

Implementation of the EPBD in Denmark

Status in November 2010

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1 > Introduction

This report presents an overview of the current status of implementation and of the plans for the evolution of the implementation of the Directive on the Energy Performance of Buildings (EPBD) in Denmark. It addresses requirements, as well as certification and inspection systems, including quality control mechanisms, training of qualified experts, information campaigns, incentives and subsidies.

Since the last country report, published in November 2008, much development has taken place, e.g. revision of energy requirements in the Danish Building Regulations. Energy requirements for new and existing buildings have been tightened and incorporated in the new Danish Building Regulations, BR10 (see section 8). The new regulations came into force in July 2010, with a transition period of 6 months, meaning that all new building permits issued after the 1st of January 2011 must comply with the BR10. In Denmark, the implementation of the EPBD is the responsibility of the Danish Energy Agency (DEA) and of the Danish Enterprise and Construction Authority. The Danish building energy certification scheme has been thoroughly revised, and the revised scheme will be published in the spring of 2011.

2 > Certification

Certification of buildings

National websites:

- > www.ens.dk
- > www.ebst.dk
- > www.sbi.dk
- > www.seeb.dk
- > www.ois.dk

In Denmark, the implementation of the EPBD with respect to certification is the responsibility of the DEA. A new secretariat for the daily operation of the Energy Performance Certification (EPC) scheme started functioning in May 2010. The new secretariat (*Energieffektive Bygninger*, SEEB) also covers quality assurance and contributions to the future development of the scheme, and marketing.

The current EPC scheme replaced the mandatory certification schemes existing from 1997. The Danish schemes have been regularly revised over the years and are currently under revision for implementation in early 2011.

The energy performance certificate

The energy performance (EP) certificate assigns an energy performance label to nearly all types of buildings and lists cost-effective measures for improving their energy performance. The energy label classifies the buildings on an efficiency scale

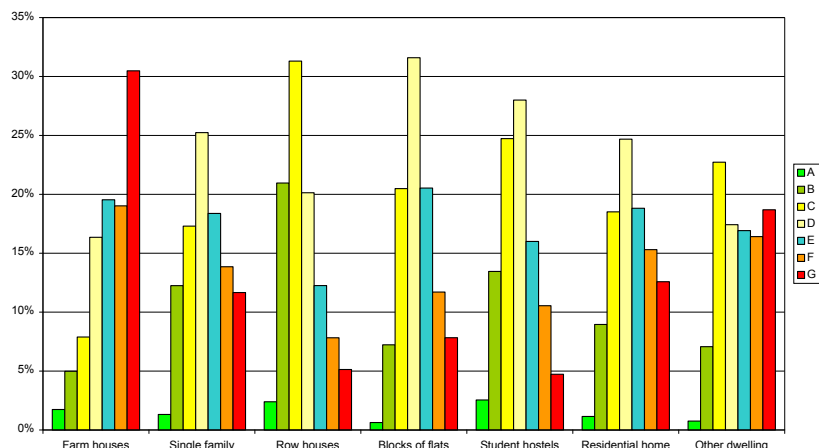


Energy label. Label "A" is sub-divided into A1 (best) and A2

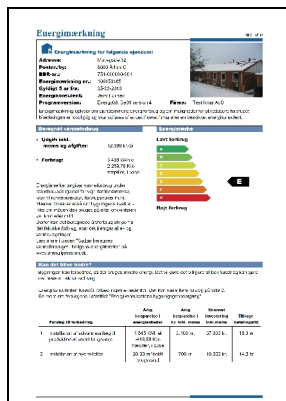
ranging from A (high energy efficiency) to G (poor efficiency). Class A is divided into two categories, A1 and A2, which identify the two low energy classes defined in the Danish Building Regulations from 2008. The validity of the energy certificates is 5 years.

Label	Residential	Non-residential
A1	< 35 + 1100/A	< 50 + 1100/A
A2	< 50 + 1600/A	< 70 + 1600/A
B	< 70 + 2200/A	< 95 + 2200/A
C	< 110 + 3200/A	< 135 + 3200/A
D	< 150 + 4200/A	< 175 + 4200/A
E	< 190 + 5200/A	< 215 + 5200/A
F	< 240 + 6500/A	< 265 + 6500/A
G	> 240 + 6500/A	> 265 + 6500/A

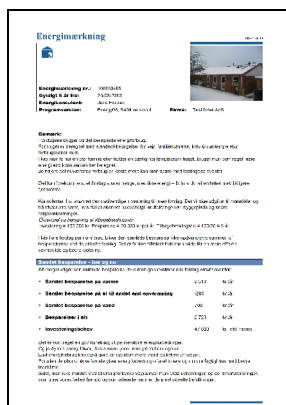
Primary energy label criteria valid until the end of 2010



Label distribution on Danish dwellings as registered in the current (since 2006) EPC scheme

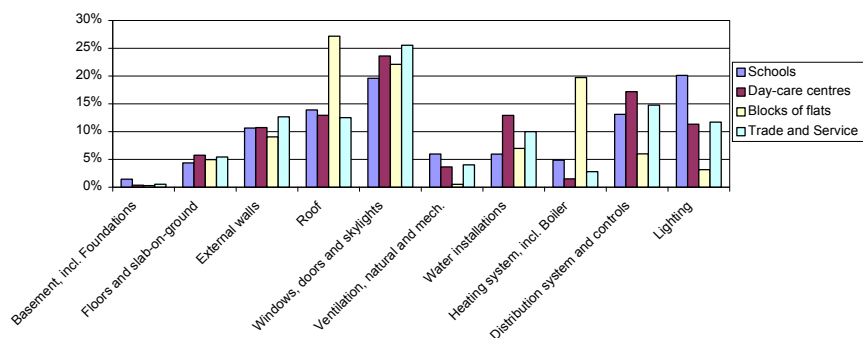


Cover page of the Energy Performance Certificate for single family houses



Recommendations for improving the energy performance are shown on page 2 and the following pages of the certificate

The real benefit of the EP certificate is in the recommendations given to the building owner. These are summarised on page 2 and following pages of the certificate (see example on the left). Suggested improvements include a short description, estimates of costs, savings and paybacks, and the impact on the energy rating if all measures were implemented. Recommendations must be made for the specific building.



The 10 most used recommendations for improving the energy performance in large buildings (Schools, Day-care, Blocks of flats, and Trade and Service)

New buildings or buildings that change type of usage, i.e. from residential to non-residential or vice versa, must achieve at least a B rating in order to be granted a permit for use. This requirement was implemented on the 1st of January 2007.

As of the 1st of January 2007, all **existing** residential and non-residential buildings need to be certified when they are sold. As of the 1st of July 2009, the owner must present a valid certificate to the buyer/renter when the selling or renting contract is established. A qualified expert must visit the property and make an assessment of the building in terms of the type of construction (walls, windows, insulation, thermal bridges, ventilation and airtightness, etc.), as well as the type and quality of HVAC and hot water systems. The qualified expert must then calculate the thermal efficiency of the building and issue the certificate. There is no minimum requirement for an existing building (it can be labelled from A to G).

The calculation methodology is the same as that used as proof of compliance in the Danish Building Regulations for a new building. The methodology is defined in a calculation engine. Any company can create its own energy certification tool, but it must use the same calculation engine as in SBi-Direction 213. For the time being, there are two available tools for energy certification in Denmark: EK-Pro and Energy08. Both tools use the required calculation engine, but have different user interfaces. The tools are web-based and require internet access.

Forslag bygning

Brændsel	MWh	Enheder	Enhed	Kr. / løbende	Kr. fast	Kr. i alt	Besparelse kr./år 0	Investering
Kedel/fjernvarme	49,21	1058	m³	15870	6195	22065	Varme kr./år	13300
Elvarme	0	0	kWh	0	0	0	El kr./år	3200
Supplerende	0	0	0	0	0	0	Vand kr./år	0
Gasvandvarmer	0	0	0	0	0	0	Besparelse i alt kr./år	16500
I alt pr. år	49,21			15870	6195	22100	Investering kr.	319700

Gruppe	Forslag	Invest. kr.	Besparelse enheder/år	besp. kr. år	S-tal	T-tal	A/B	G	Flugt
Belysning	Udskift til sparepærer og bevægelsesfaldere	10051	1325 kWh el	2650	10	2,64	3,8	A	1
Fordelingssystem	Isolering af uisolerede rør i kældere	1100	16 m³ Fjernvarme	240	10	2,18	4,6	A	1
Pumper varme	Udskiftning af centralvarmepumpe til elektronisk styret pumpe	4500	249 kWh el	500	15	1,67	9	A	1
Gulve og terrændæk	Isolering af gulv mod kældere	40800	216 m³ Fjernvarme	3240	20	1,59	12,6	A	1
Ydervægge	Isolering af massive ydervægge	263248	673 m³ Fjernvarme, 29 kWh el	10150	40	1,54	25,9	A	1
Vand	Udskiftning af toiletter	38580	30 m³ vand	1050	15	0,41	36,7	B	

Massiv ydervæg - 12 cm tegl massiv

Titel: Massiv ydervæg - 12 cm tegl massiv Areal: 20 Type: Ydervæg

B-faktor: 1 Gruppér forslag

Status tekst: Ydervægge består af 12 cm massiv teglvæg (halvstens væg).

Forbedringsforslag

Opret: [] Opret

Kort tekst: Efterisolering af massive ydervægge m... U-Værdi: 0,34

B-faktor: 1 Omkostning pr m²: 2100 Levetid: 40

Forslagstekst: Montering af indvendig isoleringsvæg på massive ydervægge med 100 mm isolering, effektiv

Suggestions for recommendations in the two Danish certification tools

After the building energy inspection and identification of energy upgrading measures, it is necessary to login into the online web-based central registration system in order to report the building description and issue the building energy certificate. It is possible to import and export all data through a XML file, and to access/consult/modify/copy the documents and print the EP certificates online, for delivery to the building owner.

In Denmark, the definition of **public building** includes 1) Buildings used for public administration. 2) Institutions, companies, associations etc., if e.g. the expenses are covered by public means. 3) Publicly-owned companies or companies where the public have the final influence on decisions. In 2009, it was decided that governmental energy consumption should be reduced by at least 10% by 2011, compared with the consumption in 2006. A new database will gather data for the energy consumption of public buildings, and the results of the energy savings initiative will be published on the Internet. Each ministry must now decide how to reduce energy consumption by 10%.

The certificate of public buildings must be put on physical display in the building itself. Furthermore, all central information from the certificates is shown on a central web-based information server (www.ois.dk). It is thus possible to see the

energy label and the calculated consumption for heat, electricity and water, plus the name and ID-number of the building energy expert who issued the certificate.

The screenshot shows the website www.OIS.dk with a search bar and navigation links. The main content area displays a building energy certificate for the property at Kilholmvvej 31. The certificate includes the following information:

- Basic information:**
 - Energimærke nr.: 06-02233-0100
 - Energimærket er gyldigt i 3 år fra: 2006-04-21 00:00:00
 - Ejendommens adresse: Kilholmvvej 31, 2720 Vanløse
- Energy labels:**
 - Energimærke varme: 85
 - Opvarmningsform: 31
 - Beregnet forbrug pr. år (m3): 16437,131
 - Beregnet varmeudgift pr. år (kr.): 8
 - Energimærke el: 4400
 - Beregnet forbrug pr. år (kWh): 8718,5596
 - Beregnet eludgift pr. år (kr.): 8
 - Energimærke vand: 180
 - Beregnet vandforbrug pr. år (m3): 6131,2998
 - Beregnet vandudgift pr. år (kr.): 415,29999
 - Miljøbelastning (ton CO2): 415,29999
- Energikonsulent:**
 - Navn: Hans Anderskov
 - Nr.: 02233

Screen dump from www.ois.dk showing information about the energy performance certificate for any certified building. The entire information set is only available to the building owner (requires login)

From 1997 to 2006, a total of approx. 770,000 certificates were issued, including approx. 18,000 large buildings (+1,500 m²) that were certified each year. In the same period, approx. 55,000 single-family houses were certified each year.

In the current EPC scheme, the number of certificates issued is shown in the table below. Since September 2006, a total of approx. 258,000 certificates have been issued in the current EPC scheme. The total number of issued certificates in Denmark, since certification was initiated in 1997, is over 1 million.

Number and distribution of energy performance labels in five major building categories from the current Danish scheme (Dec. 2010)

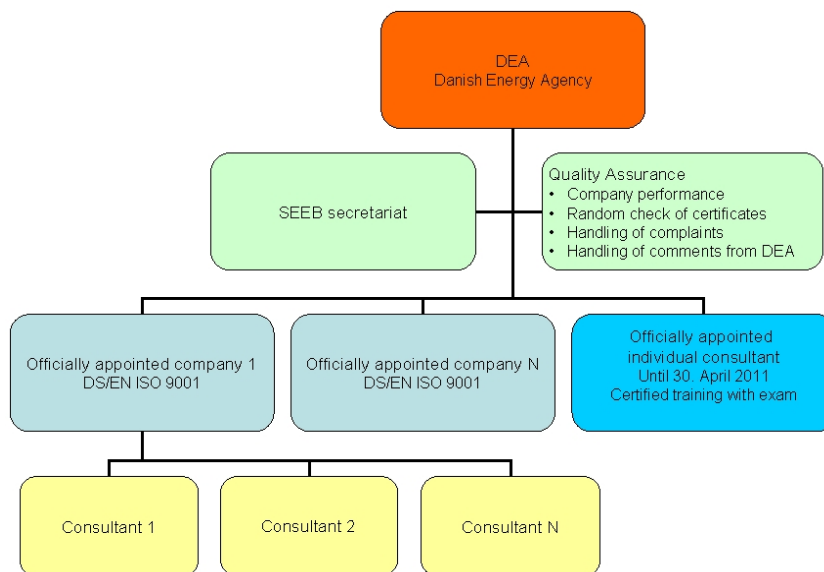
	Single family	Multi family	Office/trade	Education	Second homes	Other
A1	366	16	18	7	8	27
A2	2172	113	77	28	32	117
A	2959	143	110	39	40	151
B	26355	1595	856	265	100	1210
C	37913	4482	1262	687	90	2440
D	46058	6885	1716	1347	170	4028
E	33086	4469	1395	1237	133	3562
F	24659	2551	1015	796	6202	3033
G	21059	1700	973	618	7441	3127
Total	192089	21825	7327	4989	14176	17551

The responsibility of having a certificate always rests with the building owner. DEA fixed the maximum cost for issuing EP certificates for residential buildings up to 299 m²: up to 100 m², 730 €; up to 200 m², 800 €; and up to 299 m², 875 €. For larger buildings and other building types, the cost is market-dependent, and the price usually ranges between 1.3 € and 3 € per m² per certificate.

The operation of the scheme is financed by fees paid by the EPC experts. Each expert pays an annual fee of 135 €, plus 17 € for issuing a certificate for a small residential building and 47 € per certificate for other buildings. Experts in accredited companies pay half the fee per issued certificate, due to the mandatory internal quality assurance of the company.

Quality assurance (QA)

DEA has set up a mandatory QA scheme, the structure of which is shown in the following illustration.



Quality assurance scheme

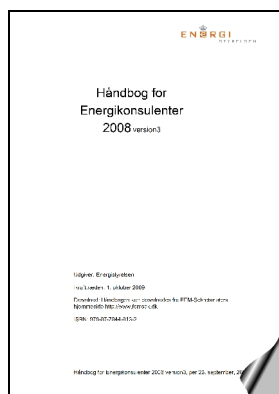
EP certificates are selected at random by the secretariat for quality checks. Of the issued certificates, 5% must undergo a manual desk audit, while 0.5% must undergo a technical revision that includes a re-certification by a specially appointed expert. For companies with internal Q&A system, the random check is at least 10% of the single-family certificates and 5% of the multifamily and commercial building certificates.

DEA has identified six topics to which energy experts must pay special attention in certificates. Too little attention to these topics may cause sanctions.

- > Possibility of utilising renewable energy sources
- > Ventilation
- > Central heating plants
- > Pumps for circulation and domestic hot water
- > Oil burner scrapping scheme
- > Energy savings in dwellings (www.energisparebolig.dk)

DEA has the competence to withdraw the registration of individual experts and accredited companies. Prior to this sanction a warning will be issued.

Quality assurance also includes an up-to-date handbook for the experts (see front page on the left). The handbook is updated and revised regularly, and describes the building energy audit process. It also offers check-lists for the audit and the calculation. The current version of the handbook dates from 2008, but a revision is in preparation.



Handbook for experts

3 > Inspections - Status of implementation

Inspection of boilers and heating systems

The requirements regarding inspection of boilers and heating systems are stated in Decree number 438 of the 3rd of June 2008, in the Inspection of Boilers and Heating Systems in Buildings issued by the DEA, and follows relevant CEN standards to a great extent. The inspections of boiler and heating systems are based on the same Act as the EPC scheme.

The inspection of boilers and heating systems were implemented on the 1st of September 2006, on the same date as the current EPC scheme. At that time, Denmark had already an inspection scheme for oil-fired burners. Boilers and heating systems have to be inspected on a regular basis. The inspections have to be carried out by a technical expert approved by the DEA. The experts have to fulfil certain requirements regarding education and skills, and pass an examination. It turned out that the implementation of the inspection scheme proceeded rather slowly, with few inspections carried through. Therefore, it was decided to revise the scheme in 2010. The revised inspection scheme is expected to come into force at the beginning of 2011.

For oil boilers, a yearly obligatory control measurement will take place. For gas boilers, no obligatory inspection scheme will take place. Instead, energy efficiency will be promoted by information campaigns etc. If an inspection of boilers and HVAC systems is made in combination with other works such as maintenance and service, the payment from the building owner must not exceed (all costs include VAT):

- › 67 € for regular inspection of oil and solid fuel burners with a power ≤ 100 kW
- › 134 € for one-time inspection of heating systems
- › 30 € for cleaning an oil burner with a power ≤ 100 kW

If inspection is made independently of other works, payment must not exceed:

- › 95 € for regular inspection of oil and solid fuel burners with a power ≤ 100 kW
- › 163 € for one-time inspection of heating systems
- › 58 € for cleaning an oil burner with a power ≤ 100 kW

Technical inspectors must pay a fee contributing to the operation of the scheme. Application for getting approval as an inspector costs a fee of 160 € for each category of inspection. Furthermore, the inspector must pay a fee of 1.3 € for every issued label.

Inspection of air conditioning and ventilation systems

An inspection scheme regarding A/C and ventilation systems came into force on the 1st of January 2008. The requirements (Article 9) are stated in Decree number 1104 of the 20th of September 2007. The A/C systems have to be inspected every fifth year. The scheme is being implemented gradually over five years, starting with plants installed in large buildings. The inspections are performed by certified companies. By October 2010, ten companies had been certified. The implementation of the scheme has been a bit slow. To speed up the process, an information campaign will be carried through in the spring of 2011.

4 > Qualified Experts

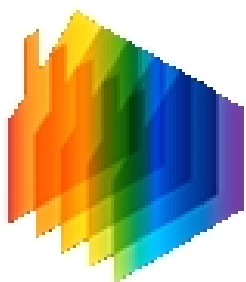
Since 2008, Denmark moved from a personal accreditation scheme to a company accreditation scheme for **building energy audits**. An accredited company must implement an ISO 9001 quality assurance scheme for its building energy certification system. Before 2009, Denmark had approx. 1000 individually certified experts. Two energy consultant appointments are available:

- › Energy consultants covering single and two-family houses of less than 500 m²,
- › Energy consultants covering multifamily houses, public buildings and the trade and service sector.

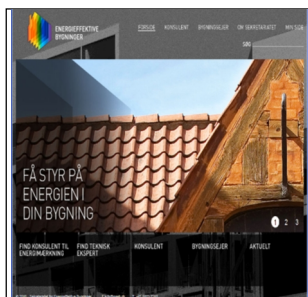
It is possible to be accredited for both types of buildings. The energy consultants must be impartial. It is possible to be an individual certified consultant only until May 2011, when this form of consultancy ends. From April 2008, it became possible to accredit a company official to issue the certificates, thus permitting companies to appoint their own consultants. The companies carry out their own quality checks according to DS/EN ISO 9001. DEA carries out a market surveillance of the companies. These quality checks occur on a regular basis, but also when there are complaints from clients, out of range values etc.



Label A to G, to be used when advertising for sale



**ENERGIEFFEKTIVE
BYGNINGER**



Secretariat for the EPC
scheme website:
www.seeb.dk

The energy consultant for small houses must be an architect, engineer, construction designer or the like, and must have at least 2 years of documented, relevant experience on building technology and energy consultancy during the last 6 years. The qualifications for energy consultants for public buildings, the trade/service sector etc. must be a trained engineer or the like.

Building energy certification experts in an accredited company must have the same qualifications as individual experts, but the company guarantees the quality of the certification. The company experts do not need to be individually accredited. A company can **inspect the ventilation and air-conditioning systems** only if the enterprise is accredited as an inspection company by the Danish Accreditation and Metrology Fund (DANAK), or an equivalent accreditation body. The company must be accredited for the inspection according to EN ISO 17020 on the general criteria for different types of bodies performing such inspections, and also according to DEA's guidelines for conducting inspections. DEA's guidelines are published on the agency website.

DEA approves the applications of technical experts to conduct **inspections of boilers and heating systems in buildings**. Recognition as a technical expert is personal and falls into the following categories:

- › Technical expert in oil-fired boilers and solid fuel boilers
- › Technical expert in gas-fired boiler
- › Technical expert in oil-fired and solid fuel-fired heating systems
- › Technical expert in gas-fired heating systems.

To be approved as a technical expert and operate in connection with servicing of boilers in buildings, the technical expert has to meet and document the following qualifications:

- › For oil fired and solid fuel boilers, to be an approved oil burner installer or oil burner technician or qualified chimney sweeper or a plumbing engineer.
- › For gas-fired boilers, to have obtained either an A gas certificate or an approval for commissioning and performance tests of large gas-fired installations or being a HVAC technician.

To be approved as a technical expert to conduct one-off inspections of heating systems in buildings not covered by the requirement of regular energy, in compliance with regulations on labelling of buildings, the technical expert has to meet and document the following qualifications:

- › For oil fired and solid fuel boilers, to be an approved oil burner installer, or a burner or HVAC technician, or a personally appointed energy expert for residential buildings or an energy expert associated with a certified energy company.
- › For gas-fired boilers, to have obtained either an A gas certificate or an approval for commissioning and performance tests of large gas-fired installations, or be a HVAC technician or a personally appointed energy expert in residential buildings or an energy expert associated with a certified energy company.

Furthermore, the technical expert must have completed training and must have passed the exam.

5 > National Information and Communication Campaigns

The web site of the Secretariat (www.seeb.dk) managing the daily operation of the EPC scheme offers general information about the scheme, as well as links in order to find a certified company to carry out a certification. Moreover, the site shows all relevant information about the legal documents, as well as case studies of good energy upgrading. Some brochures are available on the national websites.



Inspection of boilers brochure



Inspection of ventilation systems schemes brochure

From the 1st of July 2010, any real estate agent putting a building up for sale has the responsibility to present the building's energy label in the announcement. This rule does not apply to private (person to person) sale or rent.

DEA hosts several websites containing information about energy savings and energy certification in general, for example the Climate & Energy Guide

(www.klimaogenergiguiden.dk).

The Knowledge Centre for Energy Savings in Buildings was established in 2009 and gathers expertise and best practices in the field of energy savings. Professionals of the building industry have free access to information, facts and advice about selecting the right material, technical solutions and construction methods for achieving energy savings.

The Knowledge Centre strives to provide building professionals with the necessary know-how, qualifications and motivation to implement energy saving initiatives in housing and commercial development, and in the building stock.



Climate and Energy Guide (www.klimaogenergiguiden.dk);
Energy savings in buildings Knowledge Centre (www.byggeriogenergi.dk)
Energy Service (www.energitjenesten.dk)

The Danish Energy Saving Trust promotes energy savings in households, the public sector, and the commercial and industrial sectors for all forms of energy, other than transport. The website (www.savingtrust.dk) of the Trust deals with energy savings in general, but is also targeted on the EPC scheme. Information about thermal and electrical energy consumption, as well as water consumption, in state-owned buildings, including its trends since 2006, are shown in a publicly available website (see below). Each Ministry must make an action plan for their energy savings effort.

There is a plan to launch a new nation-wide campaign about energy efficient ventilation and energy efficient boilers in 2011.

ENERGIFORBRUG I STATEN

STATEN | MINISTERIER

VIS HJÆLP

LISTE AF MINISTERIER

Vis samlet forbrug for: ☐ El ☒ Varme ☐ Vand

Ministerium	Energirapport	Institutioner	Samlet forbrug i 2009 (kWh)	Udvikling siden 2006
Beskaeftigelsesministeriet	Se rapport	Se institutioner	5.222.883	4%
Finansministeriet	Se rapport	Se institutioner	3.091.982	14%
Forsvarsministeriet	Se rapport	Se institutioner	101.926.772	-2%

Information about energy consumption in Danish ministries are shown at <http://data.energibesparelseistaten.dk/StateEnergyConsumption.html>.

6 > National incentives and subsidies

In Denmark, there are not many subsidies to carry out energy savings in buildings, and none directly connected to the building energy performance certification scheme. For the time being, only the scrapping scheme for replacing oil burners is available.



Oil burner scrapping scheme website:

www.skrotditoliefyr.dk

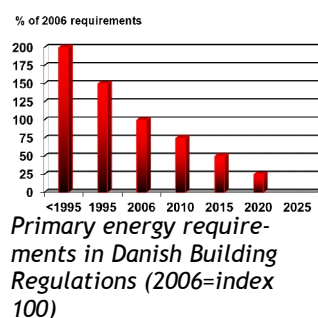
A total of 54 € million have been earmarked for subsidies for the replacement of inefficient oil-fired boilers with more energy efficient heating systems. In areas with district heating, the subsidies are only granted for the installation of district heating. Outside of district heating areas, there are three possibilities for subsidy: 1) efficient air-to-water heat pumps, 2) efficient liquid-to-water heat pumps or 3) solar heating installations. Via this scrapping scheme, subsidies can be granted for purchasing and installing approved heating systems to replace scrapped oil-fired boilers. The scheme covers all types of year-round domestic property, i.e., owner occupied houses and flats, housing association properties, rented property and holiday homes that have year-round status. The requirements for subsidy are that the oil-fired boiler is replaced either by a heat pump (geothermal or air-to-water), solar heating in combination with, for example, a new oil/natural gas/wood pellet boiler or a connection to district heating. The size of subsidy depends on the heating system installed: for single unit houses, 2,680 € for liquid-to-water heat pumps; 2,015 € for air-to-water heat pumps; 1,340 € for district heating units and 25% of investment costs for solar heating installations.

According to the political energy agreement of the 21st of February 2008, 4 € million were allocated for information campaigns, labelling of heat pumps, small subsidies schemes etc. The initiative targets consumers outside district heating areas and areas which are collectively supplied with natural gas. The efforts to promote the use of heat pumps are divided into three groups: product, consumer and market.

The following activities are respectively completed, ongoing or planned:

- > Calculation method to calculate the energy efficiency of heat pumps, taking into account the Danish climate conditions - completed
- > List of Energy-labelled heat pumps is established
- > Measuring program for heat pumps - in practice
- > Home Page with step by step guide for consumers
- > Reference guide for installers of heat pumps (*Den lille blå om varmepumper*)
- > Survey to determine if professional advice has an effect on consumers' decision to select a heat pump
- > Status of the heat pump market in Denmark
- > Barrier Study on heat pump implementation (DEA)
- > Project to study the use of heat pumps in smart grids
- > Implementation of certification schemes for installers (as requested also in the RES-directive).

7 > Impact of the EPBD at national level



Energy requirements have been a topic in Danish Building Regulations since 1961, when the first nationwide Building Regulation came into force. Since then, the energy requirements have been stepwise tightened several times. The most recent tightening, from the 1st of January 2011, requires 25% better energy performance of all new buildings compared with the 2008 requirements. Targets for the next tightening (additionally 25%) in 2015 have already been defined in the Building Regulations, and there is an ongoing work to define the expected requirements for 2020. Details will be announced as soon as the definitions have been settled.

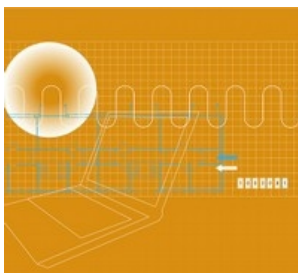
The EPBD enforced a shift from requirements for the final energy requirements for space heating (previous to 2006) to primary energy requirements for the gross

energy consumption of buildings, including space heating, domestic hot water, cooling, electricity consumption for operating the building [i.e. fans, pumps, lighting (only in non-residential buildings)] and potential penalty for indoor temperatures > 26 °C.

Energy certification of new buildings secures a higher quality of the final building, ensuring that the design and the final building are identical, and that the efficiency of the boiler, the amount of pipe insulation etc. meet the requirements. For existing buildings, the EP certificates provide greater awareness on energy matters.

The public sector has demands for energy efficient purchase of appliances. Moreover, energy management and realisation of cost-effective energy savings in buildings, e.g., as indicated in the EP certificates, must also be implemented.

8 > Further information on new energy requirements for new and existing buildings



SBI-Direction 213 describes the Danish calculation procedure

New, tightened energy requirements for new and existing buildings were implemented on the 1st of January 2011.

New buildings

The energy frame is the maximum allowed primary energy demand for a building, which includes e.g. thermal bridges, solar gains, natural ventilation, heat recovery, cooling, lighting (non-residential buildings only), boiler and heat pump efficiency, electricity for operating the building, and sanctions for overheating.

The energy frames for the primary energy demand in new buildings have been tightened by 25% compared with the previous regulations. The new frames for 2011 are:

- > $52.5 + 1,650 / A$ [kWh/m² per year] for residential buildings, and
 - > $71.3 + 1,650 / A$ [kWh/m² per year] for non-residential buildings
- where A is the conditioned gross floor area.

Furthermore, new “low energy classes 2015” have been defined as:

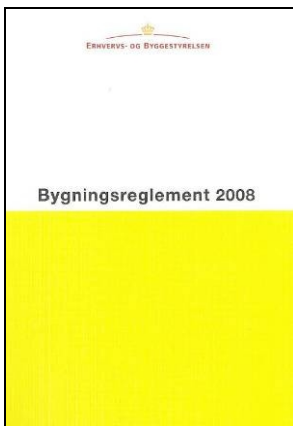
- > $30 + 1,000 / A$ [kWh/m² per year] for residential buildings, and
- > $41 + 1,000 / A$ [kWh/m² per year] for non-residential buildings

In BR10, it is stated that these low energy classes are expected to become the minimum requirements for all new buildings in 2015.

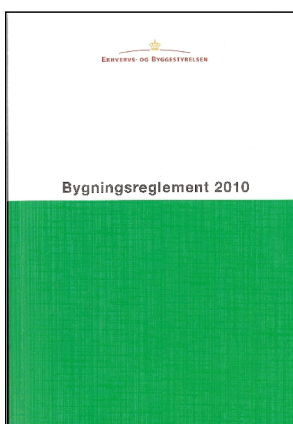
In the previous Danish Building Regulations from 2008, two low energy classes were defined (expected to become minimum requirements by 2010 and by 2015 respectively), but this is not yet the case in BR10. However, a working group has been established to prepare a new “low energy class 2020”. This class will become the first attempt towards a Danish definition of “nearly zero energy buildings”. The new low energy classes will be announced as a supplement to BR10 as soon as they are ready.

The calculation procedure in the Danish Building Regulations has been updated according to the new requirements and is described in SBI Direction 213: Energy demand in buildings (In Danish at: www.anvisninger.dk - requires license for download). The procedure follows relevant CEN standards to a great extent. This publication also includes the updated PC calculation program Be10. The calculation core from this program is to be used by all other programs for compliance checks and for energy certification, to ensure identical calculation of the energy performance of buildings. Compared with the previous calculation procedure, Be06, the new procedure has been updated with respect to:

- > New energy frames and energy requirements given in BR10
- > Low energy class 2015 incl. a new district heating factor (conversion to primary energy)
- > New energy frame for buildings heated to 5-15 °C



Building Regulations 2008



Building Regulations 2010

- › Multiple tanks for domestic hot water (DHW)
- › Improved calculation of cooling demand
- › Multiple heat pumps in same building/zone
- › Multiple solar cell (photo voltaic) systems
- › Calculation of electricity production by on-site wind turbines.

Existing buildings

In the previous Danish Building Regulations, BR08, energy upgrades were only mandatory in case of a major renovation - the 25% threshold rule of the EPBD. Then, all economically, technically and architecturally feasible measures needed to be implemented. This rule has kept some house owners from investing in energy savings, as the needed investments might outgrow their budget.

In the new Danish Building Regulation, BR10, the 25% threshold has been extended with requirements for most building components when they are renovated individually. However, the measures must be economically feasible, meaning that the annual savings multiplied by the expected lifetime of the measure divided by the investment, should be bigger than 1.33, or, put in another way, the measure must have a simple pay-back time less than 75% of the expected lifetime of the measure. In case of full replacement of a component (e.g. new roof, new window, new outer wall), the new component must meet the requirements, regardless of the economy.

Minimum requirements for replaced buildings components have been introduced as:

- › External walls and basement walls must have a U-value less than 0.20 W/m²K
- › Separations to unheated rooms or to rooms heated to a temperature 5 °C lower must have a U-value less than 0.40 W/m²K
- › Slab-on ground, basement ground floors, floors to air or to ventilated crawl spaces must have a U-value less than 0.12 W/m²K
- › Roof constructions must have an U-value less than 0.15 W/m²K
- › Doors, gates and double glazing must have a U-value less than 1.60 W/m²K
- › Foundations must have a thermal bridge loss coefficient less than 0.12 W/mK
- › Joints between external walls, windows, doors, gates, or hatches must have a thermal bridge loss coefficient less than 0.03 W/mK
- › Joints between roof construction and roof windows or skylights must have a thermal bridge loss coefficient less than 0.10 W/mK
- › When replacing a window, the energy gain during the heating season must not be less than -33 kWh/m² per year (-17 kWh/m² per year after 2015)
- › When replacing a roof window, the energy gain during the heating season must not be less than -10 kWh/m² per year (-0 kWh/m² per year after 2015)
- › When replacing a skylight, the U-value must be less than 1.60 W/m²K (1.4 W/m²K after 2015).

Installations

New, tightened requirements for installations defined in BR10 are:

- › DHW systems equipped with a heat pump must have a COP (measured according to EN 255-3) not less than 3.1 for DHW production.
- › Circulation pumps in heating, hot water, and cooling systems must have the energy label A or comply with similar requirements
- › Mechanical ventilation systems must have a heat recovery unit with an efficiency not less than 70% (80% for single dwellings)
- › Ventilation systems with a heat pump for heat recovery must have a COP not less than 3.6 in heating mode
- › Mechanical ventilation systems must meet the following requirements for specific electricity consumption for air transportation:
 - › 1,800 J/m³ in constant air volume (CAV) systems
 - › 2,100 J/m³ a max air volume for variable air volume (VAV) systems
 - › 800 J/m³ for exhaust ventilation systems
 - › 1,000 J/m³ for ventilation systems for one dwelling
- › Combined heat and power (CHP) systems must have a total efficiency (incl. heat production) ≥80% (Sterling or conventional engine, or fuel cells)

- › Oil boilers must have an efficiency, according to CE-labelling scheme, not less than 93% at full load and 98% at part load
- › Gas boilers must be condensing with an efficiency, according to CE-labelling scheme, not less than 96% at full load and 105% at part load
- › In new buildings or in combination with renovation outside district heating areas with an expected DHW consumption exceeding 2,000 l per day, a solar collector must be installed to cover the normal DHW consumption
- › In fluid/water heat pumps (ground heat systems) the norm effect factor (COP) for floor heating systems dependent on the power of the heat pump (0-3 kW: 3.0; 3-6 kW: 3.6; > 6 kW: 3.7)
- › For heat pumps supplying radiators, the requirements are: (0-3 kW: 2.6; 3-6 kW: 2.8; > 6 kW: 3.0)
- › Air-to-water heat pumps must have a norm effect factor (COP) ≥ 3.2 when supplying a floor heating system, and ≥ 2.7 when supplying a radiator system
- › Air/air heat pumps must have an efficiency ≥ 3.6 in heating mode according to EN 14511 (corresponding to an energy label A in EU's energy certification of climate systems for domestic appliances).

9 > Conclusions and future planning

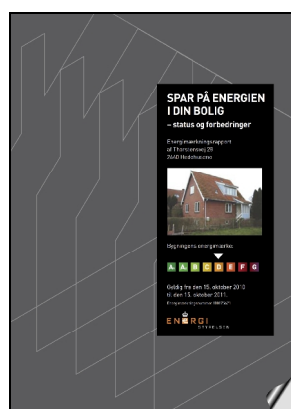
The EBPB has been implemented in Denmark to its full extent, resulting in better energy performance of the building stock. Work for implementation of the EBPB recast has already started. The tightenings of the energy requirements for new buildings in 2015 are already defined, and work has been initiated for defining the nearly zero energy buildings requirements for 2020 and beyond.

To meet the government's target for a CO₂-emission free country by 2050, existing buildings need to make their contribution. It will be a huge challenge to update the legislation and implement the changes in practice for the existing building stock. In this context, the EPC scheme will become a central element.

The Danish certification scheme is currently under revision (the new draft layout is shown on the left), and a new scheme will be launched in 2011. The new scheme will be more cost-effective, e.g. the age of the building will determine the level of detail for the certification. This will ensure that buildings with the highest potential for energy savings will get the most attention. In the new certification scheme, the validity of the certificates will be extended to 7 or 10 years, for buildings with a high or a low energy saving potential respectively. In the new scheme, energy certification of single family houses constructed less than 25-30 years before the certification can be carried out without physical inspection of the house. As something new, energy certification of selected buildings can be based on measured energy consumption. The validity of these certificates will be 5 years.

Management of the EPC database has shown many challenges. In the initial design, security to avoid the entrance of faulty data in the database was not a high priority. It was therefore decided to re-enter all information after a manual cleaning procedure. This task will certainly improve the data quality, but it requires a lot of manpower.

A major challenge is to raise the public awareness of their energy use. This, however, is slowly being promoted by the media's focus on energy consumption. There is still a strong need for official information campaigns to promote energy efficiency. Moreover, training should be mandatory for qualified experts, to improve their skills in energy audits and in giving advice regarding economical and technological building energy improvement solutions.



Draft layout of first page of new EP certificate

*This report is funded by the Community's
Intelligent Energy Europe programme
under the contract IEE/CA/07/333*



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