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## REPORT

# Sparebank1 Boligkreditt Green Bond

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### CLIENT

Sparebank1 Boligkreditt

### SUBJECT

Green residential buildings

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## REPORT

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# 1 Introduction

## Assignment

On assignment from Sparebank1 Boligkreditt, Multiconsult has developed criteria and methodologies to identify criteria to identify the most energy efficient residential buildings in Norway, to be used with respect to green covered bond issuance. In this document we describe these identification criteria and the evidence for these criteria and the result of an analysis of a part of the loan portfolio of Sparebank1 Boligkreditt. The criteria to select the buildings are all based on credible standards in Norway such as the Norwegian building regulation in combination with building year and the EPC energy label system.

## Energy

Apart from these criteria we also want to stress that residential buildings in Norway are heated mostly with renewable energy. The energy consumption of Norwegian residential buildings is predominantly electricity, with some district heating and bioenergy.

Statistics Norway made in 2013 a statistic on energy use in Norwegian households. The demand was covered by electricity (79 %), fossil oil and gas (4 %) and bioenergy etc. (16 %). Already in 2007, the building code was in clear disfavour of fossil energy, and the use of fossil energy in residential buildings has declined since. In 2020, all use of fossil oil is banned from use in residential buildings. The fuel mix in Norwegian district heating production in 2016 included only 5.4 % from fossil fuels (oil and gas) (Fjernkontrollen<sup>1</sup>). In 2016, the Norwegian power production was 98 % renewable (NVE<sup>2</sup>).

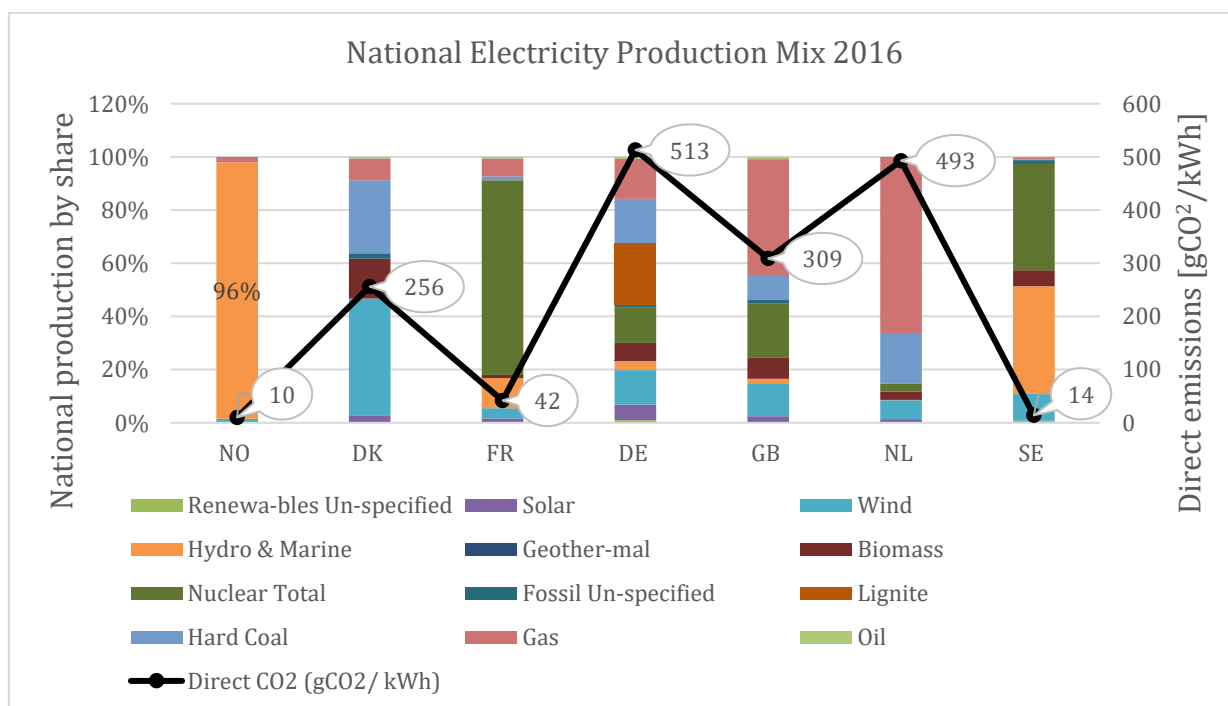


Figure 1 National electricity production mix in some relevant countries (European Residual Mixes 2016, Association of Issuing Bodies<sup>3</sup>)

<sup>1</sup> <http://fjernkontrollen.no/>

<sup>2</sup> <https://www.nve.no/reguleringmyndigheten-for-energi-rme-marked-og-monopol/varedeklarasjon/nasjonal-varedeklarasjon-2016/>

<sup>3</sup> [https://www.aib-net.org/documents/103816/176792/AIB\\_2016\\_Residual\\_Mix\\_Results.pdf/6b49295b-ad99-a189-579e-877449778f62](https://www.aib-net.org/documents/103816/176792/AIB_2016_Residual_Mix_Results.pdf/6b49295b-ad99-a189-579e-877449778f62)

As shown in figure 1, the Norwegian production mix gives resulting emissions of 10 gCO<sub>2</sub>/kWh. However, taking into account the international trade, the consumption is not necessary equal to production. The environmental classification system for buildings, BREEAM, uses in its Norwegian version an emission factor of 132 g CO<sub>2</sub>/kWh. Using BREEAM factors and the energy mix in Norwegian residential buildings<sup>4</sup>, the resulting CO<sub>2</sub>- factor is 126 g CO<sub>2</sub>/kWh.

## 2 Loan Portfolio Analysis Sparebank1 Boligkreditt

The Green loan portfolio of Sparebank1 Boligkreditt will consist of residential buildings that meet either one of the three criteria that we have formulated below. In short, these are new residential buildings that meet TEK 07 or later, OR residential buildings with energy labels A, B or C, OR certain refurbished residential buildings with substantial reduction in energy demand.

### 2.1 Eligible buildings

Multiconsult has investigated a sample of Sparebank1 Boligkreditt's portfolio and can confirm that the reviewed residential buildings have been identified as eligible for green bonds qualifying eligibility criteria 1 in the following section.

With regards to residential buildings in the rest of the loan portfolio that meet criteria 2 or 3 in the following section, the initial aim is to develop an easily applicable but nevertheless reliable assessment methodology for Sparebank1 Boligkreditt to select eligible mortgages whenever the Energy Performance Certificate data becomes publicly available in Norway.

### 2.2 Availability of data to identify the rest of the eligible buildings that meet criteria 2 or 3

Energy performance data for residential buildings are not easily available for lenders or investors. The Energy Performance Certificate, a possible source of data, is at the present not publically available.

National regulations (Energimerkeforskriften §20) specify that data from the register shall be available for science and statistical purposes. But personal ID-numbers, organization numbers or individual buildings shall not be possible to identify. It is still, as of today, possible to look up the EPC of a specific address individually on the EPC homepage [energimerking.no](http://energimerking.no). However, this is done manually address by address. It is not possible for the bank to link a portfolio of addresses or individual dwellings to energy certificates automatically, based on publically available data.

Enova, which is responsible for the EPC system, aims to make the register publically available and accessible, and several banks and other financial interests have already initiated this for the Ministry. However, an amendment of today's regulations will be necessary. Therefore, the publication of the database is uncertain and will probably prolong, depending on other considered changes in the regulation.

Multiconsult does through assignments for NVE and Enova have access to the full database. As of today it will be possible for Multiconsult, with an acceptance from Enova, to link the individual residences to the register, and give the energy certificate results for individual dwellings, based on some key information:

<sup>4</sup> Multiconsult. Based on building code assignments for DIBK

- Address- street and number, postal code
- Apartment number (if applicable )
- Building identifiers GNR (Gårdsnummer) and BNR– (Bruksnummer)

Easily accessible data is building year, and with a development in building code, expected energy performance may be calculated.

### 3 Eligibility criteria

Multiconsult has studied the Norwegian residential building stock and identified three solid eligibility criteria for Green Bonds on energy efficient buildings. The criteria are similar to Climate Bonds Initiative (CBI) methodology already used in similar markets. Criteria 1 and 2 together identifies the top 10- 15 % most energy efficient residential buildings countrywide, while criteria 3 identifies buildings that has undergone refurbishment resulting in more than 30 % reduction in energy demand.

The associated eligibility criteria are defined below. Eligible Residential Green Buildings must meet one or more of the following eligibility criteria:

1. New or existing Norwegian residential buildings that comply with the Norwegian building codes of 2007 (TEK07), 2010 (TEK10) or 2017 (TEK17) are eligible for green bonds as all these buildings have significant better energy standards and account for less than 15 % of the residential building stock. A two year lag between implementation of a new building code and the buildings built under that code must be taken into account, hence all residential buildings finished in 2009 and later are all eligible for Green Bonds under this criteria.
2. Existing Norwegian residential buildings built using older building codes than TEK07 with EPC-labels A, B and C. These buildings may be identified in data from the Energy Performance Certificate (EPC) database.
3. Refurbished Norwegian residential buildings with at least a 30 % improvement in energy efficiency measured in specific energy, kWh/m<sup>2</sup>, compared to the calculated demand based on building code in the year of construction. These buildings may be identified using the EPC database. Comparing calculated energy use available in the database with calculated demand based on relevant building code for year of construction, buildings meeting the requirements are identifiable.

### 3.1 New or existing Norwegian residential buildings that comply with the Norwegian building codes of 2007 (TEK07), 2010 (TEK10) or 2017 (TEK17): 8%

Changes in the Norwegian building code have consistently over several decades resulted in more energy efficient buildings. As of 2017, 8 % of Norwegian residential buildings are eligible according to criteria number 1; all residential buildings built according to TEK07, TEK10 and TEK17 are eligible for Green Bonds as they are the top 8 % energy efficient buildings in the country.

The Climate Bonds Initiative (CBI) methodology for energy efficient residential buildings is not yet in place for Norwegian conditions. The methodology is however based on CBI taxonomy, where the top 15 % most energy efficient buildings are considered eligible.

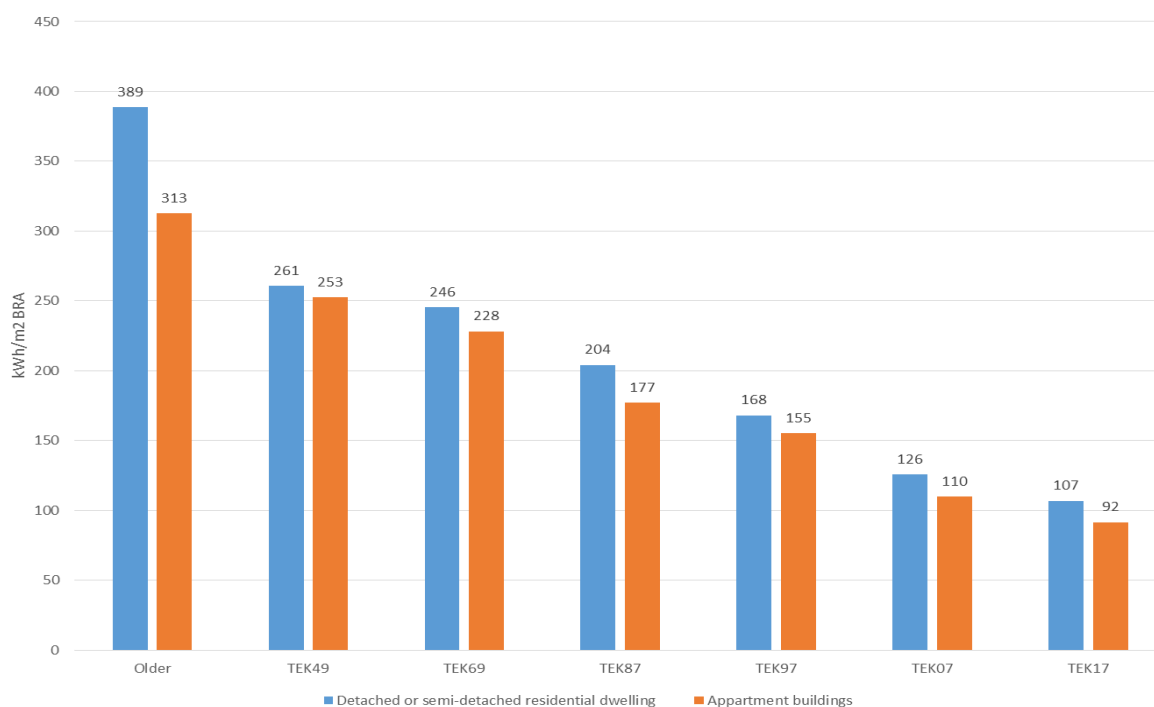


Figure 2 Development in calculated specific net energy demand based on building code and building tradition, (Multiconsult, simulated in SIMIEN)

Net energy demand is calculated for model buildings used for defining the building code (TEK7/TEK10/TEK17). The result presented in figure 2 illustrates how the calculated energy demand declines with decreasing age of the buildings. From TEK07 to TEK17 the reduction is about 15 % and the former shift from TEK97 to TEK07 was no less than 25 %. Note that, for dwellings, there was no change between TEK07 and TEK10 effecting energy efficiency, hence the missing TEK10 bar in figure 2.

The figure gives theoretical values for representative models of an apartment and a detached and semi-detached residential dwelling, calculated in the computer programme SIMIEN and in accordance to Norwegian Standard NS 3031:2014 *Calculation of energy performance of buildings. Method and data*, and not based on measured energy use. In addition to the guiding assumption in Norwegian Standard NS3031:2014, experience with building tradition is included. For older buildings the calculated values tend to be higher than the actual measured use, mostly because the ventilation air flow volume is assumed as high as in newer buildings, but no heat recovery. Indoor air quality is assumed not to be dependant on building year. This is the same methodology as used in the EPC-system.



Building code	Specific energy demand apartment buildings (model homes)	Specific energy demand other dwellings (model homes)
TEK 07 and TEK 10	110 kWh/m <sup>2</sup>	126 kWh/m <sup>2</sup>
TEK 17	92 kWh/m <sup>2</sup>	107 kWh/m <sup>2</sup>

Table 1 Specific energy demand calculated for model buildings

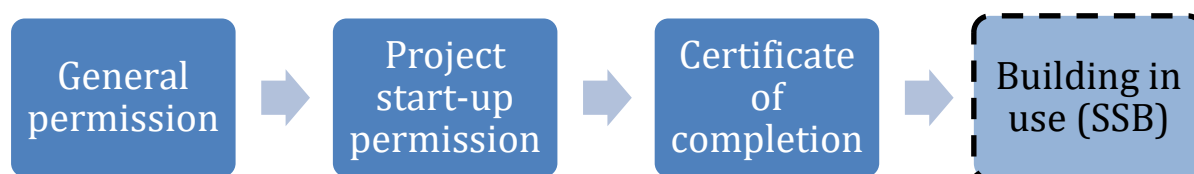
Table 1 include the specific energy demand calculated by using the standard model buildings for the building codes relevant for identifying the top 15 % energy efficient residential buildings in Norway.

The building codes are having a significant effect on energy efficiency. An investigation of the energy performance of buildings registered in the EPC database younger than 1997 show a clear improvement in the calculated energy level for buildings finished after 2008/2009 when the building code of 2007 came into force. The same observation on improvement can be done from 1997 to 1998 when the building code of 1997 came into force.

In the period between 1998 and 2009, a period when there was no change in the building code, it is difficult to see any clear changes, however a small reduction of energy use might have taken place in the latest years. This might be due to an increased use of heat pumps in new buildings, and to a certain degree better windows.

### 3.1.1 Time lag between building permit and building period

After the implementation of new a building code there is some time before we see new buildings completed according to this new code. The lag between the date of general permission received (no; rammetillatelse), which decides which code is to be used, and the date at which the building is completed and taken into use, varies a lot depending on things such as the complexity of the site and project, financing and the housing market.



The time from when general permission is granted to when the project start-up permission is granted is often used for design, sales and contracting. Based on Multiconsult's experience, six months to a year is a reasonable timespan for this phase. The figure below, based on statistics from Statistics Norway, indicates that approximately a one year construction period is standard for residential buildings.

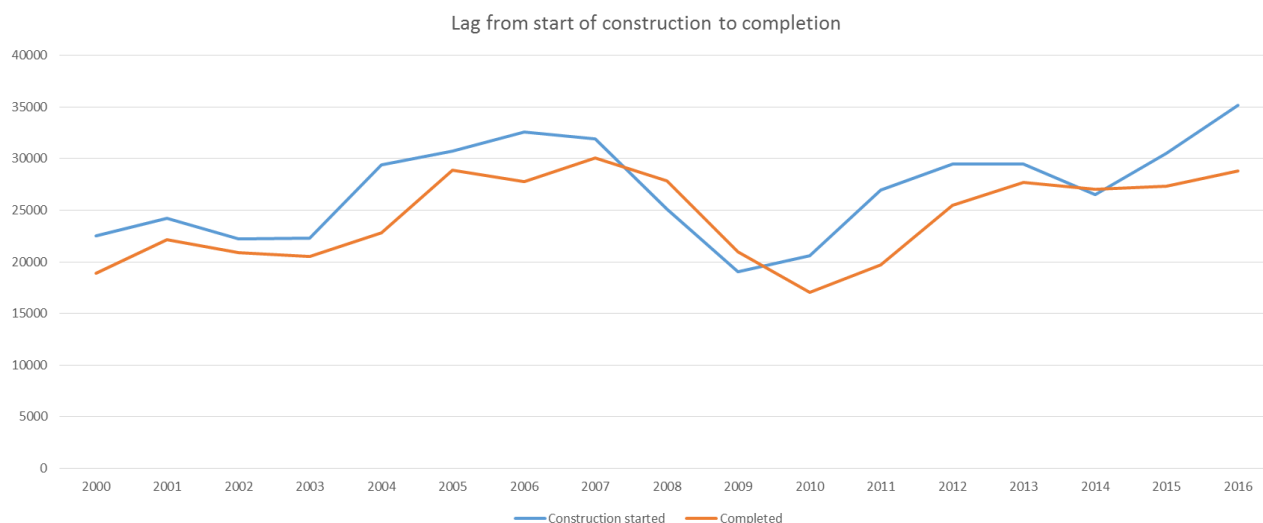


Figure 3 Project start-up and completion (Statistics Norway, bygningsarealstatistikken)

The 2007 building code was implemented in February 2007. Based on the discussions on time for design and construction, we regard a time-lag of two years between code implementation and buildings based on this code to be a robust and conservative assumption. All buildings finished in 2009 are assumed to have used TEK07. There are likely buildings finished in 2008 built under that code as well, but equally, the year 2009 may also contain some delayed projects built later based on TEK97.

### 3.1.2 Building age statistics

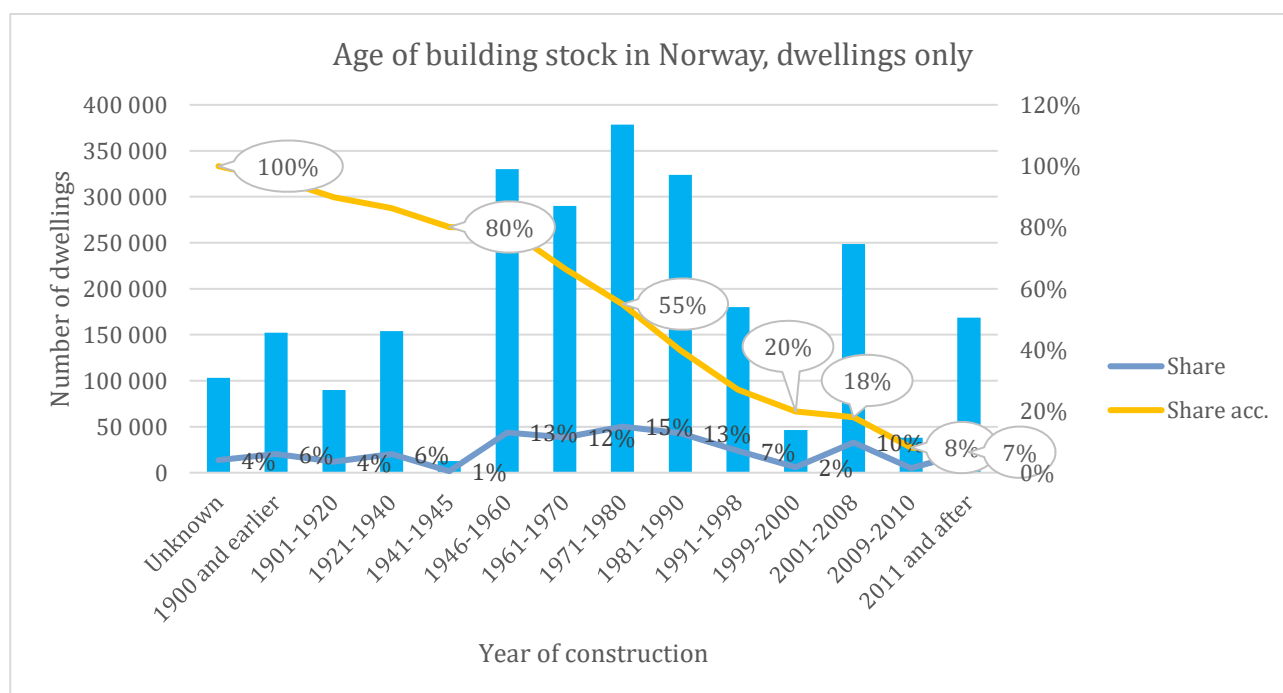


Figure 4 Age distribution of dwellings (Statistics Norway<sup>5</sup>)

<sup>5</sup> Boligstatistikken, Tabell: 06266: Boliger, etter bygningstype og byggeår (K)

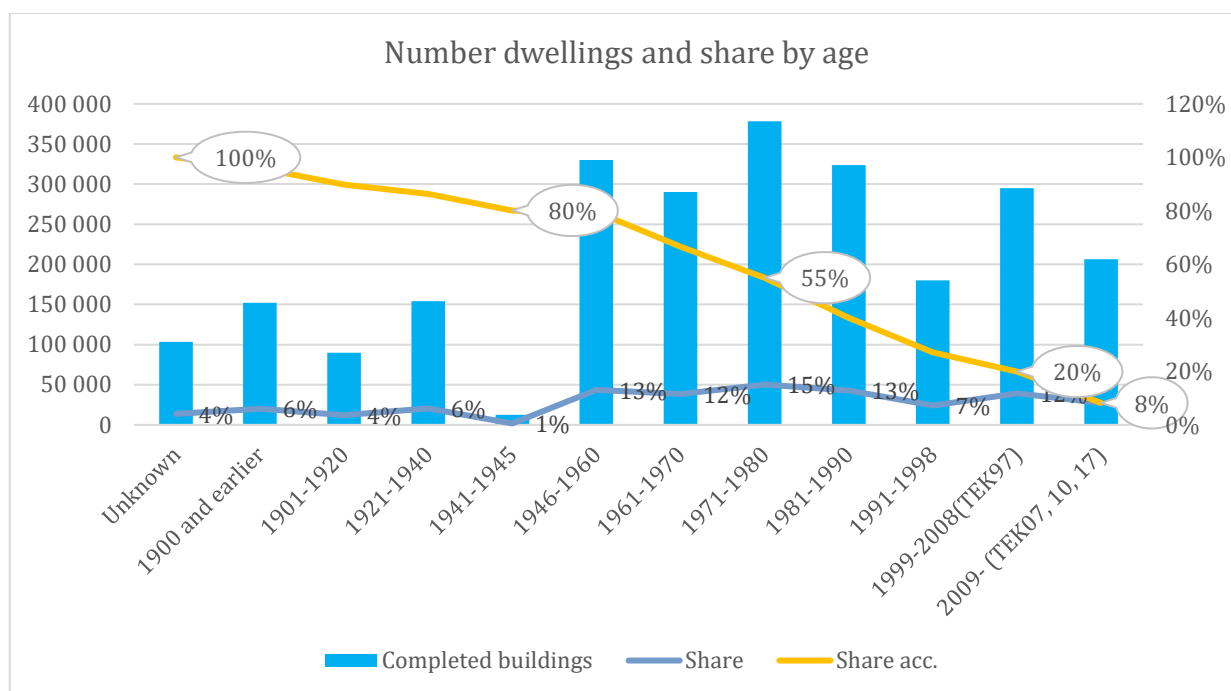


Figure 5 Age and building code distribution of dwellings (Statistics Norway<sup>65</sup> and Multiconsult)

Figure 4 above shows how the Norwegian residential building stock is distributed by age. The same statistics are adjusted by new intervals available by using statistics on building area (Bygningsarealstatistikken). Figure 5 shows how buildings finished in 2009 and later (and built on TEK07 or better) amount to 8 % of the total stock. Based on theoretical energy demand in the same building stock, the same 8 % of the stock makes up for only 3 % of the energy demand in residential buildings and 4 % of the related CO<sub>2</sub>- emissions.

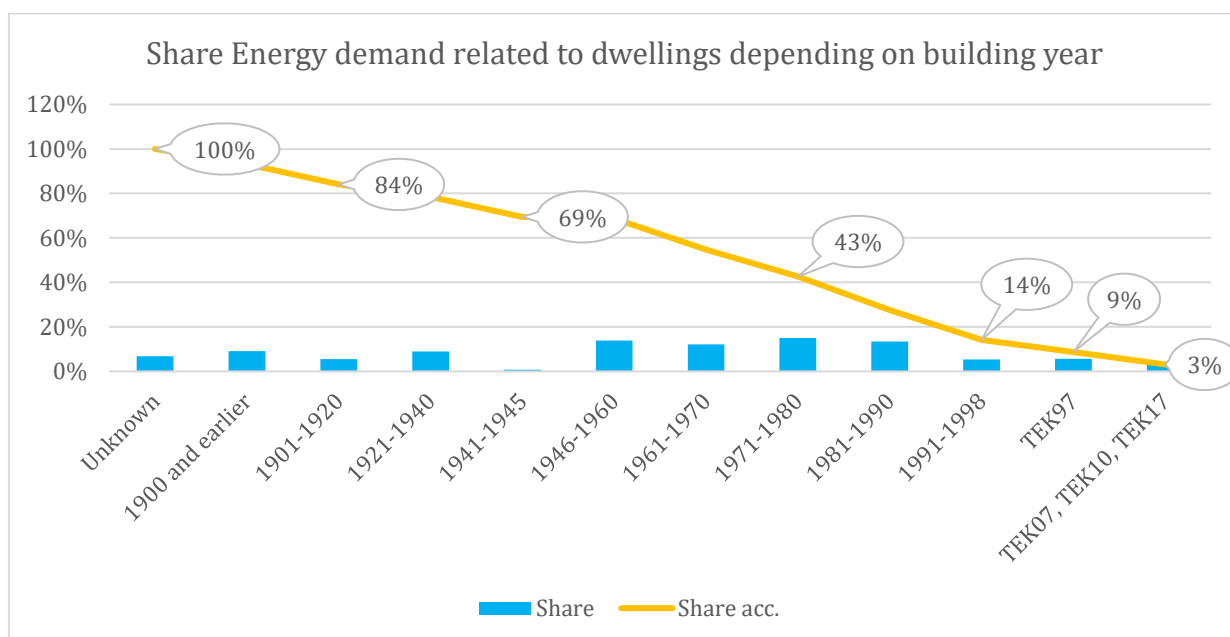


Figure 6 The building stock's relative share of energy demand dependent on building year and code (Statistics Norway and Multiconsult)

<sup>65</sup> Boligstatistikken, Tabell: 06266: Boliger, etter bygningstype og byggeår (K). Adjusted to match the development of building code.

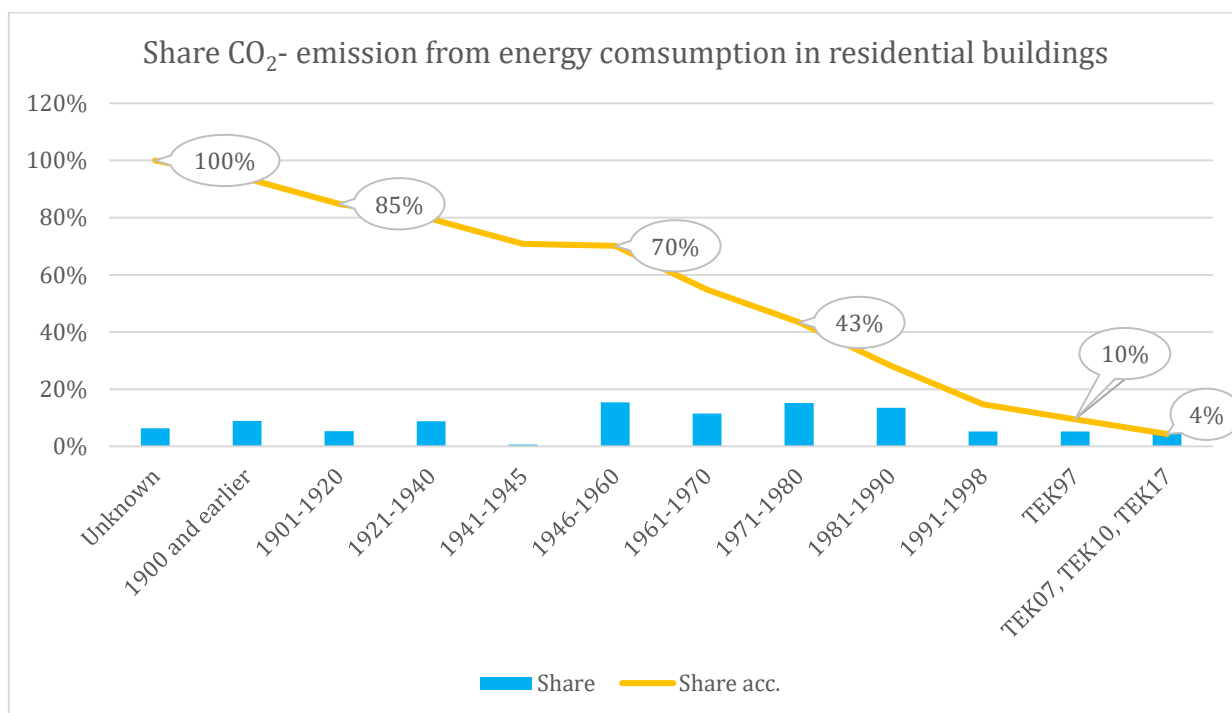


Figure 7 The building stock's relative share of CO<sub>2</sub> –emissions related to energy demand dependent on building year and code (Statistics Norway and Multiconsult)

### 3.1.3 Eligibility under criteria 1

Over the last several decades the changes in the building code have pushed for more energy efficient residential buildings. The building stock data indicates that 8 % of the current residential buildings in Norway were constructed using the 2007 code or a younger code with even more energy efficient solutions.

### 3.2 Norwegian residential buildings built using older building codes than TEK07 with EPC-labels A, B and C: 4.2 %

#### 3.2.1 EPC labels to identify energy efficient residential buildings

The Energy Performance Certificate (EPC) system would be a trustworthy and good source for definition of green mortgages. All buildings with an energy grade of A, B or C is eligible as green residential buildings according to this criteria.

The Energy Certificate Performance System became operative in 2010. It was made obligatory for all new residences finished after the 1<sup>st</sup> of July 2010 and all old residences that are sold or rented out, to have an Energy Performance Certificate.

The figure below shows how the complete stack of residences in Norway is distributed by building code, and their certificate label. Because of the earlier mentioned lag between code implementation and constructed buildings, there are no building recorded in the TEK17 column.

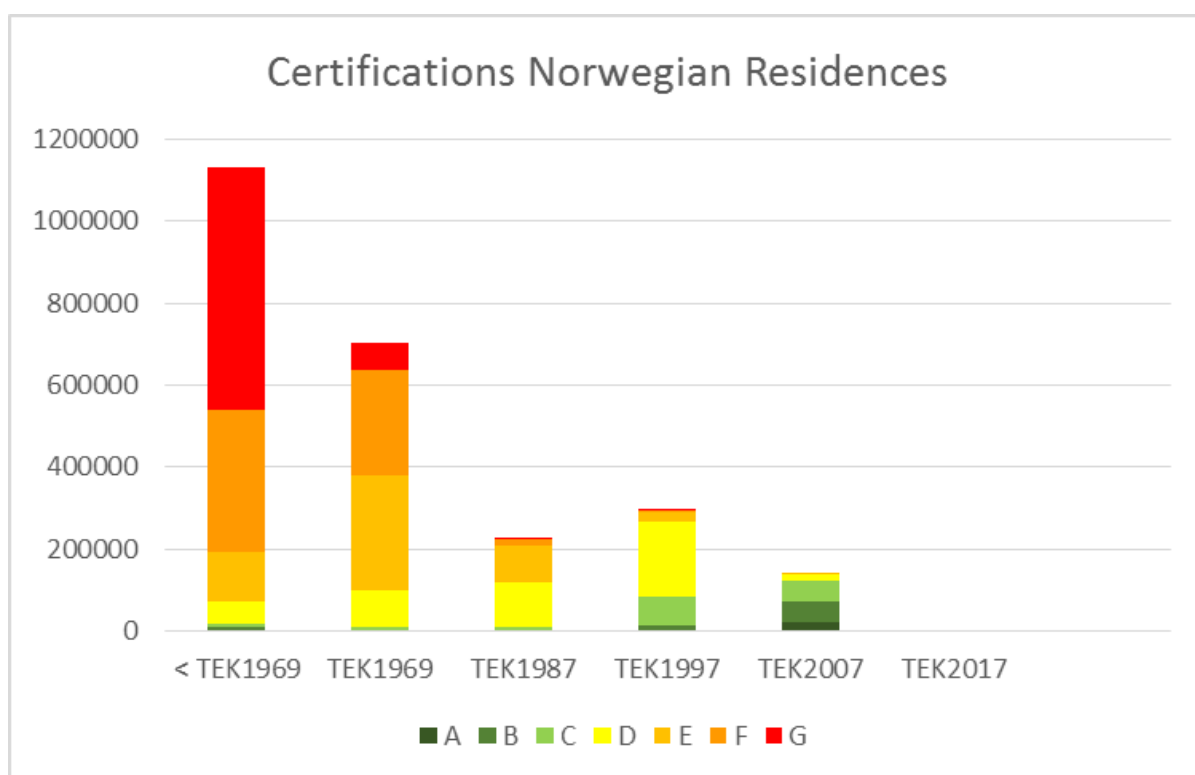


Figure 8 Total volume of residences in Norway, including individual houses and apartments, distributed per building code and Energy Performance Certificate. The numbers are based on statistics from Statistics Norway for number of Residences and statistics from the EPC database.

The registered properties in the EPC database are considered to be representative for the total stock. In total 10 % of the Norwegian Residences are expected to get a C or better (if all buildings with label D are included as well, the share adds up to more than 30 %). Extracting only buildings built before 2009, 4.2 % of the total stack is expected to get a C or better. These are buildings that have initially been built, or through refurbishment, attained higher energy efficiency standards than the original building year (and respective building code) would imply.

### 3.2.2 EPC grading statistics

#### Short facts about the Norwegian EPC

The energy label in the EPC system is based on calculated delivered energy, including the efficiencies of the building's energy system (power, heat pump, district energy, solar energy etc.). The building codes are defined by net calculated energy, not including the building's energy system.

The EPC does as of today consist of an energy label (A-G) and a heating label (defined as colour). The heating label is seldom used, and not considered relevant in the context of the criteria.

Registration is performed in two ways. Professionals must certify new buildings and non-residence buildings. Non-professional building-owners that are selling their house or apartment can however do the certification themselves in a simplified registration system. This latter system is based on simplified assumptions and conservative values, and its results are therefore less precise and might give a lower energy label than when professionals do the registration.

The energy grade is a result of calculated energy delivered to the residential building in "normal" use. The calculation method is described in the Norwegian Standard NS 3031. The table below shows the relationship between calculated energy delivered per square meters and energy grades for houses and apartments. This is the current grade scale:

Delivered energy per m <sup>2</sup> heated space (kWh/m <sup>2</sup> )							
	A	B	C	D	E	F	G
<b>Houses</b>	95	120	145	175	205	250	above F
<b>sqm. meter adjustment</b>	+800/A	+1600/A	+2500/A	+4100/A	+5800/A	+8000/A	
<b>Flats/Apartmnts.</b>	85	95	110	135	160	200	above F
<b>sqm. meter adjustment</b>	+600/A	+1000/A	+1500/A	+2200/A	+3000/A	+4000/A	

Table 2 Delivered energy EPC energy labels

A = heated floor area of the dwelling

Example: a 150 sq.m house would have a C qualification limit of  $145 + 2500/150 = 161.67 \text{ kWh/m}^2$

#### The grading system and C-label

The C grade is defined for residences so that a building built after the building codes of TEK2007 in most cases should get a C.

The limit value for reaching a C is calculated based on a representative model of an individual house and an apartment, built according to the building code of 2007, with an assumed moderate system efficiency for the building's energy system.

Residences built after the building code of 2007, as are included in criteria 1, will hence mostly get a C or better, but might also get a D.

As can be seen in figure 8, some buildings built after TEK 07 have indeed received a D. However, these are often 'strong' D's and will by a margin still be among the top 15 % of most energy efficient residences, and are included in criteria 1.

Particularly for apartments, the defined limit value between C / D in the grading system is set for an average apartment. An apartment in the top or bottom floor or at the corner will have a higher heat

loss, and will most likely get a D, and in some rare cases even an E, even though the building code of 2007 is used. But these apartments are still more energy efficient than apartments with similar locations in older apartment buildings, and are included in criteria 1.

Since a large part of the certifications are done in the simplified registration mode, and not by professionals, a larger share of existing TEK07-buildings do get a D, and in some rare cases even an E. Another reason why some existing houses and apartments built after the code of 2007 get a D, is that the grade scale has been revised and tightened three times between 2011 and 2015. So for example, a house that had a C when it was new in 2012, could have a D in its EPC when it was resold in 2015.

Therefore, most of the poorer grades D (and E) for TEK07-buildings are due to either one or a combination of these things; the conservative method of calculation in the simplified registration system, unfavourable location of an apartment in apartment buildings, a geometrically unconventional building form with higher energy losses than the representative model, and/or the revised and tightened grading scale. So the building itself is not necessarily less energy efficient.

Figure 9 shows the energy grades in the already granted certificates to Norwegian residential buildings.

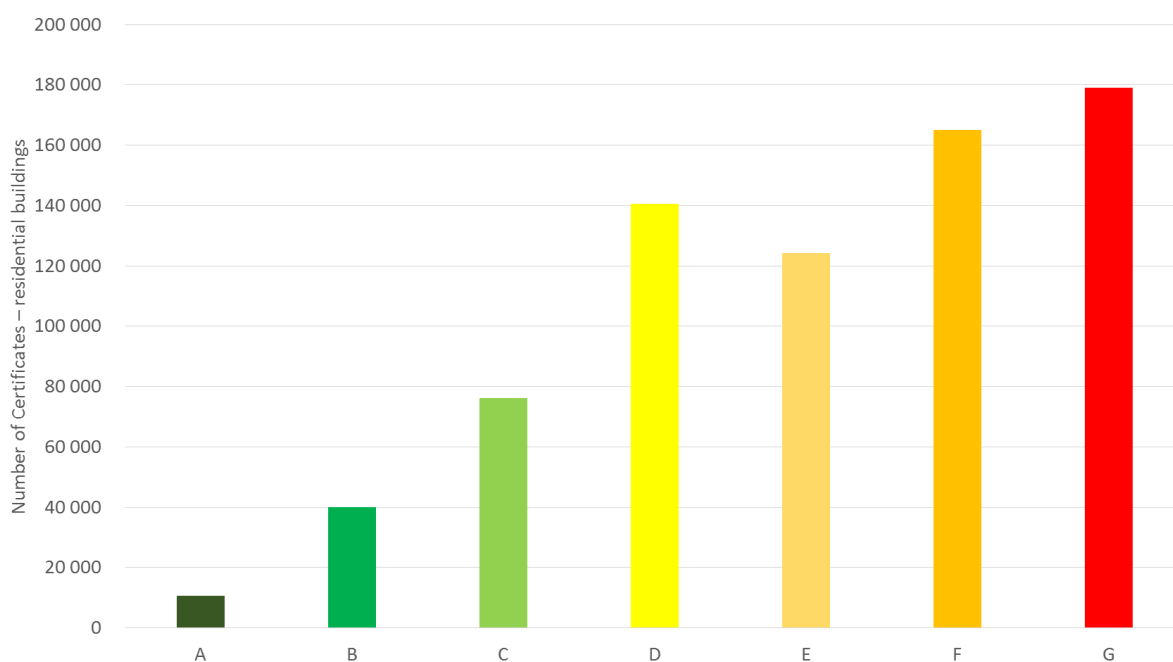


Figure 9 Energy Performance Certificates by grade- residential buildings only (Source: energimerking.no, January 2018)

### 3.2.3 Eligibility under criteria 2

An Energy Performance Certificate is mandatory for new buildings and existing residential buildings that are sold or rented. The EPC data indicates that 10 % of the current residential buildings in Norway will have a C or better. New buildings are eligible under criteria 1. Norwegian residential buildings built using older building codes than TEK07 with EPC-labels A, B and C represent 4.2 % of the residential building stock. These all are eligible under criteria 2.

### **3.3 Refurbished Norwegian residential buildings with an improved energy efficiency of 30 %; 2%**

Refurbished buildings with an improved energy efficiency of 30 % or more are eligible for Green Bonds. CBI has a similar Property Upgrade Climate Bonds Certification methodology where the carbon reduction targets can be derived using a linear equation between a 30-year bond and a 5-year bond. In this case, we are looking for identifying buildings that already have improved energy performance in this scale. To identify relevant residential buildings, the calculated delivered energy in the EPC database are compared to calculated energy demand for different TEK periods (shown in figure 2). Energy supply is then assumed to be electricity as baseline, heating included. A building that has undergone adequate measures on the building envelope (insulation, changing windows, etc.) and/or heat recovery in ventilation and/ or installed highly efficient energy supply (heat pump, solar energy) can thus qualify. The comparison is made only for buildings in the EPC database that have grade D to G and are older than 2009. This to avoid overlap with buildings qualifying criteria 1 and 2. The EPC data indicate that approx. 2 % of the current residential buildings in Norway (older than 2009 and with grade D or worse) are eligible.

#### **3.3.1 Eligibility under criteria 3**

Refurbished residential buildings with at least a 30 % improvement in energy efficiency measured in specific energy, kWh/m<sup>2</sup>, compared to the calculated demand based on building code in the year of construction. (This equates to a two step improvement in energy label).