ENERGY EFFICIENCY WATCH

Energy Efficiency Policies in Europe



Case Study

Danish Building Code - Denmark

Co-funded by the Intelligent Energy Europe
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Key facts and figures

Country	Denmark
Name of policy	Building Regulations (Bygningsreglement) (BR10), (BR15), (BR20)
Type of policy	The Danish Building Code belongs to the policy type minimum energy performance standards (MEPS) for new buildings
Target sector	Target sectors are the residential sector and the commercial sector.
Actions targeted	Today, the requirements of the Building Code are the following: For a residential building the maximum limit on energy demand per year is 1650 kWh/HFS plus 52.5 kWh/m2, where HFS is the building's total heated floor space measured in square meters. The demand must be calculated according to specific guidelines and must include energy supplied from external sources for heating, ventilation, cooling, domestic hot water and non-residential lighting. The requirements are tightened regularly. The new building regulation ("class 2015") came into force on 1 January 2016.
Duration	Energy efficiency standards for energy use of buildings were introduced in 1960; currently: BR10, BR15 will be effective from January 2016 – until July 2016 transition period (BR10 can still be applied)
Overall target and/or achievements	One of the most ambitious and strictest minimum energy performance standards (MEPS) for new buildings among comparable countries in the European Union.
Overall aim of the policy	The class 2020 requirements, which will come into force in 2020 aim to reduce the energy consumption by 75% compared to the 2006 level. The overall target is to reduce the greenhouse gas emissions by 40% compared to 1990.
Innovativeness	Innovative are the clear, ambitious and long-term goals.

Policy objectives

The overall target of the Danish government is to reduce total greenhouse gas emissions in Denmark by 40% by 2020 compared to 1990. Furthermore, Denmark aims to have an energy and transport system based on 100% renewable energy sources by 2050.
Denmark has also introduced ambitious targets for new buildings. These targets are directly linked to the Danish Building Code and the future energy efficiency requirements "class 2015" (BR15) and "class 2020" (BR20). Buildings constructed according to the "class 2015" (see also table 1) have an energy consumption framework that is reduced at least by 50% compared to 2006. In addition, Denmark has also introduced the "class 2020" level. This level was developed to meet the Energy Performance of Buildings Directive's requirements of almost nearly zero energy buildings (Danish Building Research Institute 2013). Buildings constructed according to the "class 2020" have a reduced energy consumption of at least 75% compared to 2006 (Danish Energy Agency 2014). The long-term vision of the Danish government is to build only 'plus-energy-houses' (IEA 2011; Aggerholm et al. 2010).
To achieve these targets, the Building Code ensures a minimum energy efficiency level of new buildings to avoid locking in huge amounts of potential energy savings when a building is constructed.

Barriers addressed by the Danish Building Code are the lack of interest and motivation in energy efficiency improvement and the lack of knowledge and information. For a majority of actors, energy costs are small compared to other costs and possible cost savings are therefore too small for being a strong incentive to invest in energy efficiency improvement measures. The Building Code enforces a minimum level of energy savings. This also reduces transaction costs such as information and search costs. Building regulations also help to overcome developer-buyer and landlord-tenant split incentives.

Beneficiaries and actions targeted

To increase the energy efficiency of buildings, Denmark has already introduced the first requirements in the 1960s. The first regulation dealt with insulations (e.g. roof, walls, windows and doors). The building codes were adapted in the 1970s and requirements on installations were added. In 1995, it became mandatory to provide a calculation of the overall demand for primary energy in all new buildings (Danish Energy Agency 2015).
Today, requirements are the following: For a residential building the maximum limit of energy demand per year is 1650 kWh/HFS plus 52.5 kWh/m2, where HFS is the building's total heated floor space measured in square meters. The energy demand must be calculated according to specific guidelines and must include energy supplied from external sources for heating, ventilation, cooling, domestic hot water and non-residential lighting.
The requirements are strengthened regularly. The new building regulation ("class 2015") came into force on 1 January 2016 (with a transition period until 30 June 2016). The table below gives an overview of the overall energy requirements for new buildings including a comparison between the former "class 2010" and the minimum requirements "class 2015" and "class 2020".
When the class 2010 was effective, the "class 2015" and "class 2020" were so called "premium options", which reflected the expected future minimum energy performance requirements in 2015 and 2020, respectively (Kurnitski 2013). 15-20% of the Danish building investors (individuals, private companies and public institutions) chose one of the "premium options". Some of these very efficient buildings are in special zones, where the local municipality decided that new constructions already had to comply with "class 2015" or "class 2020" (Danish Building Research Institute 2013).

Table 1: Requirements for "class 2010", "class 2015" and "class 2020"

	Class 2010	Class 2015	Class 2020
Maximum energy demand/year (residential) HFS in the building's heated floor space in m^2	52.5 kWh/m2 + 1650 kWh/ HFS	30 kWh/m2 + 1000 kWh/ HFS	20 kWh/m^2
Maximum energy demand/year (non-residential)[1] HFS in building's heated floor space in m^2	71.3 kWh/m^2 + 1650 kWh/ HFS	41 kWh/m^2 + 1000 kWh/ HFS	25 kWh/m^2
Max. air leakage/second (test pressure 50 Pa)	1.5 l/m2	1.0 l/m2	0.5 l/m2
Max. design transmission loss[2], single-storey	5 W/m^2	4 W/m^2	3.7 W/m^2
Min. energy gain[3] through windows/glazed walls	-33 kWh/m^2year	-17 kWh/m^2year	0 kWh/m^2year

[1] includes demand for lighting
[2] Average heat loss through 1m^2 of the non-transparent parts of the building envelope at 20°C inside temperature and -12 °C outside.
[3] Solar heat gain minus heat loss through 1 m^2 of window (facing south-east) during a standard Danish winter.
Source: Danish Energy Agency (2015), p. 11

According to the Danish Energy Agency (2015) other specific technical requirements for new buildings deal with:

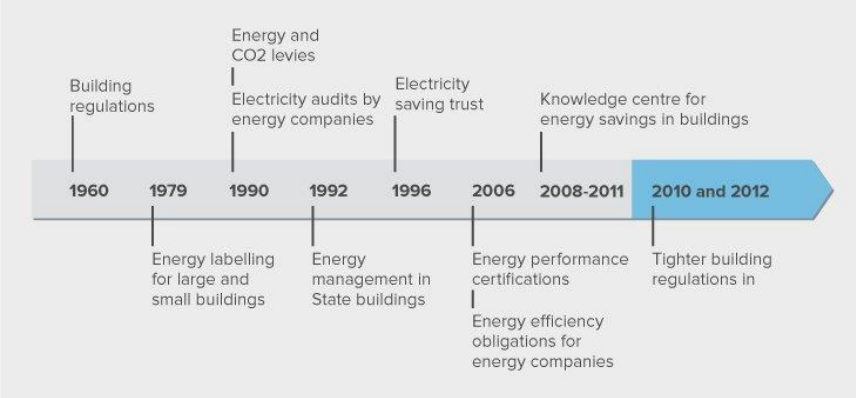
- thermal resistance for each of the non-transparent elements in the building envelope and for typical thermal bridges
- “energy gain” through a typical heating season for transparent parts of the building envelope
- overall thermal resistance of the building envelope, excluding windows and doors
- air-tightness of the building envelope as a whole
- efficiency of boilers, if any
- efficiency of heat pumps, if any
- heat distribution systems, including systems for domestic hot water
- circulation pumps
- ventilation and air conditioning
- lighting (no requirements apply in single family houses)

All building owners benefit directly from the Danish Building Code by saving energy and costs. Furthermore, building occupants also benefit from the Building Code through an increased level of thermal comfort. Indirect beneficiaries are manufacturers of energy efficient products, construction companies with a focus on low energy buildings, and energy consultants due to an increased demand for energy efficiency products and services.

Design and implementation

Denmark has a long tradition with specific policies and measures for energy efficiency in buildings, with building energy efficiency standards as the main element. In 1960, Denmark was one of the first countries worldwide to introduce nationwide energy efficiency standards for energy use of buildings; today it has one of the most ambitious and strictest minimum energy performance standards (MEPS) for new buildings among comparable countries (Danish Energy Agency 2010; WWF Scotland 2011). The Ministry for Climate, Energy and Buildings and, more specifically, the Danish Energy Agency are in charge of the Danish Building Code. The Energy Agency is supported by a group of experts from the Danish Building Research Institute, the Danish Technology Institute and other specialists (Danish Energy Agency 2015). When a new regulation is under development, stakeholder consultation forums are held regularly. In addition, the proposals of the regulation are submitted for public enquiry before they are finalised. Different actors can comment on the proposal such as the construction industry, equipment makers, academia, NGOs, national government bodies and municipalities (Danish Energy Agency 2015).
Municipal administrations are responsible for the local and practical implementation of the building code and are the contact point for the general public. This means that e.g. building permits are granted by local municipal administrations. In order to obtain a permit, a developer must fulfil specific guidelines to demonstrate that the construction plans are in accordance with the minimum standards. After the completion of the building, an energy efficiency performance review is required by an independent and certified auditor. The report (Energy Performance Certificate) is then forwarded to the respective municipality (BPIE 2015). Other enforcement mechanisms are documentations on airtightness and test for construction products. They are carried out by independent laboratories.
A key element of the Building Code is the combination with other policies and measures. Denmark has implemented an energy performance certification scheme, energy audits, advice from energy companies and from the regional energy advice offices of Energy Service Denmark, as well as a Knowledge Centre for Energy Savings in Buildings targeting the construction supply-side actors. To provide financial incentives for energy efficiency actions, some grants and subsidy programmes were implemented as well, by both the government and the energy companies. Demonstration projects provide a basis for convincing information and training to investors, architects, construction companies and other contractors. The next figure shows the policy package to increase the energy efficiency of buildings in Denmark.

Figure 1: Timeline for key policy instruments in Denmark

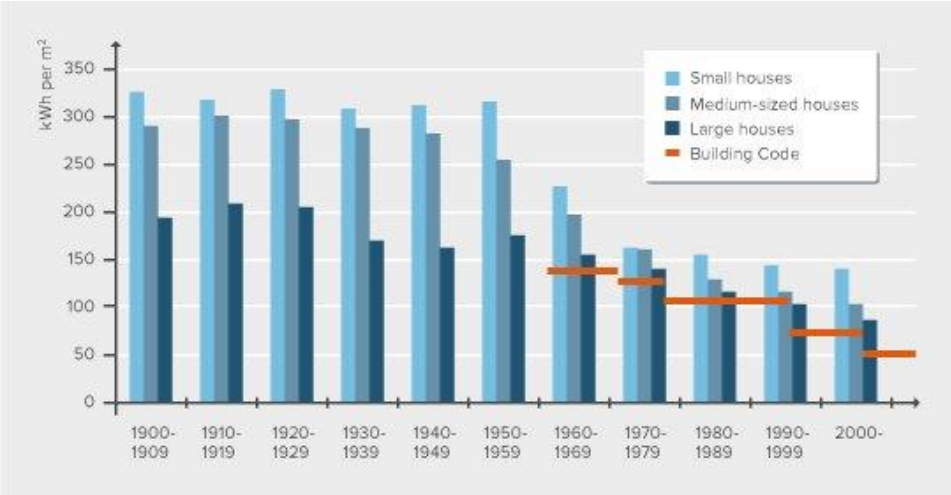


Source: McCormick and Neij 2009, p. 18

Policy impacts

According to an evaluation by Energy Analysis, Niras, RUC and 4-Fact published in December 2008 (Energy Analysis et al. 2008), the building code in Denmark is of great importance for the reduction of energy consumption in new buildings. Nevertheless, in the past the predetermined energy requirements were not always met as the following figure shows:

Figure 2: Actual energy consumption in single family houses in Denmark, relative to energy efficiency requirements in building codes



Source: Laustsen 2008, p. 14

It remains to be seen, if the high expectations regarding the planned tightening steps of the building code in 2015 and 2020 will be met.

Policy Innovation

It is innovative that Denmark has a clear and ambitious goal to have a society based on 100% renewable energies in 2050. Consequently, one of the largest consumers of energy, residential buildings, are one of the priorities to achieve this target. The energy efficiency shall be increased significantly with the new requirements BR15 and BR20. Denmark has a Building Code, which is among the highest all over the world.

Through the long-term goals, and especially by way of announcing a concrete roadmap for the further tightening of the Building Code early on, the Danish Government sends a clear signal to the building sector and allows actors to prepare themselves for these next steps. The long-term targets motivate actors on the supply side to make critical, long-term investment decisions. Without such targets up to the year 2020 the risk of sunk costs would be high.

Lessons learnt 1: Success factors

- The building industry and research institutions were continuously involved in the development of standards (Danish Energy Agency 2015).
- Builders can choose between standard options and premium options.
- The energy efficiency requirements are regularly updated, every five years.
- Design energy efficiency for a long term: The future energy classes are made publicly available at an early stage (the energy requirements for 2020 were already published with the 2010 requirements). This invites innovation and it provides the opportunity for early capacity building for affected stakeholders (Danish Energy Agency 2015).
- The targets for energy efficient buildings were agreed by 170 out of 175 members of the Danish parliament. The broad majority creates long-term credibility and a low risk of negative changes after elections (Danish Energy Agency 2015).

References and further information

- Aggerholm, Sören; Engelung Thomsen, Kirsten; Wittchen, Kim B. (2010): Implementation of the EPBD in Denmark. Status in November 2010
- BPIE (2015): Indoor air quality, thermal comfort and daylight. Analysis of residential building regulations in eight EU Member States.
- Danish Building Research Institute (2013): Cost-optimal levels of minimum energy performance requirements in the Danish Building Regulation. SBI 2013:25
- Danish Energy Agency (2014): Denmark's National Energy Efficiency Action Plan (NEEAP)
- Danish Energy Agency (2015): Energy Policy Toolkid on Energy Efficiency in New Buildings. Experiences from Denmark
- Energy Analysis, Niras, RUC and 4-Fact (2008): En vej til flere og billigere energibesparelser: Evaluering af samtlige danske energispareaktiviteter. December 2008. Only available in Danish
- Hansen, Marie Louise (2010): Danish government strategy for reduction of energy consumption in buildings. June 2010
- International Energy Agency (IEA) (2011): Implementation of the 25 energy efficiency policy recommendations in IEA member countries: recent developments. Period from March 2009 to March 2011. Prepared by Sara Bryan Pasquier
- Kurnitski, Jarek (2013) (Hrsg.): Cost Optimal and Nearly Zero-Energy Buildings (nZEB): Definitions, Calculation Principles and Case Studies.
- Laustsen, Jens (2008): Energy Efficiency Requirements in Building Codes, Energy Efficiency Policies for new Buildings. IEA Information Paper
- Odyssee & MURE (2011): Energy Efficiency Profile: Denmark. May 2011
- The Regulatory Assistance Project (RAP) (2010): A comparison of energy efficiency programmes for existing homes in eleven countries. Prepared for the Department of Energy and Climate Change United Kingdom. February 2010
- World Wildlife Fund (WWF) Scotland (2011): Maximizing the Minimum: The need for minimum energy performance standards in private housing. May 2011

Disclaimer

The Project

The Energy Efficiency Watch Project aims to facilitate the implementation of the Energy Efficiency Directive but also related policies like the Energy Performance in Buildings Directive (EPBD) and the Ecodesign (ErP) Directive on the national, but also on the regional and local level. This country report shows the progress made in implementation of national energy efficiency policies identified via a screening of NEEAPs and an extensive EU wide expert survey.
www.energy-efficiency-watch.org

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List of Abbreviations

EE – Energy Efficiency, **EED** – Energy Efficiency Directive, **EPC** – Energy Performance Certificates, **EPBD** – Energy Performance of Buildings Directive, **ErP** – Energy-related Products, **EU** – European Union, **EEW** – Energy Efficiency Watch, **MEPS** – Minimum Energy Performance Standards, **MURE** – Mesures d'Utilisation Rationelle de l'Energie, **NEEAP** – National Energy Efficiency Action Plan, **nZEB** – nearly Zero Energy Buildings, **R&D** – Research and Development

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