IMPACT
NATIONAL ENERGY PERFORMANCE CERTIFICATION TEST DENMARK

WP2.4

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IMPACT

Improving energy performance assessment and certification schemes by tests

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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 (EBPD) in 2006. In old building certification schemes barriers have been reported regarding quality, the communication aspects, the certification of apartment buildings and lack of expert (auditor) capacity. In order 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 overcoming these barriers, IMPACT aims to:

1) Test energy performance certification for existing buildings in practice in 6 country pilots projects
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 into 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

Ecofys The Netherlands	
SenterNovem The Netherlands	
Deutsche Energie-Agentur GmbH (dena) Germany	
Tribu-energie France	
Danish Building Research Institute (SBi) Denmark	
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Executive summary

The objectives for the Danish part of IMPART test is to test and optimise the Danish certification scheme in different types of apartment buildings to achieve the highest effect of possible investments. The overall objective of certification according to the EPBD is to reduce energy consumption and limit the CO_2 emissions.

The Danish certificate describes the whole block of flats on 6-8 pages and additional the flat will be described on one page. This page has a description of how the individual payment for each flat takes place for this building and furthermore energy consumption based on the measured climate-corrected heating consumption for the whole building divided by the total area and multiplied by the area of the flat.

In some multi-family buildings there will be a certain number of flats, which have about the same size. In this case the energy consultant will insert these in the certification scheme and calculate the average heating demand for each size.

In other buildings there are great variations in the sizes of the flats. In these cases the energy consultant can choose to make some average assumptions of the flat areas. The categories should be adjusted to the actual building. Normally a category must not exceed 10 m^2. The consultant should consider an appropriate way to present the heating demand of each flat.

A more detailed method was suggested by the IMPACT actors, but the decision-makers found it too complicated and decided to use this simple approach.

In the IMPACT tests it took 11-16 hours in total to make a certificate for blocks of flats between 1,500 and 5,000 m^2. This includes inspection, calculation of the energy classification and calculation of the savings.

The advantages of the new certification scheme for flats compared with the old one in Denmark are:
- the consumption and savings will always be calculated for the whole building,
- there will always be a direct dependency between the energy classification of the flat and the energy classification of the whole building,
- the total cost for the certification should be lower as some typical flats represent all flats in the building.

The lay-out of the certificate has been discussed and improved in IMPACT. The results from inquires among tenants and owners prove that it has become a good result with a high degree of user acceptance. The measured value for heating consumption is shown and the energy classification (letter) itself is based on calculation. This value is not shown as it is a mix of heating and electricity as described in the EU Building directive.

For the inspection the consultant's handbook is an indispensable tool. The handbook is the daily guide for the energy consultants. It is the:

- foundation for quality assessment
- guide for assessment of building etc.
- guide for calculation
- guide for advises on savings
- guide for filling in energy certificates
- guide for reporting / procedures etc.

High quality control is necessary as if the quality is poor, people will loose confidence in the certificates. Quality assessment is essential, as good consultants might do a good work without it, but less good consultants will not. Creditability will be lost very fast. Few poor reports can do a lot of damage. Quality assessment is to be based on clear rules and need to be based on clear procedures. It should be written down and should be public available. If rules are known, users can help by demanding quality. Also information quality is very important.

The data registration so far in Denmark is not perfect, and part of the data material is uncertain. In particular, the registration and follow-up of the saving potentials and proposed saving initiatives do not allow a consistent assessment of whether, when and to what extent suggested saving-proposals have been implemented. Hence it is recommended that registration procedures could and should be improved.

From 1 September 2006, when the scheme enters fully into force, the following information initiatives have been planned:

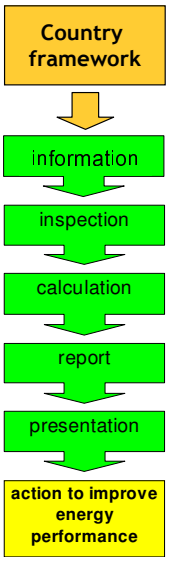
- Detailed brochures targeted at the professional groups. The purpose of the brochures is to introduce the new scheme when it is fully implemented.
- An information leaflet targeted house-owners. Primarily, the leaflet is to be handed out by the energy consultants performing the certifications (i.e. in connection with purchase or sale of a home or a property). The purpose is to urge house-owners to carry out the energy savings suggested in the certification. There will be different target groups in different types of property as mention earlier and this means that different ways of communicating messages about energy saving would be needed.
- A press kit about the new scheme for newspapers and trade magazines.

- Continuous up dating of information about the scheme on the Danish Energy Authority's web site, www.ens.dk.

Contact with energy consultants and end users on a daily basis through the scheme's secretariat, www.FEMsek.dk.

1 Introduction

One of the objectives of the IMPACT project is to develop a European good practice model for energy performance certification. This model is composed of a set of good practice guidelines covering all essential process steps for energy performance certification.



The EU directive on the energy performance of buildings (EPBD) is implemented throughout Europe in many different ways depending on the national framework.

Hence, in order to be able to derive good practice guidelines on energy performance certification for European countries, each of the national tests needs to be evaluated in relation to the national framework conditions.

Therefore the national reports on the national Impact tests are split in chapters each covering a process step, starting with a description of the national context for this process step.

Chapter 2 describes the status of EPBD implementation in the specific country and the role of the Impact test in the national implementation process. Chapter 3 gives an overview of the status and (planned) activities regarding informing stakeholders and the public on energy performance certification. In chapter 4 the building structure for the specific country is described as background for the EPBD certification approach chosen in a country. Chapter 5 covers the building inspection as part of the certification process. Chapter 6 describes the calculation methodologies used for energy performance certification. In chapter 7 the approach for the certificate, additional tailored advice reports and the appreciation of the end-user are described. The reports end with overall conclusions and recommendations (chapter 9).

As stated before, the EPBD is implemented throughout Europe in many different ways depending on the national framework. Within the Impact project all participating countries have therefore chosen their own specific focus and approach for the national IMPACT test that fitted the specific needs in the national context.

In Denmark the Impact project had the objectives to test and optimise the certification scheme in different types of apartment buildings to achieve the highest ef-

fect of possible investments. The overall objective of certification according to the EPBD is to reduce energy consumption and limit the CO_2 emissions.

Energy certification of flats in the old Danish schemes was carried out in connection with:

- Sale of owner-occupied flats (EM scheme for small properties)
- Preparation of ELO report on the collective consumption in properties of more than 1,500 m^2 with flats for rent, owner-occupied flats and flats under a multi-ownership scheme.

Energy consultants, real estate agents or owners of flats have not adopted the scheme for flats. Energy certificates are only prepared for approximately 20-25 % of traded flats. That is the background for describing and optimising the certification scheme for flats in IMPACT.

2 EPBD implementation and role of IMPACT

2.1 EPBD Implementation

2.1.1 Background, previous experiences

Energy certification

Until September 2006, there were two certification schemes in Denmark, one for large buildings (floor area more than 1,500 m²) and one for small buildings (floor area under 1,500 m²). In the certification scheme for large buildings, the *Energy management Scheme of large buildings* (Energiledelsesordningen, ELO) buildings must be surveyed and certified each year by a authorised consultant. The scheme for small buildings, *Energy Certification of small buildings* (Energimærkningsordningen, EM) claims that a house or apartment must be certified each time it is sold. A certificate issued in the EM scheme was valid for three years.

Energy certification was mandatory in residential buildings, public buildings and buildings used for trade and private services. Both new and existing buildings are included. Buildings, which are exempted, are buildings used for commercial production and for energy production and buildings with very low energy consumption.

For large buildings energy rating was not calculated, but based on registration of the actual consumption. For all buildings an energy plan should be drawn up that includes proposals for profitable savings for all types of energy and water consumption in the building. Furthermore, the energy plan should include an estimate of investments and annual savings involved in the individual proposals and the estimated economy during lifetime of the measures proposed.

Finally the plan should state the user-economic cost-effectiveness of the individual proposals. Energy rating and an energy plan should be drawn up once a year. Energy rating should consist of a standardised energy rating based on inspection of the building and the owner's registration of actual energy and water use and the calculated CO_2 emission.

The certificate consisted of four ratings on a scale from A to M. The actual heat consumption is climate adjusted to a normal year through the use of degree days, while electricity and water consumption was not climate adjusted. Finally, the energy performance and the total environmental impact are calculated and rated (A to M) based on consumption and emission figures for the actual supplied electricity and heat.

For the EM scheme the energy consumption was always calculated and compared with the measured values. Two different energy certification schemes for small buildings have existed since 1997:

1997-1999:

– Individual certification of each flat in a block of flats.

1999-September 2006:

– Individual certification of a flat and a rough estimate of the entire block of flats.

or

– Supplementary certification for the flat if:
  – Small buildings (< 1,500 m²): a less than 3 years old certificate (EM) for the whole building existed.
  – Large buildings (> 1,500 m²): an (ELO) energy management report for the whole building existed.

or

– Individual certification according to the EM scheme in case of flats in single-family or terraced houses.

In 2005 Denmark received a new act concerning the Danish certification schemes to adopt the requirements of the Building Directive [1]. The new certification scheme in Denmark was postponement until September 2006, because a delay of the development of the electronic tools.

The design of the schemes is adjusted to benefit from findings and experiences obtained over the past six years.

The most important areas of revision due to implementation of the EU directive include:

– Limits changed from 1500 m² total area in the old Danish schemes to 1000 m^2 net area according to the EU.
– New requirements concerning certification frequency in large buildings. Ten years is stated in EU Directive in contrast to yearly for large buildings and every three years for small buildings in the old Danish Schemes. It is decided in Denmark to use a 5 years frequency.
– The old energy certification in Denmark included energy classifications for heating, electricity and water consumption. According to the EU Directive, only energy consumption should be classified and the new Danish certification scheme is made according to this.
– Energy certification required of flats or buildings being renting out according to EU Directive.
– Energy certification of all new buildings according to EU Directive and not only by sale as in the old Danish scheme.
– Some additional certification components have to be included according to the EU Directive, e.g. energy performance.
– Regular inspection of gas boilers and air-conditioning systems is introduced by the EU Directive.
– Inspection of boilers and heating installation more than 15 years old is introduced by the EU Directive.

2.1.2 Implementation of EPBD requirements in building regulation

New buildings in Denmark are considered to have a relatively high insulation standard. But 75 % of existing buildings were constructed before 1979 when the first significant tightening of requirements on energy performance was introduced. So when implementing the EPBD, Denmark has taken the opportunity of tighten the regulations governing both new and existing buildings as well as the rules for certification schemes.

The energy regulations and the rules for energy certification will be linked in several ways. Before the official permit to use a new building is given, an energy audit has to be performed by an accredited energy consultant to check that the assumptions used when calculating the energy consumption to obtain a building permit are correct. Furthermore, it will be mandatory for the public authorities to implement energy-saving measures with a payback time of less than five years as described in the energy certificate of the buildings.

The present Building Regulations from 1995 (BR-95) has resulted in a reduction of 25 % in the heating demand in new buildings compared with the previous Building Regulations (BR-82). New energy regulations (BR-2005) have been prepared i.a. to facilitate the implementation of the EPBD. Here the requirements to new buildings have been tightened with 25-30 % compared with BR-95.

Since 1995 it has been possible to choose between three different ways to prove compliance with the Building Regulations. With the new energy regulations, the energy frame will always have to be calculated. The energy consumption includes heating, hot water, cooling, ventilation, as well as electricity for pumps and fans and furthermore building integrated lighting in commercial buildings. When the energy frame is estimated, electricity consumption is multiplied by 2.5 to compensate for the efficiency in the power production.

The Building Regulations governing domestic buildings stipulate that the total energy consumption must not exceed:

$$70 + \frac{2200}{A} \qquad (\text{kWh/m}^2 \text{ year})$$

where A is the total heated floor area.

A building is classified as a low energy building class 1, if the total energy consumption is less than 50 % of the energy frame and as a low energy building class 2 if less than 75 % of the energy frame. The two low energy levels indicate the levels that are expected to become minimum requirements in the next revisions in 2010 and 2015. Furthermore, there is a fixed limit for the transmission losses (6 W/m² for low rise, up to 3 floors, buildings and 8 W/m² for high rise buildings) for the thermal envelope excluding windows and doors.

There are also requirements when a building is renovated in a major way. The definition of a major renovation is taken from the Directive (25 % of the value of

the building or more than 25 % of the building envelope). The requirements to U-values of construction parts are seen in Table 1. Furthermore it is required that some individual, profitable measures have to fulfil the requirements, regardless of the size of the renovation. Individual measures are insulation of external walls when changing rain shield, insulation of attic and roof when changing roof, change of boilers and change of heat supply.

To be a profitable measure, the saving multiplied by the lifetime (in year) divided by investment should be higher than 1.33. These measures will normally appear in the certificate.

Table 1. The energy requirements of the two latest Danish Building Regulations from 1982 (BR-82) and 1995 (BR-95) for large buildings and future requirements concerning renovation from April 2006.

U-values W/m^2K	BR-82	BR-95	New rules 2006 Renovation
Wall, heavy	0.35	0.30	0.20
Wall, light	0.30	0.20	0.20
Floor with and without heating	0.30	0.20	0.15/0.12
Roof	0.20	0.15	0.15
Windows	2.9	1.8	1.5/1.8 (facade/roof)

Certification of flats

In the old schemes only 20-25 % of the flats that are sold have got a certificate because the user [2]:

- do not think the certificate is attractive enough,
- thinks that the certificate is too expensive,
- thinks that the certificate is not giving reliable information.

The main identified barriers for implementing the EPBD in Denmark is:

- Energy savings are not visible and thus only give marginal social status - in contrast to new kitchens and bathrooms.
- The certificate is only one piece of paper among many others when a house is sold.
- The market penetration of the old schemes is limited, even though the schemes were mandatory. The prime reason for this is assumed to be the lack of penalties.
- The present schemes are not connected with the rules for obtaining a permission to use the building.
- There is no penalty if the certification has not been made.

The importance of creating a national database with information about the energy quality in the certified buildings is one of the major lessons learned so far from the IMPACT project in Denmark. But also the importance of making energy plans in the certificates, primarily focussing on the profitable measures.

From the beginning of 2006, Denmark will have different certifications for different building types:
- Single family houses
- Buildings with flats
- Buildings with public service, trade and service

Concerning the flats, it will be a certification based on the whole block combined with a separate page describing the typical flats. For blocks of flats with more than 1000 m² floor area there will be a regular certification, repeated every 5 years. For buildings less than 1000 m², the certification must be done by the owner when a flat is for sale or let out (if a certificate does not exist with an age less than 5 years).

The advantages of the new certification scheme compared with the old one are:
– the consumption and savings will always be calculated for the whole building,
– there will always be a dependency between the flat and the whole building
– the total cost of the certification should be lower (as some typical flats are chosen to represent all the flats in the building).

When certifying a building with flats, the owner is responsible for doing this. In buildings with owner-occupied flats it will be the owner association and for flats under a multi ownership scheme it is the housing cooperative who must demand the certification.

2.2 IMPACT tests

The main purpose is to test and optimise the Danish certification scheme for flats in different types of apartment buildings to achieve the highest effect of possible investments. The overall objective of certification according to the EPBD is to reduce energy consumption and limit the CO_2 emissions. The work is conducted in close cooperation with the Danish Energy Authority (DEA) and the results were implemented in the Danish Certification Scheme. Besides this it aims at providing valuable input for a European best practice model for certification of flats. The overall objectives are defined in five tasks:

1. Develop promotion strategies for energy certification targeted at different types of apartment building owners. Goal is to remove the existing barriers (perceived cost/benefit ratio, promotion, legal framework for flats). Building owners (commercial or social housing) can use energy performance certification as a tool for energy analysis of their building stock, inventory of possible

improvements and estimating the related costs. Furthermore the energy certificates can be used to communicate to tenants the dwelling quality and integral housing costs (rent + energy costs). As a result, buildings with low energy consumption may rise in commercial building value. In social housing communication of integral living costs may facilitate tenant approval for rent increases related to investments in energy saving measures (certainly if the integral cost of living remains constant or go down). In this way a stimulus can be created to increase the interest of owners of large buildings for energy performance certification.

2. Test the new certification scheme and promotion strategy under a multi-ownership scheme, owner-occupied and rented. For the execution cooperation will be established with a municipality, housing association and/or an owner of an apartment building. An existing certified energy consultant makes the certifications.
3. Quality control certificates issued and interview/enquiry with the test expert.
4. Interviews and enquiries with building owners and tenants to have their opinion on the results.
5. Work out final recommendations for the certifications processes of different kind of flats.

In the IMPACT project lay-out of the certificates were discussed and finally decided. The first field tests were finished in autumn 2005. A final lay-out of the certificate was finished in December 2005 and this is tested in detail in spring/summer 2006.

According to the EPBD the new certification schemes must also include certification of flats when they are let out. This significantly increases the number of flats that must be certified and thus the importance of establishing a sound and effective certification scheme for flats in all member states.

Experiences from the old schemes have proven that energy certification of a flat in a block of flats cause special difficulties.

In the future, the energy certification of flats or other units for individual use will be based on an overall energy certification of the entire building. The energy certification of flats will be done as an energy certification of the entire building supplemented with information on energy consumption and savings in typical flats. This information is to be used for energy certification when similar flats are either sold or let.

The requirement on energy certification of flats being part of the energy certification of the entire building concerned has been set as a result of experience gained with the old energy certification scheme for owner-occupied flats. Experience has shown that it is not appropriate to have an energy certification made on the basis of just one flat. This is because there will usually be a direct connection between the total energy consumption in the entire block of flats and the energy consumption in individual flats. Energy consumption in most blocks of flats is cal-

culated for the entire building and the related expenses divided in a heat distribution account. In many buildings, there is an equalisation of heat consumption among the flats. If consumption is calculated for each individual flat, a representative result will therefore not be achieved.

Furthermore, many of the energy savings possible with flats are made jointly and implemented by the owners' association, the cooperative association or the landlord. This applies, for example, to the insulation of cavity walls, the exterior insulation on gable ends, the replacement of boilers, the improvement of heating systems and automatic-control devices for heat regulation. Savings due to individual initiatives may therefore only be assessed by assessing the overall savings for the entire building. On the other hand, the possibility for the individual owner, shareholder or tenant to achieve savings is usually much more limited.

Buildings with flats or units for special use vary widely and are thus buildings in which the energy consumption in individual flats or units and possible energy savings can be decided on without considering the entire building. Examples are terraced houses or with units constructed together and with individual and separate heating systems.

An accredited energy consultant inspected and calculated some selected buildings. Two consultants checked the test (inspection and calculation) and furthermore SBi and the Danish Energy Authority followed up and participated in all the stages of the test. The consultants' gives feedback on experience concerning building inspection, the calculation tool, the time consumed for making a certificate etc.

The main focus was to make enquiries with building owners and tenants to have their opinion on the results.

For the tests, apartment buildings with different ownership's and different numbers of flats were included.

A new lay-out and design for the certification scheme were tested. The first test served as input for the work to be able to have an energy-certification scheme ready 1 January 2006. These tests included a limited number of flats and covered the lay-out of the new certificates and the survey procedure. The second phase of the tests included a major number of questionnaires and is conducted on the full scheme in 2006.

In a longer term, a report will be automatically generated and an accredited energy consultant will provide the certificate. The certificate will then be send to the user by mail. The consultant presented the certificate to the user in the tests.

A draft handbook for helping the consultants in the field survey was prepared. In IMPACT the handbook was commented and improved.

The new scheme and handbook with inspection advice has been tested in a small scale in the IMPACT project.

The actors involved in the test were researchers, engineers, energy consultants and a communication specialist. The Danish IMPACT team is from Danish Build-

ing Research Institute (SBi), from Danish Building Information Centre (Byggecentrum), from the firm Actual Energy Consultancy and from the Communication-Compagny.

Furthermore, the Danish Energy Authority has participated with an engineer and an architect.

3 Information strategies for EPBD

3.1 Promotion strategies in Denmark

The old energy certification schemes were promoted by the Danish Energy Authority.

The interest among the end users of the schemes has been moderate. In principle the schemes were mandatory and should therefore need no special promotion. In the meanwhile, the coverage in average was 50 %, while only about 25 % of the flats got a certificate.

A barrier was e.g. that there was a lack of public campaigns and advertisement. The communication aspect will be taken better care of in the new certification scheme. Communication between the owner, the administrator and the boiler-man or caretaker also has to be improved. Furthermore, the one selling of a flat will not have to pay for the certificate in the future. Owners of owner-occupied flats may request that a valid energy certificate is available by the building's owners' association so that the owner of an owner-occupied flat may fulfil his/her obligations as seller. If the owners' association does not deliver the energy certificate, the owner of the flat must have the energy certificate drawn up at the owners' association's cost. The reason for this provision is that the energy certification of flats shall henceforth be part of the building's energy certificate.

One of the success factors in the old schemes was that a huge potential e.g. for energy savings was found. The follow-up on this is important and if only the consultant has to visit a building every 5 years in the future, it is necessary for the owner to have a yearly follow up of the measured data e.g. on the Internet. This follow up will be voluntary.

The Danish Energy Authority is in charge of the promotion. Due to the experience with the old schemes, the new schemes were revised.

In terms of buildings physics and theory it would be possible to consider owner-occupied flats and cooperative flats together. The overall principles for sharing the heating cost are not different from owner-occupied flats to rental flats and cooperative flats. But there may be many variations of the heating accounts from one housing cooperative to the next.

Similarly there is a big difference between organisations and decision-making structures in different types of property. This means that different ways of communicating messages about energy saving could be needed.

As a result of the comments received through interviews and theme meetings, a comparison can be given of the four types of housing:

- Non-profit housing associations are judged to be a group with a very positive attitude to implementing energy improvements. The residents have influence via residents' participation in decision-making processes concerning the property, resources are systematically set aside for continuous maintenance and improvements and the investments benefit the residents through subsequent energy savings.
- Private cooperative flats: Housing cooperatives are judged to have a relatively positive attitude to implementing energy improvements. According to some of the interviewed energy consultants, cooperative housing is often in a better energy condition than owner-occupied flats or private rented flats. Residents benefit from investments through subsequent energy savings. It varies from housing cooperative to housing cooperative whether resources are continuously set aside for maintenance and improvements. But it is possible to raise a loan collectively in the housing cooperative.
- Owner occupied flats: Energy saving initiatives will benefit the individual owners of flats. But owners are judged to have a stronger focus on individual improvements of their flat than on common improvements of the property. It plays an important role that the loans are raised for each flat individually - and the uncertainty regarding the investments - can be expected to give a return at a possible subsequent sale.
- Private rental flats: Extensive legislation exists to regulate housing conditions in private rented housing. The owner decides and should be able to see the benefit of investing in improvements. Investments in energy improvements can lead to increased rent in accordance with the rules about 'added value of the rented property'. The residents enjoy the subsequent energy savings.

There are properties with mixed types of flats and they are expected to grow more widespread as a consequence of the government's wish to promote greater variety in housing areas, proposal to sell non-profit housing, joint owned flats and co-housing youths.

In this type of buildings the decision-making process will be rather complicated. Owners of flats have the right to vote at the general assembly of the owners' association, members of a housing cooperative only have the right to vote through the board of the housing cooperative. The board of the local section of a non-profit housing association has the right to vote, but must continue to follow the rules governing residents' participation for non-profit housing. Independent budgets are prepared and administrators are elected for the different housing cooperatives and associations.

3.2 Promotion strategies in the IMPACT project

The Danish Energy Authority plans to launch a wide range of information activities to support the entry into force of the new energy certification scheme on 1 April 2006 with a transition period until1 September 2006.

The activities are part of an overall alliance strategy intended to equip relevant professional groups with direct contact to the end user contact to provide correct advice on the specific certification and on energy savings in general.

Consequently, the professional groups operating in the field of energy savings have been consulted during the entire planning process of the new schemes. Furthermore, the Danish Energy Authority is holding a number of meetings with selected trade organisations to discuss possible new information activities and cooperation about joint activities targeted at end users after 1 September 2006.

To support the alliance partners in their information efforts from 1 September 2006, when the scheme enters fully into force, the following initiatives have been planned:

- Detailed brochures targeted at professional groups. The purpose of the brochures is to introduce the new scheme when it is fully implemented on 1 September 2006.
- An information leaflet targeted house-owners. Primarily, the leaflet is to be handed out by the energy consultants performing the certifications (i.e. in connection with purchase or sale of a home or a property). The purpose is to urge house-owners to carry out the energy savings suggested in the certification. There will be different target groups in different types of property as mention earlier and this means that different ways of communicating messages about energy saving would be needed.
- A press kit about the new scheme for national and local newspapers as well as trade magazines.
- Continuous updating of information about the scheme on the Danish Energy Authority's web site, www.ens.dk.
- Contact with energy consultants and end users on a daily basis through the scheme's secretariat.

4 Building structure

4.1 National building structure

In Denmark there are approximately 1.5 million small buildings, which were under the EM scheme. About 50,000 new certificates were issued every year.

There were approximately 28,000 large buildings which should be certified every year under the ELO scheme. Nearly 50 % (15,000) of these buildings were actually certified every year.

Table 2. Characteristics of the Danish housing stock.

Population within the housing stock	**Number of dwellings expressed in:**	
	1000 dwellings	**Percentage of total stock**
Single family houses	129	5.0
Farm houses	1034	40.1
Terraced houses	326	12.7
Multi-family houses	978	37.9
Other	56	2.2
Total housing stock	2523	100

Blocks of flats, ownership	**Number of dwellings expressed in:**	
	1000 dwellings	**Percentage of total dwellings in blocks**
Owner occupied	460	47.1
Social housing for rent	374	38.3
Private housing for rent	100	10.2
Other or unknown	44	4.5
Total blocks of flats	978	100

Danish 2002 figures from the Danish Statistics on-line service.

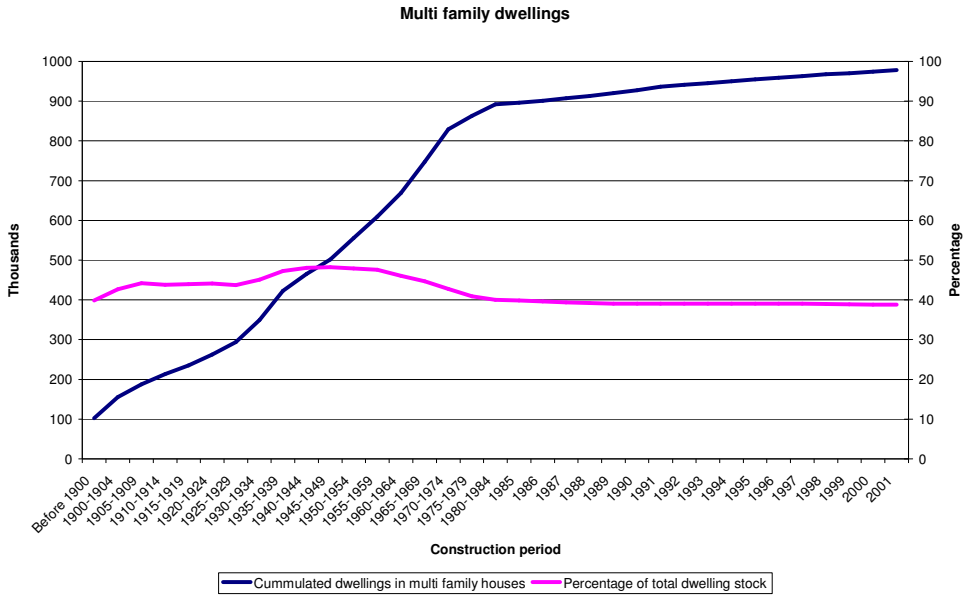


Figure 1. Cumulated number of dwellings in Danish multi family houses and in percentage of the total housing stock.

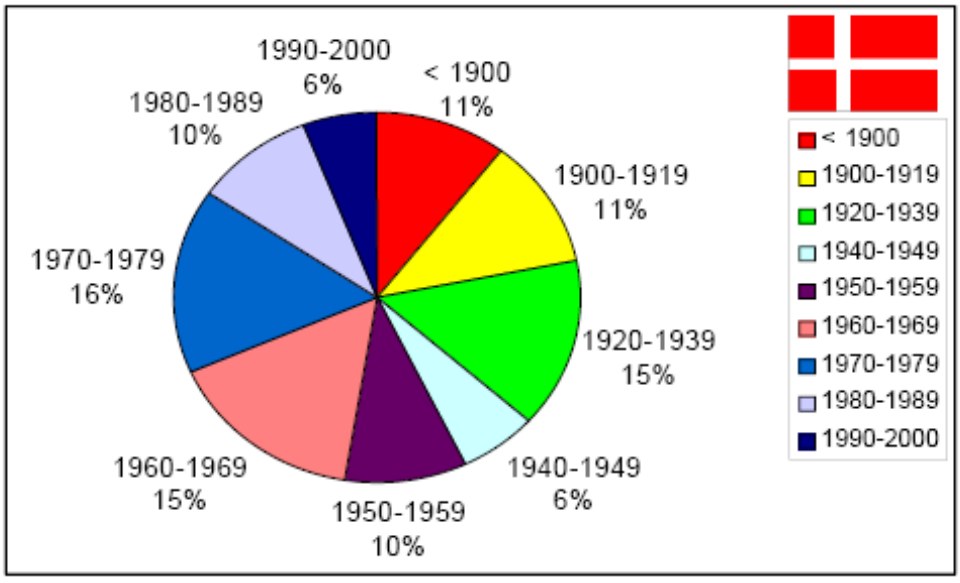


Figure 2. Dwellings in Danish multi-family houses, distributed according to the year of construction.

Approximately 10 % (approx. 47,000) of all rented flats are re-occupied every year in Denmark.

4.2 Buildings in IMPACT tests

For the first tests, there were six residential multi-family buildings representing a total of 240 flats.

Six blocks of flats have been selected for the first tests. These buildings cover three different heating sources (natural gas, district heating and oil – all as central systems) and different periods of construction. The year of construction plays an important role for the typology of the building – in general, the older a block of flats is, the more variation there is between the different apartments in terms of constructions and geometry.

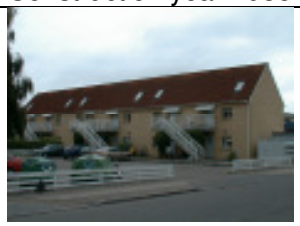
As a certificate must be issued for each flat, it has been decided to divide the block of flats into some typical flats. This is done to prevent double work by certifying numerous identical flats in a large block of flats. A typical flat is selected as a unique unit in terms of: location (under roof, at garble, exterior wall area, solar incidence, etc), constructions in the thermal envelope, and heating system in case of individual heating systems.

The test buildings are the following:

Gammel Kongevej.
Construction year 1891. Area 1663 m^2.

Skånegade.
Construction year 1935. Area 4550 m^2.

Rosenørns Alle
Construction year 1918. Area 1750 m^2.



Brandholm Alle
Construction year 1988. Area 1580 m^2.

Halskovsgade
Construction year 1965. Area 4925 m^2.

Søborg Hovedgade
Construction year 1948. Area 2543 m^2.

Figure 3. Blocks of flats selected for the Danish IMPACT tests.

The chosen buildings are representative of the general building stock as they vary in age and size.

5 Building inspection

5.1 Overview of building inspection

The qualifications to being an energy consultant for multi-family houses are to be an engineer or having a corresponding education. Furthermore at least three years' documented practical experience within the last five years is necessary. For single-family houses there are other requirements for qualification.

5.1.1 Specific past experiences

In the old schemes there were about 1,200 accredited, active consultants. Two (below mentioned) secretariats supervised and controlled the work of the approved energy consultants and took care of reported data. Based on these data the secretariats produced annual reports for the scheme.

EM secretariat (Energy Labelling Scheme secretariat) managed by the Danish Energy Authority was responsible for the old Energy Labelling Scheme. The secretariat supervised and controlled the work of the approved energy consultants and collected data from the certification. ELO secretariat (Energy Management Scheme secretariat) managed by the Danish Energy Authority was responsible for the old Energy Management Scheme.

EIS Secretariat (Secretariat of Energy Management in Denmark) managed by the Danish Energy Authority was responsible for the old Energy Management in the State. The secretariat supervised and controlled the work of the energy-responsible in public institutions and took care of reported data and based on these produced annual reports.

5.1.2 National approach for new experts

In Denmark the training in the old schemes was based on courses with duration of two times three full days, ending with an examination. In order to be approved in the EM scheme as an energy consultant one must be a trained engineer, architect, construction designer or the like. In addition the energy consultant needed minimum of 5 years documented, relevant experience in building technology and energy consultancy. The consultants had to have a compulsory professional liability insurance, which must be kept in force at least 5 years after the last certification. Further, they were obliged to take the admission course for the Energy Certification Scheme and have passed a test.

In addition, all consultants had to follow a yearly one-day training course, and they received a newsletter informing them about new rules, clarifications, frequently asked questions and general information about the development of the scheme at least four times a year. The information for the consultants was based

on experience from the quality control, reported energy certification and technical research and development.

Around 500-600 EM consultants were registered in Denmark.

A typical ELO consultant was an engineer, who had to have at least four years of energy advising experience over the last five years. The consultants and the company that he worked for had to be covered by a professional insurance. The ELO consultant or his company paid a yearly fee of € 470 ex. VAT, a fee of € 20 ex. VAT per finalised case, and fees for received material. In addition, the mandatory ELO training course costs around € 2560 ex. VAT per person. The collected fees amount to a total of € 240000, which covers the services of the secretariat.

Around 500-600 ELO consultants are registered in Denmark.

In order to be accredited as an energy consultant one in the new schemes must be a trained engineer, architect, construction designer or the like, and one must have taken out mandatory, professional liability insurance. In addition the energy consultant needs a minimum of 4-5 years documented, relevant experience in building technology and energy consultancy.

Education of the consultants has started in spring 2006. The number of consultants is nearly the same as in the old schemes. The accreditation scheme will be divided into two different educations, targeting each of the building segments: small single-family houses and blocks of flats (the latter with all sizes together with large public buildings (+1,000 m²)).

5.1.3 National quality control infrastructure

In the Danish EM scheme, every energy certificate had to be reported to the secretariat for the energy certification. The report included the date, information on the building, information registered during the audit, most of the calculation results, and all proposals for energy saving measures from the energy plan. The energy plan should include the required investment, and estimated savings. Reporting also included thermo physical values for every building part, expected losses in the boiler, pipes and tanks, data for solar gains, number and state of different appliances etc. All data were registered in a database and were controlled automatically by the system for lacking information or typing in failures and secondly by the secretariat.

Certification data that did not meet the requirements or was suspicious were investigated further. All data in the database were used on a regular basis to calculate the number of certified buildings, and the number was compared with the amount of buildings sold in the same period. In addition, the data were used to calculate the number of proposals, the investments and the possible savings and other kinds of information from the scheme. The quality assurance system was designed to identify the general situation of the certification and to identify specific problem areas in the scheme.

The general status and registered problems were used as input for information to the consultants in training courses or in the regular information letters. Whenever it was necessary, additional training or additional control was carried out. Several quantitative and qualitative investigations of the consumer acceptance of the scheme and the number of measures had been carried out, and investigations of the barriers for the use of the scheme and for carrying out the energy savings have been made. The results have been used for improvement of the scheme, for instance the layout of the scheme small buildings was changed.

Further, the quality of the certification was investigated through a quality control system including new certification of randomly selected buildings (1 out of 500 cases). This included a new calculation of the energy consumption and comparison of registration as well as the proposals for energy saving measures. A visual control of some of the certification forms was made in at least 1 out of 100 reports to see if all information was presented in an accurate way, etc. Consultants who did not meet the quality of the certification lost their accreditation and permission to work as an EM consultant.

The committee of the energy certification of small buildings and the secretariat treated complaints about the energy certification of a building. If major failures were identified, the consultant had to provide a new certification and could be held responsible for economic losses by the owners. If the consultant did not meet the requirements, the committee had the right to withdraw the accreditation or could make additional quality inspections. The Danish Energy Authority treated disagreements and complaints of the decision of the committee.

It is very important that the rating is reliable, and it has to be done by someone who has an extensive knowledge of buildings. Denmark has had big problems (in the rating for small buildings) to have building owners understand the difference between the calculated rating (for an average family) and the amount they actually pay. It has to be clarified and explained in the certification paper.

The establishment of a coherent quality control has had a relatively high priority in the Danish ELO scheme. Experience obtained through the early years of the scheme showed that it is evident that energy certificates and plans have a high level of reliability and uniformity, if the scheme is to gain ground in the sector. The quality assurance consisted of the following procedures/initiatives:

- control of randomly selected reports by inspections covering around 5 to 10 % of all reports
- quality assurance as result of enquiries
- external evaluations

The use of the standardised software program ELO-PC ensured that data were treated in a consistent way and that obvious errors and missing information were caught during entering data. However, experience showed that the built-in auto-

matics of the program also had the disadvantage that some ELO consultants tend to focus too much on the program and its output. Some of the examples are:
– uncritical use of ELO-PC standard solutions,
– lack of comments on conspicuously high consumption levels,
– lack of engagement and use of own observations.

For the new schemes Denmark has got a new secretary called FEM-sekretariatet (Five-secretariat) as they are in charge of five different schemes:
1. Energy certification
2. Dwelling inspection scheme (from 1 July 2006)
3. Inspection of oil, solid fuel and large gas boilers plus 15-year inspection of heating systems
4. Inspection of ventilation and air-conditioning plants (from 1 January 2007)
5. Energy efficiency in state institutions (EiS)

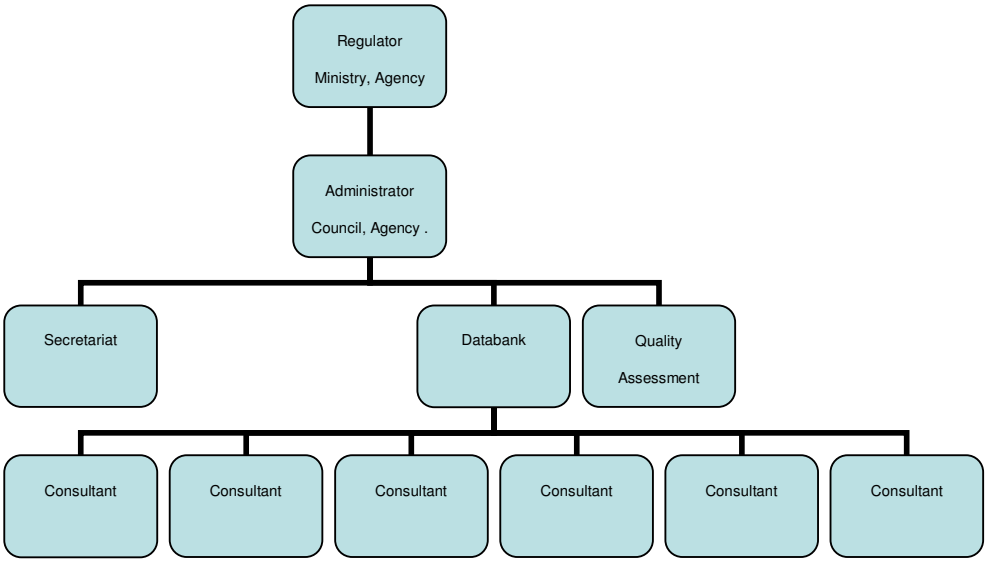


Figure 4. New scheme – overview of actors.

The secretariat is not in charge of the quality assessment of energy certification of buildings. The quality assessment consists of the following points:
- All certifications must be reported,
- Number when reporting (each certificate gets a unique number),
- Automatic screening by receiving,
- General control for instance by consultant,
- Visual control - desk report control,
- Field control - new inspection and report,
- Complaints from consumers,
- Other activities.

These tasks was made an invitation to tender, and was settled in summer 2006. Quality assessment is thus managed by a private union of impartial companies.

Automated screening: Screening of input data is managed by the user interface. Takes place automatically in conjunction with the electronic reporting of the certificates by the consultants.

Electronic screening: Statistic database review based on pre-defined criteria. The purpose is to select all reports that considerably deviate from the average.

Manual screening: Advanced statistic analysis of tendencies and patterns in the reporting for the certificates. The purpose is to assess development in the schemes.

Desk Inspection: Review of prints of energy certification, technical reports (however, only in relation to 15-year inspections) and property condition surveys. The purpose is to ensure that the certification/ reports comply with the requirements defined in handbooks and guidelines and which are not in general erroneous.

Technical audit: Inspection of completed certification/reports when visiting and inspecting the building (the secretariat does not conduct the physical inspection itself, but hires independent, renowned consultants).

5.2 Building inspection in IMPACT test

5.2.1 Approach

Two consultants performed the test (inspection and calculation) and furthermore SBi and the Danish Energy Authority followed up and participated in all the stages of the test.

A draft handbook to help the consultants in the field survey was made available. SBi and the Danish Energy Authority check the calculations. The new scheme and handbook with inspection advises has been tested.

Six blocks of flats was selected for the tests. A description of the block of flats is found in section 4.2.

5.2.2 Experts in the test

In IMPACT no bigger group of experts were trained, only existing consultants performed the test.

The group of persons involved in the establishment of a new certification scheme for flats in the IMPACT project consists of experts and central stakeholders as follows:

– Jens Laustsen (Danish Energy Authority) is the main responsible for implementation of the EPBD for flats in Denmark.
– Kirsten Engelund Thomsen (Danish Building Research Institute) is a renowned researcher and a teacher of the certified consultants for the old energy labelling of small buildings (EM).

– Kim B. Wittchen (Danish Building Research Institute), a renowned researcher who has worked for many years with energy savings in new and existing buildings.
– Rie Mayland Nielsen (Danish Building Information Centre) has been strongly involved in the development of the old Danish certification schemes.
– Marlene Rafn (Danish Building Information Centre), an engineer who has worked for many years with energy savings in new and existing buildings.
– Anette Schack Strøyer (Actual Energy Consultancy), a very skilled and accredited energy consultant for the old energy management scheme (ELO) and sparring partner for the ELO secretariat for improving the scheme.
– Yvonne Schack Barding (Actual Energy Consultancy), a very skilled and accredited energy consultant for the energy certification of small buildings.
– Pia Mortensen (The CommunicationCompacy) appointed by the Danish Energy Authority to make a new, common design for the certificates of the new energy certification schemes.

A formal agreement of collaboration among the Danish stakeholders dealing with the implementation of the EPBD in Denmark was decided. The Danish Energy Authority and Danish Building Research Institute are the core key-players and other relevant national partners were contacted for various tasks e.g. a communication expert.

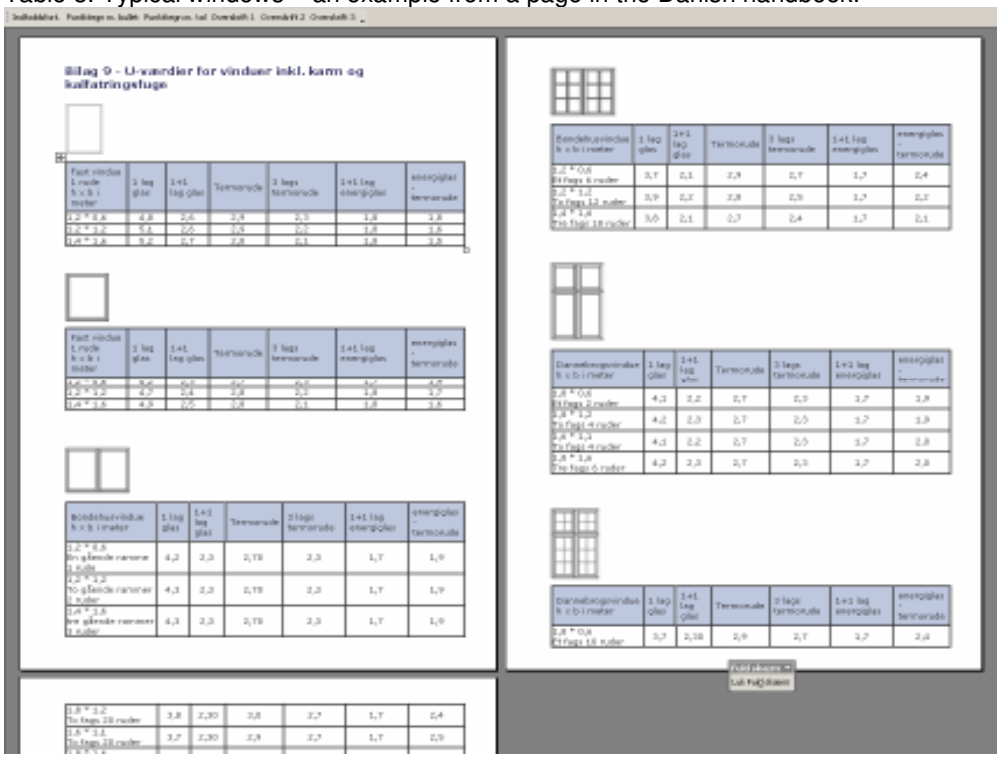
5.2.3 Results of Evaluation

In average the inspection lasted two to four hours depending of the size of the building.

The handbook is the daily guide for the energy consultants and an indispensable tool. The handbook has the following "expression", which has to be followed:
- **Must:** Mandatory, only selection among listed values
- **Should:** Can choose different, but must be able to explain
- **Can:** Some values, others can be used too
- **Examples:** Free / to be used as inspiration

It is important to emphasise, that the consultants distinguish between rules and recommendations.

Table 3. Typical windows – an example from a page in the Danish handbook.



5.2.4 Lessons learned and recommendations

A good handbook for the consultants is essential.

High quality control is necessary as if the quality is poor, people will turn the back on the certificates. Quality assessment is essential, as good consultants might do a good work without it, but bad consultants will not. Creditability will be lost very fast. Few poor reports can do a lot of damage! Quality assessment is to be based on clear rules and need to be based on clear procedures. It should be written down and should be publicly available. If rules are known, users can help by keeping up quality.

6 Calculation of energy performance

6.1 Overview of calculation methodologies

When implementing the EPBD, Denmark will take the opportunity to tighten the energy regulations governing both new and existing buildings as well as the rules for certification schemes. The energy regulations and the rules for energy certification will be linked in several ways. Before a building permit can be given, a calculation of the energy demand has to be performed. Before the official permit to use a new building is given, an energy audit has to be performed by an accredited energy consultant to check that the assumptions used for calculating the energy demand are correct. The same calculation method (the same "engine") will be used in both cases.

SBi has developed an electronic tool for calculating the energy demand for a building (called Be06 [3]). There has been great focus on the balance between:

– degree of details and calculation accuracy,
– the complexity and applicability, and
– to stimulate the motivation for energy-efficient solutions and optimisation.

In principle it is the same method used for all kinds of buildings, but the amount of input data can be quite different when describing a dwelling and a big office building respectively.

As far as possible the calculation method is based on CEN standards and the proposals to these. With the new energy regulations, the energy frame for new buildings will always have to be calculated and will include energy for heating, hot water, cooling, ventilation and electricity used for fans and pumps and also electricity used for lighting in non-residential building. The calculations account for renewable energy sources (i.e. passive solar energy, solar collectors, and photo voltaics), techniques and systems like heat recovery and heat pumps as well as energy source for heating. Based on the delivered energy needed under standard indoor and outdoor conditions, the energy demand is calculated as monthly values. The calculation engine is the core of the method and will be updated with new CEN standards as they become available. The graphic user interface (GUI) can be made depending on the use of the program e.g. for building regulations or for energy certification.

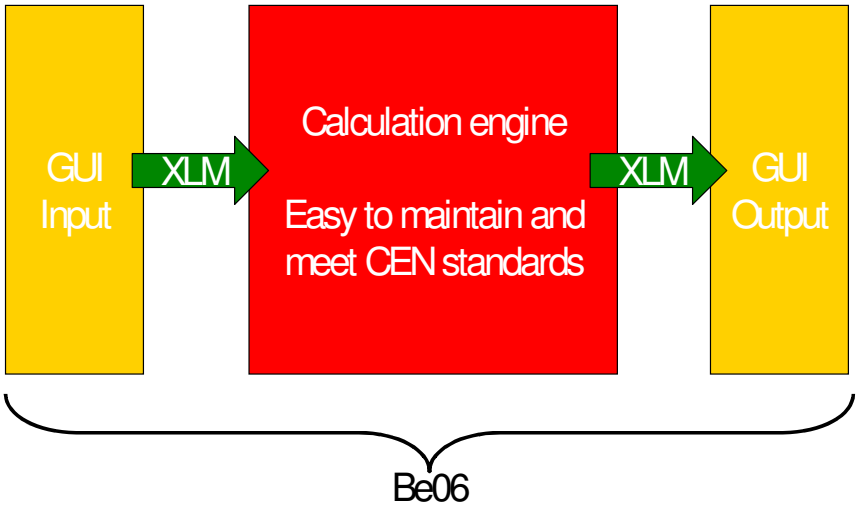


Figure 5. New Danish calculation tool.

6.2 Calculation methodology used for IMPACT test

6.2.1 Approach

A newly developed method for calculation of the energy performance to meet requirements in the Building Regulation has been used. The calculations were performed after the inspection and not used as a verification of the method.

The tool for Building Regulation was released 1 January 2006. The program interfaces for certification purposes are still under development, but the calculation engine will be the same as for the program for Building Regulations.

The tool is chosen as it is the approved national tool for calculating energy performance in relation to the EU Building Directive.

6.2.2 Results of evaluation

The consultants used the program and the consultants' handbook when making the inspections and the calculations. U-value demands in the different building codes over time are mentioned in the handbook. Furthermore suggestions for tables in the handbook for energy consultants on heat losses from heating distribution pipes should be revised to meet the requirements for blocks of flats.

In IMPACT an investigation of the different energy billing approaches in Denmark was made in order to find a way to distribute the costs to flats with a common system (heating and water). A majority of Danish blocks of flats have a collective heating system (district heating 87.3 %, other collective heating 11.2 % and individual heating 1.5 %).

The energy consumption, as described in the EPBD, in a block of flats is calculated as a whole, and must then be distributed to the individual flats. This distribution is not trivial as the location of the flat within the block plays an important role in the energy consumption of the flat. This is one of the reasons for investigating this topic.

The second reason is that the distribution of the energy bill to the individual apartments in a block of flats is important in terms of being able to compare the calculated energy consumption for the block of flats with the individual energy bills of the flats.

There are large differences in the way different companies distribute the energy bill to the individual flats, so the following decision was made in the beginning of the tests:

– In case of presence of correction factors (that means if payment for the heating is already adjusted for flat location), then the consumption distribution will be done by area.

$F_n = G + A * f_{gm}$

where F_n is the flats energy consumption in flat n,
G is a basic, area independent, energy consumption per flat and
f_{gm} is average consumption per m² area (adjusted the basic amount G).

– In case of no correction factors the distribution will be made according to the distribution factors defines in the current EM labelling scheme. In most flats are not paid for the actual consumption as the account is often corrected for the flat location so all pay the same comfort independent of the flat location.

$F_n = G + A * k_n * f_{gm}$

where F_n is the flats energy consumption in flat n,
G is a basic, area independent, energy consumption per flat
k_n is a correction factor due to location and
f_{gm} is average consumption per m² area (adjusted the basic amount G).

Another possibility is to calculate each flat individually from the start (in the program it is not possible to split the building into several zones).

Table 4. Typical correction factors because of location in a building with 6 floors and a basement.

	Roof						
House end	117%	107%	107%	107%	107%	117%	House end
	102%	92%	92%	92%	92%	102%	
	102%	92%	92%	92%	92%	102%	
	102%	92%	92%	92%	92%	102%	
	102%	92%	92%	92%	92%	102%	
	112%	102%	102%	102%	102%	112%	
	Basement / foundation						

The selected blocks of flats have been divided into typical flats and the number varies from four types in a 44-flat block to 13 types in a 17-flat block. Division into typical flats is important to gain credibility to the calculated energy consumption in the certificate. The consultant who made the test certificates stated that it would

be nearly the same effort to make a “detailed” and a simple building model. The detailed model is made so the results from the typical flat will be given and also the result for the whole block of flats in one calculation. It is only a matter of preparation before making the input (that means that it is necessary carefully to look at the drawings before input starts and decide how the building should be split up). In the simple model the entire block is represented as one, and then the typical flat have to be calculated by means of correction factors. The advantage of the detailed model, where the different types is defined beforehand, is also that the results can be used for other purposes as well, e.g. dimensioning of a new radiator system.

This approach was later found to be too difficult, and a simpler model was chosen (see section 7). It was decided to test both approaches in one of the selected blocks of flats. The tests were performed in August and September 2005.

In the test and in the certificate the measured data were presented. The owners/tenants will not see the calculated results. They are used for finding the energy classification and the energy savings.

In total (including inspection) it took the following time to perform an energy certificate for the whole building incl. flats (for an experienced consultant):

- Brandholm Alle: 11 hours
- Søborg Hovedgade: 16 hours
- Skånegade: 11 hours
- Rosenørns Alle: 12 hours
- Gl. Kongevej: 14 hours
- Halskovgade: 15 hours.

6.2.3 Lessons learned and recommendations

The calculation tool is easy to use, but a good handbook is necessary. It was decided – always - to calculate the energy consumption in a block of flats as a whole, and then distribute the consumption to the individual flats by area independent of the distribution of the energy bill to the individual flats.

The calculation of areas has taken about 2-7 hours depending on the building age and size. Entering data for the calculation has taken in average 7 hours per building.

In total, including inspection, it took 11-16 hours to make a certificate for residential buildings between 1,500 and 5,000 m^2.

These timings are valid for a first time inspection and calculation of a residential building in the new Danish certification scheme. A second time inspection will take less time as the building model for the calculation tool is available from the first inspection and the consultant can focus on changes made to the building since the previous inspection.

The efficiency of the assessment process to obtain an EP certificate for a building is of high importance. Many member states are well aware of the importance and potentials of the EP certificate for the improvement of the energy performance of the building stock in the near future. At the same time the cost for the EP certificate is a concern.

In order to design an efficient and effective energy performance assessment method, knowledge is needed on the interaction between:

- the physical accuracy and calculation
- reproducibility (deviation due to differences between inspectors using the same method)
- time effort for building inspection related to the complexity of the required data.

7 Energy performance certificate

7.1 National overview energy certificates

From the beginning of 2006, Denmark will have different certifications for different building types:

- Single family houses
- Buildings with flats
- Buildings for public services, trade and services

In principle the certificate is the same for all building types with only small variations, such as the logo etc. All relevant groups of information are the same for the different certificate types.

Concerning multi-family buildings:

1. The measured climate-corrected heating consumption for the whole building is written on the first page of the certificate.
2. A calculation is made for the whole building with standard input data (fixed temperatures, internal gains etc.) used to give the energy classification A1 to G2.
3. The same energy classification is used for each of the typical flats.
4. A new calculation is made with actual input data, which is used to propose energy saving measures and matching pay-back periods.
5. The certificate will describe the whole building on 6-8 pages and additionally each flat will be described on one page. This page will have a description of how the individual payment for each flat is being done for this building and furthermore energy consumption based on the calculation described in bullet No 1 divided by the total area and multiplied by the area of the flat.

In some countries many flats are heated with individual heating systems. Then a more applicable method is to calculate each flat individually from the start. Alternatively the energy consumption in each flat can be distributed according to a distribution key similar to the one described in Section 6.2.2.

The measured consumption will be mentioned, but there will be made no comparison with the calculated value. This is impossible, as the calculated consumption is a mix of heating and electricity consumption (and furthermore electricity is multiplied by 2.5).

A certificate for a block of flats and a typical apartment is enclosed in the Annex.

As mentioned, the measured energy consumption is shown to the left of the certificate at the first page of the certificate as seen below.

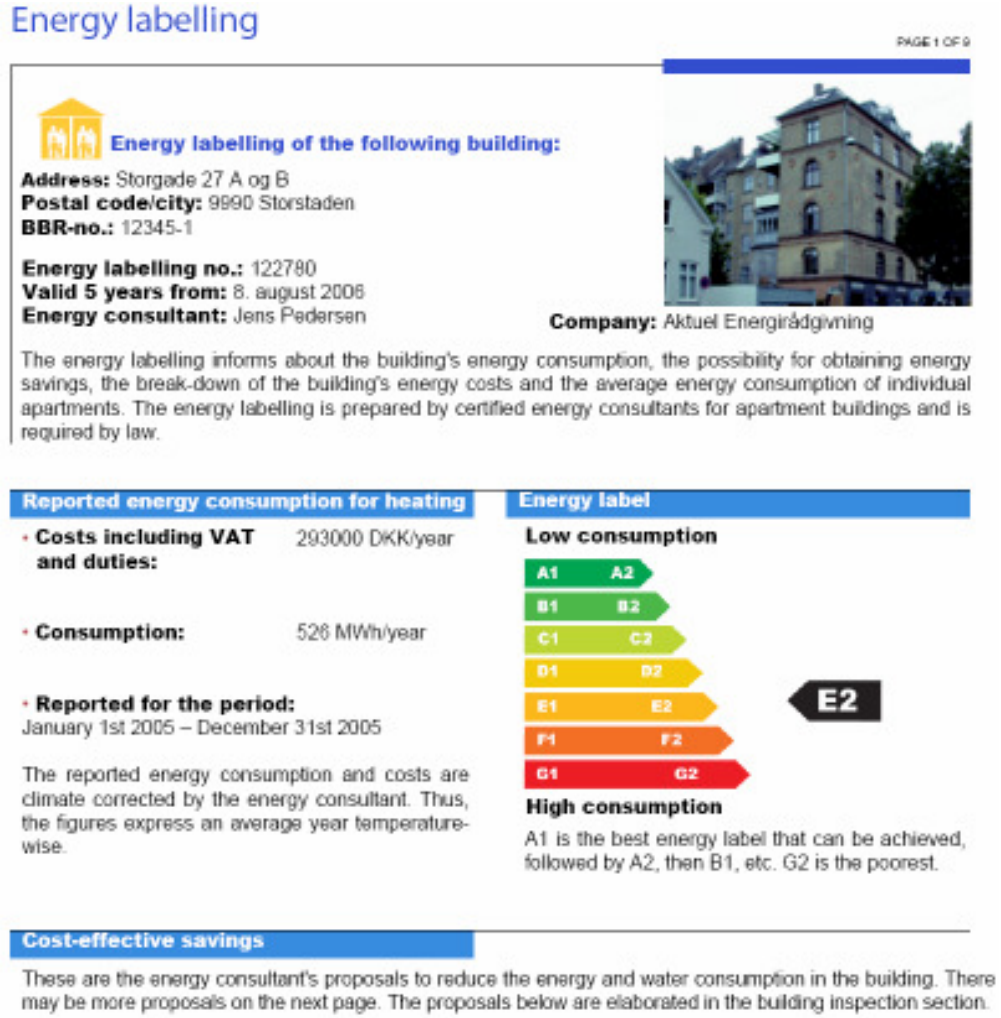


Figure 6. Example lay-out for page 1 of certificate for a block of flats.

Energy labelling

PAGE 2 OF 2

Energy labelling no.: 122780
Valid 5 years from: 8. august 2006
Energy consultant: Jens Pedersen

Company: Aktuel Energirådgivning

How the heating bill is made up

In this building, the heating bill is made up with a correction for exposed location against roof, facade or end wall.

The average costs of the individual dwellings

The energy costs of the individual dwellings depend on the total energy costs of the building. Therefore, it is in the interest of the individual residents that the building as a whole is in good energy condition, despite the fact that the energy loss may take place in an area outside of the individual dwelling unit, for instance in the heating installation. The building has different types of dwelling units. Below is an overview of the energy costs of the individual dwelling units.

Type	Area in square metres	Average annual energy costs
Apartments ground floor to the 4th floor	111	12700 DKK per year
Apartments on the 5th floor	87	9900 DKK per year

Figure 7. Example of certificate lay-out – page with information of the flat.

7.2 Energy certificate(s) used for IMPACT test

7.2.1 Approach

The lay-out of the certificate has been discussed and further developed in the IMPACT project and a final lay-out released in March 2006.

In the first test we had a certain lay-out of the certificate which was improved afterwards. In the second test round we used the final lay-out.

In some multi-family buildings there will be a certain number of flats, who have the same size e.g.:

- one-room: 45 m^2
- two-room: 57 m^2
- three-room: 76 m^2

In this case the energy consultant will insert these in the certification scheme and for each type calculate the average heating demand.

In other buildings there are great variations in the sizes of the flats. In these cases the energy consultant can choose to make some average assumptions e.g.:

– Flats between 40 and 50 m^2
– Flats between 50 and 60 m^2
– Flats between 60 and 70 m^2
– Flats between 70 and 80 m^2

The categories above should be adjusted for the actual building. Normally a category mustn't exceed 10 m^2. The consultant should consider an appropriate way to present the consumption of each flat.

7.2.2 Results of evaluation

Interview survey among end users of the new Danish energy-labelling certificate for flats – Test 1 in 2005.

In conjunction with the work on drafting the lay-out of the new energy certificate, the draft was presented to eight randomly selected tenants in five blocks of flats.

The blocks of flats were selected to have a variety in construction year and size. The five blocks of flats were constructed in 1891, 1935, 1918, 1988, 1965 and 1948. Ownership of the blocks of flats does also vary and covers owner-occupied dwellings, housing cooperatives and rented dwellings.

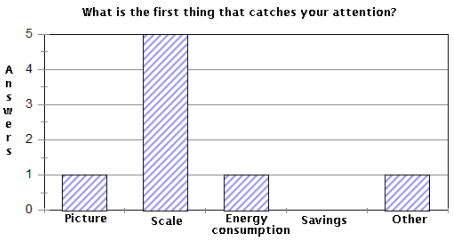
One of the blocks has not been under the ELO labelling scheme and the owner was not acquainted with the old labelling scheme.

One block of flats was heated by a central gas burning stove, one by oil burning stove and the rest by district heating.

Question 1

What is the first thing that catches your attention when you look at the draft energy certificate?

It is clear that the scale is the central point regarding attention. The answer "Other" covers the answer "The yellow logo" of the certificate (nothing to do with energy).

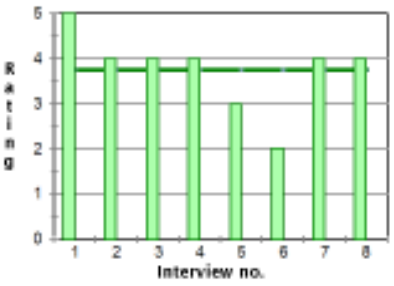


In the following questions the respondent was asked to give an evaluation on a scale from 1 (poor, in-transparent) to 5 (best evaluation, very easily seen through).

Question 2

What is your first immediate impression of the draft of the new energy certificate when you give it a quick glimpse?

On a scale from 1 (poor, in-transparent) to 5 (best evaluation, very easily seen through), the average rating is 3.8 with a variation between 2 and 5. This is considered as being a positive experience regarding the new energy certificate.



The following comments were attached to the questionnaires:

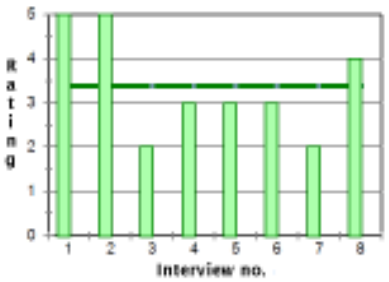
- it is a useful tool,
- it is clear,
- the new certificate increases curiosity.

Question 3

Is the scale A1 to G3 in the draft of the new energy labelling certificate understandable?

On a scale from 1 (poor, in-transparent) to 5 (best evaluation, very easily seen through), the average rating is 3.4.

The general comment is that there are too many divisions (21 on the test certificates) of the scale. The experience is confusing and badly organized. One suggested cutting the division of the scale to 5 to 7.

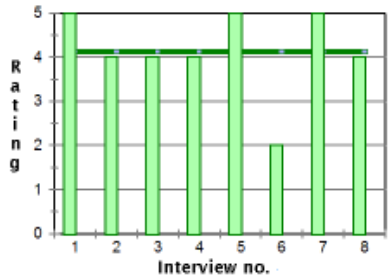


Question 4

How well do you understand the explanation of why calculated energy consumption is to be used in the future instead of recorded data?

On a scale from 1 (poor, in-transparent) to 5 (best evaluation, very easily seen through), the average rating is 3.4.

The experience is that the explanation is clear and easy to read. One person had a wish for an explanation of the wording "standard operation conditions".

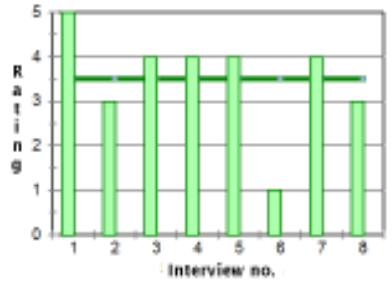


Question 5

How clear is it for you what suggestions for energy saving measures has been suggested for your block of flats, how much you can save, and what it will cost to carry out the measures?

On a scale from 1 (poor, in-transparent) to 5 (best evaluation, very easily seen through), the average rating is 4.1.

All interviewed persons felt that it was easy to understand, but some missed costs.

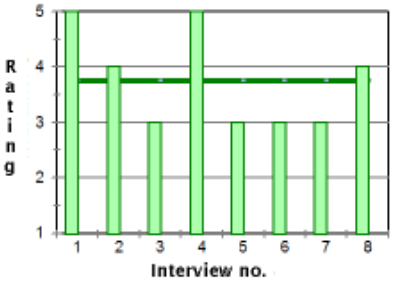


Question 6

Are you satisfied that the new energy certificate contains a more comprehensive building audit (pages 3-5 or 4-6 of the certificate)?

On a scale from 1 (poorest rating, completely uninteresting) to 5 (best rating, very satisfied), the average rating is 3.8.

The building audit is considered an improvement and most of the interviewed persons think that it is a sensible tool. Only one person rated it as being of no importance.

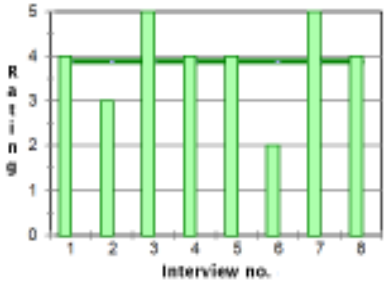


Question 7

How do you evaluate the lay-out of the energy certificate for block of flats, pages 1-7?

On a scale from 1 (poorest rating, completely unacceptable / uninteresting) to 5 (best rating, very satisfying / interesting), the average rating is 3.9.

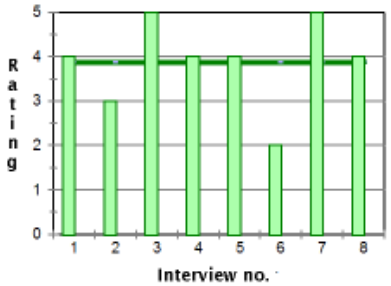
There is a general complaint about the yellow colour used in the scale.



Question 8

How do you evaluate the content of the energy certificate for block of flats, pages 1-7?

On a scale from 1 (poorest rating, completely unacceptable / uninteresting) to 5 (best rating, very satisfying / interesting), the average rating is 3.9.

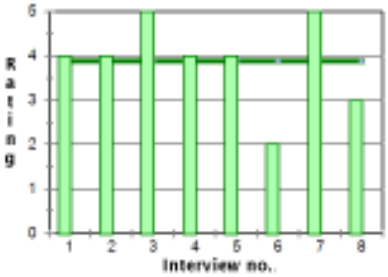


Question 9

How do you evaluate the lay-out of the small energy certificate dedicated the typical dwelling (the two last pages, 1 of 2 to 2 of 2)?

On a scale from 1 (poorest rating, badly arranged) to 5 (best rating, very clear), the average rating is 3.9.

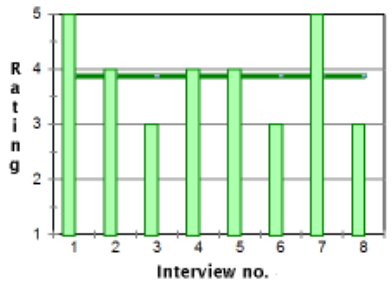
This is considered being superfluous when it is not directed to the individual dwelling. There is a general comment about replacement of toilets and white goods in the certificate for the entire block of flats.



Question 10

What is your evaluation of the content in the small energy certificate dedicated to the typical dwelling (the two last pages)?

On a scale from 1 (poorest rating, totally unacceptable / uninteresting) to 5 (best rating, very satisfying / interesting), the average rating is 3.9.

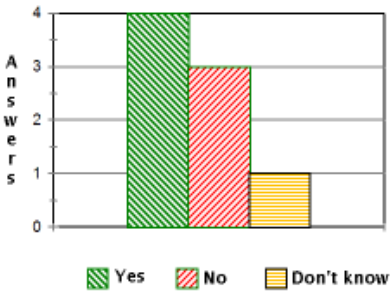


There are the same comments as for Question 9, the information could as well be shown in the overall certificate for the block of flats. One person felt that the information will be used.

Question 11

Compared with the old certificate, is the new certificate, as a whole, an improvement?

One person felt that the new certificate was clearer. Another could better relate to the old certificate, but felt that the lay-out of the new certificate was better. The photo of the block of flats did make the material more meaningful. One person missed a division between electricity, water and heating.

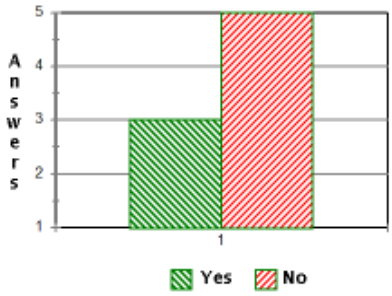


Question 12

Are there elements that you miss in the new energy certificate?

The missing elements were:

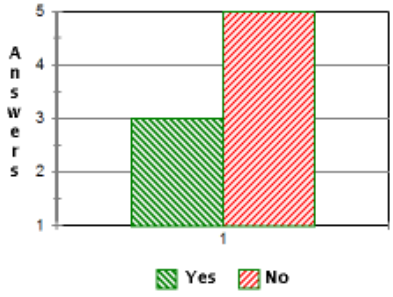
– an introduction with explanatory text,
– three labels for electricity, water and heating, as in the old certificate.



Question13

Are there elements in the new energy certificate that can do without?

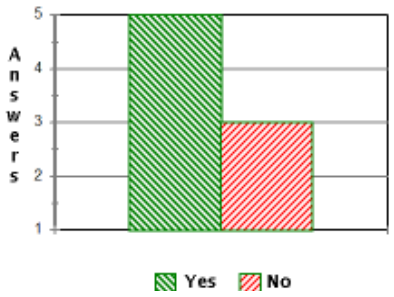
The superfluous element was the picture on page 2.



Question 14

Does the new energy certificate increase your desire for working on energy savings?

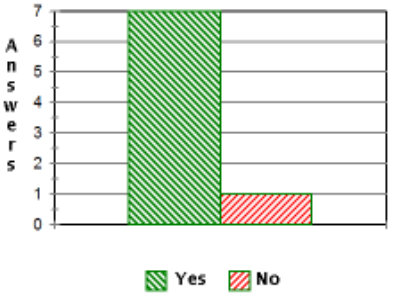
Most of the interviewed persons wanted to work on energy savings for reasons of economy.



Question 15

Do you think that an energy certification scheme is a good idea at all?

The person who said "no", find that the scheme was a waste of money. Energy savings would be made anyway, if they were economically profitable.



For certificates made on buildings larger than 500 m^2 the market price is free. Below this size the Danish Energy Authority gives some maximum prices which are allowed to use.

7.2.3 Lessons learned and recommendations

Lessons learned

The Danish Energy Authority is the body responsible for the implementation plans in Denmark and also directly involved in the working group in which the planning of the test takes place.

The test results have had a direct influence on the new Danish certification scheme for flats. There has been a positive attitude among the persons who have been asked about their opinion on the certificate.

Recommendations

A certificate must be easy to understand. Do not try to compare measured and calculated values, but still it should be possible to use both values in the certificate.

The certificate should be for the whole building with information about the typical flats.

8 Presentation to end-user

8.1 Planned national approach

In Denmark both old schemes operated in the same way with respect to communication to the end-users, who received a certificate, with a energy classification and an energy plan. The energy plan contained calculations of economic energy savings, which could be made in the building. The report was sent by mail to the end user. In the ELO scheme there was a follow-up the next year when the building was certified again.

In the new schemes the certificate will probably be sent by mail, but in the IMPACT project the consultant presents the certificate for the home-owner and in that way gets a response on the new scheme and its lay-out.

8.2 Approach in IMPACT test

8.2.1 Approach

End-users have been interviewed and answered some questions. In section 7 the questions and answers are found. In general: understandability and acceptance of the certification. Do they trust it? Does it inspire to do some energy savings? Did they know about the certification scheme beforehand?

The first test was carried out to see how the new scheme worked. The test included performing the certification schemes (inspection and calculation), making interview/enquiry with consultants and with building owners and tenants. The second phase of the tests included a large number of questions to the end-users. These results from Test 2 are shown below.

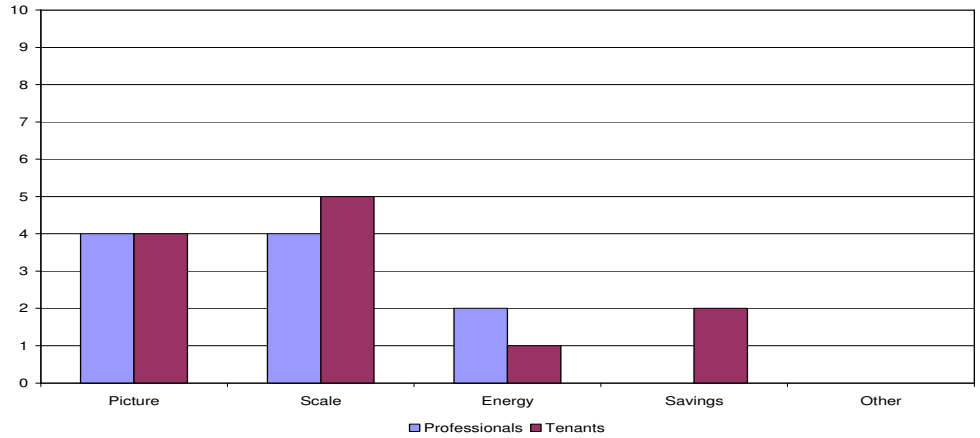
Results of Evaluation

The properties in Test 2 have all been selected because they have been energy labelled within the last five months. The selection has been random though aiming towards a geographic spreading and a spreading in the type of flat – owner-occupied flats or flats under a cooperative ownership scheme.

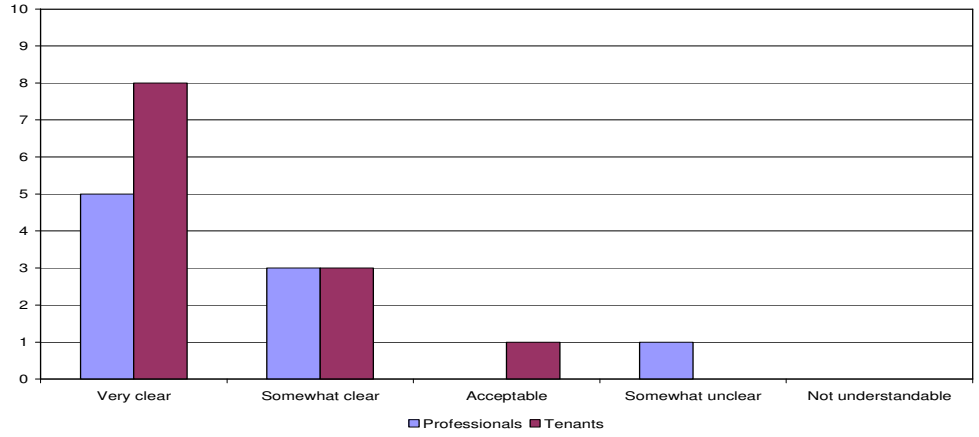
Another criterion of selection has been the type of energy used for space heating and domestic hot water. Some properties use natural gas, some use oil and some district heating.

In June 2006, 110 questionnaires were sent out to 26 property owners/administrators and 84 tenants. Twenty-two replies was returned (9 owners/administrators and 13 tenants) which add up to a percentage of replies on only 19 %.

Question 1 + 2 – *What is the first thing catching your attention when looking at the draft of the new energy certificate?*
The photograph of the property and the scale are the first things that catch the attention of the respondents. The comments show that it is the colours in general, that the respondents notice.

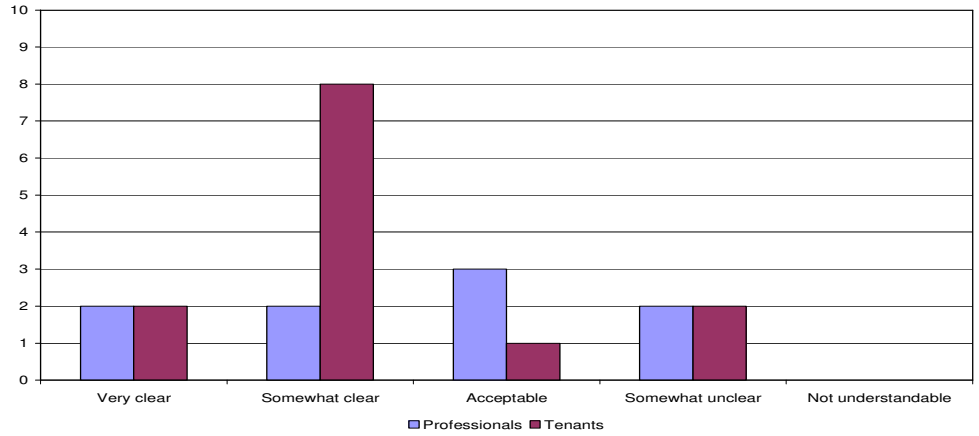


Question 3 – *Is the scale A1 to G2 in the new energy certificate understandable? The answers are on a scale from 1 (poor, in-transparent) to 5 (best evaluation, very easily seen through).*
Sixty-one % of tenants and 56 % of owners/administrators found the scale “very clear”. Furthermore 33 % and 31 % have given the evaluation "somewhat clear", which overall is a very positive result. The respondents find that the scale is easy to see and to understand, and the colouring is an advantage.



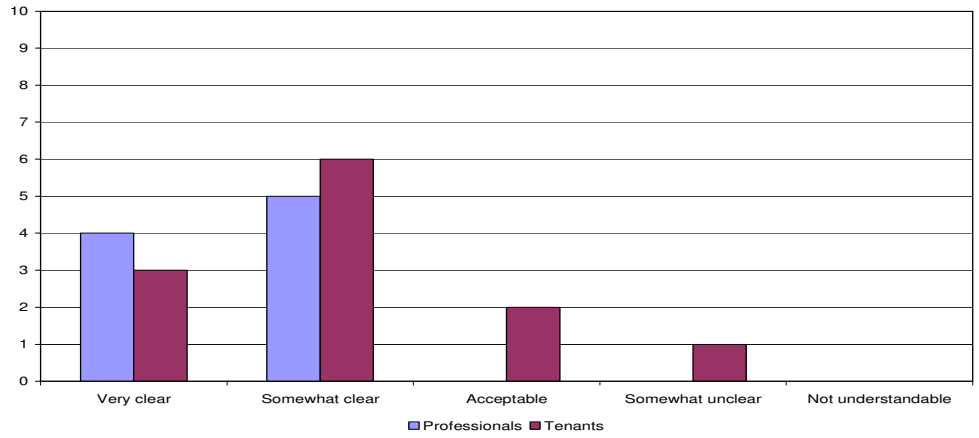
Question 4 – *How easy do you understand the explanation why a calculated consumption will be used instead of actual readings?*
As for owners/administrators, there is quite a difference of opinion of how easy the explanation is to understand. The explanation was found “Acceptable” by 33 % while 22 % found it “Somewhat clear” and 22 % “Very clear”. Furthermore 22 % found it “Somewhat unclear”.

In the group of tenants, 62 % find the explanation “Somewhat clear” .



Question 5 – *How clear is it for you, what energy saving suggestions are given for your block of flats, how much you can save and what the cost is for carrying out the measures?*

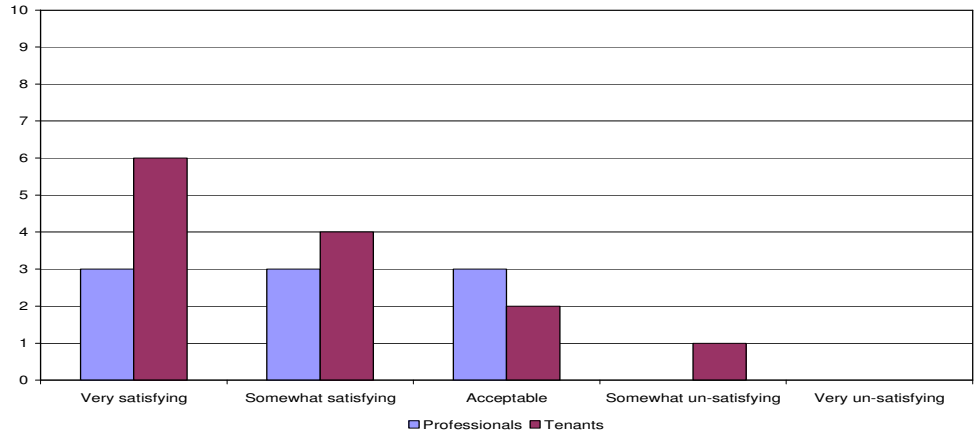
The energy saving suggestions is clear to the owners/administrators. Unanimously they give the grade "Very clear" or "Somewhat clear". Of the tenants, 69 % find the suggestions “Very Clear” or “Somewhat clear”.



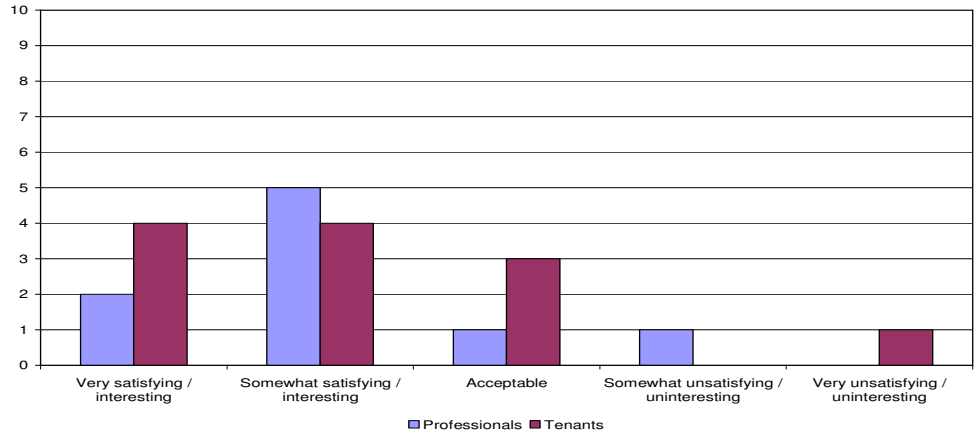
Question 6 – *Are you satisfied that the new energy certificate includes a more comprehensive building audit?*

A majority of the owners/administrators are happy with the more comprehensive building audit because it gives constructive knowledge of the property and the challenges you are facing. A minority found it only to be of importance in connection with renewal and extension of loans.

A little less than 50 % of the tenants are very satisfied with the more comprehensive building audit.

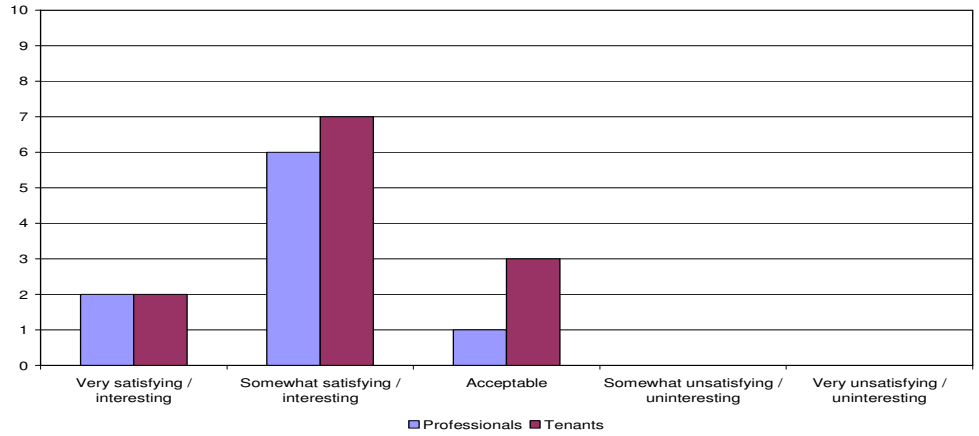


Question 7 – *How do you judge the lay-out of the certificate for the block of flats?*
Both owners/administrators and tenants are satisfied when it comes to the lay-out of the certificate for block of flats. 78 and 62 % respectively find the lay-out "Somewhat satisfying“ or “Very satisfying”.



Question 8 – *How do you judge the content of the energy certificate for the block of flats?*
The respondents are generally happy with the content of the energy certificate. 67% of the owners/administrators find it “Somewhat clear” and think the information level is all right. Some are less content.

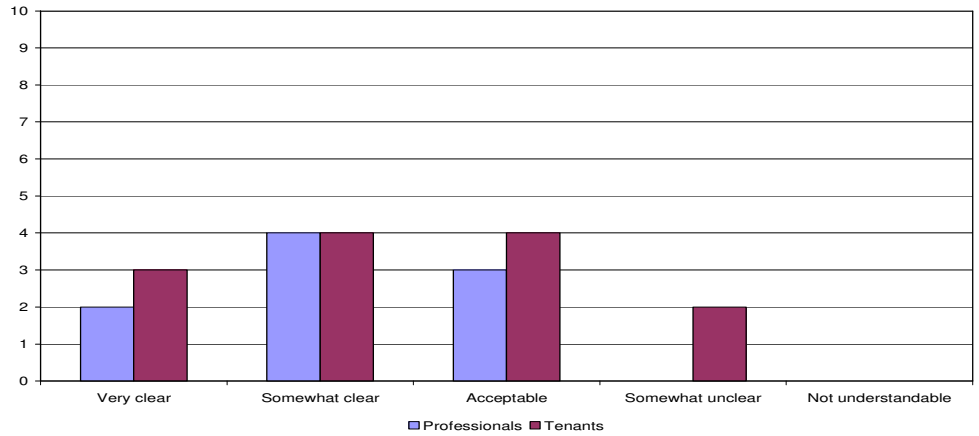
Of the tenants 54 % find it “Somewhat clear” while 23 % are more critical and find it unclear and nor exciting.



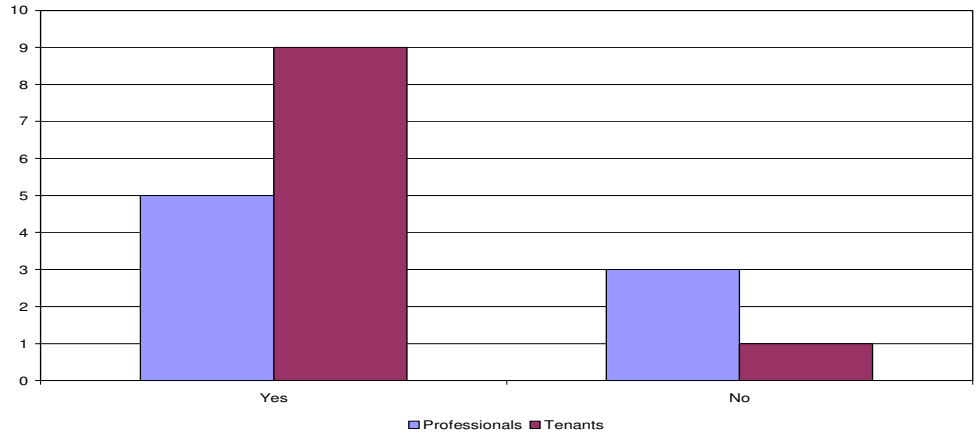
Question 9 + 10 – *What is your evaluation of the lay-out and content of the small certificate (individual flats) for the inhabitants?*

In general it scores an "Acceptable" evaluation, with 22 % of the owners/administrators finding the small certificate is "Very clear" and 44 % found it is "Somewhat clear".

The tenants evaluate the small certificate as "Somewhat acceptable" and "Very clear".



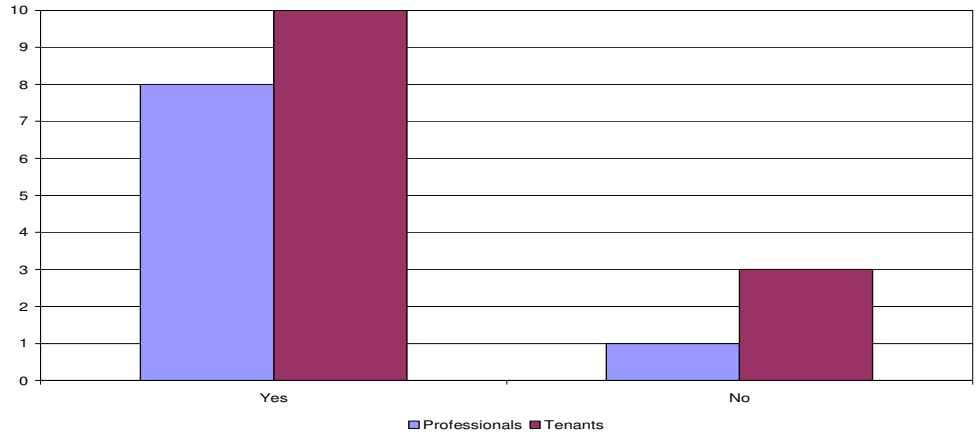
Question 11 – *Is the certificate – as a whole – an improvement compared with the previous certificate?*
"Yes" – both the tenants and the owner/administrators think it has improved compared with the old energy certificate.



Question 12 – *Do you miss any information in the new energy certificate?*
Most of the respondents said no. One person would have liked to have numbers from earlier years, so a comparison would have been possible.

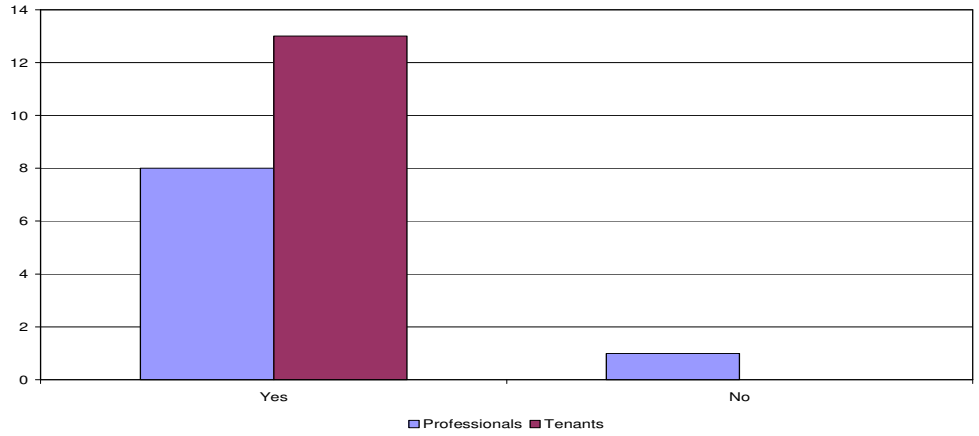
Question 13 –*Do you see any unnecessary information in the new energy certificate?*
All respondents in both groups answered "No"

Question 14 – *Does the certificate make you wish to work with energy saving?*
Of the owners/administrators 56 % want to work with energy savings and 77 % of the tenants. That implies that they wish to do something about reducing the use of energy and do some good for the environment. Especially if you get some help and guidance along the way to show you the results, more people will save energy on a daily basis.



Question 15 – *Do you, as an overall objective, think that an energy certificate is a good idea?*

All tenants found that it is a good idea, while 89 % of the owners/administrators are positive of the idea. Overall the respondents think it is a good incentive for saving energy and it helps improve the environment. At the same time it is judged very useful, and makes it easier to follow the state of the building.



8.2.2 Lessons learned and recommendations

Lessons learned

The test results in IMPACT have had a direct influence on the new Danish certification scheme for flats. The lay-out has been improved and made easier to understand both for tenants and for owners/administrators.

Recommendations

The photo of the block of flats did make the material more meaningful.

In Denmark and maybe also in other countries there is an economic and legislative barrier, which has to be overcoming somehow. An owner of social housing can, by law, not charge the tenant for additional costs spent for energy saving investments, although the tenant receives the benefits in terms of lower energy bills.

9 Conclusions and Recommendations

9.1 Recommendations for national EPBD implementation

Energy certification of flats is a delicate matter, especially when dealing with flats in old buildings. There are often many differences between originally identical flats, that have been introduced over time plus the fact that the geometry of old buildings is normally not as straightforward as that found in new industrialised buildings.

9.1.1 The certificate

The Danish certificate describes the whole building on 6-8 pages and additionally the flat will be described on one page. This page contains a description of how the individual payment for each flat is made for this building and furthermore energy consumption based on the measured climate-adjusted heating consumption for the whole building divided by the total area and multiplied by the area of the flat.

A more detailed method was suggested by the IMPACT actors, but the decision-makers found it too complicated and decided to use this simple approach.

The advantages of the new certification scheme for flats compared with the old schemes in Denmark are:
- the consumption and savings will always be calculated for the whole building
- there will always be a dependency between the flat and the whole building and
- the total cost of the certification should be lower (as some typical flats are chosen to represent all flats in the building).

The lay-out of the certificate has been discussed and improved in IMPACT. The results from enquiries among tenants and owners prove that tha resulting lay-out has a high degree of user acceptance. The measured value for heating consumption is shown and the energy classification itself is based on calculation. This value is not shown, as it is a mix of heating and electricity as described in the EU Building Directive.

9.1.2 Consultant's handbook

The handbook is an indispensable tool for the consultant for the inspection. The handbook is the daily guide for the energy consultants as:
- Base for quality assessment

- Guide for assessment of building etc.
- Guide for calculation
- Guide for advising on savings
- Guide for filling in energy certificates
- Guide for reporting / procedures etc.

9.1.3 Quality control

Quality control is necessary because, people will loose confidence in the certificates if the quality is poor. Quality assessment is essential, as good consultants might do good work without it, but less competent consultants will not. Creditability will be lost very fast. A few poor reports can do a lot of damage. Quality assessment should be based on clear rules and procedures. It should be written down and be publicly available. If rules are known, users can contribute by demanding quality. Also information quality is very important.

So far the data registration in Denmark is not perfect and part of the data material is uncertain. In particular, the registration and follow-up of the saving potentials and proposed saving initiatives do not permit a consistent assessment of whether, when and to what extent suggested saving proposals have been implemented. Hence it is recommended that registration procedures could and should be improved.

9.1.4 Communication to end-users

From 1 September 2006, when the scheme enters fully into force, the following initiatives have been planned:

- Detailed brochures targeted at professional groups. The purpose of the brochures is to introduce the new scheme when it is fully implemented.
- An information leaflet targeted at house-owners. Primarily, the leaflet is to be handed out by the energy consultants performing the certifications (i.e. in connection with purchase or sale of a home or a property). The purpose is to urge house-owners to implement the energy savings suggested in the certification. There will be different target groups in different types of property as mentioned earlier, and this means that different ways of communicating messages about energy saving will be needed.
- A press kit about the new scheme intended for dailies and local newspapers as well as trade magazines.
- Continuous up-dating of information about the scheme on the Danish Energy Authority's web site, www.ens.dk.
- Contact on a daily basis with energy consultants and end-users through the scheme's secretariat, www.FEMsek.dk.

9.2 Recommendations for other countries

As Denmark has had energy certification of flats since 1997, a lot of the recommendations given to the Danish scheme, will be valid for other member states as well.

9.2.1 The certificate

The lay-out of the certificate should be kept simple and facilitate an easy overview. Communication professionals might help to improve the understandability of the certificate. The content should be selected and shown so that the user can make a link direct from the certificate to her knowledge about the building.

Due to the complexity of residential blocks of flats, especially old ones, there should be focus on the calculation / inspection routines needed to make the certificate and to calculate energy classification. It is thus recommended to make certificates for typical flats and let these be valid for all flats of the same type. Each type of flat does not need to be 100 % identical with any other flat of the same type the flats could with reasonable accuracy be grouped based on their size. The difference in size within each category should not differ too much, normally not more than 10 m². The division into categories should be left to the consultant making the certificate and doing the inspection.

9.2.2 Inspection and calculation of the energy classification

Using a practice like the one used in Denmark will lead to reasonable time consumption for the inspection and calculation of the energy classification. In the IMPACT tests it took a skilled energy consultant a total of 11-16 hours to make a first-time certificate for residential buildings between 1,500 and 5,000 m^2. This includes inspection, calculation of the energy classification and calculation of the savings.

In some countries the flats can be heated with individual heating systems. A more reliable possibility is then to calculate each flat individually from the start. Alternatively the energy consumption in each flat can be distributed according to a distribution key similar to the one described in Section 6.2.2.

9.2.3 Quality control

The quality of the certificates is crucial for acceptance by the end-users. If the quality of the certificate and the information is poor, end users will loose confidence in the scheme and try to avoid performing the certification. It is thus important that two energy consultants making a certificate of the same building reach the same result. To ensure this the method must be standardised and robust so that minor discrepancies in the input data do not result in significant variations in the results. One way is to ensure uniformity of input data. This can be done by supporting the consultants with a limited list of default input data to select from.

These data can be located in a consultant's handbook or given in the interface of the calculation tool.

Another issue to ensure quality of the certificates is to establish an accreditation scheme for education of energy consultants and an impartial quality check system of a randomly selected number of the issued certificates.

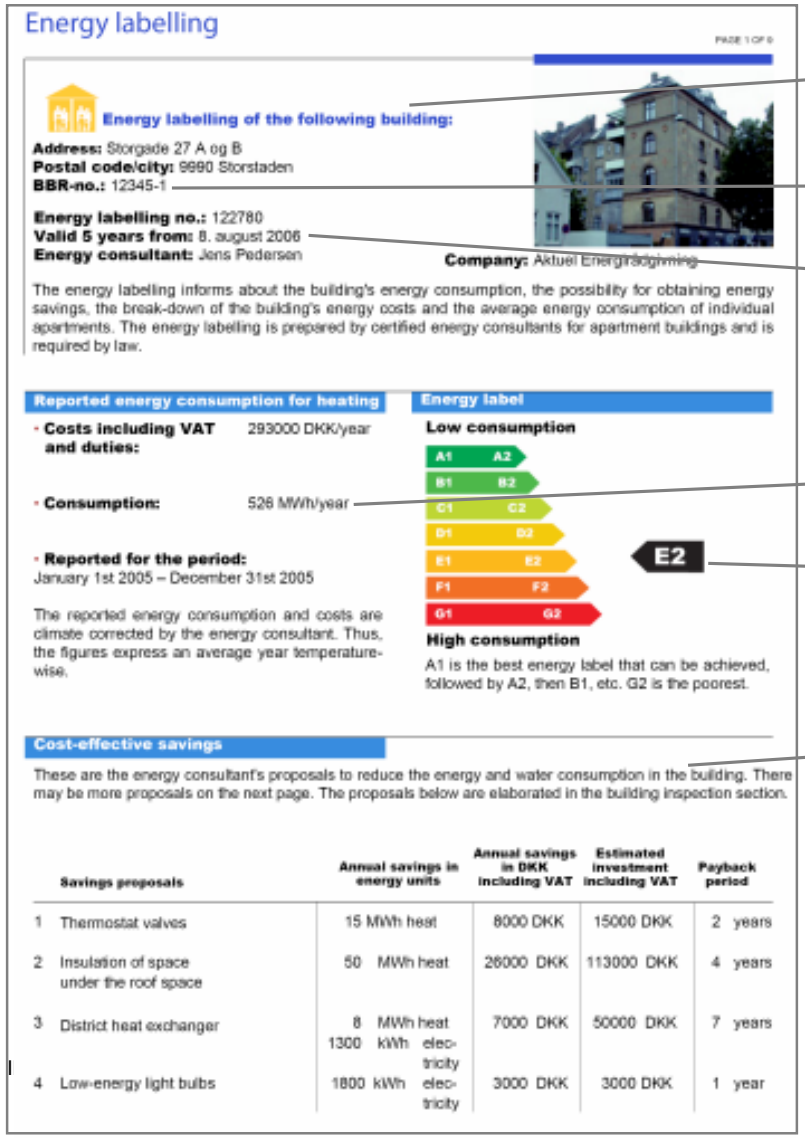
9.2.4 Communication

In the old Danish schemes there was a marked penetration about 50 %. This was primarily due to lack of broad information campaigns promoting the scheme and the fact that there were no penalties connected with not having a certificate. Thus it is recommended to launch information campaigns advertising that a mandatory energy certification scheme has been established, how to find an accredited energy consultant to issue a certificate and what kind of information is found in the certificate.

Another level of communication takes place directly between the energy consultant and the end-user. This is an important task as the consultant has the opportunity of highlighting certain parts of the certificate and to discuss the energy savings in the energy plan. This task is not foreseen in the Danish scheme, but it can easily be done when (if) the consultant makes a new certificate when the old one has to be renewed.

10 Annexes

10.1 Certificates in standardised template



Energy labelling

PAGE 1 OF 6

Energy labelling of the following building:

Address: Storgade 27 A og B
Postal code/city: 9990 Storstaden
BBR-no.: 12345-1

Energy labelling no.: 122780
Valid 5 years from: 8. august 2006
Energy consultant: Jens Pedersen

Company: Aktuel Energirådgivning

The energy labelling informs about the building's energy consumption, the possibility for obtaining energy savings, the break-down of the building's energy costs and the average energy consumption of individual apartments. The energy labelling is prepared by certified energy consultants for apartment buildings and is required by law.

Reported energy consumption for heating

- **Costs including VAT and duties:** 293000 DKK/year
- **Consumption:** 526 MWh/year
- **Reported for the period:** January 1st 2005 – December 31st 2005

The reported energy consumption and costs are climate corrected by the energy consultant. Thus, the figures express an average year temperature-wise.

Energy label

Low consumption

A1 A2
B1 B2
C1 C2
D1 D2
E1 E2 **E2**
F1 F2
G1 G2

High consumption

A1 is the best energy label that can be achieved, followed by A2, then B1, etc. G2 is the poorest.

Cost-effective savings

These are the energy consultant's proposals to reduce the energy and water consumption in the building. There may be more proposals on the next page. The proposals below are elaborated in the building inspection section.

	Savings proposals	Annual savings in energy units	Annual savings in DKK including VAT	Estimated investment including VAT	Payback period
1	Thermostat valves	15 MWh heat	8000 DKK	15000 DKK	2 years
2	Insulation of space under the roof space	50 MWh heat	26000 DKK	113000 DKK	4 years
3	District heat exchanger	8 MWh heat 1300 kWh elec-tricity	7000 DKK	50000 DKK	7 years
4	Low-energy light bulbs	1800 kWh elec-tricity	3000 DKK	3000 DKK	1 year

Block of Flats

Identification of building

Date

Measured consumption

Energy classification based on calculation

Most important recommendations including possible savings, investments, prices in DKK and pay back

10.2 Reference list, standards used for calculation

1. Danish Act to Promote Energy Savings in Buildings, Act no 585 of 24th June 2005. Danish Building Research Institute. October 2005.
2. Jens Laustsen, Danish Energy Authority, Kirstine Lorenzen, COWI: Danish Experience in Energy Labelling of Buildings, OPET Building report studies September 2003
3. Søren O. Aggerholm, Karl E. Grau (2006). SBi Direction 213 – Buildings energy consumption (In Danish). Danish Building Research Institute, Hørsholm, Denmark.

10.3 Questionnaire guide to Energy certificate in connection with test certification of 6 blocks of flats, August 2005 and June 2006.

1. What is the first thing catching your attention when you look at the draft for the new energy certificate?

The picture of your block of flats	( )
The scale	( )
The energy consumption	( )
Suggestions for savings	( )
Other	( )

Any further comments: _____

_____

_____

2. What is your first, immediate impression of the draft for the new energy certificate, when you briefly browse it?

Answer: _____

_____

_____

***3.** Is the scale A1 to G3 in the new energy certificate understandable?*

Very clear	( )
Somewhat clear	( )
Acceptable	( )
Somewhat unclear	( )
Not understandable at all	( )

Any further comments: _____

_____

_____

***4.** How easy do you understand the explanation why a calculated consumption will be used instead of actual readings?*

Very clear	( )
Somewhat clear	( )
Acceptable	( )
Somewhat unclear	( )
Not understandable at all	( )

Any further comments: _____

_____

_____

5. *How clear is it to you, what energy saving suggestions are given for your block of flats, how much you can save and what the cost is for carry out the measures?*

Very clear	( )
Somewhat clear	( )
Acceptable	( )
Somewhat unclear	( )
Not understandable at all	( )

Any further comments:_____

_____

_____

6. *Are you satisfied that the new certificate includes a more comprehensive building audit (pages 3 -5 or 4 – 6 in some certificates)?*

Very satisfied	( )
Somewhat satisfied	( )
Satisfied	( )
Somewhat unsatisfied	( )
Very unsatisfied	( )

Any further comments:_____

_____

_____

7. *How do you judge the lay-out of the certificate for the block of flats on pages 1-7?*

Very satisfying/interesting	( )
Somewhat satisfying/interesting	( )
Acceptable	( )
Somewhat unsatisfying/not interesting	( )
Very unsatisfying/not interesting	( )

Any further comments:_____

_____

_____

8. *How do you judge the content of the energy certificate for the block of flats, page 1-7?*

Very satisfying/interesting	( )
Somewhat satisfying/interesting	( )
Acceptable	( )
Somewhat unsatisfying/not interesting	( )
Very unsatisfying/not interesting	( )

Any further comments:_____

_____

_____

9. *What is your evaluation of the lay-out of the small certificate (individual flats) for the inhabitants (the last 2 pages: 1 of 2 and 2 of 2)?*

Very clear ( )
Somewhat clear ( )
Acceptable ( )
Somewhat unclear ( )
Very unclear ( )

Any further comments:_____
_____
_____

10. *What is you evaluation of the content of the small certificate (individual flats) for the inhabitants (the last 2 pages: 1 of 2 and 2 of 2)?*

Very acceptable/interesting ( )
Somewhat acceptable/interesting ( )
Acceptable/interesting ( )
Somewhat unacceptable/not interesting ( )
Very unacceptable/not interesting ( )

Any further comments:_____
_____
_____

11. *Is the certificate - as a whole - an improvement compared with the previous certificate?*

Yes ( ) Why _____

No ( ) Why not _____

12. *Do you miss any information in the new energy certificate?*

_____
_____
_____

13. *Do you see any unnecessary information in the new energy certificate?*

_____
_____
_____

14. *Does the new certificate make you wish to work with energy saving issues?*

Yes ( ) Why _____

No ( ) Why not _____

15. *Do you, as an overall objective, thinks that an Energy certificate is a good idea?*

Yes ( ) Why _____

No ( ) Why not _____

10.4 Example energy certificate for a block of flats in the new Danish energy certification scheme

Energy labelling

Energy labelling of the following building:

Address: Storgade 27 A og B
Postal code/city: 9990 Storstaden
BBR-no.: 12345-1

Energy labelling no.: 122780
Valid 5 years from: 8. august 2006
Energy consultant: Jens Pedersen

Company: Aktuel Energirådgivning

The energy labelling informs about the building's energy consumption, the possibility for obtaining energy savings, the break-down of the building's energy costs and the average energy consumption of individual apartments. The energy labelling is prepared by certified energy consultants for apartment buildings and is required by law.

Reported energy consumption for heating

- **Costs including VAT and duties:** 293000 DKK/year
- **Consumption:** 526 MWh/year
- **Reported for the period:** January 1st 2005 – December 31st 2005

The reported energy consumption and costs are climate corrected by the energy consultant. Thus, the figures express an average year temperature-wise.

Energy label

Low consumption

High consumption

A1 is the best energy label that can be achieved, followed by A2, then B1, etc. G2 is the poorest.

Cost-effective savings

These are the energy consultant's proposals to reduce the energy and water consumption in the building. There may be more proposals on the next page. The proposals below are elaborated in the building inspection section.

	Savings proposals	Annual savings in energy units	Annual savings in DKK including VAT	Estimated investment including VAT	Payback period
1	Thermostat valves	15 MWh heat	8000 DKK	15000 DKK	2 years
2	Insulation of space under the roof space	50 MWh heat	26000 DKK	113000 DKK	4 years
3	District heat exchanger	8 MWh heat 1300 kWh elec-tricity	7000 DKK	50000 DKK	7 years
4	Low-energy light bulbs	1800 kWh elec-tricity	3000 DKK	3000 DKK	1 year

Energy labelling

Energy labelling no.: 122780
Valid 5 years from: 8. august 2006
Energy consultant: Jens Pedersen

Company: Aktuel Energirådgivning

Cost-effective savings

	Savings proposals	Annual savings in energy units	Annual savings in DKK including VAT	Estimated investment including VAT	Payback period
5	Insulation of basement deck	6 MWh heat	3000 kr.	72000 kr.	24 years
6	Insulation of loft	45 MWh heat	24000 kr.	136000 kr.	6 years

Explanation:
The savings proposals have been prepared on the basis of the calculated energy consumption in the building based on the actual application of the building. Consequently, the actual operating time of the building and installations, etc., has been taken into consideration. Not all savings proposals will result in energy savings, but all proposals will result in an economic gain for the owner, for instance in the shape of a lower water bill, or because expensive electricity is replaced by cheaper district heating.

The estimated investment costs include materials, hourly wages and possible costs for project planning, building site and other derived costs. The payback period is the number of years that it takes to earn back the investment. Possible borrowing costs have been left out of account.

In the case of concurrent implementation of more proposals in the plan, the total energy savings may be different from the sum of the savings that can be obtained from the individual proposals. Therefore, the total cost that is stated below may not necessarily correspond to the sum of savings from the individual proposals.

Savings and investment need

- **Total savings on heating:** 65000 DKK/year
- **Total savings on electricity:** 6000 DKK/year
- **Total savings on water:** 0 DKK/year
- **Investment need:** 389000 DKK including VAT
- **Total savings from the cost-effective proposals:** 51000 DKK/year

Energy labelling

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Company: Aktuel Energirådgivning

Savings and investment need

Conclusion:
The energy savings proposals all are a good investment for the building owner. If all savings proposals are implemented, the energy label can be improved to:

D2

Savings proposals in case of renovation

If the building will undergo a renovation due to other reasons, it is often profitable to incorporate energy savings in the renovation. The following measures should be considered in connection with a renovation of the building.

	Saving proposals	Annual savings in energy units		Annual savings in DKK including VAT	
7	Insulation behind radiators	36	MWh heat	19000	DKK
8	Insulation of attics	14	MWh heat	7000	DKK
9	Storm frames in kitchen windows	12	MWh heat	6000	DKK

Required by law to improve the energy condition of the building in the case of reconstruction and other significant changes:
The building regulation makes a number of demands on building owners in connection with reconstruction and other changes of buildings. Among other things, the demands mean that the building envelope and installations must be improved in the case of a larger renovation.

Comments for the energy labelling

The building was erected in 1897. District heating was installed around 1975. Only few energy savings measures have been implemented.

There is a certain potential for immediately cost-effective energy savings. By carrying out improvements in connection with enhancement or renovation work, the energy consumption can be reduced even more.

Energy labelling

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Energy consultant: Jens Pedersen

Company: Aktuel Energirådgivning

Building inspection

Building parts

- **Loft and roof**

Status: The loft is not insulated except for a layer of clay pugging. The loft space is inaccessible for which reason the above-mentioned information is based on an estimate of the construction year of the building, etc.

Building parts against the space under the roof space is inaccessible for which reason the above-mentioned information is based on an estimate of the construction year of the building, etc.

Attics on the top floor are un-insulated.

Proposal 6: It is recommended to re-insulate the loft with at least 250 mm mineral wool.

Proposal 2: It is recommended to insulate the walls of the space under the roof space and the partition against this space with at least 250 mm mineral wool. In particular, good insulation behind the radiators is essential.

Proposal 8: When the attics at some future point in time needs a new external facing, it is recommended to insulate them with at least 50 mm insulation.

- **Exterior walls**

Status: The exterior walls are made of solid brick with a thickness that varies from 1½ to 2½ bricks (35 – 60 centimetre). In the breastboards behind the radiators, there is only one brick (24 cm).

Proposal 7: When the radiators at some future point in time are to be replaced or removed for another reason, it is recommended to insulate the breastboard behind the radiator with at least 50 mm mineral wool.

- **Windows, doors, top lights, etc.**

Status: The windows are palace or dannebrog windows installed when the building was erected. The windows in the kitchen and on the stairs have one layer of glass. Generally, the windows and doors are in good condition.

Proposal 8: When the windows in the kitchen need to be replaced at a future point in time, it is recommended to mount storm frames with energy glass.

Energy labelling

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Company: Aktuel Energirådgivning

Floors and ground deck

- **Floors and ground deck**

Status: The partition against the basement is un-insulated except for a layer of clay pugging.

Proposal 5: It is recommended to re-insulate the partition against the basement by blowing mineral granulate into the construction.

Ventilation

- **Ventilation**

Status: The building has natural ventilation via leakiness in the building envelope.

Heating

- **Heating installation**

Status: The building had district heating installed in 1975. The district heating alternator and automatics originate from the original installation. The district heating alternator is un-insulated. The automatics only have outdoor temperature compensation of the flow temperature, but lacks functions such as summer and pump stop. The pump is an older single-stage model.

Some radiators have thermovalves, for instance in the living rooms, while other radiators have old-fashioned radiator valves, for instance in the bedrooms.

Proposal 1: It is recommended to mount new thermovalves on radiators that do not already have it or have a defective thermostat.

Proposal 3: It is recommended to replace the district heating alternator with a new efficient and well-insulated alternator, to replace the automatics with a model that provides outdoor temperature compensation, summer stop and pump controls, and to mount a new, energy-efficient, pressure-operated pump. Alternator and automatics should be selected and adjusted by a specialist in order to obtain the highest possible level of cooling of the district heating water. It is recommended to use a specialist under the District Heating's Service Scheme.

Energy labelling

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Company: Aktuel Energirådgivning

Heating

- **Hot water**

Status: There is a 300 litre hot-water tank from 2003 connected to the district heating installation. The tank is insulated with 80 mm insulation. The temperature of the tank is controlled by a thermovalve via a sensor in the tank.

- **Distribution system**

Status: The pipes in the basement are insulated with approximately 1 cm insulation while valves and assemblies are un-insulated. The pipes in the apartments are uninsulated.

Electricity

- **Lighting**

Status: Ordinary incandescent bulbs are used for outdoor lighting, on the stairs and in the basement.

Proposal 4: It is recommended to mount energy-efficient light bulbs in the existing outdoor light fittings, on the main stairs and backstairs.

Water

- **Water**

Status: It requires access to the apartments to make the registration.

Energy labelling

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Company: Aktuel Energirådgivning

Description of the building

• **Year of erection:**	1897
• **Year of significant renovation:**	None
• **Heating:**	District heating
• **Supplemental heating:**	None
• **Livable area according to BBR:**	2568 square metres
• **Commercial area according to BBR:**	0 square metres
• **Heated area:**	2568 square metres
• **Application according to BBR:**	Co-operative dwelling
• **Comments for the BBR information:**	None

Basic information

• **Applied energy prices including VAT and duties:**	Heating: 525 DKK per MWh Fixed duty on heating: 120 DKK per kW per year Electricity: 1.85 DKK per kWh Water: 28 DKK per cubic metre

Energy labelling

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How the heating bill is made up

In this building, the heating bill is made up with a correction for exposed location against roof, facade or end wall.

The average costs of the individual dwellings

The energy costs of the individual dwellings depend on the total energy costs of the building. Therefore, it is in the interest of the individual residents that the building as a whole is in good energy condition,

despite the fact that the energy loss may take place in an area outside of the individual dwelling unit, for instance in the heating installation. The building has different types of dwelling units. Below is an

overview of the energy costs of the individual dwelling units.

Type	Area in square metres	Average annual energy costs
Apartments ground floor to the 4th floor	111	12700 DKK per year
Apartments on the 5th floor	87	9900 DKK per year

Energy labelling

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Company: Aktuel Energirådgivning

What is energy labelling?

The purpose of energy labelling is to promote energy savings and make visible the possibilities for saving energy to the benefit of the building owner's personal financial affairs, the environment and society.

When a dwelling unit is sold or let out, the seller or landlord must present an energy labelling, no older than five years. The rules also apply for co-operative dwellings. Buildings that are larger than 1,000 square metres must be energy labelled every fifth year.

The energy labelling is carried out by certified energy consultants. The Danish Energy Authority is responsible for the education, licensing and quality control of the energy consultants and their work. The daily administration is handled by the FEM-secretariat.

Further information

Disclaimer for prices
The savings proposal of the energy labelling is based on the energy consultant's experience and judgment. Before the energy savings proposals are implemented, the building owner should always seek tenders from more than one supplier, and a specialist evaluation of solutions and product selection should be made. In addition, it should be checked whether it is necessary to obtain an approval of the project from the authorities.

How to read the labelling?
If you would like further information about how the energy labelling should be read or how it has been prepared, please be referred to www.sparenergi.dk.

Hearing of complaints
If an owner or a buyer of a building assumes that the energy labelling has faults/deficiencies, one must first contact the energy consultant that has carried out the energy labelling. Should this not clarify the situation, one can send a written complaint to The Danish Energy Authority. Complaints about energy labellings can be taken to The Danish Energy Authority by owners of buildings, of owner-flats and of cooperative dwellings, including owners' associations and co-operative associations.

Inspiration for energy savings
Inspiration for energy savings can be found at www.sparenergi.dk.

Energy consultant:

Energy consultant:	**Company:**
Address:	**Tel:**
E-mail:	**Date for building inspection:**
Energy consultant no.:	**Signature:**

Please see www.sparenergi.dk for updated contact information about the energy consultant.