



## Long-term renovation strategy

**Division/Department**  
Centre for Energy Efficiency

**Date**  
18. September 2020

**Ref. No** 2019 - 93913

MSC/AGJ/HLM

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## Introduction

It follows from Article 2a of the Energy Performance of Buildings Directive (EPBD) that each Member State is required to establish a long-term renovation strategy to support the renovation of the national stock of residential and non-residential buildings. The strategy shall contribute to the fulfilment of the EU's long-term goal for 2050 of reducing greenhouse gas emissions by 80-95% compared with 1990. The goal is to achieve a highly efficient and decarbonised building stock by 2050 and facilitate the cost-effective transformation of existing buildings into nearly zero-energy buildings (NZEBs). The renovation strategy must include indicative milestones for improving the efficiency of the building stock in 2030, 2040 and 2050 and a roadmap for fulfilling these goals.

The implementation of Article 2a of EPBD is the focus of this strategy. The following section describes existing and known future support for Denmark's energy renovation initiative.

Energy requirements for new buildings have been progressively tightened over recent decades in Denmark. The energy requirements for new buildings are therefore currently very limited. However, because buildings have a very long life span, many buildings in Denmark were built before the introduction of more stringent energy requirements. A targeted effort will thus be required if the energy consumption of buildings is to be reduced.

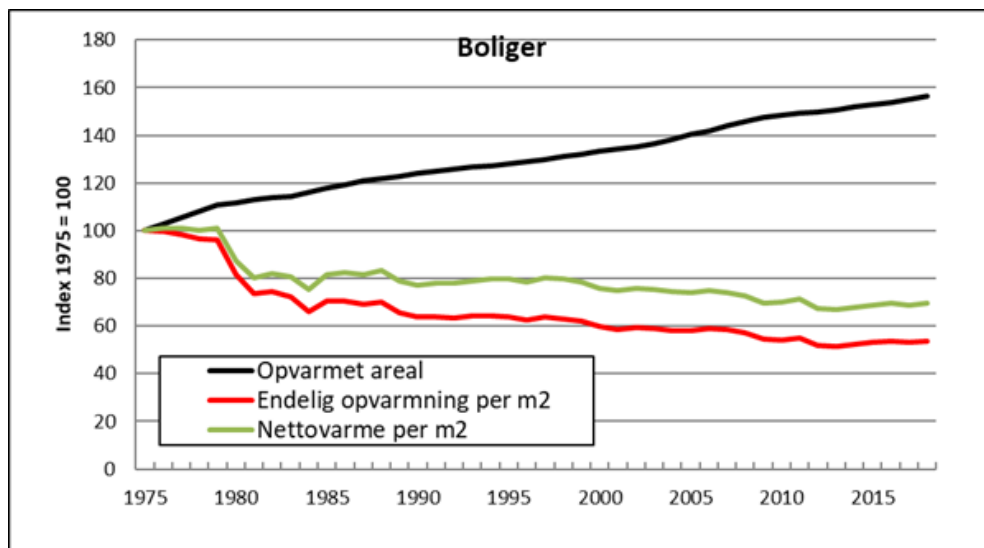
The Danish Government has set an ambitious target to reduce greenhouse gasses by 70% by 2030 compared with the level in 1990. Extensive restructuring in all sectors will be required to achieve this target. In connection with a future climate action plan, the Danish Government will focus in greater detail on the area of energy efficiency to ensure that climate and energy policy is coherent. Regarding the requirements of Article 2a of EPBD, the Danish Government will establish indicative milestones for improving the energy efficiency of the building stock in 2030, 2040 and 2050, a roadmap for fulfilling these goals and a report on how these contribute to fulfilment of the EU's energy efficiency targets. This part of the renovation strategy will first be considered in more detail in connection with the work on the climate action plan.

## Status of energy efficiency of buildings in Denmark

Promoting energy savings has been a recurring theme in Danish energy policy, and successive governments have implemented a raft of specific initiatives promoting energy savings in Denmark. At the same time, there have been active efforts within the EU to ensure a higher level of ambition for energy saving initiatives in the EU's Member States.

A significant proportion of the total energy consumption in Denmark is used for heating buildings. Since the first energy plan was established in 1976, there has been a focus on reducing energy consumption for heating buildings, and significant efficiencies have been achieved. Because of this, the final energy consumption for heating properties per square metre of area heated has been reduced by almost 45% in relation to 1975 and net heat consumption per m<sup>2</sup> has been reduced by almost 30%.

**Figure 1: Trend in heat consumption per m<sup>2</sup> in properties**



Source: Energy Statistics 2018

Boliger	Housing
Opvarmet areal	Heated area
Endelig opvarmning per m2	Final heating per m2
Nettovarme per m2	Net heat per m2

The figure shows very substantial and permanent reductions in heat consumption between 1979 and 1984. This was a consequence of the second oil crisis, which resulted in a sharply rise in energy prices and a very active political effort, with

significant contributions to energy improvements and extensive campaigns concerning consumer information and behaviour.

There was a steady reduction in consumption per m<sup>2</sup> from the mid-1980s through until 2013. The efficiencies in energy consumption achieved in buildings are partly the result of active efforts and a comprehensive range of initiatives. Central to this have been the energy requirements of the building regulations and an extensive information initiative, including the energy rating scheme, grant funds and energy taxes.

Heat consumption increased between 2013 and 2018, including an increase in consumption per m<sup>2</sup>. The reason for this increase in consumption is currently unclear, but it is believed it may partly have been due to changes in behaviour, including the use of higher indoor temperatures.

The average annual reductions in energy consumption per m<sup>2</sup> are presented in Table 1.

**Table 1: Average annual changes in consumption per m2**

	1975-2018	2000-2018	2013-2018
Final energy consumption per m2	-1.44%	-0.66%	+0.75%
Net consumption per m2	-0.84%	-0.48%	+0.69%

Note: The changes relate to the entire building stock and, in addition to the energy renovation of existing buildings, are affected by the growth in the number of new buildings with lower levels of consumption than existing buildings.

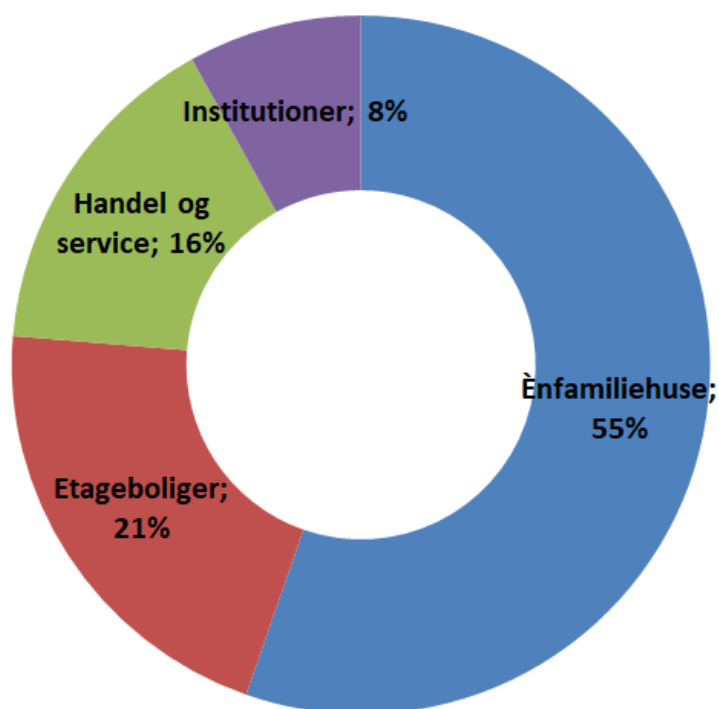
## Overview of the building stock and status of the scope of renovation

Article 2a(1)(a) of the EPBD stipulates that each long-term renovation strategy (LTRS) 'shall encompass an overview of the national building stock, based, as appropriate, on statistical sampling and expected share of renovated buildings in 2020'.

### Current distribution of heat consumption

The figure below illustrates the distribution of heat consumption in the Danish building stock and is based on heat consumption in 2017:

**Figure 2: Distribution of heat consumption in the existing building stock**



Institutioner	Institutions
Handel og service	Trade and services
Etageboliger	Apartment buildings
Enfamiliehuse	Single-family houses

More than half of the energy consumption for heating in buildings was used in single-family houses (detached houses, terraced houses and farmhouses), and

together these properties accounted for more than 70% of the energy consumption used for heating.

In 2017, the Danish Building Research Institute (SBI) carried out an analysis and calculation for the national building stock based on data from 600 000 energy ratings ('Heat savings in existing buildings'), SBI for the Danish Energy agency, 2017 – presented as Annex 1 and Annex 1a). The calculation provides an overview of the building area and the energy saving potential divided according to the most common building types (detached houses, apartment buildings, trade and services, etc.). The analysis calculates potential savings of around 30% in the period leading up to 2050 by complying with the requirements of the building regulations.

Table 2 below is an extract from the report containing the calculation of the existing building stock covering the number of buildings, the floor area of the building stock in Mm<sup>2</sup> (million m<sup>2</sup>), current net heat consumption in TWh/year, the net heat consumption per m<sup>2</sup> floor area in kWh/year per m<sup>2</sup> and the design heat output in MW.

**Table 2: Statement of the existing building stock**

	Bygninger	Mm <sup>2</sup>	TWh/år	kWh/år pr m <sup>2</sup>	MW
Stuehuse	113.980	22,0	2,77	126	1.115
Parcelhuse	1.102.462	162,2	20,50	126	8.015
Række-/kædehuse	244.885	37,1	4,05	109	1.532
Etageboliger og lign.	102.558	92,3	10,36	112	4.040
Handel og service	109.180	84,4	7,72	91	3.868
Institutioner	44.515	38,3	3,97	104	1.969
Samlet	1.717.580	436,3	49,37	113	20.539

Stuehuse	Farmhouses
Parcelhuse	Detached house
Række-kædehuse	Terraced house
Etageboliger og lign.	Apartment building, etc.
Handel og service	Trade and services
Institutioner	Institutions
Samlet	Total
Bygninger	Buildings
TWh/år	TWh/year
kWh/år pr m <sup>2</sup>	kWh/year per m <sup>2</sup>

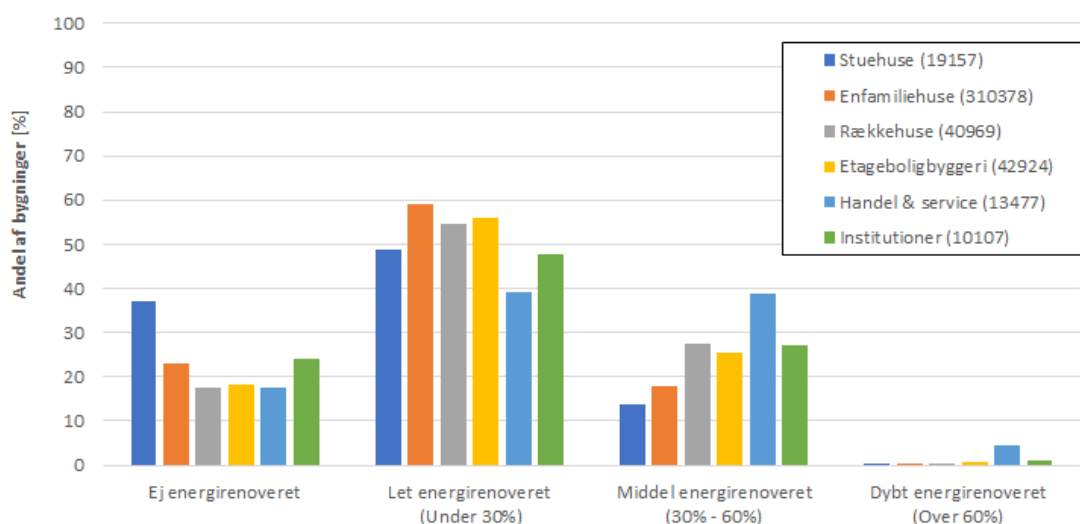
## Renovation depth of the existing building stock

Based on data from the energy rating database, the Danish Building Research Institute has prepared an overview of the anticipated renovation depth of existing buildings in 2020 (a description of the anticipated percentage of renovated buildings in 2020 is provided in Annex 2). This is based on the EU Commission's recommendations for the renovation depth, which groups the level of a building's energy renovation into the following categories:

- *Light*: Energy consumption is reduced by up to 30%
- *Medium*: Energy consumption is reduced by 30% – 60%
- *Deep*: Energy consumption is reduced by more than 60%<sup>1</sup>.

There has been a focus on buildings built before 1980, as buildings built after this year have relatively good levels of insulation because building regulation requirements for energy consumption in new builds were tightened significantly in 1979.<sup>2</sup> This is supported by the aforementioned SBI analysis from 2017, which concludes that around 80 – 85% of the potential energy savings associated with renovations in the overall Danish building stock lie in buildings built before 1980.

**Figure 3: Anticipated renovation depth in 2020 of buildings built before 1980.**



Andel af bygninger	Proportion of buildings
Ej energirenoveret	No energy renovation

<sup>1</sup> 'Energy' in this case refers to heat consumption for space heating, heating of ventilation air and hot water. This definition has been chosen because the energy renovation of a building in a climate such as that in Denmark only reduces heat consumption.

<sup>2</sup> This is because buildings built from 1980 onwards were built to comply with building regulations with significantly higher insulation demands compared with the requirements for buildings built before 1980.



Let energirenoveret (Under 30%)	Light energy renovation (<30%)
Middel energirenoveret	Medium energy renovation
Dybt energirenoveret (Over 60%)	Deep energy renovation (>60%)
Stuehuse	Farmhouses
Enfamiliehuse	Single-family houses
Rækkehuse	Terraced houses
Etageboligbyggeri	Apartment buildings
Handel & service	Trade and services
Institutioner	Institutions

Around 20% of the building stock built before 1980 has not been energy renovated. Around 55-60% has undergone light energy renovation, around 20-25% has undergone medium energy renovation, and only a very limited number of deep energy renovations have been performed. There are however differences between the various building use types.

## Roadmap for energy efficiency: Overview of existing and allocated support

Article 2a of EPBD stipulates that each Member State must establish a roadmap with measures and indicators. The roadmap must include indicative milestones for 2030, 2040 and 2050. There are also a number of requirements regarding what the renovation strategy must cover.

In accordance with *inter alia* the 2018 energy agreement, Denmark has established a raft of policies and instruments to promote a cost-effective and deep energy renovation initiative, including measures aimed at public buildings and the least energy efficient segments of the building stock.

This section gives an account of these existing and future instruments aimed at energy renovation in Denmark, and thus forms the starting point for the roadmap leading up to 2050 to ensure a highly energy efficient and decarbonised national building stock and in order to facilitate the cost-effective transformation of existing buildings into nearly zero-energy buildings, so that the instruments constitute Denmark's contribution to the other requirements for what the renovation strategy must include. See Annex 4 for a systematic overview of the implementation of the individual points of Article 2a of EPBD.

Future energy efficiency initiatives will be considered in connection with the forthcoming climate action plan, including indicative milestones for the renovation of the building stock for 2030, 2040 and 2050 and progress indicators.

Instruments for making the building stock more energy efficient are generally based around three different regulatory approaches: Normative instruments (e.g. component-specific requirements in connection with renovations), financial instruments (e.g. taxes and grants) and informative instruments (e.g. information for citizens, energy rating of buildings or additional training of tradesmen).

## Requirements and norms

### Building regulation requirements for renovations

The energy renovation of buildings may be performed in the most cost-effective way in connection with ongoing renovations, e.g. the retrospective insulation of roof structures when the roof is being replaced. Denmark has therefore stipulated a requirement in the building regulations that profitable energy savings must be implemented when the building owner renovates the various building elements due to wear and tear. This ensures that energy measures are carried out at the most cost-effective time, i.e. in connection with other non energy-related renovation. Renovation classes may be used as an alternative under certain circumstances.

### Energy efficiency in State institutions

An initiative has been under way for a number of years to reduce energy consumption in the Ministries and underlying institutions. All Ministries are therefore obliged to reduce their energy consumption by 14% by 2020 as compared with 2006 levels in accordance with the circular 'Energy efficiency in State institutions'. The circular is based on a framework management principle, hence the Ministries are responsible for achieving the energy saving goal in their own area. Thus, a considerable number of initiatives are under way both within the Ministries and State building owners to promote energy efficiency in State buildings. Overall, the State has cut its energy consumption by 10.9% in the period 2006-2018 despite a significant increase in activity level expressed as the number of employees.

On 17 January 2020, a revised circular entered into force, which introduced supplementary requirements for the institutions under State management. This means that buildings purchased in future must comply with energy requirements, and that a supplementary energy saving target is established for the period 2014-2020.

### Rental accommodation initiatives

#### *Private rental accommodation*

The energy efficiency of private rental accommodation can be inhibited by the owner/tenant issue, where the building owner is responsible for making the necessary investments in energy improvement and the tenant must pay the ongoing energy expenses. There are therefore numerous measures in place aimed at countering this problem.

In the case of buildings built before 1991, landlords have the option of increasing the rent from a cost-determined rent level to a value-based rent level for the premises. This option only covers leases in properties which *inter alia* have an energy framework of A-D under the energy rating scheme at the time of rental.

There is also an optional alternative to calculate an improvement-based increase under the ordinary provisions (*total economically viable energy improvements*). Landlords can therefore decide whether energy improvements are to be implemented with the calculation of the rent increase under the ordinary rules of the Danish Rent Act or under the special rules concerning viable energy improvements from a total cost of ownership perspective.

There is also a scheme known as '*Agreed green urban renewal*' for energy renovations of private rental buildings. The scheme allows for a rent increase by agreement between the parties calculated based on the total agreed and documented costs for the energy improvement works. The increase in rent may therefore exceed the increase in rent which may otherwise have been determined

under ordinary tenancy legislation rules, according to which only the improvement part of the expenses may lead to a rent increase.

#### *Public housing*

A pilot scheme has been established for public housing enabling public housing organisations to perform trials with so-called dynamic heat accounts where the heating expenses are billed according to the measured indoor climate (indoor temperature, humidity and CO<sub>2</sub> content) as an alternative to the traditional measurement of heat consumption. The purpose of this is to motivate tenants to choose a good indoor climate, because this is good for their health and the condition of the property and may lead to a reduction in energy consumption.

### **Financial incentives**

Financial incentives for energy renovation in Denmark take the form of high taxes on space heating, tax deductions and grants targeted at buildings, businesses and the conversion of oil-fired boilers and loan options for municipalities.

#### **Taxes**

All energy consumption for heating buildings apart from biomass is subject to high taxes. For oil, natural gas and electricity for heating, energy and CO<sub>2</sub> taxes collectively amount to more than DKK 65/GJ. Additionally, there are quota costs for a large proportion of district heating. Taxes for oil and natural gas are indexed and thus maintained at fixed prices. Taxes on electricity used for heating have reduced significantly in recent years, with the result that in 2021, they will amount to around DKK 43/GJ and thus be lower than taxes on fossil fuels. A significant incentive to reduce energy consumption for heating is therefore achieved through taxes, and taxes have contributed to the reduction in heat consumption over the past 20-25 years.

#### **Energy companies' Energy-saving initiative**

Energy companies (network and distribution companies for gas, oil, district heating and electricity) have entered into a voluntary agreement with the State to realise energy savings in energy consumption. Undertakings and private consumers can therefore apply for grants and/or advice on energy saving measures up until the end of 2020, including building renovations under this scheme. It is possible to apply for aid for a wide range of measures such as summer insulation, window replacement, heat conversion and the control of heating systems, etc. Aid may be applied for directly via an energy company or through an operator with an agreement with an energy company, provided the work results in energy improvements. The scheme will be replaced from 2021 by a fund targeted at savings in process energy amongst undertakings and a fund targeted at energy consumption savings in the buildings described below.

### **Fund for energy savings in buildings**

As shown in Figure 2 on page 6 on the distribution of heat consumption in the existing building stock, more than half of the energy consumption is used for heating in buildings in single-family houses. Residential properties and detached houses in particular are therefore a central focus area for energy renovation. A total of DKK 200 million annually has been allocated in the 2018 energy agreement for the period 2021-2024 for energy savings in buildings. The initiative has been targeted at properties for year-round use because the savings potential is greatest in this segment.

The fund will support energy measures featuring in a positive list. There will be requirements regarding the 'after-situation' for individual measures on the positive list to ensure that the fund is used in the most effective way. The requirements for the after-situation will ensure that aid is only provided for deep renovations where the overall cost-effective potential is realised to the greatest extent possible. The building's energy rating is included as part of the documentation basis.

Grants are awarded to building owners who can document the greatest energy saving potential (greatest possible saving in kWh/m<sup>2</sup>). This ensures the least energy efficient segments of the national building stock are targeted.

### **Fund for energy savings in business**

A total of DKK 300 million annually has been allocated in the 2018 energy agreement for the period 2021-2024 for energy savings in businesses, including non-residential buildings. Over 50% of the savings must be found in process energy. Energy consumption for space heating, hot water and comfort cooling is not generally considered to constitute process energy. However, it is possible to obtain grants for savings in space heating, hot water and comfort cooling provided the requirement that over 50% of the total energy savings are derived from process energy is adhered to. The projects essentially compete for funding based on the greatest number of kWh per DKK of aid.

### **Heat pumps on subscription**

High initial costs are a barrier to the spread of heat pumps. In order to counter this, Denmark has established the scheme *Heat pumps on subscription*. Under this scheme, selected companies install, own and operate a heat pump for a building owner. The building owner typically only pays a connection fee, ongoing subscription and payment for heat that is consumed. The selected companies receive a grant for each heat pump installation. The scheme expires in 2020.

### **Scrapping of oil-fired boilers**

An aid scheme worth DKK 20 million annually has been allocated in the energy agreement from 2018 for the period 2021-2024 to scrap oil boilers outside collective supply arrangements. The aid is triggered when a property owner

receives a heat pump on subscription after scrapping their oil boiler, and aid is paid to companies supplying and operating heat pumps.

### **Housing-Job scheme**

The Housing-Job scheme grants tax reductions of up to DKK 12 200 per person per year (in 2019) for wages, including VAT, for skilled trade work carried out in homes. This reduction can be utilised through additional insulation, window replacement, improving heating systems and the replacement of heating control systems, etc.

### **Loan fund for municipalities and regions**

A political agreement was reached in 2018 to establish a loan fund of DKK 100 million annually for the energy renovation of buildings by municipalities and regions during the period 2021-24.

### **Information, education and advice**

In Denmark, informative instruments to promote energy renovation take the form of information aimed at both individual home and building owners, increasing the level of training of tradesmen performing the work and at the housing market more generally.

### **Data and digitalisation**

Denmark is focused on how the potential of data and increasing digitalisation can be better utilised so that energy efficiencies are implemented where they provide most value and so that the transaction costs of energy renovations are reduced. A total of DKK 33 million in 2019, DKK 34 million in 2020 and DKK 44 million annually during the period 2021-2024 has been allocated in the 2018 energy agreement for the information and data initiative overall. Activities include a number of analyses and demonstration projects focusing on promoting the use of data and digitalisation as the driving force for achieving energy efficiencies and flexible energy consumption in buildings, including supporting an energy management approach using databases.

### **Danish Knowledge Centre for Energy Savings in Buildings [Videncenter for Energibesparelser i Bygninger]**

The Danish Knowledge Centre for Energy Savings in Buildings collates and systematises knowledge concerning energy savings in buildings and communicates this to the construction sector. The purpose of this is to provide tradesmen and consultants with the best possible conditions to carry out profitable energy renovations. The Danish Knowledge Centre for Energy Savings in Buildings develops *inter alia* tools and training materials targeted at executive and vocational training courses. The Knowledge Centre is part of the Danish Energy Agency's targeted information initiative.

### **SparEnergi.dk**

SparEnergi.dk is the central platform for information activities relating to energy efficient solutions. The target group comprises both private and public building owners. The site contains good advice on energy savings and information on common renovation measures. The site also contains numerous digital tools to support and qualify the decisions of building owners in relation to energy renovation. For example, one tool enables property owners to look up their energy rating, explore their energy saving potential in more detail and compare themselves to other houses in the neighbourhood. There are also numerous renovation case studies and an option to obtain an overview of subsidy options.

### **Energy rating of buildings**

There is a requirement in Denmark under EPBD specifying that all year-round accommodation and non-residential properties larger than 60 m<sup>2</sup> must be energy rated when they are sold, leased, advertised or transferred. This ensures that the buyer or lessee receives an overview over the energy status of the building. This means that the building's market price reflects its energy status to a greater extent. Both parties also have an overview of energy consumption expenses and the savings potential via the energy rating report's list of profitable energy savings that may therefore be implemented at the most cost-optimal time. The energy rating provides an overview of the building segments, including those that are least energy efficient. There are currently over 600 000 energy rated buildings in Denmark. An initiative was implemented in 2018 to create greater precision in energy ratings, and to involve and support data and digitalisation and motivate the performance of profitable energy renovations to a greater extent.

The energy rating is performed by an energy consultant. The energy consultant prepares the energy rating and energy rating report based on a review of all of the building conditions and installations important for energy consumption. The report contains calculations of the building's energy consumption and proposals for improvements in the building's energy situation.

### **Training of energy consultants**

Energy rating companies must be certified and registered to prepare energy ratings, and it is the responsibility of these companies to ensure that energy consultants are trained appropriately. Energy consultant training constitutes supplementary training taken via the general education system. In order to perform energy ratings, energy consultants must undergo a training programme and pass an associated examination. More detailed rules on who may prepare energy ratings are set out in the Danish Executive Order on energy certification of buildings.

### **BedreBolig (BetterHomes)**

BetterHomes is a national market-based scheme developed by the Danish Energy Agency to make it easier for building owners to renovate in an energy-efficient way.

Advice can be given at any stage of a renovation project, and may include drawing up a Better Housing plan that creates a complete overview of the anticipated investment and savings. The BetterHomes plan can help building owners throughout renovation projects (one-stop-shop), and a BetterHomes plan can be used as a basis for dialogue with banks or mortgage credit institutions.

BetterHomes consultants are tradesmen, building constructors, engineers and architects, etc. who have completed a special BetterHomes training course.

### **Renewable energy (RE) accreditation scheme**

The renewable energy accreditation scheme covers companies installing and fitting small renewable energy systems in private homes, i.e. heat pumps, PV cells, solar heating and small biomass boilers and furnaces. The Danish Energy Agency approves companies that both install and fit renewable energy systems. In order to be a certified renewable energy undertaking, the undertaking must already be an authorised electrical or heating, ventilation, plumbing, sanitary and refrigeration installation company and have employees who have completed a special RE training course.

### **Green Climate Fund**

An initiative was agreed in connection with the establishment of the Green Climate Fund for 2018 to ensure a smaller climatic impact resulting from construction by upscaling the best solutions in green development. Analysis work and knowledge sharing has therefore been initiated to ensure that all parties involved in construction can put the latest knowledge, research and innovation into practice.

## **Other initiatives**

### **Measures to help alleviate energy poverty**

There are many initiatives in Denmark to help tackle energy poverty. Poverty-related deprivation, including housing deprivation is generally addressed through social policy.

### *Heating supplements*

Old age pensioners and people who began taking an early retirement pension before 1 January 2003 can apply for a heating supplement. The supplement is awarded to pensioners with the worst financial circumstances and contributes to the heating of the dwelling and hot water.



### *Individual payments*

Following a specific assessment, municipal authorities may provide assistance for the payment of particularly large heating bills for persons subject to a change in their circumstances (e.g. unemployment or illness), in cases where paying such bills would make it difficult for such persons to manage in future. This assistance is normally only paid if the expense has arisen because of unforeseen needs.

### *Special support*

Individuals fulfilling the conditions for receiving cash assistance, education assistance or self-sufficiency and repatriation benefit or transitional benefit (but not necessarily in receipt of such assistance) and who have high housing costs or a large dependency burden may receive special support if the need for assistance cannot be met through other benefits. Special support is not paid as a fixed amount, but is generally calculated as the difference between the amount that the applicant is assumed to be able to afford relating to housing costs (threshold amount) and the beneficiary's net housing expenses, including water, heating, gas and electricity.

### **Financial Instruments**

Denmark has a system for financing energy efficiency measures in both buildings and business premises. The main elements of Denmark's financing system include:

- A mortgage credit system which lends money to building owners with the value of the building as collateral,
- Municipal Mortgage Credit (Kommunekredit), which provides financial services to municipalities, including loans and leasing,
- Banking system, where building owners have access to financing for energy efficiency projects,
- National Building Fund (Landsbyggefonden), which is a self-governing institution funded by tenants in the public housing sector. The fund provides *inter alia* aid for the renovation of social housing, and provides indirect aid for energy improvements.

There are also many other schemes, including heat pumps on subscription and the BetterHomes scheme, which is a market-based consultancy scheme that makes it easier for building owners to renovate in an energy-efficient way, etc.

See Annex 4 for a more detailed review of the Danish system for financing energy efficiency measures.

## Estimate of anticipated energy savings and indirect effects

Article 2a(1)(g) of EPBD stipulates that an evidence-based estimate of expected energy savings in the Danish building stock shall be provided in addition to the wider benefits associated with energy renovation, i.e. improved indoor climate, higher productivity and fewer sick days, etc.

### Anticipated energy savings

The Danish Energy Agency's baseline projection is used to provide an evidence-based assessment of anticipated energy savings. The Danish Energy Agency will prepare annual baseline projections of how energy consumption and energy production and the discharge of greenhouse gasses will develop subject to a so-called 'Frozen Policy' scenario. 'Frozen Policy' means that the development is subject to the 'politically frozen' absence of new measures. The assessment of the anticipated energy savings in existing buildings has been calculated based on energy consumption projections in the Danish Energy Agency's Baseline projection 2019<sup>3</sup>

The trends in heated area, net heat consumption and consumption per m<sup>2</sup> for housing built before 2017 are shown in Table 33.

**Table 3: Trend in net heat consumption for homes built before 2017**

		2017	2020	2025	2030
Heated area	Million m <sup>2</sup>	324.5	321.6	316.7	311.8
Net heat	PJ	139.8	137.4	132.2	127.3
	PJ/million				
Unit consumption	m <sup>2</sup>	0.431	0.427	0.417	0.408
	kWh/m <sup>2</sup>	119.7	118.7	116.0	113.4

From 2020 to 2030, net heat consumption will fall per m<sup>2</sup> by 4.4%, and in relation to a baseline with unchanged consumption per m<sup>2</sup>, net heat consumption will be reduced by 5.9 PJ in 2030 as compared with 2020, not including the effect of the demolition of existing buildings. Preliminary calculations indicate that the building fund of DKK 200 million per year in 2021-2024 will have an effect of around 1.2 PJ in 2030. The remainder of the reduction may be attributed to a combination of the

<sup>3</sup> See the Danish Energy Agency's website for documentation of general projection results and the methods and models used in connection with the projection: <https://ens.dk/service/fremskrivninger-analyser-modeller/basisfremskrivninger>.

other instruments aimed at existing buildings, i.e. an active information initiative, an effective energy rating scheme and building regulation requirements.

### Indirect effects

The Danish Energy Agency has conducted a literature study on the indirect effects of energy renovation. The study shows that while the link between improved ventilation and indoor climate-related productivity and health is well-documented, the situation is more complex when it comes to documenting the link between a good indoor climate and deep renovation, renovation of the building envelope or lighting/daylight improvements alone. The study identifies, assesses and summarises the results from the studies that may be relevant in a Danish context.

The study uses four concepts: 1) the energy renovation itself, e.g. an insulation measure, 2) the direct effect, e.g. less condensation and mould formation on the walls, 3) the indirect effect, e.g. a decline in the number of cases of asthma, 4) economic value, e.g. measured in terms of fewer sick days related to asthma.



There has been a particular focus on studies involving the valuation of the indirect effects, with the most prominent of these being the COMBI study, which has created an overview of the most important direct effects in the 28 EU Member States. There has also been an assessment of the analyses required in future to perform a complete valuation of indirect effects in a Danish context. This formed the basis for assessing and recognising the value of the indirect effects of energy renovation in the longer term.

## Future initiatives

As noted in the introduction, this strategy includes a review of existing instruments. Many of the instruments arise from the energy agreement from 2018, predominantly covering the period up to 2024. Two years prior to expiry of the energy agreement, the Danish Government will initiate discussions concerning energy policy after 2024, and a decision will be made regarding the extension of existing instruments or the execution of new measures. A status review of completed initiatives will also be carried out in 2024 to assess effect and progress and to target any future initiatives.

### Analyses

A number of analyses were implemented in 2019 in connection with the renovation strategy work, including the promotion of the renovation of buildings, which may form the basis for future initiatives:

#### *Analysis of compliance with building regulations*

Compliance with building regulation requirements is necessary for the realisation of profitable energy saving potentials. Moreover, if insulation is not installed in accordance with building regulations, the potential to achieve energy savings is lost far into the future because renovations are performed at intervals of many years. However, small-scale analyses conducted by SBI in 2013 and 2017 indicate challenges relating to compliance with the rules in existing buildings. Reasons include a lack of knowledge of building regulations among tradesmen and property owners, a lack of interest on the part of property owners and inadequate economic conditions. Aesthetic factors also play a role<sup>4</sup>.

A new study has therefore been initiated regarding compliance with building regulations based on more data. Depending on the results of the analysis, consideration may be given to whether knowledge of the building regulations can be increased amongst building owners and tradesmen, for example, and whether it might be possible to simplify the requirements. The analysis will be complete by mid-2020.

#### *Analysis of user behaviour in connection with renovation*

As described in the section on 'Status of energy efficiency of buildings in Denmark', there has been an increase in heat consumption in the building stock and one of the reasons for this may be due to changes in user behaviour, including higher indoor temperatures. This change in user behaviour may occur following the renovation of a building, and an assessment of user behaviour has therefore been initiated to examine the scope and influence of behavioural changes following

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<sup>4</sup> 'Compliance with the requirements of building regulations', SBI 2013:02 and 'Compliance with energy requirements for renovation and follow-up projects for larger buildings', SBI 2017:02.

renovation and how these impact on the heat saving potential. If the user behaviour is inappropriate for realising the theoretical energy saving potential, consideration will be given to the scope to remedy this. The assessment was completed at the end of December 2019.

#### *Analysis on effect on behaviour via energy ratings*

An analysis has also been carried out concerning behaviour in connection with energy ratings, where behavioural economic experiments were conducted with user-driven design and interactive dissemination of the energy rating report to increase motivation to perform profitable energy renovations. This includes the implementation of a project where behavioural economic experiments were performed with user-driven design and interactive dissemination of the energy rating report to promote the interest and potential of property owners to reduce energy consumption in their properties. Behaviour mapping and a barrier analysis have provisionally indicated there may be potential to use a behavioural science approach in connection with energy renovation and create effective and measurable behavioural changes. A number of experiments have been implemented based on this. This involves testing different versions of the energy rating report in cooperation with real estate agents, financial institutes and building owners to better adapt the content and use of the energy rating for various users. However, barriers have also been identified in connection with energy renovation that cannot be described as a behavioural problem, but instead relate to economic constraints, a lack of information or preferences. The project will be completed at the beginning of 2020, after which possible recommendations regarding potential follow-up will be considered.

#### *Analysis of renovation requirement in the public sector*

Finally, the Danish Construction, Transport and Housing Authority have implemented an analysis of the need for renovation in the entire public housing sector, which will form the basis for the political negotiations regarding the size of the renovation frameworks in a forthcoming housing agreement. The overall potential for energy efficiency improvements in the public housing sector will also be identified as part of the analysis.

#### **Climate action plan, energy efficiency and indicative milestones**

The existing instruments described in the section ‘

Roadmap for energy efficiency: Overview of existing and allocated support' constitute the preliminary approved instruments in a roadmap for energy efficiency in the building stock. The work of preparing a climate action plan will investigate how the energy efficiency initiative can be considered together with other instruments and climate initiatives. A decision will be taken in connection with the climate action plan on establishing indicative milestones and indicators for improving the energy efficiency of the building stock in 2030, 2040 and 2050, and where appropriate, supplementary instruments for existing initiatives.

## **Annexes**

**Annex 1: 'Heat conservation in existing buildings', SBI 2017**

**Annex 1a: Excel sheet for Annex 1: 'Heat conservation in existing buildings', SBI 2017**

**Annex 2: Memorandum on the anticipated percentage of renovated buildings in 2020, SBI 2019**

**Annex 3a: 'Cost-optimal levels of minimum energy performance requirements in the Danish Building Regulations', SBI 2018**

**Annex 3b: 'Energy renovation of apartment buildings: Economy and related benefits associated with the energy renovation of apartment buildings to the requirements in BR15 and Building Class 2020 level', SBI 2017**

**Annex 4: Schedule for the fulfilment of Article 2a of EPBD**

**Annex 5: Implementation overview of the long-term renovation strategy from 2014/2017**

**Annex 6: Summary from public consultation**