REPORT

Residential building portfolio- carbon and energy footprint

CLIENT

Eika Boligkreditt AS

SUBJECT

Norwegian Energy Efficient Residential Buildings

DATE: / REVISION: March 14th, 2024 / 02

DOCUMENT CODE: 10256963-01-TVF-RAP-001

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REPORT

PROJECT	**Residential building portfolio- carbon and energy footprint**	DOCUMENT CODE	10256963-01-TVF-RAP-001
SUBJECT	Norwegian Energy Efficient Residential Buildings	ACCESSIBILITY	Open
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02	14.03.2024	Revised report	KJRK	IBT	IBT
01	17.02.2024	Revised report	KJRK	IBT	IBT
00	12.02.2024	Draft	KJRK, IBT	KJRK	IBT
REV.	DATE	DESCRIPTION	PREPARED BY	CHECKED BY	APPROVED BY

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1 Introduction

On assignment from Eika Boligkreditt, Multiconsult has studied the Eika residential loan portfolio and compared its energy efficiency and CO_2-emissions related to energy demand in use to the Norwegian building stock. In this report, the methodology is presented and substantiated based on both energy requirements in the national building code and Energy Performance Certificates.

Multiconsult has applied available criteria and methodology to identify the most energy efficient residential buildings in Norway, to be used with respect to a potential green bond issuance. The Eika Boligkreditt Green Bond Framework identify eligibility criteria, and this report describe the evidence for the criteria and the result of an impact assessment of the loan portfolio of Eika. The criteria to select the buildings are based on credible standards in Norway such as the Norwegian building regulation and Energy Performance Certificates, with the criteria being in line with international accepted standards.

2 The Norwegian building stock

The Norwegian building stock consists of approximately 2.6 million dwellings in apartment buildings and small residential buildings. Figure 1 illustrates the building stock according to the latest available statistics.

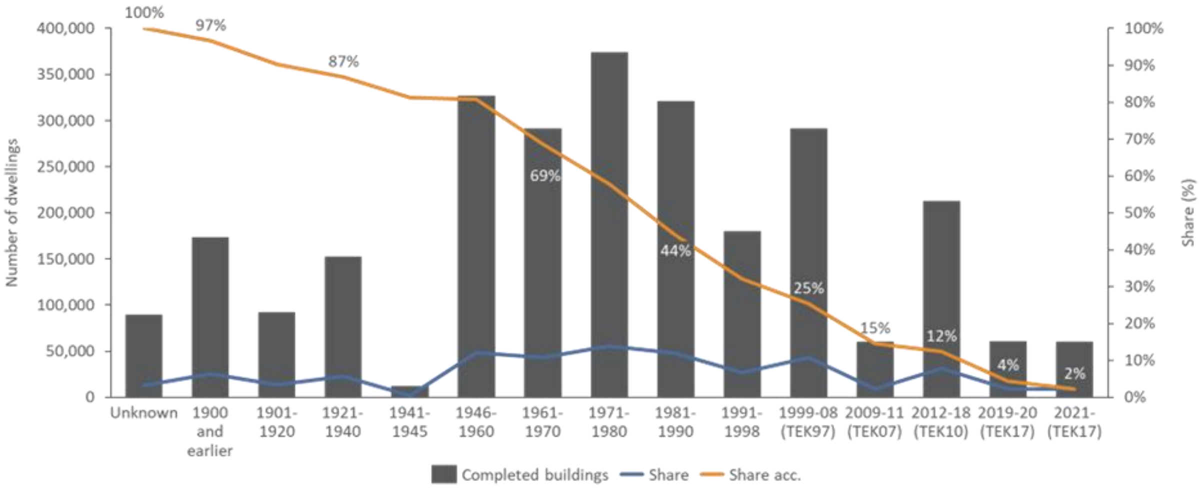


Figure 1 Age and building code distribution of dwellings. (Source: Statistics Norway and Multiconsult, December 2023)

Of the total stock, apartments constitute about 30 percent, and small residential buildings the remaining 70 percent. However, the share of apartments is increasing and has been over the last couple of decades.

3 Grid factors for energy efficiency analysis and impact assessment

The CO_2 emissions resulting from in use energy demand in residential buildings depends to a large degree on the age of the building. This again is due to two factors: the differences in energy efficiency requirements in the building code, and development in the predominant solutions and energy sources for heating in new buildings. Examples of the latter are direct electric heating, several types of heat pumps, bioenergy, and district heating.

Multiconsult takes these two factors into consideration when calculating the emission factors to be used in both total portfolio energy efficiency analyses (section 4) and green portfolio impact assessments (section 5-6). This section first presents some general statistics on energy usage in Norwegian buildings and the Norwegian electricity production, before presenting the grid factors used in following sections.

3.1 Energy consumption in Norwegian buildings

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.

In 2013, Statistics Norway assessed energy use in Norwegian households. They found demand was covered by electricity (79 percent), fossil oil and gas (4 percent) and bioenergy etc. (16 percent). 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, fossil oil is banned from use in buildings. The fuel mix in Norwegian district heating production in 2022 included only 4 percent from fossil fuels (oil and gas) (Fjernkontrollen[1]). In 2022, the Norwegian power production was 99 percent renewable (SSB[2]).

As shown in Figure 2, the Norwegian production mix in 2022 (88 percent hydropower and 10 percent wind power) results in emissions of 7 gCO_2-eq/kWh. The production mix is also included in the figure for other selected European states for illustration. These values vary from year to year.

[1] http://fjernkontrollen.no/
[2] https://www.ssb.no/energi-og-industri/energi/statistikk/elektrisitet

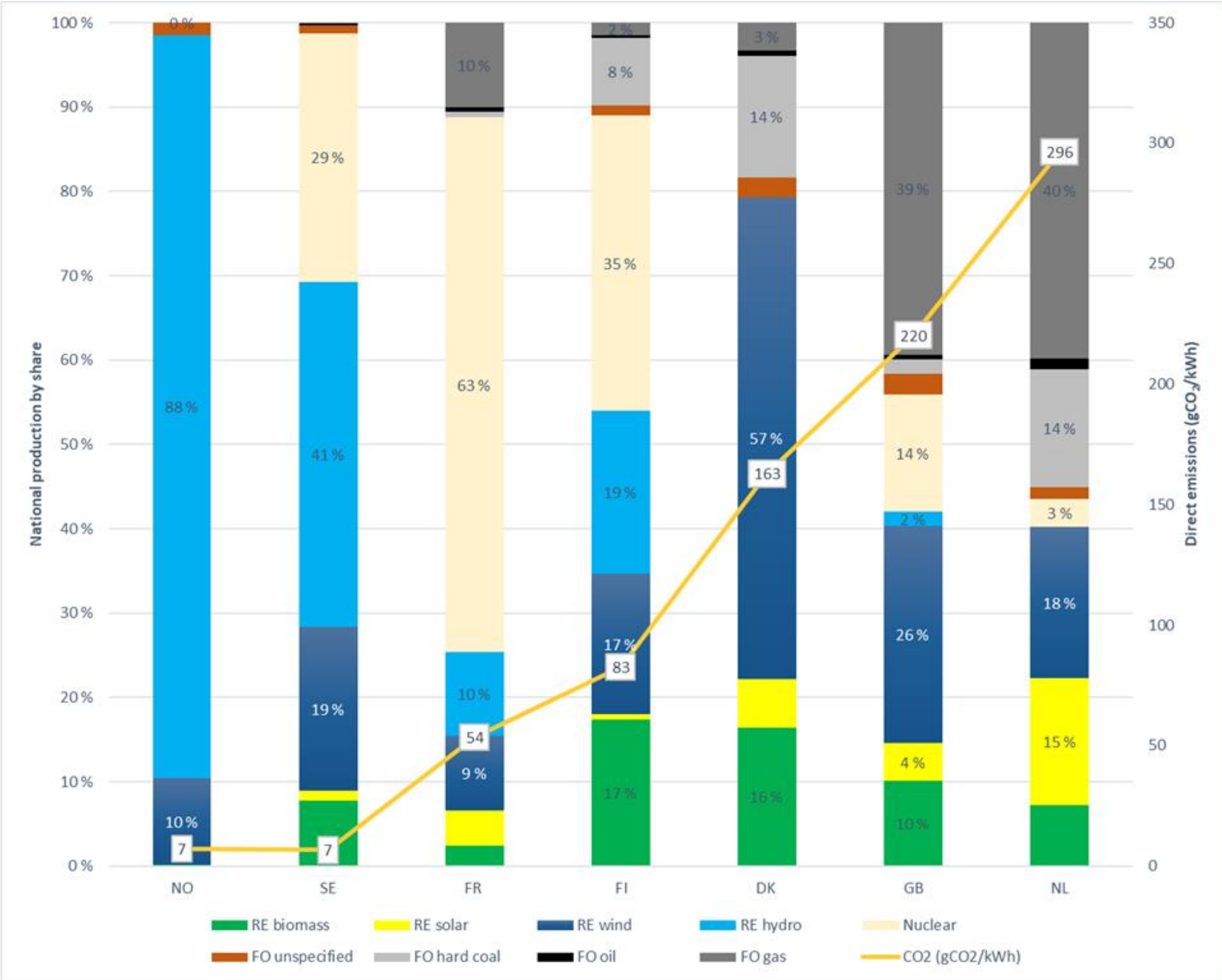


Figure 2 National electricity production mix in some selected countries. (Source: European Residual Mixes 2022, Association of Issuing Bodies[3])

3.2 Emission factors for total loan portfolio

Since the Norwegian buildings are predominantly heated by electricity, the placement of the system boundary for power production heavily influences the emission factor. To demonstrate how emissions vary depending on grid factor, emissions for the total loan portfolio energy efficiency analysis in section 4 are presented based on four different factors shown as scenario 1) – 4) in Table 1.

The factors 1) European production mix, 2) Norwegian production mix and 3) Norwegian NVE (Norwegian Water Resources and Energy Directorate) physically delivered electricity are location-based and 4) Norwegian residual mix is market-based. For all scenarios, emission factors per building code and building category are computed using the influx of other energy sources for heating[4] and used in the emission calculations.

[3] https://www.aib-net.org/facts/european-residual-mix
[4] Multiconsult. Based on building code assignments for DiBK

Table 1 Four emission factors used in computations of portfolio emissions, with description of system boundaries, import/export and whether market- or location-based. (Sources: Association of Issuing Bodies[5], NVE[6], Multiconsult)

Scenario	Description	CO_2-factor [gCO_2-eq/kWh]
1) European 2020/21/22 production mix	Location-based production mix with wide system boundary including EU countries, UK, and Norway	241
2) Norwegian 2020/21/22 production mix	Location-based production mix with narrow system boundary not including export and import	7
3) Norwegian NVE physically delivered electricity 2022	Location-based production mix with narrow system boundary including net export/ import only to neighbouring countries and average annual emission factors	19
4) Norwegian NVE residual mix 2022	Market-based residual mix with a European marketplace	502

3.2.1 Scenarios 1 and 2 – European and Norwegian production mixes

As mentioned, the placement of the system boundaries for power production heavily influences the emission factor. Norway is part of a larger, integrated European power grid, and import and export of electricity throughout the year means not all electricity consumed in Norway is produced here. To account for this, we present emissions based on both Norwegian and European power mixes. The Norwegian and European production mixes are both non-supplier specific, location-based grid factors.

The emissions from production mixes may fluctuate from year to year, depending on external factors such as changes in global energy supply. Taking a rounded average reduces the impact of these fluctuations on the yearly emissions from residential buildings presented in this report, making it easier to identify impact of changes in the portfolio composition.

The two first factors are then the rounded averages of national production mixes for the three years 2020 to 2022, which indicate factors of 241 and 7 gCO_2-eq/kWh for European and Norwegian energy mixes, respectively[7]. This differs from the lifecycle average emission factor used in the green portfolio impact assessment, where the emissions throughout the building lifetime is more relevant (see section 3.3).

3.2.2 Scenario 3 – Norwegian physically delivered electricity

As an alternative to production mixes, NVE calculates a climate declaration for physically delivered electricity for the previous year. This factor represents electricity consumed in Norway, accounting for emissions from net import and export of electricity from neighbouring countries and these countries' average annual emission factors. For 2022, this grid factor is 19 gCO_2-eq/kWh[6]. This is also a location-based grid factor.

3.2.3 Scenario 4 – Norwegian residual mix

Certificates of origin, direct power purchase agreements or other documentation of which power has been purchased for the buildings in the portfolio is not available to the bank. There is also no basis for making assumptions on the share of the energy consumed by the buildings in the portfolio that has been purchased with Guarantees of Origin. An alternative market-based grid factor for Norway is then

[5] https://www.aib-net.org/facts/european-residual-mix, 2023
[6] https://www.nve.no/energi/energisystem/kraftproduksjon/hvor-kommer-stroemmen-fra/, 2023
[7] Multiconsult based on European Residual Mixes 2022, Association of Issuing Bodies: https://www.aib-net.org/facts/european-residual-mix, 2023

the electricity disclosure published by NVE[8] and Association of Issuing Bodies[3]. This is the electricity residual mix of the country, which shows the sources of the electricity supply that is not covered with Guarantees of Origin, considering a European marketplace for electricity. Guarantees of Origin are not very widespread in the Norwegian electricity end-user market, resulting in a high emission factor of 502 gCO_2-eq/kWh for 2022[8].

3.3 Emission factors for green portfolio impact assessment

Since the financed qualifying objects in the portfolio are rather new, and expected to have a 60-year life, the impact is considered best illustrated by the yearly average CO_2 emissions in their lifetime. The grid factors used in this green portfolio impact assessment reflects an average in the buildings lifetime, assuming a decarbonisation in the European energy system. This differs from the grid factors used in the total portfolio energy efficiency analysis that are based on current emission factors from Norwegian and European electricity production (see section 3.2).

Using a life-cycle analysis, the Norwegian Standard NS 3720:2018 “Method for greenhouse gas calculations for buildings” considers international trade of electricity and the fact that consumption and grid factor does not necessarily mirror domestic production. The grid factor, as average in the lifetime of an asset, is based on a linear 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, according to two scenarios as described in Table 2.

Table 2 Electricity production greenhouse gas factors (CO_2-eq) for buildings in two scenarios. (Source: NS 3720:2018, Table A.1)

Scenario	CO_2- factor [gCO_2-eq/kWh]
European (EU27+ UK+ Norway) electricity mix over lifetime	136
Norwegian electricity mix over lifetime	18

Calculations in this report are based on both factors in Table 2. The European (EU27+ UK+ Norway) factor is 136 gCO_2/kWh, which constitutes 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 power production mix is close to zero in 2050. This value is comparable to the equivalent determined in Nordic Public Sector Issuers: Position Paper on Green Bonds Impact Reporting (January 2020)[9].

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 also includes other energy carriers as bio energy and district heating.

The influx of other energy sources for heating purposes[4] is applied to the factors based on EU27+UK + Norway energy production mix and Norwegian production mix from Table 2. **The resulting CO_2- factors for European and Norwegian residential buildings is 115 and 18 gCO_2/kWh[10],** respectively, used in the impact analysis in section 6. The same factors are used for commercial buildings.

For clarity if comparing avoided emissions from the green portfolio with total portfolio calculations, the two Finans Norge recommended grid factors from The Norwegian Water Resources and Energy Directorate (NVE) are included (scenario 3 and scenario 4 in section 3.2). Considering the same influx

[8] https://www.nve.no/energy-supply/electricity-disclosure/?ref=mainmenu
[9] https://www.kbn.com/globalassets/dokumenter/npsi_position_paper_2020_final_ii.pdf
[10] This is higher than the 111 g CO_2/kWh used in previous impact assessments, due to correction of the allocation of heating sources between small residential buildings and apartments.

of alternative heating sources, the resulting CO_2- factor for the Norwegian NVE physically delivered electricity 2022 is 19 gCO_2/kWh (scenario 3) and for the Norwegian NVE residual mix 2022 it is 416 gCO_2/kWh (scenario 4).

3.4 Energy efficiency in the building stock

The actual energy performance of individual buildings is not publicly available, and the bank cannot request energy data from their clients and expect sufficient data of reliable quality. Two options for describing buildings' energy performance are presented in the following sections. The two are historic energy requirements in the national building code and the Energy Performance Certificate system (EPC). The two have different qualities and for the purpose of describing a full portfolio, the building code approach stands out as the most reliable.

3.5 National building code

Changes in the Norwegian building code have consistently, over several decades, resulted in more energy efficient buildings. The building codes are defined by calculated net energy demand, not including the efficiency of the building's energy system. The calculated specific energy demand [kWh/m^2] dependent on building code, presented in Figure 3, illustrates how the energy demand declines with decreasing age of the buildings.

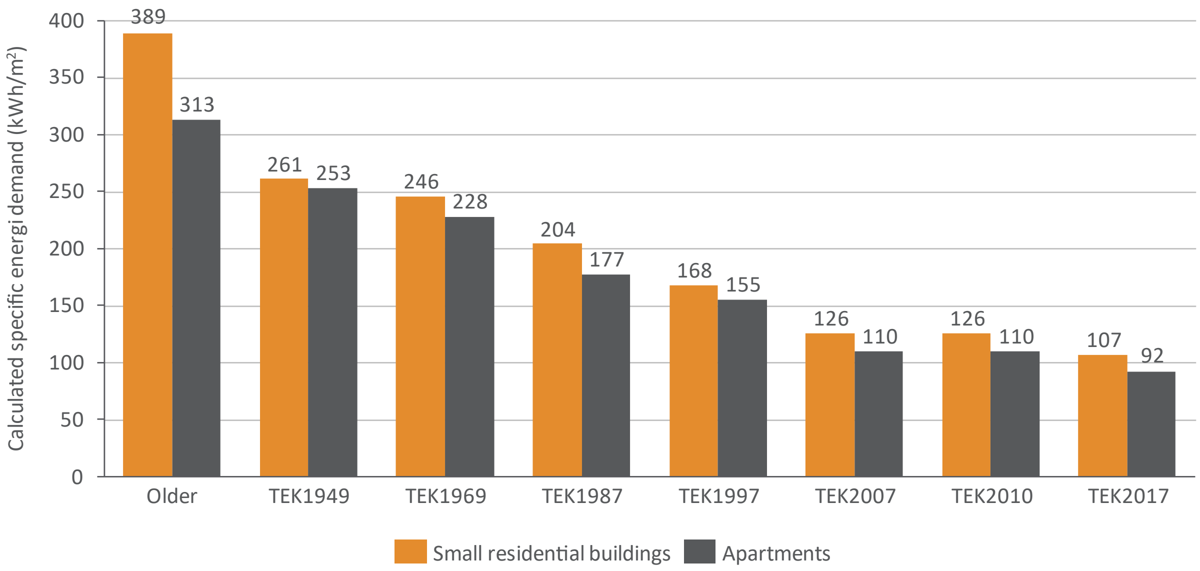


Figure 3 Development in calculated specific net energy demand based on building code and building tradition. (Source: Multiconsult, simulated in SIMIEN)

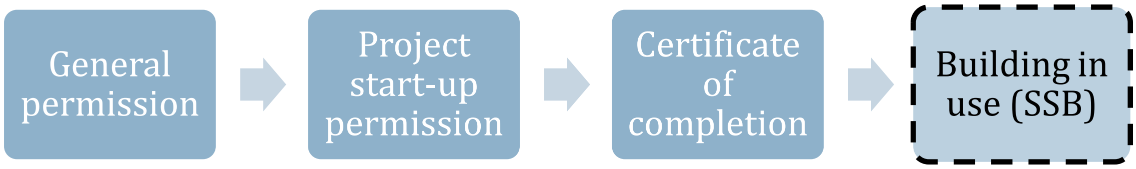
From TEK07 to TEK17 the reduction is about 15 percent and the former shift from TEK97 to TEK07 was no less than 25 percent. Note that, for residential buildings, there was no change between TEK07 and TEK10 with respect to energy efficiency requirements.

The figure gives theoretical values for representative models of an apartment and a small residential building, calculated in the computer programme SIMIEN and in accordance with 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. Net energy demand is calculated for model buildings used for defining the building code. For older buildings, the calculated values tend to be higher than the actual measured demand, mostly because the calculated ventilation air flow volume in older buildings is assumed to be as high as in newer buildings, but without heat recovery. Indoor air quality is hence assumed not to be dependent on building year. This is the same methodology as used in the EPC-system (Energy Performance Certificate).

The building codes have a significant effect on energy efficiency. An investigation of the energy performance of buildings registered in the EPC database younger than 1997, shows 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 is evident when the building code of 1997 came into force. In the period between 1997 and 2007- 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 coming up to 2007. This might be due to an increased use of heat pumps in new buildings, and to a certain degree, better windows.

3.5.1 Time lag between building permit and building period

After the implementation of a new 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 factors such 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.

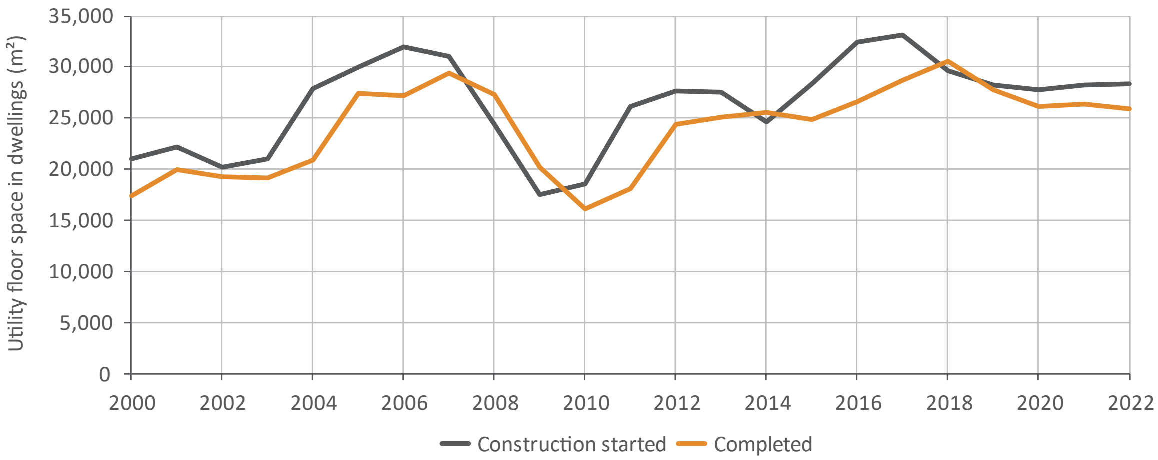


Figure 4 Project start-up and completion. (Source: Statistics Norway, byggearealstatistikken)

Based on expert input on time for design and construction, we regard a time-lag of two years, in most cases, between code implementation and completion of buildings based on this code, to be a robust and conservative assumption. Some deviations may however occur, but the methodology must account for the building year information (completed construction), which is only available to the bank on a yearly basis (for example, the 2010 building code (TEK10) was implemented July 1st, 2010). 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.

3.5.2 The suitability of building codes to demonstrate energy performance in large portfolios

The registered efficiency improvements substantiate that Norwegian buildings comply with the building code in force.

The bank may obtain sufficient information about the financed objects to estimate the energy performance of the buildings in a bank's loan portfolio. For objects with available information on building year and building category, the energy performance may be calculated based on specific energy demand illustrated in Figure 3. Living area can be used when available, or an average for each building category may be utilized for large portfolios.

For buildings without recorded building year, the category "Older" in Figure 3 (buildings from 1950 and earlier) may be applied in a conservative approach.

3.6 Energy Performance Certificate

The Energy Performance Certificate system became operative in 2010. It was made mandatory for all new residences finished after the 1st of July 2010, and all older residences - sold or rented out, were to have an Energy Performance Certificate. Enova - an entity owned by the Norwegian Ministry of Climate and Environment, is now responsible for operation and development of the Energy Performance Certificate system (EPC). The system is under revision and changes may include new limit values and calculation methods.

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 consists currently 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 this work.

Registration of certificates is performed in two ways. Professionals must be involved when certifying all 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. This latter system is based on simplified assumptions and conservative calculations, and the results are therefore less precise and might give a lower energy label than a registration for the same building performed by professionals. As from 2023, all registrations must be linked to a listing in Norway's official property register (no; matrikkelen).

The energy label 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 labels for small residential buildings and apartments for the current grade scale.

Table 3 Current grade scale and delivered energy for EPC labels. (Source: www.enova.no/energimerking)

Delivered energy per square meter heated space [kWh/m^2]							
	EPC A	EPC B	EPC C	EPC D	EPC E	EPC F	EPC 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	

3.6.1 Registered Energy Performance Certificates in the Norwegian residential stock

The whole EPC database is available for statistical purposes and an investigation shows that, comparing the number of certificates with actual buildings in the building stock from Statistics Norway, coverage of individual dwellings is about 50 percent. This is based on raw data, even before the database has been cleaned of double entries and test entries. Low coverage influences the basis for establishing a base line and eligibility criteria. Low coverage reduces the pool volume of which a bank may identify objects in their portfolio.

The figure below shows how the stock of residences in Norway registered in the EPC database is distributed by building code, and their certificate label.

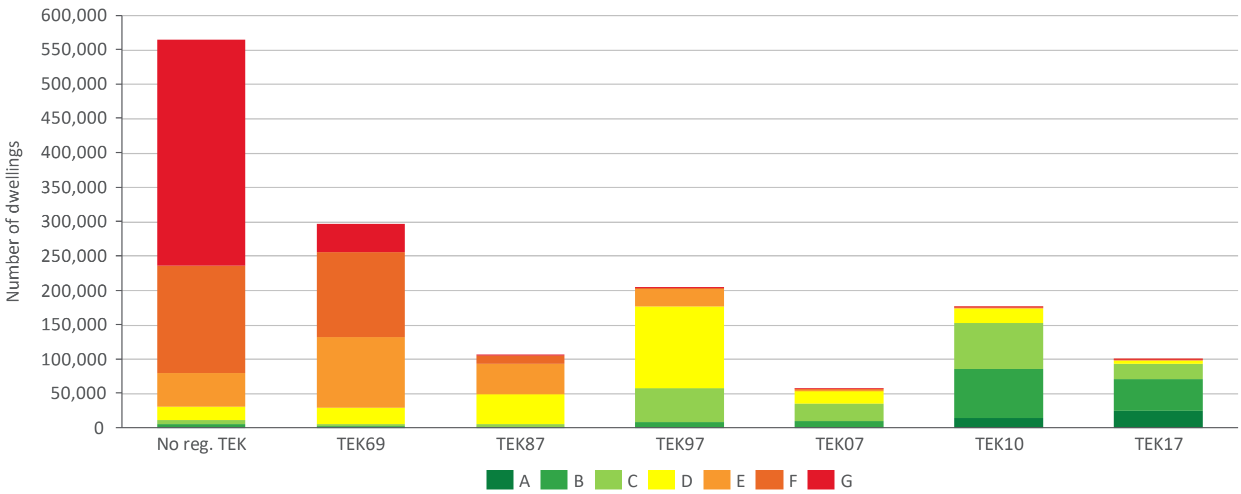


Figure 5 Registered EPC Certificates Norwegian residences distributed per building code and Energy Performance Certificate. (Source: EPC database, energimerking.no January 2023, enova.no/energimerking February 2024).

The registered properties in the EPC database are considered 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. Extracting only buildings built before 2009 (TEK07 or older building codes), 7 percent of the total stock is expected to get a C or better and 1.7 percent of the total registered buildings have 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. Figure 6 shows the energy grades in the already granted certificates to Norwegian residential buildings.

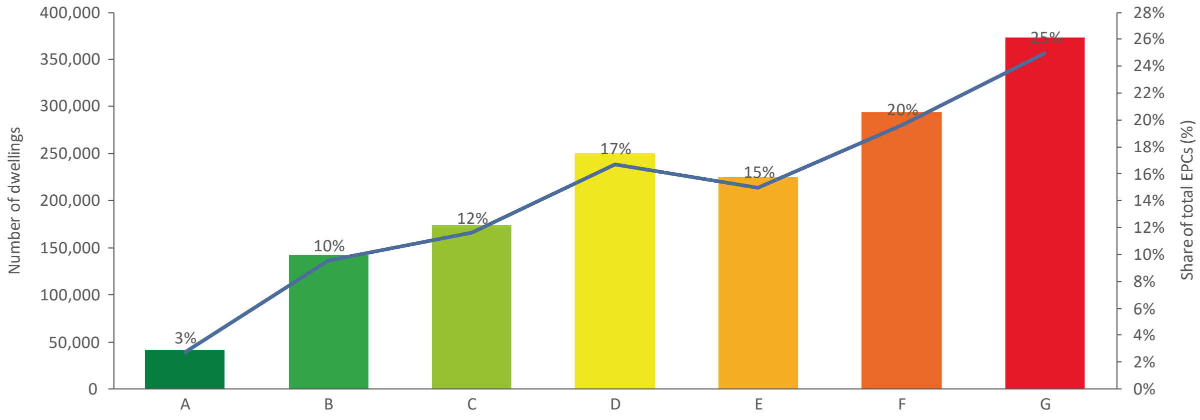


Figure 6 Norwegian building stock Energy Performance Certificates by grade- residential buildings only, representative only of buildings with EPCs. (Source: energimerking.no January 2023, enova.no/energimerking February 2024).

The EPC coverage is, as mentioned, not equally distributed over the building stock. Figure 7 shows the age of the buildings with EPCs and the total number of buildings in the building stock, age distribution in brackets of applicable building code, and how much of the building stock is represented in the EPC database. This illustrates how younger buildings are overrepresented in the EPC database. Note that EPC data is regularly updated and the data behind the figure includes new registrations in 2023. Building stock data is, however, only updated on a yearly basis and the figure only includes buildings finished before the end of 2022.

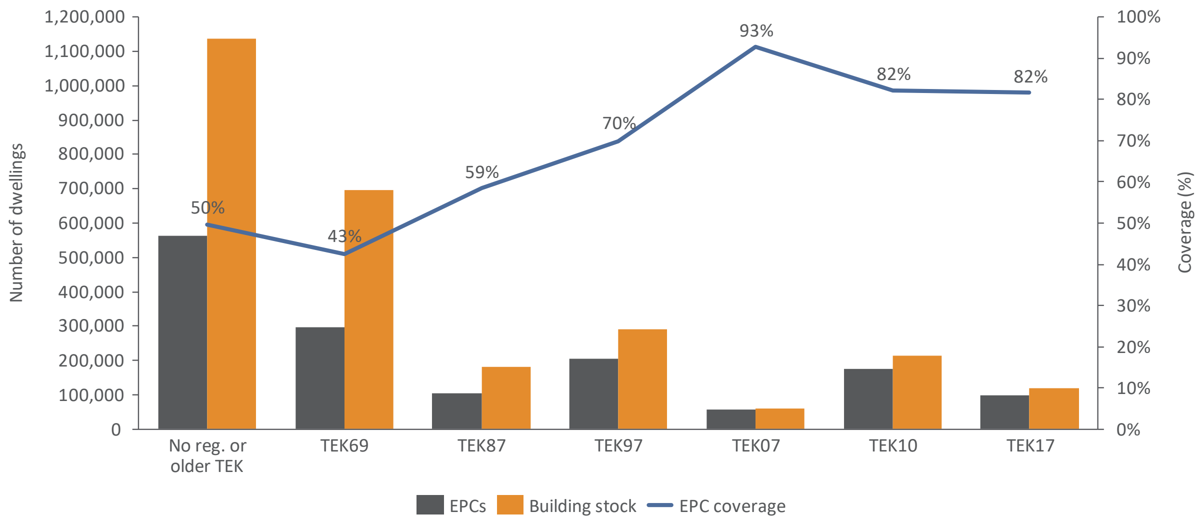


Figure 7 Age distribution in Energy Performance Certificates vs. actual residential building stock and EPC coverage by building year. (Source: energimerking.no January 2023, enova.no/energimerking February 2024, Statistics Norway, incl. 2022 figures)

Assuming registered EPCs for each period are representative for the building stock, we can indicate what the label distribution would be if all residential buildings were given a certificate. Figure 8 illustrates how EPCs would be distributed based on this assumption.

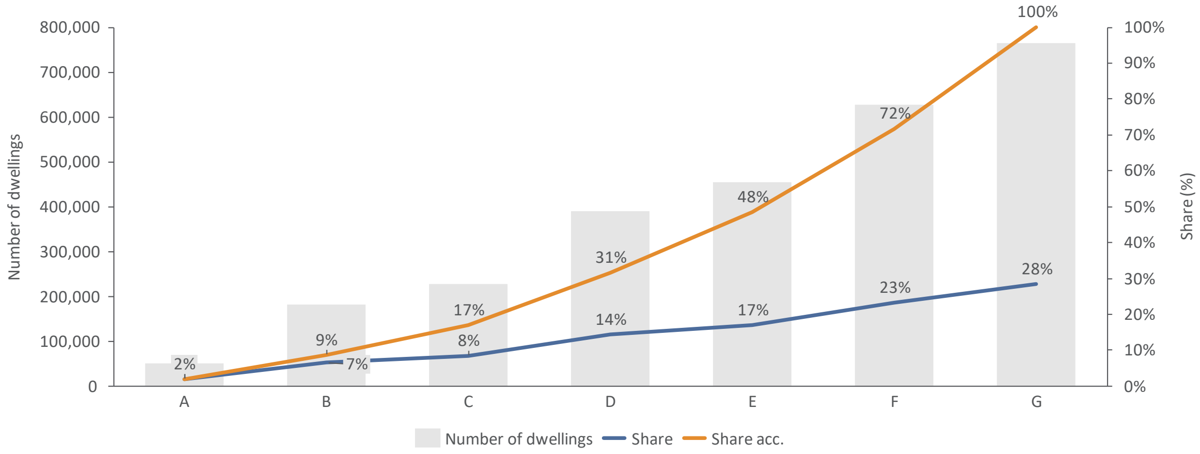


Figure 8 EPCs extrapolated to include the whole residential building stock. (Source: energimerking.no January 2023, enova.no/energimerking February 2024, Statistics Norway, Multiconsult)

3.6.2 *The suitability of the EPC system to demonstrate energy performance in large portfolios*

Energy Performance Certificates can consider building specific data and illustrate a buildings energy efficiency performance. The bank may obtain relevant information about the financed objects in the EPC database. Eika has linked the individual residences to the EPC database and included the energy certificate results for individual assets, based on some key information. The data this analysis is based on, is limited to energy labels, and does not include specific energy demand [kWh/m^2]. The EPC coverage of about 50 percent is however limiting for reporting purposes, as half of the dwellings are not to be found in the database. There is as well a varied quality of the registrations.

To calculate the energy demand in buildings, average values derived from Table 3, or recent revealed specific energy demand, may be utilized in combination with living area. Living area is to a large degree available information to the bank, but an alternative is to apply an average for each building category.

Coming changes in the EPC system will not mean all old certificates are invalid. Hence, for the green portfolio assessment in section 5-6, both building code and EPC criteria will prevail until certificates based on the old system have expired. For identifying the most energy efficient buildings, the changes in the system are not expected to be problematic.

3.7 Building code and EPC as basis for energy efficiency analysis

Combining EPCs and building code in a dynamic portfolio might give fluctuating results as the two solutions use different system boundaries.

As mentioned, the energy label in the EPC system is based on calculated delivered energy and the building codes are defined by net calculated energy, not including the building’s energy system. The difference between the two values will vary depending on energy supply solution, building category, applied energy efficiency measures and local climate. According to Finans Norge, delivered energy is the most relevant measure when calculating portfolio footprint, but the difference between delivered energy and net energy usually is below five percent, and the sizes can therefore be interchanged.

Our calculations indicate that the difference might be greater than the five percent indicated by Finans Norge. However, depending on the heating source, the difference can be in favour of both delivered energy and net energy. This means that the average for all residential buildings probably will have little difference between net and delivered energy.

This difference in system boundaries also means that for buildings with both identified building code and EPC, the calculated energy demand might vary depending on which method is used.

The building code approach is based on consistently updated statistics on building stock and standardized calculations of energy performance dependent on building code and age of the buildings, combined with portfolio specific area per dwelling. This is found to be a robust and consistent approach to monitor a complete portfolio over time and illustrate the energy use related carbon footprint of the buildings in use. Using the building code is also considered a more conservative approach related to portfolio footprint calculations compared to using the EPC system, giving a larger footprint. The building code is also base for calculations of green portfolio footprint for buildings eligible under criterion 1 in Eika's Green Bond Framework, while EPC is base for the calculations under criterion 2.

Using specific energy demand or median energy usage per energy grade to estimate energy usage do correspond to higher data quality scores than building codes according to PCAF's standard for mortgages, as referenced by Finans Norge's guidance document for calculation of financed greenhouse gas emissions[11]. In Eika's residential portfolio, 43 percent of buildings have an energy label.

The building code and EPC approaches are therefore combined in the following analysis of the complete Eika residential loan portfolio. Where energy labels are available, energy demand have been calculated based on middle values of energy usage per energy grade. Labels A and G do not have a middle value. For EPC A, 95 percent of the upper limit of the grade is used and for EPC G, 115 percent of the upper limit of EPC F, in accordance with Finans Norge. The estimated energy demand is then multiplied directly with the emission factors presented in section 3.2. For the rest of the residential buildings, and for all BM buildings, the calculations are based on building code and emission factors take into consideration building age and sources of heating[4].

Only the building code approach has been applied in previous analyses. In any later updates, consistency and transparency will be pursued when describing the portfolio's energy and climate performance, even with transition in methodology or enhanced data quality.

[11] https://www.finansnorge.no/dokumenter/maler-og-veiledere/veileder-for-beregning-av-finansierte-klimagassutslipp/

4 Eika loan portfolio - Energy efficiency analysis

4.1 Portfolio information

The analysis is based on the portfolio as of December 31st, 2023. The Private Market (PM) portfolio include individual dwellings, while the Business Market (BM) portfolio include apartment buildings and loans to cooperative housing. Of the Eika PM residential loan portfolio, 37,415 unique small residential buildings and 12,184 apartments, have been analysed. The last 733 objects could not be classified in a building category that would allow calculating energy performance of these objects. From the BM portfolio, 166 unique apartment buildings have been analysed and 19 buildings could not be classified. From the loan portfolio, holiday homes and buildings registered in the portfolio as second mortgages (no; tilleggssikkerhet) have been excluded from the analysis. These dwellings are excluded due to miscellaneous reasons; as there are no energy requirements in the building code (holiday homes), and to avoid double counting as same assets may be included in other portfolios (second mortgages).

Figure 9 shows how the remaining assets in the PM and BM portfolio are distributed by age, indicated by building code, and taking into consideration the time lag from time of implementation of a code to most finished buildings adhering to the new code. For objects without building year information, the building is conservatively assumed to fall into the "Older" category. For dwellings without living area information, the category average in the national statistics is assumed.

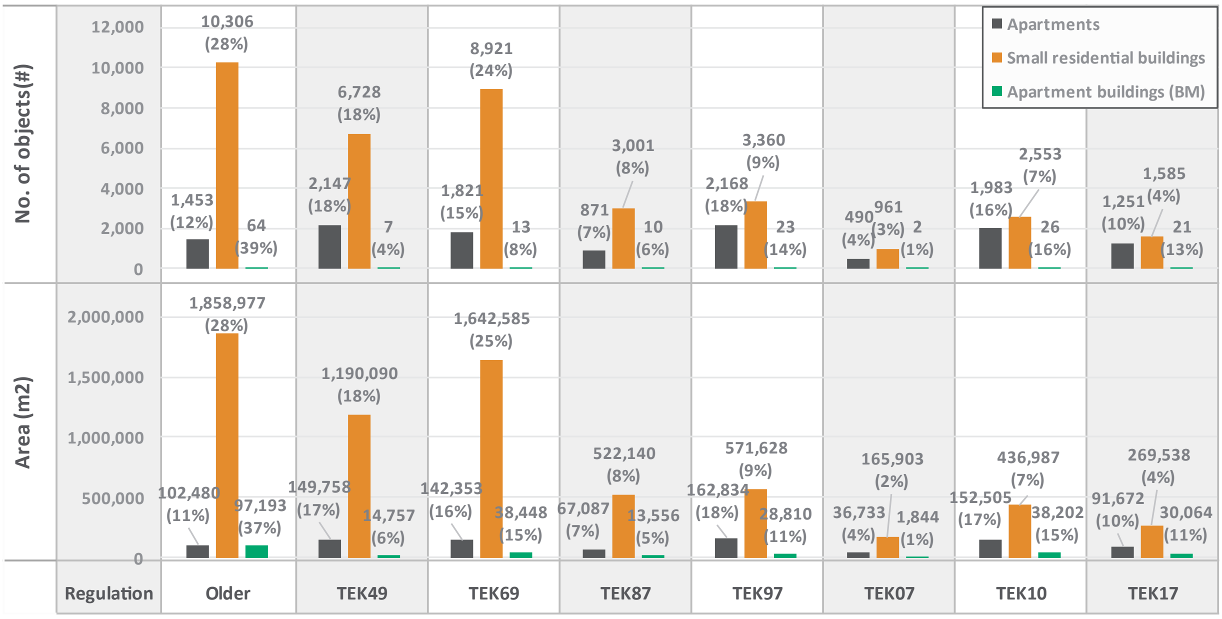


Figure 9 Eika PM and BM loan portfolio as of December 31st, 2023. (Source: Eika, Multiconsult. Assumptions apply)

4.2 Calculated energy demand

Combining the age distribution of the living area in the portfolio with calculated energy demand in the building stock dependent on energy label or building code, we can illustrate the energy demand in the whole portfolio. Over the years, the energy footprint of this dynamic portfolio will develop, and the bank will be able to monitor the energy efficiency of their portfolio.

Figure 10 illustrates energy demand in buildings in the current portfolio applying information in Figure 3, Figure 9, and Table 3. The energy demand in the buildings is scaled down to reflect the bank's engagement. The scaling simply reflects the loan's share of the object value at loan origin.

Buildings in the current portfolio, as of December 31st, 2023, represents yearly energy demand of 1,960 GWh. Adjusted to only reflect the bank's engagement relative share of property value at origin, the portfolio represents yearly energy demand of 930 GWh.

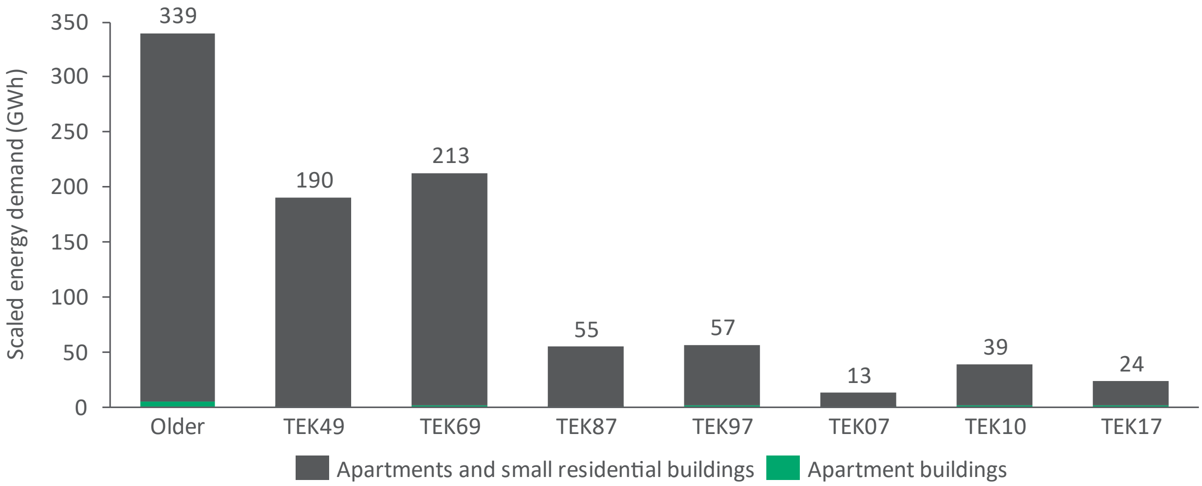


Figure 10 Portfolio in-use energy demand scaled by bank's engagements share of property value distributed by age of buildings. (Source: Eika, Multiconsult)

4.3 Calculated CO_2 emissions related to operational energy demand

Four emission factor scenarios are used to calculate the energy related CO_2-emisions from Eika's total portfolio (see section 3.2). Emissions for about half of the PM portfolio have been calculated based on individual EPC labels and average energy usage, while the rest are calculated based on building code. Graphs are sorted by building code for comparability to previous analyses. In previous reports, emissions have only been presented based on scenarios 1 and 2.

Figure 11 and Figure 12 illustrate the building code specific CO_2 emissions per square meter in the Norwegian residential building stock dependent on whether it is calculated based on a European power production mix (scenario 1) or a Norwegian power production mix (scenario 2), respectively. Emissions for a Norwegian physically delivered grid factor (scenario 3) and Norwegian residual mix (scenario 4) have been calculated similarly, only changing input grid factors.

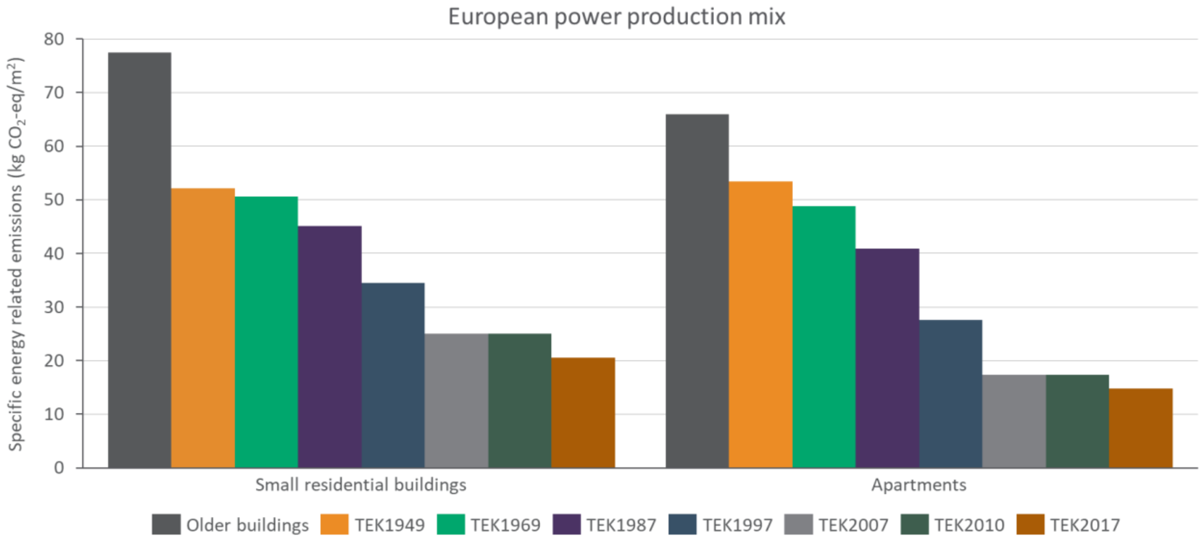


Figure 11 Total Norwegian residential building stock specific CO_2 emissions [kgCO_2-eq/m^2] dependent on building category and age of buildings, scenario 1) European power production mix. (Source: Multiconsult)

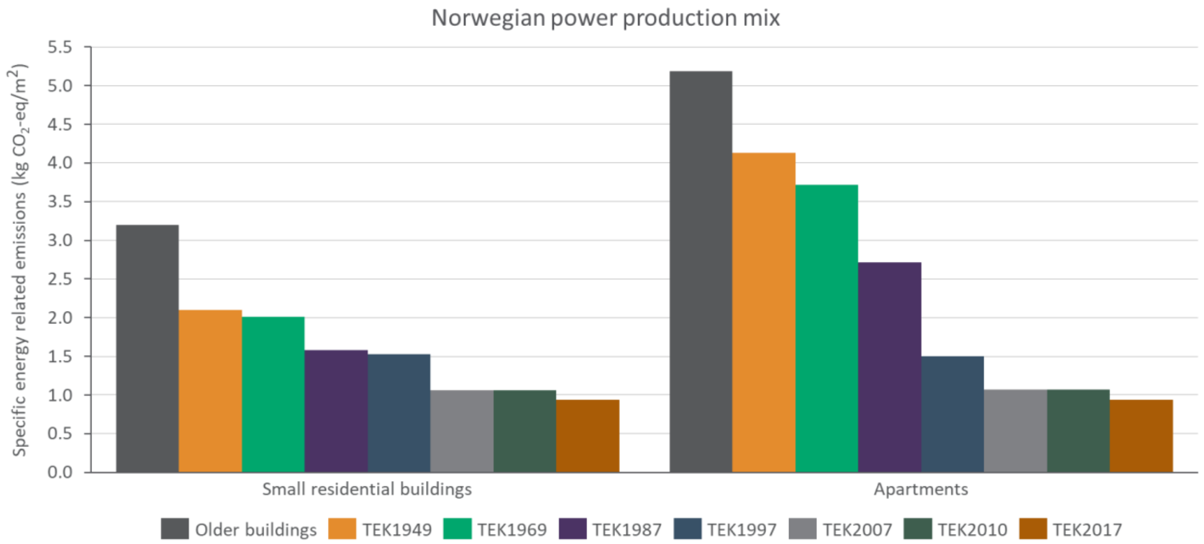


Figure 12 Total Norwegian residential building stock specific CO_2 emissions [kgCO_2-eq/m^2] dependent on building category and age of buildings, scenario 2) Norwegian power production mix. (Source: Multiconsult)

Average energy usage per energy label, the calculated energy demand distributed by age of the buildings in the portfolio and the estimated specific emissions in figures above, gives a basis to estimate the CO_2 emissions of the total Eika residential buildings portfolio. Figure 13 to Figure 16 illustrate the CO_2 emissions related to in-use energy demand in the buildings in the current portfolio scaled down to reflect the bank's engagement. The figures show emissions calculated based on the four grid factors European power production mix (scenario 1), Norwegian power production mix (scenario 2), Norwegian physically delivered electricity (scenario 3) and Norwegian residual mix (scenario 4), respectively.

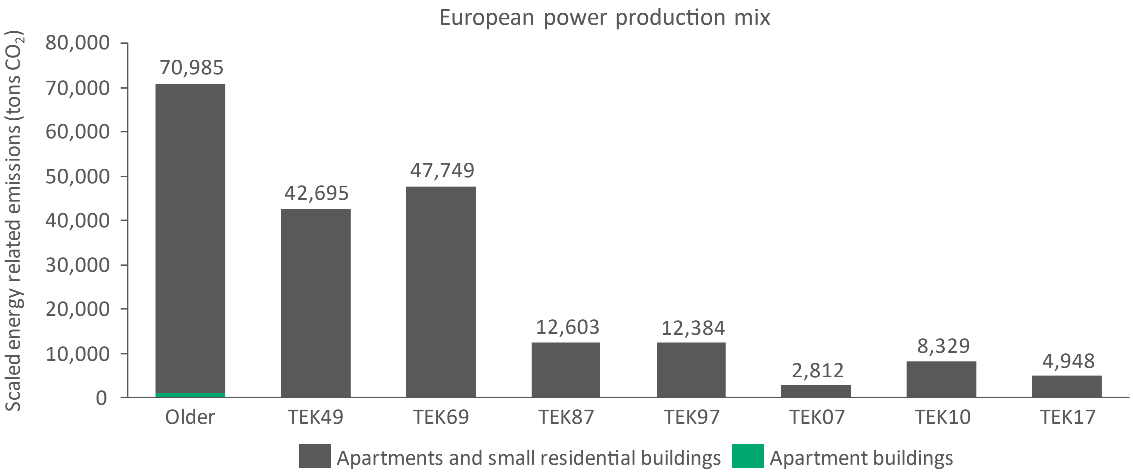


Figure 13 Portfolio CO_2 emissions related to yearly in-use energy demand, scaled by engagements share of property value. Scenario 1) European power production mix as basis for calculation. (Source: Eika, Multiconsult)

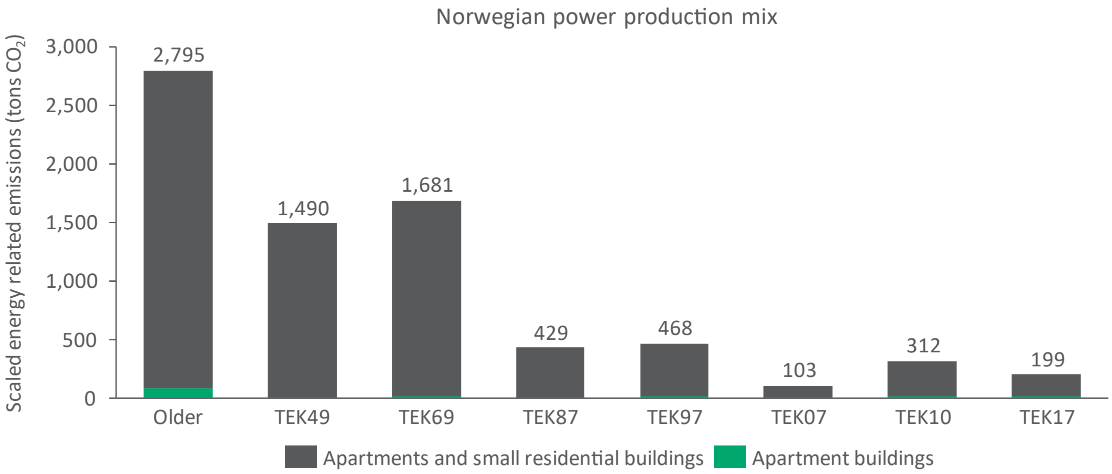


Figure 14 Portfolio CO_2 emissions related to yearly in-use energy demand, scaled by engagements share of property value. Scenario 2) Norwegian power production mix as basis for calculation. (Source: Eika, Multiconsult)

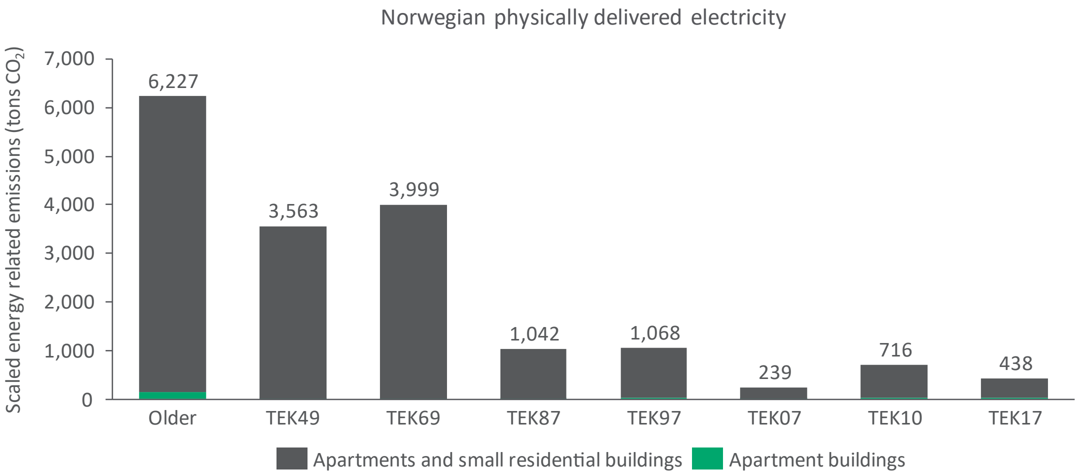


Figure 15 Portfolio CO_2 emissions related to yearly in-use energy demand, scaled by engagements share of property value. Scenario 3) Norwegian physically delivered el. as basis for calculation. (Source: Eika, Multiconsult)

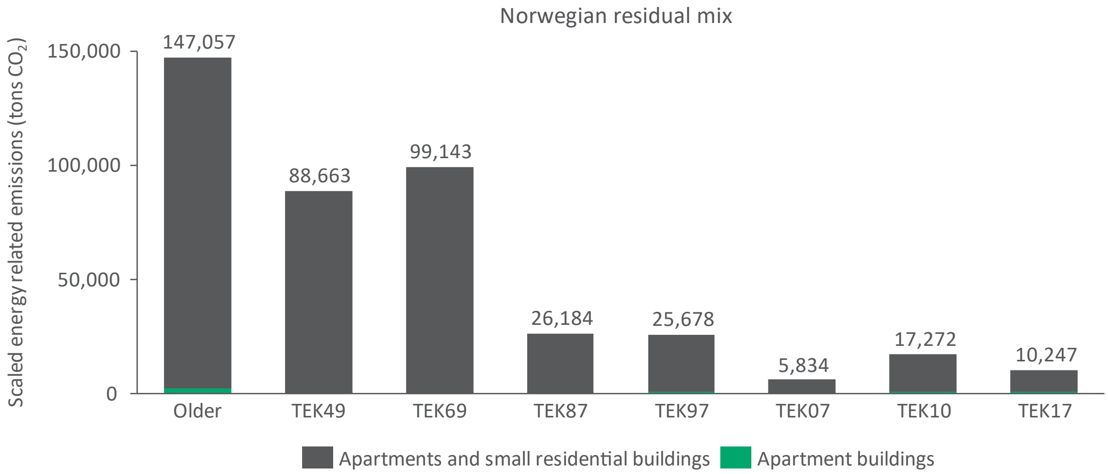


Figure 16 Portfolio CO_2 emissions related to yearly in-use energy demand, scaled by engagements share of property value. Scenario 4) Norwegian residual mix as basis for calculation. (Source: Eika, Multiconsult)

Adjusted to only reflect the bank's engagement relative share of property value at loan origin, the portfolio as of December 31st, 2023, represents the yearly emissions shown in Table 4 for all four scenarios. Emission factors per building code and building type considering the influx of other heating sources are computed based on the CO_2-factors in the table below and used to calculate the scaled emissions. The table also includes emissions relative to the dwelling area in the portfolio, the portfolio emission intensity. Both emissions and area are scaled by the bank's share of engagement in the calculation.

Table 4 PM + BM Portfolio sum of energy related emissions and emission intensity of CO_2-eq based on the four emission factors presented in section 3.2 (scenario 1-4), considering influx of other heating sources.

Scenario	Electricity CO_2- factor [gCO_2-eq/kWh]	Scaled portfolio emissions per year [tonnes CO_2-eq]	Portfolio emission intensity [$kgCO_2$-eq/m^2]
1) European 2020/21/22 production mix	241	202,500	54.3
2) Norwegian 2020/21/22 production mix	7	7,500	2.0
3) Norwegian NVE physically delivered electricity 2022	19	17,300	4.6
4) Norwegian NVE residual mix 2022	502	420,000	113

5 Green bonds 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. Criterion 1 and 2 have been aligned with the Climate Bonds Initiative (CBI) and is published as a CBI baseline for Norwegian residential buildings. Criterion 1 identifies the top 12 percent most energy efficient residential buildings countrywide. The CBI baseline methodology also includes criteria using data from Energy Performance Certificates, and according to CBI taxonomy, residential buildings may also qualify after being refurbished to a standard resulting in at least a 30 percent reduction in energy demand[12].

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

1. New or existing Norwegian residential buildings that comply with the Norwegian building code of 2010 (TEK10) and later codes, as all these buildings have significantly better energy standards and account for no more than 15 percent 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 considered. Previously, TEK07 were included for small residential buildings, and these buildings have been grandfathered as of 31/12/2021.
2. Existing Norwegian residential buildings with EPC-labels A or B. These buildings may be identified in data from the Energy Performance Certificate (EPC) database. Previously EPC C labels were included, and these buildings built before 2012 (apartments) /2009 (other dwellings) have been grandfathered as of 31/12/2020.
3. Refurbished Norwegian residential buildings with EPC-labels which corresponds to at least a 30 percent improvement in energy efficiency. These buildings may in time be identified using the EPC database.

5.1 Criterion 1: New or existing Norwegian residential buildings that comply with the Norwegian building code of 2010 (TEK10) or later codes for small residential buildings and apartments

Changes in the Norwegian building code have consistently over several decades resulted in more energy efficient buildings. As of the end of year 2022, 12 percent of Norwegian residential buildings were eligible according to the Eika building code criterion.

The methodology is based on Climate Bonds Initiative (CBI) taxonomy, where the top 15 percent most energy efficient buildings are considered eligible. Eika's baseline and criterion are somewhat stricter than the CBI baseline methodology for energy efficient residential buildings for Norwegian conditions published in spring 2018.

Net energy demand is calculated for model buildings used for defining the building code. The results presented in Table 5 illustrates how the calculated energy demand declines with decreasing age of the buildings. From TEK07 to TEK17 the reduction is about 15 percent and the former shift from TEK97 to TEK07 was no less than 25 percent. Note that, for small residential buildings, there was no change between TEK07 and TEK10 with respect to energy efficiency requirements.

[12] https://www.climatebonds.net/standard/buildings/upgrade

Table 5 Specific energy demand calculated for model buildings representing apartments and small residential buildings. (Source: Multiconsult)

	Specific energy demand (model homes) [kWh/m²]	
Building code	**Apartments**	**Small residential buildings**
TEK07/TEK10	110	126
TEK17	92	107

Table 5 includes the specific energy demand calculated by using the standard model buildings for the building codes relevant for identifying the top 12 percent most energy efficient residential buildings in Norway.

As discussed in section 3.5.1, a two-year lag between code implementation and buildings based on this code is to be a robust and conservative assumption.

5.1.1 Building age statistics

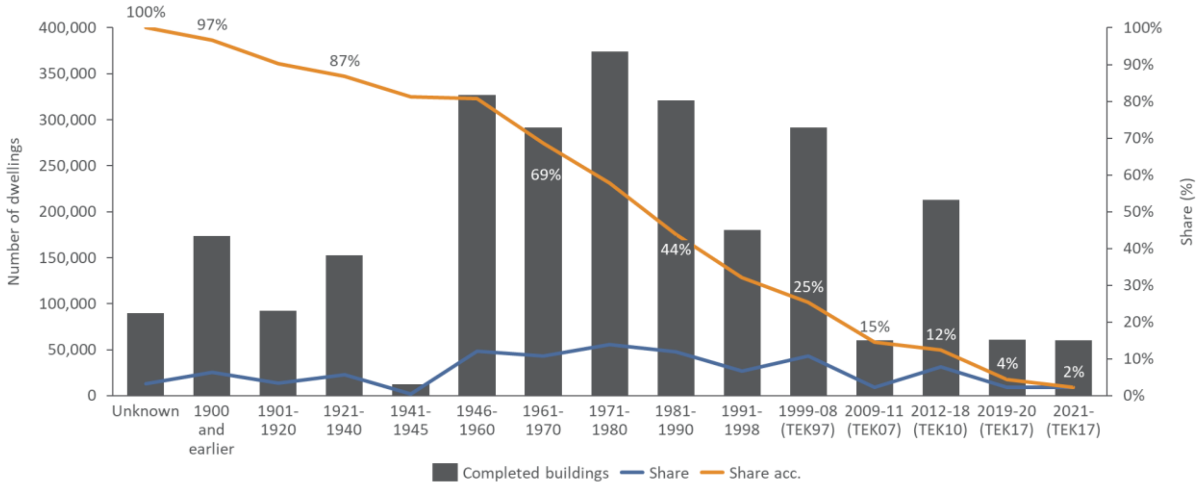


Figure 17 Age and building code distribution of dwellings. (Source: Statistics Norway and Multiconsult)

Figure 17 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 (Byggearealstatistikken). The figure shows how buildings finished in 2012 and later (and built according to TEK10 and TEK17) amount to 12.4 percent of the total stock. Based on theoretical energy demand in the same building stock, the same 12.4 percent of the stock makes up for only 4.7 percent of the energy demand in residential buildings and 4.3 percent of the related CO_2 emissions, as indicated in Figure 18 and Figure 19, respectively. The difference between energy demand and CO_2 emissions are due to the slightly less CO_2-intensive heating solutions in newer buildings. It must be noted that these calculations are based on the European power production mix that reflects an average in the buildings lifetime, assuming a decarbonisation in the European energy system as presented in section 3.3.

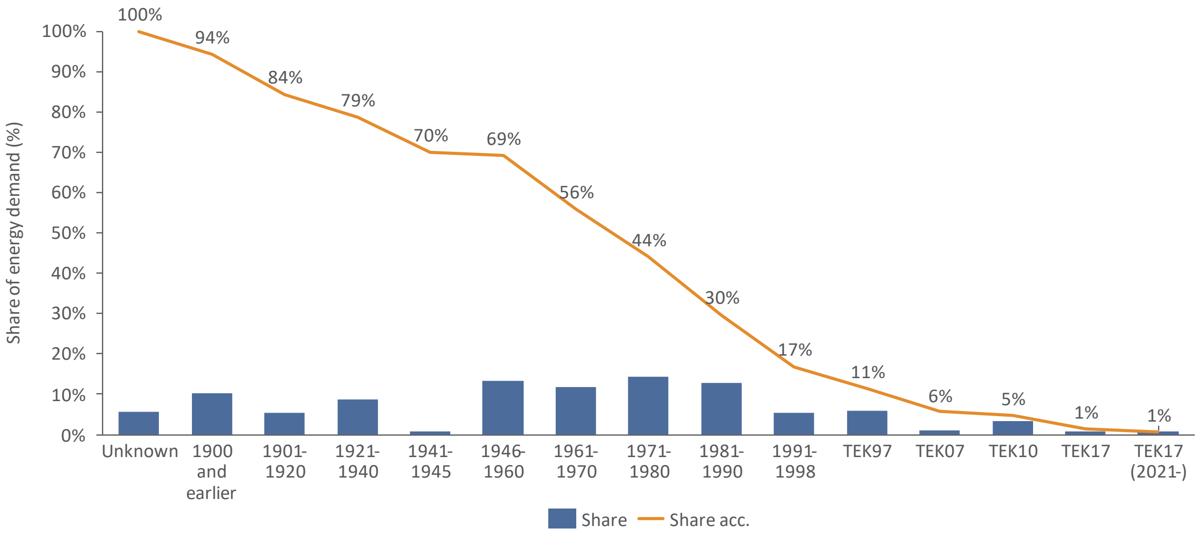


Figure 18 The building stock's relative share of energy demand dependent on building year and code. (Source: Statistics Norway and Multiconsult)

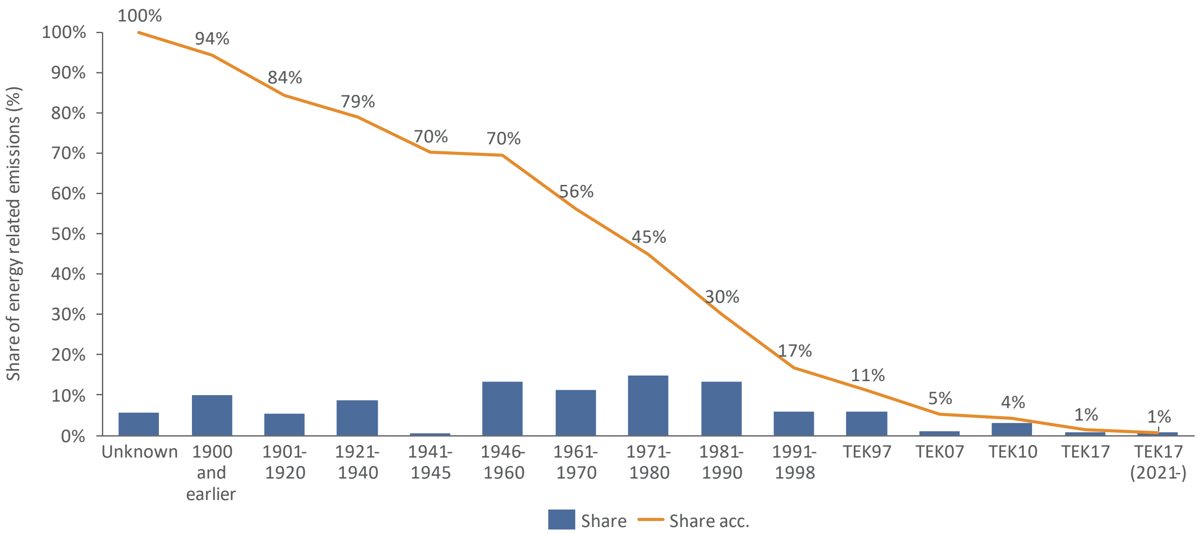


Figure 19 The building stock's relative share of CO_2 emissions related to energy demand dependent on building year and code. Calculation based on European power production mix in asset lifetime. (Source: Statistics Norway and Multiconsult)

5.1.2 Eligibility under criterion 1

Over the last several decades, changes in the building code have pushed for more energy efficient buildings. The building stock data indicates that 12.4 percent of the current residential buildings in Norway were constructed using the code of 2010 (TEK10) and later codes.

Combining the information on the calculated energy demand related to building code in Figure 3 and information on the residential building stock in Figure 17, the calculated average specific energy demand on the Norwegian residential building stock is 251 kWh/m^2. Dependent on building code, the demand for qualifying buildings is 120 kWh/m^2 (TEK07/TEK10) or 102 kWh/m^2 (TEK17). Building codes TEK10 and TEK17 give an average specific energy demand for existing houses and apartments, weighted for actual stock, of 114 kWh/m^2.

Hence, compared to the average residential building stock, building codes TEK10 and TEK17 give a calculated specific energy demand reduction of 54 percent.

New or existing Norwegian residential buildings 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 percent 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 considered. The criterion has been tightened to only include TEK10 and TEK17. Small residential building constructed using the TEK07, that entered the portfolio before 31/12/2021, have been grandfathered as of this date.

5.2 Criterion 2: Norwegian residential buildings with EPC-labels A or B

5.2.1 EPC labels to identify energy efficient residential buildings

The energy label in the EPC system is based on calculated delivered energy, including the efficiencies of the building's energy system, while the building codes are defined by net calculated energy, not including the building's energy system. The criteria are hence based on two different system boundaries and must be regarded as two separate criteria describing and classifying the buildings level energy efficiency differently.

The C grade in 2010 was defined so that a building built after the building codes of TEK07 in most cases should get a C. Residences built after the building code of 2007 will hence mostly get a C or better.

80 percent of all certifications for residential buildings are registered in a simplified registration system. This system is based on simplified assumptions and conservative values, and the results are less precise and might give a lower energy label than the optional, more detailed approach.

The EPC coverage is not equally distributed over the building stock. There is currently a coverage ratio of EPC labels relative to the total building stock of about 50 percent, where younger buildings are overrepresented in the EPC database, as previously illustrated in Figure 7. Assuming registered EPCs for each period are representative for the building stock, we can indicate what the label distribution would be if all residents were given a certificate. Figure 20 illustrates how EPCs would be distributed based on this assumption. 8.6 percent of the residential buildings would have an A or B.

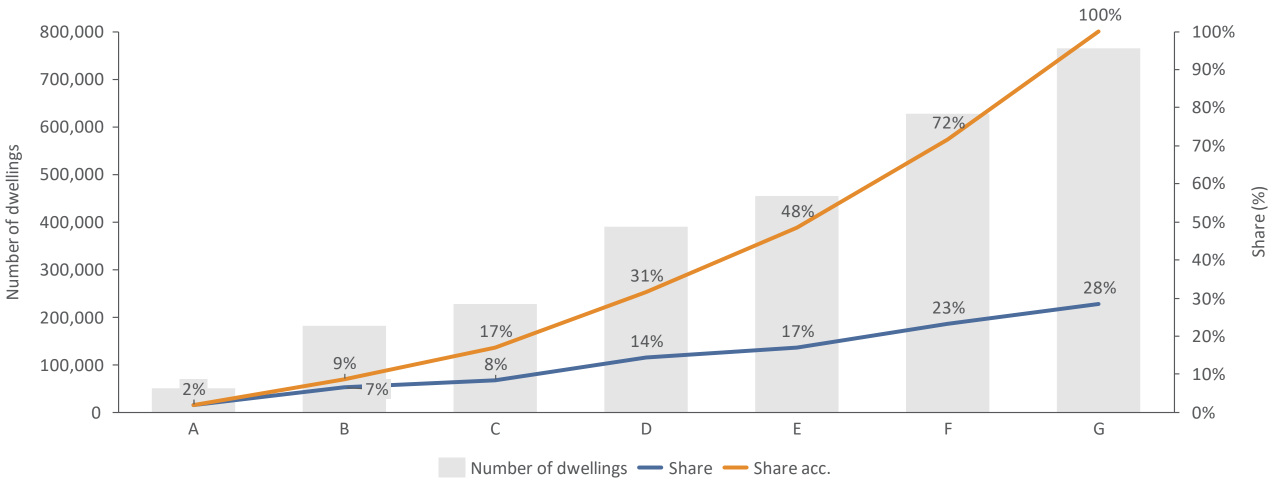


Figure 20 EPCs extrapolated to include the whole residential building stock. (Source: enova.no/energimerking and Statistics Norway, Multiconsult, January 2024)

5.2.2 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 17 percent of the current residential buildings in Norway will have a C or better, and 8.6 percent will have an A or B. The criterion has been tightened to only include A and B. Objects with a C that entered the portfolio before 31/12/2020 have been grandfathered as of this date.

5.3 Criterion 3: Refurbished residential buildings with substantial CO_2 emissions reduction targets

Refurbished buildings with substantial CO_2 emission reduction targets qualify for green bonds against this criterion. This is in line with CBI's refurbishment criterion in their 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.

CO_2 emissions related to operation of residential buildings are dominated by direct and indirect emissions related to energy use. Energy supply differs to some degree between buildings, but in a heavily electrified heating market in Norway, the grid factor dominates the calculations, and energy efficiency will most likely qualify most buildings according to this criterion, rather than fuel switch. If historic EPC-labels are made available, the EPC database may be a source to identify eligible objects.

5.3.1 Eligibility under criterion 3

Refurbished residential buildings with substantial CO_2 emissions reduction targets qualify. The minimum target value is determined by the term of the bond (e.g. 5-year bond > 30 percent). A lower threshold is set at an achieved energy label D.

6 Green portfolio analysis – Eligible assets for green bond issuance

The green loan portfolio of Eika consists of residential and commercial buildings that meet the criteria as formulated.

6.1 Eligible buildings

Multiconsult has investigated Eika's Private Market (PM) and Business Market (BM) portfolio and can confirm that the reviewed buildings have been identified as eligible for green bonds according to Eika's eligibility criteria related to building code and EPC-label for residential buildings. Criterion 3 on refurbishment has not been applied.

Holiday homes and second mortgages have been excluded from the analysis, due to data availability and to avoid double counting of assets. The eligible 8,806 unique buildings/apartments/apartment buildings in Eika's portfolio are estimated to amount to 1.2 million m^2. Living area per object is available in intervals for most objects. The average value for the intervals is used in the calculation. Where object specific living area data is missing, the area is calculated based on national statistics (Statistics Norway[13]).

The portfolio is first matched against criterion 1 (building code/year). The objects eligible under criterion 1 are supplemented with objects qualifying due to energy performance certificate, criterion 2. There is no double-counting of objects that qualify pursuant to more than one criterion. As the criteria have developed since first issuance, measures are taken to ensure new objects entering the portfolio are within the latest definition of top 15 percent energy efficient buildings in the building stock. Therefore, as of 31/12/2020 no new buildings with energy grade C qualify and as of 31/12/2021 no new small residential buildings built according to TEK07 qualify. These buildings have been grandfathered as of the respective dates. Buildings with EPC label C or small residential buildings built according to TEK07 already in the portfolio at these dates, are grandfathered until they exit the portfolio.

In total, 17 percent of the objects in the total PM portfolio qualify. 23 percent of the apartment buildings in the BM portfolio qualify. The eligible objects and related area are presented in more detail in Table 6 and Table 7.

Table 6 Number of eligible individual dwellings in PM and estimated total building areas.

Criterion	Type of PM building	Number of objects	Area total [m^2]
Criterion 1 and 2	Small residential buildings	4,395	756,892
	Apartments	3,314	250,149
Grandfathered under criterion 1 and 2	Small residential buildings	873	152,479
	Apartments	177	13,276
Total criterion 1 and 2		**8,759**	**1,172,796**

Table 7 Number of eligible apartment buildings in BM and estimated total building areas.

Criterion	Type of BM building	Number of objects	Area total [m^2]
Criterion 1	Apartment buildings	47	68,266

[13] Table 06513: Dwellings, by type of building and utility floor space

6.2 Impact assessment

Impact is here defined as the difference in energy consumption and related emissions of CO_2-eq between a baseline and the deemed qualities of the qualifying green objects in the portfolio.

For the building code criteria, the baseline is defined by the energy demand of the average residential building in the current national building stock. The calculated average energy demand of the total residential building stock is 251 kWh/m^2. The calculated average specific energy demand for national eligible assets, weighted for building stock, is then 114 kWh/m^2. This is 54 percent lower than for the total building stock. The difference between total and average qualifying can be multiplied to the emission factor and area of eligible assets, to calculate impact.

For the buildings qualifying according to the EPC-criterion only, the difference between energy demand for achieved energy label and weighted average in the EPC database is used. The baseline is based on the EPC statistics where the average dwelling gets an E.

To calculate the impact on climate gas emissions, a towards net zero trajectory is applied to all electricity consumption in all buildings. Electricity is the dominant energy carrier to Norwegian buildings, but the energy mix also includes bioenergy and district heating, resulting in total specific emission factors for European and Norwegian buildings of 115 and 18 gCO_2-eq/kWh, respectively, as an average over the building's lifetimes (see section 3.3).

For comparison, the avoided emissions also have been calculated using Finans Norge's suggested grid factors for Norway, that is the Norwegian NVE physically delivered electricity mix 2022 and Norwegian NVE residual mix 2022[14].

A proportional relationship is expected between energy consumption and emissions.

Table 8 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 avoided energy demand results in. All values are scaled down to reflect Eika's engagement relative to the objects' market value at loan origin.

Table 8 Avoided energy usage and CO_2 emissions from eligible objects compared to average building stock using Norwegian and European electricity mixes as average over the building's lifetimes. Norwegian physically delivered electricity and Norwegian residual mix for 2022 included for comparison.

	Avoided energy [GWh/ year]	**Avoided CO_2 emissions [tonnes CO_2/year]**			
		European life cycle mix	Norwegian life cycle mix	Norwegian phys. del. el. 2022	Norwegian residual mix 2022
Eligible buildings in the PM portfolio (crit. 1 and 2)	70.9	8,150	1,260	1,320	29,490
Grandfathered eligible buildings in the PM portfolio (crit. 1 and 2)	8.5	980	150	160	1,030
Eligible apartment buildings in the BM portfolio (crit. 1)	4.3	490	80	80	1,790
Total PM+BM	**83.8**	**9,620**	**1,490**	**1,560**	**32,310**

[14] https://www.finansnorge.no/dokumenter/maler-og-veiledere/veileder-for-beregning-av-finansierte-klimagassutslipp/