and simplifications were released in anticipation of the future legal regulation.

For the IMPACT tests in **The Netherlands** an updated trial version of the existing Energy Advice Procedure software has been used. In the context of the EPBD implementation a new reporting template for the advice, improved cost indicators and a new equation for the energy index was integrated enabling the generation of energy labels. Furthermore the energy advice software was updated a.o. with a new reporting template for the advice and improved cost indicators.

The official calculation tool for certification wasn't fully available at the beginning of the tests in **Spain**. In comparison to the trial versions of the future legal tool which were used a software tool developed in the context of a European project was used.

6.2.2 Results of Evaluation

The comparison of the two procedures in **Belgium** has produced significant differences in the results. Applied to the same building the two procedures have lead to differences of 58% in the calculated energy consumption. This was mainly caused by the different definitions of characteristics in the calculation (e.g. primary or final energy reference, use of high or low caloric value, different indoor temperatures, some energy consumptions as cooling taken into account or not). Despite these differences a high coherence in the procedures is given.

The **Danish** calculation tool was found easy to use, but a good handbook to be necessary. For the certification of flats the detailed model, with the results of typical flats and the entire building given in one calculation was found too difficult. It was decided to always calculate the energy consumption of the entire block of flats as a whole and then distribute the consumption to the individual flat by area, independent of the distribution of the billing system.

The 3CL tool used in **France** offered different levels of detail for the input data. 57% of the individual houses and 65% of the flats have been delivered with a high level description (description of the materials). 60% of the experts would prefer calculating the energy consumption with the tool instead of collecting the bills, which 83% expect to be difficult. The experts found the tool simple to use and the results were found reliable, since there was a good coherence of the calculation and the bills in the test.

In about 60% of all cases in the **German** residential test simplifications were used. In the non-residential test all experts used default values and simplifications to some extent. The comparison of the calculated final energy demand and the measured energy consumption indicates considerable deviations in all building types. In most cases the calculated energy consumptions were higher than the operational metered consumptions. The sensitivity analysis of the default values showed that geometric simplification can be used to a good extent without distorting the results too much. For the non-residential buildings a user-friendly software is needed, but the new calculation procedure is appreciated by most experts. Nevertheless it is regarded a too complicated tool for the purpose of certification by the experts. The efforts on more simplified approaches should be strengthened.

The new software used in **The Netherlands** offered a considerably improved reporting template. Nevertheless a couple problems were discovered concerning the “quality descriptions” of elements which in some cases seemed to foster misinterpretation if no additional comments are added. There also seemed to be some deficits in clearly defining the qualifications ‘sufficient’ and ‘optimal’. The tested advice report will be regarded supplementary (on a voluntary basis) to the legal certificate, a useful additional information on the certificate would be the comparison of the actual energy efficiency of the building and the potential energy efficiency after implementation of the measures. Some miscalculations were discovered in the tool. Regarding the calculated investment costs and payback times it can be stated that even for a ‘moderate’ level of refurbishment the average payback times were fairly long. A solution would be to use only the additional investment costs, which would have to be clearly explained in the report.

In the **Spanish** test some severe problems were encountered with the calculation procedures. The EPA scheme was fairly easy to handle and self-explanatory. During the project some errors in the output data were discovered, concerning most importantly the sum of the energy consumption. The official Spanish tool is currently not working correctly and still contains several bugs. Despite that the tool is quite complicated to use with a lot of necessary input data which leads to many unavoidable assumptions when dealing with existing buildings. The mere processing of the data takes a lot of time. Till now no technical support is

available for the tool, which couldn't be verified because of the "black-box" structure.

7 Energy performance certificate

7.1 National overview energy certificates

Official certificate formats or draft versions of the future certificate formats are not available yet in all countries. But there are some significantly different approaches chosen by the countries:

Belgium (draft for new buildings in the Flemish region) and Germany will separate the energy certificate from the renovation recommendations. The certificate is reduced to basic information according to the legal requirements and the requirements of the EPBD. In Germany the tailored renovation measures are listed on a separate sheet which has to be issued with the certificate. The legal format contains both options (calculated or metered certificate).

The Netherlands will introduce a simple and concise energy certificate basically displaying the energy label and a list of standard renovation measures (without investments costs and pay-back times). The certificate can be supplemented by more comprehensive tailored advice report on a voluntary basis.

In France and in Denmark the tailored advice is included in the certificate format. In France there will probably be three different formats for the certificates, one for residential buildings based on the calculated demand, one based on the metered consumption and one for non-residential buildings (metered consumption). The Danish certificates are in principle the same for all building types, with only small variations. For multifamily-buildings with flats, the entire building will be described in the main certificate and additionally each typical flat will be described on one extra page.

The Spanish software until now only produces the energy label which is not yet intergrated into a separate report but will be included in the building documents.

7.2 Energy certificate(s) used for Impact test

7.2.1 Approach

In **Belgium** and in **The Netherlands** the tests were performed with an additional report format which was more elaborate and detailed than the mere energy certificate. These reports were based on existing energy advice procedures. The final legal certificates weren't available in both countries at the time of the tests, so in Belgium the Flemish draft-certificate was tested by an online inquiry. In The

Netherlands the IMPACT certificate was based on the draft certificate that cannot be used as official certificate later on.

In **France** and in **Germany** draft versions of the legal certificates were issued. The revision of the drafts was a main aspect in both tests. In Germany all certificates issued during the tests will remain valid after the legal implementation, even though meanwhile the certificate format has been revised.

The layout of the certificate for multifamily-buildings and flats was one main issue in the IMPACT tests in **Denmark**. The end-user interviews were very much focussed on the perception of the new and in comparison the old certificate format.

The result-report derived from the **Spanish** calculation tool is not a certificate in a end-user friendly layout but mainly meant for administrative purposes. Some mistakes in the output were discovered. The European tool used for comparison doesn't generate a certificate, so the results were recalculated in order to present the results conform to the output report of the Spanish label.

7.2.2 Results of Evaluation

End-user responses on the certificates

In **The Netherlands** 69% of those questioned regarded the certificate useful or thought that it provided added value. In the **German** test the certificates were well accepted by private owners and equally so by some housing companies. Similar responses were gathered in the **Danish** and **Belgian** test.

For 65% of the end-users questioned in **France** the certificate could be an argument when buying or renting a house. 50% would be willing to pay more for a house with a good energy performance. In the **Dutch** test 82% of the end-users stated that the certificate could be a factor when selling the house, but on the other hand 60% said, that the certificate would play no role or a minor role when buying a house themselves.

Generally the certificate contributed to a better understanding of the energy efficiency of the house by the users. The most eye-catching element in the certificates was the label or scale, which allowed the judgement of the house "at a glance". This was stated by 90% of those questioned in **The Netherlands**. Equally important were the given energy saving measures for the end-users. 75% of the **Belgian** responses stated that these were interesting. In the **French** inquiry the recommendations are even stated as the most important aspect on the certificate. The more comprehensive audit in the new certificate in **Denmark** was appreciated by most of those questioned, some critical comments were made on the separate "small" certificate for flats, stating that the information could as well be integrated in the document of the whole building. The comparison to the old

certificate format did not produce a uniform picture. A slight majority of those questioned regard the new certificate to be an improvement.

The terms used in the certificates / reports were well understood by most end-users in the **German** and in the **French** test also the amount of information given in the certificates was regarded sufficient. Even though the tests in **Belgium** delivered an elaborate report only 30% of the questioned end-users stated that it contained enough information. The elaborate advice report is regarded to be more comprehensible but in both types of documents the terms should be explained more detailed or understandable, since only 25% of those questioned understood everything.

In **The Netherlands** the comparison of the certificate and the additional tailored advice report was hampered by the fact that both documents had to be sent to the end-users together and the respondents seemed to have given a combined judgement on both documents. This has led to rather small differences in the ratings. The personal comments added to the questionnaires however show that a majority of users regard the elaborate tailored report as an added value to the basic information in the certificate. The certificate supplied more general information that could be understood “at first sight”.

In none of the IMPACT partner countries the end-users stated that the certification was entirely dispensable. Most of the questioned end-users appreciate the additional information and transparency of the certificates.

Comparison of different label types

In **Germany** and in **Belgium** two different label types were evaluated. In the German residential test the participants could choose between an energy class label and a coloured band strip label in a standardised report format. In the Belgian test the Flemish draft-certificate contained a linear indicator label whereas the energy advice report contains several A to F class labels. The results in both tests have led to contrary results. The classes were far more appreciated in the Belgian test. In the German test the coloured band strip was slightly more accepted. This was particularly true for housing companies.

8 Presentation to end-user

8.1 Planned national approaches

In none of the IMPACT countries a personal presentation of the certificates will be mandatory. Since the personal presentation of the final certificate would generally mean a second visit, the most probable approach is to send the certificate by mail or by email to the client. The national regulations probably won't define requirements on the presentation to the client.

Another aspect has been noted by the IMPACT partners. Since the usual occasion for the audit is selling of a house or a tenancy changeover, the client who pays for the certificate probably would hardly have a deep interest in a detailed explanation of the certificate, let alone the renovation measures. Therefore the right addressee for the presentation would be the future owner or tenant. In most countries the certificate is seen as one initial bit of information on the energy efficiency of buildings that should be supplemented by more elaborate energy advice procedures that clearly addresses the building owners. The Dutch approach somehow addresses this issue because the seller is addressed with a concise cost-effective mandatory certificate and the buyer is addressed with a voluntary tailored advice for improvements.

8.2 Approach in Impact test

8.2.1 Approach

In the IMPACT tests most of the certificates were personally presented to the customers, who were own-property users by the majority. Personal advice was recommended in most of the tests. In some cases the personal advice and the explanations on the certificate contents were given during the building inspection.

8.2.2 Results of Evaluation

Feedback on the presentation

In the Belgian test 54% of the certificates were personally handed over and explained to the client. 28% received the certificate by mail and got a feedback (call) from the expert. In 15% of the cases explanations and advice was given during the building inspections. Only 3% received the certificate without explanations.

In the German residential test 80% of the own-property users received a personal explanation of the certificate. Only a very small fraction did not receive an explanation or had to ask for it.

Personal advice and explanations by the auditor are highly appreciated by the end-users. This could be perceived in all of the tests. In France the auditors states concerns on the cost factor follow-up questions of the clients will impose on them and propose central “information-points” that they can refer to.

The qualification of the experts was perceived positively by the end-users. Almost 100% of those questioned in The Netherlands stated that they agreed (or agreed to some extent) to the statement that the advisor seemed to know what he was talking about. The competence of the auditors was fairly independent of their initial profession. The participating experts without higher professional degrees, such as the building inspectors in France and the craftsmen and chimney sweepers in Germany were perceived equally positive as their colleagues with engineering degrees, both in terms of their efficiency and neutrality and in terms of communication with the proprietors. Almost 90% of the own-property user questioned in the German test state that the explanations of the auditor contributed to their understanding.

Influence of the renovation measures

An important aim of the EPBD implementation in the countries is to incite renovation measures. The information given in the certificates can be seen as an initial information on energy saving potentials in the building.

56% of the building owners and 77% of the tenants questioned in **Denmark** stated that the certificate has lead to their wish to improve their energy consumption. Even though the recommendations were regarded suitable and understandable by 95% of the end-users in **France**, only 59% of them stated that they want to restore their dwelling. This may be caused by the fact that tenants usually cannot take many of the proposed measures themselves and a majority of 58% of the buildings already had been restored. About the same percentage of own-property users in **Germany** stated that they will now restore their dwellings. About 15% will implement the measures partly and 10% said they won't take any measures. For about 30% of the own-property users and the private landlords the certificate prompted the renovation activity. For about 35% the planning was facilitated by the certificate.

The tests in **The Netherlands** showed some deviations between the recommendations given in the tailored report and the standard recommendations on the certificate. Furthermore in some cases the advice given by the auditor during the visit appeared to differ from the advice in the report. This may have

been caused by the fact that little effort has been put into tailoring the automatically produced reports.

Feedback from housing companies

The feedback from housing companies received in **France** and in **Germany** were very similar. In both countries the housing companies stated a very low interest in passing the certificate to their tenants. The principle reasons for rejecting the energy certificates were possible differences between the calculated energy demand and the actual consumption. It was also feared that pressure may be exerted on the housing companies by the tenants as a result of the renovation recommendations. Some housing companies assumed that the tenants may not properly understand the energy certificate. Many housing companies in both countries will probably not present the entire certificate with the recommendations to their tenants, they are only prepared to pass on the certificate in a perhaps “slimmed down” form. Private landlords saw considerably less difficulties in this respect in the German test.

9 Conclusions and Recommendations

9.1 Recommendations from the national tests

9.1.1 *Building inspection*

Belgium:

- People are willing to pay more, if certification is not mandatory, also if the advice is tailored to the building (not general), the experts are independent and if quality is guaranteed (by an official authority)
- end-users are willing to pay a fair price, up to € 400.
- The certificate can influence the purchase and renting price and may guide investments, but it will seldom be the decisive aspect.
- A raise in awareness is needed to make sure the certificate contributes to the decision making process in the future.
- In case of selling of the property, it is mainly the recommendations that are valuable for the beneficiary (buyer), quality and accuracy are important, leading to a more elaborate procedure which the future owner will (indirectly) pay.
- In case of renting the tenant will not pay for the certificate and is mainly interested in the label, so a less accurate procedure may be sufficient.

Denmark:

- A good handbook for the consultants is essential.
- High level of quality control is necessary to ensure the end-users' trust in the procedure in a long-term.
- Quality assessments should be based on clear rules and procedures that have to be written down and be publically available.

France:

- A one-day training workshop seems to be too short to fully cover the topic, two to three days are regarded sufficient.
- Software may include standardised improvement measures that can be used by more inexperienced auditors.
- A final energy scale should be avoided if a large amount of buildings have electrical heating.
- Certification of experts and control of delivered certificates may be a good way to guarantee quality.

Germany:

- Energy certification for existing buildings can only be offered at a reasonable price if there are ways to facilitate the data-collection on-site.

- Using the same calculation procedure for an extensive and a short procedure avoids confusion, simplifications can be achieved by simplified geometrical assumptions and the option to use default values.
- Experts, regardless of their original profession need some additional training on the certification procedure.
- If no national quality assurance is introduced, a quality assurance system on a voluntary basis run by market actors may be an alternative.

The Netherlands:

- Owners are able to supply information on general characteristics of the building and previous renovation measures and provide construction drawings and technical manuals. Surface areas and levels of insulation supplied by owners show considerable deviations from those of the professional auditors.
- Almost 80% of the owners are willing to spend up to two hours on collecting data for a 20% discount on the price, the data collection can save the auditors about one hour time. For the owners a simple assessment form should be provided.
- The training, software and the manual for auditors should contain clear instructions for the process of composing sets of measures.
- The training courses should provide detailed information on tailored adjustments of standardised renovation measures.

Spain:

- Use a standard check-list in order to make the building analysis easy and standardised for the building inspector.
- In the case of an apartment building several flats should be visited and the owner/tenants should be interviewed.
- Offer standard options (default values) for simplifications (U-values, characteristics of boilers etc.) with respect to the building age.

9.1.2 Calculation of energy performance

Belgium:

- Coexisting procedures for new and existing building should be coherent in terms of the calculation procedure, so identical input data leads to at least similar results.
- An integrated procedure for new and existing buildings with several levels of complexity would be a good long term solution. For existing buildings more default values and for new buildings a more detailed calculation could be used.

Denmark:

- Even for an easy-to-use software a good handbook is necessary.
- For the certification of individual flats it has proven to be a feasible solution to distribute the total consumption to the individual flat by area, independent of the energy billing system.

- Making the calculation model of the building available in a central data base will save time for following inspections, because the consultant can focus on the changes made to the building since the previous inspection.
- The efficiency of the assessment process to obtain a certificate is of high importance, for that the interactions of the following elements have to be known and considered: physical accuracy and calculation, reproducibility (impact of different inspectors), time effort for building inspection related to the complexity of the required data.

France:

- A simplified method allows non-energy experts to deliver energy certificates.
- High amount of standardised data reduces the risk of mistakes in the input.
- Asset rating should be allowed if the operational data seems doubtful.

Germany:

- Default values should be “on-the-safe-side” to encourage detailed analysis.
- Simplifications should be kept at a consistent level covering all building aspects (geometric, thermal insulation and technical parameters).
- The use of simplified methods and default values should be clearly documented in the certificate.
- A good documentation and support on the simplified methods and the default values is necessary.
- Simplifications should be implemented in all software tools used for certification.

The Netherlands:

- The software and the manual for auditors should contain clear instructions for the process of composing sound sets of measures with regard to building physics.

Spain:

- The certification tool should be kept simple and easy to use.
- Due to the complexity of the proposed official tool, an online helpdesk should be available.
- The manual of the tool should be more user friendly and easy to use

9.1.3 Energy Performance Certificate

Belgium:

- A picture of the building is a highly appreciated element and should be added to the certificate format.
- The energy consumption and the advice are the most essential and prominent bits of information in the certificate, other indicators such as reference values, financial data, CO₂-emissions and renewable energy are secondary.

- Adjacent legal requirements on the displayed indicators should be considered.
- Separate labels for every energy consumer seem to be an appreciated element.

Denmark:

- A certificate must be easy to understand.
- Do not try to compare measured and calculated values, but still it should be possible to display both values in the certificate.
- The certificate should relate to the entire building with additional information on typical flats, if needed.

France:

- End-users want more information and advice on energy savings. Campaigns on energy savings should be developed.
- Energy scales are a well understood item.

Germany:

- The same label and certificate format should be used for all building types.
- Tailored renovation measures should be a mandatory element of the certificate.
- The mandatory legal certificate should be kept short and significant, additional information may be added on a voluntary basis.
- Critical addressees such as housing companies should be specially addressed in the marketing campaigns on certification.

The Netherlands:

- A simple and concise certificate (label and standardised list of measures) is appreciated by home-owners as long as it is supplemented with a tailored voluntary advice that includes investment cost and pay-back times as a decision document. As the financial basis for a voluntary advice procedure is low it could be promoted by linking it to investment subsidies or other financial or fiscal instruments.

Spain:

- Insert a picture of the building into the certificate.
- Recommendations on insulation improvements should be inserted in the certificate.
- Recommendations on the correct use of the installations should be integrated.
- General information on energy efficiency should be included.
- Give reference values for comparison of the buildings' CO₂-emissions and other typical sources (transport kilometers by car, plane, ship etc.)

9.1.4 Presentation to end-user

Belgium:

- Communicative skills and the personal presentation of the results are highly appreciated by the end-users if they are own-property users.
- The special situation for the legal certification occasions have to be considered.
- It will certainly be an added value if the new owner of the building can contact the expert after the purchase.

Denmark:

- The picture of the block of flats is appreciated by the users

France:

- Experts fear the additional (unpaid) work if future buyers call them to get more information, central “points of information” may close the gap. Otherwise the experts will probably need to charge additional “advice hours”.
- End-users welcome the implementation of the certificates because of the increasing energy prices. National incentives/subsidies or “white certificates” may help to finance the renovation measures.
- Housing companies should be able to split the document and only show the scales and ratings without the recommendations to their tenants.

Germany:

- Renovation measures in the certificate give incentives for renovation measures especially for own-property users.
- A personal presentation of by the auditor emphasises the importance of the certificate.
- All terms and procedures should be clearly defined to avoid misinterpretation.

The Netherlands:

- Personal advice and explanations by the advisor are regarded important by most of the home owners.

Spain:

- The certification should be easy to read and understand.
- There should be a list of renovation measures added to the certificate, including an approximation of the investment costs for the application of these measures.
- An estimation of the savings (energy and economical) with respect to the proposed measures should be added to the certificate