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## **Danish building typologies**

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Participation in the TABULA project





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# Foreword

This report is made as part of the Danish participation in the TABULA (Typology Approach for Building Stock Energy Assessment) project supported by Intelligent Energy Europe (IEE/08/495/SI2.528396).

The TABULA project has the following European partners:

- IWU; Institute for Housing and Environment (coordinator), Germany,
- NOA; National Observatory of Athens, Greece,
- BCEI ZRMK; Building and Civil Engineering Institute ZRMK, Slovenia,
- POLITO; Politecnico di Torino – Department of Energetics, Italy,
- ADEME; French Energy and Environment Agency, France,
- Energy Action Limited, Ireland,
- VITO; Flemish Institute of Technological Research, Belgium,
- NAPE; National Energy Conservation Agency, Poland,
- AEA; Austrian Energy Agency, Austria,
- SOFENA; Sofia Energy Agency, Bulgaria,
- MDH; Mälardalens University, Sweden,
- STU-K; Structural Design, Czech Republic,
- SBI; Danish Building Research Institute, Aalborg University, Denmark.

The objective of TABULA is to develop a harmonised building typology for European countries. Each national building typology will consist of a set of residential model buildings with characteristic energy-related properties (element areas of the thermal building envelope, U-values, supply system efficiencies). The model buildings will each represent a specific construction period of the country in question and a specific building size. Furthermore the number of buildings, flats and the overall floor areas will be given, which are represented by the different building types of the national typologies.

This report outlines the Danish contribution to the TABULA project in the first 2 years. Furthermore, it gives an overview of the potential of building typologies for estimating the national energy balance for selected building types and the potential national energy savings in these buildings, depending on their age.

Danish Building Research Institute, Aalborg University  
Department for Energy and Environment  
August 2011

*Søren Aggerholm*  
Research director

# Summary

A Danish typology for residential buildings was established in the TABULA project. Three different main building types were used: Single-family houses, terraced houses and apartment blocks. Each main building type was again split up in nine periods of buildings representing typical building tradition and insulation levels.

Within each main building type and building period, a typical building has been selected from the energy labelling scheme database as a **real example building**. The selected buildings are buildings that have not yet been through any major energy upgrading (except windows and doors), since they were erected. These model buildings can be used for promoting energy-savings potentials for homeowners.

Another main purpose of the building typology was to establish a tool that is able to calculate different energy-saving scenarios for the entire residential building stock. To make such calculation **average buildings** were constructed. These theoretically designed building models are based on statistical data obtained from the Danish Energy Labelling Scheme and other knowledge sources of buildings. A national energy balance was calculated using the TABULA tool for each building typology and results multiplied by the total heated floor area representing each of the building typologies in Denmark. In this way it was possible to establish a national energy balance within each building typology (building type and building period). The total calculated energy demand was compared with the statistics of the energy consumptions of residential buildings made every year by the Danish Energy Agency. The difference between them was found to be -7 % for single-family houses and terraced houses and + 5% for apartment blocks.

The technical energy saving potential was calculated following different recommended measures given by the Danish Knowledge Centre for Energy Savings in Buildings. The total potential energy savings in residential buildings were found to be approx. 35 and 52 PJ for the standard and for the ambitious measures and the corresponding CO<sub>2</sub> reduction 1.5 and 2.3 million tons CO<sub>2</sub>, respectively.

Each of the real example buildings are presented in a brochure called display sheets. The display sheet is intended to be used in Denmark for promoting energy upgrading and therefore the descriptions are in Danish. The display sheets give a short and easy-to-understand overview of the energy upgrading possibilities for each example buildings. The display sheet contains information on the envelope constructions (area and U-values) at the current state and the possible savings at two levels of measures.



# Establishing national building typologies

Article 5 of the EPBD (Directive 2010/31/EU) requires Member States (MS) to establish the comparative methodology framework in accordance with Annex III and to differentiate between building categories. EPBD Annex III further states that MS should define reference buildings (building typologies) that are characterised by and representative of their functionality and geographic location, including indoor and outdoor climate conditions. The reference buildings should cover residential and non-residential buildings, both new and existing ones.

There are two fundamentally different ways of defining building typologies: average buildings and example buildings.

The *average building* is composed of small areas of all kinds of construction types, e.g. brick, concrete, timber-frame, etc. with average insulation thickness. Each of the sub-areas represents the share of that particular construction type found when auditing the entire building stock of a specific construction period. Thus the artificially average building does not exist in real life, but is a statistical valid representation of a selected share of the entire building stock.

The *example building* is, as the name indicates, a representative example of a specific building type and age. When defining an example building, it is extremely important to decide whether the example building should represent the building as it was originally constructed or whether it should represent the building with a number of common (more common than the unchanged building) changes to the building. Neither approach is better than the other, as it depends on the statistical significance of the two variants which one is preferable and the intended use of the example building model.

Each of the two building typologies can be used for different purposes. The average building can be used to analyse the energy-saving potential for the entire building stock in a country or region by multiplying the heated floor area or number of buildings in the country/region. These results can be used by policymakers to make decisions on the implementation of various incentives to promote energy savings. The main purpose of the example building is the calculation of (cost-optimal) energy-saving measures for one real building, more or less similar to the example building. This information can for example be used to validate implementation of energy performance requirements for existing buildings.

In addition to these building typologies, which represent the thermal envelope, any typology should be able to be equipped with any (common) technical installations. It is crucial to be able to combine building typologies (thermal envelopes) with technical installations as the installations are more or less independent of the building typology. Combining building typologies and installations will thus reduce the number of individual building models.

The Danish average and the example building typologies were defined in the TABULA project.

## Identifying building types

The Danish building stock were divided into three types and nine periods of construction (Wittchen, 2009) (Kragh & Wittchen, 2010). The building typology and construction types were judged to be uniform for each period of construction. Furthermore, building usage has been used to identify the

three most common residential building types, namely: Single-family houses, terraced houses and apartment blocks. The reason for selecting these building types was that these types were the dominant building types in the EPC (Energy Performance Certification) database containing information collected in the course of building energy audits since 2006. Additionally, buildings denoted trade and service (including offices) is a widespread Danish building type, and it was therefore crucial to define building typologies for this building type as well. The construction periods were identified from acknowledged changes in building tradition in the early periods and from changes in the energy requirements stated in the Danish Building Regulations in more recent periods. The eight periods of construction and their corresponding energy-related changes in building tradition or the Danish Building Regulations' energy requirements are shown in Table 1.

Table 1. The Danish building stock can be divided into 8 different age classes – depending on shifts in building tradition or shifts in energy requirements in the Danish Building Regulations. Each class is somewhat uniform with respect to construction principle and initial, specific energy standard.

Building period	Comment
Before 1850	shift in building tradition
1851 - 1930	shift in building tradition
1931 – 1950	cavity walls introduced
1951 – 1960	insulated cavity walls introduced
1961 – 1972	first energy requirements in BR61 <sup>1)</sup>
1973 – 1978	tightened energy requirements in BR72 <sup>1)</sup>
1979 – 1998	tightened energy requirements in BR78 <sup>1)</sup>
1999 – 2007	tightened energy requirements in BR98 <sup>1)</sup>
2007 – 2011	tightened energy requirements in BR06/08 <sup>1)</sup>

1) BR is a reference to the Danish Building Regulations and the following digits refer to the year when the BR came into force.

Similar knowledge for Danish single-family houses is established by Realia. The photos below illustrate Danish single-family detached houses typical of different decades of the twentieth century.



Figure 1. Typical Danish single-family example houses from different decades in the 20<sup>th</sup> century.

## Extracting knowledge from the EPC scheme

Denmark has had a mandatory EPC scheme since 1997 when owner-occupied residential houses and flats needed a valid EP certificate (based on a calculated energy performance) when sold. Additionally, all large buildings (+1500 m<sup>2</sup>) needed to be certified every year based on a measured energy performance. From 1997 to 2006, a total of approx. 770 000 certificates were issued, including approx. 18 000 certificates for large buildings. Over the period, approx. 55 000 single-family houses were certified each year.

In the current EPC scheme (since 2006), the number of issued certificates (all based on calculated energy performance) is shown in the table below. Since September 2006, a total of approx. 258 000<sup>1</sup> 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.

Table 2. Number and distribution of energy performance labels<sup>1</sup> in five major building categories from the current Danish EPC 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

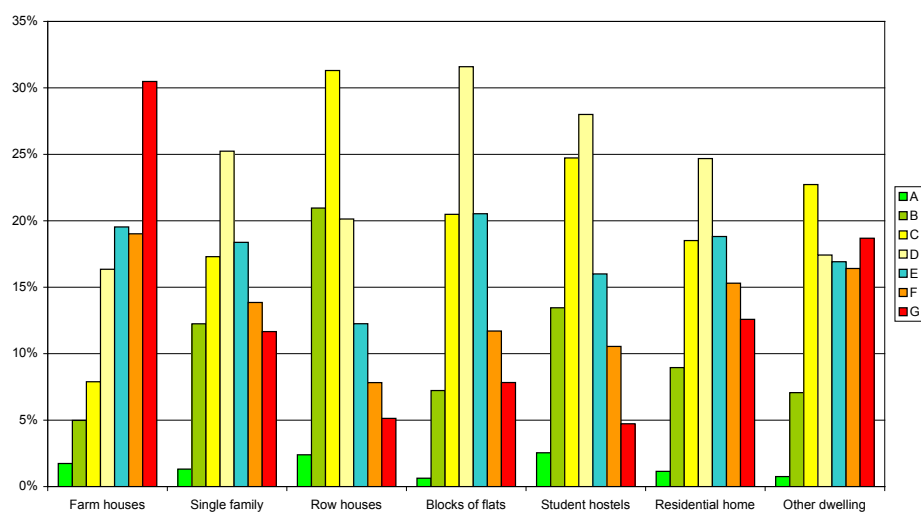


Figure 2. Label distribution<sup>1</sup> on Danish dwellings as registered in the current (since 2006) EPC scheme.

A label on the certification scale indicates a range for the energy performance according to the table below.

Table 3. Calculated primary energy consumption and corresponding EPC label (valid until end of 2010).

Label	Residential [kWh/m <sup>2</sup> per year]	Non-residential [kWh/m <sup>2</sup> per year]
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

All kinds of information collected, while performing an energy audit to be able to issue an EP (Energy Performance) certificate, are stored in one central register. Among these kinds of information are:

- Element areas of the thermal envelope and their corresponding U-values,
- Heated floor area,
- Orientation, thermal and optical properties of all windows including information about shadings,
- Type and efficiency of heating supply systems,
- Efficiency and size of heating and domestic hot water distribution systems,
- Efficiency and areas of renewable energy systems (PV and thermal solar system),
- Efficiency and size of lighting fittings (only in case of non-residential buildings).

In addition to these pieces of factual information about the building and its envelope, the registered as well as the calculated energy consumption are being stored together with the expert's suggestions for energy-saving measures and the corresponding investments as well as the calculated energy savings. Finally there is information about the age of the building and the year of the most recent energy refurbishment.

Access to this central database was willingly granted Danish Building Research Institute, Aalborg University by the Danish Energy Agency and made it possible to perform all the mentioned analyses and to extract data for the TABULA project.

## Supplemental data

To establish a total overview of the energy performance of the Danish building stock, some additional information is required. The EPC database only covers that part of the building stock that has been certified in conjunction with sale or rent of existing buildings and in conjunction with finalisation of new buildings. The current EP scheme has been running since 2006 and covers approx. 10-15% of the total building stock in the selected typologies. This kind of information can be obtained from two sources in Denmark and they are the Dwelling and Building Stock Register and Statistics Denmark. From these two sources, it is possible to extract information that enables an extrapolation of the EPC database information to cover the entire Danish building stock.

## **Danish Dwelling and Building Stock Register**

The Danish National Dwelling and Building Stock Register (BBR) was created in 1976. The register was originally designed to deliver basic information for the assessment of real estate and for censuses. Originally all information in BBR was provided by the building and dwelling owners.

Over time, BBR has been used in conjunction with other administrative tasks by the state, regions and municipalities.

Today, BBR holds information about 1.6 million properties, 3.8 million buildings and 2.7 million dwellings and commercial units.

The data model and the plans for a new BBR was created in the years around 1995, while the responsibility for the register was at the National Survey and Cadastre Agency. With the new plans, an agreement was made about the framework and the targets for the future development of BBR and the basic structure. More than 10 years have passed, and now the changes are being implemented.

The new BBR is expected to be launched during 2011.

In the current version of BBR, it is possible to extract information about each property in the register regarding (only data that can be used in the definition of a Danish typical building typology are listed):

### **Areas**

- Total building area
- Total residential area
- Total commercial area
- Built-up area
- Number of storeys
- Total area of attic
- Area of unexploited part of attic
- Total basement area
- Basement area with ceiling height less than 1.25 meters above terrain
- Other areas
- Source for building areas
- Area of in-house garage
- Area of in-house carport
- Area of in-house shed
- Area of patio
- Area of legal residential share of partly exposed basement
- Area of covered terrace
- Area of waste-room at terrain level
- Not covered areas
- Area of finished part of building
- Temporarily finished area

### **Building constructions:**

- Constructional issues
- External walls materials
- Roof covering material

### **Installations:**

- Heating installation
- Heating source (oil, gas, district heating, etc.)
- Energy supply
- Elevators
- Date of energy certificate
- Additional heating

Additionally, BBR contains information about the main use of the building:

- Farmhouses
- Detached houses

- Terraced house
- Blocks of flats
- Students hostels
- Residential home
- Other whole-year dwelling
- Trade/Farm
- Trade/Industry
- Supply plants
- Other production buildings
- Transport
- Office/Trade
- Hotel & service
- Other trades & services
- Culture buildings
- Education
- Hospitals
- Day care
- Other institutions
- Single-family vacation home
- Multi-family vacation building
- Sports facilities
- Allotments
- Other leisure buildings.

In addition to knowledge about how buildings have been constructed during different periods of time, knowledge about the size of the building stock is vital for establishing the national overview. It should thus be possible to summarise the number and size (built-up area and total heated floor area) of buildings during each of the time periods and for each of the evaluated building categories.

Additional information (in Danish) about the BBR register is given at [www.bbr.dk](http://www.bbr.dk).

### **Statistics Denmark**

Statistics Denmark provides all kinds of statistical data about Denmark and the Danes. Some of the information is free, while other must be paid for. Among the free statistics is information about the Danish building stock as listed in Figure 3. Data are aggregated, but can be used for identifying building typologies.

The screenshot displays the 'Construction and housing' section of the Statistics Denmark website. On the left, there is a 'Subjects' menu with categories like 'Population and elections', 'Education and culture', 'Labour market', 'Earnings', 'Social conditions, health and justice', 'Income, consumption and prices', 'General economic statistics', 'Agriculture and fishery', 'Manufacturing industries', 'Construction and housing' (highlighted), 'Service sector', 'Transport', 'Environment and energy', 'External trade', 'National accounts, balance of payments and international investment position', 'Public finance', and 'Money and capital market'. Below this is a 'Log on' section with fields for 'Username' and 'Password', an 'Automatic Logon' checkbox, and links for 'Register as new user' and 'Forgot your password?'. The main content area shows a tree view of statistics under 'Construction and housing', including 'Indices for construction, civil engineering and transport', 'Number of persons employed in the construction industry', 'Housing', 'Building stock', and 'Building activity'. Each item is accompanied by a code (e.g., BV111, BV112) and a description, with a download icon to the right.

Figure 3. Screen dump from Statistics Denmark ([www.statistikbanken.dk](http://www.statistikbanken.dk)) listing free statistics related to the Danish building stock. Any of the links can be expanded and filtered according to a number of fixed criteria and exported for further processing in a spread sheet tool.

Most of the information (in Danish and English) is publicly available at [www.statistikbanken.dk](http://www.statistikbanken.dk).

# The TABULA excel sheet

An Excel tool was developed within the TABULA project by IWU, which was used to generate the typology buildings. The Excel tool consists of several sheets containing input of the boundary conditions, building type definitions and the building envelope and heating installation data.

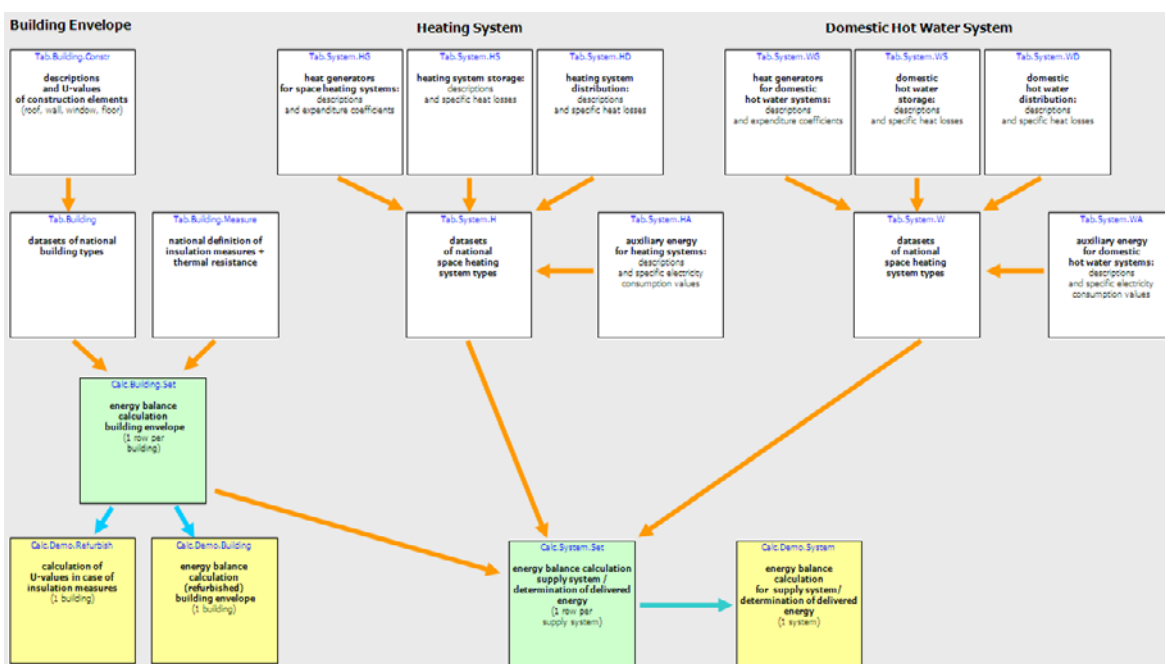


Figure 4. Screen dump from the excel tool showing the workflow diagram. Any building typology can be combined with a heating system and a domestic hot water system, radically reducing the number of individually needed building typologies to cover the entire building stock.

## Building type definitions

### Single-family houses

Single-family houses cover all residential buildings in Denmark with one dwelling. It also includes old farmhouses (residential houses at large farms).

### Terraced houses

Terraced houses or row houses cover all residential buildings in Denmark with a vertical division between the individual dwellings.

### Block of flats

In the Danish EPC scheme, blocks of flats cover all residential buildings with horizontal divisions between the individual dwellings. The definition "block of flats" covers from a two-family house (with the two dwellings on top of each other) to a high-rise multi-family building. The reason for grouping these very different building typologies is the similarities in the requirements due to fire regulations.

### Trade and service buildings

Trade and service buildings are not part of the Danish participation in the TABULA project.



## Periods of buildings

According to previous analyses of the energy-saving potentials in the Danish building stock, it was decided to use nine periods of buildings representing typical building tradition, building regulation demands, building materials, insulations thicknesses, heated areas etc.

Table 4. Building age periods.

Period	Year
1	Before 1850
2	1850 – 1930
3	1931 – 1950
4	1951 – 1960
5	1961 – 1972
6	1973 – 1978
7	1979 – 1998
8	1999 – 2006
9	After 2007

## Climate data of Denmark

For Denmark only one climate zone is being used in the energy performance calculations. The specific climatic data are shown in the table below.

Table 5. Climate data of Denmark.

Heating base temperature: heat demand is calculated in case that the daily average external temperature is below this value (TABULA standard value: 12 °C)	12 °C
Number of days per year during heating season with an average daily temperature is below or equal to the base temperature	246
Average outdoor air temperature during the heating season	4.2 °C
Average global irradiation on a horizontal surface during the heating season	447 kWh/a
Average global irradiation on a vertical surface oriented East during the heating season	313 kWh/a
Average global irradiation on a vertical surface oriented South during the heating season	524 kWh/a
Average global irradiation on a vertical surface oriented West during the heating season	313 kWh/a
Average global irradiation on a vertical surface oriented North during the heating season	150 kWh/a

## Building envelope data

The main source of information used to establish the typology buildings is the official handbook of the Danish EPC scheme (Danish Energy Agency, 2008). This handbook contains all knowledge necessary for issuing EP certificates for typically buildings.

The opaque envelope constructions are represented by their type name, a short description and the corresponding U-value. Some examples are shown in the tables below. A complete list of constructions is found in the TABULA Excel sheets. In Annex I, some screen dumps from the tool are shown.

### Construction type examples

Table 6. Ceilings and floors (examples).

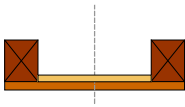
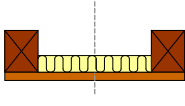
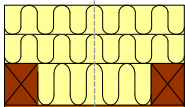

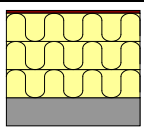
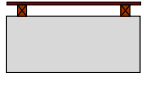
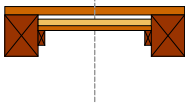
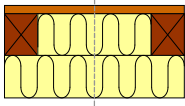


Description	Illustration	U-value [W/m <sup>2</sup> K]
Boards / rafter / clay layer		1.50
Boards / rafter, 50 mm insulation		0.60
Boards / rafter, 300 mm insulation		0.11
Wood boards + 50 insulation / 20 cm light-weight concrete		0.47
Concrete + 300 mm insulation		0.12
Wood boards / 20 cm lightweight concrete		1.00
Floor boards on rafter / clay layer		1.50
Boards / rafter / 250 mm insulation		0.13
10-20 cm concrete		2.30
Boards / 50 mm insulation / 20 cm lightweight concrete		0.47

Table 7. Walls (examples).


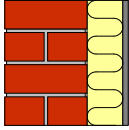
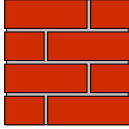
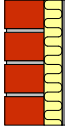
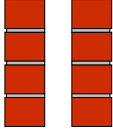
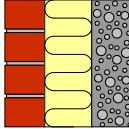
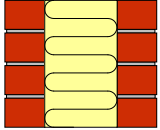
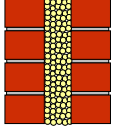
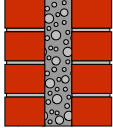

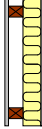
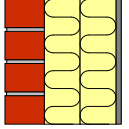
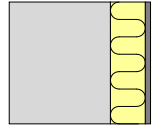
Description	Illustration	U-value [W/m <sup>2</sup> K]
12 cm brick		3.20
1/1 brick (massive) + 100 insulation		0.36
36 cm brick (massive)		1.50
12 cm brick + 50 mm insulation		0.62
30 cm brick (cavity wall), not insulated		1.60
36 cm brick insulated with 130 mm and 110 mm tiled concrete		0.30
40 cm brick, 200 mm insulation		0.16
30 cm brick (cavity wall), re-insulated with 7.5 cm granulate		0.67
30 cm brick (cavity wall), re-insulated with 7.5 cm tiled concrete		1.00
10 cm lightweight construction, not insulated		1.90
10 cm lightweight construction, 50 mm insulation		0.70
Brick wall with 2x95 mm insulation		0.20
29 cm lightweight concrete + 100 mm insulation		0,25

Table 8. Window data (examples).

Description	Illustration	U-value [W/m <sup>2</sup> K]	g-value [-]
Fixed window, wood profiles, single glass pane		5.1	0.85
Side/Top hung windows, wood profiles, single-glazed unit		4.7	0.85
Dannebrog window, wood profiles, single-glazed units		4.2	0.85
Mansion windows, single-glazed units		3.9	0.85
Side/Top hung window, wood profiles, double glazing		2.8	0.76
Side hung window, 2 or more sections, wood profiles, double glazing		2.7	0.76
Farm-house window, wood profiles, glazing bars, double glazing		2.8	0.76
Dannebrog window, wood profiles, double glazing		2.7	0.76
Side/Top hung window, wood profiles, double low-energy glazing		1.5	0.63
Farmhouse window, wood profiles, glazing bars, double low-energy glazing		1.9	0.63
Dannebrog window, wood profiles, double low-energy glazing		1.7	0.63
Fixed window, wood profiles, triple low-energy glazing		0.8	0.5
Side/Top hung window, wood profiles, triple low-energy glazing		0.9	0.5

## Heating and ventilation data

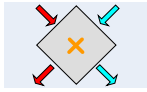

To establish the typology regarding the heating and ventilation installations in existing buildings, data analysed and estimated by the Danish Technological Institute were used [[tools.sparolie.dk/statusliste.asp](https://tools.sparolie.dk/statusliste.asp)] and supplemented with data from a handbook on ventilation (Danish Energy Agency, 2008).

Table 9. Heat supply units.

Description	Typical expenditure coefficient <sup>A</sup> of the heat generator
Constant temp. / non-condensing / Solo / Group 1 / not insulated / 40 kW	1.54
Constant temp. / non-condensing / Solo / Group 2 / partly insulated / 40 kW	1.45
Constant temp. / non-condensing / Solo / Group 3 / not insulated / 16 kW	1.43
Constant temp. / non-condensing / Solo / Group 4 / partly insulated / 18 kW	1.37
Constant temp. / non-condensing / Solo / Group 5 / partly insulated / 20 kW	1.35
Constant temp. / non-condensing / Solo / Group 6 / partly insulated / 21 kW	1.43
Constant temp. / non-condensing / Unit / Group 7 / partly insulated / 23 kW	1.35
Boiler Energy label A	1.05
Boiler Energy label B	1.07
Boiler Energy label C	1.10
Boiler Energy label D	1.14
Boiler Energy label E	1.18
Boiler Energy label F	1.23
District heating transfer station / exchanger unit very old	1.06
District heating transfer station / exchanger unit old	1.05
District heating transfer station / exchanger unit new	1.03
Electric heating panels	1.00
Heat pump, air/air	0.29
Heat pump, ground/water	0.25

<sup>A</sup> Calculated as the reverse of the efficiency (1/eff) of the heat generator.

Table 10. Ventilation with heat recovery.

Description	Illustration	Heat recovery
Old ventilation system with 60 % heat recovery – Cross flow		60 %
New ventilation system with 90 % heat recovery – Counter flow		90 %

## Building models

Two types of building models were created in the TABULA tool. They are: Real Example buildings (ReEx) and Synthetically Average buildings (SyAv).

### Example buildings

The real example buildings exist and were selected from the EPC database as typical examples from the building period with respect to heated area, constructions, energy label etc. The U-value of the real example buildings are shown in Table 11, Table 12 and Table 13.

Table 11. Thermal envelope: U-values [ $W/m^2K$ ] of the specific examples (single-family houses).

Single-family houses	Building period	Floor	Wall	Ceiling	Window
	Before 1850	0.60	0.62	1.00	2.80
	1850 – 1930	0.60	1.60	1.50	2.70
	1931 – 1950	1.50	1.60	1.50	2.70
	1951 – 1960	0.38	1.00	0.52	2.80
	1961 – 1972	0.30	0.60	1.30	2.80
	1973 – 1978	0.30	0.30	0.54	2.70
	1979 – 1998	0.11	0.48	0.33	1.50
	1999 – 2006	0.11	0.16	0.14	1.90
	After 2007	0.11	0.16	0.12	1.50

Table 12. Thermal envelope: U-values [W/m<sup>2</sup>K] of the specific examples (terraced houses).

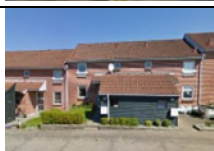
Terraced houses	Building period	Floor	Wall	Ceiling	Window
	Before 1850	0.60	1.60	0.34	2.80
	1850 – 1930	1.50	1.50	1.50	2.70
	1931 – 1950	0.20	1.60	1.30	2.70
	1951 – 1960	0.38	0.67	0.60	2.70
	1961 – 1972	0.30	0.67	0.60	2.80
	1973 – 1978	0.47	0.30	0.47	2.80
	1979 – 1998	0.20	0.30	0.18	2.80
	1999 – 2006	0.20	0.30	0.14	1.50
	After 2007	0.12	0.24	0.14	1.50

Table 13. Thermal envelope: U-values [ $W/m^2K$ ] of the specific examples (blocks of flats buildings).

Block of flats	Building period	Floor	Wall	Ceiling	Window
	Before 1850	0.20	2.80	1.50	2.70
	1850 – 1930	0.38	0.62	0.52	2.70
	1931 – 1950	1.90	1.20	1.90	2.80
	1951 – 1960	0.60	1.60	1.00	2.80
	1961 – 1972	0.33	0.60	1.40	2.70
	1973 – 1978	0.19	0.49	0.54	2.80
	1979 – 1998	0.19	0.34	0.19	2.70
	1999 – 2006	0.19	0.30	0.17	1.60
	After 2007	0.19	0.24	0.17	1.60



### **Average buildings**

The SyAv buildings were composed by average U-values extracted from the EPC database. U-values of ceilings, walls, floors, and windows were calculated within each building period and building type by using the equation:

# National energy balances

National energy balances have been calculated using the TABULA tool for each building typology and results multiplied by the total heated floor area representing each of the building typologies in Denmark. In this way, it was possible to establish an estimate for the national energy balance within each building typology (building type and building age class). The total heated floor area of the Danish building stock has been extracted from the Danish Dwelling and Building Stock Register (BBR) supplemented with information from Statistics Denmark.

In Denmark, a national energy balance method already exists. The model has been used in several studies of the energy-saving potential (Wittchen et al., 2011). The knowledge of the different input data has been used to make a similar energy balance calculation model using the TABULA approach and artificially average model buildings.

Statistics on the energy consumptions of residential buildings are made every year by the Danish Energy Agency. The statistics include both the net energy demands and the energy carriers.

## Comparison adjustments

When comparing the national statistic statement with the TABULA approach, the calculated total energy consumption for heating was climate adjusted according to the number of degree-days. Table 15 compares the number of actual heating degree days in 2010 and the climatic impact data of the TABULA tool.

Table 15. Number of heating degree days.

Statistics (2010)	3.221
TABULA approach – DK	3.118
Difference	3.3 %

To calculate the total energy consumption the unit consumption in kWh/m<sup>2</sup> (internal floor area) was converted to external area using a factor 1.18 (according to the TABULA methodology).

## Adjustment of calculated energy demand

In practice, there is always a difference between the calculated and the measured energy consumption, even when the calculation result is climate adjusted (degree days). There is a tendency that buildings with high calculated energy demand in practice (and average) consume less and vice versa that buildings with low calculated energy demand in practice consume more. The measured consumption is also registered in the database of the Energy Labelling Scheme. Therefore, an analysis of the ratio between the measured consumption and the calculated demand was performed for three buildings types. For each building type the average ratio for six intervals of energy demand was calculated as shown in Table 16. These average ratio values are used by the TABULA calculation.

Ratio = Measured / Calculated

Table 16. Average ratio between measured energy consumption and calculated energy demand for the three building type.

Building type	Calculated energy demand					
	< 75 kWh/m <sup>2</sup>	75 - 150 kWh/m <sup>2</sup>	150 - 250 kWh/m <sup>2</sup>	250 - 350 kWh/m <sup>2</sup>	350 - 450 kWh/m <sup>2</sup>	> 500 kWh/m <sup>2</sup>
<b>SFH</b>						
Average ratio	3.09	0.91	0.75	0.61	0.51	0.45
No. of buildings	535	21.562	27.160	6.995	1.644	495
<b>TH</b>						
Average ratio	3.18	0.96	0.74	0.58	0.51	0.51
No. of buildings	75	5669	3011	599	102	16
<b>AB</b>						
Average ratio	3.03	1.02	0.72	0.59	0.43	0.38
No. of buildings	7	349	705	261	60	8

## Boundary conditions

Calculation of the energy balance is very dependent on the assumed boundary conditions. The calculated space heating demand and the national statistics on the net heating energy consumption were used to calibrate the boundary conditions.

Comparison of the national boundary conditions with the TABULA standard conditions are shown in Table 16 for single-unit houses (SUH) and multi-family houses (MUH).

Table 17. Comparison of boundary conditions.

Boundary conditions	Single unit houses (SUH)				Multi-unit houses (MUH)	
	EU.SUH	DK.SUH_19	DK.SUH	DK.SUH_21	EU.MUH	DK.MUH
Internal temperature [°C]	20	19	20	21	20	21
Reduction factor, considering the effect of night setback and unheated space. value at $h_{tr} = 1 \text{ W/(m}^2\text{K)}$ .	0.9	0.9	0.9	0.9	0.95	0.95
Reduction factor, considering the effect of night setback and unheated space. value at $h_{tr} = 4 \text{ W/(m}^2\text{K)}$ .	0.8	0.8	0.8	0.8	0.85	0.85
Average air change rate, due to use of the building [1/h]	0.4	0.45	0.45	0.35	0.4	0.7/0.6/0.5
Room height (based on internal dimensions) [m]	2.5	2.8	2.8	2.8	2.5	2.8
Average internal heat loads per $\text{m}^2$ reference area	3	5	5	5	3	5
Reduction factor due to horizontal, external shading	0.8	0.8	0.8	0.8	0.8	0.8
Reduction factor due to vertical, external shading	0.6	0.6	0.6	0.6	0.6	0.6
Frame area (fraction of total window area)	0.3	0.3	0.3	0.3	0.3	0.3
Reduction factor. Considering radiation non-perpendicular to the glazing	0.9	0.9	0.9	0.9	0.9	0.9
Internal heat capacity per $\text{m}^2$ reference area [Wh/( $\text{m}^2\text{K}$ )]	45	100	100	100	45	100
Net energy demand for domestic hot water [kWh/( $\text{m}^2\text{a}$ )]	10	15	15	15	15	18

The different boundary conditions were used in the national energy balance calculation as shown in Table 17.

Table 18. Use of the boundary conditions in the national energy balance calculation.

Building period	Single-family houses	Terraced houses	Block of flats
Before 1850	DK.SUH_19	DK.SUH_19	DK.MUH
1850 – 1930	DK.SUH_19	DK.SUH_19	DK.MUH
1931 – 1950	DK.SUH	DK.SUH	DK.MUH
1951 – 1960	DK.SUH	DK.SUH	DK.MUH
1961 – 1972	DK.SUH	DK.SUH	DK.MUH
1973 – 1978	DK.SUH	DK.SUH	DK.MUH_n06*
1979 – 1998	DK.SUH	DK.SUH	DK.MUH_n06*
1999 – 2006	DK.SUH_21	DK.SUH_21	DK.MUH_n05*
After 2007	DK.SUH_21	DK.SUH_21	DK.MUH_n05*

\*Air change rate reduced from 0.7 1/h to 0.6 or 0.5 1/h.

## Total heated building area

The total heated floor area of the Danish building stock has been extracted from the Danish Dwelling and Building Stock Register (BBR) as shown in Table 18.

Table 19. External floor areas (m<sup>2</sup>) distributed on primary heating source in different building types and ages. Data extracted from BBR 2011.

Period	Heating source	SFH	TH	AB
1 Before 1850	Total			
	District Heating	607.706	247.320	608.101
	Gas boiler	921.379	51.122	58.732
	Oil Boiler	9.353.692	72.166	80.312
	Electricity	1.187.538	60.693	41.729
	Stoves	4.314.182	38.776	37.153
	Heat pump	801.331	6.813	3.177
	Other	29.178	1.853	3.992
2 1851-1930	District Heating	9.521.125	2.112.204	22.344.803
	Gas boiler	5.286.915	305.749	1.093.569
	Oil boiler	12.984.905	442.131	1.410.522
	Electricity	2.486.159	215.366	351.323
	Stoves	4.429.384	125.115	219.589
	Heat pump	950.218	25.785	24.866
	Other	47.367	10.808	13.905
	3 1931-1950	District Heating	6.649.131	1.044.508
Gas boiler		3.390.442	478.361	895.512
Oil boiler		4.827.595	293.120	743.888
Electricity		581.297	35.499	71.884
Stoves		1.046.965	23.336	47.012
Heat pump		282.856	4.108	5.142
Other		15.238	4.477	9.995
4 1951-1960		District Heating	5.809.014	1.340.807
	Gas boiler	3.325.124	492.625	622.348
	Oil boiler	3.284.105	275.158	349.496
	Electricity	408.086	47.911	17.778
	Stoves	532.263	14.272	8.919
	Heat pump	180.697	2.299	2.285
	Other	8.775	2.933	1.327
	5 1961-1972	District Heating	18.863.891	3.507.075
Gas boiler		11.305.024	740.580	992.806
Oil boiler		6.468.568	265.594	602.038
Electricity		1.232.446	120.615	15.420
Stoves		696.559	6.722	5.171
Heat pump		469.460	7.649	2.463
Other		16.541	1.650	6.127
6 1973-1978		Total		
	District Heating	10.480.185	2.689.502	4.183.155
	Gas boiler	5.713.541	418.782	171.355
	Oil boiler	3.335.692	109.727	123.194
	Electricity	2.615.210	522.927	45.448
	Stoves	518.481	14.739	2.248
	Heat pump	325.523	8.013	497
	Other	11.200	873	-

## 7 1979-1998

District Heating	7.991.944	8.401.638	6.981.472
Gas boiler	4.440.923	2.960.862	765.728
Oil boiler	1.756.151	232.208	85.695
Electricity	3.163.722	1.231.583	94.393
Stoves	456.623	51.859	23.818
Heat pump	396.059	42.493	4.282
Other	9.852	11.955	2.307

## 8 1999-2006

District Heating	3.605.792	2.623.421	3.376.726
Gas boiler	2.591.679	1.357.756	446.156
Oil boiler	707.530	76.027	7.938
Electricity	151.047	41.237	3.441
Stoves	347.010	5.283	2.364
Heat pump	398.397	11.421	1.510
Other	8.342	2.374	772

## 9 2007-2011

District Heating	2.576.216	1.342.827	2.308.268
Gas boiler	1.589.209	679.602	266.917
Oil boiler	1.446.930	36.691	5.754
Electricity	165.568	16.599	16.286
Stoves	825.639	6.291	1.609
Heat pump	722.208	41.223	11.139
Other	16.714	465	10.413

## Space heating demand calculation

The results obtained by applying the TABULA standard and the Danish boundary conditions are shown below. Energy consumption for hot water is not included in the presented results of energy demands for space heating.

Table 20. Calculated energy consumption for space heating (not including DHW) [kWh/m<sup>2</sup> (internal floor area)].

Space heating demand [kWh/m <sup>2</sup> ]	Single-family houses	Terraced houses	Blocks of flats
	DK.SUH	DK.SUH	DK.MUH
Building period			
Before 1850	177	176	159
1851-1930	182	192	173
1931-1950	206	211	173
1951-1960	208	198	155
1961-1972	166	153	139
1973-1978	126	131	134
1979-1998	108	87	123
1999-2006	66	67	86
After 2007	54	54	71

The difference between the TABULA and the Danish boundary condition is found to be approx. 5 - 20 kWh/m<sup>2</sup> for single-family and for terraced houses. For block of flats, the Danish boundary condition increases the net energy consumption by 25-35 kWh/m<sup>2</sup>, mainly due to the higher assumed indoor temperature and higher ventilation rate.

## Energy demand for heating and domestic hot water by energy carrier

Results from the TABULA approach are only presented for boundary conditions DK as shown in Table 19.

Table 21. Calculated net energy demand for heating and domestic hot water by energy carrier [kWh/m<sup>2</sup> (internal floor area)].

Period	Building type	SFH DK.SUH	TH DK.SUH	AB DK.MUH
1	Before 1850			
	Total			
	District Heating	213	212	201
	Gas boiler	228	227	216
	Oil Boiler	237	235	216
	Electricity	197	196	189
	Heat pumps	76	76	57
2	1851-1930			
	District Heating	219	220	215
	Gas boiler	234	235	231
	Oil boiler	242	244	231
	Electricity	202	203	202
	Heat pumps	78	81	60
3	1931-1950			
	District Heating	245	240	215
	Gas boiler	262	256	231
	Oil boiler	270	265	231
	Electricity	227	222	202
	Heat pumps	81	83	60
4	1951-1960			
	District Heating	247	236	197
	Gas boiler	265	252	211
	Oil boiler	273	261	211
	Electricity	229	218	185
	Heat pumps	81	81	56
5	1961-1972			
	District Heating	202	189	179
	Gas boiler	216	202	193
	Oil boiler	224	210	193
	Electricity	186	174	168
	Heat pumps	73	65	52
6	1973-1978			
	Total			
	District Heating	174	153	164
	Gas boiler	186	163	176
	Oil boiler	194	171	176
	Electricity	160	140	154
	Heat pumps	62	59	50
7	1979-1998			
	District Heating	141	118	153
	Gas boiler	150	126	164
	Oil boiler	159	134	164
	Electricity	129	108	144
	Heat pumps	52	51	48
8	1999-2006			
	District Heating	94	94	104
	Gas boiler	95	96	112
	Oil boiler	95	96	112
	Electricity	87	88	69
	Heat pumps	46	40	38
9	2007-2011			
	District Heating	48	48	57
	Gas boiler	49	49	57
	Oil boiler	49	49	57
	Electricity	74	75	36
	Heat pumps	34	33	34

## Comparison with official Danish energy statistics

Using data on the total building stock area for three residential building types, calculation results were compared with the 2010 national statistics on energy consumption (Danish Energy Agency, 2010) in order to verify the model. For calculations according to the TABULA approach, boundary conditions described in Table 17 have been used. The results are shown in Table 20.

Table 22. Calculated net energy usage compared with the corresponding national statistics on energy consumption in residential buildings.

Net energy demand for heating and domestic hot water [PJ]	Single-family houses and terraced houses	Block of flats
Statistics Denmark 2010	109,5	43,4
TABULA approach – DK	113,3	44,5
Difference TABULA approach – DK	3,4%	2,4%

## Calculated energy-saving potential

The technical energy-saving potential is calculated without taking into account different barriers such as economy, technical limitations or architecture.

The different measures follow the recommendations given by the Danish Knowledge Centre for Energy Savings in Buildings [www.byggeriogenergi.dk]. Recommendations for specific energy-saving measures are shown in Table 22.

Table 23. Recommended energy-saving measures.

	Standard	Ambitious
Ceiling	300 mm	400 mm
Wall (outside)	> 100 mm	> 200 mm
Wall (inside)	50 mm	50 mm
Cavity wall	Filled	Filled
Slab on ground	250 mm	250 mm
Floor above basement	> 100 mm	> 200 mm
Windows	with double energy glazing	with triple energy glazing

The energy saving potential is calculated for both scenarios: Standard and Ambitious. The results are presented in the Table 23.

Table 24. Calculated theoretical/technical energy saving potential

Net energy demand for heating and domestic hot water [PJ]	Single-family houses and terraced houses	Block of flats
Reference (TABULA approach)	113,3	43.7
Standard measures	60.8	24.5
Ambitious measures	57.1	22.4

The total theoretical potential of energy savings are approx. 72 and 78 PJ for the standard and the ambitious measures, respectively. The corresponding CO<sub>2</sub> reduction is 3.1 and 3.4 million tons CO<sub>2</sub> respectively assuming the current mix of energy sources.

The energy-saving potential is a theoretical figure and not fully achievable for the whole building stock due to previously mentioned barriers of economy, technical and architectural limitations.



## Display sheets – example buildings

Each of the real example buildings are presented in a brochure called display sheets. The intention is that the display sheet should be used in Denmark for promoting energy upgrading and therefore the descriptions are in Danish. The display sheets give a brief and easy-to-understand overview of the energy upgrading possibilities for each of the example buildings. The display sheet contains information of the envelope constructions (area and U-values) at the current state and the possible savings at the two levels of measures given in Table 22. A corresponding overview is given with regard to the current state of the heating and ventilation installations.

Figure 5 and Figure 6 show an example of one display sheet. All the display sheets of the example buildings are shown in Appendix II.

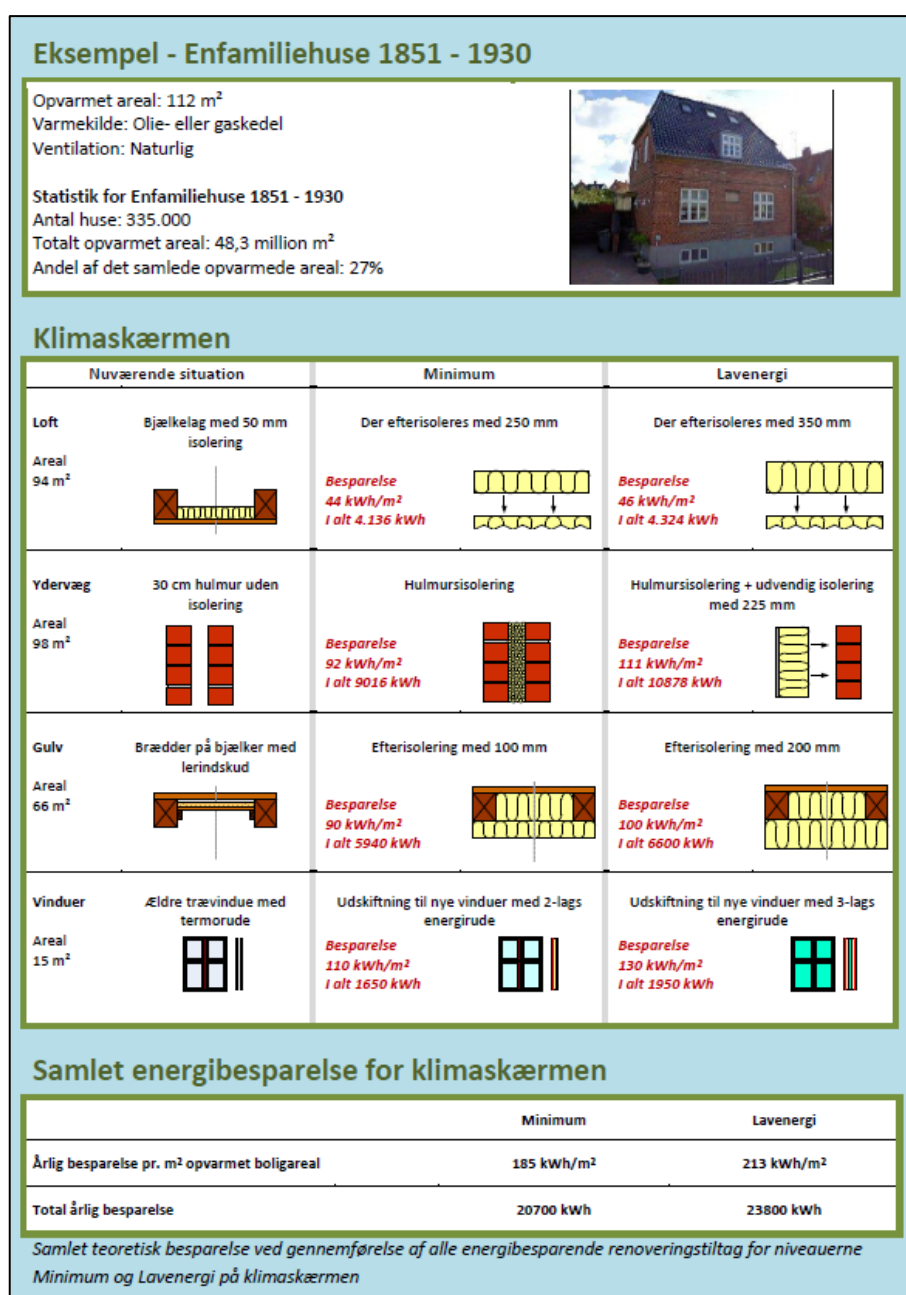


Figure 5 Example of a display sheet showing the building envelope constructions of one of the real example buildings (Single-family house from 1851 – 1930).







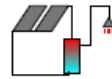
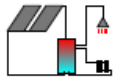
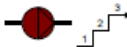




Varme og ventilation		
Nuværende situation	Minimum	Lavenergi
<b>Varmeanlæg</b> Ældre ikke kondenserende kedel (15 år gammel) 	Udskiftning til A-mærket kedel (Virkningsgrad minimum 105% ved delast og 96% ved fuldlast) <i>Besparelse 10.000 - 12.000 kWh afhængigt af forbrug</i> 	Varmekonvertering til jordvarme/varmepumpe <i>Besparelse 26.000 - 28.000 kWh afhængigt af forbrug</i> 
<b>Varme rør</b> (brugsvand eller varmforsyning) Mindre end 30 mm isolering 	Isoleret med 40 mm <i>Besparelse 5-7 kWh/m</i> 	Isoleret med 50 mm <i>Besparelse 6-9 kWh/m</i> 
<b>Solvarme</b> Solvarme anlæg ikke installeret	Anlæg til varmt brugsvand <i>Besparelse 500 - 800 kWh/m² solfanger</i> 	Anlæg til varmt brugsvand og varme <i>Besparelse 400 - 600 kWh/m² solfanger</i> 
<b>Pumper</b> Ældre trinreguleret pumpe 	Trinløs regulerbar A-mærket cirkulationspumpe <i>Besparelse 350 kWh</i> 	Trinløs regulerbar A-mærket cirkulationspumpe <i>Besparelse 350 kWh</i> 
<b>Ventilation</b> Naturlig via ventilationsåbninger i vinduer og ydervægge	Ventilationsanlæg med en tør virkningsgrad på 80% og et specifikt elforbrug (SFP) på 1.000 J/m³ <i>Besparelse 3.000 - 6.000 kWh</i> 	Ventilationsanlæg med en tør virkningsgrad på 85% og et specifikt elforbrug (SFP) på 800 J/m³ <i>Besparelse 3.500 - 6.500 kWh</i> 

Figure 6 Example of a display sheet showing the information on the heating and ventilation installation of one of the real example buildings (Single-family house from 1851 – 1930).

## Perspectives for using TABULA building typologies

According to the Energy Performance of Buildings Directive (Directive 2010/31/EU) (EPBD), European Member States (MS) are obliged to use reference buildings (building typologies) to evaluate cost-optimal energy-saving measures in new and existing buildings. Article 5 of the EPBD requires MS to establish the comparative methodology framework in accordance with EPBD Annex III and to differentiate between different categories of buildings. Annex III states that MS must define reference buildings that are characterised by and representative of their functionality and geographic location, including indoor and outdoor climate conditions. The reference buildings shall cover residential and non-residential buildings, both new and existing ones.

Application of the TABULA building typologies and building models represent a golden opportunity for kick-starting the establishment of a collection of reference buildings in the European MS (Wittchen, et. Al., 2011).

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# Annex I – Screen dumps from Danish TABULA building typologies

Screen dump from the TABULA Excel sheet  
“Tab.Building.Constr”

Row	Code	Description	Material	Energy Type	Energy Type	Diagram	U-value	Area	Volume	
360	BE_Kvæg_WaR_01_01	Træ på inderside	Skælforsigtig inderside	EnergyType 6.1	EnergyType 6.1.aaf		0	9999	0,00	1,4
362	BE_Kvæg_WaR_01_02	Træ på inderside og væksthul	Skælforsigtig inderside og væksthul	EnergyType 6.2	EnergyType 6.2.aaf		0	9999	0,00	1,8
364	BE_Kvæg_WaR_01_03	Træ på inderside 80 mm styrelse	Skælforsigtig inderside 80 mm styrelse	EnergyType 6.4	EnergyType 6.4.aaf		0	9999	0,00	0,6
366	BE_Kvæg_WaR_01_04	Træ på inderside 100 mm styrelse	Skælforsigtig inderside 100 mm styrelse	EnergyType 6.8	EnergyType 6.8.aaf		0	9999	0,10	0,20
370	BE_Kvæg_WaR_01_05	Træ på inderside 100 mm styrelse	Skælforsigtig inderside 100 mm styrelse	EnergyType 6.6	EnergyType 6.6.aaf		0	9999	0,10	0,3
371	BE_Kvæg_WaR_01_06	Isstyrelse 200 mm	Skælforsigtig inderside 200 mm styrelse	EnergyType 6.7	EnergyType 6.7.aaf		0	9999	0,20	0,3
373	BE_Kvæg_WaR_01_07	Isstyrelse 200 mm	Skælforsigtig inderside 200 mm styrelse	EnergyType 6.8	EnergyType 6.8.aaf		0	9999	0,20	0,13
375	BE_Kvæg_WaR_01_08	Isstyrelse 200 mm	Skælforsigtig inderside 200 mm styrelse	EnergyType 6.9	EnergyType 6.9.aaf		0	9999	0,20	0,11
374	BE_Kvæg_WaR_01_09	Skælforsigtig inderside og Skælforsigtig inderside	Skælforsigtig inderside og Skælforsigtig inderside	EnergyType 6.10	EnergyType 6.10.aaf		0	9999	0,00	1,3
376	BE_Kvæg_WaR_01_10	Stålbånd 10-20 cm	Stålbåndindsigtelse, 10-20 cm ind	EnergyType 7.1	EnergyType 7.1.aaf		0	9999	0,00	2,3
378	BE_Kvæg_WaR_01_11	Træ 80 mm styrelse på 30 cm afstand	Træ på inderside 80 mm styrelse på 30 cm afstand	EnergyType 7.10	EnergyType 7.10.aaf		0	9999	0,00	0,17
379	BE_Kvæg_WaR_01_12	Træ 10-20 cm	Træ på inderside 10-20 cm ind	EnergyType 7.2	EnergyType 7.2.aaf		0	9999	0,00	1,4
378	BE_Kvæg_WaR_01_13	Stålbånd 80 mm styrelse	80 mm styrelse på stålbåndindsigtelse	EnergyType 7.3	EnergyType 7.3.aaf		0	9999	0,00	0,04
379	BE_Kvæg_WaR_01_14	Stålbånd 100 mm styrelse	100 mm styrelse på stålbåndindsigtelse	EnergyType 7.4	EnergyType 7.4.aaf		0	9999	0,10	0,23
380	BE_Kvæg_WaR_01_15	Stålbånd 100 mm styrelse	100 mm styrelse på stålbåndindsigtelse	EnergyType 7.8	EnergyType 7.8.aaf		0	9999	0,10	0,24
381	BE_Kvæg_WaR_01_16	Stålbånd 200 mm styrelse	200 mm styrelse på stålbåndindsigtelse	EnergyType 7.6	EnergyType 7.6.aaf		0	9999	0,20	0,15
382	BE_Kvæg_WaR_01_17	Stålbånd 200 mm styrelse	200 mm styrelse på stålbåndindsigtelse	EnergyType 7.7	EnergyType 7.7.aaf		0	9999	0,20	0,13
383	BE_Kvæg_WaR_01_18	Træ 30 cm afstand	Træ på inderside 30 cm afstand	EnergyType 7.9	EnergyType 7.9.aaf		0	9999	0,00	1
384	BE_Kvæg_WaR_01_19	Træ på inderside	Skælforsigtig inderside	EnergyType 6.1	EnergyType 6.1.aaf		0	9999	0,00	1,4
386	BE_Kvæg_WaR_01_20	Styrelse 80 mm styrelse	Styrelse på inderside, 80 mm styrelse, og 80 mm styrelse uden inderside	EnergyType 6.10	EnergyType 6.10.aaf		0	9999	0,00	0,03
386	BE_Kvæg_WaR_01_21	Styrelse 100 mm styrelse	Styrelse på inderside, 100 mm styrelse, og 100 mm styrelse uden inderside	EnergyType 6.11	EnergyType 6.11.aaf		0	9999	0,10	0,27
387	BE_Kvæg_WaR_01_22	Styrelse 100 mm styrelse	Styrelse og 100 mm styrelse uden inderside	EnergyType 6.12	EnergyType 6.12.aaf		0	9999	0,10	0,20
388	BE_Kvæg_WaR_01_23	Træ på inderside og væksthul	Skælforsigtig inderside og væksthul	EnergyType 6.2	EnergyType 6.2.aaf		0	9999	0,00	1,8
389	BE_Kvæg_WaR_01_24	Styrelse 80 mm styrelse og væksthul	Skælforsigtig inderside og væksthul	EnergyType 6.3	EnergyType 6.3.aaf		0	9999	0,00	1,3

Figure 7. Tab.Building.Constr holds information about the defined building constructions in the TABULA Excel sheet.

## Annex II – Display sheets



## Eksempel - Enfamiliehus før 1850

Opvarmet areal: 155 m<sup>2</sup>

Varmekilde: Oli kedel

Ventilation: Naturlig

### Statistik for Enfamiliehus før 1850

Antal huse: 30.000

Totalt opvarmet areal: 5,0 million m<sup>2</sup>

Andel af det samlede opvarmede areal: 3%



## Klimaskærmen

	Nuværende situation	Minimum	Lavenergi
<b>Loft</b> Areal 155 m <sup>2</sup>	Bjælkelag med 50 mm isolering 	Der efterisoleres med 250 mm  <i>Besparelse</i> <b>44 kWh/m<sup>2</sup></b> <i>I alt 6.820 kWh</i> 	Der efterisoleres med 350 mm  <i>Besparelse</i> <b>46 kWh/m<sup>2</sup></b> <i>I alt 7.130 kWh</i> 
<b>Ydervæg</b> Areal 146 m <sup>2</sup>	12 cm tegl med 50 mm indvendig isolering 	Udvendig efterisolering med 125 mm  <i>Besparelse</i> <b>31 kWh/m<sup>2</sup></b> <i>I alt 4526 kWh</i> 	Udvendig efterisolering med 225 mm  <i>Besparelse</i> <b>37 kWh/m<sup>2</sup></b> <i>I alt 5402 kWh</i> 
<b>Gulv</b> Areal 127 m <sup>2</sup>	Gulv på strøer uisolaret mod jord 	Udgravning og etablering af nyt gulv med 250 mm isolering  <i>Besparelse</i> <b>65 kWh/m<sup>2</sup></b> <i>I alt 8255 kWh</i> 	Udgravning og etablering af nyt gulv med 300 mm isolering  <i>Besparelse</i> <b>67 kWh/m<sup>2</sup></b> <i>I alt 8509 kWh</i> 
<b>Vinduer</b> Areal 27 m <sup>2</sup>	Ældre trævindue med termorude 	Udskiftning til nye vinduer med 2-lags energirude  <i>Besparelse</i> <b>110 kWh/m<sup>2</sup></b> <i>I alt 2970 kWh</i> 	Udskiftning til nye vinduer med 3-lags energirude  <i>Besparelse</i> <b>130 kWh/m<sup>2</sup></b> <i>I alt 3510 kWh</i> 

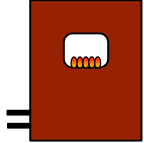
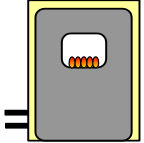




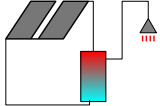
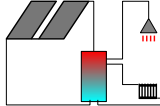
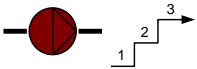




## Samlet energibesparelse for klimaskærmen

	Minimum	Lavenergi
Årlig besparelse pr. m <sup>2</sup> opvarmet boligareal	146 kWh/m <sup>2</sup>	159 kWh/m <sup>2</sup>
Total årlig besparelse	22600 kWh	24600 kWh

Samlet teoretisk besparelse ved gennemførelse af alle energibesparende renoveringstiltag for niveauerne Minimum og Lavenergi på klimaskærmen



## Varme og ventilation

Nuværende situation	Minimum	Lavenergi
<p><b>Varmeanlæg</b></p> <p>Ældre ikke kondenserende kedel (15 år gammel)</p> 	<p>Udskiftning til A-mærket kedel (Virkningsgrad minimum 105% ved delast og 96% ved fuldlast)</p> <p><i>Besparelse 10.000 - 12.000 kWh afhængigt af forbrug</i></p> 	<p>Varmekonvertering til jordvarme/varmepumpe</p> <p><i>Besparelse 32.000 - 35.000 kWh afhængigt af forbrug</i></p> 
<p><b>Varmerør</b> (brugsvand eller varmforsyning)</p> <p>Mindre end 30 mm isolering</p> 	<p>Isoleret med 40 mm</p> <p><i>Besparelse 5-7 kWh/m</i></p> 	<p>Isoleret med 50 mm</p> <p><i>Besparelse 6-9 kWh/m</i></p> 
<p><b>Solvarme</b></p> <p>Solvarme anlæg ikke installeret</p>	<p>Anlæg til varmt brugsvand</p> <p><i>Besparelse 500 - 800 kWh/m<sup>2</sup> solfanger</i></p> 	<p>Anlæg til varmt brugsvand og varme</p> <p><i>Besparelse 400 - 600 kWh/m<sup>2</sup> solfanger</i></p> 
<p><b>Pumper</b></p> <p>Ældre trinreguleret pumpe</p> 	<p>Trinløs regulerbar A-mærket cirkulationspumpe</p> <p><i>Besparelse 350 kWh</i></p> 	<p>Trinløs regulerbar A-mærket cirkulationspumpe</p> <p><i>Besparelse 350 kWh</i></p> 
<p><b>Ventilation</b></p> <p>Naturlig via ventilationsåbninger i vinduer og ydervægge</p>	<p>Ventilationsanlæg med en tør virkningsgrad på 80% og et specifikt elforbrug (SFP) på 1.000 J/m<sup>3</sup></p> <p><i>Besparelse 3.000 - 6.000 kWh</i></p> 	<p>Ventilationsanlæg med en tør virkningsgrad på 85% og et specifikt elforbrug (SFP) på 800 J/m<sup>3</sup></p> <p><i>Besparelse 3.500 - 6.500 kWh</i></p> 





## Eksempel - Enfamiliehuse 1851 - 1930

Opvarmet areal: 112 m<sup>2</sup>  
 Varmekilde: Olie- eller gaskedel  
 Ventilation: Naturlig

### Statistik for Enfamiliehuse 1851 - 1930

Antal huse: 335.000  
 Totalt opvarmet areal: 48,3 million m<sup>2</sup>  
 Andel af det samlede opvarmede areal: 27%



## Klimaskærmen

	Nuværende situation	Minimum	Lavenergi
<b>Loft</b> Areal 94 m <sup>2</sup>	Bjælkelag med 50 mm isolering 	Der efterisoleres med 250 mm  <i>Besparelse</i> <b>44 kWh/m<sup>2</sup></b> <i>I alt 4.136 kWh</i> 	Der efterisoleres med 350 mm  <i>Besparelse</i> <b>46 kWh/m<sup>2</sup></b> <i>I alt 4.324 kWh</i> 
<b>Ydervæg</b> Areal 98 m <sup>2</sup>	30 cm hulmur uden isolering 	Hulmursisolering  <i>Besparelse</i> <b>92 kWh/m<sup>2</sup></b> <i>I alt 9016 kWh</i> 	Hulmursisolering + udvendig isolering med 225 mm  <i>Besparelse</i> <b>111 kWh/m<sup>2</sup></b> <i>I alt 10878 kWh</i> 
<b>Gulv</b> Areal 66 m <sup>2</sup>	Brædder på bjælker med lerindskud 	Efterisolering med 100 mm  <i>Besparelse</i> <b>90 kWh/m<sup>2</sup></b> <i>I alt 5940 kWh</i> 	Efterisolering med 200 mm  <i>Besparelse</i> <b>100 kWh/m<sup>2</sup></b> <i>I alt 6600 kWh</i> 
<b>Vinduer</b> Areal 15 m <sup>2</sup>	Ældre trævindue med termorude 	Udskiftning til nye vinduer med 2-lags energirude  <i>Besparelse</i> <b>110 kWh/m<sup>2</sup></b> <i>I alt 1650 kWh</i> 	Udskiftning til nye vinduer med 3-lags energirude  <i>Besparelse</i> <b>130 kWh/m<sup>2</sup></b> <i>I alt 1950 kWh</i> 

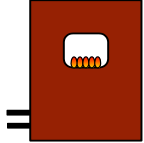
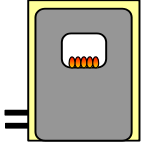
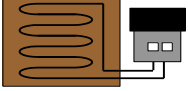



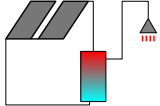
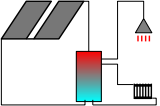
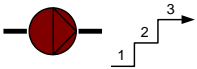




## Samlet energibesparelse for klimaskærmen

	Minimum	Lavenergi
Årlig besparelse pr. m <sup>2</sup> opvarmet boligareal	185 kWh/m <sup>2</sup>	213 kWh/m <sup>2</sup>
Total årlig besparelse	20700 kWh	23800 kWh

Samlet teoretisk besparelse ved gennemførelse af alle energibesparende renoveringstiltag for niveauerne Minimum og Lavenergi på klimaskærmen



## Varme og ventilation

Nuværende situation	Minimum	Lavenergi
<p><b>Varmeanlæg</b></p> <p>Ældre ikke kondenserende kedel (15 år gammel)</p> 	<p>Udskiftning til A-mærket kedel (Virkningsgrad minimum 105% ved delast og 96% ved fuldlast)</p> <p><i>Besparelse 10.000 - 12.000 kWh afhængigt af forbrug</i></p> 	<p>Varmekonvertering til jordvarme/varmepumpe</p> <p><i>Besparelse 26.000 - 28.000 kWh afhængigt af forbrug</i></p> 
<p><b>Varmerør</b> (brugsvand eller varmforsyning)</p> <p>Mindre end 30 mm isolering</p> 	<p>Isoleret med 40 mm</p> <p><i>Besparelse 5-7 kWh/m</i></p> 	<p>Isoleret med 50 mm</p> <p><i>Besparelse 6-9 kWh/m</i></p> 
<p><b>Solvarme</b></p> <p>Solvarme anlæg ikke installeret</p>	<p>Anlæg til varmt brugsvand</p> <p><i>Besparelse 500 - 800 kWh/m<sup>2</sup> solfanger</i></p> 	<p>Anlæg til varmt brugsvand og varme</p> <p><i>Besparelse 400 - 600 kWh/m<sup>2</sup> solfanger</i></p> 
<p><b>Pumper</b></p> <p>Ældre trinreguleret pumpe</p> 	<p>Trinløs regulerbar A-mærket cirkulationspumpe</p> <p><i>Besparelse 350 kWh</i></p> 	<p>Trinløs regulerbar A-mærket cirkulationspumpe</p> <p><i>Besparelse 350 kWh</i></p> 
<p><b>Ventilation</b></p> <p>Naturlig via ventilationsåbninger i vinduer og ydervægge</p>	<p>Ventilationsanlæg med en tør virkningsgrad på 80% og et specifikt elforbrug (SFP) på 1.000 J/m<sup>3</sup></p> <p><i>Besparelse 3.000 - 6.000 kWh</i></p> 	<p>Ventilationsanlæg med en tør virkningsgrad på 85% og et specifikt elforbrug (SFP) på 800 J/m<sup>3</sup></p> <p><i>Besparelse 3.500 - 6.500 kWh</i></p> 



## Eksempel - Enfamiliehuse 1931 - 1950

Opvarmet areal: 140 m<sup>2</sup>  
 Varmekilde: Olie- eller gaskedel  
 Ventilation: Naturlig

### Statistik for Enfamiliehuse 1931 - 1950

Antal huse: 150.000  
 Totalt opvarmet areal: 18,2 million m<sup>2</sup>  
 Andel af det samlede opvarmede areal: 10%



## Klimaskærmen

	Nuværende situation	Minimum	Lavenergi
<b>Loft</b> Areal 89 m <sup>2</sup>	Træ på bjælker med lerindskud 	Der efterisoleres med 300 mm <i>Besparelse 125 kWh/m<sup>2</sup></i> <i>I alt 11.125 kWh</i> 	Der efterisoleres med 400 mm <i>Besparelse 127 kWh/m<sup>2</sup></i> <i>I alt 11.303 kWh</i> 
<b>Ydervæg</b> Areal 109 m <sup>2</sup>	30 cm hulmur uden isolering 	Hulmursisolering <i>Besparelse 92 kWh/m<sup>2</sup></i> <i>I alt 10028 kWh</i> 	Hulmursisolering + udvendig isolering med 225 mm <i>Besparelse 111 kWh/m<sup>2</sup></i> <i>I alt 12099 kWh</i> 
<b>Gulv</b> Areal 88 m <sup>2</sup>	Brædder på bjælker med lerindskud 	Efterisolering med 100 mm <i>Besparelse 90 kWh/m<sup>2</sup></i> <i>I alt 7920 kWh</i> 	Efterisolering med 200 mm <i>Besparelse 100 kWh/m<sup>2</sup></i> <i>I alt 8800 kWh</i> 
<b>Vinduer</b> Areal 22 m <sup>2</sup>	Ældre trævindue med termorude 	Udskiftning til nye vinduer med 2-lags energirude <i>Besparelse 110 kWh/m<sup>2</sup></i> <i>I alt 2420 kWh</i> 	Udskiftning til nye vinduer med 3-lags energirude <i>Besparelse 130 kWh/m<sup>2</sup></i> <i>I alt 2860 kWh</i> 

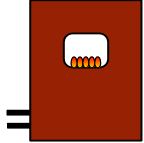
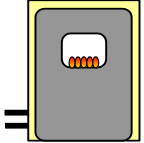
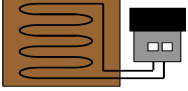



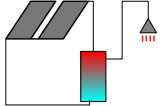
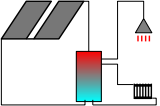
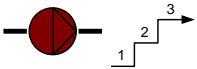




## Samlet energibesparelse for klimaskærmen

	Minimum	Lavenergi
Årlig besparelse pr. m <sup>2</sup> opvarmet boligareal	225 kWh/m <sup>2</sup>	251 kWh/m <sup>2</sup>
Total årlig besparelse	31500 kWh	35100 kWh

Samlet teoretisk besparelse ved gennemførelse af alle energibesparende renoveringstiltag for niveauerne Minimum og Lavenergi på klimaskærmen



## Varme og ventilation

Nuværende situation	Minimum	Lavenergi
<p><b>Varmeanlæg</b></p> <p>Ældre ikke kondenserende kedel (15 år gammel)</p> 	<p>Udskiftning til A-mærket kedel (Virkningsgrad minimum 105% ved delast og 96% ved fuldlast)</p> <p><i>Besparelse 10.000 - 12.000 kWh afhængigt af forbrug</i></p> 	<p>Varmekonvertering til jordvarme/varmepumpe</p> <p><i>Besparelse 32.000 - 35.000 kWh afhængigt af forbrug</i></p> 
<p><b>Varme rør</b> (brugsvand eller varmforsyning)</p> <p>Mindre end 30 mm isolering</p> 	<p>Isoleret med 40 mm</p> <p><i>Besparelse 5-7 kWh/m</i></p> 	<p>Isoleret med 50 mm</p> <p><i>Besparelse 6-9 kWh/m</i></p> 
<p><b>Solvarme</b></p> <p>Solvarme anlæg ikke installeret</p>	<p>Anlæg til varmt brugsvand</p> <p><i>Besparelse 500 - 800 kWh/m<sup>2</sup> solfanger</i></p> 	<p>Anlæg til varmt brugsvand og varme</p> <p><i>Besparelse 400 - 600 kWh/m<sup>2</sup> solfanger</i></p> 
<p><b>Pumper</b></p> <p>Ældre trinreguleret pumpe</p> 	<p>Trinløs regulerbar A-mærket cirkulationspumpe</p> <p><i>Besparelse 350 kWh</i></p> 	<p>Trinløs regulerbar A-mærket cirkulationspumpe</p> <p><i>Besparelse 350 kWh</i></p> 
<p><b>Ventilation</b></p> <p>Naturlig via ventilationsåbninger i vinduer og ydervægge</p>	<p>Ventilationsanlæg med en tør virkningsgrad på 80% og et specifikt elforbrug (SFP) på 1.000 J/m<sup>3</sup></p> <p><i>Besparelse 3.000 - 6.000 kWh</i></p> 	<p>Ventilationsanlæg med en tør virkningsgrad på 85% og et specifikt elforbrug (SFP) på 800 J/m<sup>3</sup></p> <p><i>Besparelse 3.500 - 6.500 kWh</i></p> 



## Eksempel - Enfamiliehuse 1951 - 1960

Opvarmet areal: 106 m<sup>2</sup>  
 Varmekilde: Olie- eller gaskedel  
 Ventilation: Naturlig

### Statistik for Enfamiliehuse 1951 - 1960

Antal huse: 125.000  
 Totalt opvarmet areal: 13,4 million m<sup>2</sup>  
 Andel af det samlede opvarmede areal: 8%



## Klimaskærmen

	Nuværende situation	Minimum	Lavenergi
<b>Loft</b> Areal 106 m <sup>2</sup>	Bjælkelag med 100 mm isolering 	Der efterisoleres med 200 mm  <i>Besparelse</i> <b>24 kWh/m<sup>2</sup></b> <i>I alt 2.544 kWh</i> 	Der efterisoleres med 300 mm  <i>Besparelse</i> <b>26 kWh/m<sup>2</sup></b> <i>I alt 2.756 kWh</i> 
<b>Ydervæg</b> Areal 101 m <sup>2</sup>	30 cm hul efterisoleret med brændte klinker 	Udførelse af ny hulmursisolering  <i>Besparelse</i> <b>47 kWh/m<sup>2</sup></b> <i>I alt 4747 kWh</i> 	Hulmursisolering + udvendig isolering med 225 mm  <i>Besparelse</i> <b>66 kWh/m<sup>2</sup></b> <i>I alt 6666 kWh</i> 
<b>Gulv</b> Areal 106 m <sup>2</sup>	Trægulv på bjælker med 50 mm isolering 	Efterisolering med 50 mm  <i>Besparelse</i> <b>16 kWh/m<sup>2</sup></b> <i>I alt 1696 kWh</i> 	Efterisolering med 150 mm  <i>Besparelse</i> <b>26 kWh/m<sup>2</sup></b> <i>I alt 2756 kWh</i> 
<b>Vinduer</b> Areal 28 m <sup>2</sup>	Ældre trævindue med termorude 	Udskiftning til nye vinduer med 2-lags energirude  <i>Besparelse</i> <b>120 kWh/m<sup>2</sup></b> <i>I alt 3360 kWh</i> 	Udskiftning til nye vinduer med 3-lags energirude  <i>Besparelse</i> <b>140 kWh/m<sup>2</sup></b> <i>I alt 3920 kWh</i> 

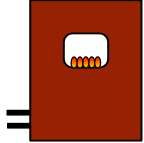
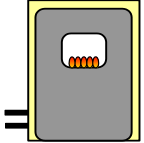
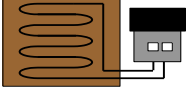



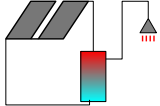
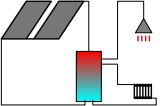
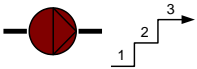



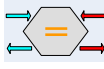
## Samlet energibesparelse for klimaskærmen

	Minimum	Lavenergi
Årlig besparelse pr. m <sup>2</sup> opvarmet boligareal	116 kWh/m <sup>2</sup>	152 kWh/m <sup>2</sup>
Total årlig besparelse	12300 kWh	16100 kWh

Samlet teoretisk besparelse ved gennemførelse af alle energibesparende renoveringstiltag for niveauerne Minimum og Lavenergi på klimaskærmen



## Varme og ventilation

Nuværende situation	Minimum	Lavenergi
<p><b>Varmeanlæg</b></p> <p>Ældre ikke kondenserende kedel (10 år)</p> 	<p>Udskiftning til A-mærket kedel (Virkningsgrad minimum 105% ved delast og 96% ved fuldlast)</p> <p><i>Besparelse 4.000 - 5.000 kWh afhængigt af forbrug</i></p> 	<p>Varmekonvertering til jordvarme/varmepumpe</p> <p><i>Besparelse 20.000 - 22.000 kWh afhængigt af forbrug</i></p> 
<p><b>Varmerør</b> (brugsvand eller varmforsyning)</p> <p>Mindre end 30 mm isolering</p> 	<p>Isoleret med 40 mm</p> <p><i>Besparelse 5-7 kWh/m</i></p> 	<p>Isoleret med 50 mm</p> <p><i>Besparelse 6-9 kWh/m</i></p> 
<p><b>Solvarme</b></p> <p>Solvarme anlæg ikke installeret</p>	<p>Anlæg til varmt brugsvand</p> <p><i>Besparelse 500 - 800 kWh/m<sup>2</sup> solfanger</i></p> 	<p>Anlæg til varmt brugsvand og varme</p> <p><i>Besparelse 400 - 600 kWh/m<sup>2</sup> solfanger</i></p> 
<p><b>Pumper</b></p> <p>Ældre trinreguleret pumpe</p> 	<p>Trinløs regulerbar A-mærket cirkulationspumpe</p> <p><i>Besparelse 350 kWh</i></p> 	<p>Trinløs regulerbar A-mærket cirkulationspumpe</p> <p><i>Besparelse 350 kWh</i></p> 
<p><b>Ventilation</b></p> <p>Naturlig via ventilationsåbninger i vinduer og ydervægge</p>	<p>Ventilationsanlæg med en tør virkningsgrad på 80% og et specifikt elforbrug (SFP) på 1.000 J/m<sup>3</sup></p> <p><i>Besparelse 3.000 - 6.000 kWh</i></p> 	<p>Ventilationsanlæg med en tør virkningsgrad på 85% og et specifikt elforbrug (SFP) på 800 J/m<sup>3</sup></p> <p><i>Besparelse 3.500 - 6.500 kWh</i></p> 



## Eksempel - Enfamiliehuse 1961 - 1972

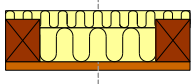
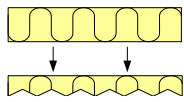
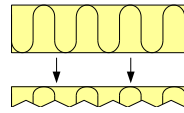
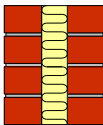
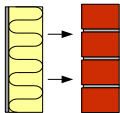
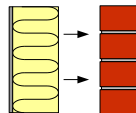
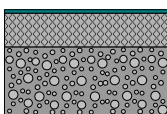
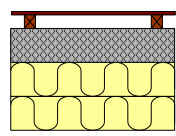
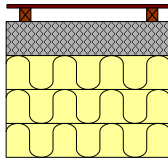


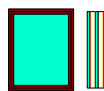
Opvarmet areal: 180 m<sup>2</sup>  
 Varmekilde: Olie- eller gaskedel  
 Ventilation: Naturlig

### Statistik for Enfamiliehuse 1961 - 1972

Antal huse: 306.000  
 Totalt opvarmet areal: 39,2 million m<sup>2</sup>  
 Andel af det samlede opvarmede areal: 22%



## Klimaskærmen

Nuværende situation		Minimum	Lavenergi
<b>Loft</b> Areal 180 m <sup>2</sup> Bjælkelag med 150 mm isolering 	Der efterisoleres med 150 mm <b>Besparelse 17 kWh/m<sup>2</sup></b> <b>I alt 3.060 kWh</b> 	Der efterisoleres med 250 mm <b>Besparelse 19 kWh/m<sup>2</sup></b> <b>I alt 3.420 kWh</b> 	
<b>Ydervæg</b> Areal 121 m <sup>2</sup> 30 cm hulmur isoleret samtidig med opførelsen 	Udvendig efterisolering med 125 mm <b>Besparelse 30 kWh/m<sup>2</sup></b> <b>I alt 3630 kWh</b> 	Udvendig efterisolering med 225 mm <b>Besparelse 35 kWh/m<sup>2</sup></b> <b>I alt 4235 kWh</b> 	
<b>Gulv</b> Areal 160 m <sup>2</sup> Beton med ca. 20 cm letklinker 	Udgravning og etablering af nyt gulv med 250 mm isolering <b>Besparelse 23 kWh/m<sup>2</sup></b> <b>I alt 3680 kWh</b> 	Udgravning og etablering af nyt gulv med 300 mm isolering <b>Besparelse 25 kWh/m<sup>2</sup></b> <b>I alt 4000 kWh</b> 	
<b>Vinduer</b> Areal 34 m <sup>2</sup> Ældre trævindue med termorude 	Udskiftning til nye vinduer med 2-lags energirude <b>Besparelse 120 kWh/m<sup>2</sup></b> <b>I alt 4080 kWh</b> 	Udskiftning til nye vinduer med 3-lags energirude <b>Besparelse 140 kWh/m<sup>2</sup></b> <b>I alt 4760 kWh</b> 	

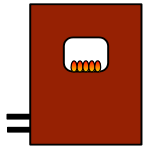
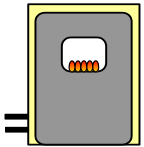
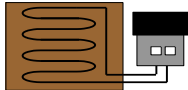



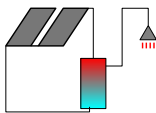
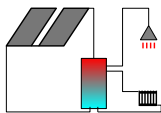
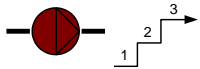




## Samlet energibesparelse for klimaskærmen

	Minimum	Lavenergi
Årlig besparelse pr. m <sup>2</sup> opvarmet boligareal	81 kWh/m <sup>2</sup>	91 kWh/m <sup>2</sup>
Total årlig besparelse	14500 kWh	16400 kWh

Samlet teoretisk besparelse ved gennemførelse af alle energibesparende renoveringstiltag for niveauerne Minimum og Lavenergi på klimaskærmen



## Varme og ventilation

Nuværende situation	Minimum	Lavenergi
<p><b>Varmeanlæg</b></p> <p>Ældre ikke kondenserende kedel (10 år)</p> 	<p>Udskiftning til A-mærket kedel (Virkningsgrad minimum 105% ved delast og 96% ved fuldlast)</p> <p><i>Besparelse 4.000 - 5.000 kWh afhængigt af forbrug</i></p> 	<p>Varmekonvertering til jordvarme/varmepumpe</p> <p><i>Besparelse 24.000 - 26.000 kWh afhængigt af forbrug</i></p> 
<p><b>Varme rør</b> (brugsvand eller varmforsyning)</p> <p>Mindre end 30 mm isolering</p> 	<p>Isoleret med 40 mm</p> <p><i>Besparelse 5-7 kWh/m</i></p> 	<p>Isoleret med 50 mm</p> <p><i>Besparelse 6-9 kWh/m</i></p> 
<p><b>Solvarme</b></p> <p>Solvarme anlæg ikke installeret</p>	<p>Anlæg til varmt brugsvand</p> <p><i>Besparelse 500 - 800 kWh/m<sup>2</sup> solfanger</i></p> 	<p>Anlæg til varmt brugsvand og varme</p> <p><i>Besparelse 400 - 600 kWh/m<sup>2</sup> solfanger</i></p> 
<p><b>Pumper</b></p> <p>Ældre trinreguleret pumpe</p> 	<p>Trinløs regulerbar A-mærket cirkulationspumpe</p> <p><i>Besparelse 350 kWh</i></p> 	<p>Trinløs regulerbar A-mærket cirkulationspumpe</p> <p><i>Besparelse 350 kWh</i></p> 
<p><b>Ventilation</b></p> <p>Naturlig via ventilationsåbninger i vinduer og ydervægge</p>	<p>Ventilationsanlæg med en tør virkningsgrad på 80% og et specifikt elforbrug (SFP) på 1.000 J/m<sup>3</sup></p> <p><i>Besparelse 3.000 - 6.000 kWh</i></p> 	<p>Ventilationsanlæg med en tør virkningsgrad på 85% og et specifikt elforbrug (SFP) på 800 J/m<sup>3</sup></p> <p><i>Besparelse 3.500 - 6.500 kWh</i></p> 





## Eksempel - Enfamiliehuse 1973 - 1978

Opvarmet areal: 138 m<sup>2</sup>  
 Varmekilde: Olie- eller gaskedel  
 Ventilation: Naturlig

### Statistik for Enfamiliehuse 1973 - 1978

Antal huse: 172.000  
 Totalt opvarmet areal: 22,7 million m<sup>2</sup>  
 Andel af det samlede opvarmede areal: 13%



## Klimaskærmen

	Nuværende situation	Minimum	Lavenergi
<b>Loft</b> Areal 131 m <sup>2</sup>	Bjælkelag med 150 mm isolering 	Der efterisoleres med 150 mm <i>Besparelse 17 kWh/m<sup>2</sup></i> <i>I alt 2.227 kWh</i> 	Der efterisoleres med 250 mm <i>Besparelse 19 kWh/m<sup>2</sup></i> <i>I alt 2.489 kWh</i> 
<b>Ydervæg</b> Areal 97 m <sup>2</sup>	35 cm tegl-letbeton med 130 mm isolering 	Den eksisterende isolering opfylder anbefalingen <i>Besparelse 0 kWh/m<sup>2</sup></i> <i>I alt 0 kWh</i> 	Udvendig efterisolering med 225 mm <i>Besparelse 0 kWh/m<sup>2</sup></i> <i>I alt 0 kWh</i> 
<b>Gulv</b> Areal 118 m <sup>2</sup>	Beton med 50 mm isolering 	Udgravning og etablering af nyt gulv med 250 mm isolering <i>Besparelse 32 kWh/m<sup>2</sup></i> <i>I alt 3776 kWh</i> 	Udgravning og etablering af nyt gulv med 300 mm isolering <i>Besparelse 34 kWh/m<sup>2</sup></i> <i>I alt 4012 kWh</i> 
<b>Vinduer</b> Areal 22 m <sup>2</sup>	Ældre trævindue med termorude 	Udskiftning til nye vinduer med 2-lags energirude <i>Besparelse 120 kWh/m<sup>2</sup></i> <i>I alt 2640 kWh</i> 	Udskiftning til nye vinduer med 3-lags energirude <i>Besparelse 140 kWh/m<sup>2</sup></i> <i>I alt 3080 kWh</i> 

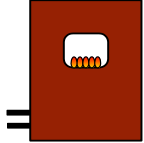
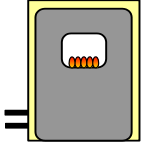




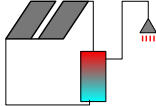
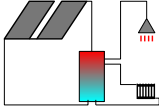
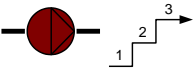




## Samlet energibesparelse for klimaskærmen

	Minimum	Lavenergi
Årlig besparelse pr. m <sup>2</sup> opvarmet boligareal	62 kWh/m <sup>2</sup>	70 kWh/m <sup>2</sup>
Total årlig besparelse	8600 kWh	9600 kWh

Samlet teoretisk besparelse ved gennemførelse af alle energibesparende renoveringstiltag for niveauerne Minimum og Lavenergi på klimaskærmen



## Varme og ventilation

Nuværende situation	Minimum	Lavenergi
<p><b>Varmeanlæg</b></p> <p>Ældre ikke kondenserende kedel (10 år)</p> 	<p>Udskiftning til A-mærket kedel (Virkningsgrad minimum 105% ved delast og 96% ved fuldlast)</p> <p><i>Besparelse 4.000 - 5.000 kWh afhængigt af forbrug</i></p> 	<p>Varmekonvertering til jordvarme/varmepumpe</p> <p><i>Besparelse 20.000 - 22.000 kWh afhængigt af forbrug</i></p> 
<p><b>Varmerør</b> (brugsvand eller varmforsyning)</p> <p>Mindre end 30 mm isolering</p> 	<p>Isoleret med 40 mm</p> <p><i>Besparelse 5-7 kWh/m</i></p> 	<p>Isoleret med 50 mm</p> <p><i>Besparelse 6-9 kWh/m</i></p> 
<p><b>Solvarme</b></p> <p>Solvarme anlæg ikke installeret</p>	<p>Anlæg til varmt brugsvand</p> <p><i>Besparelse 500 - 800 kWh/m<sup>2</sup> solfanger</i></p> 	<p>Anlæg til varmt brugsvand og varme</p> <p><i>Besparelse 400 - 600 kWh/m<sup>2</sup> solfanger</i></p> 
<p><b>Pumper</b></p> <p>Ældre trinreguleret pumpe</p> 	<p>Trinløs regulerbar A-mærket cirkulationspumpe</p> <p><i>Besparelse 350 kWh</i></p> 	<p>Trinløs regulerbar A-mærket cirkulationspumpe</p> <p><i>Besparelse 350 kWh</i></p> 
<p><b>Ventilation</b></p> <p>Naturlig via ventilationsåbninger i vinduer og ydervægge</p>	<p>Ventilationsanlæg med en tør virkningsgrad på 80% og et specifikt elforbrug (SFP) på 1.000 J/m<sup>3</sup></p> <p><i>Besparelse 3.000 - 6.000 kWh</i></p> 	<p>Ventilationsanlæg med en tør virkningsgrad på 85% og et specifikt elforbrug (SFP) på 800 J/m<sup>3</sup></p> <p><i>Besparelse 3.500 - 6.500 kWh</i></p> 



## Eksempel - Enfamiliehuse 1979 - 1998

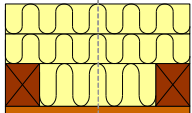


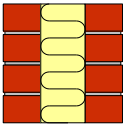

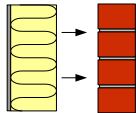
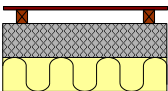




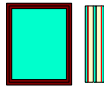
Opvarmet areal: 143 m<sup>2</sup>  
 Varmekilde: Olie- eller gaskedel  
 Ventilation: Naturlig

### Statistik for Enfamiliehuse 1979 - 1998

Antal huse: 209.000  
 Totalt opvarmet areal: 18,7 million m<sup>2</sup>  
 Andel af det samlede opvarmede areal: 11%



## Klimaskærmen

Nuværende situation		Minimum	Lavenergi
<b>Loft</b> Areal 143 m <sup>2</sup>	Bjælkelag med 300 mm isolering 	Det eksisterende isoleringslag er tilstrækkelig  <i>Besparelse</i> 0 kWh/m <sup>2</sup> I alt 0 kWh  	Det eksisterende isoleringslag er tilstrækkelig  <i>Besparelse</i> 0 kWh/m <sup>2</sup> I alt 0 kWh  
<b>Ydervæg</b> Areal 124 m <sup>2</sup>	35 cm mur isoleret med 130 mm 	Den eksisterende isolering opfylder anbefalingen  <i>Besparelse</i> 0 kWh/m <sup>2</sup> I alt 0 kWh  	Udvendig efterisolering med 100 mm  <i>Besparelse</i> 20 kWh/m <sup>2</sup> I alt 2480 kWh  
<b>Gulv</b> Areal 122 m <sup>2</sup>	Beton med 100 mm isolering 	Den eksisterende isolering er tilstrækkelig  <i>Besparelse</i> 0 kWh/m <sup>2</sup> I alt 0 kWh  	Den eksisterende isolering er tilstrækkelig  <i>Besparelse</i> 0 kWh/m <sup>2</sup> I alt 0 kWh  
<b>Vinduer</b> Areal 25 m <sup>2</sup>	Ældre trævindue med termorude 	Udskiftning til nye vinduer med 2-lags energirude  <i>Besparelse</i> 120 kWh/m <sup>2</sup> I alt 3000 kWh  	Udskiftning til nye vinduer med 3-lags energirude  <i>Besparelse</i> 140 kWh/m <sup>2</sup> I alt 3500 kWh  

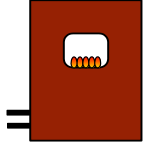
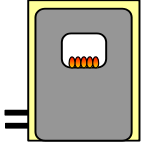
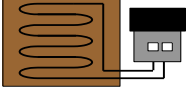



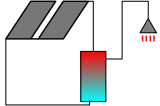
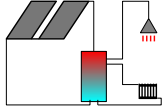
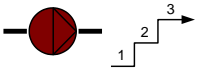




## Samlet energibesparelse for klimaskærmen

	Minimum	Lavenergi
Årlig besparelse pr. m <sup>2</sup> opvarmet boligareal	21 kWh/m <sup>2</sup>	42 kWh/m <sup>2</sup>
Total årlig besparelse	3000 kWh	6000 kWh

Samlet teoretisk besparelse ved gennemførelse af alle energibesparende renoveringstiltag for niveauerne Minimum og Lavenergi på klimaskærmen



## Varme og ventilation

Nuværende situation	Minimum	Lavenergi
<p><b>Varmeanlæg</b></p> <p>Ældre ikke kondenserende kedel (10 år)</p> 	<p>Udskiftning til A-mærket kedel (Virkningsgrad minimum 105% ved delast og 96% ved fullast)</p> <p><i>Besparelse 3.000 - 4.000 kWh afhængigt af forbrug</i></p> 	<p>Varmekonvertering til jordvarme/varmepumpe</p> <p><i>Besparelse 12.000 - 14.000 kWh afhængigt af forbrug</i></p> 
<p><b>Varmerør</b> (brugsvand eller varmforsyning)</p> <p>Mindre end 30 mm isolering</p> 	<p>Isoleret med 40 mm</p> <p><i>Besparelse 5-7 kWh/m</i></p> 	<p>Isoleret med 50 mm</p> <p><i>Besparelse 6-9 kWh/m</i></p> 
<p><b>Solvarme</b></p> <p>Solvarme anlæg ikke installeret</p>	<p>Anlæg til varmt brugsvand</p> <p><i>Besparelse 500 - 800 kWh/m² solfanger</i></p> 	<p>Anlæg til varmt brugsvand og varme</p> <p><i>Besparelse 400 - 600 kWh/m² solfanger</i></p> 
<p><b>Pumper</b></p> <p>Ældre trinreguleret pumpe</p> 	<p>Trinløs regulerbar A-mærket cirkulationspumpe</p> <p><i>Besparelse 350 kWh</i></p> 	<p>Trinløs regulerbar A-mærket cirkulationspumpe</p> <p><i>Besparelse 350 kWh</i></p> 
<p><b>Ventilation</b></p> <p>Naturlig via ventilationsåbninger i vinduer og ydervægge</p>	<p>Ventilationsanlæg med en tør virkningsgrad på 80% og et specifikt elforbrug (SFP) på 1.000 J/m³</p> <p><i>Besparelse 3.000 - 6.000 kWh</i></p> 	<p>Ventilationsanlæg med en tør virkningsgrad på 85% og et specifikt elforbrug (SFP) på 800 J/m³</p> <p><i>Besparelse 3.500 - 6.500 kWh</i></p> 



## Eksempel - Enfamiliehuse 1999 - 2006

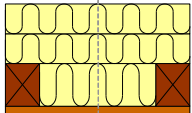
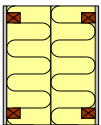
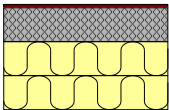

Opvarmet areal: 175 m<sup>2</sup>  
 Varmekilde: Olie- eller gaskedel  
 Ventilation: Mekanisk med varmegenvinding

### Statistik for Enfamiliehuse 1999 - 2006

Antal huse: 74.000  
 Totalt opvarmet areal: 7,8 million m<sup>2</sup>  
 Andel af det samlede opvarmede areal: 4%



## Klimaskærmen

Nuværende situation		Minimum	Lavenergi
<b>Loft</b> Areal 120 m <sup>2</sup>	Bjælkelag med 300 mm isolering 	Det eksisterende isoleringslag er tilstrækkelig <i>Besparelse 0 kWh/m<sup>2</sup></i> <i>I alt 0 kWh</i> ✓	Det eksisterende isoleringslag er tilstrækkelig <i>Besparelse 0 kWh/m<sup>2</sup></i> <i>I alt 0 kWh</i> ✓
<b>Ydervæg</b> Areal 117 m <sup>2</sup>	Let ydervæg med 300 mm isolering 	Den eksisterende isolering opfylder anbefalingen <i>Besparelse 0 kWh/m<sup>2</sup></i> <i>I alt 0 kWh</i> ✓	Den eksisterende isolering er tilstrækkelig <i>Besparelse 0 kWh/m<sup>2</sup></i> <i>I alt 0 kWh</i> ✓
<b>Gulv</b> Areal 90 m <sup>2</sup>	Terrændæk med 200 mm isolering 	Den eksisterende isolering er tilstrækkelig <i>Besparelse 0 kWh/m<sup>2</sup></i> <i>I alt 0 kWh</i> ✓	Den eksisterende isolering er tilstrækkelig <i>Besparelse 0 kWh/m<sup>2</sup></i> <i>I alt 0 kWh</i> ✓
<b>Vinduer</b> Areal 27 m <sup>2</sup>	Nyere vindue med energirude 	Eksisterende vinduer er ok <i>Besparelse kWh/m<sup>2</sup></i> <i>I alt 0 kWh</i> ✓	Eksisterende vinduer er ok <i>Besparelse 0 kWh/m<sup>2</sup></i> <i>I alt 0 kWh</i> ✓

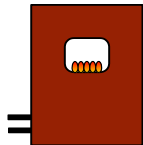





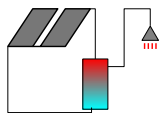
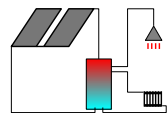





## Samlet energibesparelse for klimaskærmen

	Minimum	Lavenergi
Årlig besparelse pr. m <sup>2</sup> opvarmet boligareal	0 kWh/m <sup>2</sup>	0 kWh/m <sup>2</sup>
Total årlig besparelse	0 kWh	0 kWh

Samlet teoretisk besparelse ved gennemførelse af alle energibesparende renoveringstiltag for niveauerne Minimum og Lavenergi på klimaskærmen



## Varme og ventilation

Nuværende situation		Minimum	Lavenergi	
<b>Varmeanlæg</b> Nyere kedel (5 år) 	Eksisterende kedel er ok	<i>Besparelse</i> <b>0 kWh afhængigt af forbrug</b> 	Varmekonvertering til jordvarme/varmepumpe <i>Besparelse</i> <b>10.000 kWh afhængigt af forbrug</b> 	
<b>Varme rør</b> <small>(brugsvand eller varmforsyning)</small> Mere end 40 mm isolering 	Eksisterende rørisolering er ok	<i>Besparelse</i> <b>-</b> 	Eksisterende rørisolering er ok	<i>Besparelse</i> <b>-</b> 
<b>Solvarme</b> Solvarme anlæg ikke installeret	Anlæg til varmt brugsvand	<i>Besparelse</i> <b>500 - 800 kWh/m<sup>2</sup> solfanger</b> 	Anlæg til varmt brugsvand og varme	<i>Besparelse</i> <b>400 - 600 kWh/m<sup>2</sup> solfanger</b> 
<b>Pumper</b> Trinløs regulerbar A-mærket cirkulationspumpe 	Eksisterende pumpe er ok	<i>Besparelse</i> <b>- kWh</b> 	Eksisterende pumpe er ok	<i>Besparelse</i> <b>- kWh</b> 
<b>Ventilation</b> Mekanisk ventilation med varmegenvinding	Eksisterende anlæg er ok	<i>Besparelse</i> 	Eksisterende anlæg er ok	<i>Besparelse</i> 



## Eksempel - Enfamiliehuse 2007 - 2011

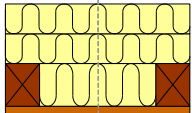
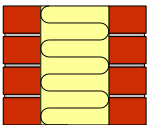
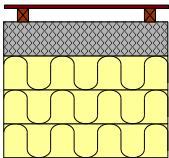

Opvarmet areal: 171 m<sup>2</sup>  
 Varmekilde: Olie- eller gaskedel  
 Ventilation: Mekanisk med varmegenvinding

### Statistik for Enfamiliehuse 2007 - 2011

Antal huse: 37.000  
 Totalt opvarmet areal: 4,4 million m<sup>2</sup>  
 Andel af det samlede opvarmede areal: 2%



## Klimaskærmen

Nuværende situation		Minimum	Lavenergi
<b>Loft</b> Areal 171 m <sup>2</sup>	Bjælkelag med 300 mm isolering 	Det eksisterende isoleringslag er tilstrækkelig  <i>Besparelse</i> 0 kWh/m <sup>2</sup> I alt 0 kWh  ✓	Det eksisterende isoleringslag er tilstrækkelig  <i>Besparelse</i> 0 kWh/m <sup>2</sup> I alt 0 kWh  ✓
<b>Ydervæg</b> Areal 150 m <sup>2</sup>	40 cm teglervæg med 200 mm isolering 	Den eksisterende isolering opfylder anbefalingen  <i>Besparelse</i> 0 kWh/m <sup>2</sup> I alt 0 kWh  ✓	Den eksisterende isolering er tilstrækkelig  <i>Besparelse</i> 0 kWh/m <sup>2</sup> I alt 0 kWh  ✓
<b>Gulv</b> Areal 149 m <sup>2</sup>	Beton med 300 mm isolering 	Den eksisterende isolering er tilstrækkelig  <i>Besparelse</i> 0 kWh/m <sup>2</sup> I alt 0 kWh  ✓	Den eksisterende isolering er tilstrækkelig  <i>Besparelse</i> 0 kWh/m <sup>2</sup> I alt 0 kWh  ✓
<b>Vinduer</b> Areal 25 m <sup>2</sup>	Nyere vindue med energirude 	Eksisterende vinduer er ok  <i>Besparelse</i> kWh/m <sup>2</sup> I alt 0 kWh  ✓	Eksisterende vinduer er ok  <i>Besparelse</i> 0 kWh/m <sup>2</sup> I alt 0 kWh  ✓

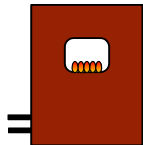
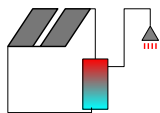
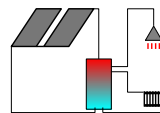

## Samlet energibesparelse for klimaskærmen

	Minimum	Lavenergi
Årlig besparelse pr. m <sup>2</sup> opvarmet boligareal	0 kWh/m <sup>2</sup>	0 kWh/m <sup>2</sup>
Total årlig besparelse	0 kWh	0 kWh

Samlet teoretisk besparelse ved gennemførelse af alle energibesparende renoveringstiltag for niveauerne Minimum og Lavenergi på klimaskærmen



## Varme og ventilation

Nuværende situation		Minimum	Lavenergi
<b>Varmeanlæg</b>	Ny kondenserende kedel 	Eksisterende kedel er ok  <i>Besparelse</i> <i>0 kWh afhængigt af forbrug</i> ✓	Eksisterende kedel er ok  <i>Besparelse</i> <i>0 kWh afhængigt af forbrug</i> ✓
<b>Varme rør</b> (brugsvand eller varmforsyning)	Mere end 50 mm isolering ✓	Eksisterende rørisolering er ok  <i>Besparelse</i> - ✓	Eksisterende rørisolering er ok  <i>Besparelse</i> - ✓
<b>Solvarme</b>	Solvarme anlæg ikke installeret	Anlæg til varmt brugsvand  <i>Besparelse</i> <i>500 - 800 kWh/m<sup>2</sup> solfanger</i> 	Anlæg til varmt brugsvand og varme  <i>Besparelse</i> <i>400 - 600 kWh/m<sup>2</sup> solfanger</i> 
<b>Pumper</b>	Trinløs regulerbar A-mærket cirkulationspumpe 	Eksisterende pumpe er ok  <i>Besparelse</i> <i>- kWh</i> ✓	Eksisterende pumpe er ok  <i>Besparelse</i> <i>- kWh</i> ✓
<b>Ventilation</b>	Mekanisk ventilation med varmegenvinding	Eksisterende anlæg er ok  <i>Besparelse</i> ✓	Eksisterende anlæg er ok  <i>Besparelse</i> ✓





## Eksempel - Rækkehuse før 1850

Opvarmet areal: 109 m<sup>2</sup>

Varmekilde: Fjernvarme

Ventilation: Naturlig

### Statistik for Rækkehuse før 1850

Antal huse: 4.000

Totalt opvarmet areal: 0,5 million m<sup>2</sup>

Andel af det samlede opvarmede areal: 1%



## Klimaskærmen

	Nuværende situation	Minimum	Lavenergi
<b>Loft</b> Areal 88 m <sup>2</sup>	Bjælkelag med 50 mm isolering 	Der efterisoleres med 250 mm <i>Besparelse 44 kWh/m<sup>2</sup></i> <i>I alt 3.872 kWh</i> 	Der efterisoleres med 350 mm <i>Besparelse 46 kWh/m<sup>2</sup></i> <i>I alt 4.048 kWh</i> 
<b>Ydervæg</b> Areal 33 m <sup>2</sup>	30 cm hulmur uden isolering 	Hulmursisolering <i>Besparelse 92 kWh/m<sup>2</sup></i> <i>I alt 3036 kWh</i> 	Hulmursisolering + udvendig isolering med 225 mm <i>Besparelse 111 kWh/m<sup>2</sup></i> <i>I alt 3663 kWh</i> 
<b>Gulv</b> Areal 66 m <sup>2</sup>	Trægulv med strøer på beton og 20 cm letklinker 	Udgravning og etablering af nyt gulv med 250 mm isolering <i>Besparelse 17 kWh/m<sup>2</sup></i> <i>I alt 1122 kWh</i> 	Udgravning og etablering af nyt gulv med 300 mm isolering <i>Besparelse 17 kWh/m<sup>2</sup></i> <i>I alt 1122 kWh</i> 
<b>Vinduer</b> Areal 10 m <sup>2</sup>	Ældre trævindue med termorude 	Udskiftning til nye vinduer med 2-lags energirude <i>Besparelse 110 kWh/m<sup>2</sup></i> <i>I alt 1100 kWh</i> 	Udskiftning til nye vinduer med 3-lags energirude <i>Besparelse 130 kWh/m<sup>2</sup></i> <i>I alt 1300 kWh</i> 

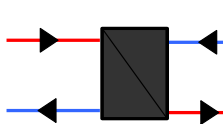
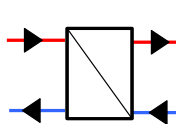
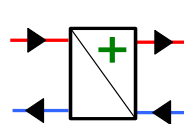



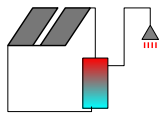
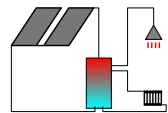
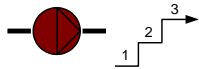
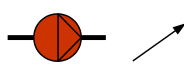
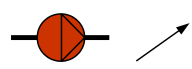


## Samlet energibesparelse for klimaskærmen

	Minimum	Lavenergi
Årlig besparelse pr. m <sup>2</sup> opvarmet boligareal	83 kWh/m <sup>2</sup>	93 kWh/m <sup>2</sup>
Total årlig besparelse	9100 kWh	10100 kWh

Samlet teoretisk besparelse ved gennemførelse af alle energibesparende renoveringstiltag for niveauerne Minimum og Lavenergi på klimaskærmen



## Varme og ventilation

	Nuværende situation	Minimum	Lavenergi
<b>Varmeanlæg</b>	<p>Ældre fjernvarmeveksler</p> 	<p>Udskiftes til ny fjernvarmeveksler</p> <p><i>Besparelse 1.000 - 1.500 kWh afhængigt af forbrug</i></p> 	<p>Udskiftes til optimeret fjernvarmeunit</p> <p><i>Besparelse 1.500 - 2.200 kWh afhængigt af forbrug</i></p> 
<b>Varmerør</b> (brugsvand eller varmforsyning)	<p>Mindre end 30 mm isolering</p> 	<p>Isoleret med 40 mm</p> <p><i>Besparelse 5-7 kWh/m</i></p> 	<p>Isoleret med 50 mm</p> <p><i>Besparelse 6-9 kWh/m</i></p> 
<b>Solvarme</b>	<p>Solvarme anlæg ikke installeret</p>	<p>Anlæg til varmt brugsvand</p> <p><i>Besparelse 500 - 800 kWh/m² solfanger</i></p> 	<p>Anlæg til varmt brugsvand og varme</p> <p><i>Besparelse 400 - 600 kWh/m² solfanger</i></p> 
<b>Pumper</b>	<p>Ældre trinreguleret pumpe</p> 	<p>Trinløs regulerbar A-mærket cirkulationspumpe</p> <p><i>Besparelse 350 kWh</i></p> 	<p>Trinløs regulerbar A-mærket cirkulationspumpe</p> <p><i>Besparelse 350 kWh</i></p> 
<b>Ventilation</b>	<p>Naturlig via ventilationsåbninger i vinduer og ydervægge</p>	<p>Ventilationsanlæg med en tør virkningsgrad på 80% og et specifikt elforbrug (SFP) på 1.000 J/m³</p> <p><i>Besparelse 3.000 - 6.000 kWh</i></p> 	<p>Ventilationsanlæg med en tør virkningsgrad på 85% og et specifikt elforbrug (SFP) på 800 J/m³</p> <p><i>Besparelse 3.500 - 6.500 kWh</i></p> 



## Eksempel - Rækkehuse 1851 - 1930

Opvarmet areal: 138 m<sup>2</sup>

Varmekilde: Fjernvarme

Ventilation: Naturlig

### Statistik for Rækkehuse 1851 - 1930

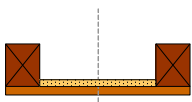
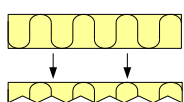
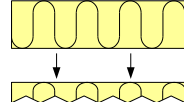
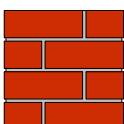
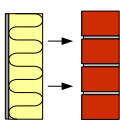
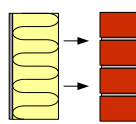
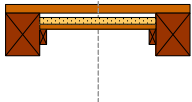
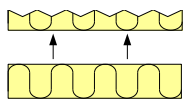
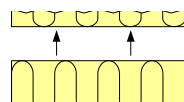
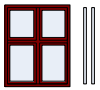
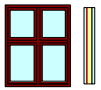
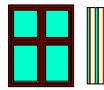
Antal huse: 26.000

Totalt opvarmet areal: 3,4 million m<sup>2</sup>

Andel af det samlede opvarmede areal: 10%



## Klimaskærmen

Nuværende situation		Minimum	Lavenergi
<b>Loft</b> Areal 65 m <sup>2</sup>	Træ på bjælker med lerindskud 	Der efterisoleres med 300 mm <i>Besparelse</i> <b>125 kWh/m<sup>2</sup></b> <i>I alt 8.125 kWh</i> 	Der efterisoleres med 400 mm <i>Besparelse</i> <b>127 kWh/m<sup>2</sup></b> <i>I alt 8.255 kWh</i> 
<b>Ydervæg</b> Areal 59 m <sup>2</sup>	36 cm massiv teglmur, uisoleret 	Udvendig efterisolering med 125 mm <i>Besparelse</i> <b>94 kWh/m<sup>2</sup></b> <i>I alt 5546 kWh</i> 	Udvendig efterisolering med 225 mm <i>Besparelse</i> <b>101 kWh/m<sup>2</sup></b> <i>I alt 5959 kWh</i> 
<b>Gulv</b> Areal 49 m <sup>2</sup>	Brædder på bjælker med lerindskud 	Efterisolering med 100 mm <i>Besparelse</i> <b>90 kWh/m<sup>2</sup></b> <i>I alt 4410 kWh</i> 	Efterisolering med 200 mm <i>Besparelse</i> <b>100 kWh/m<sup>2</sup></b> <i>I alt 4900 kWh</i> 
<b>Vinduer</b> Areal 15 m <sup>2</sup>	Ældre trævindue med termorude 	Udskiftning til nye vinduer med 2-lags energirude <i>Besparelse</i> <b>110 kWh/m<sup>2</sup></b> <i>I alt 1650 kWh</i> 	Udskiftning til nye vinduer med 3-lags energirude <i>Besparelse</i> <b>130 kWh/m<sup>2</sup></b> <i>I alt 1950 kWh</i> 

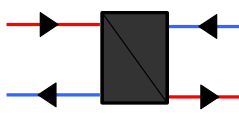
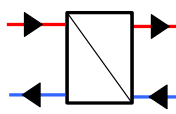
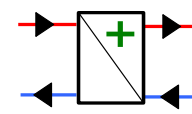



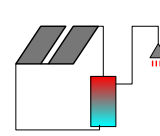
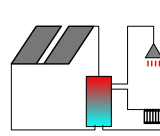
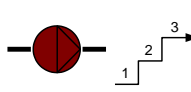
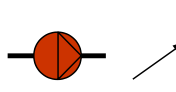
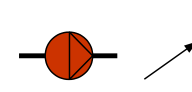


## Samlet energibesparelse for klimaskærmen

	Minimum	Lavenergi
Årlig besparelse pr. m <sup>2</sup> opvarmet boligareal	143 kWh/m <sup>2</sup>	153 kWh/m <sup>2</sup>
Total årlig besparelse	19700 kWh	21100 kWh

Samlet teoretisk besparelse ved gennemførelse af alle energibesparende renoveringstiltag for niveauerne Minimum og Lavenergi på klimaskærmen



## Varme og ventilation

Nuværende situation		Minimum	Lavenergi
<b>Varmeanlæg</b>	Ældre fjernvarmeveksler (20 år) 	Udskiftes til ny fjernvarmeveksler  <i>Besparelse 1.000 - 1.500 kWh afhængigt af forbrug</i> 	Udskiftes til optimeret fjernvarmeunit  <i>Besparelse 1.500 - 2.200 kWh afhængigt af forbrug</i> 
<b>Varmerør</b> (brugsvand eller varmforsyning)	Mindre end 30 mm isolering 	Isoleret med 40 mm  <i>Besparelse 5-7 kWh/m</i> 	Isoleret med 50 mm  <i>Besparelse 6-9 kWh/m</i> 
<b>Solvarme</b>	Solvarme anlæg ikke installeret	Anlæg til varmt brugsvand  <i>Besparelse 500 - 800 kWh/m² solfanger</i> 	Anlæg til varmt brugsvand og varme  <i>Besparelse 400 - 600 kWh/m² solfanger</i> 
<b>Pumper</b>	Ældre trinreguleret pumpe 	Trinløs regulerbar A-mærket cirkulationspumpe  <i>Besparelse 350 kWh</i> 	Trinløs regulerbar A-mærket cirkulationspumpe  <i>Besparelse 350 kWh</i> 
<b>Ventilation</b>	Naturlig via ventilationsåbninger i vinduer og ydervægge	Ventilationsanlæg med en tør virkningsgrad på 80% og et specifikt elforbrug (SFP) på 1.000 J/m³  <i>Besparelse 3.000 - 6.000 kWh</i> 	Ventilationsanlæg med en tør virkningsgrad på 85% og et specifikt elforbrug (SFP) på 800 J/m³  <i>Besparelse 3.500 - 6.500 kWh</i> 



## Eksempel - Rækkehuse 1931 - 1950

Opvarmet areal: 112 m<sup>2</sup>

Varmekilde: Fjernvarme

Ventilation: Naturlig

### Statistik for Rækkehuse 1931 - 1950

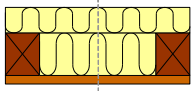
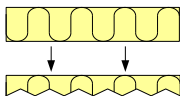
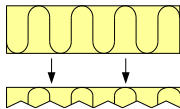
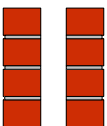
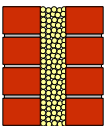
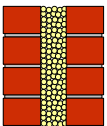
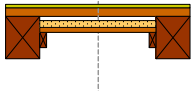
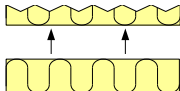
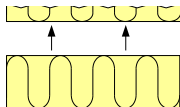



Antal huse: 15.000

Totalt opvarmet areal: 1,9 million m<sup>2</sup>

Andel af det samlede opvarmede areal: 5%



## Klimaskærmen

Nuværende situation		Minimum	Lavenergi
<b>Loft</b> Areal 75 m <sup>2</sup>	Bjælkelag med 200 mm isolering 	Der efterisoleres med 100 mm <i>Besparelse            8 kWh/m<sup>2</sup>            I alt 600 kWh</i> 	Der efterisoleres med 200 mm <i>Besparelse            10 kWh/m<sup>2</sup>            I alt 750 kWh</i> 
<b>Ydervæg</b> Areal 30 m <sup>2</sup>	30 cm hulmur uden isolering 	Hulmursisolering <i>Besparelse            92 kWh/m<sup>2</sup>            I alt 2760 kWh</i> 	Hulmursisolering + udvendig isolering med 225 mm <i>Besparelse            111 kWh/m<sup>2</sup>            I alt 3330 kWh</i> 
<b>Gulv</b> Areal 62 m <sup>2</sup>	Brædder og tæppe på bjælker med lerindskud 	Efterisolering med 100 mm <i>Besparelse            76 kWh/m<sup>2</sup>            I alt 4712 kWh</i> 	Efterisolering med 200 mm <i>Besparelse            85 kWh/m<sup>2</sup>            I alt 5270 kWh</i> 
<b>Vinduer</b> Areal 13 m <sup>2</sup>	Ældre trævindue med termorude 	Udskiftning til nye vinduer med 2-lags energirude <i>Besparelse            110 kWh/m<sup>2</sup>            I alt 1430 kWh</i> 	Udskiftning til nye vinduer med 3-lags energirude <i>Besparelse            130 kWh/m<sup>2</sup>            I alt 1690 kWh</i> 

## Samlet energibesparelse for klimaskærmen

	Minimum	Lavenergi
Årlig besparelse pr. m <sup>2</sup> opvarmet boligareal	85 kWh/m <sup>2</sup>	98 kWh/m <sup>2</sup>
Total årlig besparelse	9500 kWh	11000 kWh

Samlet teoretisk besparelse ved gennemførelse af alle energibesparende renoveringstiltag for niveauerne Minimum og Lavenergi på klimaskærmen



# Varme og ventilation

Nuværende situation		Minimum	Lavenergi
<b>Varmeanlæg</b>	Ældre fjernvarmeveksler (20 år) 	Udskiftes til ny fjernvarmeveksler  <i>Besparelse 1.000 - 1.500 kWh afhængigt af forbrug</i> 	Udskiftes til optimeret fjernvarmeunit  <i>Besparelse 1.500 - 2.200 kWh afhængigt af forbrug</i> 
<b>Varmerør</b> (brugsvand eller varmforsyning)	Mindre end 30 mm isolering 	Isoleret med 40 mm  <i>Besparelse 5-7 kWh/m</i> 	Isoleret med 50 mm  <i>Besparelse 6-9 kWh/m</i> 
<b>Solvarme</b>	Solvarme anlæg ikke installeret	Anlæg til varmt brugsvand  <i>Besparelse 500 - 800 kWh/m² solfanger</i> 	Anlæg til varmt brugsvand og varme  <i>Besparelse 400 - 600 kWh/m² solfanger</i> 
<b>Pumper</b>	Ældre trinreguleret pumpe 	Trinløs regulerbar A-mærket cirkulationspumpe  <i>Besparelse 350 kWh</i> 	Trinløs regulerbar A-mærket cirkulationspumpe  <i>Besparelse 350 kWh</i> 
<b>Ventilation</b>	Naturlig via ventilationsåbninger i vinduer og ydervægge	Ventilationsanlæg med en tør virkningsgrad på 80% og et specifikt elforbrug (SFP) på 1.000 J/m³  <i>Besparelse 3.000 - 6.000 kWh</i> 	Ventilationsanlæg med en tør virkningsgrad på 85% og et specifikt elforbrug (SFP) på 800 J/m³  <i>Besparelse 3.500 - 6.500 kWh</i> 



## Eksempel - Rækkehuse 1951 - 1960

Opvarmet areal: 102 m<sup>2</sup>

Varmekilde: Fjernvarme

Ventilation: Naturlig

### Statistik for Rækkehuse 1951 - 1960

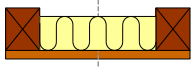
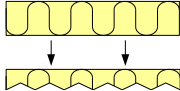
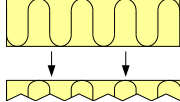
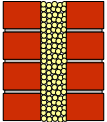
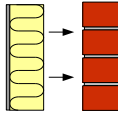
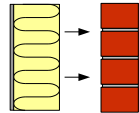
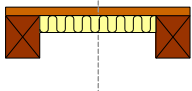
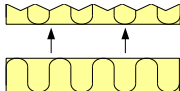
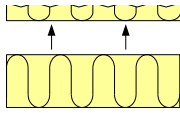



Antal huse: 16.000

Totalt opvarmet areal: 2,2 million m<sup>2</sup>

Andel af det samlede opvarmede areal: 6%



## Klimaskærmen

Nuværende situation		Minimum	Lavenergi
<b>Loft</b> Areal 90 m <sup>2</sup>	Bjælkelag med 100 mm isolering 	Der efterisoleres med 200 mm <i>Besparelse            24 kWh/m<sup>2</sup>            I alt 2.160 kWh</i> 	Der efterisoleres med 300 mm <i>Besparelse            26 kWh/m<sup>2</sup>            I alt 2.340 kWh</i> 
<b>Ydervæg</b> Areal 38 m <sup>2</sup>	30 cm hul efterisoleret granulat 	Udvendig efterisolering med 125 mm <i>Besparelse            35 kWh/m<sup>2</sup>            I alt 1330 kWh</i> 	Udvendig efterisolering med 225 mm <i>Besparelse            40 kWh/m<sup>2</sup>            I alt 1520 kWh</i> 
<b>Gulv</b> Areal 58 m <sup>2</sup>	Brædder på bjælker med 50 mm isolering 	Efterisolering med 50 mm <i>Besparelse            20 kWh/m<sup>2</sup>            I alt 1160 kWh</i> 	Efterisolering med 150 mm <i>Besparelse            32 kWh/m<sup>2</sup>            I alt 1856 kWh</i> 
<b>Vinduer</b> Areal 17 m <sup>2</sup>	Ældre trævindue med termorude 	Udskiftning til nye vinduer med 2-lags energirude <i>Besparelse            110 kWh/m<sup>2</sup>            I alt 1870 kWh</i> 	Udskiftning til nye vinduer med 3-lags energirude <i>Besparelse            130 kWh/m<sup>2</sup>            I alt 2210 kWh</i> 

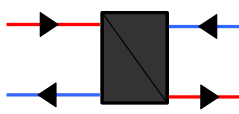
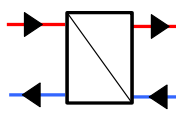
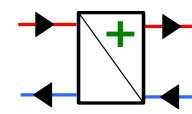



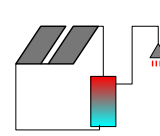
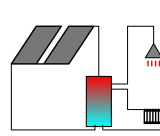
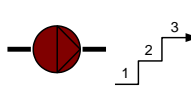
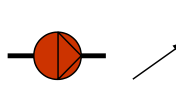
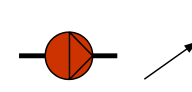


## Samlet energibesparelse for klimaskærmen

	Minimum	Lavenergi
Årlig besparelse pr. m <sup>2</sup> opvarmet boligareal	64 kWh/m <sup>2</sup>	77 kWh/m <sup>2</sup>
Total årlig besparelse	6500 kWh	7900 kWh

Samlet teoretisk besparelse ved gennemførelse af alle energibesparende renoveringstiltag for niveauerne Minimum og Lavenergi på klimaskærmen



## Varme og ventilation

Nuværende situation		Minimum	Lavenergi
<b>Varmeanlæg</b>	Ældre fjernvarmeveksler (20 år) 	Udskiftes til ny fjernvarmeveksler  <i>Besparelse 1.000 - 1.500 kWh afhængigt af forbrug</i> 	Udskiftes til optimeret fjernvarmeunit  <i>Besparelse 1.500 - 2.200 kWh afhængigt af forbrug</i> 
<b>Varmerør</b> (brugsvand eller varmforsyning)	Mindre end 30 mm isolering 	Isoleret med 40 mm  <i>Besparelse 5-7 kWh/m</i> 	Isoleret med 50 mm  <i>Besparelse 6-9 kWh/m</i> 
<b>Solvarme</b>	Solvarme anlæg ikke installeret	Anlæg til varmt brugsvand  <i>Besparelse 500 - 800 kWh/m² solfanger</i> 	Anlæg til varmt brugsvand og varme  <i>Besparelse 400 - 600 kWh/m² solfanger</i> 
<b>Pumper</b>	Ældre trinreguleret pumpe 	Trinløs regulerbar A-mærket cirkulationspumpe  <i>Besparelse 350 kWh</i> 	Trinløs regulerbar A-mærket cirkulationspumpe  <i>Besparelse 350 kWh</i> 
<b>Ventilation</b>	Naturlig via ventilationsåbninger i vinduer og ydervægge	Ventilationsanlæg med en tør virkningsgrad på 80% og et specifikt elforbrug (SFP) på 1.000 J/m³  <i>Besparelse 3.000 - 6.000 kWh</i> 	Ventilationsanlæg med en tør virkningsgrad på 85% og et specifikt elforbrug (SFP) på 800 J/m³  <i>Besparelse 3.500 - 6.500 kWh</i> 





## Eksempel - Rækkehuse 1961 - 1972

Opvarmet areal: 101 m<sup>2</sup>

Varmekilde: Fjernvarme

Ventilation: Naturlig

### Statistik for Rækkehuse 1961 - 1972

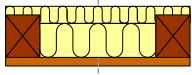
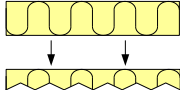
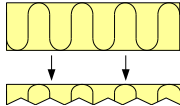
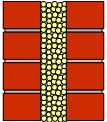
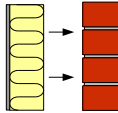
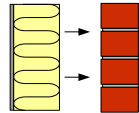
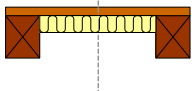
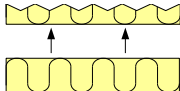
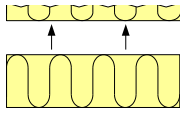



Antal huse: 32.000

Totalt opvarmet areal: 4,6 million m<sup>2</sup>

Andel af det samlede opvarmede areal: 13%



## Klimaskærmen

Nuværende situation		Minimum	Lavenergi
<b>Loft</b> Areal 73 m <sup>2</sup>	Bjælkelag med 150 mm isolering 	Der efterisoleres med 150 mm <i>Besparelse</i> <b>17 kWh/m<sup>2</sup></b> <i>I alt 1.241 kWh</i> 	Der efterisoleres med 250 mm <i>Besparelse</i> <b>19 kWh/m<sup>2</sup></b> <i>I alt 1.387 kWh</i> 
<b>Ydervæg</b> Areal 37 m <sup>2</sup>	30 cm hul efterisoleret granulat 	Udvendig efterisolering med 125 mm <i>Besparelse</i> <b>35 kWh/m<sup>2</sup></b> <i>I alt 1295 kWh</i> 	Udvendig efterisolering med 225 mm <i>Besparelse</i> <b>40 kWh/m<sup>2</sup></b> <i>I alt 1480 kWh</i> 
<b>Gulv</b> Areal 50 m <sup>2</sup>	Brædder på bjælker med 50 mm isolering 	Efterisolering med 50 mm <i>Besparelse</i> <b>20 kWh/m<sup>2</sup></b> <i>I alt 1000 kWh</i> 	Efterisolering med 150 mm <i>Besparelse</i> <b>32 kWh/m<sup>2</sup></b> <i>I alt 1600 kWh</i> 
<b>Vinduer</b> Areal 37 m <sup>2</sup>	Ældre trævindue med termorude 	Udskiftning til nye vinduer med 2-lags energirude <i>Besparelse</i> <b>110 kWh/m<sup>2</sup></b> <i>I alt 4070 kWh</i> 	Udskiftning til nye vinduer med 3-lags energirude <i>Besparelse</i> <b>130 kWh/m<sup>2</sup></b> <i>I alt 4810 kWh</i> 

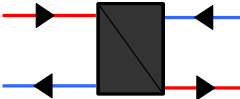
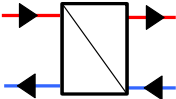
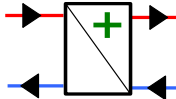



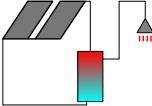
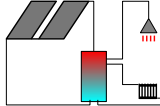
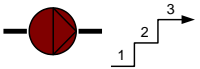

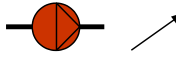


## Samlet energibesparelse for klimaskærmen

	Minimum	Lavenergi
Årlig besparelse pr. m <sup>2</sup> opvarmet boligareal	75 kWh/m <sup>2</sup>	92 kWh/m <sup>2</sup>
Total årlig besparelse	7600 kWh	9300 kWh

Samlet teoretisk besparelse ved gennemførelse af alle energibesparende renoveringstiltag for niveauerne Minimum og Lavenergi på klimaskærmen



## Varme og ventilation

Nuværende situation	Minimum	Lavenergi
<p><b>Varmeanlæg</b></p> <p>Ældre fjernvarmeveksler (20 år)</p> 	<p>Udskiftes til ny fjernvarmeveksler</p> <p><i>Besparelse 1.000 - 1.500 kWh afhængigt af forbrug</i></p> 	<p>Udskiftes til optimeret fjernvarmeunit</p> <p><i>Besparelse 1.500 - 2.200 kWh afhængigt af forbrug</i></p> 
<p><b>Varmerør</b> (brugsvand eller varmforsyning)</p> <p>Mindre end 30 mm isolering</p> 	<p>Isoleret med 40 mm</p> <p><i>Besparelse 5-7 kWh/m</i></p> 	<p>Isoleret med 50 mm</p> <p><i>Besparelse 6-9 kWh/m</i></p> 
<p><b>Solvarme</b></p> <p>Solvarme anlæg ikke installeret</p>	<p>Anlæg til varmt brugsvand</p> <p><i>Besparelse 500 - 800 kWh/m² solfanger</i></p> 	<p>Anlæg til varmt brugsvand og varme</p> <p><i>Besparelse 400 - 600 kWh/m² solfanger</i></p> 
<p><b>Pumper</b></p> <p>Ældre trinreguleret pumpe</p> 	<p>Trinløs regulerbar A-mærket cirkulationspumpe</p> <p><i>Besparelse 350 kWh</i></p> 	<p>Trinløs regulerbar A-mærket cirkulationspumpe</p> <p><i>Besparelse 350 kWh</i></p> 
<p><b>Ventilation</b></p> <p>Naturlig via ventilationsåbninger i vinduer og ydervægge</p>	<p>Ventilationsanlæg med en tør virkningsgrad på 80% og et specifikt elforbrug (SFP) på 1.000 J/m³</p> <p><i>Besparelse 3.000 - 6.000 kWh</i></p> 	<p>Ventilationsanlæg med en tør virkningsgrad på 85% og et specifikt elforbrug (SFP) på 800 J/m³</p> <p><i>Besparelse 3.500 - 6.500 kWh</i></p> 



## Eksempel - Rækkehuse 1973 - 1978

Opvarmet areal: 130 m<sup>2</sup>

Varmekilde: Fjernvarme

Ventilation: Naturlig

### Statistik for Rækkehuse 1973 - 1978

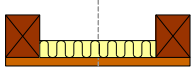
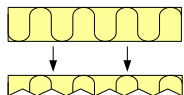
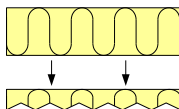
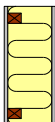


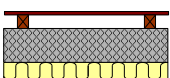
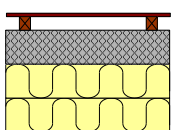
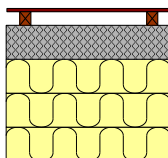
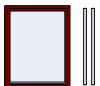

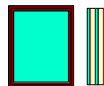
Antal huse: 24.000

Totalt opvarmet areal: 3,8 million m<sup>2</sup>

Andel af det samlede opvarmede areal: 11%



## Klimaskærmen

Nuværende situation		Minimum	Lavenergi
<b>Loft</b> Areal 95 m <sup>2</sup>	Bjælkelag med 50 mm isolering 	Der efterisoleres med 250 mm <i>Besparelse 32 kWh/m<sup>2</sup></i> <i>I alt 3.040 kWh</i> 	Der efterisoleres med 350 mm <i>Besparelse 35 kWh/m<sup>2</sup></i> <i>I alt 3.325 kWh</i> 
<b>Ydervæg</b> Areal 22 m <sup>2</sup>	Let ydervæg med 130 mm isolering 	Den eksisterende isolering opfylder anbefalingen <i>Besparelse 0 kWh/m<sup>2</sup></i> <i>I alt 0 kWh</i> 	Den eksisterende isolering opfylder anbefalingen <i>Besparelse 0 kWh/m<sup>2</sup></i> <i>I alt 0 kWh</i> 
<b>Gulv</b> Areal 65 m <sup>2</sup>	Træ/strøer med 50 mm isolering på letbeton 	Udgravning og etablering af nyt gulv med 250 mm isolering <i>Besparelse 26 kWh/m<sup>2</sup></i> <i>I alt 1690 kWh</i> 	Udgravning og etablering af nyt gulv med 300 mm isolering <i>Besparelse 28 kWh/m<sup>2</sup></i> <i>I alt 1820 kWh</i> 
<b>Vinduer</b> Areal 17 m <sup>2</sup>	Ældre trævindue med termorude 	Udskiftning til nye vinduer med 2-lags energirude <i>Besparelse 120 kWh/m<sup>2</sup></i> <i>I alt 2040 kWh</i> 	Udskiftning til nye vinduer med 3-lags energirude <i>Besparelse 140 kWh/m<sup>2</sup></i> <i>I alt 2380 kWh</i> 

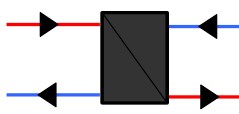
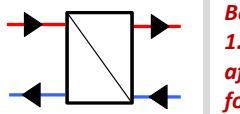
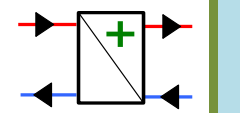


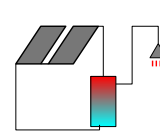
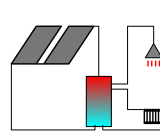
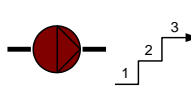
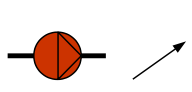
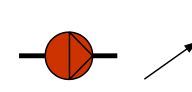


## Samlet energibesparelse for klimaskærmen

	Minimum	Lavenergi
Årlig besparelse pr. m <sup>2</sup> opvarmet boligareal	52 kWh/m <sup>2</sup>	58 kWh/m <sup>2</sup>
Total årlig besparelse	6800 kWh	7500 kWh

Samlet teoretisk besparelse ved gennemførelse af alle energibesparende renoveringstiltag for niveauerne Minimum og Lavenergi på klimaskærmen



## Varme og ventilation

Nuværende situation		Minimum	Lavenergi	
<b>Varmeanlæg</b> Ældre fjernvarmeveksler (20 år) 	Udskiftes til ny fjernvarmeveksler  <i>Besparelse 1.000 - 1.500 kWh afhængigt af forbrug</i>	 <i>Besparelse 1.500 - 2.200 kWh afhængigt af forbrug</i>	Udskiftes til optimeret fjernvarmeunit  	
<b>Varmerør</b> (brugsvand eller varmforsyning) Mindre end 30 mm isolering 	Isoleret med 40 mm  <i>Besparelse 5-7 kWh/m</i>	Isoleret med 50 mm  <i>Besparelse 6-9 kWh/m</i>		
<b>Solvarme</b> Solvarme anlæg ikke installeret	Anlæg til varmt brugsvand  <i>Besparelse 500 - 800 kWh/m² solfanger</i>		Anlæg til varmt brugsvand og varme  <i>Besparelse 400 - 600 kWh/m² solfanger</i>	
<b>Pumper</b> Ældre trinreguleret pumpe 	Trinløs regulerbar A-mærket cirkulationspumpe  <i>Besparelse 350 kWh</i>		Trinløs regulerbar A-mærket cirkulationspumpe  <i>Besparelse 350 kWh</i>	
<b>Ventilation</b> Naturlig via ventilationsåbninger i vinduer og ydervægge	Ventilationsanlæg med en tør virkningsgrad på 80% og et specifikt elforbrug (SFP) på 1.000 J/m³  <i>Besparelse 3.000 - 6.000 kWh</i>		Ventilationsanlæg med en tør virkningsgrad på 85% og et specifikt elforbrug (SFP) på 800 J/m³  <i>Besparelse 3.500 - 6.500 kWh</i>	



## Eksempel - Rækkehuse 1979 - 1998

Opvarmet areal: 100 m<sup>2</sup>

Varmekilde: Fjernvarme

Ventilation: Naturlig

### Statistik for Rækkehuse 1979 - 1998

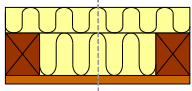
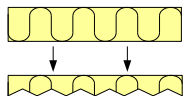
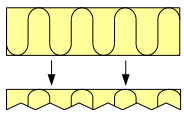
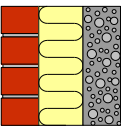


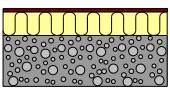


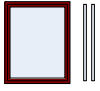
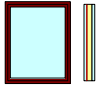
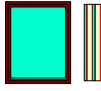
Antal huse: 82.000

Totalt opvarmet areal: 12,9 million m<sup>2</sup>

Andel af det samlede opvarmede areal: 37%



## Klimaskærmen

Nuværende situation		Minimum	Lavenergi
<b>Loft</b> Areal 53 m <sup>2</sup>	Bjælkelag med 200 mm isolering 	Der efterisoleres med 100 mm <i>Besparelse            8 kWh/m<sup>2</sup>            I alt 424 kWh</i> 	Der efterisoleres med 200 mm <i>Besparelse            10 kWh/m<sup>2</sup>            I alt 530 kWh</i> 
<b>Ydervæg</b> Areal 30 m <sup>2</sup>	35 cm tegl-letbeton med 130 mm isolering 	Den eksisterende isolering opfylder anbefalingen <i>Besparelse            0 kWh/m<sup>2</sup>            I alt 0 kWh</i> 	Den eksisterende isolering opfylder anbefalingen <i>Besparelse            0 kWh/m<sup>2</sup>            I alt 0 kWh</i> 
<b>Gulv</b> Areal 43 m <sup>2</sup>	Terrændæk med 75 mm isolering 	Den eksisterende isolering er tilstrækkelig <i>Besparelse            0 kWh/m<sup>2</sup>            I alt 0 kWh</i> 	Den eksisterende isolering er tilstrækkelig <i>Besparelse            0 kWh/m<sup>2</sup>            I alt 0 kWh</i> 
<b>Vinduer</b> Areal 13 m <sup>2</sup>	Ældre trævindue med termorude 	Udskiftning til nye vinduer med 2-lags energirude <i>Besparelse            120 kWh/m<sup>2</sup>            I alt 1560 kWh</i> 	Udskiftning til nye vinduer med 3-lags energirude <i>Besparelse            140 kWh/m<sup>2</sup>            I alt 1820 kWh</i> 

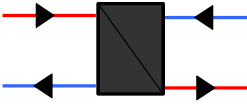
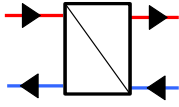
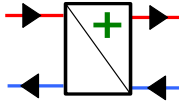



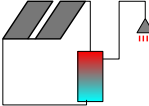
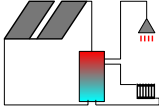
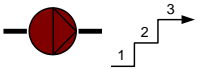




## Samlet energibesparelse for klimaskærmen

	Minimum	Lavenergi
Årlig besparelse pr. m <sup>2</sup> opvarmet boligareal	20 kWh/m <sup>2</sup>	24 kWh/m <sup>2</sup>
Total årlig besparelse	2000 kWh	2400 kWh

Samlet teoretisk besparelse ved gennemførelse af alle energibesparende renoveringstiltag for niveauerne Minimum og Lavenergi på klimaskærmen



## Varme og ventilation

Nuværende situation	Minimum	Lavenergi
<p><b>Varmeanlæg</b></p> <p>Ældre fjernvarmeveksler (20 år)</p> 	<p>Udskiftes til ny fjernvarmeveksler</p> <p><i>Besparelse 1.000 - 1.500 kWh afhængigt af forbrug</i></p> 	<p>Udskiftes til optimeret fjernvarmeunit</p> <p><i>Besparelse 1.500 - 2.200 kWh afhængigt af forbrug</i></p> 
<p><b>Varmerør</b> (brugsvand eller varmforsyning)</p> <p>Mindre end 30 mm isolering</p> 	<p>Isoleret med 40 mm</p> <p><i>Besparelse 5-7 kWh/m</i></p> 	<p>Isoleret med 50 mm</p> <p><i>Besparelse 6-9 kWh/m</i></p> 
<p><b>Solvarme</b></p> <p>Solvarme anlæg ikke installeret</p>	<p>Anlæg til varmt brugsvand</p> <p><i>Besparelse 500 - 800 kWh/m² solfanger</i></p> 	<p>Anlæg til varmt brugsvand og varme</p> <p><i>Besparelse 400 - 600 kWh/m² solfanger</i></p> 
<p><b>Pumper</b></p> <p>Ældre trinreguleret pumpe</p> 	<p>Trinløs regulerbar A-mærket cirkulationspumpe</p> <p><i>Besparelse 350 kWh</i></p> 	<p>Trinløs regulerbar A-mærket cirkulationspumpe</p> <p><i>Besparelse 350 kWh</i></p> 
<p><b>Ventilation</b></p> <p>Naturlig via ventilationsåbninger i vinduer og ydervægge</p>	<p>Ventilationsanlæg med en tør virkningsgrad på 80% og et specifikt elforbrug (SFP) på 1.000 J/m³</p> <p><i>Besparelse 3.000 - 6.000 kWh</i></p> 	<p>Ventilationsanlæg med en tør virkningsgrad på 85% og et specifikt elforbrug (SFP) på 800 J/m³</p> <p><i>Besparelse 3.500 - 6.500 kWh</i></p> 



## Eksempel - Rækkehuse 1999 - 2006

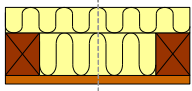
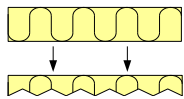
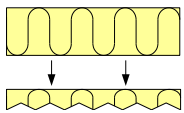
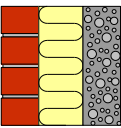


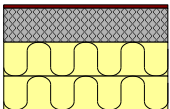


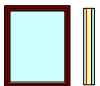


Opvarmet areal: 119 m<sup>2</sup>  
 Varmekilde: Fjernvarme  
 Ventilation: Mekanisk med varmegenvinding

### Statistik for Rækkehuse 1999 - 2006

Antal huse: 25.000  
 Totalt opvarmet areal: 4,1 million m<sup>2</sup>  
 Andel af det samlede opvarmede areal: 12%



## Klimaskærmen

Nuværende situation		Minimum	Lavenergi
<b>Loft</b> Areal 53 m <sup>2</sup>	Bjælkelag med 200 mm isolering 	Der efterisoleres med 100 mm <i>Besparelse 8 kWh/m<sup>2</sup></i> <i>I alt 424 kWh</i> 	Der efterisoleres med 200 mm <i>Besparelse 10 kWh/m<sup>2</sup></i> <i>I alt 530 kWh</i> 
<b>Ydervæg</b> Areal 38 m <sup>2</sup>	35 cm tegl-letbeton med 130 mm isolering 	Den eksisterende isolering opfylder anbefalingen <i>Besparelse 0 kWh/m<sup>2</sup></i> <i>I alt 0 kWh</i> 	Den eksisterende isolering opfylder anbefalingen <i>Besparelse 0 kWh/m<sup>2</sup></i> <i>I alt 0 kWh</i> 
<b>Gulv</b> Areal 34 m <sup>2</sup>	Terrændæk med 200 mm isolering 	Den eksisterende isolering er tilstrækkelig <i>Besparelse 0 kWh/m<sup>2</sup></i> <i>I alt 0 kWh</i> 	Den eksisterende isolering er tilstrækkelig <i>Besparelse 0 kWh/m<sup>2</sup></i> <i>I alt 0 kWh</i> 
<b>Vinduer</b> Areal 20 m <sup>2</sup>	Nyere vindue med energirude 	Eksisterende vinduer er ok <i>Besparelse kWh/m<sup>2</sup></i> <i>I alt 0 kWh</i> 	Eksisterende vinduer er ok <i>Besparelse 0 kWh/m<sup>2</sup></i> <i>I alt 0 kWh</i> 

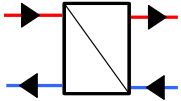
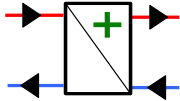
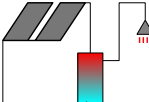
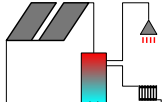

## Samlet energibesparelse for klimaskærmen

	Minimum	Lavenergi
Årlig besparelse pr. m <sup>2</sup> opvarmet boligareal	3 kWh/m <sup>2</sup>	4 kWh/m <sup>2</sup>
Total årlig besparelse	400 kWh	500 kWh

Samlet teoretisk besparelse ved gennemførelse af alle energibesparende renoveringstiltag for niveauerne Minimum og Lavenergi på klimaskærmen



## Varme og ventilation

Nuværende situation		Minimum	Lavenergi
<b>Varmeanlæg</b>	Nyere fjernvarmeveksler 	Eksisterende fjernvarmeunit er ok  <i>Besparelse 0 kWh afhængigt af forbrug</i> ✓	Udskiftes til optimeret fjernvarmeunit  <i>Besparelse 300 - 600 kWh afhængigt af forbrug</i> 
<b>Varme rør</b> (brugsvand eller varmforsyning)	Mere end 40 mm isolering ✓	Eksisterende rørisolering er ok  <i>Besparelse -</i> ✓	Eksisterende rørisolering er ok  <i>Besparelse -</i> ✓
<b>Solvarme</b>	Solvarme anlæg ikke installeret	Anlæg til varmt brugsvand  <i>Besparelse 500 - 800 kWh/m<sup>2</sup> solfanger</i> 	Anlæg til varmt brugsvand og varme  <i>Besparelse 400 - 600 kWh/m<sup>2</sup> solfanger</i> 
<b>Pumper</b>	Trinløs regulerbar A-mærket cirkulationspumpe 	Eksisterende pumpe er ok  <i>Besparelse - kWh</i> ✓	Eksisterende pumpe er ok  <i>Besparelse - kWh</i> ✓
<b>Ventilation</b>	Mekanisk ventilation med varmegenvinding	Eksisterende anlæg er ok  <i>Besparelse</i> ✓	Eksisterende anlæg er ok  <i>Besparelse</i> ✓





## Eksempel - Rækkehuse 2007 - 2011

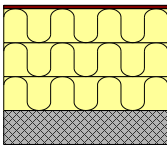
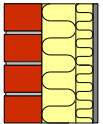
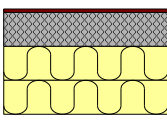

Opvarmet areal: 130 m<sup>2</sup>  
 Varmekilde: Fjernvarme  
 Ventilation: Mekanisk med varmegenvinding

### Statistik for Rækkehuse 2007 - 2011

Antal huse: 12.000  
 Totalt opvarmet areal: 1,8 million m<sup>2</sup>  
 Andel af det samlede opvarmede areal: 5%



## Klimaskærmen

Nuværende situation		Minimum	Lavenergi
<b>Loft</b> Areal 130 m <sup>2</sup>	Bjælkelag med 300 mm isolering 	Det eksisterende isoleringslag er tilstrækkelig  <i>Besparelse                      1 kWh/m<sup>2</sup>                      I alt 130 kWh</i>	Det eksisterende isoleringslag er tilstrækkelig  <i>Besparelse                      3 kWh/m<sup>2</sup>                      I alt 390 kWh</i>
<b>Ydervæg</b> Areal 60 m <sup>2</sup>	12 cm tegl med 150 mm isolering 	Den eksisterende isolering opfylder anbefalingen  <i>Besparelse                      0 kWh/m<sup>2</sup>                      I alt 0 kWh</i>	Den eksisterende isolering opfylder anbefalingen  <i>Besparelse                      0 kWh/m<sup>2</sup>                      I alt 0 kWh</i>
<b>Gulv</b> Areal 118 m <sup>2</sup>	Terrændæk med 200 mm isolering 	Den eksisterende isolering er tilstrækkelig  <i>Besparelse                      0 kWh/m<sup>2</sup>                      I alt 0 kWh</i>	Den eksisterende isolering er tilstrækkelig  <i>Besparelse                      0 kWh/m<sup>2</sup>                      I alt 0 kWh</i>
<b>Vinduer</b> Areal 30 m <sup>2</sup>	Nyere vindue med energirude 	Eksisterende vinduer er ok  <i>Besparelse                      kWh/m<sup>2</sup>                      I alt 0 kWh</i>	Eksisterende vinduer er ok  <i>Besparelse                      0 kWh/m<sup>2</sup>                      I alt 0 kWh</i>

## Samlet energibesparelse for klimaskærmen

	Minimum	Lavenergi
Årlig besparelse pr. m <sup>2</sup> opvarmet boligareal	1 kWh/m <sup>2</sup>	3 kWh/m <sup>2</sup>
Total årlig besparelse	100 kWh	400 kWh

Samlet teoretisk besparelse ved gennemførelse af alle energibesparende renoveringstiltag for niveauerne Minimum og Lavenergi på klimaskærmen



## Varme og ventilation

Nuværende situation		Minimum		Lavenergi	
<b>Varmeanlæg</b>	Optimeret fjernvarmeveksler  	Eksisterende fjernvarmeunit er ok  <i>Besparelse 0 kWh afhængigt af forbrug</i>  		<i>Besparelse 0 kWh afhængigt af forbrug</i>  	
<b>Varme rør</b> (brugsvand eller varmforsyning)	Mere end 50 mm isolering  	Eksisterende rørisolering er ok  <i>Besparelse -</i>  		Eksisterende rørisolering er ok  <i>Besparelse -</i>  	
<b>Solvarme</b>	Solvarme anlæg ikke installeret	Anlæg til varmt brugsvand  <i>Besparelse 500 - 800 kWh/m<sup>2</sup> solfanger</i>  		Anlæg til varmt brugsvand og varme  <i>Besparelse 400 - 600 kWh/m<sup>2</sup> solfanger</i>  	
<b>Pumper</b>	Trinløs regulerbar A-mærket cirkulationspumpe  	Eksisterende pumpe er ok  <i>Besparelse - kWh</i>  		Eksisterende pumpe er ok  <i>Besparelse - kWh</i>  	
<b>Ventilation</b>	Mekanisk ventilation med varmegenvinding	Eksisterende anlæg er ok  <i>Besparelse</i>  		Eksisterende anlæg er ok  <i>Besparelse</i>  	



## Eksempel - Etageboligerbyggeri før 1850

Opvarmet areal: 437 m<sup>2</sup>

Varmekilde: Fjernvarme

Ventilation: Naturlig

### Statistik for Etageboligerbyggeri før 1850

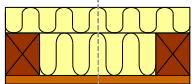
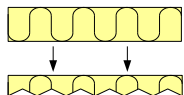
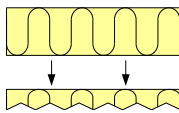

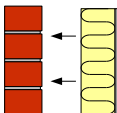
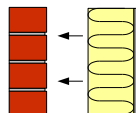
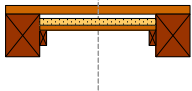
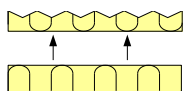
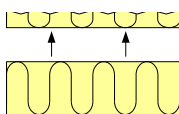


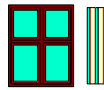
Antal huse: 2.200

Totalt opvarmet areal: 0,9 million m<sup>2</sup>

Andel af det samlede opvarmede areal: 1%



## Klimaskærmen

Nuværende situation		Minimum	Lavenergi
<b>Loft</b> Areal 222 m <sup>2</sup>	Bjælkelag med 200 mm isolering 	Der efterisoleres med 100 mm <i>Besparelse 8 kWh/m<sup>2</sup></i> <i>I alt 1.776 kWh</i> 	Der efterisoleres med 200 mm <i>Besparelse 10 kWh/m<sup>2</sup></i> <i>I alt 2.220 kWh</i> 
<b>Ydervæg</b> Areal 414 m <sup>2</sup>	Bindingsværk af ½ sten og 15% træ, uisoleret 	Indvendig efterisolering med 50 mm <i>Besparelse 166 kWh/m<sup>2</sup></i> <i>I alt 68724 kWh</i> 	Indvendig efterisolering med 100 mm <i>Besparelse 185 kWh/m<sup>2</sup></i> <i>I alt 76590 kWh</i> 
<b>Gulv</b> Areal 201 m <sup>2</sup>	Brædder på bjælker med lerindskud 	Efterisolering med 100 mm <i>Besparelse 90 kWh/m<sup>2</sup></i> <i>I alt 18090 kWh</i> 	Efterisolering med 200 mm <i>Besparelse 100 kWh/m<sup>2</sup></i> <i>I alt 20100 kWh</i> 
<b>Vinduer</b> Areal 58 m <sup>2</sup>	Ældre trævindue med termorude 	Udskiftning til nye vinduer med 2-lags energirude <i>Besparelse 110 kWh/m<sup>2</sup></i> <i>I alt 6380 kWh</i> 	Udskiftning til nye vinduer med 3-lags energirude <i>Besparelse 130 kWh/m<sup>2</sup></i> <i>I alt 7540 kWh</i> 

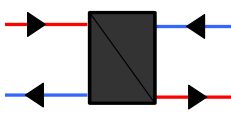
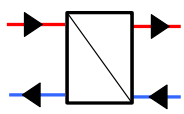
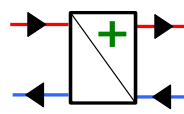



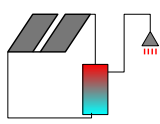
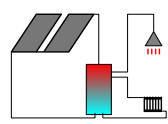
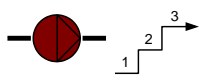
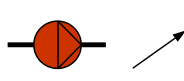
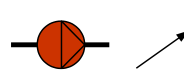

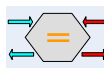
## Samlet energibesparelse for klimaskærmen

	Minimum	Lavenergi
Årlig besparelse pr. m <sup>2</sup> opvarmet boligareal	217 kWh/m <sup>2</sup>	244 kWh/m <sup>2</sup>
Total årlig besparelse	95000 kWh	106500 kWh

Samlet teoretisk besparelse ved gennemførelse af alle energibesparende renoveringstiltag for niveauerne Minimum og Lavenergi på klimaskærmen



## Varme og ventilation

Nuværende situation		Minimum	Lavenergi
<b>Varmeanlæg</b> Ældre fjernvarmeveksler (20 år) 	Udskiftes til ny fjernvarmeveksler  <i>Besparelse 1.500 - 2.000 kWh afhængigt af forbrug</i> 	Udskiftes til optimeret fjernvarmeunit  <i>Besparelse 1.500 - 2.200 kWh afhængigt af forbrug</i> 	
<b>Varmerør</b> (brugsvand eller varmforsyning) Mindre end 30 mm isolering 	Isoleret med 40 mm  <i>Besparelse 5-7 kWh/m</i> 	Isoleret med 50 mm  <i>Besparelse 6-9 kWh/m</i> 	
<b>Solvarme</b> Solvarme anlæg ikke installeret	Anlæg til varmt brugsvand  <i>Besparelse 500 - 800 kWh/m² solfanger</i> 	Anlæg til varmt brugsvand og varme  <i>Besparelse 400 - 600 kWh/m² solfanger</i> 	
<b>Pumper</b> Ældre trinreguleret pumpe 	Trinløs regulerbar A-mærket cirkulationspumpe  <i>Besparelse 350 kWh</i> 	Trinløs regulerbar A-mærket cirkulationspumpe  <i>Besparelse 350 kWh</i> 	
<b>Ventilation</b> Naturlig via ventilationsåbninger i vinduer og ydervægge	Ventilationsanlæg med en tør virkningsgrad på 80% og et specifikt elforbrug (SFP) på 1.000 J/m³  <i>Besparelse 25 - 35 kWh/m²</i> 	Ventilationsanlæg med en tør virkningsgrad på 85% og et specifikt elforbrug (SFP) på 800 J/m³  <i>Besparelse 30 - 40 kWh/m²</i> 	



## Eksempel - Etageboligerbyggeri 1851 - 1930

Opvarmet areal: 565 m<sup>2</sup>

Varmekilde: Fjernvarme

Ventilation: Naturlig

### Statistik for Etageboligerbyggeri 1851 - 1930

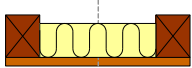
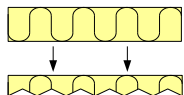
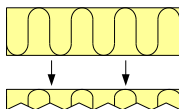
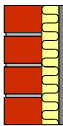
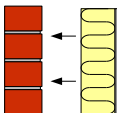
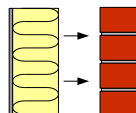
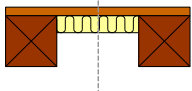
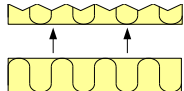
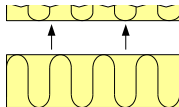


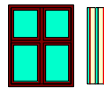
Antal huse: 42.600

Totalt opvarmet areal: 23,5 million m<sup>2</sup>

Andel af det samlede opvarmede areal: 30%



## Klimaskærmen

Nuværende situation		Minimum	Lavenergi
<b>Loft</b> Areal 303 m <sup>2</sup>	Bjælkelag med 100 mm isolering 	Der efterisoleres med 200 mm <i>Besparelse</i> <b>24 kWh/m<sup>2</sup></b> <i>I alt 7.272 kWh</i> 	Der efterisoleres med 300 mm <i>Besparelse</i> <b>26 kWh/m<sup>2</sup></b> <i>I alt 7.878 kWh</i> 
<b>Ydervæg</b> Areal 399 m <sup>2</sup>	12 cm tegl med 50 mm isolering 	Indvendig efterisolering med 50 mm <i>Besparelse</i> <b>21 kWh/m<sup>2</sup></b> <i>I alt 8379 kWh</i> 	Udvendig efterisolering med 225 mm <i>Besparelse</i> <b>37 kWh/m<sup>2</sup></b> <i>I alt 14763 kWh</i> 
<b>Gulv</b> Areal 194 m <sup>2</sup>	Trægulv på bjælker med 50 mm isolering 	Efterisolering med 50 mm <i>Besparelse</i> <b>16 kWh/m<sup>2</sup></b> <i>I alt 3104 kWh</i> 	Efterisolering med 150 mm <i>Besparelse</i> <b>26 kWh/m<sup>2</sup></b> <i>I alt 5044 kWh</i> 
<b>Vinduer</b> Areal 94 m <sup>2</sup>	Ældre trævindue med termorude 	Udskiftning til nye vinduer med 2-lags energirude <i>Besparelse</i> <b>110 kWh/m<sup>2</sup></b> <i>I alt 10340 kWh</i> 	Udskiftning til nye vinduer med 3-lags energirude <i>Besparelse</i> <b>130 kWh/m<sup>2</sup></b> <i>I alt 12220 kWh</i> 

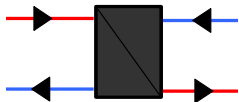
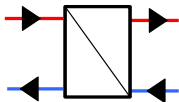
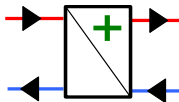



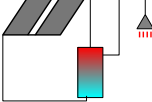
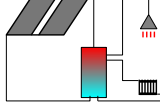
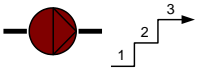




## Samlet energibesparelse for klimaskærmen

	Minimum	Lavenergi
Årlig besparelse pr. m <sup>2</sup> opvarmet boligareal	52 kWh/m <sup>2</sup>	71 kWh/m <sup>2</sup>
Total årlig besparelse	29100 kWh	39900 kWh

Samlet teoretisk besparelse ved gennemførelse af alle energibesparende renoveringstiltag for niveauerne Minimum og Lavenergi på klimaskærmen



## Varme og ventilation

Nuværende situation		Minimum	Lavenergi
<b>Varmeanlæg</b> Ældre fjernvarmeveksler (20 år) 	Udskiftes til ny fjernvarmeveksler  <i>Besparelse 1.500 - 2.000 kWh afhængigt af forbrug</i> 	Udskiftes til optimeret fjernvarmeunit  <i>Besparelse 1.500 - 2.200 kWh afhængigt af forbrug</i> 	
<b>Varmerør</b> (brugsvand eller varmforsyning) Mindre end 30 mm isolering 	Isoleret med 40 mm  <i>Besparelse 5-7 kWh/m</i> 	Isoleret med 50 mm  <i>Besparelse 6-9 kWh/m</i> 	
<b>Solvarme</b> Solvarme anlæg ikke installeret	Anlæg til varmt brugsvand  <i>Besparelse 500 - 800 kWh/m² solfanger</i> 	Anlæg til varmt brugsvand og varme  <i>Besparelse 400 - 600 kWh/m² solfanger</i> 	
<b>Pumper</b> Ældre trinreguleret pumpe 	Trinløs regulerbar A-mærket cirkulationspumpe  <i>Besparelse 350 kWh</i> 	Trinløs regulerbar A-mærket cirkulationspumpe  <i>Besparelse 350 kWh</i> 	
<b>Ventilation</b> Naturlig via ventilationsåbninger i vinduer og ydervægge	Ventilationsanlæg med en tør virkningsgrad på 80% og et specifikt elforbrug (SFP) på 1.000 J/m³  <i>Besparelse 25 - 35 kWh/m²</i> 	Ventilationsanlæg med en tør virkningsgrad på 85% og et specifikt elforbrug (SFP) på 800 J/m³  <i>Besparelse 30 - 40 kWh/m²</i> 	



## Eksempel - Etageboligerbyggeri 1931 - 1950

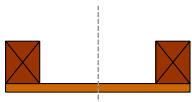
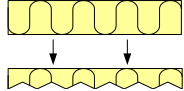
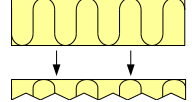
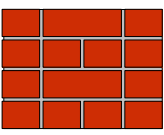
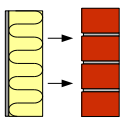
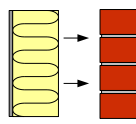

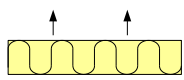
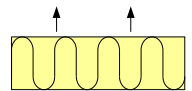


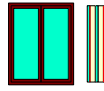
Opvarmet areal: 2755 m<sup>2</sup>  
 Varmekilde: Fjernvarme  
 Ventilation: Naturlig

### Statistik for Etageboligerbyggeri 1931 - 1950

Antal huse: 16.800  
 Totalt opvarmet areal: 14,4 million m<sup>2</sup>  
 Andel af det samlede opvarmede areal: 18%



## Klimaskærmen

Nuværende situation		Minimum	Lavenergi
<b>Loft</b> Areal 556 m <sup>2</sup>	Uisoleret bjælkelag 	Der efterisoleres med 300 mm <i>Besparelse</i> 161 kWh/m <sup>2</sup> I alt 89.516 kWh 	Der efterisoleres med 400 mm <i>Besparelse</i> 163 kWh/m <sup>2</sup> I alt 90.628 kWh 
<b>Ydervæg</b> Areal 1516 m <sup>2</sup>	48 cm massiv tegl ydervæg 	Udvendig efterisolering med 125 mm <i>Besparelse</i> 72 kWh/m <sup>2</sup> I alt 109152 kWh 	Udvendig efterisolering med 225 mm <i>Besparelse</i> 79 kWh/m <sup>2</sup> I alt 119764 kWh 
<b>Gulv</b> Areal 556 m <sup>2</sup>	Brædder på bjælker uisoleret 	Efterisolering med 100 mm <i>Besparelse</i> 119 kWh/m <sup>2</sup> I alt 66164 kWh 	Efterisolering med 200 mm <i>Besparelse</i> 130 kWh/m <sup>2</sup> I alt 72280 kWh 
<b>Vinduer</b> Areal 429 m <sup>2</sup>	Ældre trævindue med termorude 	Udskiftning til nye vinduer med 2-lags energirude <i>Besparelse</i> 120 kWh/m <sup>2</sup> I alt 51480 kWh 	Udskiftning til nye vinduer med 3-lags energirude <i>Besparelse</i> 140 kWh/m <sup>2</sup> I alt 60060 kWh 

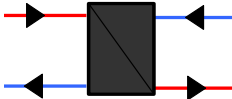
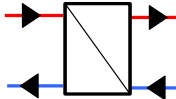
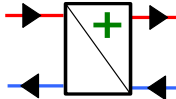



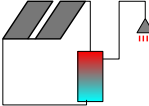
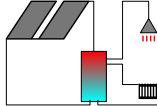
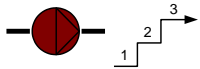
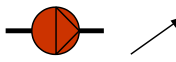
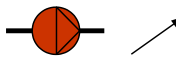


## Samlet energibesparelse for klimaskærmen

	Minimum	Lavenergi
Årlig besparelse pr. m <sup>2</sup> opvarmet boligareal	115 kWh/m <sup>2</sup>	124 kWh/m <sup>2</sup>
Total årlig besparelse	316300 kWh	342700 kWh

Samlet teoretisk besparelse ved gennemførelse af alle energibesparende renoveringstiltag for niveauerne Minimum og Lavenergi på klimaskærmen



## Varme og ventilation

Nuværende situation	Minimum	Lavenergi
<p><b>Varmeanlæg</b></p> <p>Ældre fjernvarmeveksler (20 år)</p> 	<p>Udskiftes til ny fjernvarmeveksler</p> <p><i>Besparelse 1.500 - 2.000 kWh afhængigt af forbrug</i></p> 	<p>Udskiftes til optimeret fjernvarmeunit</p> <p><i>Besparelse 1.500 - 2.200 kWh afhængigt af forbrug</i></p> 
<p><b>Varmerør</b> (brugsvand eller varmforsyning)</p> <p>Mindre end 30 mm isolering</p> 	<p>Isoleret med 40 mm</p> <p><i>Besparelse 5-7 kWh/m</i></p> 	<p>Isoleret med 50 mm</p> <p><i>Besparelse 6-9 kWh/m</i></p> 
<p><b>Solvarme</b></p> <p>Solvarme anlæg ikke installeret</p>	<p>Anlæg til varmt brugsvand</p> <p><i>Besparelse 500 - 800 kWh/m² solfanger</i></p> 	<p>Anlæg til varmt brugsvand og varme</p> <p><i>Besparelse 400 - 600 kWh/m² solfanger</i></p> 
<p><b>Pumper</b></p> <p>Ældre trinreguleret pumpe</p> 	<p>Trinløs regulerbar A-mærket cirkulationspumpe</p> <p><i>Besparelse 350 kWh</i></p> 	<p>Trinløs regulerbar A-mærket cirkulationspumpe</p> <p><i>Besparelse 350 kWh</i></p> 
<p><b>Ventilation</b></p> <p>Naturlig via ventilationsåbninger i vinduer og ydervægge</p>	<p>Ventilationsanlæg med en tør virkningsgrad på 80% og et specifikt elforbrug (SFP) på 1.000 J/m³</p> <p><i>Besparelse 25 - 35 kWh/m²</i></p> 	<p>Ventilationsanlæg med en tør virkningsgrad på 85% og et specifikt elforbrug (SFP) på 800 J/m³</p> <p><i>Besparelse 30 - 40 kWh/m²</i></p> 





## Eksempel - Etageboligerbyggeri 1951 - 1960

Opvarmet areal: 367 m<sup>2</sup>

Varmekilde: Fjernvarme

Ventilation: Naturlig

### Statistik for Etageboligerbyggeri 1951 - 1960

Antal huse: 5.600

Totalt opvarmet areal: 7,7 million m<sup>2</sup>

Andel af det samlede opvarmede areal: 10%



## Klimaskærmen

	Nuværende situation	Minimum	Lavenergi
<b>Loft</b> Areal 163 m <sup>2</sup>	Bjælkelag med 50 mm isolering 	Der efterisoleres med 250 mm  <i>Besparelse</i> <b>44 kWh/m<sup>2</sup></b> <i>I alt 7.172 kWh</i> 	Der efterisoleres med 350 mm  <i>Besparelse</i> <b>46 kWh/m<sup>2</sup></b> <i>I alt 7.498 kWh</i> 
<b>Ydervæg</b> Areal 276 m <sup>2</sup>	36 cm hulmur uden isolering 	Hulmursisolering  <i>Besparelse</i> <b>92 kWh/m<sup>2</sup></b> <i>I alt 25392 kWh</i> 	Hulmursisolering og udvendig isolering med 225 mm  <i>Besparelse</i> <b>111 kWh/m<sup>2</sup></b> <i>I alt 30636 kWh</i> 
<b>Gulv</b> Areal 147 m <sup>2</sup>	Træ/Strøer på letbetonetageadskillelse 20 cm 	Efterisolering med 100 mm  <i>Besparelse</i> <b>55 kWh/m<sup>2</sup></b> <i>I alt 8085 kWh</i> 	Efterisolering med 200 mm  <i>Besparelse</i> <b>63 kWh/m<sup>2</sup></b> <i>I alt 9261 kWh</i> 
<b>Vinduer</b> Areal 57 m <sup>2</sup>	Ældre trævindue med termorude 	Udskiftning til nye vinduer med 2-lags energirude  <i>Besparelse</i> <b>120 kWh/m<sup>2</sup></b> <i>I alt 6840 kWh</i> 	Udskiftning til nye vinduer med 3-lags energirude  <i>Besparelse</i> <b>140 kWh/m<sup>2</sup></b> <i>I alt 7980 kWh</i> 

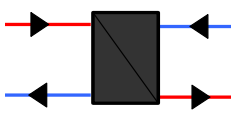
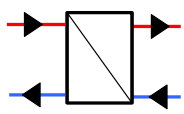
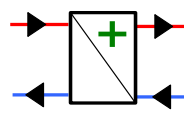



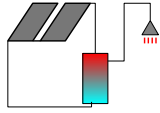
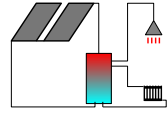
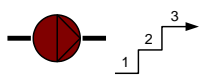
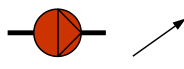
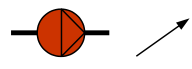

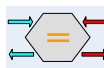
## Samlet energibesparelse for klimaskærmen

	Minimum	Lavenergi
Årlig besparelse pr. m <sup>2</sup> opvarmet boligareal	129 kWh/m <sup>2</sup>	151 kWh/m <sup>2</sup>
Total årlig besparelse	47500 kWh	55400 kWh

Samlet teoretisk besparelse ved gennemførelse af alle energibesparende renoveringstiltag for niveauerne Minimum og Lavenergi på klimaskærmen



## Varme og ventilation

Nuværende situation		Minimum	Lavenergi
<b>Varmeanlæg</b> Ældre fjernvarmeveksler (20 år) 	Udskiftes til ny fjernvarmeveksler  <i>Besparelse 1.500 - 2.000 kWh afhængigt af forbrug</i> 	Udskiftes til optimeret fjernvarmeunit  <i>Besparelse 1.500 - 2.200 kWh afhængigt af forbrug</i> 	
<b>Varmerør</b> (brugsvand eller varmforsyning) Mindre end 30 mm isolering 	Isoleret med 40 mm  <i>Besparelse 5-7 kWh/m</i> 	Isoleret med 50 mm  <i>Besparelse 6-9 kWh/m</i> 	
<b>Solvarme</b> Solvarme anlæg ikke installeret	Anlæg til varmt brugsvand  <i>Besparelse 500 - 800 kWh/m² solfanger</i> 	Anlæg til varmt brugsvand og varme  <i>Besparelse 400 - 600 kWh/m² solfanger</i> 	
<b>Pumper</b> Ældre trinreguleret pumpe 	Trinløs regulerbar A-mærket cirkulationspumpe  <i>Besparelse 350 kWh</i> 	Trinløs regulerbar A-mærket cirkulationspumpe  <i>Besparelse 350 kWh</i> 	
<b>Ventilation</b> Naturlig via ventilationsåbninger i vinduer og ydervægge	Ventilationsanlæg med en tør virkningsgrad på 80% og et specifikt elforbrug (SFP) på 1.000 J/m³  <i>Besparelse 25 - 35 kWh/m²</i> 	Ventilationsanlæg med en tør virkningsgrad på 85% og et specifikt elforbrug (SFP) på 800 J/m³  <i>Besparelse 30 - 40 kWh/m²</i> 	



## Eksempel - Etageboligerbyggeri 1961 - 1972

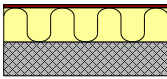
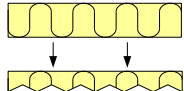
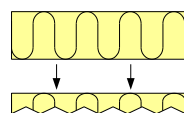
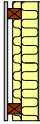
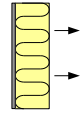
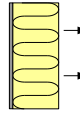

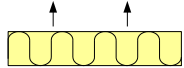
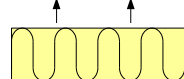


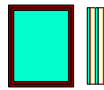
Opvarmet areal: 1600 m<sup>2</sup>  
 Varmekilde: Fjernvarme  
 Ventilation: Udsugning

### Statistik for Etageboligerbyggeri 1961 - 1972

Antal huse: 6.600  
 Totalt opvarmet areal: 13,8 million m<sup>2</sup>  
 Andel af det samlede opvarmede areal: 18%



## Klimaskærmen

Nuværende situation		Minimum	Lavenergi
<b>Loft</b> Areal 535 m <sup>2</sup>	Bjælkelag med 100 mm isolering 	Der efterisoleres med 200 mm <i>Besparelse 19 kWh/m<sup>2</sup></i> <i>I alt 10.165 kWh</i> 	Der efterisoleres med 300 mm <i>Besparelse 22 kWh/m<sup>2</sup></i> <i>I alt 11.770 kWh</i> 
<b>Ydervæg</b> Areal 735 m <sup>2</sup>	Let ydervæg med ca. 75 mm isolering 	Udvendig efterisolering med 300 mm <i>Besparelse 37 kWh/m<sup>2</sup></i> <i>I alt 27195 kWh</i> 	Udvendig efterisolering med 400 mm <i>Besparelse 39 kWh/m<sup>2</sup></i> <i>I alt 28665 kWh</i> 
<b>Gulv</b> Areal 535 m <sup>2</sup>	Træ/Strøer på beton etageadskillelse 20 cm 	Efterisolering med 100 mm <i>Besparelse 83 kWh/m<sup>2</sup></i> <i>I alt 44405 kWh</i> 	Efterisolering med 200 mm <i>Besparelse 93 kWh/m<sup>2</sup></i> <i>I alt 49755 kWh</i> 
<b>Vinduer</b> Areal 345 m <sup>2</sup>	Ældre trævindue med termorude 	Udskiftning til nye vinduer med 2-lags energirude <i>Besparelse 120 kWh/m<sup>2</sup></i> <i>I alt 41400 kWh</i> 	Udskiftning til nye vinduer med 3-lags energirude <i>Besparelse 140 kWh/m<sup>2</sup></i> <i>I alt 48300 kWh</i> 

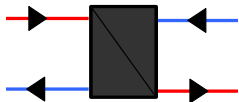
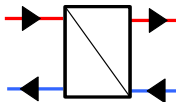
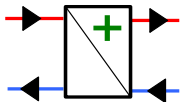



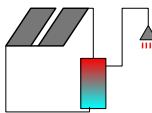
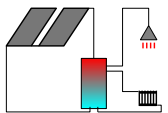
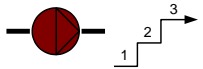




## Samlet energibesparelse for klimaskærmen

	Minimum	Lavenergi
Årlig besparelse pr. m <sup>2</sup> opvarmet boligareal	77 kWh/m <sup>2</sup>	87 kWh/m <sup>2</sup>
Total årlig besparelse	123200 kWh	138500 kWh

Samlet teoretisk besparelse ved gennemførelse af alle energibesparende renoveringstiltag for niveauerne Minimum og Lavenergi på klimaskærmen



## Varme og ventilation

Nuværende situation		Minimum	Lavenergi
<b>Varmeanlæg</b> Ældre fjernvarmeveksler (20 år) 	Udskiftes til ny fjernvarmeveksler  <i>Besparelse 1.500 - 2.000 kWh afhængigt af forbrug</i> 	Udskiftes til optimeret fjernvarmeunit  <i>Besparelse 1.500 - 2.200 kWh afhængigt af forbrug</i> 	
<b>Varmerør</b> (brugsvand eller varmforsyning) Mindre end 30 mm isolering 	Isoleret med 40 mm  <i>Besparelse 5-7 kWh/m</i> 	Isoleret med 50 mm  <i>Besparelse 6-9 kWh/m</i> 	
<b>Solvarme</b> Solvarme anlæg ikke installeret	Anlæg til varmt brugsvand  <i>Besparelse 500 - 800 kWh/m² solfanger</i> 	Anlæg til varmt brugsvand og varme  <i>Besparelse 400 - 600 kWh/m² solfanger</i> 	
<b>Pumper</b> Ældre trinreguleret pumpe 	Trinløs regulerbar A-mærket cirkulationspumpe  <i>Besparelse 350 kWh</i> 	Trinløs regulerbar A-mærket cirkulationspumpe  <i>Besparelse 350 kWh</i> 	
<b>Ventilation</b> Naturlig via ventilationsåbninger i vinduer og ydervægge	Ventilationsanlæg med en tør virkningsgrad på 80% og et specifikt elforbrug (SFP) på 1.000 J/m³  <i>Besparelse 25 - 35 kWh/m²</i> 	Ventilationsanlæg med en tør virkningsgrad på 85% og et specifikt elforbrug (SFP) på 800 J/m³  <i>Besparelse 30 - 40 kWh/m²</i> 	



## Eksempel - Etageboligerbyggeri 1973 - 1978

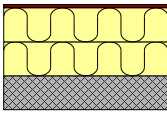
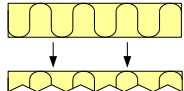
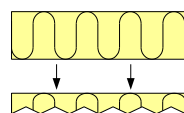
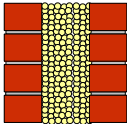


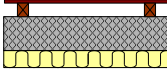
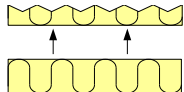
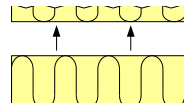


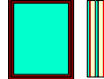
Opvarmet areal: 2300 m<sup>2</sup>  
 Varmekilde: Fjernvarme  
 Ventilation: Udsugning

### Statistik for Etageboligerbyggeri 1973 - 1978

Antal huse: 2.100  
 Totalt opvarmet areal: 4,4 million m<sup>2</sup>  
 Andel af det samlede opvarmede areal: 6%



## Klimaskærmen

Nuværende situation		Minimum	Lavenergi
<b>Loft</b> Areal 470 m <sup>2</sup> Bjælkelag med 200 mm isolering 	Der efterisoleres med 100 mm <i>Besparelse 7 kWh/m<sup>2</sup></i> <i>I alt 3.290 kWh</i> 	Der efterisoleres med 200 mm <i>Besparelse 9 kWh/m<sup>2</sup></i> <i>I alt 4.230 kWh</i> 	
<b>Ydervæg</b> Areal 584 m <sup>2</sup> 36 cm hulmur efterisoleret med granulat 	Den eksisterende isolering opfylder anbefalingen <i>Besparelse 0 kWh/m<sup>2</sup></i> <i>I alt 0 kWh</i> 	Den eksisterende isolering opfylder anbefalingen <i>Besparelse 0 kWh/m<sup>2</sup></i> <i>I alt 0 kWh</i> 	
<b>Gulv</b> Areal 470 m <sup>2</sup> Etageadskillelse af beton med 50 mm isolering 	Efterisolering med 50 mm <i>Besparelse 17 kWh/m<sup>2</sup></i> <i>I alt 7990 kWh</i> 	Efterisolering med 150 mm <i>Besparelse 28 kWh/m<sup>2</sup></i> <i>I alt 13160 kWh</i> 	
<b>Vinduer</b> Areal 754 m <sup>2</sup> Ældre trævindue med termorude 	Udskiftning til nye vinduer med 2-lags energirude <i>Besparelse 120 kWh/m<sup>2</sup></i> <i>I alt 90480 kWh</i> 	Udskiftning til nye vinduer med 3-lags energirude <i>Besparelse 140 kWh/m<sup>2</sup></i> <i>I alt 105560 kWh</i> 	

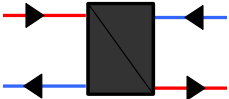
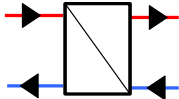
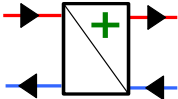



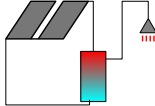
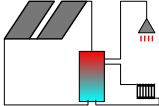
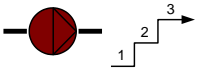




## Samlet energibesparelse for klimaskærmen

	Minimum	Lavenergi
Årlig besparelse pr. m <sup>2</sup> opvarmet boligareal	44 kWh/m <sup>2</sup>	53 kWh/m <sup>2</sup>
Total årlig besparelse	101800 kWh	123000 kWh

Samlet teoretisk besparelse ved gennemførelse af alle energibesparende renoveringstiltag for niveauerne Minimum og Lavenergi på klimaskærmen



## Varme og ventilation

Nuværende situation	Minimum	Lavenergi
<p><b>Varmeanlæg</b></p> <p>Ældre fjernvarmeveksler (20 år)</p> 	<p>Udskiftes til ny fjernvarmeveksler</p> <p><i>Besparelse 1.500 - 2.000 kWh afhængigt af forbrug</i></p> 	<p>Udskiftes til optimeret fjernvarmeunit</p> <p><i>Besparelse 1.500 - 2.200 kWh afhængigt af forbrug</i></p> 
<p><b>Varmerør</b> (brugsvand eller varmforsyning)</p> <p>Mindre end 30 mm isolering</p> 	<p>Isoleret med 40 mm</p> <p><i>Besparelse 5-7 kWh/m</i></p> 	<p>Isoleret med 50 mm</p> <p><i>Besparelse 6-9 kWh/m</i></p> 
<p><b>Solvarme</b></p> <p>Solvarme anlæg ikke installeret</p>	<p>Anlæg til varmt brugsvand</p> <p><i>Besparelse 500 - 800 kWh/m² solfanger</i></p> 	<p>Anlæg til varmt brugsvand og varme</p> <p><i>Besparelse 400 - 600 kWh/m² solfanger</i></p> 
<p><b>Pumper</b></p> <p>Ældre trinreguleret pumpe</p> 	<p>Trinløs regulerbar A-mærket cirkulationspumpe</p> <p><i>Besparelse 350 kWh</i></p> 	<p>Trinløs regulerbar A-mærket cirkulationspumpe</p> <p><i>Besparelse 350 kWh</i></p> 
<p><b>Ventilation</b></p> <p>Naturlig via ventilationsåbninger i vinduer og ydervægge</p>	<p>Ventilationsanlæg med en tør virkningsgrad på 80% og et specifikt elforbrug (SFP) på 1.000 J/m³</p> <p><i>Besparelse 25 - 35 kWh/m²</i></p> 	<p>Ventilationsanlæg med en tør virkningsgrad på 85% og et specifikt elforbrug (SFP) på 800 J/m³</p> <p><i>Besparelse 30 - 40 kWh/m²</i></p> 



## Eksempel - Etageboligerbyggeri 1979 - 1998

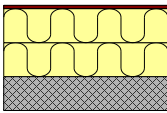
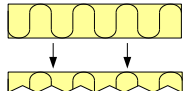
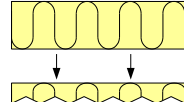
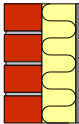


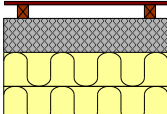





Opvarmet areal: 2937 m<sup>2</sup>  
 Varmekilde: Fjernvarme  
 Ventilation: Udsugning

### Statistik for Etageboligerbyggeri 1979 - 1998

Antal huse: 8.700  
 Totalt opvarmet areal: 7,7 million m<sup>2</sup>  
 Andel af det samlede opvarmede areal: 10%



## Klimaskærmen

Nuværende situation		Minimum	Lavenergi
<b>Loft</b> Areal 782 m <sup>2</sup>	Bjælkelag med 200 mm isolering 	Der efterisoleres med 100 mm  <i>Besparelse</i> <b>7 kWh/m<sup>2</sup></b> <i>I alt 5.474 kWh</i> 	Der efterisoleres med 200 mm  <i>Besparelse</i> <b>9 kWh/m<sup>2</sup></b> <i>I alt 7.038 kWh</i> 
<b>Ydervæg</b> Areal 1120 m <sup>2</sup>	12 cm tegl med 100 mm isolering 	Den eksisterende isolering opfylder anbefalingen  <i>Besparelse</i> <b>0 kWh/m<sup>2</sup></b> <i>I alt 0 kWh</i> 	Den eksisterende isolering opfylder anbefalingen  <i>Besparelse</i> <b>0 kWh/m<sup>2</sup></b> <i>I alt 0 kWh</i> 
<b>Gulv</b> Areal 754 m <sup>2</sup>	Etageadskillelse af beton med 200 mm isolering 	Den eksisterende isolering er tilstrækkelig  <i>Besparelse</i> <b>0 kWh/m<sup>2</sup></b> <i>I alt 0 kWh</i> 	Den eksisterende isolering er tilstrækkelig  <i>Besparelse</i> <b>0 kWh/m<sup>2</sup></b> <i>I alt 0 kWh</i> 
<b>Vinduer</b> Areal 428 m <sup>2</sup>	Nyere vindue med energirude 	Eksisterende vinduer er ok  <i>Besparelse</i> <b>kWh/m<sup>2</sup></b> <i>I alt 0 kWh</i> 	Eksisterende vinduer er ok  <i>Besparelse</i> <b>0 kWh/m<sup>2</sup></b> <i>I alt 0 kWh</i> 

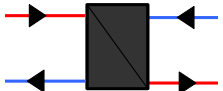
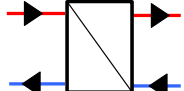
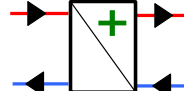



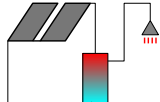
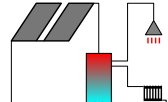
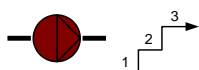



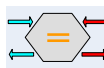
## Samlet energibesparelse for klimaskærmen

	Minimum	Lavenergi
Årlig besparelse pr. m <sup>2</sup> opvarmet boligareal	2 kWh/m <sup>2</sup>	2 kWh/m <sup>2</sup>
Total årlig besparelse	5500 kWh	7000 kWh

Samlet teoretisk besparelse ved gennemførelse af alle energibesparende renoveringstiltag for niveauerne Minimum og Lavenergi på klimaskærmen



## Varme og ventilation

Nuværende situation		Minimum	Lavenergi
<b>Varmeanlæg</b> Ældre fjernvarmeveksler (20 år) 	Udskiftes til ny fjernvarmeveksler  <i>Besparelse 1.500 - 2.000 kWh afhængigt af forbrug</i> 	Udskiftes til optimeret fjernvarmeunit  <i>Besparelse 1.500 - 2.200 kWh afhængigt af forbrug</i> 	
<b>Varmerør</b> (brugsvand eller varmforsyning) Mindre end 30 mm isolering 	Isoleret med 40 mm  <i>Besparelse 5-7 kWh/m</i> 	Isoleret med 50 mm  <i>Besparelse 6-9 kWh/m</i> 	
<b>Solvarme</b> Solvarme anlæg ikke installeret	Anlæg til varmt brugsvand  <i>Besparelse 500 - 800 kWh/m² solfanger</i> 	Anlæg til varmt brugsvand og varme  <i>Besparelse 400 - 600 kWh/m² solfanger</i> 	
<b>Pumper</b> Ældre trinreguleret pumpe 	Trinløs regulerbar A-mærket cirkulationspumpe  <i>Besparelse 350 kWh</i> 	Trinløs regulerbar A-mærket cirkulationspumpe  <i>Besparelse 350 kWh</i> 	
<b>Ventilation</b> Naturlig via ventilationsåbninger i vinduer og ydervægge	Ventilationsanlæg med en tør virkningsgrad på 80% og et specifikt elforbrug (SFP) på 1.000 J/m³  <i>Besparelse 25 - 35 kWh/m²</i> 	Ventilationsanlæg med en tør virkningsgrad på 85% og et specifikt elforbrug (SFP) på 800 J/m³  <i>Besparelse 30 - 40 kWh/m²</i> 	





## Eksempel - Etageboligerbyggeri 1999 - 2006

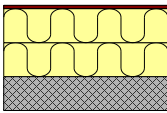
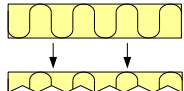
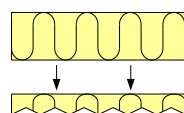
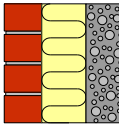


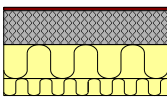





Opvarmet areal: 2925 m<sup>2</sup>  
 Varmekilde: Fjernvarme  
 Ventilation: Mekanisk med varmegenvinding

### Statistik for Etageboligerbyggeri 1999 - 2006

Antal huse: 3.400  
 Totalt opvarmet areal: 3,6 million m<sup>2</sup>  
 Andel af det samlede opvarmede areal: 4%



## Klimaskærmen

Nuværende situation		Minimum	Lavenergi
<b>Loft</b> Areal 609 m <sup>2</sup>	Bjælkelag med 200 mm isolering 	Der efterisoleres med 100 mm  <i>Besparelse</i> 7 kWh/m <sup>2</sup> I alt 4.263 kWh 	Der efterisoleres med 200 mm  <i>Besparelse</i> 9 kWh/m <sup>2</sup> I alt 5.481 kWh 
<b>Ydervæg</b> Areal 792 m <sup>2</sup>	35 cm tegl-letbeton med 130 mm isolering 	Den eksisterende isolering opfylder anbefalingen  <i>Besparelse</i> 0 kWh/m <sup>2</sup> I alt 0 kWh 	Den eksisterende isolering opfylder anbefalingen  <i>Besparelse</i> 0 kWh/m <sup>2</sup> I alt 0 kWh 
<b>Gulv</b> Areal 595 m <sup>2</sup>	Terrændæk med 150 mm isolering 	Den eksisterende isolering er tilstrækkelig  <i>Besparelse</i> 0 kWh/m <sup>2</sup> I alt 0 kWh 	Den eksisterende isolering er tilstrækkelig  <i>Besparelse</i> 0 kWh/m <sup>2</sup> I alt 0 kWh 
<b>Vinduer</b> Areal 513 m <sup>2</sup>	Nyere vindue med energirude 	Eksisterende vinduer er ok  <i>Besparelse</i> kWh/m <sup>2</sup> I alt 0 kWh 	Eksisterende vinduer er ok  <i>Besparelse</i> 0 kWh/m <sup>2</sup> I alt 0 kWh 

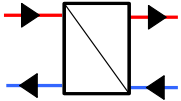
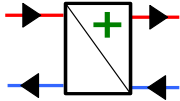
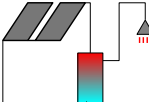
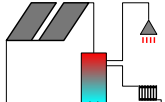

## Samlet energibesparelse for klimaskærmen

	Minimum	Lavenergi
Årlig besparelse pr. m <sup>2</sup> opvarmet boligareal	1 kWh/m <sup>2</sup>	2 kWh/m <sup>2</sup>
Total årlig besparelse	4300 kWh	5500 kWh

Samlet teoretisk besparelse ved gennemførelse af alle energibesparende renoveringstiltag for niveauerne Minimum og Lavenergi på klimaskærmen



## Varme og ventilation

Nuværende situation		Minimum	Lavenergi
<b>Varmeanlæg</b>	Nyere fjernvarmeveksler 	Eksisterende fjernvarmeunit er ok  <i>Besparelse 0 kWh afhængigt af forbrug</i> ✓	Udskiftes til optimeret fjernvarmeunit  <i>Besparelse 300 - 600 kWh afhængigt af forbrug</i> 
<b>Varme rør</b> (brugsvand eller varmforsyning)	Mere end 40 mm isolering ✓	Eksisterende rørisolering er ok  <i>Besparelse -</i> ✓	Eksisterende rørisolering er ok  <i>Besparelse -</i> ✓
<b>Solvarme</b>	Solvarme anlæg ikke installeret	Anlæg til varmt brugsvand  <i>Besparelse 500 - 800 kWh/m<sup>2</sup> solfanger</i> 	Anlæg til varmt brugsvand og varme  <i>Besparelse 400 - 600 kWh/m<sup>2</sup> solfanger</i> 
<b>Pumper</b>	Trinløs regulerbar A-mærket cirkulationspumpe 	Eksisterende pumpe er ok  <i>Besparelse - kWh</i> ✓	Eksisterende pumpe er ok  <i>Besparelse - kWh</i> ✓
<b>Ventilation</b>	Mekanisk ventilation med varmegenvinding	Eksisterende anlæg er ok  <i>Besparelse</i> ✓	Eksisterende anlæg er ok  <i>Besparelse</i> ✓



## Eksempel - Etageboligerbyggeri 2007 - 2011

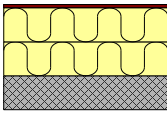
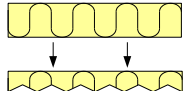
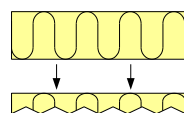
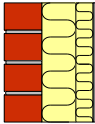


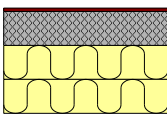





Opvarmet areal: 772 m<sup>2</sup>  
 Varmekilde: Fjernvarme  
 Ventilation: Mekanisk med varmegenvinding

### Statistik for Etageboligerbyggeri 2007 - 2011

Antal huse: 1.400  
 Totalt opvarmet areal: 2,1 million m<sup>2</sup>  
 Andel af det samlede opvarmede areal: 3%



## Klimaskærmen

Nuværende situation		Minimum	Lavenergi
<b>Loft</b> Areal 156 m <sup>2</sup> Betondæk med 200 mm isolering 	Der efterisoleres med 100 mm  <i>Besparelse 7 kWh/m<sup>2</sup></i> <i>I alt 1.092 kWh</i> 	Der efterisoleres med 200 mm  <i>Besparelse 9 kWh/m<sup>2</sup></i> <i>I alt 1.404 kWh</i> 	
<b>Ydervæg</b> Areal 369 m <sup>2</sup> 12 cm tegl med 150 mm isolering 	Den eksisterende isolering opfylder anbefalingen  <i>Besparelse 0 kWh/m<sup>2</sup></i> <i>I alt 0 kWh</i> 	Den eksisterende isolering opfylder anbefalingen  <i>Besparelse 0 kWh/m<sup>2</sup></i> <i>I alt 0 kWh</i> 	
<b>Gulv</b> Areal 162 m <sup>2</sup> Terrændæk med 200 mm isolering 	Den eksisterende isolering er tilstrækkelig  <i>Besparelse 0 kWh/m<sup>2</sup></i> <i>I alt 0 kWh</i> 	Den eksisterende isolering er tilstrækkelig  <i>Besparelse 0 kWh/m<sup>2</sup></i> <i>I alt 0 kWh</i> 	
<b>Vinduer</b> Areal 208 m <sup>2</sup> Nyere vindue med energirude 	Eksisterende vinduer er ok  <i>Besparelse kWh/m<sup>2</sup></i> <i>I alt 0 kWh</i> 	Eksisterende vinduer er ok  <i>Besparelse 0 kWh/m<sup>2</sup></i> <i>I alt 0 kWh</i> 	

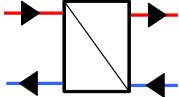
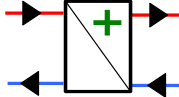
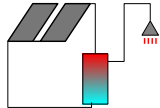
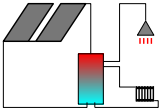

## Samlet energibesparelse for klimaskærmen

	Minimum	Lavenergi
Årlig besparelse pr. m <sup>2</sup> opvarmet boligareal	1 kWh/m <sup>2</sup>	2 kWh/m <sup>2</sup>
Total årlig besparelse	1100 kWh	1400 kWh

Samlet teoretisk besparelse ved gennemførelse af alle energibesparende reoveringstiltag for niveauerne Minimum og Lavenergi på klimaskærmen



## Varme og ventilation

Nuværende situation		Minimum	Lavenergi
<b>Varmeanlæg</b>	Ny fjernvarmeveksler 	Eksisterende fjernvarmeunit er ok  <i>Besparelse 0 kWh afhængigt af forbrug</i> ✓	Udskiftes til optimeret fjernvarmeunit  <i>Besparelse 300 - 600 kWh afhængigt af forbrug</i> 
<b>Varme rør</b> (brugs vand eller varmforsyning)	Mere end 50 mm isolering ✓	Eksisterende rørisolering er ok  <i>Besparelse -</i> ✓	Eksisterende rørisolering er ok  <i>Besparelse -</i> ✓
<b>Solvarme</b>	Solvarme anlæg ikke installeret	Anlæg til varmt brugsvand  <i>Besparelse 500 - 800 kWh/m<sup>2</sup> solfanger</i> 	Anlæg til varmt brugsvand og varme  <i>Besparelse 400 - 600 kWh/m<sup>2</sup> solfanger</i> 
<b>Pumper</b>	Trinløs regulerbar A-mærket cirkulationspumpe 	Eksisterende pumpe er ok  <i>Besparelse - kWh</i> ✓	Eksisterende pumpe er ok  <i>Besparelse - kWh</i> ✓
<b>Ventilation</b>	Mekanisk ventilation med varmegenvinding	Eksisterende anlæg er ok  <i>Besparelse</i> ✓	Eksisterende anlæg er ok  <i>Besparelse</i> ✓





This report was made as part of the Danish participation in the TABULA (Ty-pology Approach for Building Stock Energy Assessment) project supported by Intelligent Energy Europe (IEE/08/495/SI2.528396). The objective of TABULA was to develop a harmonised building typology for European countries. A Danish typology for residential buildings was established by SBI in the project. Three different main building types were used: Single-family houses, terraced houses and apartment blocks. Each main building type was again split up in nine periods of buildings representing typical building tradition and insulation levels. Within each main building type and building period, a typical building has been selected from the energy labelling scheme database as a **real example building**. Another main purpose of the building typology was to establish a tool that is able to calculate different energy-saving scenarios for the entire residential building stock. To make such calculation **average buildings** were constructed. These theoretically designed building models are based on statistical data obtained from the Danish Energy Labelling Scheme and other knowledge sources of buildings.

1<sup>st</sup> edition, 2011

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