REPORT

Sparebank1 Boligkreditt Green Bond

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 applied developed criteria and a methodology to identify the most energy efficient residential buildings in Norway, to be used with respect to a green covered bond issuance. The criteria is in line with CBI country specific sector criteria. In this document we describe Sparebank1 Boligkreditt's identification criteria, the evidence for the criteria and the result of an analysis of a part of the loan portfolio of Sparebank1 Boligkreditt. The criteria to select the buildings are based on credible standards in Norway such as the Norwegian building regulation and Energy Performance Certificates.

Energy use in Residential buildings

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

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. From 2020, all use of fossil oil is banned from use in buildings. The fuel mix in Norwegian district heating production in 2018 included only 5.2 % from fossil fuels (oil and gas) (Fjernkontrollen[1]). In 2018, the Norwegian power production was 98 % renewable (NVE[2]).

As shown in figure 1, the Norwegian production mix in 2018 gives resulting emissions of 11 gCO_2/kWh. In a life-cycle analysis, the Norwegian Standard NS 3720:2018 "Method for greenhouse gas calculations for buildings" take into account international electricity trade and that the consumption is not necessarily equal to domestic production. The standard calculates the average CO_2- factor for the lifetime of a building to 136 g CO_2/kWh for EU28+ Norway and 18 g CO_2/kWh for Norwegian production mix only. Applying the factor based on EU28 + Norway energy production mix, the resulting CO_2- factor for Norwegian residential buildings[3] is on average 126 g CO_2/kWh.

[1] http://fjernkontrollen.no/
[2] https://www.nve.no/energy-market-and-regulation/retail-market/electricity-disclosure-2018/
[3] Multiconsult. Based on building code assignments for DiBK

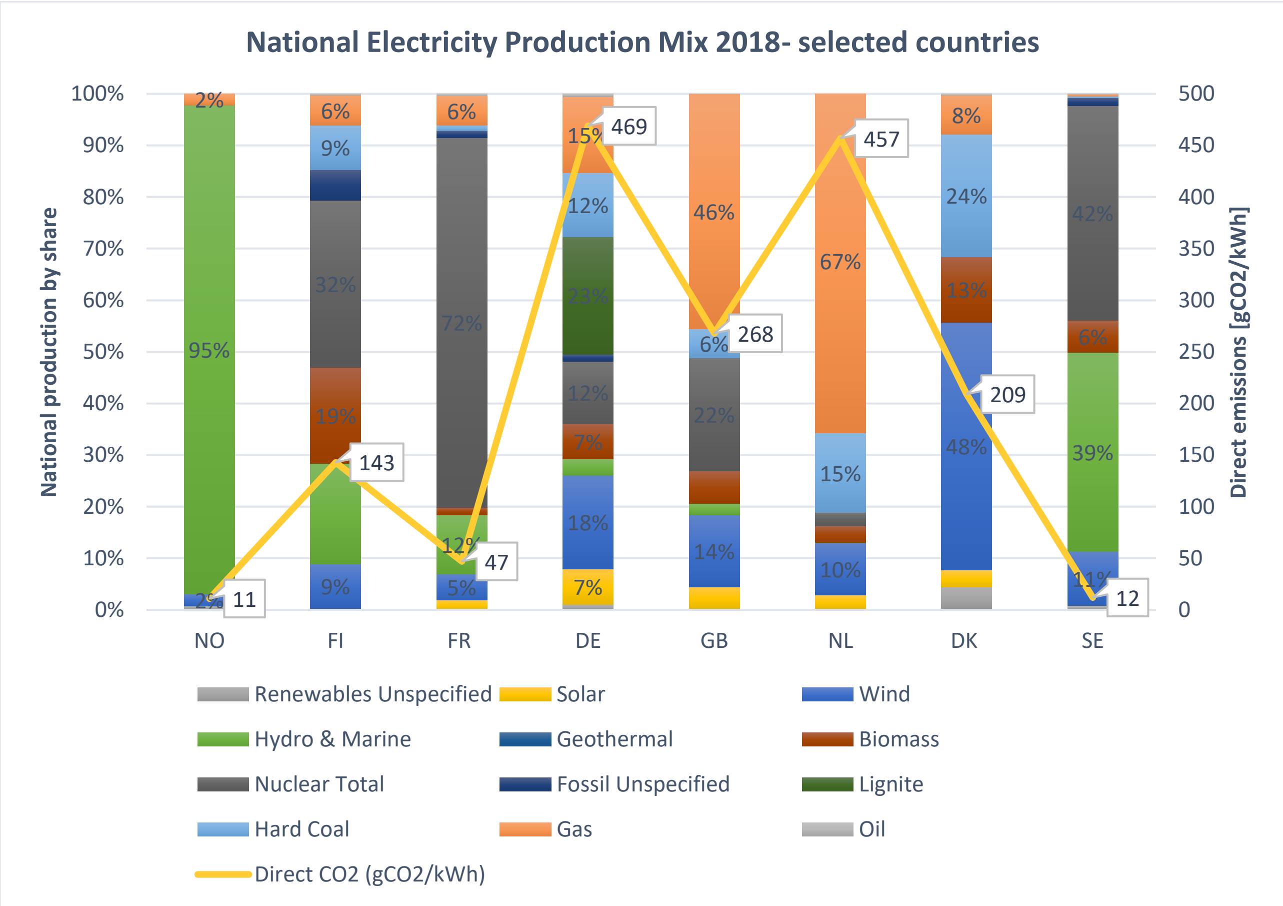


Figure 1 National electricity production mix in some relevant countries (European Residual Mixes 2018, Association of Issuing Bodies[4])

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 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.

[4] https://www.aib-net.org/facts/european-residual-mix

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

There are two notable limitations with respect to the EPC database. The first regards some process and data quality issues. It is currently difficult for the public to fully utilise the database and link it to the mortgage data. While the process of sorting the existing data is ongoing, ENOVA, state owned entity responsible for the EPC database and system development, is also restructuring the approach to the energy labels and a new system which may be in place in a few years. The other limitation is that the EPC database only covers around 50% of the total residential building stock. Both of these conjointly mean that the EPC database in its current form is not representative of the total Norwegian building stock and hence the use of building regulation remains the most relevant proxy for identifying green buildings in Norway.

Individual energy performance data for residential buildings are not easily available for lenders or investors. The Energy Performance Certificates are at the present not publically available, however, matching against a portfolio is possible on the existing data set for the purpose of green bond issuance. Before the data is made publicly available the database is to be cleaned of faulty data and IT solution established for easy access. The released data will be limited to some key items as energy label. Specific energy demand or certificate history for individual assets will not be made available, at least not first time around.

When permission is granted to access and utilise the database, it will be possible to link the individual residences to the register, and give the energy certificate results for individual assets, based on some key information:

- 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.

The database is already available for statistical purposes and an investigation shows that, comparing the number of certificates with actual buildings in the building stock from Statistics Norway, less than 50 % of dwellings have an energy performance certificate. This is based on raw data, even before the database has been cleaned of double entries and test entries. This influences the data quality for developing eligibility criteria and the pool of which a bank may identify objects in their portfolio. Furthermore, new buildings are much better represented in the statistics than older and less energy efficient buildings. In case all buildings had a certificate, the distribution in the statistics would shift towards poorer energy grades.

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 have been aligned with the Climate Bonds Initiative (CBI) and will be published as a CBI baseline for Norwegian residential buildings. The criteria that derive the baseline are similar to the CBI methodology already used in similar markets. Criterion 1 identifies the top 10 % most energy efficient residential buildings countrywide. The CBI baseline methodology also includes criteria using data from Energy Performance Certificates when available and according to CBI taxonomy, residential buildings may also qualify after being refurbished to a standard resulting in at least a 30 % reduction in energy demand[5].

Eligible Residential Green Buildings for Sparebank1 Boligkreditt must meet the following eligibility criteria:

1. New or existing Norwegian residential buildings that comply with the Norwegian building code of 2007 (TEK07) and later codes for small residential buildings [6]and code of 2010 (TEK10) and later codes for apartments 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.

2. Existing Norwegian residential buildings with EPC-labels A, B or C. These buildings may be identified in data from the Energy Performance Certificate (EPC) database.

3. Refurbished Norwegian residential buildings with EPC-labels which corresponds to at least a 30 % improvement in energy efficiency compared to the calculated specific delivered energy [kWh/m^2] based on building code in the year of construction. These buildings may be identified using the EPC database and prepared tables in this report identify which EPC-label corresponds to at least 30% energy reduction for the given construction year.

[5] https://www.climatebonds.net/standard/buildings/upgrade
[6] Include residential buildings from single family houses, detached, undetached and semi-detached dwellings, and buildings with up to four apartments.

3.1 New or existing Norwegian residential buildings that comply with the Norwegian building code of 2007 (TEK07) or later codes for small residential buildings, and code of 2010 (TEK10) and later codes for apartments: 10 %

Changes in the Norwegian building code have regularly over several decades resulted in more energy efficient buildings. As of 2019, 10 % of Norwegian residential buildings are eligible according to the Sparebank1 Boligkreditt's criterion.

The methodology is based on Climate Bonds Initiative (CBI) taxonomy, where the top 15 % most energy efficient buildings are considered eligible. The Sparebank1 Boligkreditt's criterion is in line with the CBI baseline methodology for energy efficient residential buildings for Norwegian conditions published in spring 2018.

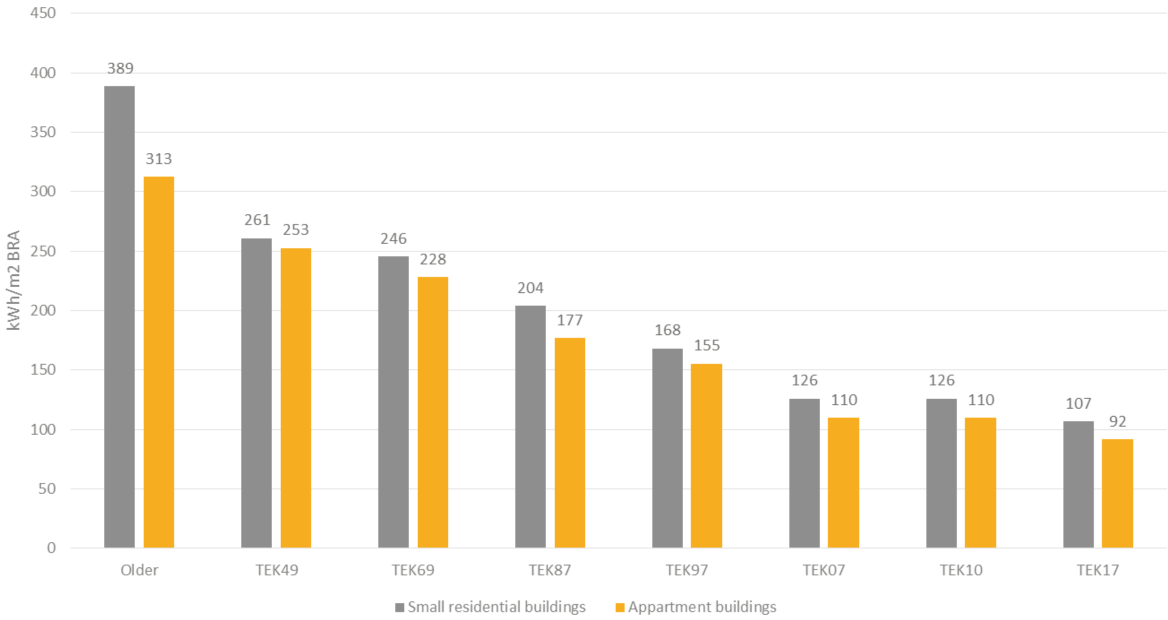


Figure 2 Development in calculated specific net energy demand based on building code and building tradition, (Multiconsult simulations performed in SIMIEN)

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.

The figure gives theoretical values for representative models of an apartment and a detached and semi-detached residential building, calculated in the computer programme SIMIEN and in accordance to Norwegian Standard NS 3031:2014 *Calculation of energy performance of buildings. Method and dat*a. The values do not include information of 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 dependent 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^2	126 kWh/m^2
TEK 17	92 kWh/m^2	107 kWh/m^2

Table 1 Specific energy demand calculated for model buildings

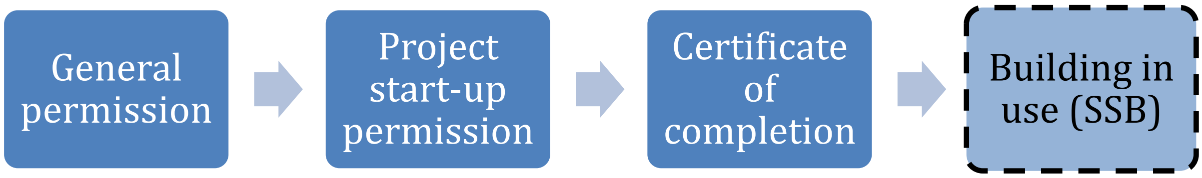
Table 1 include the specific energy demand calculated by using the standard model buildings for the building codes relevant for identifying the top 15 % energy efficient residential buildings in Norway.

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 us 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 a new 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 the complexity of the site and project, financing and the housing market etc.



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.

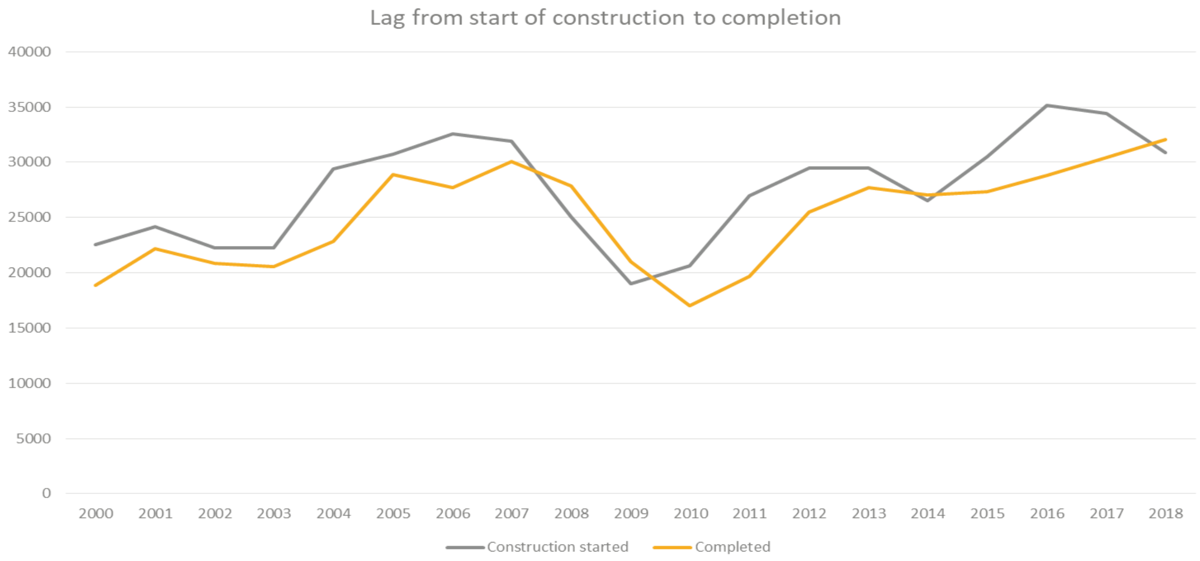


Figure 3 Project start-up and completion (Statistics Norway, bygningsarealstatistikken 2019)

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. All buildings finished in 2012 are assumed to have used TEK10.

3.1.2 Building age statistics

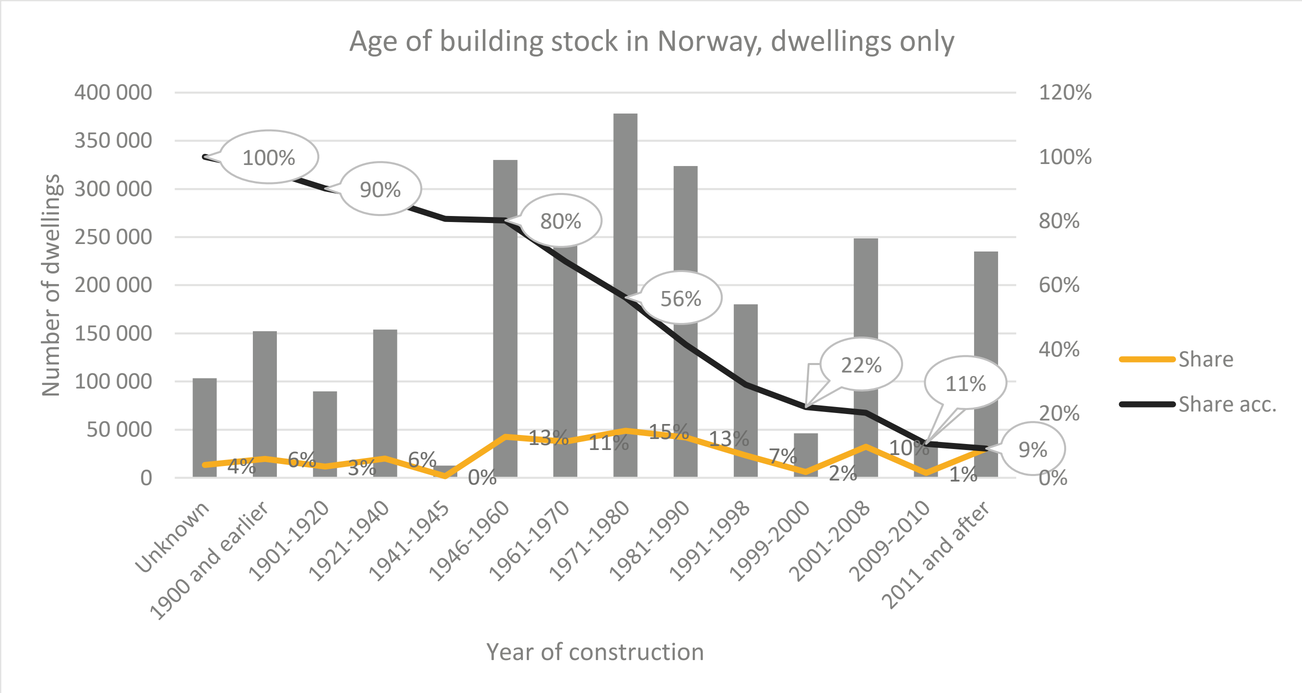


Figure 4 Age distribution of dwellings (Statistics Norway[7])

[7] Boligstatistikken, Tabell: 06266: Boliger, etter bygningstype og byggeår (K)

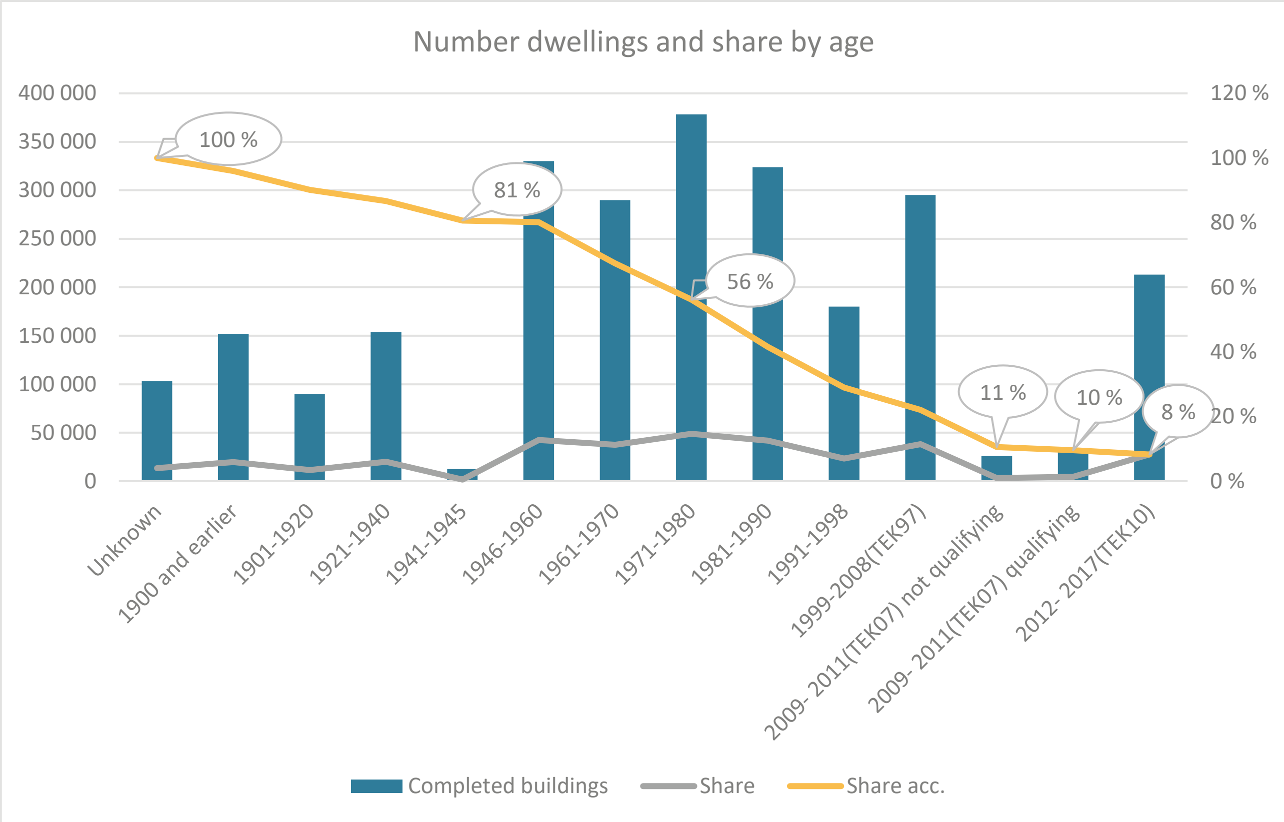


Figure 5 Age and building code distribution of dwellings (Statistics Norway[8] and Multiconsult)

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. Figure 5 shows how the sum of small residential buildings finished in 2009 and later (TEK07 or better) and apartments finished in 2012 and later (TEK10 or better) amount to 10 % of the total stock. Based on theoretical energy demand in the same building stock, the same 10 % of the stock makes up for only 4 % of the energy demand in residential buildings and 3 % of the related CO_2- emissions.

[8] Boligstatistikken, Tabell: 06266: Boliger, etter bygningstype og byggeår (K). Adjusted to match the development of building code.

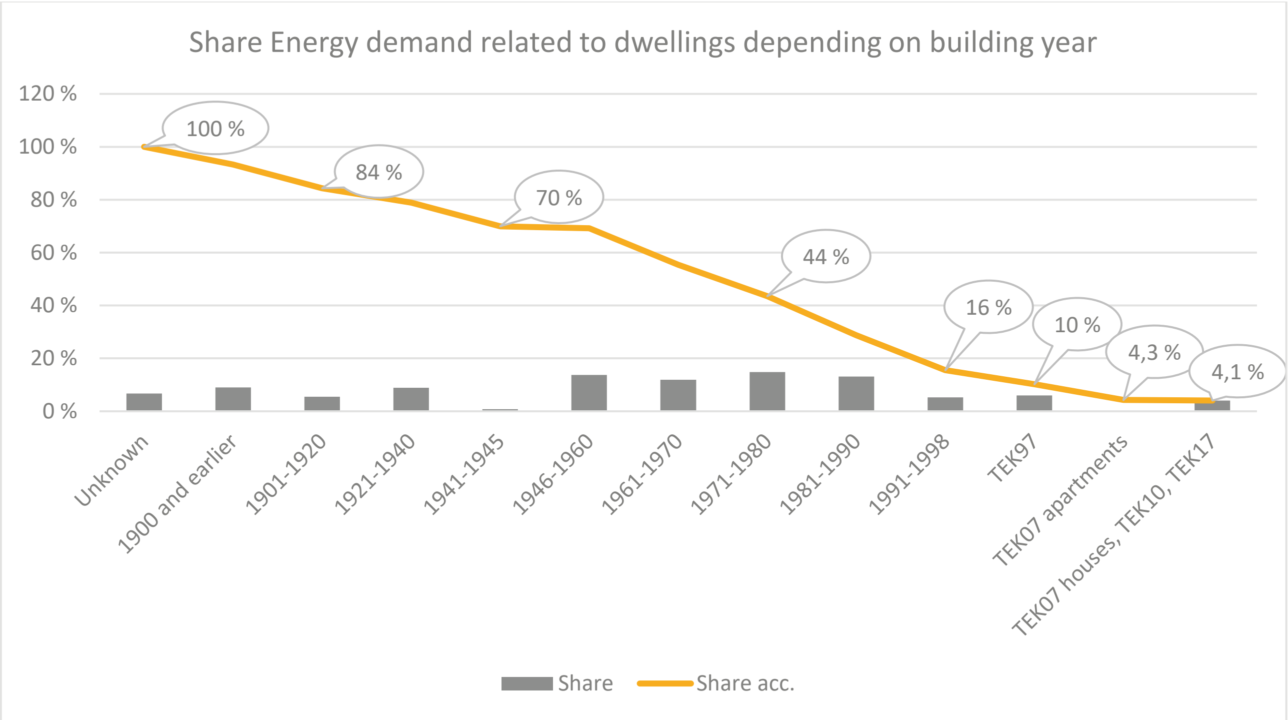


Figure 6 The building stock's relative share of energy demand dependent on building year and code (Statistics Norway and Multiconsult)

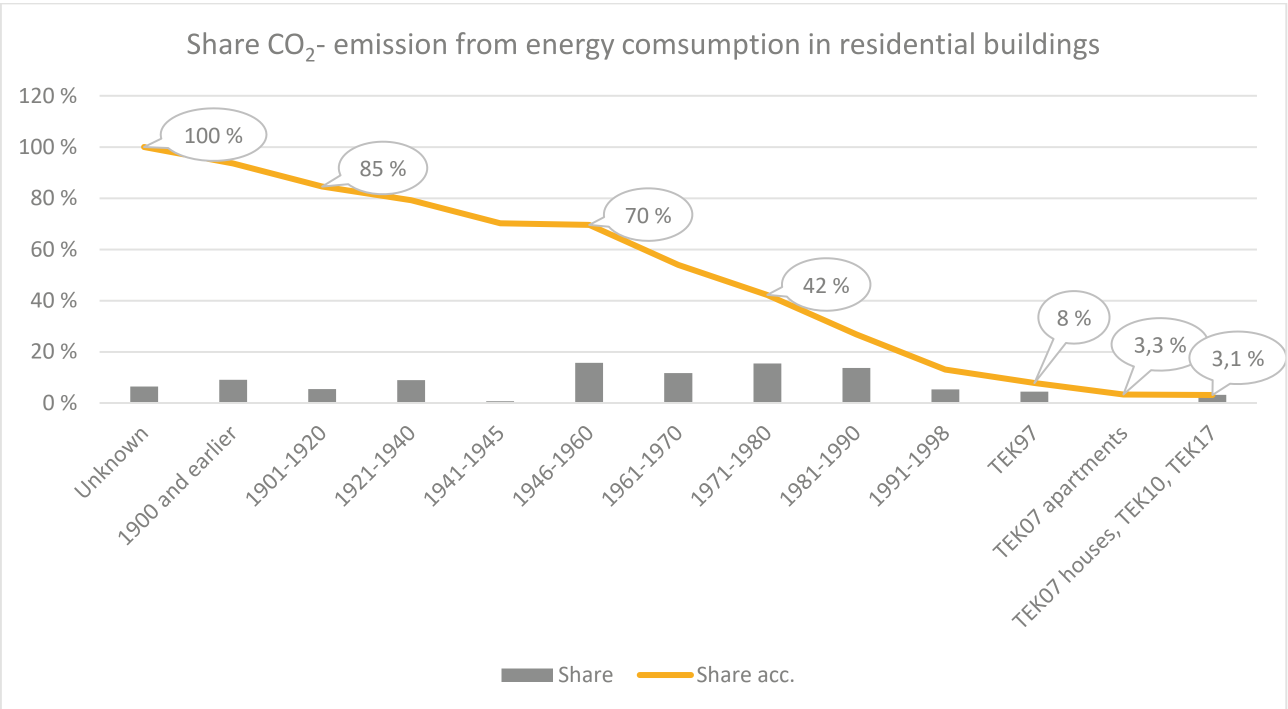


Figure 7 The building stock's relative share of CO_2 –emissions related to energy demand dependent on building year and code (Statistics Norway and Multiconsult)

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 10 % of the current residential buildings in Norway were constructed using the most recent codes qualifying under the criterion.

3.2 Norwegian residential buildings built using older building codes than TEK07 for small residential buildings and TEK10 for apartments with EPC-labels A, B and C: 5.2 %

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 Performance Certificate System became operative in 2010. It was made obligatory for all new residences finished after the 1st 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 with EPC's in Norway is distributed by building code, and their certificate energy label. Because of the earlier mentioned lag between code implementation and constructed buildings, there are no building recorded in the TEK17 column.

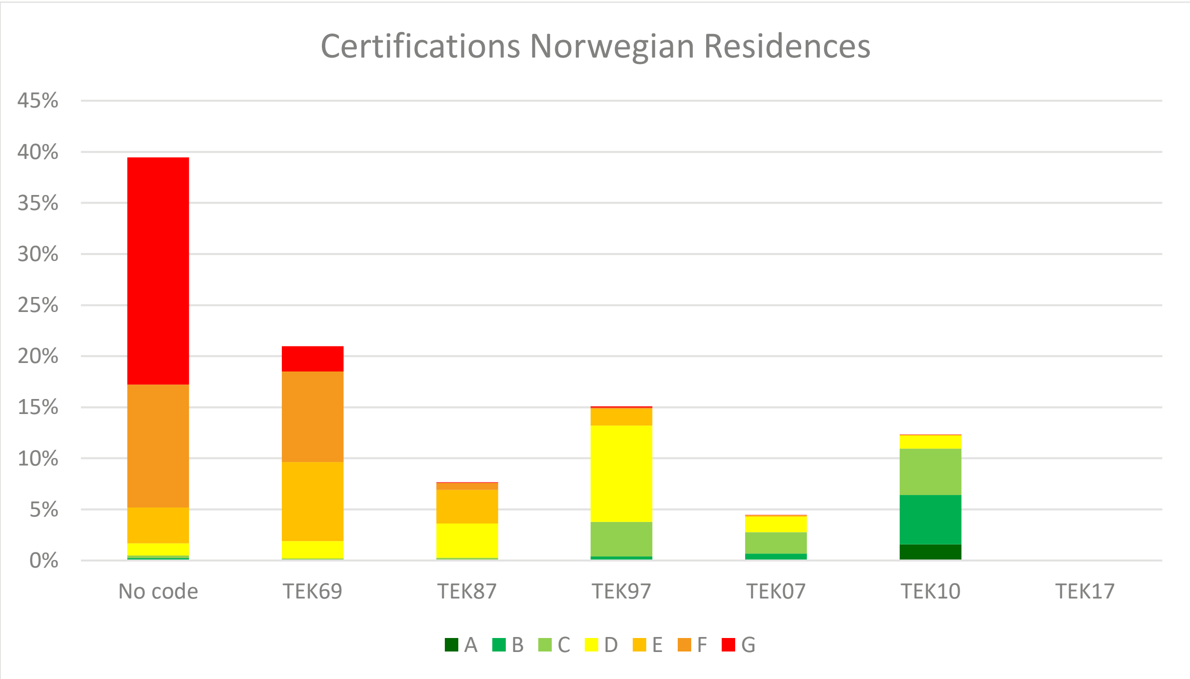


Figure 8 Total volume of residences in Norway, including individual houses and apartments, distributed per building code and Energy Performance Certificate. The numbers are based on statistics from Statistics Norway on number of Residences and statistics from the EPC database (representative for 50 % of the total building stock).

The registered properties in the EPC database may be considered to be representative for the buildings built under the same building code, however not representative for the total stock as younger buildings are highly overrepresented in the database. There is currently a coverage ratio of EPC labels relative to the total building stock equal to 50 %. Extracting from the EPC database only small residential buildings built before 2009 and apartments built before 2012, 5.2 % 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 by colour codes). The heating label is seldom used, and not considered relevant in the context of the green asset selection criteria.

Registration of a residential buildings energy label is performed in two ways. Professionals must certify all newly constructed buildings and all non-residence buildings. Non-professional building-owners that are selling their house or apartment must, however, since January 2010 perform the certification themselves in a simplified registration system. Non-professional building-owners may trust a professional but this is very rarely the case. This simplified registration system, run by ENOVA (which is the government's agency for energy transformation policies), 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 meter and energy grades for houses and apartments. This is the current grade scale:

Delivered energy per m^2 heated space (kWh/m^2)							
	A	**B**	**C**	**D**	**E**	**F**	**G**
Houses	95	120	145	175	205	250	above F
sqm. meter adjustment	+800/A	+1600/A	+2500/A	+4100/A	+5800/A	+8000/A	
Flats/Apartments	85	95	110	135	160	200	above F
sqm. meter adjustment	+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 kWh/m^2

As described in the following section it is a direct connection between building code TEK10 and the energy grade C's lower limit value. The same connection is between TEK69 and the energy grade F's lower limit value. There are no other direct connections between the two scales. The net energy limit values in the building code is included in the table below for illustration.

Net energy demand per m² heated space (kWh/m²)							
	TEK17	**TEK10**	**TEK07**	**TEK97**	**TEK87**	**TEK69**	**TEK49**
Houses	107	126	126	168	204	246	261
Flats/Apartments	92	110	110	155	177	228	253

Table 3 Net energy demand calculated for different building codes (Note that values in tables 2 and 3 are not directly comparable since EPCs are based on delivered energy and TEK on net energy demand)

The grading system and C-label

The C grade lower limit value was initially defined by the, at that time, current building code. The EPC system came in place in 2010, and the prevailing building code at that time was the code of 2007 (TEK07). Since then, the limit values have been updated, so that the code of 2010 (TEK10) is currently the lower limit for C, and if a TEK07 building was to be given a certificate today, it would most likely get a D. Limit values have not been adjusted since and are not in line with the current TEK17. Indicated by ongoing work on the EPC system, the next changes to the system will be more extensive than a mere adjustment in limit values.

The lower limit value for reaching a C is still calculated based on a representative model for each building category, with standard values as in the building code of 2010 (TEK010). A moderate system efficiency, equal to the one of an energy system based on district heating, is assumed.

Residences built in accordance to the building codes TEK07 and TEK10, as are included in criterion 1, will hence mostly have a C or better when graded in due time in accordance to the regulations, but might with some diversions from the model building also get a D.

As can be seen in figure 8, some buildings built in accordance to 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 criterion 1.

For individual apartments, the defined limit value between C/D in the grading system is set for an <u>average</u> apartment (average specific energy demand in the model building, a three story apartment building of 900 m^2). Apartments are given individual EPC’s and the apartment on 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 criterion 1. With the next revision of the EPC system, we anticipate that apartments will not be graded individually as now but the apartment buildings as one.

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 since 2010. So for example, a house that would qualify for a C when it was new in 2011, 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 unfavourable 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.

Upcoming radical revision of the EPC system

The EPC system is under revision and full implementation of somewhat radical changes is expected to come into force in 2021-22. Capacity demand will most likely be introduced as a parameter. This will, however, not affect the system's ability to serve as a background for green bonds.

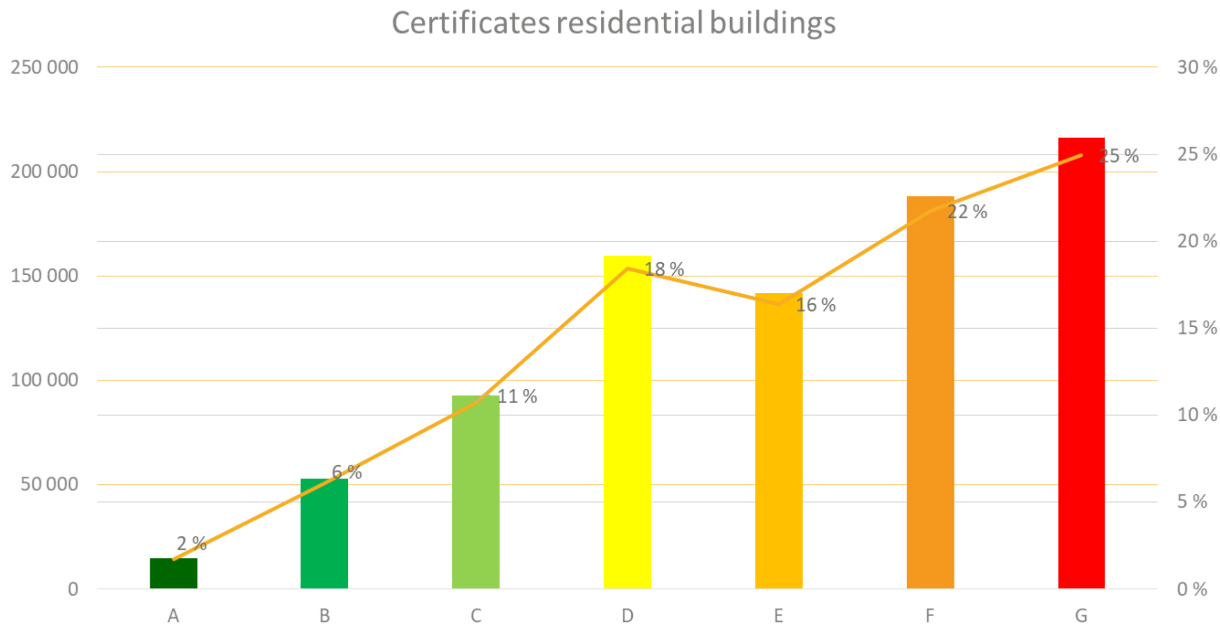


Figure 9 Energy Performance Certificates by grade- residential buildings only, representative only of buildings with EPCs (Source: energimerking.no, August 2019)

The EPC coverage is, however not equally distributed over the building stock. Figure 10 shows the age of the buildings with EPCs and in the building stock, respectively, and how much of the building stock is represented in the EPC database. This illustrates how younger buildings are overrepresented in the EPC database.

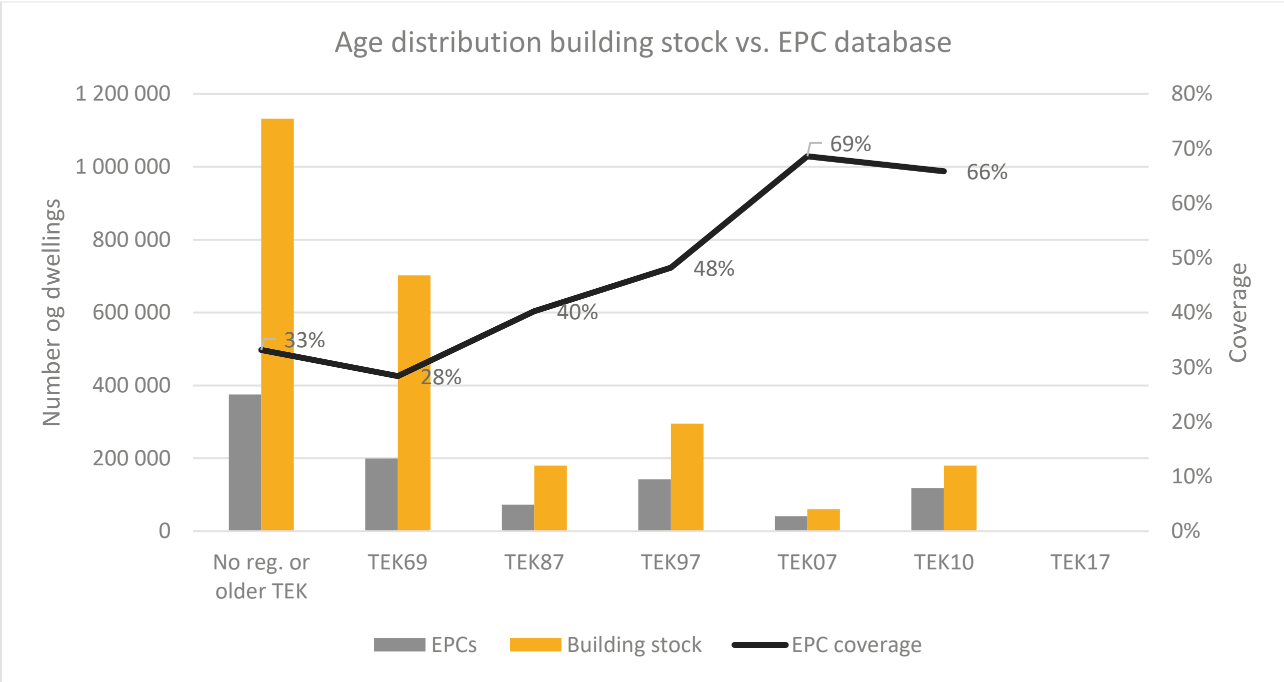


Figure 10 Age distribution in Energy Performance Certificates vs. actual residential building stock and EPC coverage by building year (Source: energimerking.no and Statistics Norway, August 2019)

Assuming registered EPCs for each time period are representative for the building stock, we are able to indicate what the label distribution would be if all residents were given a certificate. Figure 11 illustrates how EPCs would be distributed based on this assumption. 12 % of the residents would have a C or better.

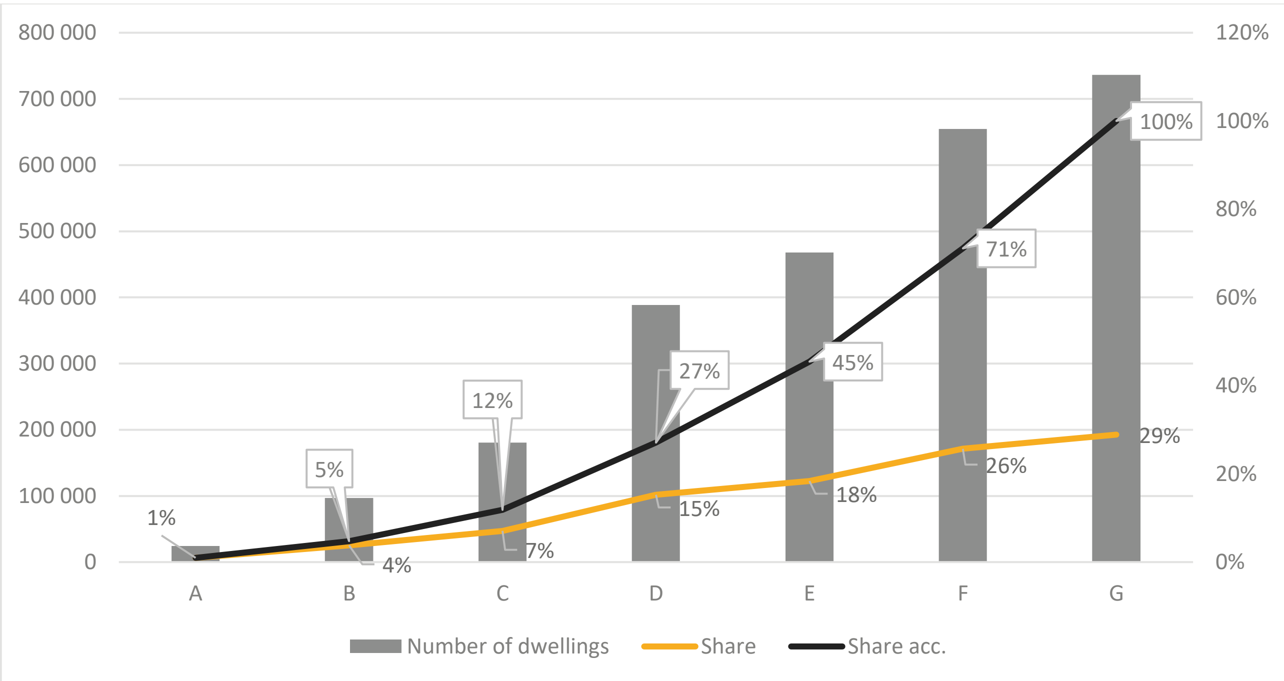


Figure 11 EPCs extrapolated to include the whole residential building stock (Source: energimerking.no and Statistics Norway, Multiconsult, August 2019)

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 12 % 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 5.5 % 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 bond with 30-year tenure and a 5-year tenure. In this case, we are looking to identify buildings that already have improved energy performance in this scale. To identify relevant residential buildings, the EPC-labels are compared to calculated energy demand for different TEK periods (shown in figure 2). Energy supply is then assumed to be electricity as the baseline, heating included. This is a conservative assumption as it gives the building a lower specific energy demand as a starting point than a moderate system efficiency which is the basis for the energy labeling scale. In the figures below calculated energy delivered are shown for respectively a small residential building 160 m^2 and apartment 65 m^2 (models which make up the basis for the energy grade scale) for different building periods (building codes) shown in the grade scale (coloured background).

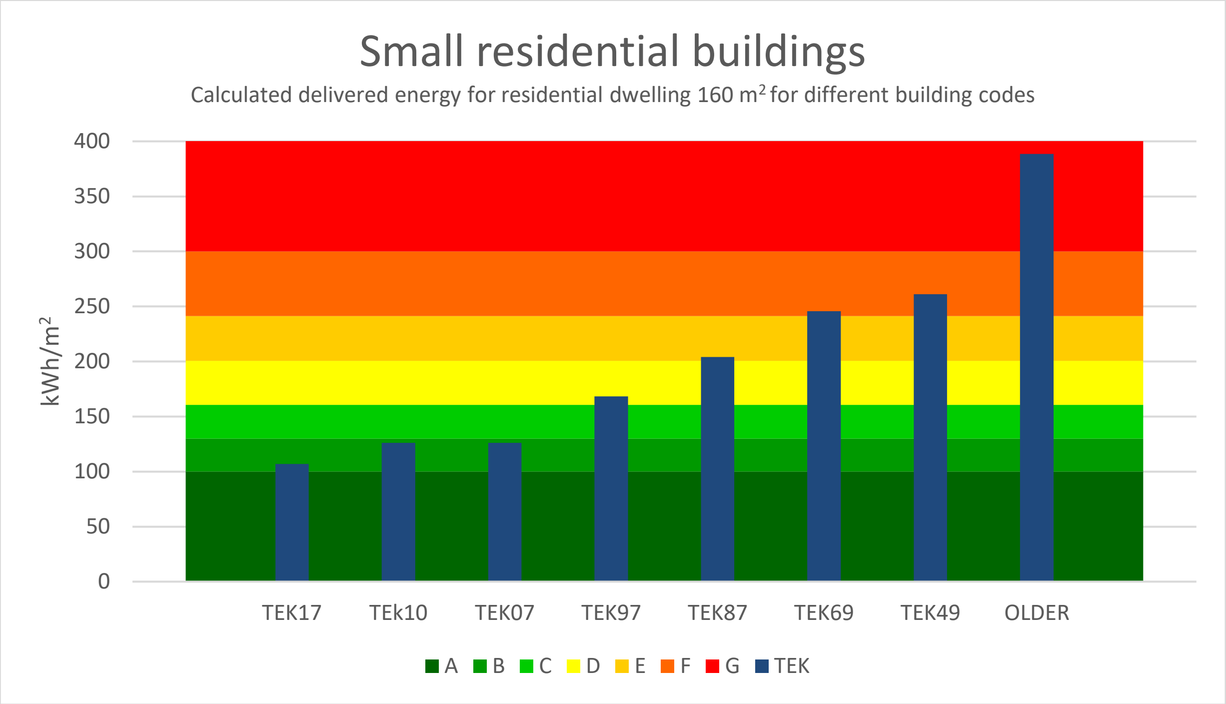


Figure 12 EPC label limit values and TEK - small residential buildings

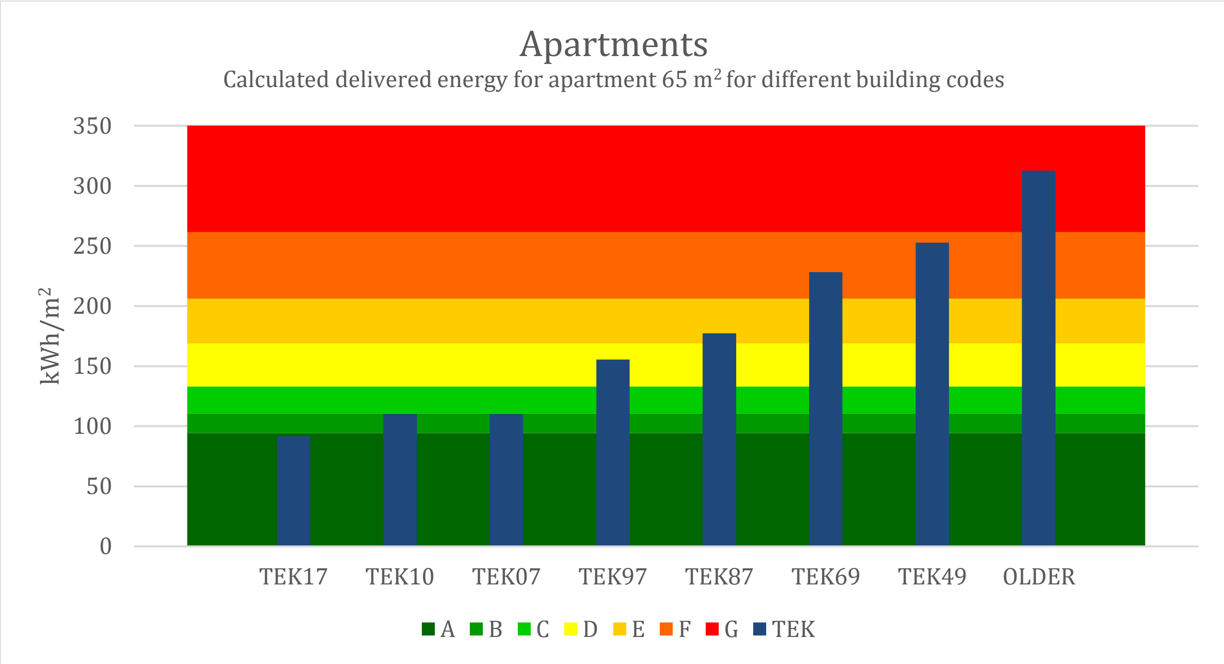


Figure 13 EPC label limit values and TEK – apartments/apartments buildings

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. A percentage improvement is calculated to the mean value for each grade-interval, and it requires at least 30% improvement to qualify. This is shown in the figures below. Figure 14 illustrates the calculated delivered energy for a small residential building 160 m^2 for different building codes, and with minimum 30 % improvement, shown in the corresponding EPC grade scale in the background.

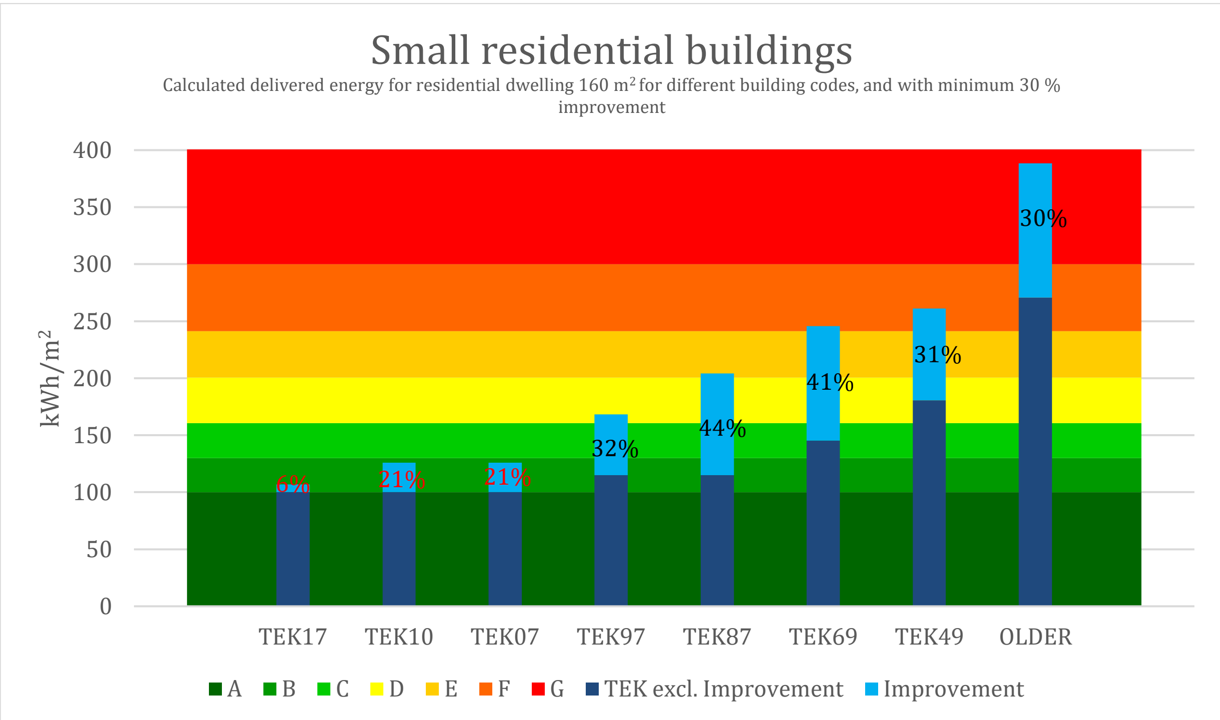


Figure 14 EPC label limit values and improvements from TEK to qualify– small residential buildings

Figure 15 illustrates the calculated delivered energy for apartment 65 m^2 for different building codes, with minimum 30 % improvement, shown in the corresponding EPC grade scale in the background.

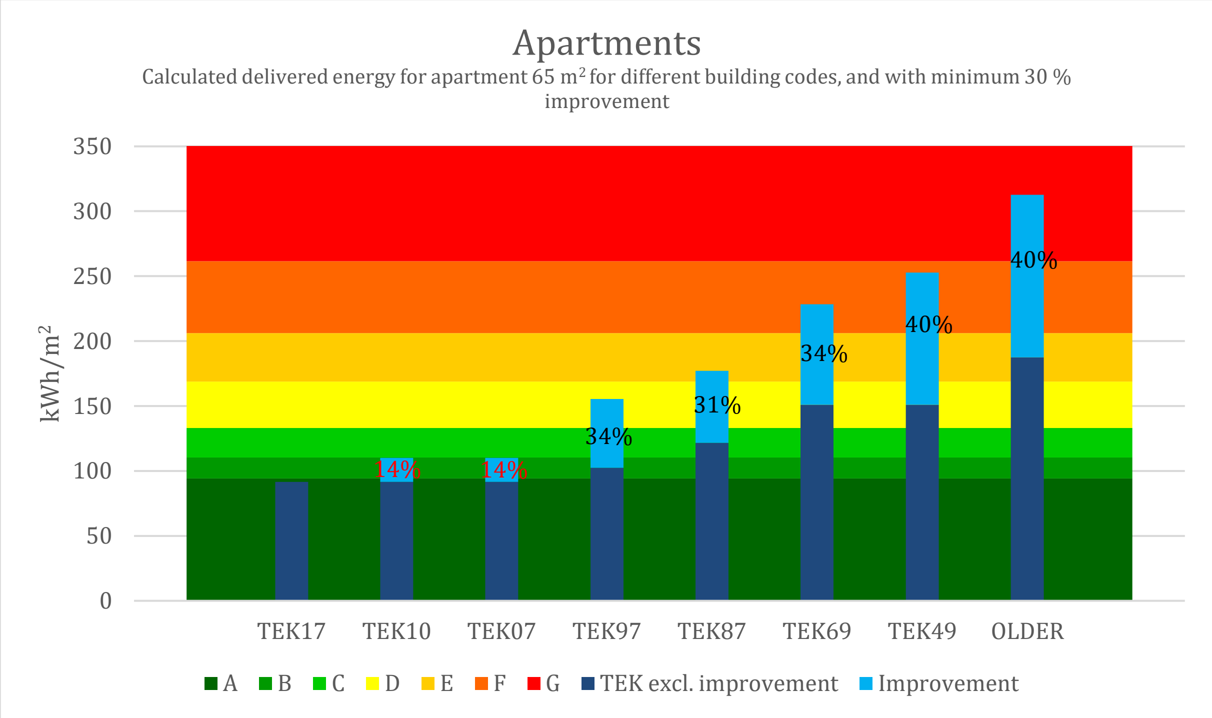


Figure 15 EPC label limit values and improvements from TEK to qualify– apartments/apartments buildings

The figures show that for a building built after the building code of TEK07 or later, the energy label A does not qualify according to this criterion, however qualifies under criterion 2. This is due to the fact that there is no good estimate on a mean value for specific energy demand for an A.

3.3.1 Eligibility under criterion 3

Refurbished residential buildings with EPC-labels which corresponds to at least a 30 % improvement in energy efficiency compared to the calculated specific delivered energy [kWh/m^2] based on building code in the year of construction. The EPC statistics indicate that approx. 2 % of the current residential buildings in Norway (both older than 2009 for small residential buildings and older than 2012 for apartments and with a energy grade D or lower) are eligible according to this criterion.

These buildings may be identified using the EPC database and prepared tables below that verify which EPC-label corresponds to at least 30% energy reduction for the given construction year.

Building year:	after 2018	2012-2018	2009-2018	1999-2008	1989-1998	1971-19887	1951-1970	before 1951
Building code:	TEK17	TEK10	TEK07	TEK97	TEK87	TEK69	TEK49	OLDER
Calculated delivered energy [kWh/m^2,year]:	106,9	126	126	168,2	204,2	245,6	261	388,5
Improvement (average)								
A	6 %	21 %	21 %	41 %	51 %	59 %	62 %	74 %
B		9 %	9 %	32 %	44 %	53 %	56 %	70 %
C				14 %	29 %	41 %	44 %	63 %
D					12 %	26 %	31 %	54 %
E						10 %	15 %	43 %
F								30 %

Table 4 Eligible small residential building

Building year:	after 2018	2012-2018	2009-2018	1999-2008	1989-1998	1971-19887	1951-1970	before 1951
Building code:	TEK17	TEK10	TEK07	TEK97	TEK87	TEK69	TEK49	OLDER
Calculated delivered energy [kWh/m^2,year]:	91,7	110,1	110,1	155,4	177,2	228,3	252,7	312,7
Improvement (average)								
A		14 %	14 %	39 %	47 %	59 %	63 %	70 %
B				34 %	42 %	55 %	60 %	67 %
C				22 %	31 %	47 %	52 %	61 %
D					15 %	34 %	40 %	52 %
E						18 %	26 %	40 %
F								25 %

Table 5 Eligible apartments

4 Impact assessment

Impact is calculated for the criteria in the earlier sections.

The grid factor on electricity consumption, as average in the buildings lifetime, is based on a trajectory from the current grid factor to a close to zero emission factor in 2050 and steady until the end of the lifetime. (The expected life of a building from 2010 is 60 years.) According to Norwegian Standard NS 3720:2018 "Method for greenhouse gas calculations for buildings" greenhouse gas are to be calculated on a life-cycle basis according to two scenarios:

Scenario	**CO_2- factor (g/kWh)**
European (EU28+ Norway) consumption mix	136
Norwegian consumption mix	18

Table 6 Electricity production greenhouse gas factors (CO_2- equivalents) for two scenarios (source: NS 3020:2018, Table A.1)

The following calculations apply the European mix in table 5. This is in line with Nordic Public Sector Issuers: Position Paper on Green Bonds Impact Reporting (January 2019)[9]. 136 gCO_2/kWh constitute the GHG emission intensity baseline for energy use in buildings with a life span of 50-60 years and assuming that the CO_2-factor of the European production mix is close to zero in 2050.

To calculate the impact on climate gas emissions the trajectory is applied to all electricity consumption in all residential buildings. Electricity is the dominant energy carrier to Norwegian residential buildings but the energy mix includes also bio energy and district heating, resulting in a total specific factor of 126 g CO_2eq/kWh. A proportional relationship is expected between energy consumption and emissions.

A reduction of energy demand from the average 256 kWh/m^2 of the total residential building stock to 126 kWh/m^2 (TEK07/TEK10) or 103 kWh/m^2 (TEK17) dependent on building code can then be multiplied to the emission factor and area of eligible assets to calculate impact.

[9] https://www.kommunalbanken.no/media/545579/npsi_position_paper_2019_final.pdf

4.1 Eligible objects in Sparebank1 Boligkreditt's portfolio and related impact

The eligible 10,840 buildings/apartments in Sparebank1 Boligkreditt's portfolio is estimated to amount to 1,539,000 square meters. Area per object is available for all objects.

The portfolio is first matched against criterion 1 (building code/year). The objects eligible under criterion 1. The eligible objects are presented in somewhat more detail in table 6.

Criterion	Type of dwelling	Number of objects	Area total [m^2]
Criterion 1 (Building code)	Apartments	3,890	308,652
	Small residential buildings	6,950	1,230,348
Sum		10,840	1,539,000

Table 7 Eligible objects and estimated building areas

Based on the calculated figures in table 6 the energy efficiency of this part of the portfolio is estimated.

The calculated average specific energy demand for the eligible assets is 123 kWh/m^2. This is 52 % lower than the calculated average of the total residential building stock.

All these residential buildings are not included in one single bond issuance. The table below indicates how much more energy efficient the eligible part of the portfolio is compared to the average residential Norwegian building stock, and how much less CO_2-emissions, directly and mostly indirectly, this reduced energy demand results in.

	Area	Reduced energy compared to baseline	Reduced CO_2-emissions compared to baseline
Eligible buildings in portfolio	1,539,000 m^2	**206 GWh/year**	**25,100 tons CO_2/year**

Table 8 Performance of eligible objects compared to average building stock