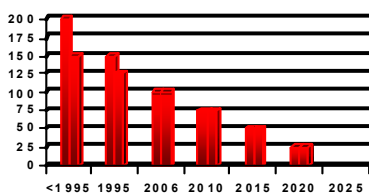




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Energy consumption in new  
buildings until 2025  
(2006 is 100 %).

## Denmark: Impact, compliance and control of legislation

In Denmark the implementation of the EPBD has changed the national energy performance (EP) requirements and the certification schemes. This has an influence on the building stock. This paper describes the Danish way of handling EPBD compliance and control. The Danish rules are described in more detail in IP 136 [1].

### 1 > Impact of the EPBD on national requirements

The implementation of the Energy Performance Building Directive (EPBD) is the responsibility of the Danish Energy Agency (Articles 3, 5, 7, 8, 9 and 10) and of the Danish National Agency of Enterprise and Construction (Articles 3, 4, 5 and 6). Denmark has implemented the EPBD since 1 January, 2006. For many years Denmark has had fairly strict energy requirements in its building regulations and an obligatory certification scheme for buildings as well as an obligatory inspection scheme for boilers. Denmark has now further tightened the energy requirements in the building regulations and developed new certification and inspection schemes.

An energy policy agreement of 21 February 2008 stipulated that new buildings should cut back energy consumption by at least 25 % in 2010, by least an additional 25 % in 2015 and furthermore by least an additional 25 % in 2020, totalling a reduction of at least 75 % by 2020. The effect is higher targets for energy efficiency. The annual savings should be increased to 1.5 % of the final energy consumption in 2006, corresponding to annual savings of 10.3 PJ.

Furthermore a so-called "Knowledge Centre for Energy Savings in Buildings" was launched in 2008 and up to DKK 10 million will be allocated annually from 2008 to 2011.

The following figure shows the Danish energy consumption in households. It has stayed rather constant over the years in spite of an ever growing number of m<sup>2</sup>. The energy consumption per m<sup>2</sup> is decreasing due to better insulation and boiler efficiencies, etc.



Air tightness proven by Blower Door test

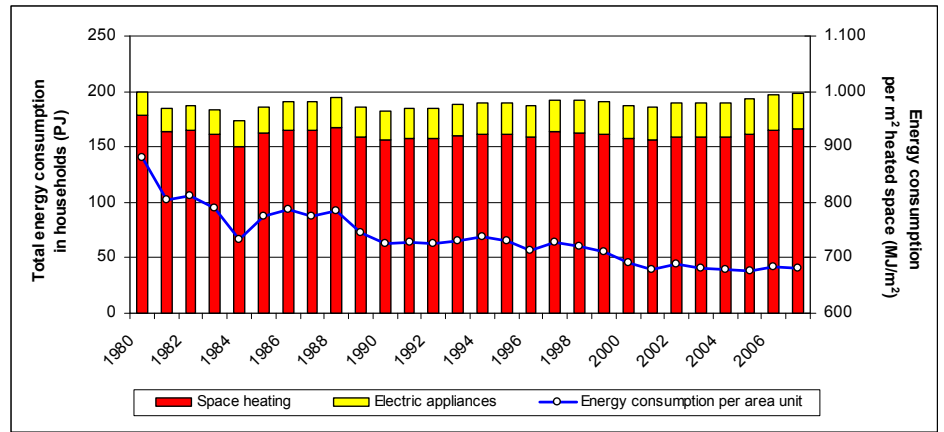


Figure 1. Total energy consumption in households and consumption per m<sup>2</sup> heated space in Denmark. Adjusted for climate.

## Danish Building Regulations

### New buildings

Due to the EPBD and new energy regulations, the energy consumption always has to be calculated and kept inside the energy frame. The new calculation method includes e.g. thermal bridges, solar gains, natural ventilation, heat recovery, air conditioning, lighting (for large buildings), boiler and heat pump efficiency. Furthermore, if the average monthly indoor temperature exceeds 26 °C, a fictive mechanical cooling system is assumed to be installed and the electricity for the cooling is taken into account in the calculation. Overheating is often caused by architectural decisions, e.g. large glazed areas, lack of solar shading, etc.

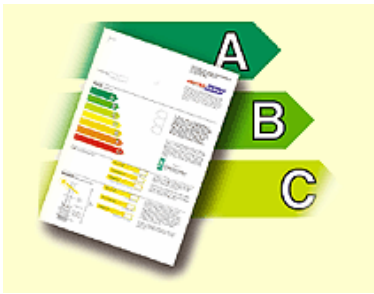
For new non-residential buildings or zones needing e.g. a high lighting level (>200 lux), extra ventilation (>1.2 liter/s per m<sup>2</sup>) or high consumption of domestic hot water (>100 liter/m<sup>2</sup> per year) or many operational hours (>45 hours/week) there is a supplement to the energy frame intended to cover the calculated additional energy demand for these purposes.

It is necessary to build airtight to comply with the energy requirements. Local authorities can demand documentation of airtightness. For larger buildings the airtightness can be proven by part of a building. If a test has been made, the result can be used in the calculation of the energy consumption for ventilation. If not, the value 1.5 l/s per m<sup>2</sup> heated floor area at 50 Pa is used.

In Denmark there have been ventilation requirements for all kinds of buildings for many years and it has not been necessary to change them because of the EPBD.

When energy consumption is estimated, the electricity consumption for building operations (ventilators, pumps etc.) is multiplied by 2.5 to compensate for the efficiency of the power production, high CO<sub>2</sub> emissions and high energy prices. All other energy sources have a factor 1.0.

Due to the EPBD, renewable energy has gained a more central position. At the moment Denmark has a total of 19 % coverage and the goal is 30 % in 2020. All types of renewable sources are taken into account in the calculation of energy consumption. Normally the building regulations do not recommend stoves because of their pollution of the local urban area. After introduction to the new requirements in 2006 an increase in solar



Energy certificates.

thermal, heat pumps and mechanical ventilation system have been observed.

The building market has expanded with the introduction of products and materials that comply the new low energy class 1 and class 2 buildings. Building prices increased due to the higher energy efficiency standard. The price for a new building compared with a building built according to the previous building regulation is approx 15-30 euros higher per m<sup>2</sup>.

### Renovation

There are requirements when a building is renovated in a major way. The definition of a major renovation is given in the Directive. A major renovation is when 25 % of the value of the building or more than 25 % of the building envelope are affected. When it is a major renovation, **all** cost-effective energy savings must be performed. This is a stricter rule than the EPBD requirement.

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 the weather shield, insulation of attic and roof when changing roof, change of boilers and change of heat supply.

To be a profitable measure, the saving (in DKK) multiplied by the lifetime (in years) divided by investment (in DKK) should be higher than 1.33. These measures will normally be listed in the certification scheme.

Furthermore it is mandatory for public authorities to implement energy-saving measures with a pay-back time of less than five years as described in the energy certificate of the buildings. This is also a stricter rule than the EPBD requirement.

### Energy certification

Since 1997 Denmark has had a certification scheme for nearly all kinds of buildings. This scheme has been revised to accommodate the requirements of the EPBD and adjusted to benefit from findings and experience gained over the years.

Since the beginning of 2006, an energy certificate is issued when a building or an apartment is constructed, sold or rented. Denmark has different certification schemes for different users: single-family houses, blocks of flats and buildings with public service, trade and service.

Due to the EPBD, another big adjustment was made that all certificates have to be calculated. Denmark used operational rating for large buildings before the EPBD was introduced.

The energy regulations and the rules for energy certification are linked in several ways. Before the official permit to use a new building is given, an energy audit has to be performed by a certified or approved energy consultant who checks that the energy calculation is correct, a quality and compliance check.

In Denmark the lifetime of the certificate is 5 years, so this is tighter than the EPBD requirement.

In Denmark there are rather strict requirements to the qualifications and also to the independence of the energy consultants. This was not changed after introduction of the EPBD.

The gross heating consumption for houses based on approx. 300 000 energy certificates is shown below. Due to the EPBD, Denmark has a really good knowledge of the building stock. This is used among others to estimate energy savings in different building types and during different periods.

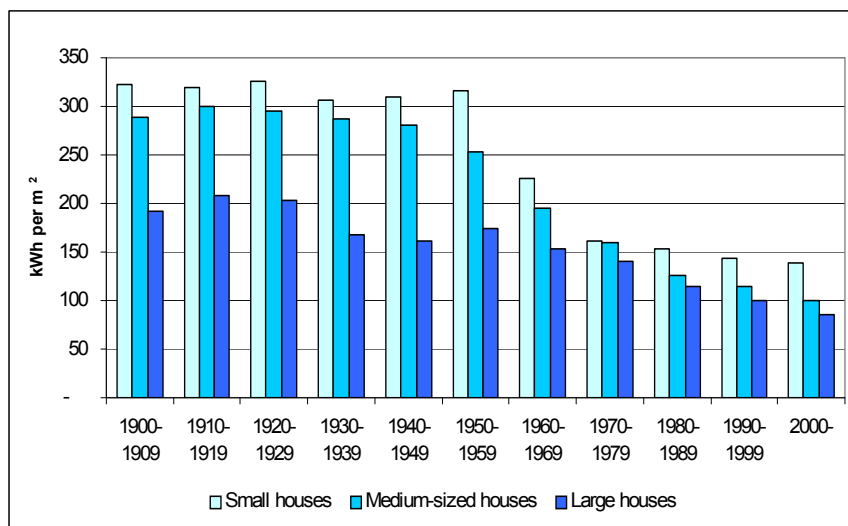


Figure 2. Gross heating consumption for houses - distributed over the decades of houses (data from the energy certification schemes).

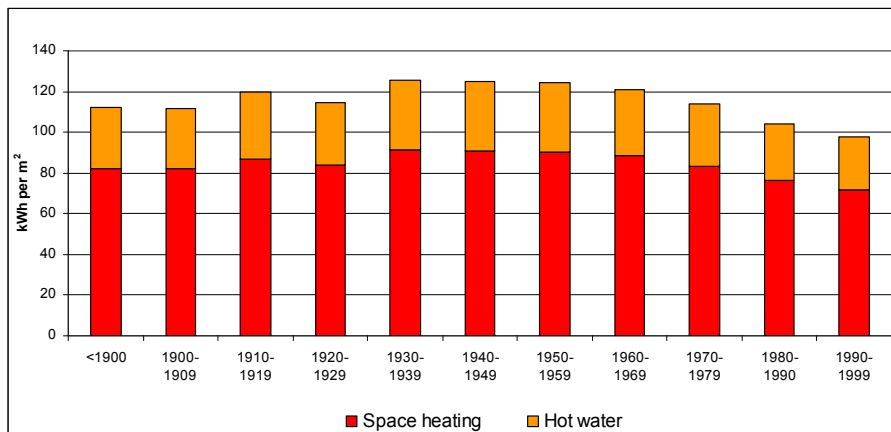


Figure 3. Actual heating consumption in Danish blocks of flats - distributed over the decades of building (data from the energy certification schemes).

## 2 > Compliance and control

### Danish Building Regulations

To get a building permit, a calculation of the energy consumption has to be made. The local authorities are responsible for controlling compliance with regulations. In Denmark 98 local authorities control compliance with the requirements in different ways. Some do it very detailed, others in a more cursory way.



*A building permit is given by the local authorities. A permit to use the building is given after a certificate and a quality control is made*

In practice the control of the new building in relation to the energy requirements is performed by the energy consultants who also issue the energy certificate. This rule was introduced in 2006. The proof of compliance with the energy requirements for new buildings must be made after the completion of the building in order to get the permit to use the building. If the building does not comply with the energy performance requirements, it has to be made to do so!

For large buildings the building owner normally has an additional external consultant to make the quality check and follow up.

At present there is no financial support for energy saving measures in Denmark. The political climate has not been in favour of financial support; however it is currently on the political agenda and negotiations are ongoing and it seems that they will be successful.

### Energy certification

The Danish Energy Agency is responsible for the certification scheme. The daily operation of the scheme is delegated to a secretariat also operating the other schemes related to the EPBD. From April 2008 it became possible to appoint a company official to issue the certificates, thus permitting companies to appoint their own consultants. The companies carry out their own quality checks according to DS/EN ISO 9001. The Danish Energy Agency carries out a market surveillance of the companies. These quality checks are made regularly, but also when there are complaints from clients, out-of-range values, etc. They also check the energy consultants' independence and qualifications by checking the consultants' CV presenting their expertise and projects involvements. In this way the consultants' business experience is evidenced.

Quality assessment of energy certificates of buildings include:

- > All certifications must be reported
- > Automatic screening at receipt
- > General control for instance by consultant
- > Visual control - desk report control
- > Field control - new inspection and report
- > Complaints from consumers
- > Other activities

If certification is omitted, the possibility of penalties exists.

In a report published by the AKF, the Danish Institute of Governmental Research [2], the author claims that there are no real difference in consumption levels between houses with a certificate and those without one. This study is based on data on 3 956 single-family houses obtained under the old scheme. But the conclusion is also: Even though analysis of the data did not reveal any significant reduction in natural gas consumption for houses with an energy certificate compared with those without one, the certification scheme might still have an effect. If the owner of a certified house implements some or all of the recommended improvements and thereby obtains the same indoor temperature at a lower energy level/price, he might decide to raise the indoor temperature with the saved amount of energy, and reach a higher utility level, instead of saving the money and energy. This would be a welfare gain, but since indoor temperature is not registered, it would not be possible to use this change for estimation of the certification effect. It must be emphasised that all data in this report are based on the old certification scheme. There have been changes made to the certification scheme after this survey was made.

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A certification scheme is a good basis for energy savings, but the scheme in itself does not necessarily generate savings. The certification scheme draws the building owners' attention to the fact that there are possibilities for energy savings etc. The certificates are now beginning to be available to the public on the "Public Information Server" ([www.ois.dk](http://www.ois.dk)). Hopefully this will help activate the recommendations in the certificates.

**3 > References**

1. Søren Aggerholm. IP 136, EPBD Buildings Platform, Implementation of the EPBD in Denmark: Status 2008. November 2008.
2. Vibeke Hansen Kjærby. Does energy certification of Residential Housing Cause Energy Savings? AKF Working paper, December 2008.  
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