
REPORT

Sparebanken Vest Green Buildings portfolio

CLIENT

Sparebanken Vest AS

SUBJECT

Norwegian Energy Efficient Buildings- Green residential and commercial buildings

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REPORT

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1 Introduction

Assignment

On assignment from Sparebanken Vest, Multiconsult has applied developed criteria and a methodology to identify the most energy efficient residential and commercial buildings in Norway, to be used with respect to a potential green bond issuance. In this document we describe Sparebanken Vest's identification criteria, the evidence for the criteria and the result of an analysis of the loan portfolio of Sparebanken Vest. The criteria to select the buildings is based on credible standards in Norway such as the Norwegian building regulation and Energy Performance Certificates.

Buildings included in this analysis

The analysis of the commercial building stock includes office buildings, commercial/retail buildings (shops and stores), hotel and restaurants and small industrial buildings and warehouses. These categories cover the most relevant commercial buildings in Sparebanken Vest's portfolio.

All categories of residential buildings are included in the analysis.

Energy

Apart from these criteria, we also want to stress that both residential and commercial buildings in Norway are mostly heated with renewable energy. The energy consumption of Norwegian 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 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) (Fjernkontrollen¹). In 2018, the Norwegian power production was 98 % renewable (NVE²).

As shown in figure 1, the Norwegian production mix in 2018 gives resulting emissions of 11 gCO₂/kWh. Using 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 mentioned standard calculates the average CO₂- factor for the lifetime of a building to 136 g CO₂/kWh for EU28+ Norway and 18 g CO₂/kWh for Norwegian production mix only. Applying the factor based on EU28 + Norway energy production mix, the resulting CO₂- factor for Norwegian residential buildings³ is on average 126 g CO₂/kWh.

¹ <http://fjernkontrollen.no/>

² <https://www.nve.no/reguleringsmyndigheten-for-energi-rme-marked-og-monopol/varedeklarasjon/nasjonal-varedeklarasjon-2017/>

³ Multiconsult. Based on building code assignments for DIBK

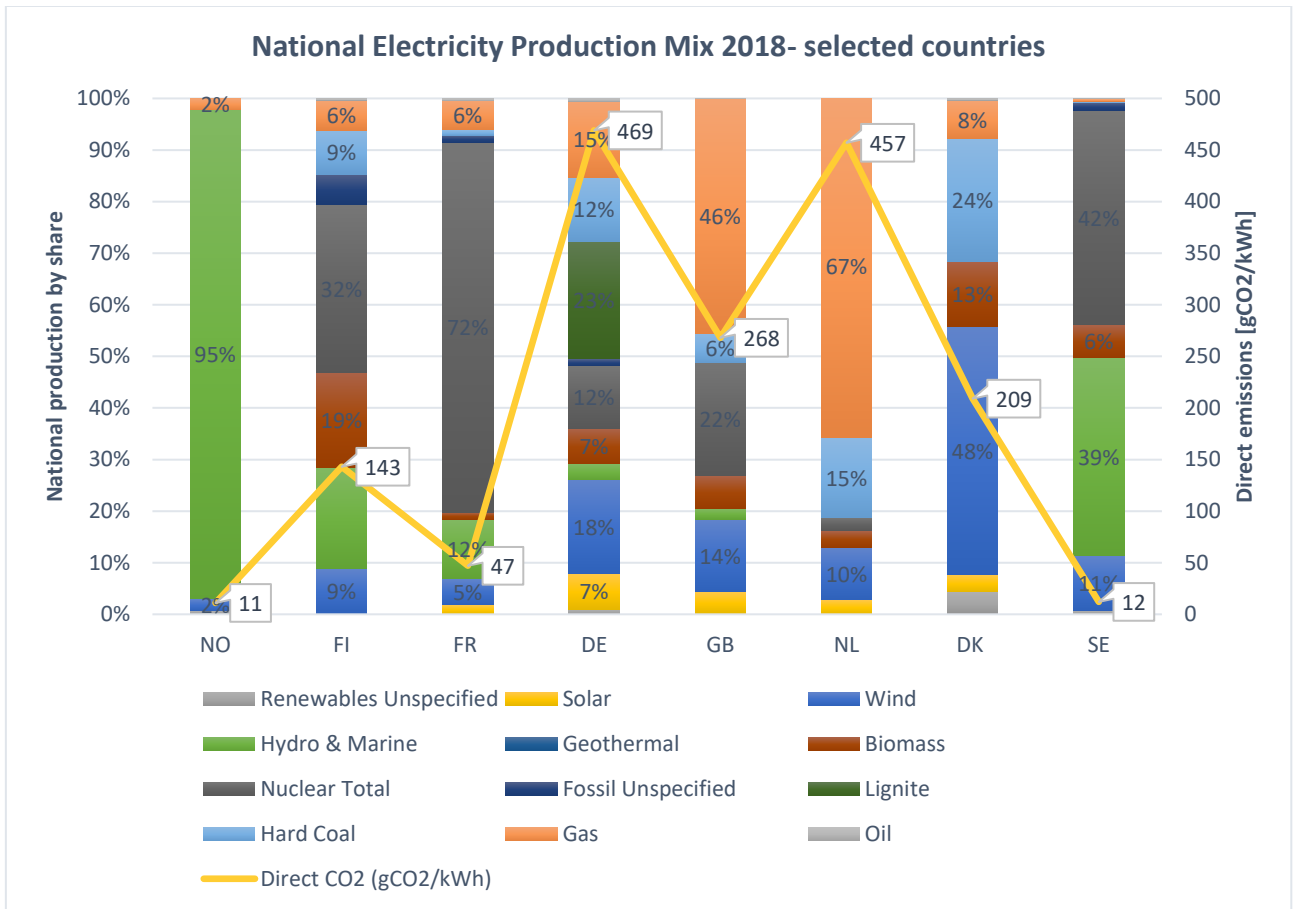


Figure 1 National electricity production mix in some relevant countries (European Residual Mixes 2018, Association of Issuing Bodies⁴)

2 Loan Portfolio Analysis Sparebanken Vest

The Green loan portfolio of Sparebanken Vest will consist of residential and commercial buildings that meet the criteria as formulated below.

2.1 Eligible buildings

Multiconsult has investigated Sparebanken Vest’s portfolio and can confirm that the reviewed buildings have been identified as eligible for green bonds according to Sparebanken Vest’s eligibility criteria related to building code both for residential and commercial buildings.

2.2 Availability of data to identify other eligible buildings

Energy performance data for buildings are not easily available for lenders or investors. The Energy Performance Certificate (EPC), a possible source of data, is at the present not publically available. Some essential data will be made available. The release is, however, not expected to be in the near future. Before the data is made available the database is to be cleaned of faulty data and IT solution established for easy access.

⁴ <https://www.aib-net.org/facts/european-residual-mix>

Enova, entity owned by the Norwegian Ministry of Climate and Environment, responsible for the EPC system, aims to make the register publically available and accessible e.g. for banks using the data for the purpose of green bonds. The work is prioritised. The date for publication of the database is uncertain and dependent on the IT solutions and necessary cleaning of the database to ensure high data quality. 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
- Building identifiers GNR (Gårdsnummer) and BNR– (Bruksnummer)

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, at the best, only 35 % of all office and retail buildings, 3 % of all hotel and restaurant buildings and 4 % of all industry buildings have an energy performance certificate. Corresponding coverage of individual dwellings is less than 50 %. 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.

All buildings over 1,000 m² are required to have a certificate. 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- Residential buildings

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 8 % 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 demand⁵.

Eligible Residential Green Buildings for Sparebanken Vest 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 buildings⁶ 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/m²] based on building code in the year of construction. These buildings may be identified using the EPC database and prepared tables in this report that identify which EPC-label corresponds to at least 30% energy reduction for the given construction year.

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: 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 the Sparebanken Vest criterion.

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

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.

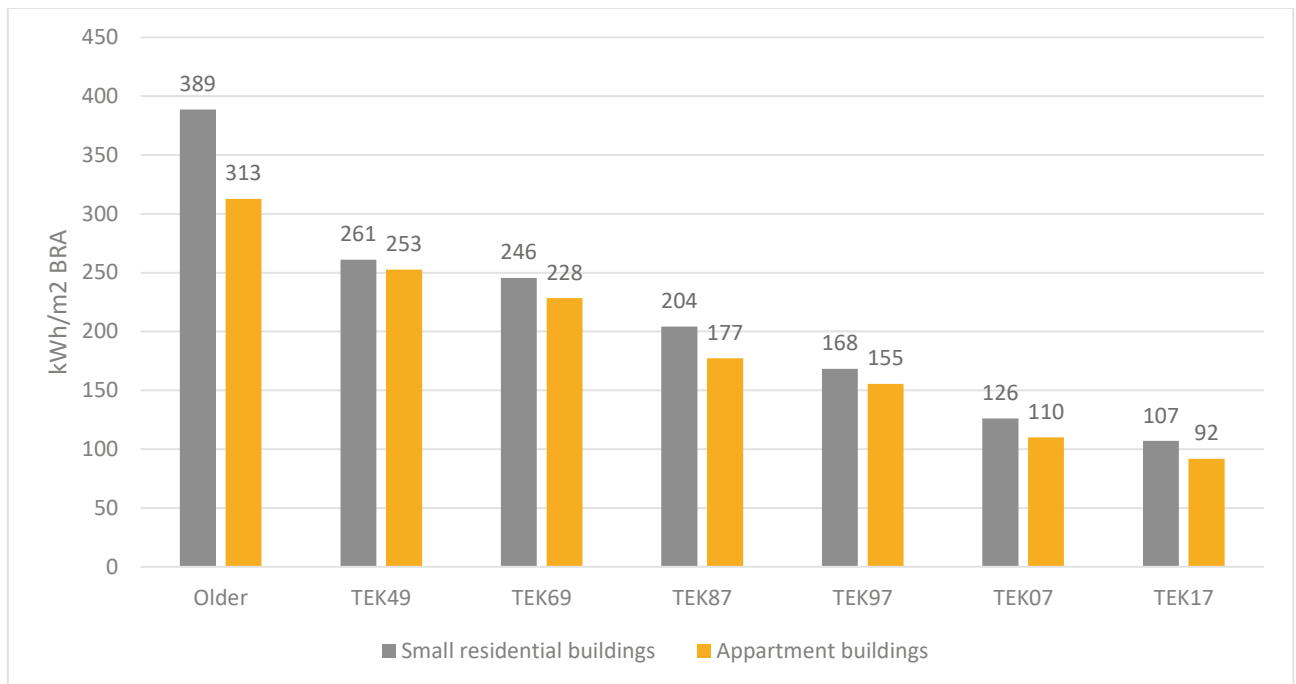


Figure 2 Development in calculated specific net energy demand based on building code and building tradition, (Multiconsult, simulated in SIMIEN)

Net energy demand is calculated for model buildings used for defining the building code (TEK07/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 small residential buildings, there was no change between TEK07 and TEK10 with respect to energy efficiency requirements.

The figure gives theoretical values for representative models of an apartment and a small 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 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 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 small residential buildings (model homes)
TEK 07/ 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

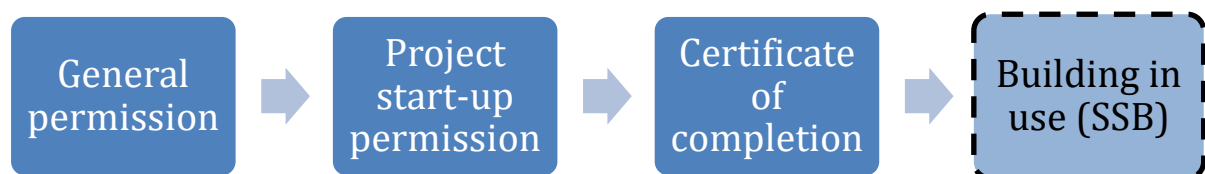
Table 1 includes the specific energy demand calculated by using the standard model buildings for the building codes relevant for identifying the top 8 % most energy efficient residential buildings in Norway.

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 lag 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 such things as the complexity of the site and project, financing and the housing market.



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

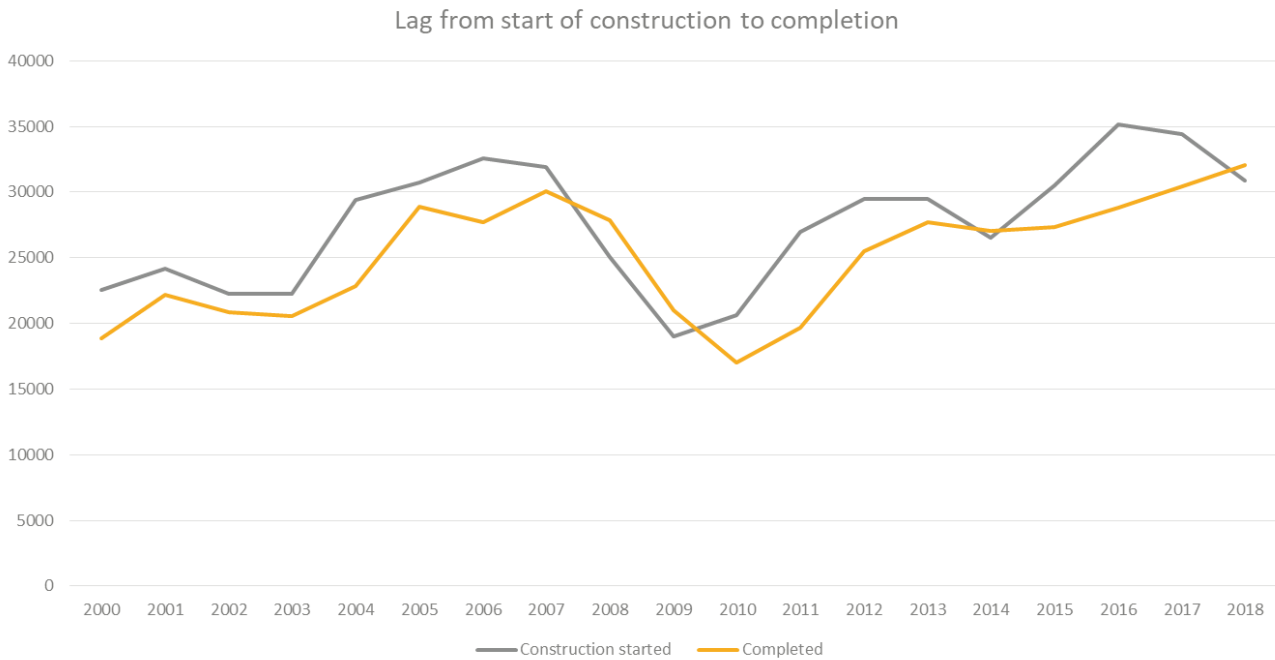


Figure 3 Project start-up and completion (Statistics Norway, bygningsarealstatistikken)

The 2007 building code was implemented in February 2007 and the 2010 building code was implemented July 1st 2010. Based on the discussions on time for design and construction, we regard a time-lag of two years, in most cases, between code implementation and buildings based on this code to be a robust and conservative assumption. The data available on completed construction is only available to the issuer on a yearly basis. Since the energy requirements were unchanged from TEK07 to TEK10 it is a very robust assumption that all buildings finished in 2012 have used energy requirements according to TEK10. There are likely buildings finished in 2011 built under the 2010 code as well, but equally, the year 2012 may also contain projects built based on TEK07. All buildings finished in 2009- 2011 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

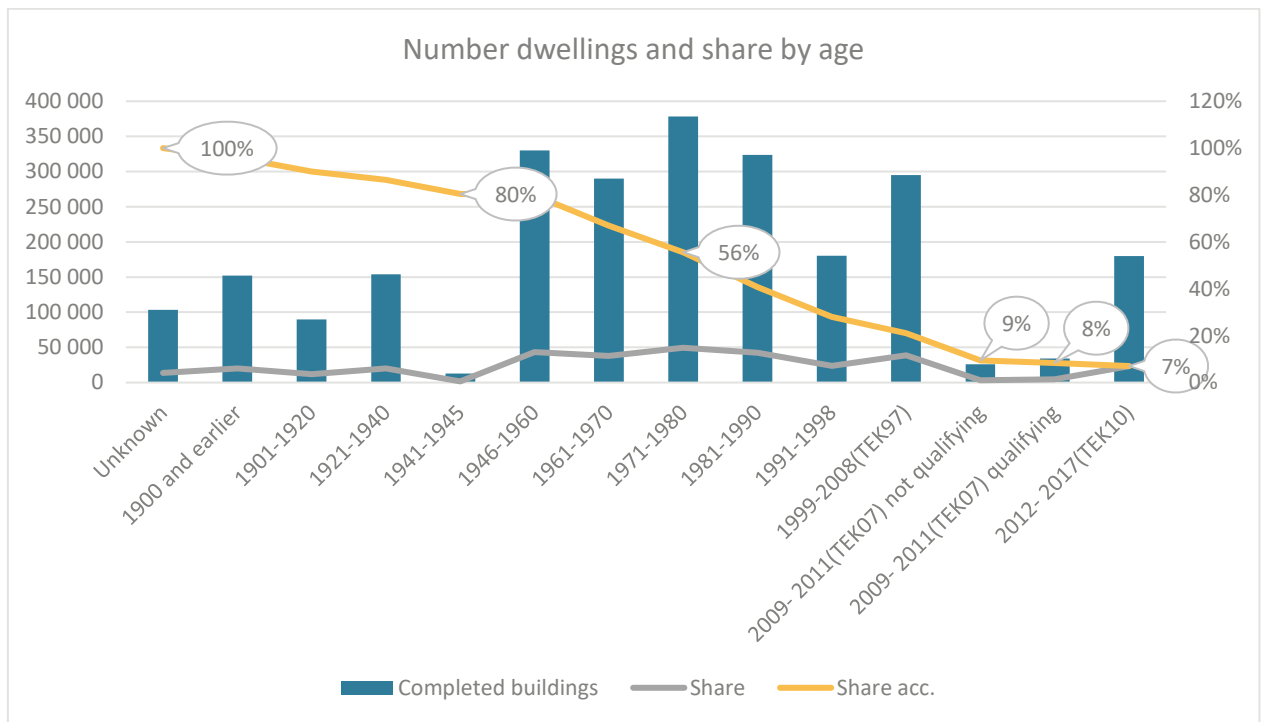


Figure 4 Age and building code distribution of dwellings (Statistics Norway and Multiconsult)

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). The figure shows how buildings finished in 2012 and later (and built according to TEK10) amount to 7 % of the total stock. Adding the small residential buildings built under the TEK07 code, 1 %, the total qualifying dwellings accounts for 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 4 % of the energy demand in residential buildings and 3 % of the related CO₂- emissions. The difference between energy demand and CO₂-emissions are due to the slightly less CO₂-intensive heating solutions in newer buildings.

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

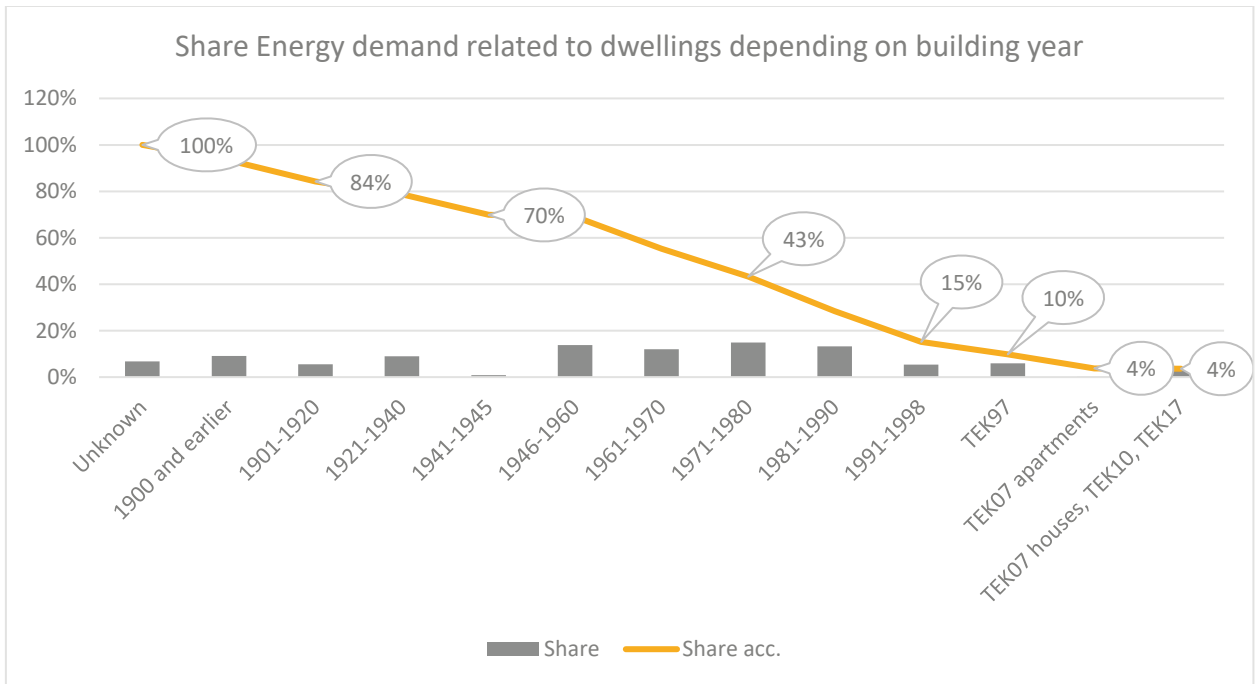


Figure 5 The building stock’s relative share of energy demand dependent on building year and code (Statistics Norway and Multiconsult)

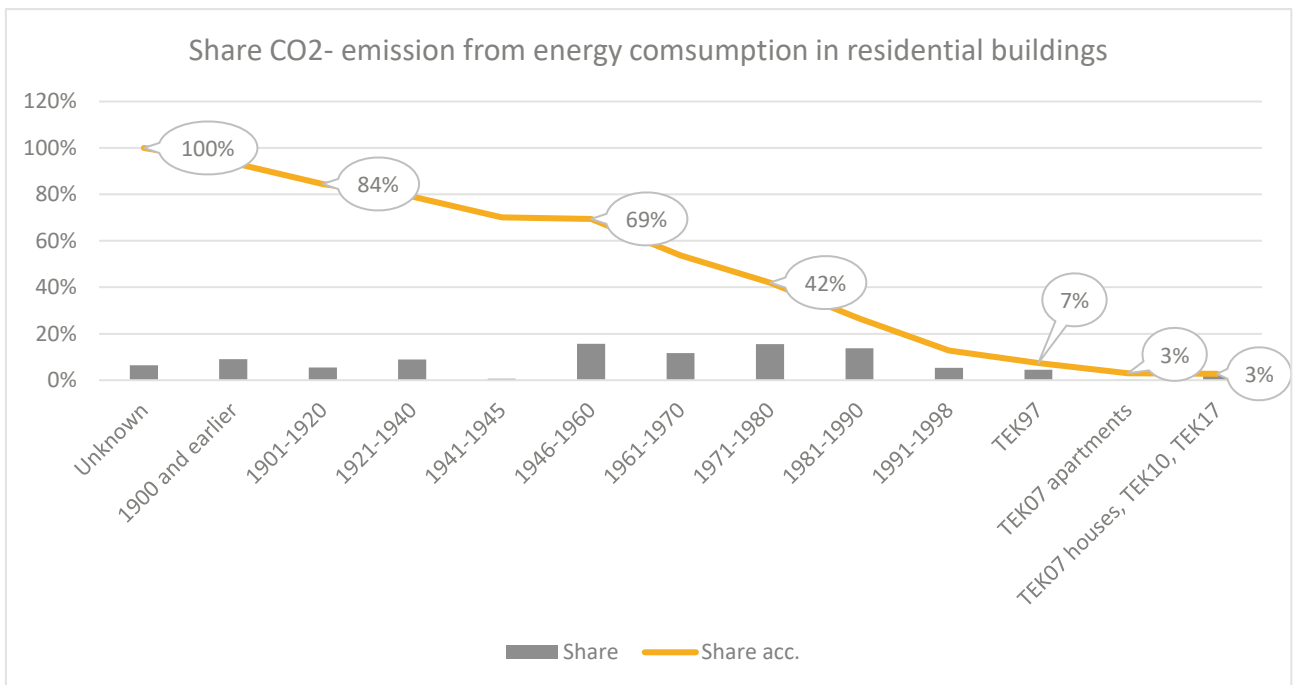


Figure 6 The building stock’s relative share of CO₂ –emissions related to energy demand dependent on building year and code (Statistics Norway and Multiconsult)

3.1.3 Eligibility under criterion 1

Over the last several decades, the changes in the building code have pushed for more energy efficient buildings. The building stock data indicates that 8 % of the current residential buildings in Norway were constructed using the code of 2007 (TEK07) and later codes for small residential buildings and code of 2010 (TEK10) and later codes for apartments.

Combining the information on the calculated energy demand related to building code in Figure 2 and information on the residential building stock in Figure 4, the calculated average specific energy demand on the Norwegian residential building stock is 256 kWh/m². Building code TEK07 (small residential buildings), TEK10 and TEK17 gives an average specific energy demand for existing houses and apartments, weighted for actual stock, of 122 kWh/m².

Hence, compared to the average residential building stock;

- the building code TEK07 (small residential buildings), TEK10 and TEK17 gives a calculated specific energy demand reduction of 52 %

1. New or existing Norwegian residential buildings that comply with the Norwegian building code of 2007 (TEK07) and later codes for small residential buildings and code of 2010 (TEK10) and later codes for apartments are eligible for green bonds as all these buildings have significantly 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.

3.2 Norwegian residential buildings with EPC-labels A, B or C

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 and B 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 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 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.

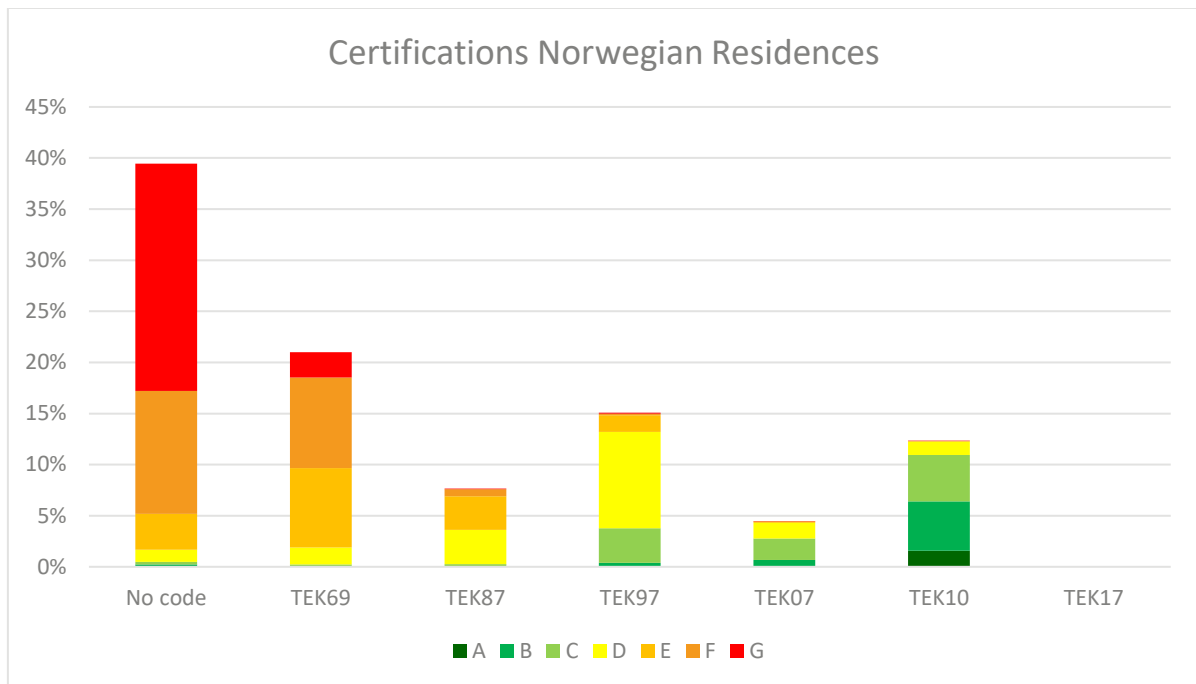


Figure 7 Total volume of residences in Norway, including individual houses and apartments, distributed per building code and Energy Performance Certificate. The numbers are based on statistics from Statistics Norway for number of Residences and statistics from the current EPC database (representative for 50 % of the total building stock).

The registered properties in the EPC database are 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 %. In total 12 % of the Norwegian Residences are expected to get a C or better. Extracting only buildings built before 2009, 4.2 % of the total stock is expected to get a B 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 ² heated space (kWh/m ²)							
	A	B	C	D	E	F	G
Houses	95	120	145	175	205	250	above F
Sq. m adjustment	+800/A	+1600/A	+2500/A	+4100/A	+5800/A	+8000/A	
Flats/Apartments	85	95	110	135	160	200	above F
Sq. m 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 *small residential building* would have a C qualification limit of $145+2500/150 = 161.67$ kWh/m²

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 a small residential building 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 7, 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 criterion 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. E.g. a small residential building that had a C when it was new in 2012, could have a D in its EPC if given a new EPC 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 8 shows the energy grades in the already granted certificates to Norwegian residential buildings.

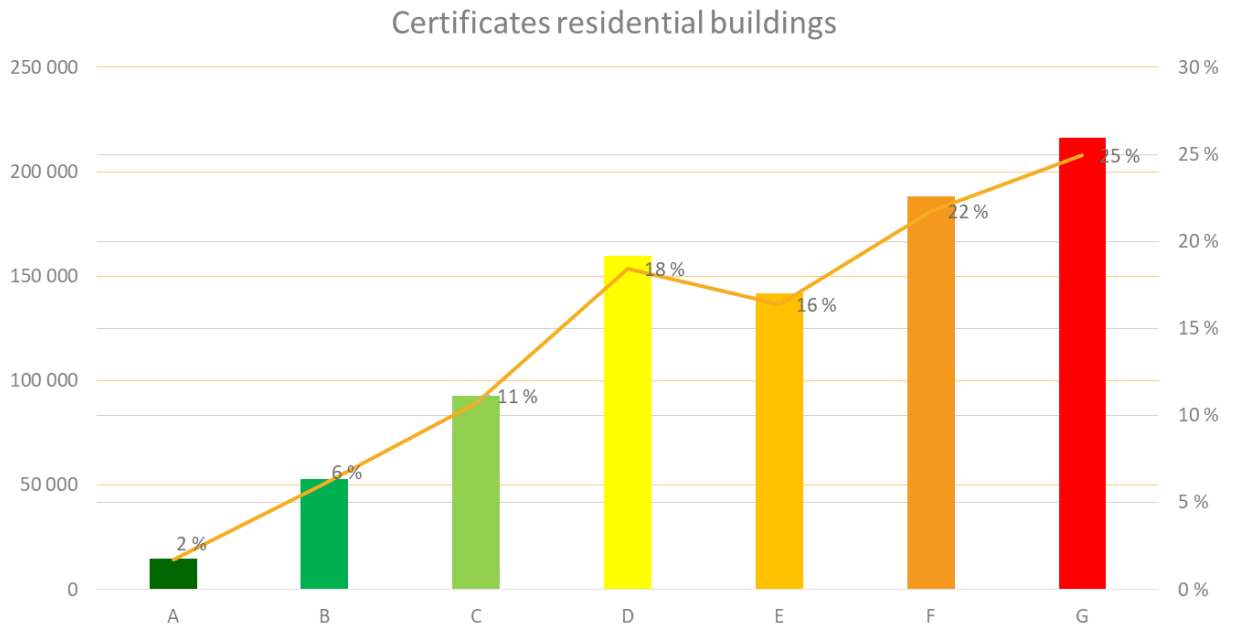


Figure 8 Energy Performance Certificates by grade- residential buildings only, representative only of buildings with EPCs (Source: energimerking.no, December 2018)

The EPC coverage is, however not equally distributed over the building stock. Figure 9 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.

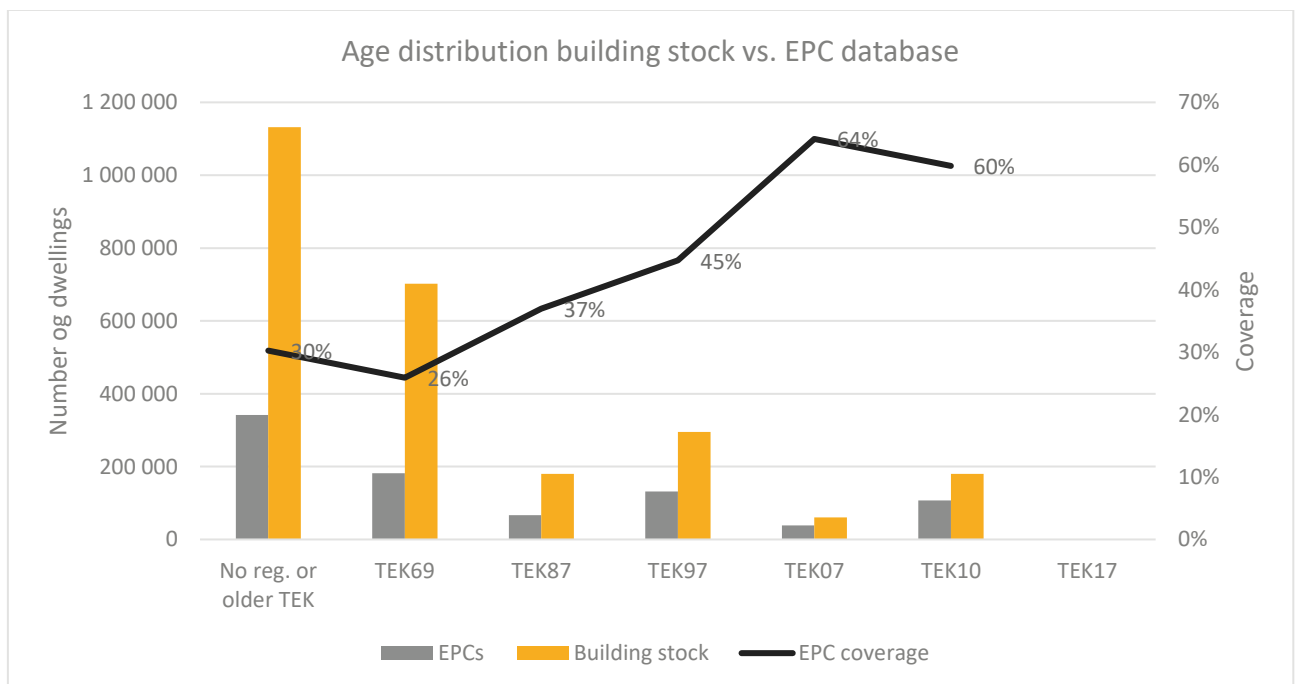


Figure 9 Age distribution in Energy Performance Certificates vs. actual residential building stock and EPC coverage by building year (Source: energimerking.no and Statistics Norway)

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 10 illustrates how EPCs would be distributed based on this assumption. 12 % of the residents would have a C or better.

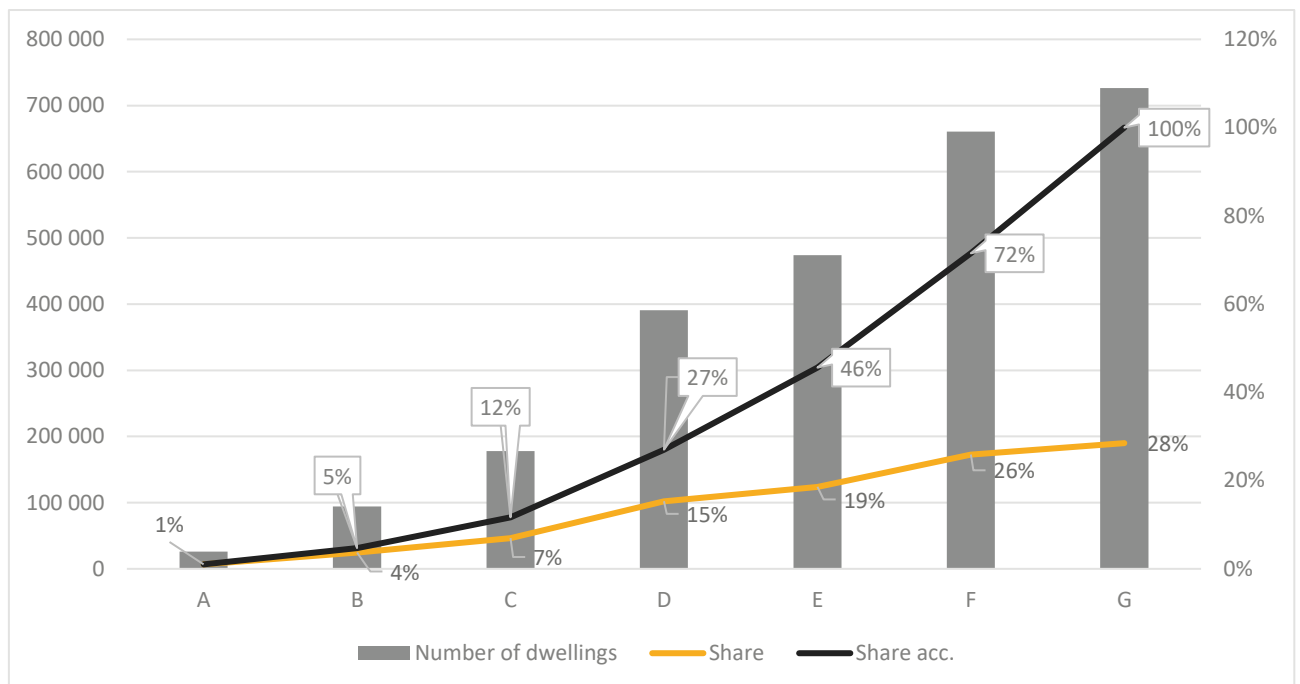


Figure 10 EPCs extrapolated to include the whole residential building stock (Source: energimerking.no and Statistics Norway, Multiconsult)

3.2.3 Eligibility under criterion 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.

3.3 Refurbished Norwegian residential buildings with an improved energy efficiency of $\geq 30\%$

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 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 m² and apartment 65 m² (models which make up the basis for the energy grade scale) for different building periods (building codes) shown in the grade scale (coloured background).

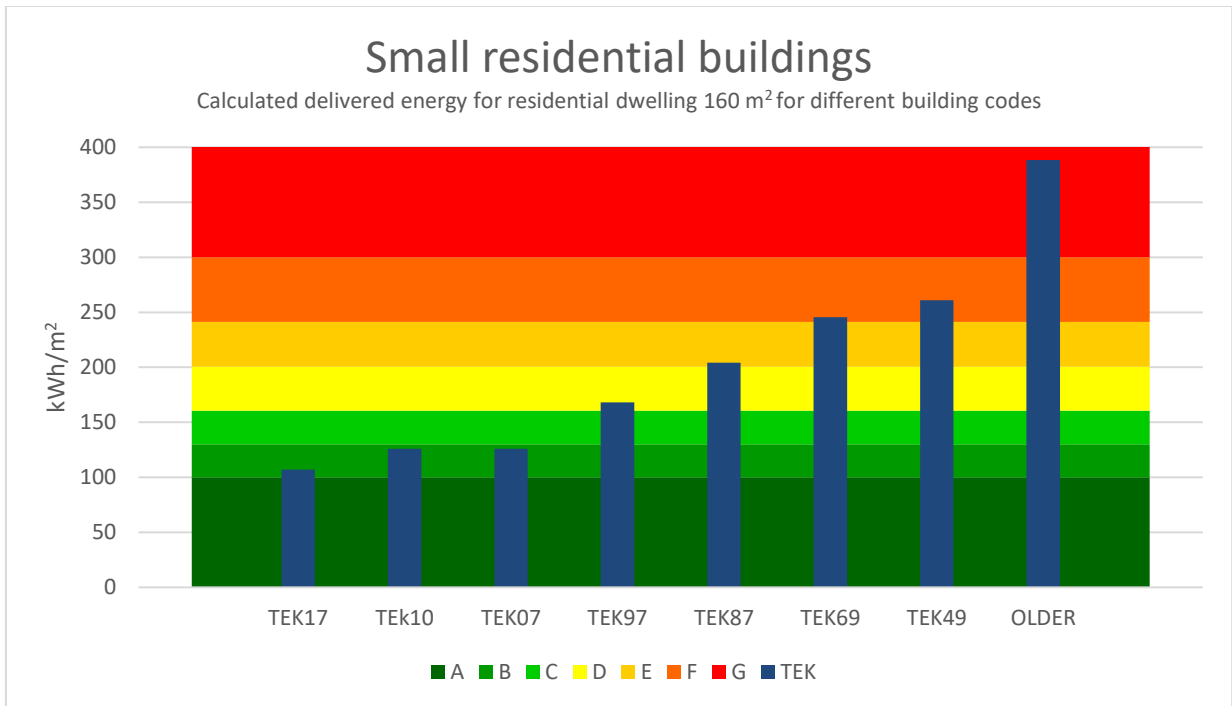


Figure 11 EPC label limit values and TEK - small residential buildings

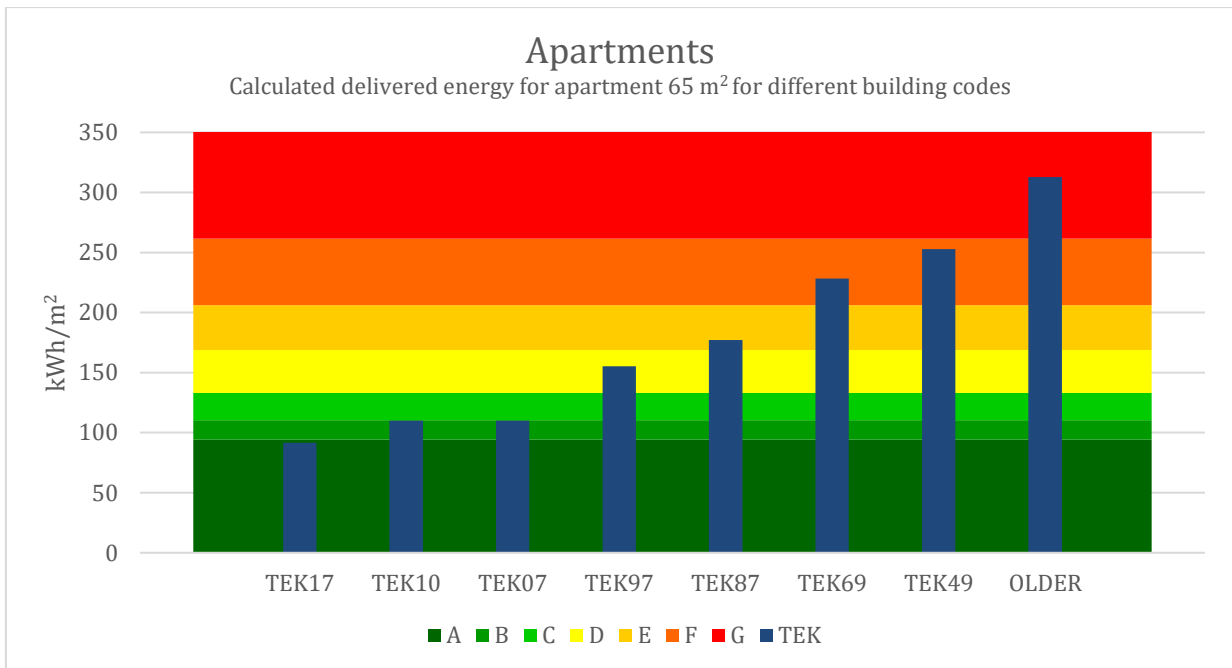


Figure 12 EPC label limit values and TEK – apartments/apartments buildings

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 13 illustrates the calculated delivered energy for a small residential building 160 m² for different building codes, and with minimum 30 % improvement, shown in the corresponding EPC grade scale in the background.

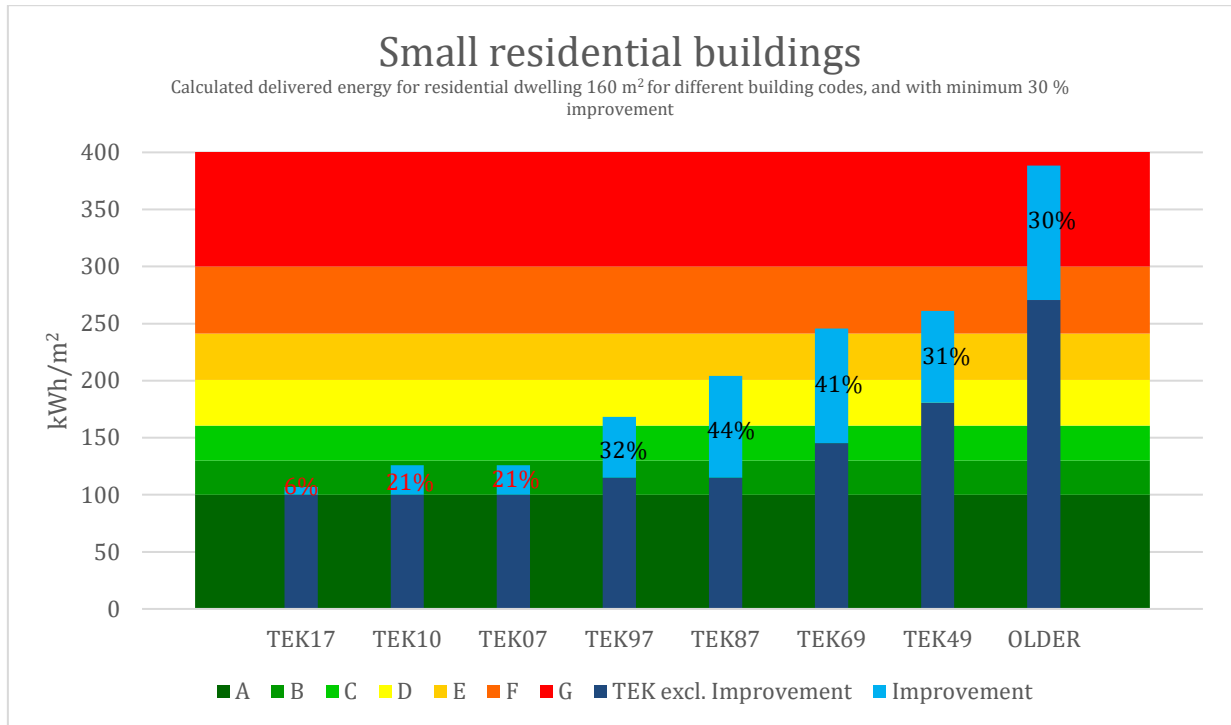


Figure 13 EPC label limit values and improvements from TEK to qualify– small residential buildings

Figure 14 illustrates the calculated delivered energy for apartment 65 m² for different building codes, with minimum 30 % improvement, shown in the corresponding EPC grade scale in the background.

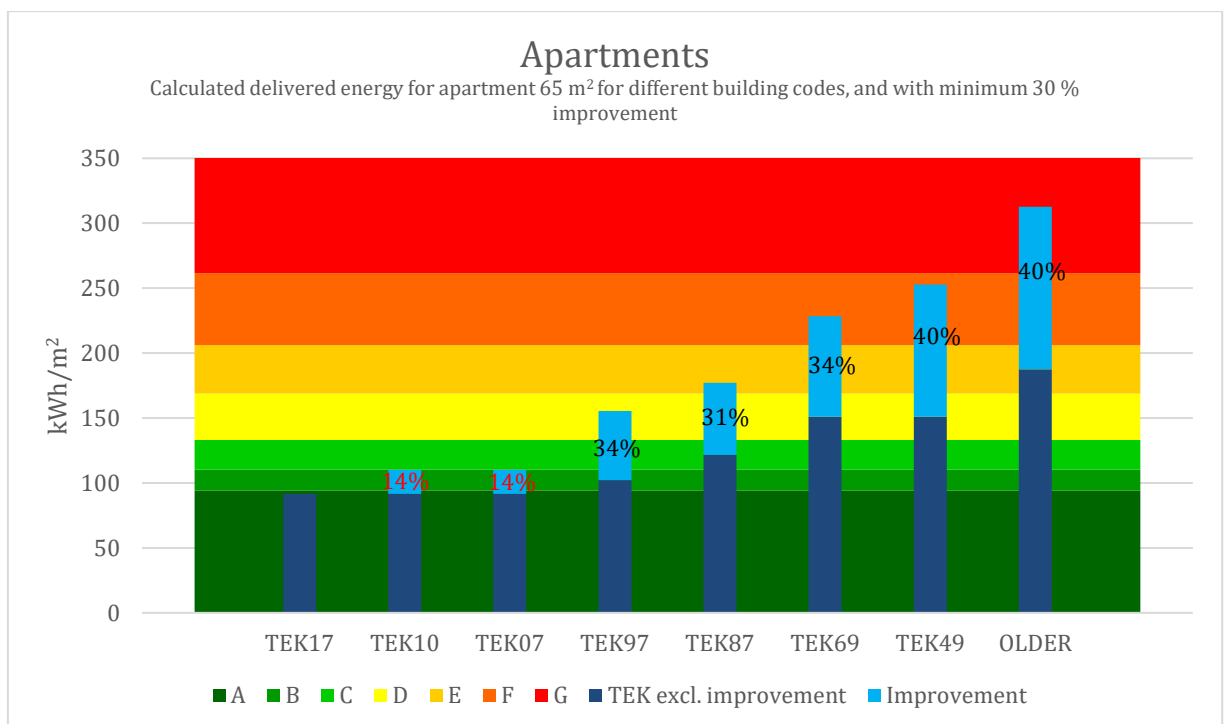


Figure 14 EPC label limit values and improvements from TEK to qualify– apartments/apartments buildings

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/m²] based on building code in the year of construction.

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 3 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 4 Eligible apartments

4 Eligibility criteria- Commercial buildings

Multiconsult has studied sections of the Norwegian commercial building stock and identified solid eligibility criteria for Green Bonds on energy efficient commercial buildings in specific subcategories. Unique criteria have been established for the four subcategories: office buildings, retail, hotel and restaurant buildings and industry/warehouses. The criteria identifies no more than the top 15 % most energy efficient commercial buildings countrywide based on building code. The methodology is based on Climate Bonds Initiative (CBI) taxonomy, where the top 15 % most energy efficient buildings are considered eligible.

Eligible Commercial Green Buildings for Sparebanken Vest must meet the following eligibility criterion:

Hotel and restaurant buildings. New or existing Norwegian hotel buildings that comply with the Norwegian building code of 2007 (TEK07) and later codes are eligible for green bonds as all these buildings have significantly better energy standards and account for less than 15 % of the hotel and

restaurant building stock. A three year lag between implementation of a new building code and the buildings built under that code must be taken into account. Hence all buildings finished in 2011 or later qualify.

Office buildings, retail buildings and industrial buildings and warehouses. New or existing Norwegian office, retail and industrial buildings/warehouses that comply with the Norwegian building code of 2007 (TEK07) and later codes are eligible for green bonds as all these buildings have significantly better energy standards and account for less than 15 % of the office, commercial and industry/warehouse 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 buildings finished in 2010 or later qualify.

Data quality and sources

To establish a robust methodology, data on number and age of existing buildings are crucial, and for impact assessments, the relevant factors are area and age.

For the most important period, the latest years stretching even further back than the criteria cut-off point, the data on number of buildings and age in the total stock have good quality for the whole stock. These data have been published from 2000. Some building categories are only available on an aggregated level but the necessary splits are made on the basis of data available for the years 2006 and 2018. Building years for older buildings are somewhat uncertain and assumptions on building rate and demolition rate had to be made.

Regarding building area, data is available on new buildings every year from 1983. These data have been supplemented by data in a study on energy efficiency in existing buildings.⁸

4.1 New or existing buildings within the relevant building categories that comply with the chosen criteria

New or existing Norwegian hotel and restaurant buildings that comply with the Norwegian building code of 2007 (TEK07) or later codes: 6.8 %

New or existing Norwegian office buildings that comply with the Norwegian building code of 2007 (TEK07) or later codes: 5.1 %

New or existing Norwegian retail/commercial buildings that comply with the Norwegian building code of 2007 (TEK07) or later codes: 5.1 %

New or existing Norwegian small industrial buildings and warehouses that comply with the Norwegian building code of 2007 (TEK07) or later codes: 13.9 %

Changes in the Norwegian building code have consistently over several decades resulted in more energy efficient buildings. As of January 1st 2018, significantly less than 15 % of the Norwegian commercial buildings, within the investigated subcategories, are eligible according to the Sparebanken Vest criterion; commercial buildings in the specific subcategories built according to TEK07, TEK10 and TEK17 are eligible for Green Bonds.

⁸ Enova publication "Potensial- og barrierestudie Energieffektivisering i norske yrkesbygg», Multiconsult 2011

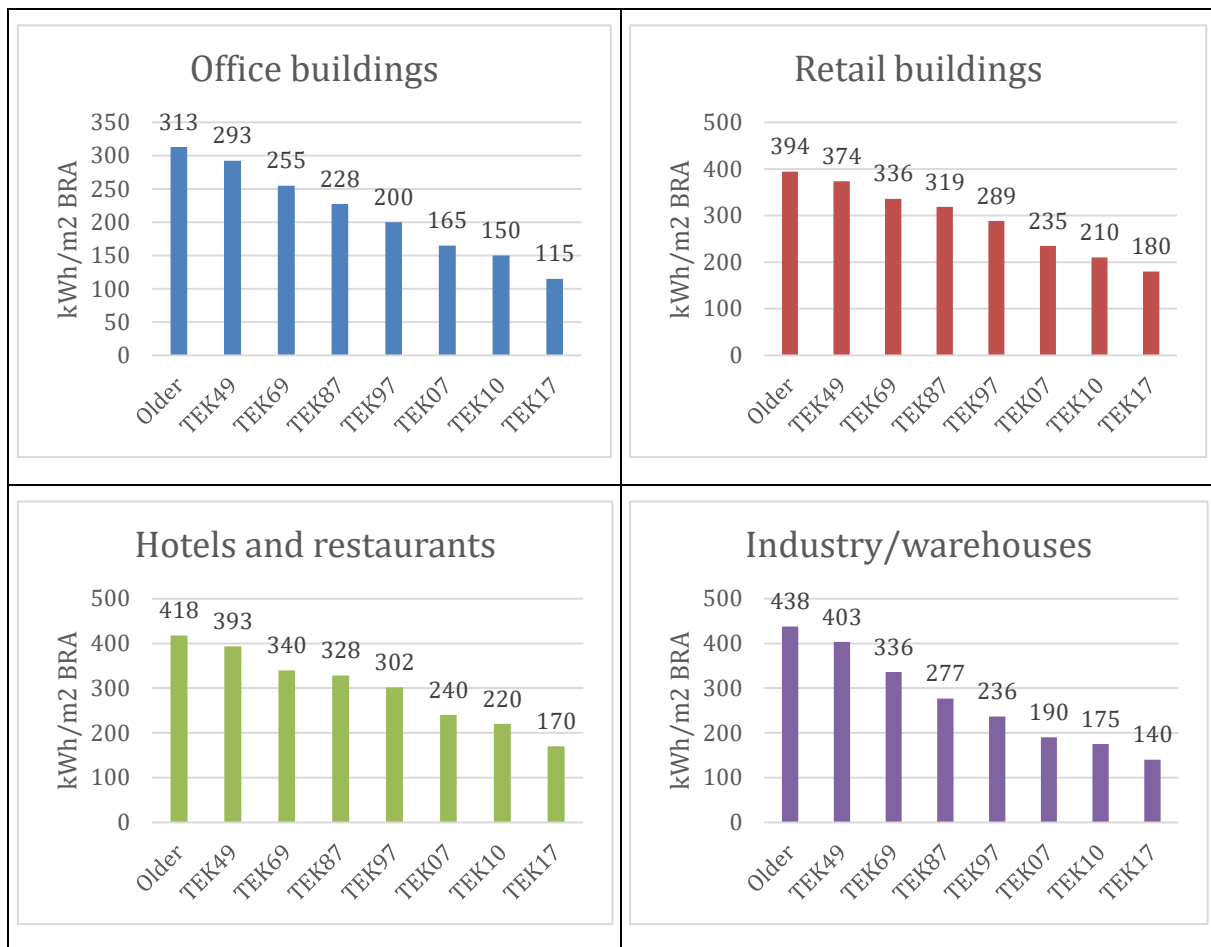


Figure 15 Development in calculated specific net energy demand based on building code and building tradition, (Multiconsult, simulated in SIMIEN)

Net energy demand is calculated for model buildings used for defining the building code (TEK07/TEK10/TEK17). The result presented in figure 15 illustrates how the calculated energy demand declines with decreasing age of the buildings. From TEK10 to TEK17 the reduction is between 14 – 23 %. The former shifts from TEK07 to TEK10 was about 10 %, and from TEK97 to TEK07 about 20 %.

Figure 15 gives theoretical values for representative models of an office building, retail/commercial building, hotel building and industry/ warehouse, 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 is not based on measured energy use. In addition to the guiding assumption in Norwegian Standard NS3031:2014, experience with building tradition is included. Indoor air quality is assumed not to be dependent on building year. By that, it is assumed that older buildings (TEK69 - older) that originally had natural ventilation or mechanical exhaust with relatively small air volumes, have at one time upgraded to balanced ventilation with satisfactory air volumes - this is assumed to be a necessary upgrade the property owner had to take to meet the tenancy requirements. Many such older buildings underwent such upgrades in the 80's and 90's. For these, a minimum allowable airflow from NS 3031: 2014 Table A.6 is used. This is the same methodology as used in the EPC-system.

Building code	Specific energy demand office building	Specific energy demand commercial building	Specific energy demand industry/warehouse	Specific energy demand hotels and restaurants
TEK07	165 kWh/m ²	235 kWh/m ²	190 kWh/m ²	240 kWh/m ²
TEK 10	150 kWh/m ²	210 kWh/m ²	175 kWh/m ²	220 kWh/m ²
TEK 17	115 kWh/m ²	180 kWh/m ²	140 kWh/m ²	170 kWh/m ²

Table 5 Specific energy demand as from the building codes

Table 5 includes the specific energy demand as a maximum requirement in the respective building codes, relevant for identifying the top 15 %, by a margin, most energy efficient commercial buildings in Norway.

The building codes are having a significant effect on energy efficiency.

4.1.1 Time lag between building permit and building period

After the implementation of new a building code there is some time lag before we see new buildings completed according to this new code. First there is some transition period where two codes are overlapping. Further, 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 like the complexity of the site and project, financing, the market and the building category.

The time from granted general permission to granted project start-up permission is often spent on design, sales and contracting. Based on Multiconsult's experience, six months to a year is a reasonable timespan for commercial buildings in this phase. As an illustration, the figure below, based on statistics from Statistics Norway (SSB), indicates that approximately six months to a year construction period is standard for office buildings.

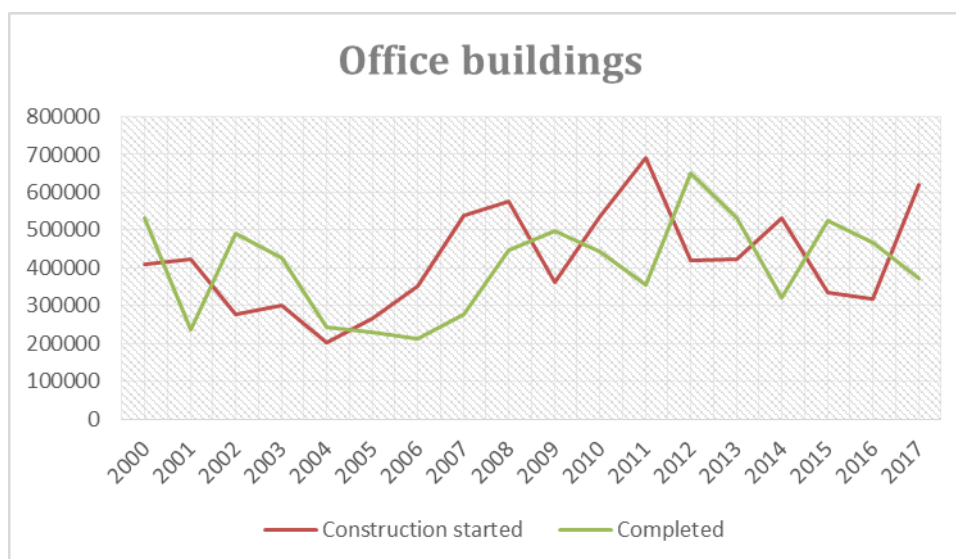


Figure 16 Project start-up and completion (Statistics Norway, bygningsarealstatistikken)

The 2007 building code was implemented February 2007. Based on the discussions on time for design and construction, we regard a time-lag of two years for offices, retail and industry/ warehouses between code implementation and buildings based on this code to be a robust and conservative assumption. Being more complex buildings, a time-lag of three years are assumed for hotel and restaurant buildings. The data available on completed construction is only available to the issuer on a yearly basis.

4.1.2 Building age statistics

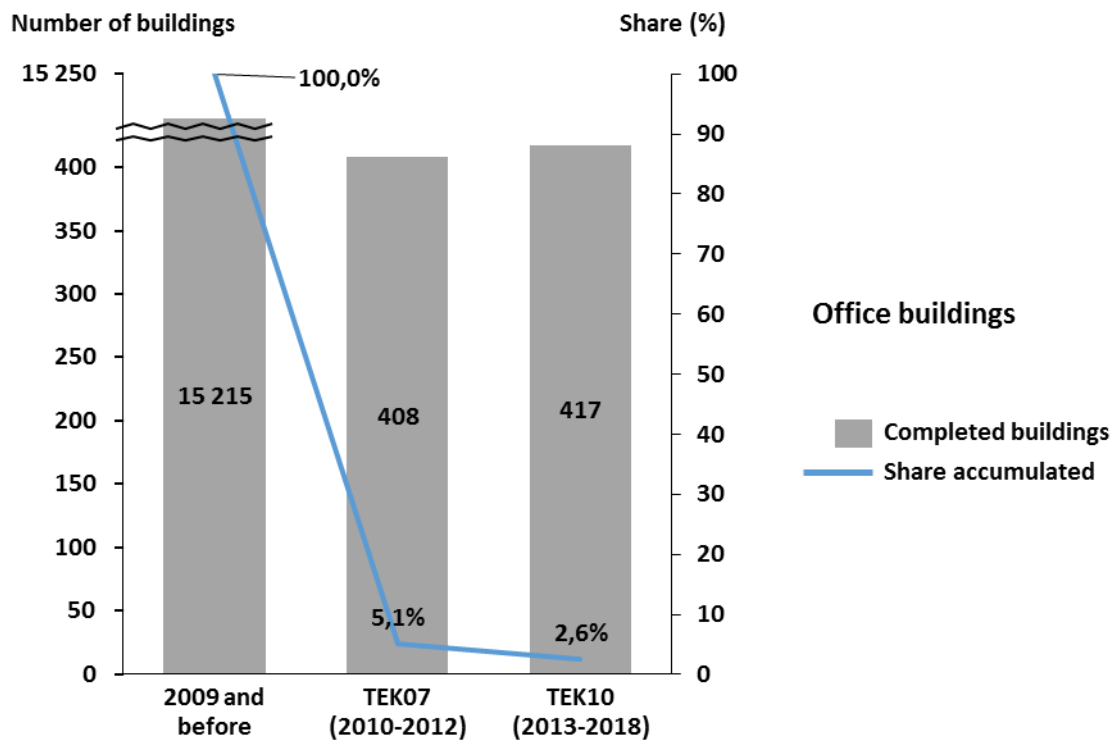


Figure 17 Age and building code distribution of office buildings (Statistics Norway and Multiconsult)

Figure 17 above shows how the Norwegian office building stock is distributed by age. The figure shows also how office buildings finished in 2010 and later (built according to TEK07) amount to 5.1 % of the total stock. The three figures below include the same information for the other three subcategories.

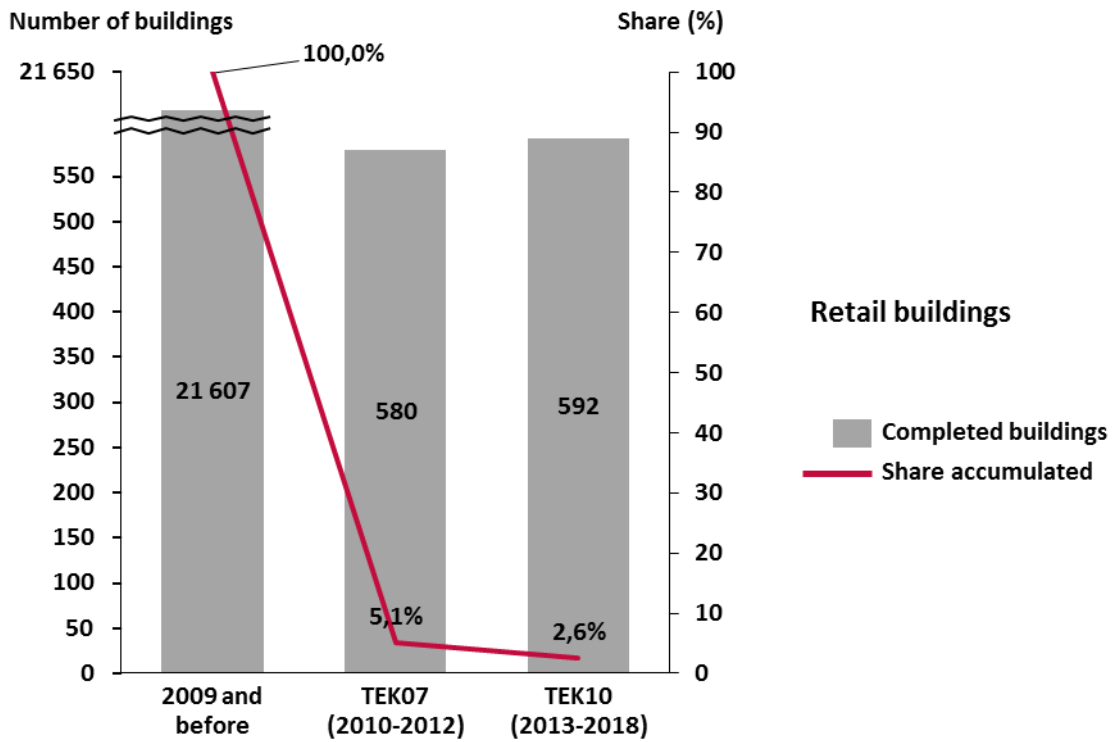


Figure 18 Age and building code distribution of commercial/retail buildings (Statistics Norway and Multiconsult)

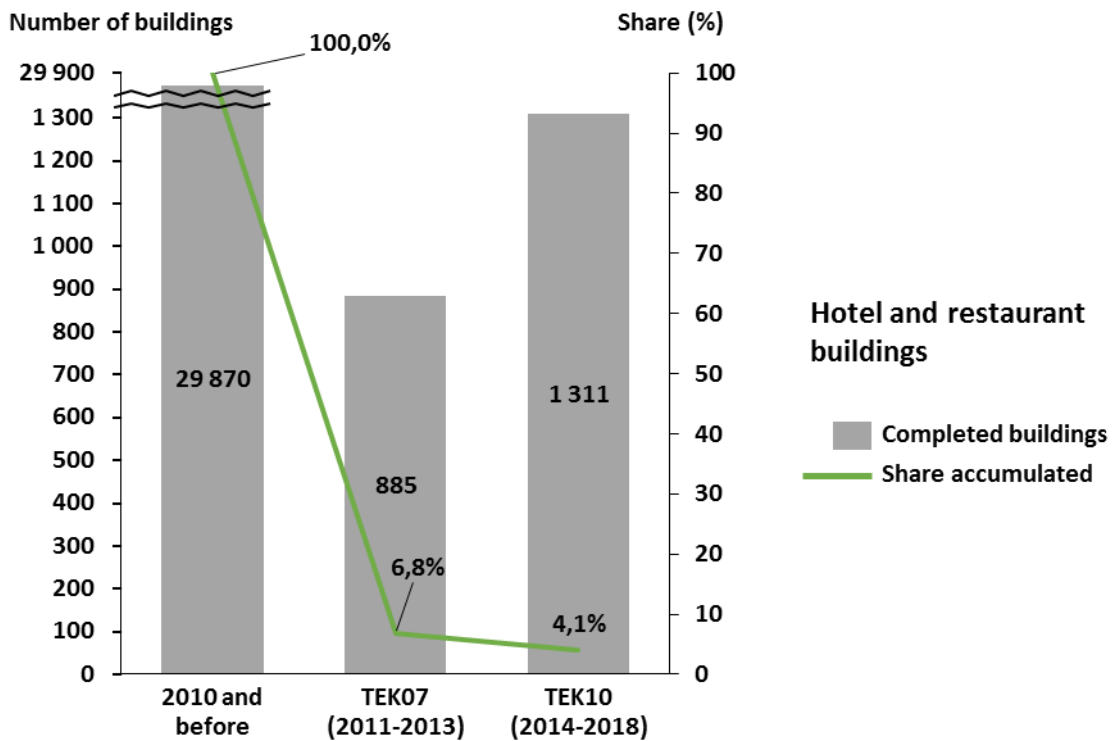


Figure 19 Age and building code distribution of hotel and restaurant buildings (Statistics Norway and Multiconsult)

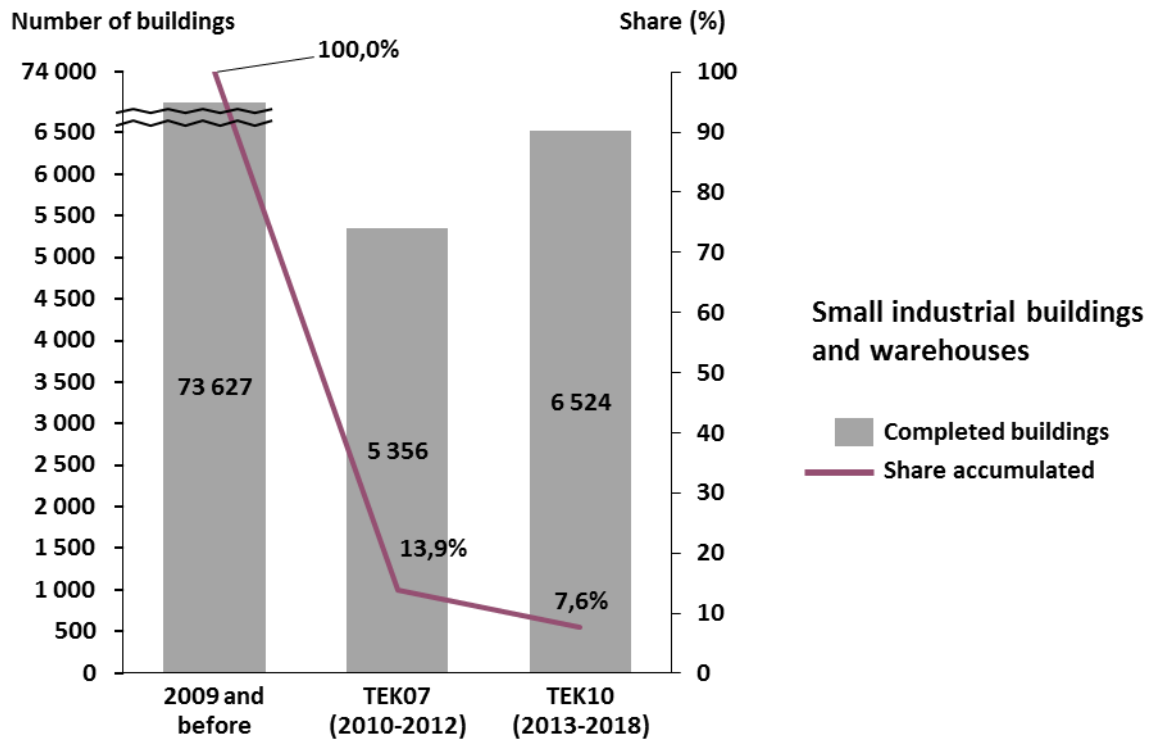


Figure 20 Age and building code distribution of small industrial buildings and warehouses (Statistics Norway and Multiconsult)

Figures 21 through 24 below show how much, based on theoretical energy demand in the same building stock, the same share of the building stock make up in share of the energy demand in the same subcategories. The same picture is relevant for CO₂- emissions.

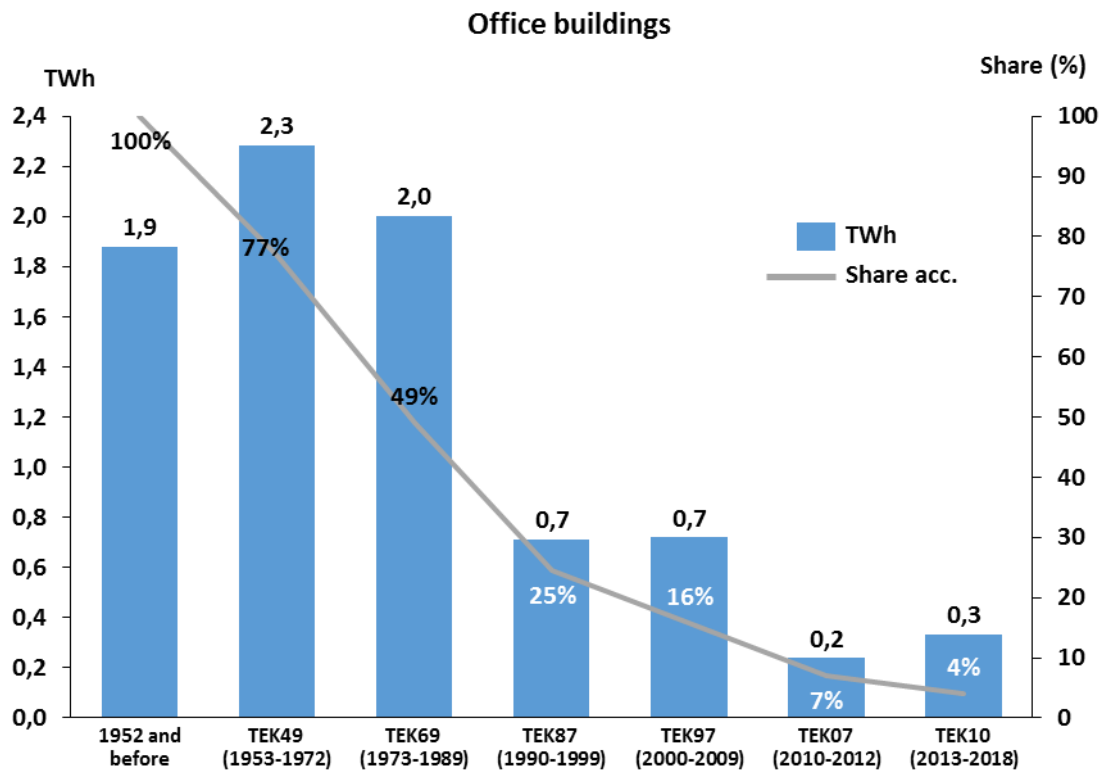


Figure 21 Share energy demand related to office buildings depending on building year

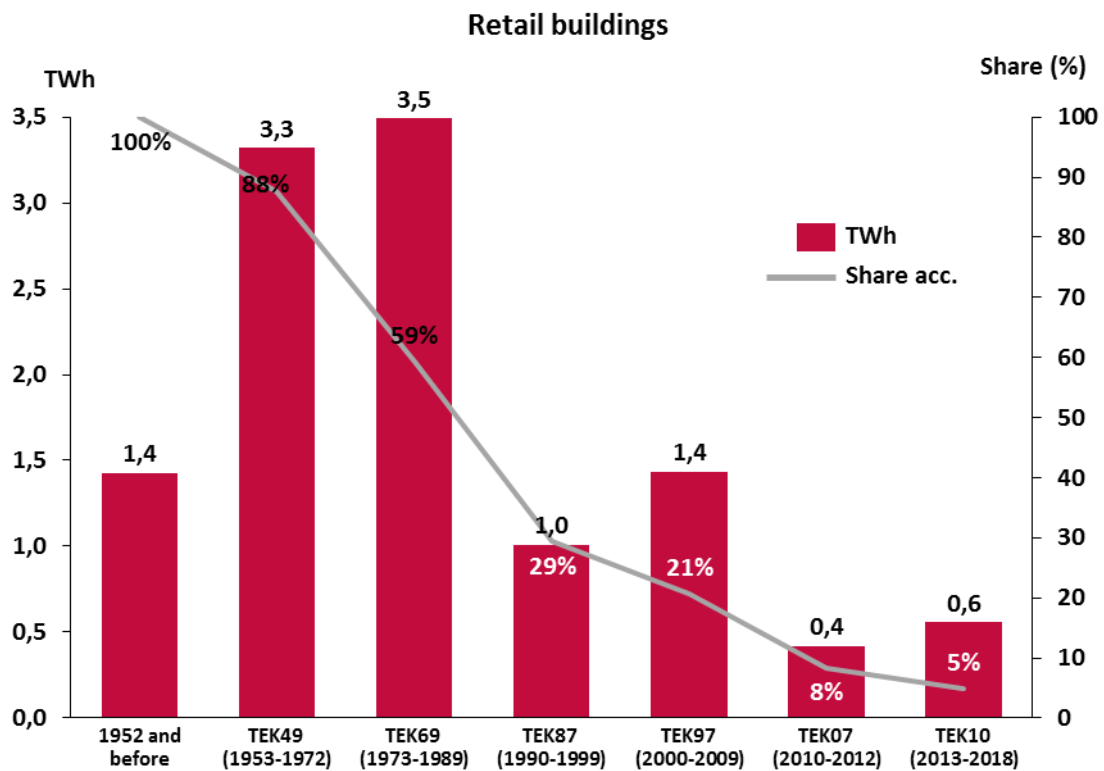


Figure 22 Share energy demand related to retail buildings depending on building year

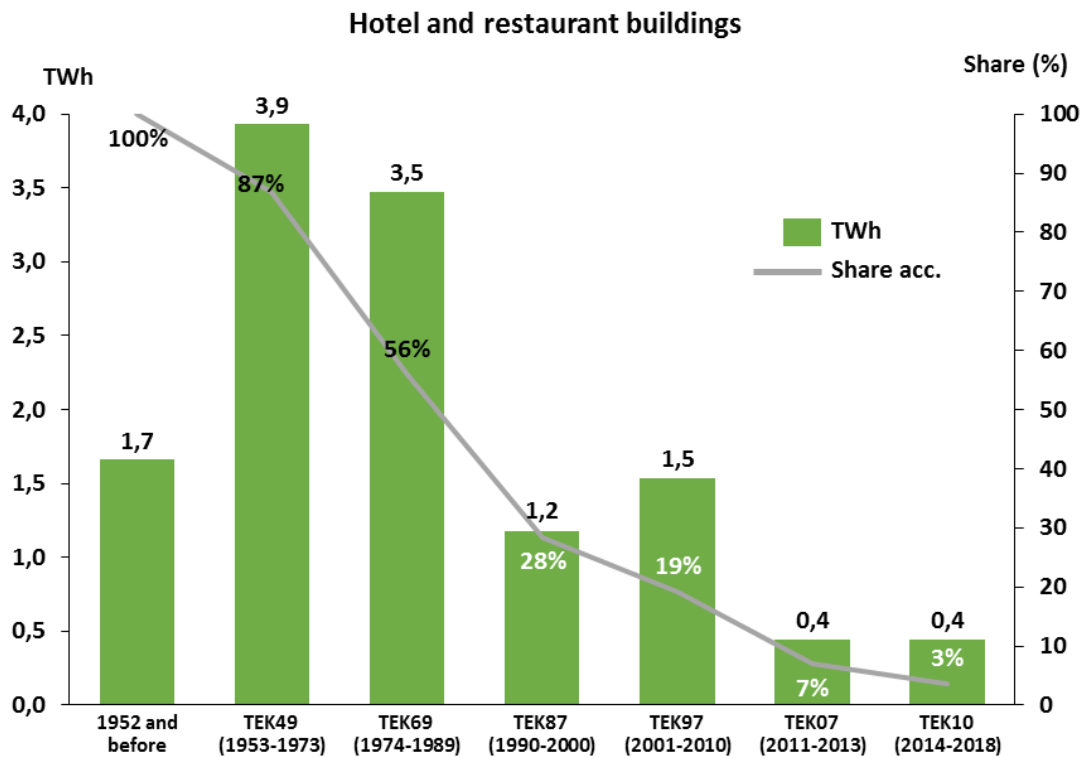


Figure 23 Share energy demand related to hotel and restaurant buildings depending on building year

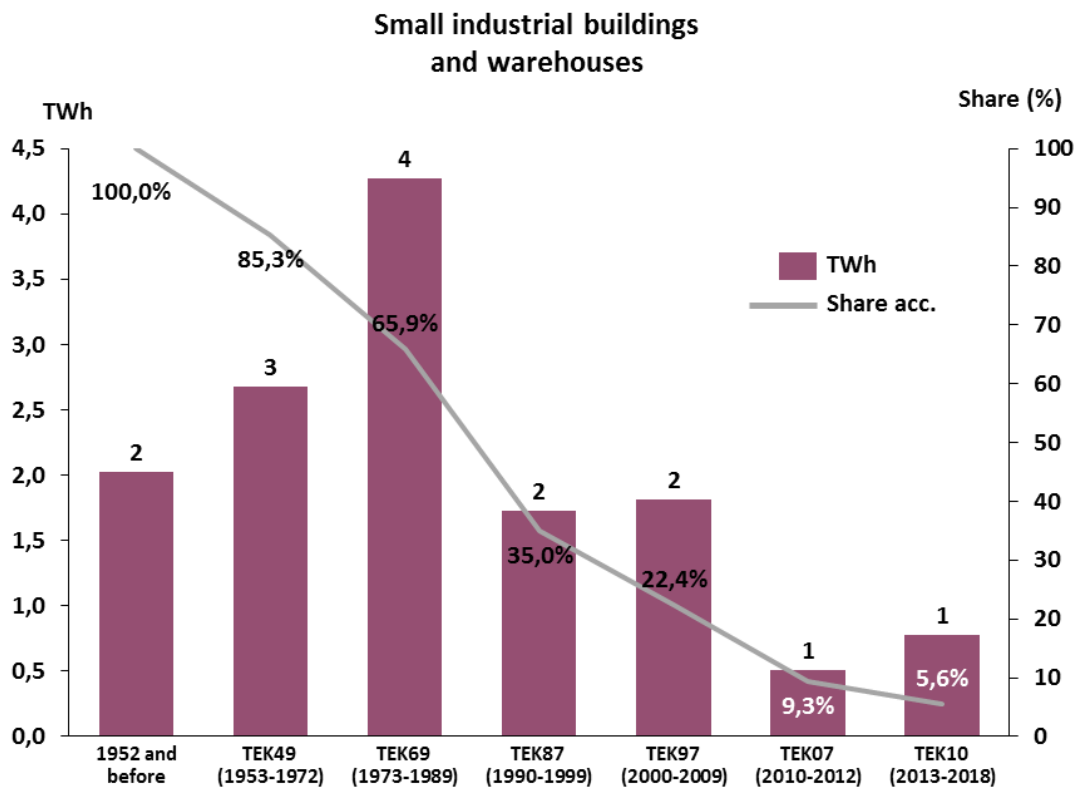


Figure 24 Share energy demand related to small industrial buildings and warehouses depending on building year

4.1.3 Eligibility under Sparebanken Vest's building code criterion

Over the last several decades, the changes in the building code have pushed for more energy efficient commercial buildings. The building stock data indicates that, dependent on type of commercial building, between 5.1 and 13.9 % of the current buildings in Norway were constructed using the 2007 code or a younger code with even more energy efficient solutions.

Combining the information on the calculated specific energy demand related to building code in figure 15 and information on the commercial building stock in figures 17 through 20, the calculated average specific energy demand on the part of the Norwegian building stock examined is presented in the table below. The table also presents the average specific energy demand for the younger and qualifying part of the building stock and the relative reduction in energy demand.

	Average total stock [kWh/m ²]	Average TEK07, TEK10 and TEK17 [kWh/m ²]	Reduction [kWh/m ²]
Office buildings	255	156	39 %
Commercial buildings	329	220	33 %
Hotel buildings	345	230	34 %
Small industry and warehouses	307	181	39 %

Table 6 Average specific energy demand for the building stock; whole stock, part eligible according to criteria and reduction

4.2 Refurbished Norwegian commercial buildings with an improved energy efficiency of ≥30 %

Refurbished buildings with an improved energy efficiency of at least 30 % or more are eligible for Green Bonds. This is aligned with the CBI taxonomy, where buildings qualify after being refurbished to a standard resulting in at least a 30 % reduction in energy demand⁹. In this case, we are looking to identify buildings that already have improved energy performance in this scale. To identify relevant buildings, the EPC database would be a very well suited source of data. Data in the database is likely to be released for this purpose in 2019. As well as only being representative of a small percentage of the total commercial building stock, the first data release will only include current certificates and will not include historic certificates for the buildings. The historic EPC-labels may be made available at a later stage, so two approaches are included in this criteria, one solely based on the EPCs, current and historic, and one approach based on the current certificate compared to calculated energy demand for different building code (TEK) periods (shown in figure 15).

Table 7 below includes limit values for qualifying to the different energy grades in the EPC system that make up the basis for the following calculations. It is important to note that these values are calculated with a different system boundary than the building code requirements.

⁹ <https://www.climatebonds.net/standard/buildings/upgrade>

Building categories	Delivered energy per m ² heated area (kWh/m ²)						
	A	B	C	D	E	F	G
Office	90	115	145	180	220	275	> F
Hotel and restaurant	140	190	240	290	340	415	> F
Commercial	115	160	210	255	300	375	> F
Industry/warehouse	105	145	185	250	315	405	> F

Table 7 Limit values in specific energy demand for energy grades in the EPC system

Table 8 below present calculated reduction in energy demand for an improvement of two steps on the energy grade scale in the Norwegian EPC system. To be able to include buildings originally only qualifying for a G, the values are calculated based on average values, and the average G building is assumed to have a specific energy demand as far off from the limit value for F as the average F is from the limit value for E ($G_{av} = F_{lim} + (F_{lim} + E_{lim})/2$).

This can be exemplified by an office building with an F (specific energy demand average of the limit value for F and limit value for E) will, with a 34 % reduction in energy demand end up with a specific energy demand average of the limit value for a C and the limit value for a D and with a D as new energy grade.

	Two-step improvement D → B	Two-step improvement E → C	Two-step improvement F → D	Two-step improvement G → E
Office buildings	37 %	35 %	34 %	34 %
Commercial buildings	41 %	33 %	31 %	33 %
Hotel buildings	38 %	32 %	30 %	30 %
Small industry and warehouses	43 %	42 %	40 %	37 %

Table 8 Improvement in specific energy demand from a two-step improvement in energy grade in EPC system calculated for average values.

4.2.1 Eligibility under building upgrade criteria

Refurbished Commercial buildings in Norway with an improved energy efficiency of 30%:

- i. Refurbished Norwegian commercial buildings with at least two steps of improvement in energy label compared to the calculated label based on building code in the year of construction.
- ii. Refurbished Norwegian commercial buildings with at least a 30% improvement in calculated energy efficiency, kWh/m² delivered energy to the building, compared to the calculated energy efficiency based on building code in the year of construction.

5 Impact assessment

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 new building is 60 years.) According to Norwegian Standard NS 3720:2018 “Method for greenhouse gas calculations for buildings” greenhouse gas factor for electricity used in buildings are to be calculated on a life-cycle basis according to two scenarios:

Scenarios GHG emissions related to electricity demand	CO ₂ - factor (g/kWh)
European (EU28+ Norway) consumption mix	136
Norwegian consumption mix (in tables 11, 13 and 14 “low”)	18

Table 9 Electricity production greenhouse gas factors (CO₂- equivalents) for two scenarios (source: NS 3020:2018, Table A.1)

In this assessment calculations are performed for both grid factors, however, we put emphasis on the international factor due to the ever more interconnected energy systems. This is in line with the grid factor used by the environmental certification system for buildings, BREEAM-NOR. Figure 25 illustrates the assumed linear development from the 2010 European production mix.

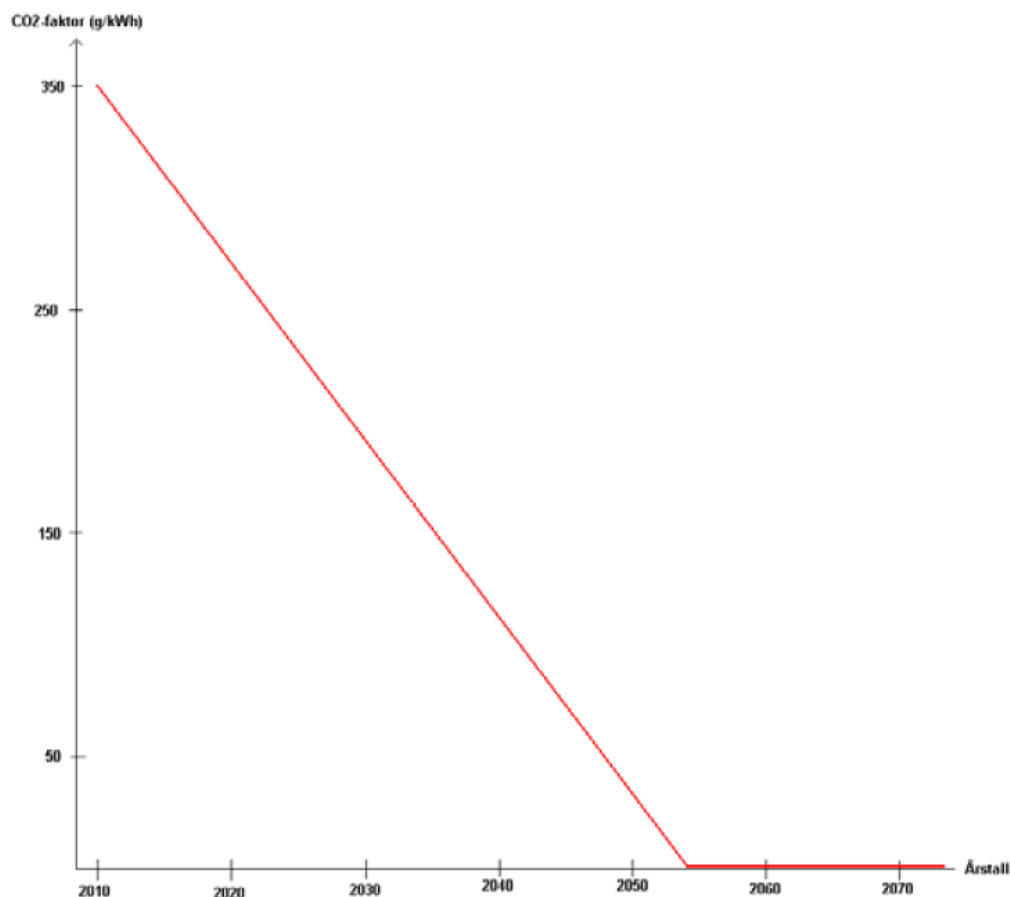


Figure 25 Simulated and extrapolated specific CO₂-emission from the European electricity system from 2010 to 2070 (the typical lifetime of a new building is 60 years). (Source: The Research Centre on Zero Emission Buildings, “Proposal for CO₂-factor for electricity and outline of a full ZEB-definition” May 2011)

To calculate the impact on climate gas emissions the trajectory is applied to all electricity consumption in all buildings. Electricity is the dominant energy carrier to Norwegian buildings but the energy mix includes also bio energy and district heating, resulting in a total specific factor of 123 g CO₂eq/kWh when the European consumption mix is applied. When the Norwegian consumption mix is applied, the factor is 32 g CO₂eq/kWh. Proportional relationship is expected between energy consumption and emissions.

5.1 Residential buildings

A reduction of energy demand from the average 257 kWh/m² of the total residential building stock to 126 kWh/m² (TEK07/TEK10) or 103 kWh/m² (TEK17) dependent on building code is multiplied to the emission factor and area of eligible assets to calculate impact.

5.1.1 Sparebanken Vest's criterion - 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

The eligible buildings in Sparebanken Vest's portfolio is estimated to amount to 1.55 million square meters. The available data include reliable area per object for about 51 % of eligible dwellings. Area per dwelling of 49 % of the eligible dwellings are calculated on the basis of average area. Due to the fact that the bank does not have area per object available, the area is calculated based on the assumption that the residents are representative of the total Norwegian residential building stock. Statistics have been taken from Statistics Norway¹⁰. The values in the column [area per unit] in the table below are calculated from these statistics.

	Area per unit [m ²]	Area total [m ²]
Apartments	75	290,000
Undetached houses	115	110,000
Detached houses	188	900,000
Semi-detached houses	121	250,000
Sum		1,550,000

Table 10 Eligible objects and calculated building areas

Based on the calculated figures in table 10 the energy efficiency of this part of the portfolio is estimated. All these residential buildings are not included in one single bond issuance.

The calculated average specific energy demand for the eligible assets is 123 kWh/m². This is 52 % lower than the calculated average of the total residential building stock.

The table below indicates how much more energy efficient the eligible part of the portfolio is compared to the average residential Norwegian building stock. It also present how much the calculated reduction in energy demand constitutes in CO₂-emissions.

¹⁰ Table 06513: Dwellings, by type of building and utility floor space

	Area	Reduced energy compared to baseline	Reduced CO ₂ -emissions compared to baseline	
Eligible buildings in portfolio	1.55 Million m ²	207 GWh/year	EU28+ Norway	25,000 tons CO ₂ /year
			Low	6,500 tons CO ₂ /year

Table 11 Performance of eligible objects compared to average building stock (high and low in reference to table 9)

5.2 Commercial buildings

A reduction of energy demand in line with table 6 does together with the emission factor and area of eligible assets forms the basis of calculating impact.

5.2.1 Sparebanken Vest's criterion - New or existing Norwegian commercial buildings that comply with the Norwegian building code of 2007 (TEK07) or later codes

The cumulative surface of the eligible commercial buildings in Sparebanken Vest's portfolio is approximately 145 000 square meters. The bank has specific data on assets including area and building category. Where a building falls into several categories, the total area is distributed between the categories. The areas in the table below makes basis for the following impact assessments.

	Number of objects	Area total [m ²]
Office buildings	11	40,846
Commercial buildings	16	16,746
Hotel buildings	6	882
Small industry and warehouses	94	86,313
Sum	127	144,787

Table 12 Eligible objects and calculated building areas

The calculated average specific energy demand for the eligible assets is 193 kWh/m². This is in the area of 35 % lower than the calculated average of the total commercial building stock of the same categories.

The table below indicates how much more energy efficient the eligible part of the portfolio is compared to the average commercial Norwegian building stock. It also present how much the calculated reduction in energy demand constitutes in CO₂-emissions.

	Area	Reduced energy compared to baseline	Reduced CO ₂ -emissions compared to baseline	
Eligible buildings in portfolio	144,787 m ²	16 GWh/year	EU28+ Norway	2,000 tons CO ₂ /year
			Low	500 tons CO ₂ /year

Table 13 Performance of eligible objects compared to average building stock (high and low in reference to table 9)

5.3 Total – residential and commercial buildings

Table 14 sums up the difference in energy efficiency and related emissions of CO₂ between eligible residential and commercial buildings in the bank's portfolio and the baselines for the relevant building categories.

	Area	Reduced energy compared to baseline	Reduced CO ₂ -emissions compared to baseline	
Eligible buildings in portfolio	1.69 Million m ²	223 GWh/year	EU28+ Norway	27,000 tons CO ₂ /year
			Low	7,000 tons CO ₂ /year

Table 14 Performance of eligible objects compared to average building stock (high and low in reference to table 9)