REPORT

Sparebanken Øst Green Portfolio Impact Assessment

CLIENT

Sparebanken Øst

SUBJECT

Impact assessment- energy efficient residential buildings

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REPORT

PROJECT	**Sparebanken Øst Green Portfolio Impact Assessment**	DOCUMENT CODE	10249088-01-TVF-RAP-001
SUBJECT	Energy efficient residential buildings	ACCESSIBILITY	Open
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1 Introduction

Assignment

On assignment from Sparebanken Øst, Multiconsult has assessed the impact of the part of the bank's loan portfolio eligible for green bonds according to Sparebanken Øst's Green Bonds Framework.

In this document we briefly describe Sparebanken Øst's green bond qualification criteria, the evidence for the criteria and the result of an analysis of the loan portfolio of Sparebanken Øst. More information and documentation will be made available on the bank's website, e.g. in the bank's Green Bond Framework.

1.1 CO_2 emission factors related to electricity demand and production

The energy consumption of Norwegian buildings is also predominantly electricity, with some district heating and bioenergy. The share of fossil fuel is very low and declining.

As shown in figure 1, the Norwegian electricity production mix in 2021 (91% hydropower and 8% wind) results in emissions of 4 gCO_2/kWh. The production mix for other selected European states is also included in the figure for illustration.

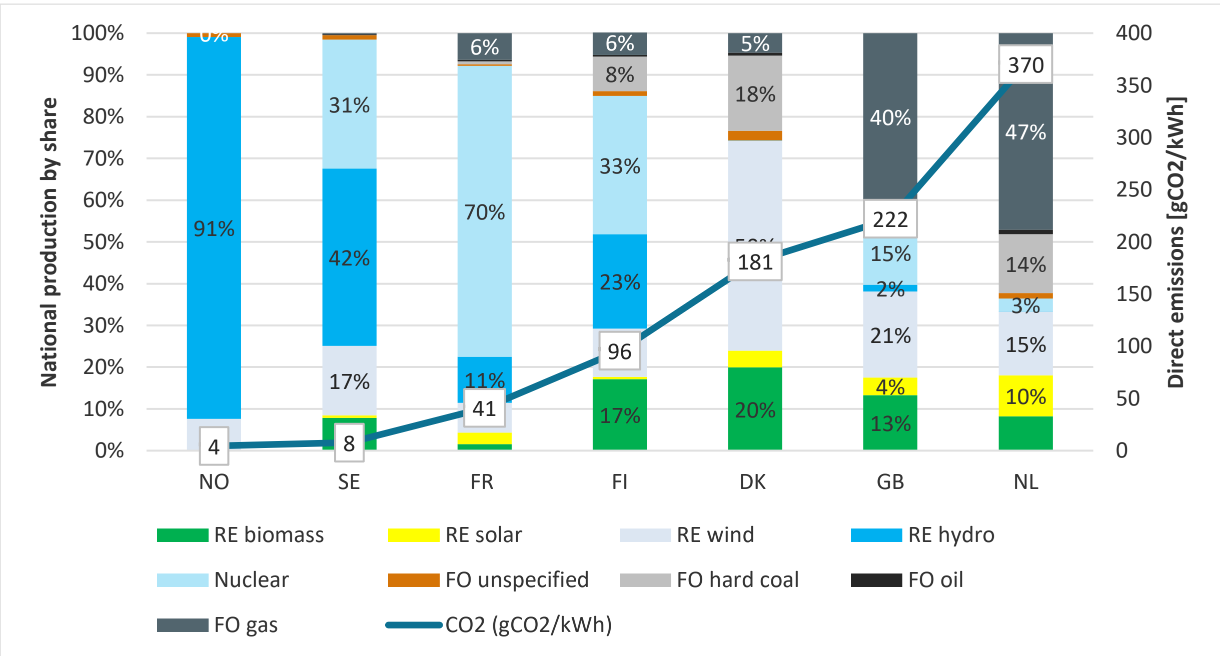


Figure 1 National electricity production mix in some selected countries (European Residual Mixes 2021, Association of Issuing Bodies[1])

Power is traded internationally in an ever more interconnected European electricity grid. For impact calculations, the regional or European production mix is more relevant than national production. Using a life-cycle analysis, the Norwegian Standard NS 3720:2018 "Method for greenhouse gas calculations for buildings" takes into account international electricity trade and that the consumption is not necessarily equal to domestic production. The grid factor, as average in the lifetime of an asset, is

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

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 mentioned standard calculates, on a life-cycle basis, the average CO_2 factor for the next 60 years, a lifetime relevant for buildings, according to two scenarios as described in table 1.

Scenario	CO_2 factor (g/kWh)
European (EU27 + UK + Norway) electricity mix	136
Norwegian electricity mix	18

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

The impact calculations in this report apply the European mix in table 1. This is in line with Nordic Public Sector Issuers: Position Paper on Green Bonds Impact Reporting (February 2020)[2].

Applying the factor based on EU27 + UK + Norway energy production mix, the resulting CO_2 factor for Norwegian residential buildings, including the influence of bioenergy and district heating in the energy mix, is on average 111 gCO_2/kWh due to. This factor is used in impact calculations in section 2.

2 Energy efficient residential buildings

Sparebanken Øst has defined the following eligibility criteria for Green Residential Buildings, for which eligible buildings must meet one:

1. Buildings built in 2021 or later with energy consumption that is 10% lower than national minimum requirements stated in the latest building code, or have a BREEAM-NOR Excellent certificate.
   (This criterion is not examined further by Multiconsult and also not considered in impact assessment as adequate object specific documentation is not available.)
2. Buildings built before 2021 with Energy Performance Certificate A
3. Buildings built before 2021 that comply with the Norwegian building code of 2010 (TEK10) 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 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.
4. Buildings built before 2012 with EPC-labels B. These buildings may be identified by using data from the Energy Performance Certificate (EPC) database.
5. Renovated Norwegian residential buildings which after renovation meets the criteria above, or renovations that achieve an improvement in energy-efficiency of at least 30%. (This criterion is not examined further by Multiconsult and not considered in impact assessment as adequate object specific documentation is not available.)

[2] https://www.kbn.com/globalassets/dokumenter/npsi_position_paper_2020_final_ii.pdf

Multiconsult has studied the Norwegian residential building stock and presents in the following how the building code criterion (criterion 3 above) is justified by building stock statistics, historic building code development and building customs over the years. The following also examines the EPC-system and how the database of certificates may be used to identify eligibility criteria (criteria 2 and 4 above).

2.1 New or existing Norwegian residential buildings that comply with building code TEK10 or newer: 11%

Criterion 3 above.

Changes in the Norwegian building code have consistently over several decades resulted in increasingly energy efficient buildings. As of 2020, **11% of Norwegian residential buildings are built following TEK10** or a newer building code, well within 15% and thus being eligible according to the Sparebanken Øst criterion.

The methodology is in line with the Climate Bonds Initiative (CBI) taxonomy, where the top 15% most energy efficient buildings are considered eligible. The baseline and criterion are in line with, or stricter than, the CBI baseline methodology for energy efficient residential buildings for Norwegian conditions, which was published in spring 2018. The threshold of top 15% is in line with the relevant building acquisition and ownership of buildings criteria in the EU Taxonomy Delegated Acts[3].

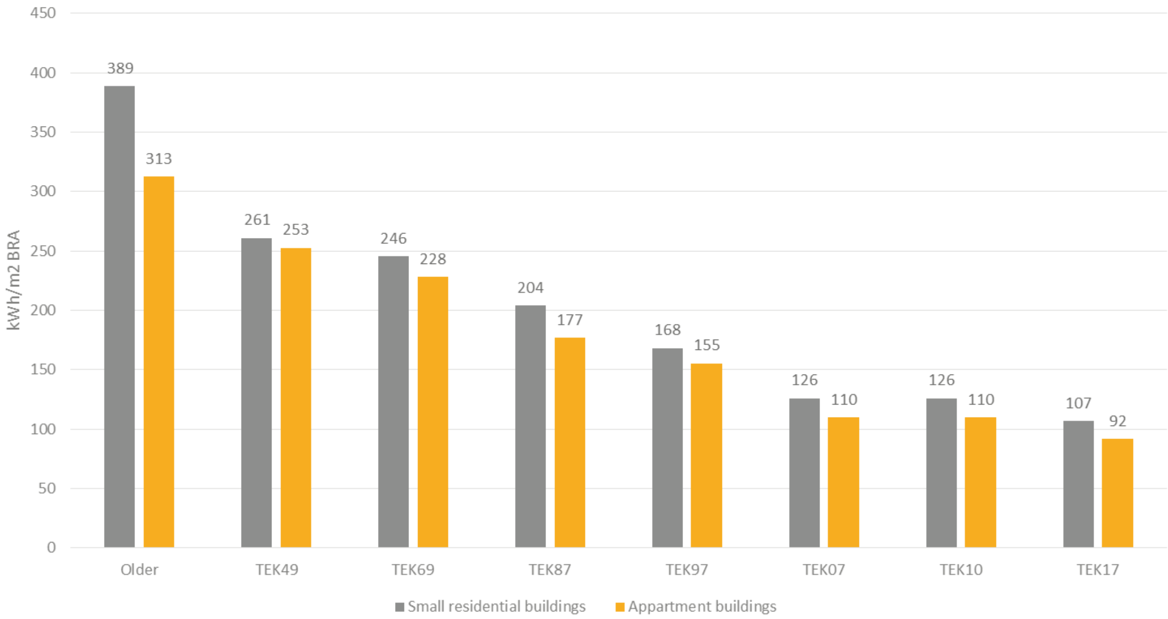


Figure 2 Development in calculated specific net energy demand based on building code and building tradition, (Multiconsult, simulated in SIMIEN)

Net energy demand is calculated using standard building models identical to the models used for defining the building codes (TEK10/TEK17). Figure 2 illustrates how the calculated energy demand declines with decreasing age of the buildings. From TEK10 to TEK17 the reduction is about 15%, and the former shift from TEK97 to TEK10 was 25%. It should be noted that for 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 simulation software SIMIEN and in accordance with Norwegian Standard NS

[3] https://ec.europa.eu/info/law/sustainable-finance-taxonomy-regulation-eu-2020-852/amending-and-supplementary-acts/implementing-and-delegated-acts_en

3031:2014 *Calculation of energy performance of buildings - Method and data*, and not based on measured/actual energy use. In addition to the guidelines and assumptions from the standard, building tradition has also been considered. For older buildings, the calculated theoretical values tend to be higher than the actual measured use, mostly because the ventilation air flow volume is assumed to be the same as in newer buildings, while there is no heat recovery. Indoor air quality is not assumed to be dependent on building year. This is consistent with the methodology used in the EPC-system.

Building code	**Specific energy demand Apartment buildings (model homes)**	**Specific energy demand Small residential buildings (model homes)**
TEK10	110 kWh/m^2	126 kWh/m^2
TEK17	92 kWh/m^2	107 kWh/m^2

Table 2 Specific energy demand calculated for model buildings

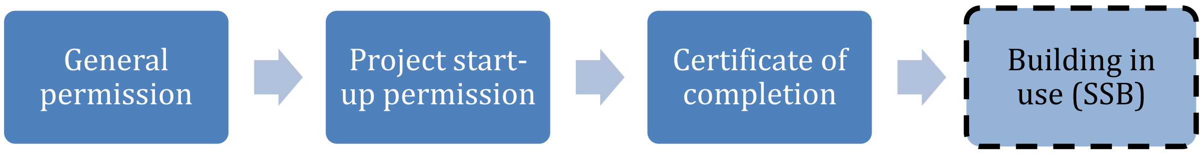
Error! Reference source not found. Table 2 shows the specific energy demand calculated by using the standard model buildings, for the building codes relevant for identifying the top 15% most energy efficient residential buildings in Norway.

The building codes are having a significant effect on the energy efficiency of buildings. An investigation of the energy performance of buildings registered in the EPC database that were built after 1997 show a clear improvement in the calculated energy level for buildings completed after 2008/2009 when the building code of 2007 came into force. Similar improvements can be observed between 1997 to 1998, after the building code of 1997 came into force.

In the period between 1998 and 2009, when there was no change in the building code, there is no observable improvement, however a small reduction in energy use might have taken place during those years. This might be due to an increased use of heat pumps in new buildings, and to a certain degree, improved windows.

2.1.1 Time lag between building permit and building period

Following the implementation of a new building code, there is a time lag before we see new buildings completed in accordance with this new code. The lag between the date of general permission received (in Norwegian: "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 factors like 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 usually spent on design, sales and contracting. Based on Multiconsult's experience, a reasonable timespan for residential buildings in this phase is six months to a year. Figure 3 below, based on statistics from Statistics Norway (SSB), indicates that a standard construction period for residential buildings lasts approximately six months to a year.

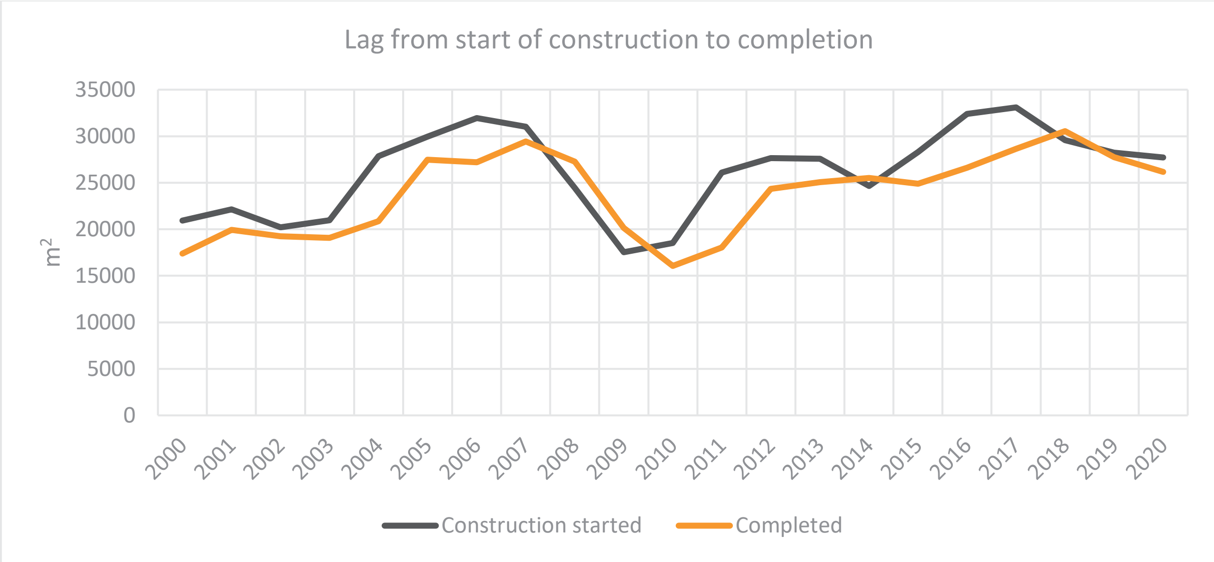


Figure 3 Project start-up and completion (Statistics Norway, bygningsarealstatistikken)

The 2010 building code was implemented on July 1st, 2010. Based on the discussions above, we regard a time-lag of two years between code implementation and completed buildings based on that code to be a robust and conservative assumption in most cases. 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, while at the same time, there might be buildings completed in 2012 based on TEK07.

2.1.2 Building age statistics

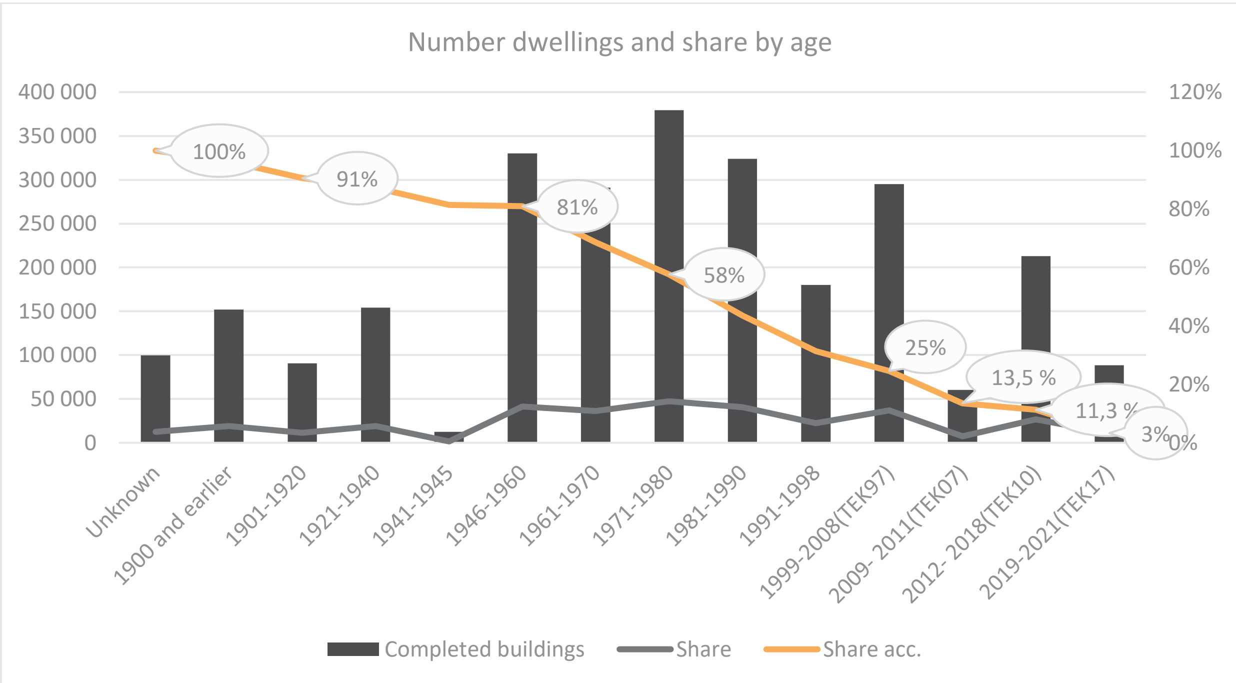


Figure 4 Age and building code distribution of dwellings (Statistics Norway and Multiconsult)

Figure 4 above shows how the Norwegian residential building stock is distributed by age. The same statistics are adjusted by new intervals using statistics on building area (in Norwegian "Bygningsarealstatistikken"). The figure shows how buildings finished in 2012 or later (built according to TEK10 or TEK17) make up 11% of the total stock. Based on theoretical energy demand in the same building stock, those 11% of the stock stand for 4.3% of the energy demand in residential buildings (Figure 5) and 3.9% of the associated CO_2-emissions (Figure 6). The difference between energy demand and CO_2-emissions can be explained by heating solutions in newer buildings being slightly less CO_2-intensive.

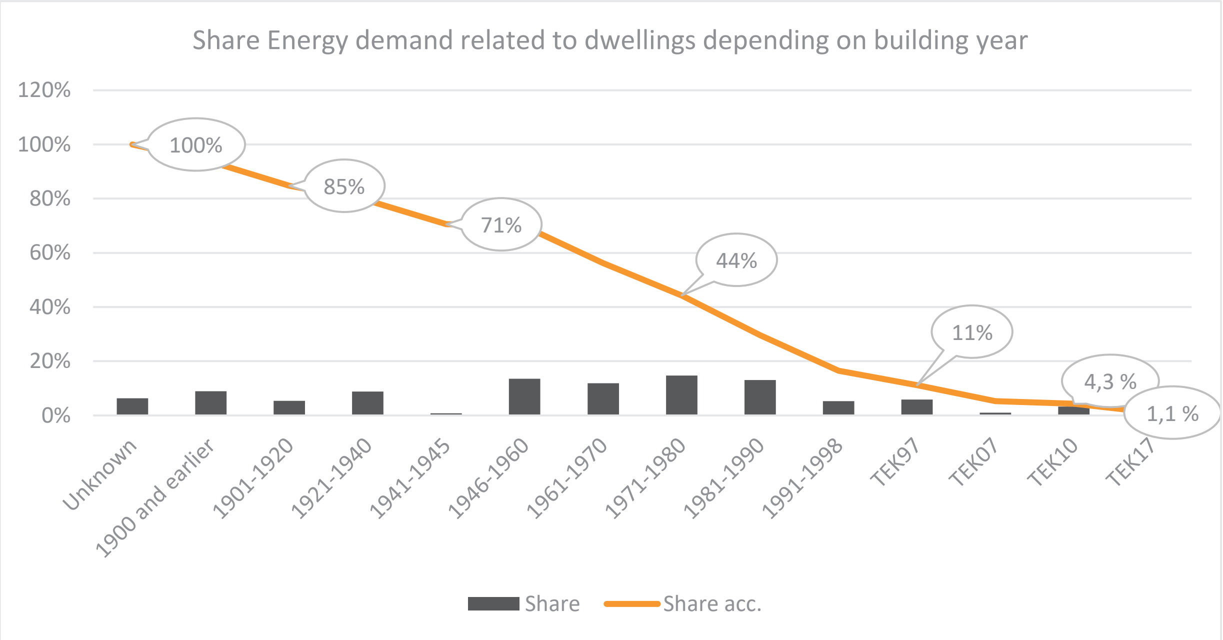


Figure 5 The building stock's relative share of energy demand (Statistics Norway and Multiconsult)

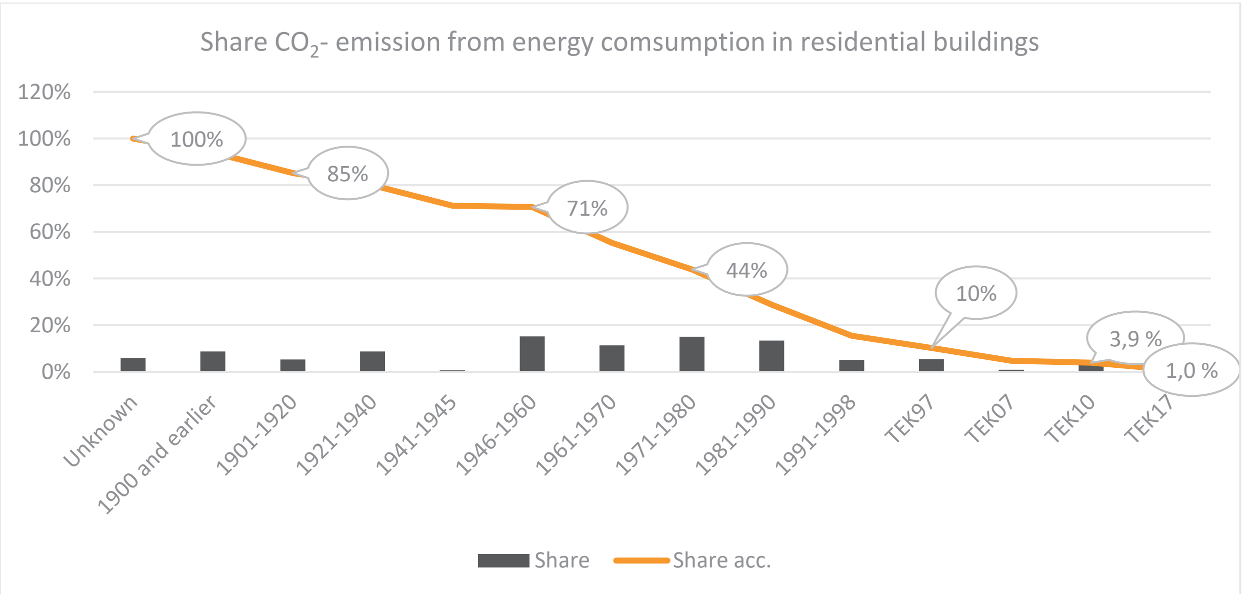


Figure 6 The building stock's relative share of CO_2-emissions related to energy demand dependent on building year and code (Statistics Norway and Multiconsult)

Figure 7 illustrate how the top 15% most energy efficient buildings may be identified by building code TEK10 (or later codes) until the end of 2024. These projections are based on building statistics including buildings built in 2021 and NVE's building stock projections used in their energy demand projections.

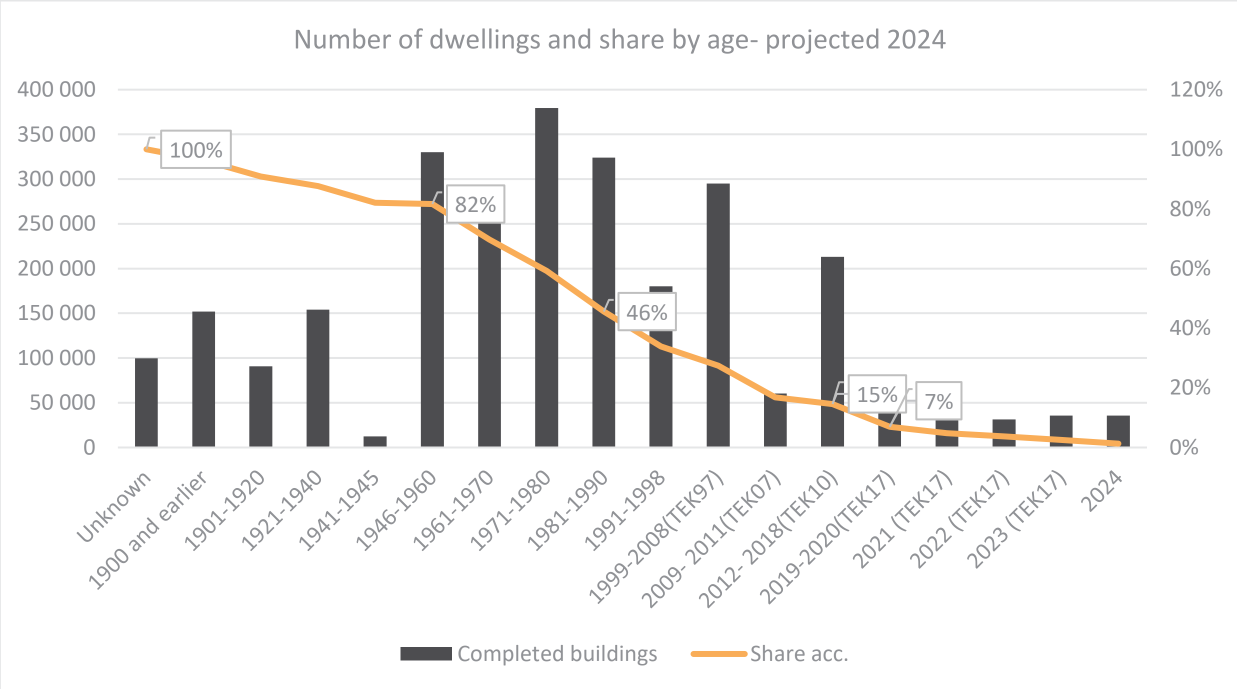


Figure 7 Age and building code distribution of dwellings projected in 2024 (Statistics Norway, NVE and Multiconsult)

If top 15% is to include only buildings finished before January 2021, the building code criterion will only be moved from 10% (building years 2012-2020) by a large number of upgrades with documented energy performance according to new building codes.

2.1.3 *Eligibility under a building code criterion*

Over the last several decades, the changes in the building code have pushed for more energy efficient buildings and allows for identifying the 15% most energy efficient buildings based on building year. The national building stock data indicates that 11% of the current residential buildings in Norway were constructed using the building code of 2010 (TEK10). Combining the information on the calculated energy demand related to building codes in Figure 2 and information on the residential building stock in Figure 4, the calculated average specific energy demand on the total Norwegian residential building stock is 251 kWh/m^2. Building codes TEK10 and TEK17 give an average specific energy demand for existing houses and apartments, weighted for actual stock, of 116 kWh/m^2, which is 54% lower than the average.

2.2 Norwegian residential buildings with EPC-labels A or B

Criterion 2 and 4 on page 6.

2.2.1 Identification of energy efficient residential buildings through EPC labels

The Energy Performance Certificate (EPC) system is another source for identifying assets eligible for green mortgages. All buildings with an energy grade of A or B are eligible as green residential buildings according to this criterion.

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

The figure below shows the distribution of all residential buildings with EPCs in Norway by building code, and their certificate label.

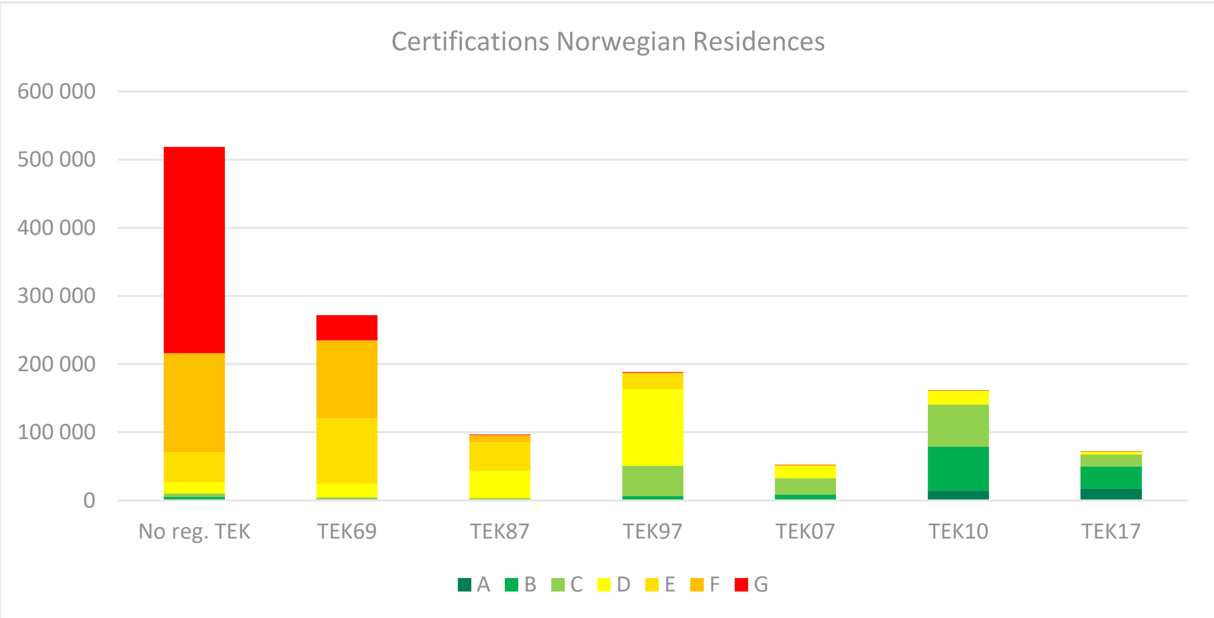


Figure 8 Residences in Norway with Energy Performance Certificates distributed per building code and energy grade in the EPC system. The numbers are based on statistics from the EPC database (representing about 50% of the total building stock).

The properties already registered in the EPC database are considered to be representative for all the residential buildings built under the same building code. However, they are 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 residential building stock of about 50%.

2.2.2 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 with necessary credentials must certify new buildings and non-residential buildings. Non-professional building-owners that are selling their house or apartment can however do the certification themselves in a simplified registration system. The 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 3 Delivered energy EPC energy labels (Source: www.energimerking.no)
A = heated floor area of the dwelling
Example: a 150 sq. m *small residential building (house)* → a C qualification limit of 145+(2500/150) = 161.67 kWh/m^2

The grading system and C-label

The C-grade for residential buildings is defined so that a building built after the building codes of TEK2010 in most cases should receive a C.

The limit value for reaching a C is calculated based on representative models of a small residential building and an apartment, built according to the building codes of 2007/2010, with an assumed moderate system efficiency for the building's energy system.

Residences built according to the building code of 2010, which are included in criterion 3, will hence mostly get a C or better, but might in some cases get a D. Extracting only buildings built according to TEK07 or older building codes from the EPC database, 1.4% of the total registered buildings have a B or better. These are buildings that have initially been built with, or through refurbishment attained, higher energy efficiency standards than what the original building year (and respective building code) would imply.

The Norwegian EPC-system requires every apartment to be certified separately. However, the defined limit values in the grading system are set for an average apartment. An apartment located on the top or bottom floor or at a corner will have a higher heat loss and may very well get a lower grade than other apartments in the same building. Hence, a TEK10 building may have apartments with energy label C and D, and in some rare cases even an energy label E. But these apartments are still more energy efficient than apartments with similar locations in older apartment buildings.

Since a dominant part of the certifications for residential buildings are done in the simplified registration mode, and not by professionals, a larger share of existing TEK10-buildings gets a D, and in some rare cases even an E. This is in many cases due to the more conservative calculation methods used in this simplified registration mode. Another reason why some existing houses and apartments built according to TEK10 receive a D, is that the grade scale has been revised and made stricter three times between 2011 and 2015. E.g., a small residential building that was graded a C when it was new in 2012, could be graded a D in 2015.

Therefore, most of the poorer certificates in new buildings are due to either one or a combination of the above-mentioned aspects; 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 stricter grading scale. In sum, the building itself is not necessarily less energy efficient.

Figure 9 shows the energy grades in granted certificates to Norwegian residential buildings, all included, also buildings finished since January 1st 2021.

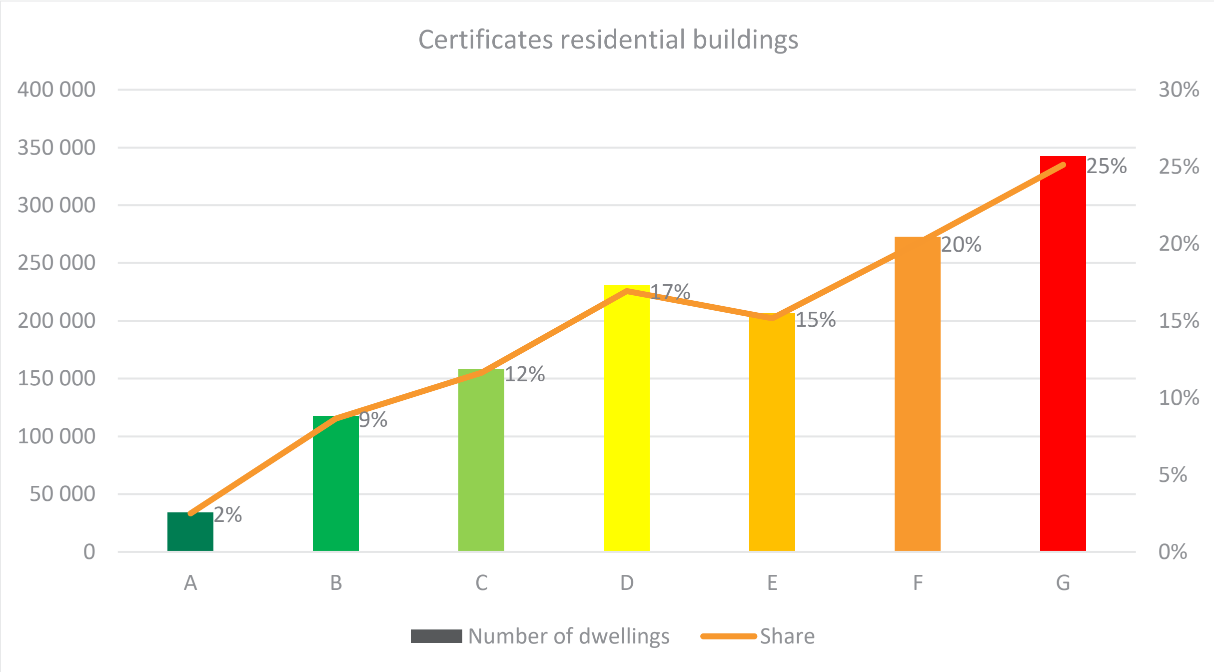


Figure 9 Energy Performance Certificates by grade- residential buildings only, representative only of buildings with EPCs (Source: energimerking.no, January 2023)

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

Figure 10 compares the number of buildings with EPCs and in the total building stock, by the building code according to which they were built to illustrate the distribution of building age. It also shows how much of the building stock is represented in the EPC database. This illustrates how newer buildings are overrepresented in the EPC database. Note that EPC data is regularly updated and the data behind the figure include all registrations. Building stock data is only updated on a yearly basis, and the figure includes buildings finished until the end of 2021.

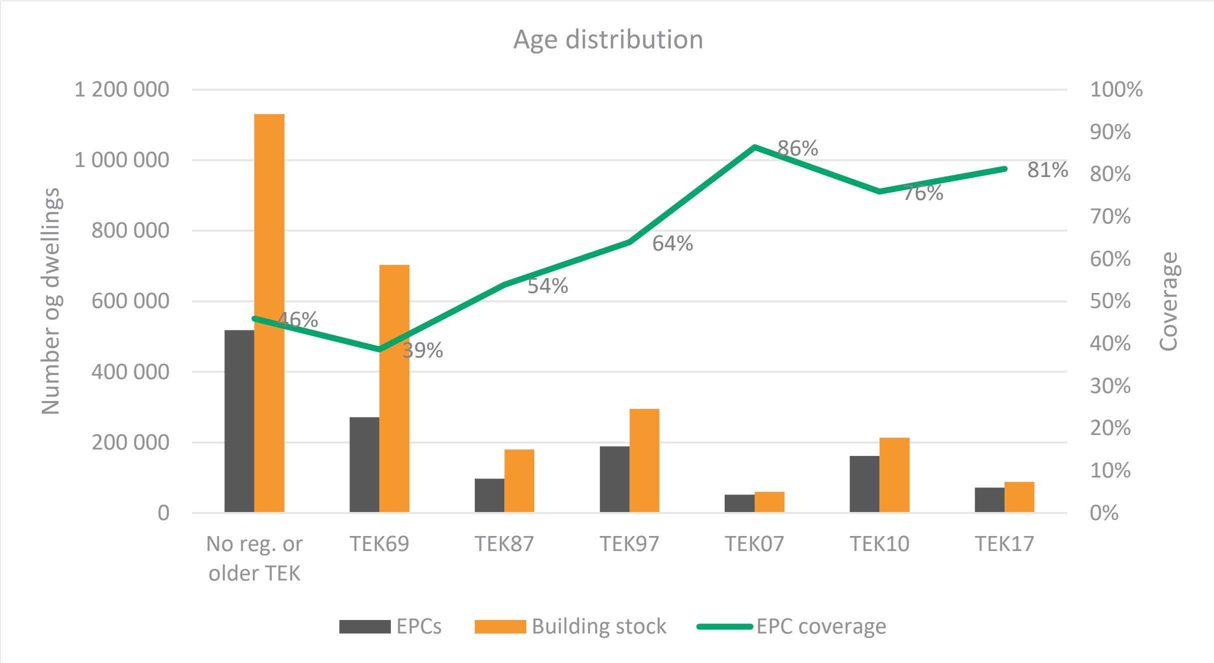


Figure 10 Age distribution in Energy Performance Certificates vs. actual residential building stock and EPC coverage by building year (Source: energimerking.no January 2023 and Statistics Norway incl. 2021 figures)

Assuming registered EPCs for each time period are representative for the building stock, it is possible to indicate what the label distribution would be if all residential buildings were given a certificate. Figure 11 illustrates how EPCs would be distributed based on this assumption. 7.6% of the residences would have a B or better.

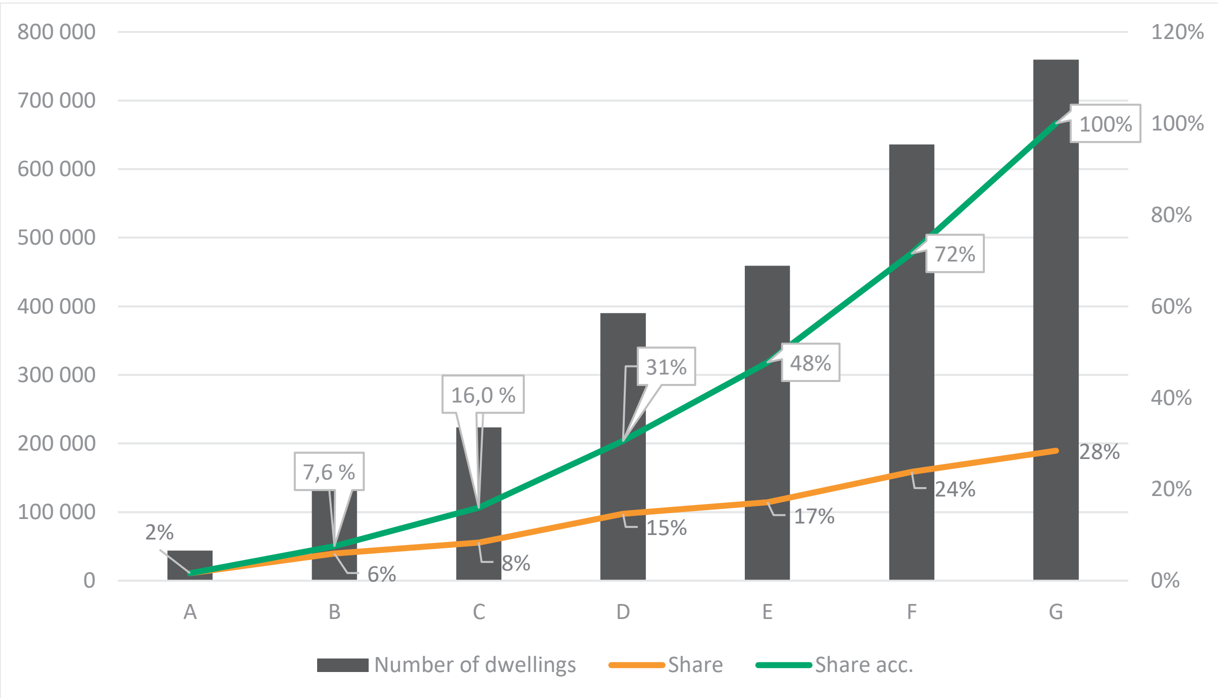


Figure 11 EPCs extrapolated to include the whole residential building stock (Source: energimerking.no Jan23 and Statistics Norway Apr22, Multiconsult)

2.2.3 Eligibility under EPC-related criteria[4]

An Energy Performance Certificate is mandatory for new buildings and existing residential buildings that are sold or rented out, and the criterion is set at EPC energy grade A or B. The EPC data indicates that 7.6% of the residential buildings in Norway will have a B or better.

2.3 Combination of criteria

The top 15% energy efficient residential buildings are identified by more than one criterion and based on more than one statistic. It is then interesting to view them in combination.

TEK10 and newer buildings in isolation represents 11.3% of the building stock. Since many of these buildings have energy labels A and B, in isolation representing 7.5% of the building stock, in combination the criteria identify 12.7% of the building stock as most energy efficient.

2.4 Impact assessment

Eligibility is first checked against criterion 2, energy label A, secondly against the building code criterion, and last criterion 4, energy label B. The buildings are only counted once even if they qualify according to several criteria. Impact related to a building is calculated according to what criterion it has been selected.

A reduction of energy demand from the average 251 kWh/m^2 of the total residential building stock to an average of 116 kWh/m^2 (TEK10/TEK17), is multiplied to the emission factor and the area of the eligible assets to calculate impact for buildings qualifying to the building code criterion.

For the buildings qualifying according to the EPC-criterion only, the difference between achieved energy label and weighted average energy label in the EPC database is used.

The 1723 eligible residential dwellings in Sparebanken Øst's portfolio are estimated to amount to about 217 000 square meters, where the majority of those, 1544 objects, are eligible through the building code criterion. 101 dwellings are eligible due to energy label A, and 78 due to energy label B.

Impact is not calculated for buildings finished since January 1st 2021 (122 dwellings) due to lack of detailed information on energy performance. It is expected to be more detailed information available next time impact is calculated.

Data on dwelling area for this analysis was largely made available by the bank. For the objects where this data was not available, the qualifying building area is calculated based on average area per building sub-category derived from national statistics (Statistics Norway[5]).

	Area qualifying buildings in portfolio [m^2]				Area qualifying in total [m^2]
	TEK10	TEK17	EPC A	EPC B	
Apartments	48 675	14 769	5927	1 195	70 566
Small residential houses	111 698	28 950	4135	13 989	158 772
Sum	160 373	43 719	10 062	15 184	229 338

Table 4 Eligible residential objects and qualifying building area

[4] Work is ongoing to remodel the EPC system. The changes are expected to be substantial and require a supplementary EPC eligibility criterion. For the purpose of green bonds, this is expected to be relevant in 2023.
[5] Table 06513: Dwellings, by type of building and utility floor space

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 presents the calculated associated avoided CO_2-emissions based on energy mix delivered to Norwegian residential buildings and an European power production mix.

	Area [m^2]	Avoided energy consumption compared to baseline [GWh/yr]	Avoided CO_2-emissions compared to baseline [tons CO_2/yr]
Buildings eligible under the EPC criterion A	10 062	1.1	116
Buildings eligible under the building code criterion	204 092	28	3 050
Buildings eligible under the EPC criterion B	15 184	1.6	175
Eligible buildings in portfolio-total	229 338	30	3 341
Impact scaled by bank's engagement		**14**	**1 557**

Table 5 Performance of eligible residential objects compared to average building stock

If only Norwegian production mix and import is considered[6], and not a full integration and the building's lifecycle, the CO_2- impact is about 1/10 of table values.

[6] https://www.nve.no/energi/energisystem/kraftproduksjon/hvor-kommer-strommen-fra/