REPORT

Aurskog Sparebank Green Portfolio Impact Assessment

CLIENT

Aurskog Sparebank

SUBJECT

Impact assessment - Energy efficient residential buildings

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REPORT

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SUMMARY

In summary, impact has been assessed for energy efficient residential buildings in the Aurskog Sparebank portfolio qualifying according to the bank's Green Bond Framework. The following table sums up the impact calculated based on European location-based mix in rounded numbers:

Energy efficient residential buildings	1,360 tons CO_2e/year

Note that the impact above is scaled by the bank's engagement. Impact not scaled may be found in the report.

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1 Introduction

On assignment from Aurskog Sparebank, Multiconsult has assessed the impact of the part of Aurskog Sparebank's loan portfolio eligible for green bonds according to the bank's Green Bonds Framework[1].

In this document we describe Aurskog Sparebank's green bond qualification criteria, the evidence for the criteria and the result of an analysis of the loan portfolio of Aurskog Sparebank.

1.1 Electricity demand and production

The eligible assets are using electricity from the existing power system. 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 production mix in 2022 (88 percent hydropower and 10 percent wind) results in emissions of 7 gCO_2/kWh. The production mixes for other selected European states are also included in the figure for illustration.

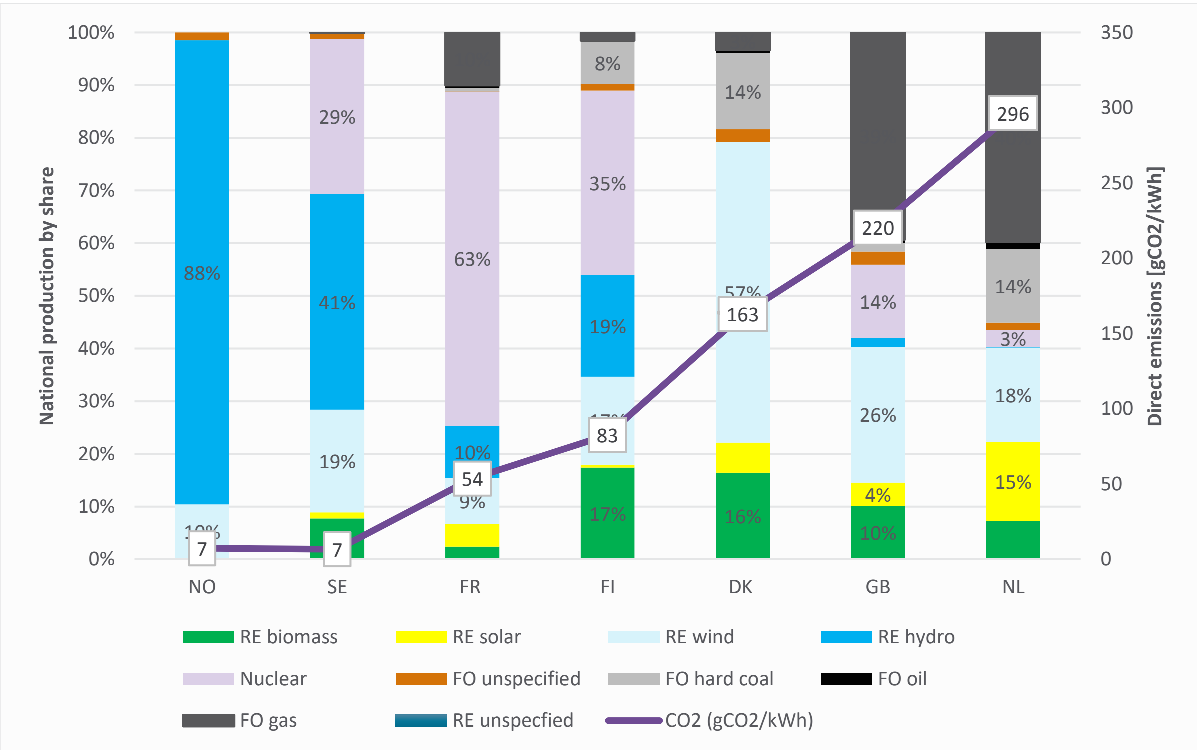


Figure 1 National electricity production mix in some selected countries (European Residual Mixes 2022, Association of Issuing Bodies[2])

Due to the interconnection of the power grid, the placement of the system boundary for power production heavily influences the emission factor. To demonstrate how emissions vary depending on grid factor, the impact assessments for buildings are presented based on several emission factors.

1.2 Emission factors for energy efficient buildings

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

[1] https://www.aurskog-sparebank.no/-/media/banker/aurskog-sparebank/dokumenter/rapporter/2022/Aurskog-Sparebank---Green-Bond-Framework---final---May-2022.pdf
[2] https://www.aib-net.org/facts/european-residual-mix

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. The share of fossil fuel is very low and declining.

Since the Norwegian buildings are predominantly heated by electricity, the placement of the system boundary for power production heavily influences the emission factor. 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 main grid factor used in this green portfolio impact assessment reflects an average in the buildings lifetime, assuming a decarbonisation in the European energy system.

Finans Norge recently released a guidance document for calculation of financed greenhouse gas emissions, including recommendations for grid factors to be used[3]. To demonstrate how emissions vary depending on grid factor and for clarity if comparing avoided emissions from the green portfolio with total portfolio calculations, the two recommended grid factors from The Norwegian Water Resources and Energy Directorate (NVE) are included. That is the most recent Norwegian physically delivered electricity for 2022[4] and the Norwegian residual mix, as calculated by the Association of Issuing Bodies for 2022[5]. The grid factors are summarized in Table 1 and described more in detail in the following sub-sections.

Table 1 Electricity production greenhouse gas factors (CO_2-eq) with and without influx of other heating sources for buildings in three scenarios. (Source: NS 3720:2018, Table A.1, NVE[4], AIB[5])

Scenario	Description	Emission factor electricity [gCO_2/kWh]	Emission factor incl. other heating sources [gCO_2/kWh] [6]
European (EU27+ UK+ Norway) NS 3720:2018 electricity mix	Location-based electricity mix with wide system boundary including EU countries, UK and Norway, average emissions over building's 60-year lifetime	136	115
Norwegian NVE physically delivered electricity 2022	Location-based production mix with narrow system boundary of Norway only but including net export/ import only to neighbouring countries and average annual emission factors	19	19
Norwegian NVE residual mix 2022	Market-based residual mix for Norway with a European marketplace	502	416

To calculate the impact on climate gas emissions, the grid factors are applied to all electricity consumption in the residential buildings in the portfolio eligible for green bonds. Electricity is, as mentioned, the dominant energy carrier to Norwegian residential buildings, but the energy mix also includes other energy carriers such as bio energy and district heating. The influx of other energy sources for heating purposes is applied to all electricity emission factors resulting in the "Emission factor considering other heating sources", found in the rightmost column in Table 1.

1.2.1 European (EU27+ UK+ Norway) and Norwegian electricity mix over building's lifetime

Using a life-cycle analysis (LCA), the Norwegian Standard NS 3720:2018 "Method for greenhouse gas calculations for buildings" considers international trade of electricity and the fact that consumption

[3] https://www.finansnorge.no/dokumenter/maler-og-veiledere/veileder-for-beregning-av-finansierte-klimagassutslipp/, 2024
[4] https://www.nve.no/energi/energisystem/kraftproduksjon/hvor-kommer-stroemmen-fra/, 2024
[5] https://www.aib-net.org/facts/european-residual-mix, 2023
[6] Multiconsult. Based on building code assignments for DiBK, 2015.

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. These factors are location-based.

The mentioned standard calculates, on a life-cycle basis, the average CO_2- factor for the next 60 years, according to European (EU27+ UK+ Norway) system boundary, as described in Table 1.

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. The standard also calculates the equivalent Norway only emission factor. Using the European mix instead of the Norway only mix, is then a more conservative approach.

The European electricity factor is 136 gCO_2-eq/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).

1.2.2 Norwegian physically delivered electricity 2022

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. The most recent factor published is for 2022, this grid factor is 19 gCO_2-eq/kWh. This is also a location-based grid factor.

1.2.3 Norwegian residual mix 2022

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 the electricity disclosure published by NVE[7] and Association of Issuing Bodies[8]. 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.

2 Energy efficient residual buildings

2.1 New residential buildings TEK17 minus 10 percent - criterion for buildings finished since December 31st, 2020

The EU Taxonomy for sustainable activities distinguishes between new and existing buildings, with criteria dependent on whether the building is completed before or after 31st December 2020. The technical screening criteria for new buildings requires the building to have an energy performance, described in primary energy demand, at least 10 percent lower than the threshold set in the national definition of a nearly zero-energy building (NZEB). The energy performance is to be documented by an Energy Performance Certificate (EPC).

[7] https://www.nve.no/energy-supply/electricity-disclosure/?ref=mainmenu, 2024
[8] As calculated by AIB. Lower than Norwegian residual mix due to larger share of electricity usage covered by Guarantees of Origin.

The Norwegian national definition of NZEB was published in January 2023[9] with a correction issued in January 2024[10]. The NZEB definition has clear references to the building code TEK17, and in practical terms, the definition is no stricter than TEK17. The difference lies in a) a shift of system boundary to delivered energy and by introducing primary energy factors, and b) an exclusion of energy demand related to lighting and technical equipment.

As the Norwegian definition had not yet been published at the time of Aurskog Sparebank's Green Bond Framework, we currently apply TEK17.

2.2 Top 15 percent residential buildings - criteria for buildings finished before January 1st, 2021

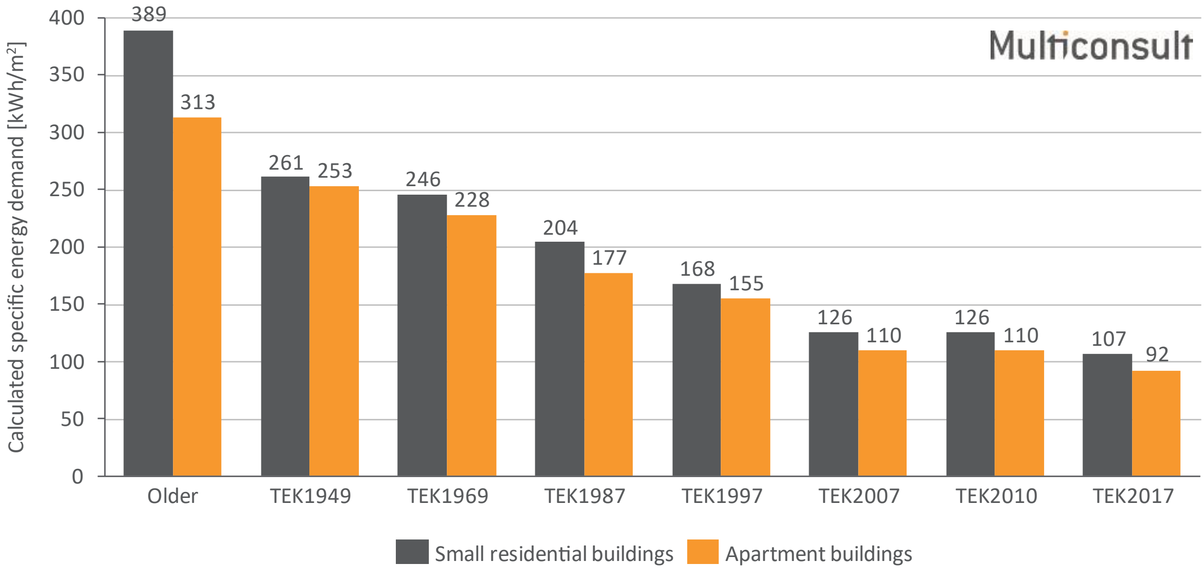
The Aurskog Sparebank eligibility criteria for existing residential buildings are based on building code and on EPCs. Buildings are eligible if they have

- Energy Performance Certificate A, or
- are within the top 15% of the national or regional stock in terms of primary energy demand:
    - built according to Norwegian building codes of 2010 (TEK10) or 2017 (TEK17)
    - if built prior to 2012, minimum Energy Performance Certificate B

2.2.1 Building code criterion

i. Existing Norwegian residential building that complies with the Norwegian building codes of 2010 (TEK10) or 2017 (TEK17). Hence, built in 2012 and later.

Changes in the Norwegian building code (TEK) have consistently, over several decades, resulted in increasingly energy efficient buildings. The building codes are defined by calculated net energy demand, not including the efficiency of the building's energy system. Figure 2 illustrates how the calculated net energy demand declines with decreasing age of the buildings. Net energy demand in the figure is calculated using standard building models identical to the models used for defining the building codes (TEK10/TEK17).



[9] https://www.regjeringen.no/no/aktuelt/rettleiing-om-utrekning-av-primarenergibehov-i-bygningar-og-energirammer-for-nesten-nullenergibygningar/id2961158/, 2023

[10] https://www.regjeringen.no/contentassets/296636deecef419590fe6b5668fe196f/23-12-korrigert-veiledning-om-beregning-av-primarenergibehov-og-nesten-nullenergibygg.pdf, 2024

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

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

The figure shows theoretical values for representative building category models, calculated in the simulation software SIMIEN and in accordance with Norwegian Standard NS 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, independent of age, while there is no heat recovery in the older buildings. Indoor air quality is assumed to be independent of building year. This is consistent with the methodology used in the EPC-system.

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 built after 1997 show for example a clear improvement in the calculated energy level for buildings completed after 2008/2009 when the building code of 2007 (TEK07) 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 due to an increased market share for heat pumps in new buildings, and to a certain degree, improved windows.

Figure 3 shows how the Norwegian residential building stock is distributed by age. The figure shows how buildings finished in 2012 or later (built according to TEK10 or TEK17) make up 13.3 percent of the total stock.

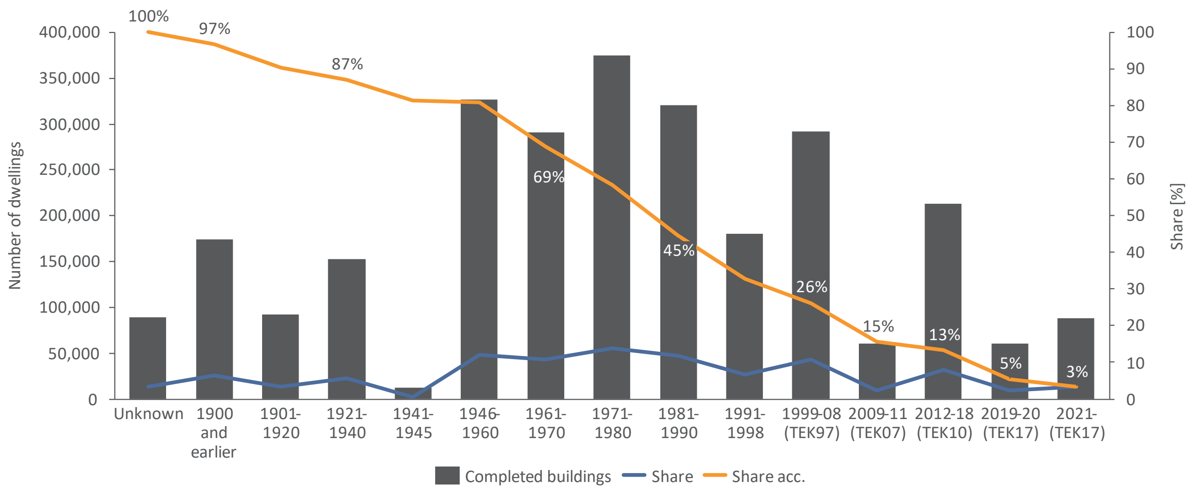


Figure 3 Age and building code distribution of dwellings. (Source: Statistics Norway, Multiconsult)

2.2.2 EPC criterion

i. Existing Norwegian residential buildings with EPC-label A.

ii. Existing Norwegian residential buildings built prior to 2012, with EPC-label B.

The EPC System became operative in 2010 and made mandatory for all new residences completed after the 1st of July 2010 and for all residences sold or rented out. The properties already registered in the EPC database are considered representative for all the residential buildings built under the same building code. However, they are not representative for the total stock, as younger residential buildings are highly overrepresented in the database. The EPC labels coverage ratio relative to the total residential building stock is about 50 percent, and only a share of these labels is currently made available to the banks due to data quality issues.

Assuming registered EPCs are representative for the building stock completed in the time period a certain building code is applied, it is possible to indicate what the label distribution would be if all residential buildings were given a certificate. Figure 4 illustrates how EPCs would be distributed based on this assumption. 9.3 percent of the residences would have a B or better.

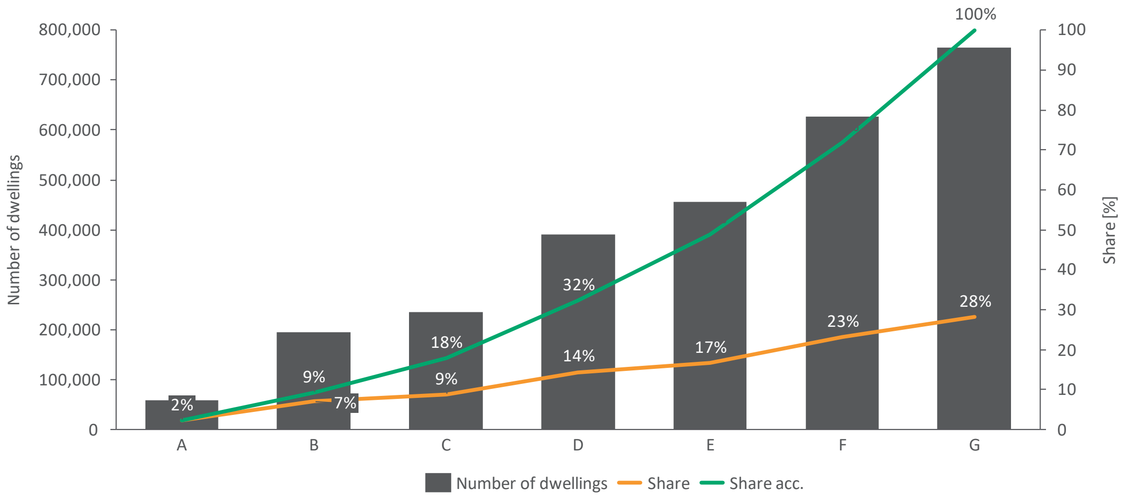


Figure 4 EPCs extrapolated to include the whole residential building stock (Source: energimerking.no, Statistics Norway, Multiconsult)

2.2.3 Combination of criteria

The criteria are based on different statistics. It is, however, interesting to view them in combination. Table 2 illustrates how the criteria, independently and in combination, make up cumulative percent.

Interpretation: TEK10 and newer in isolation represents 13.3 percent; TEK10 and newer in combination with A+B labels represents 14.8 percent; TEK10 and newer in combination with A+B+C labels represents 19.2 percent of the total Norwegian residential building stock.

Table 2 Matrix of Cumulative percentages for criteria combinations (FY23), relative to the total residential building stock in Norway.

	TEK10+TEK17	EPC A+B	EPC A+B+C
TEK10+TEK17	13.3 percent	14.8 percent	19.2 percent
EPC A+B		9.3 percent	
EPC A+B+C			16.8 percent

2.3 Impact assessment - Residential buildings

The eligible residential buildings in Aurskog Sparebank's portfolio are estimated to amount to almost 150,000 square meters. For most units, the bank has supplied reliable area for most objects. Where it is missing, the area has been calculated based on the assumption that the dwellings in the portfolio are equivalent to the average Norwegian residential building stock[11]. Table 3 below shows the resulting building area eligible under each of the bank's criteria.

[11] Statistics Norway Table 06513: Dwellings, by type of building and utility floor space

Table 3 Calculated building areas for eligible buildings.

Area of eligible buildings in portfolio [m^2]					
	TEK17 >2021	EPC A	TEK17/TEK10	EPC B <2012	**Sum**
Apartments	13,618	1,580	37,280	977	**53,455**
Small residential buildings	23,710	1,737	60,610	7,871	**93,928**
Sum	**37,328**	**3,317**	**97,890**	**8,848**	**147,383**

Based on the calculated figures in Table 3, the energy efficiency of this part of the portfolio is estimated. All the residential buildings are not included in one single bond issuance.

Eligibility is first checked against the TEK criterion for new buildings. For existing buildings, the buildings are first checked against EPC A, then the building code criterion, and lastly against the EPC B criterion so no double counting of objects will occur.

Over the last several decades, the changes in the building code have pushed for more energy efficient buildings. Combining the information on the calculated energy demand related to building code and information on the residential building stock, the calculated average specific energy demand on the Norwegian residential building stock is 249 kWh/m^2. Separated on apartments and small residential buildings, the averages are 202 kWh/m^2 and 257 kWh/m^2, respectively. Building code TEK10 and TEK17 gives an average specific energy demand for existing buildings, weighted for actual stock, of 102 kWh/m^2 for apartments and 119 kWh/m^2 for houses. Hence, compared to the average apartment stock, the building codes TEK10 and TEK17 gives a calculated specific energy demand reduction of 50 percent. For small residential houses, the same number is 54 percent.

As specific energy demand for each object has not been made available to check availability against the TEK17 minus 10 percent, new buildings are as a proxy qualified based on building year and building code only. Impact for these buildings is calculated similarly to existing buildings qualifying on the TEK criterion.

As only half of all dwellings have a registered EPC, we choose to use the average specific energy demand of the Norwegian residential building stock, calculated based on building code and information on the residential building stock, as baseline for the buildings qualifying according to the EPC criterion also. The calculated specific energy demand reduction is found between the energy demand for the achieved energy label and the average energy demand for the apartment and small residential building stock.

Table 4 indicates how much more energy efficient the eligible part of the portfolio is compared to the average residential Norwegian building stock. It also presents how much the calculated reduction in energy demand constitutes in CO_2-emissions. The avoided energy usage and avoided emissions of the eligible buildings are also shown as scaled by the bank's share of financing by the loan-to-value ratio. The CO_2-emissions are calculated using the three emission factors described in section 1.2: European NS 3720:2018 electricity mix, and NVE's grid factors for only Norway, representing physically delivered electricity and the residual mix for 2022.

Table 4 Avoided energy demand and emissions (CO_2-eq) of eligible objects in the portfolio compared to average residential building stock using three emission factors. (Source: public statistics, Statistics Norway, Energimerking.no, Multiconsult)

	Avoided energy demand compared to baseline [GWh/year]	**Avoided emissions compared to baseline [tons CO_2e/year]**		
		European lifetime mix	Norwegian physically delivered el. 2022	European residual mix 2022
Buildings eligible under new buildings criterion	5	582	94	2,108
Buildings eligible under existing buildings criterion	14	1,585	257	5,739
Total impact eligible buildings	**19**	**2,167**	**352**	**7,848**
Total impact scaled by bank's engagement	**12**	**1,360**	**221**	**4,924**