REPORT

Sparebanken Sør Buildings Portfolio Climate Gas Emissions

CLIENT

Sparebanken Sør

SUBJECT

Energy demand and related climate gas emissions- residential and commercial buildings

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REPORT

PROJECT	**Sparebanken Sør Buildings Portfolio Climate Gas Emissions**	DOCUMENT CODE	10219865-1-TVF-RAP-001
SUBJECT	Energy demand and related climate gas emissions-residential and commercial buildings	ACCESSIBILITY	Open
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Sparebanken Sør's loan portfolio includes a diverse set of asset classes with equally divers impact on climate gas emissions. This report describes yearly operational energy demand and related emissions of climate gases for the two major assets classes, residential and commercial buildings. Due to lack of available data and to the smaller loan volumes and type of financed activities, other loans are not expected to have emission impact at the same scale as buildings. The emissions are based on information on building year and assets in the portfolio and national building code requirements.

The calculated buildings portfolio impact scaled by the loan volume's share of building value in rounded numbers:

Retail Market	*(147,000 ton CO_2e/year, not scaled)*	*66,000 ton CO_2e/year*
Corporate Market	*(52,600 ton CO_2e/year, not scaled)*	*12,500 ton CO_2e/year*
Total in-use footprint		*72,500 ton CO_2e/year*

About 6,360 buildings in the portfolio are qualifying the Sparebanken Sør green bond criteria for energy efficient residential and commercial buildings. The difference in climate gas emissions between the qualifying part of the portfolio and the national average in rounded numbers:

Energy efficient buildings Retail Market	*(14,600 CO_2e/year, not scaled)*	*8,700 ton CO_2e/year*
Energy efficient buildings Corporate Market	*(9,400 CO_2e/year, not scaled)*	*3,100 ton CO_2e/year*
Total avoided emissions		*11,800 ton CO_2e/year*

02	11.03.2021	Revised loan volume calculation	STJ, JANO	STJ	STJ
01	14.02.2021	Draft	STJ, JANO	STJ	STJ
00	08.02.2021	Draft	STJ, JANO, MSD	STJ	STJ
REV.	DATE	DESCRIPTION	PREPARED BY	CHECKED BY	APPROVED BY

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1 Introduction

On assignment from Sparebanken Sør, Multiconsult has studied the residential and commercial buildings in Sparebanken Sør's retail and corporate market and compared their energy efficiency and CO_2-emissions related to operational energy demand to the Norwegian building stock. In this report the methodology is presented and substantiated based on energy requirements in the national building code.

In addition Multiconsult has applied available developed criteria and methodology to identify the most energy efficient residential and commercial buildings in Norway, applicable in a green bond issuance. In this document we describe identification criteria, the evidence for the criteria and the result of an analysis of the loan portfolio of Sparebanken Sør. More detailed documentation on baseline, methodologies and eligibility criteria is made available on Sparebanken Sør's website[1]. The criteria to select the buildings are based on credible standards in Norway such as the Norwegian building regulation and Energy Performance Certificates, and the criteria are in line with international accepted standards. Multiconsult has assessed the impact of the part of Sparebanken Sør's portfolio meeting the technical eligibility criteria for green bonds, measured in energy and related climate gas emissions.

2 Energy efficiency in the residential building stock

2.1 The Norwegian residential building stock

The Norwegian residential building stock consist 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.

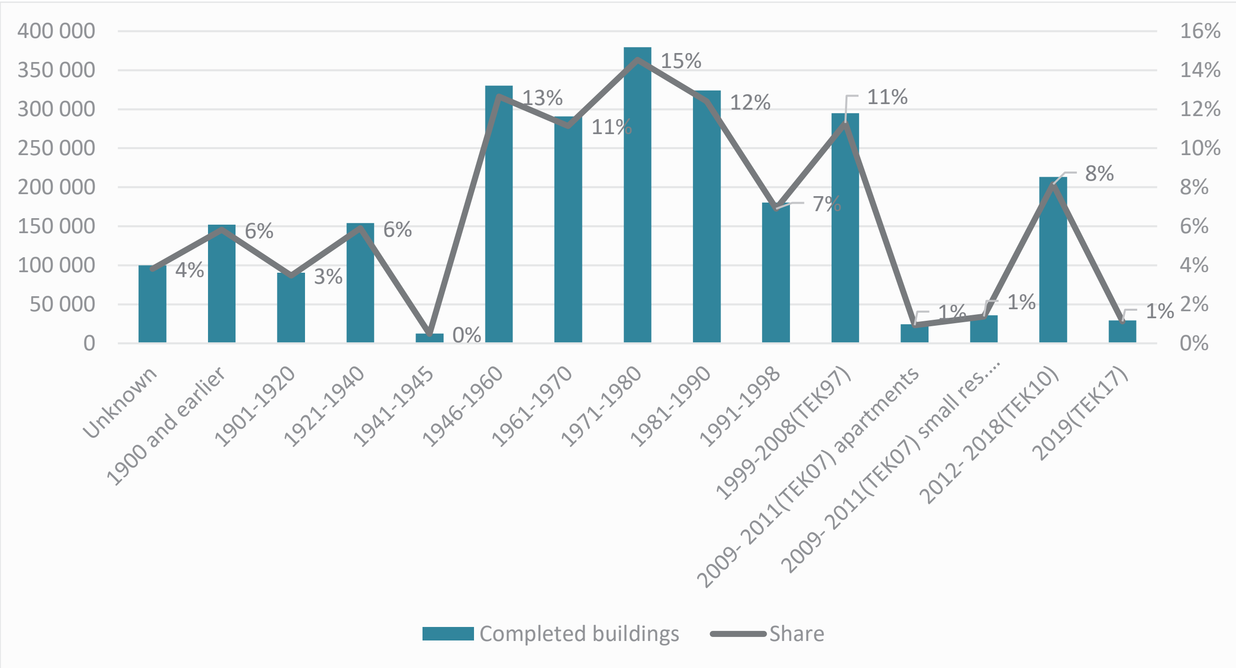


Figure 1 Age and building code distribution of dwellings (Statistics Norway[2] and Multiconsult)

[1] https://www.sor.no/felles/om-sparebanken-sor/about/investor-relations/green-and-sustainability-bond-framework/
[2] Boligstatistikken, Tabell: 06266: Boliger, etter bygningstype og byggeår (K). Adjusted to match the development of building code.

Of the total stock, apartments constitute 30%, and small residential buildings the remaining 70%. Apartment's share is however increasing and has been over the last couple of decades.

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 chapters. 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.

2.2 National building code

Changes in the Norwegian building code have consistently over several decades resulted in more energy efficient buildings. The calculated specific energy demand (kWh/m^2) dependent on building code, presented in Figure 2, illustrates how the energy demand declines with decreasing age of the buildings.

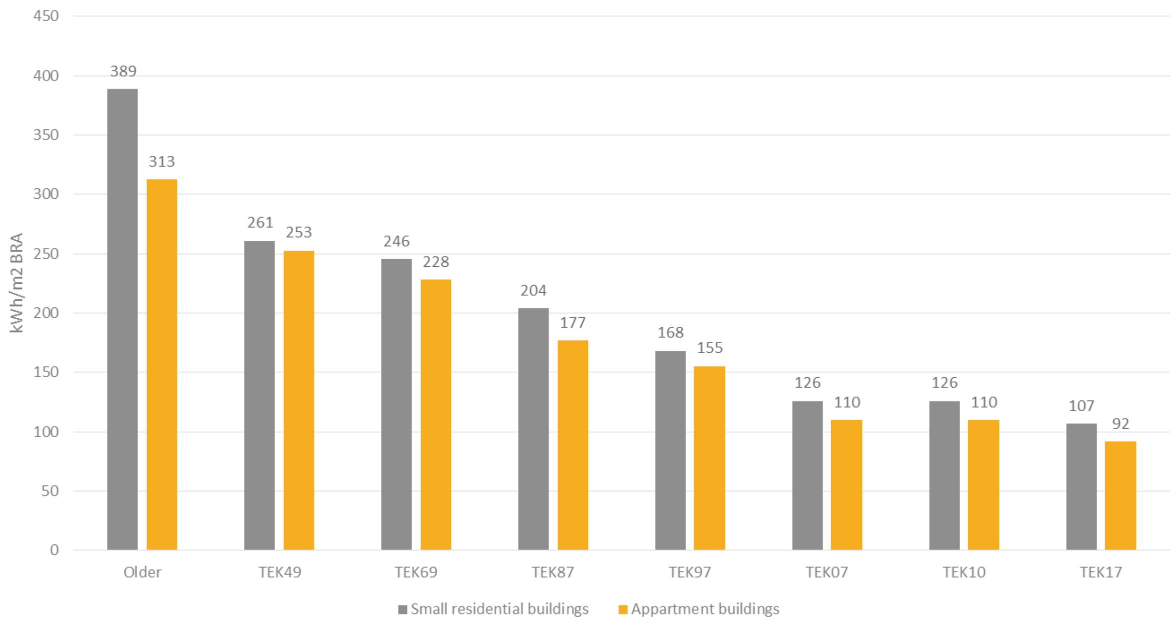


Figure 2 Development in calculated specific net energy demand based on building code and building tradition, (Multiconsult, simulated in SIMIEN)

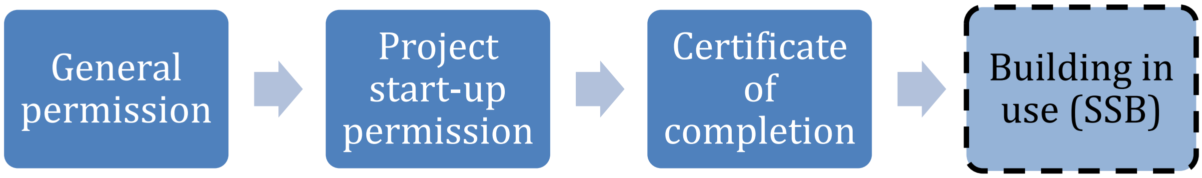
From TEK07 to TEK17 the reduction is about 15 % and the former shift from TEK97 to TEK07 was no less than 25 %. Note that, for small residential buildings, there was no change between TEK07 and TEK10 with respect to energy efficiency requirements.

The figure gives theoretical values for representative models of an apartment and a small residential building, calculated in the computer programme SIMIEN and in accordance to Norwegian Standard NS 3031:2014 *Calculation of energy performance of buildings. Method and data*, and not based on measured energy use. In addition to the guiding assumption in Norwegian Standard NS3031:2014, experience with building tradition is included. Net energy demand is calculated for model buildings used for defining the building code (TEK07/TEK10/TEK17). 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 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.

2.2.1 Time lag between building permit and building period

After the implementation of new a building code there is some time lag before we see new buildings completed according to this new code. The lag between the date of general permission received (no; rammetillatelse), which decides which code is to be used, and the date at which the building is completed and taken into use, varies a lot depending on such things as the complexity of the site and project, financing and the housing market.



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

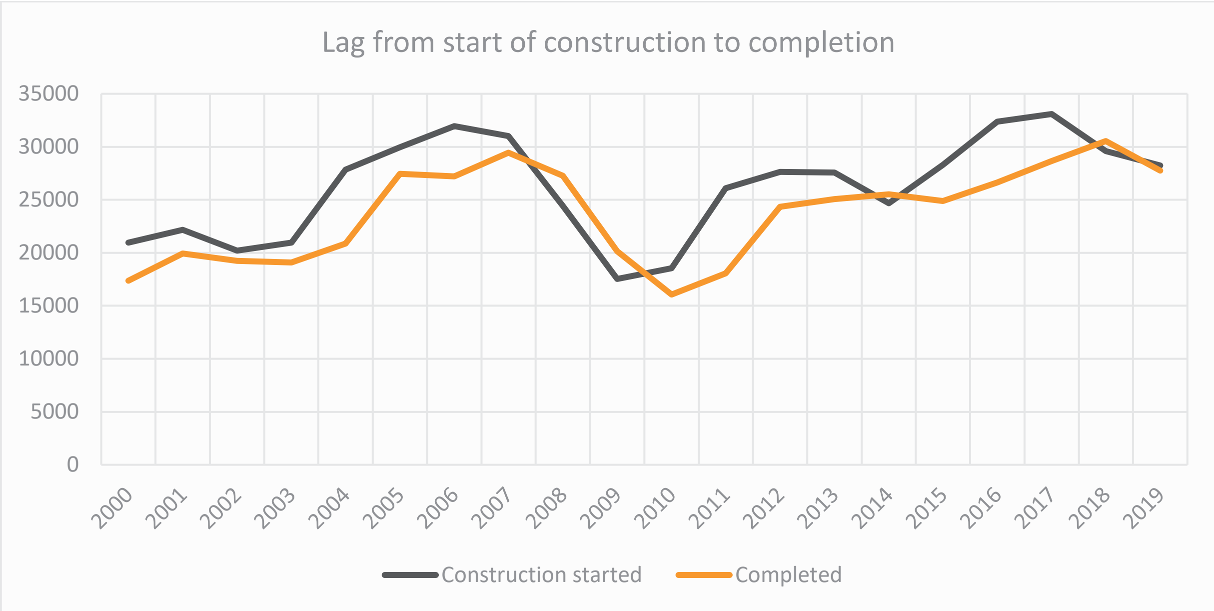


Figure 3 Project start-up and completion (Statistics Norway, bygningsarealstatistikken)

Based on the discussions on time for design and construction, we regard a time-lag of two years, in most cases, between code implementation and 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) only is available to the bank on a yearly basis. E.g. the 2007 building code (TEK07) was implemented in February 2007 and 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.

2.2.2 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 2. 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 2 (buildings from 1951 and earlier) may be applied in a conservative approach.

2.3 Energy Performance Certificate

The Energy Performance Certificate system became operative in 2010. It was made obligatory for all new residences finished after the 1st of July 2010, and all older residences, sold or rented out, were to have an Energy Performance Certificate. Enova, 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 public consultation of new regulations is expected in 2020. Changes may include new limit values and calculation methods.

The whole 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 less than 50 %. 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.

Sparebanken Sør has linked the individual residences to the EPC database, and include the energy certificate results for individual assets, based on some key information.

2.3.1 EPC labels to demonstrate energy efficiency in residential buildings

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

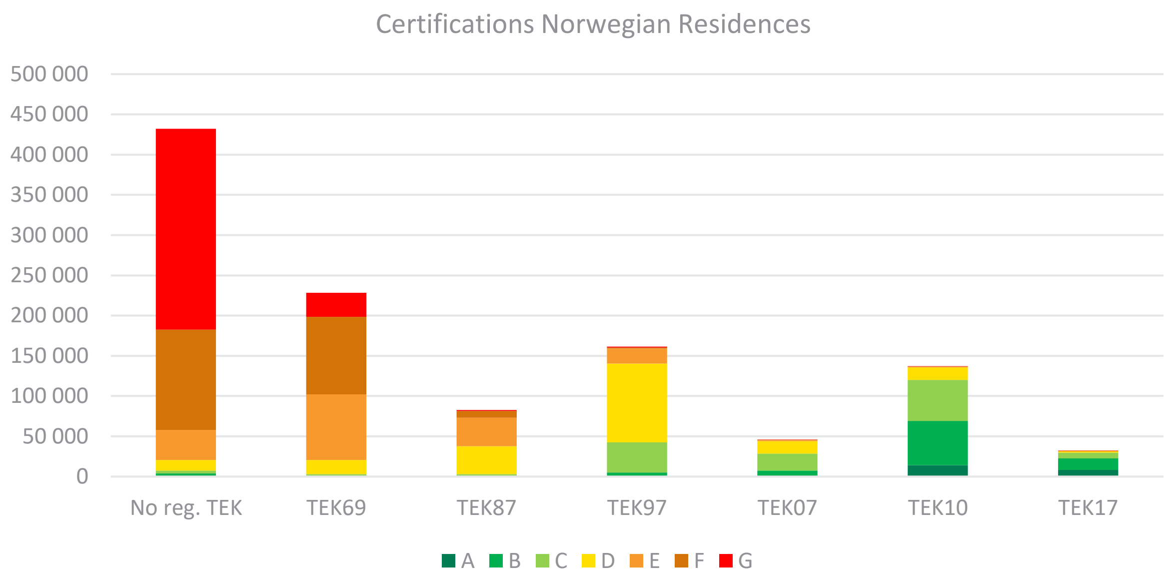


Figure 4 Residences in Norway with Energy Performance Certificates distributed per building code and energy grade in the EPC system. The numbers are based on statistics from the EPC database (representing no more than 44% of the total building stock).

The registered properties in the EPC database are considered to be representative for the buildings built under the same building code, however not representative for the total stock as younger buildings are highly overrepresented in the database. There is currently a coverage ratio of EPC labels relative to the total building stock equal to 50%. Extracting only buildings built before 2009, 5% of the total stock is expected to get a C or better. These are buildings that have initially been built, or through refurbishment, attained higher energy efficiency standards than the original building year (and respective building code) would imply.

2.3.2 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 consist currently of an energy label (A-G) and a heating label (defined as colour). The heating label is seldom used, on its way out, and not considered relevant in the context of this work.

Registration of certificates is performed in two ways. Professionals must certify 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 values, and its results are therefore less precise and might give a lower energy label than registration performed by professionals.

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. 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 1 Delivered energy EPC energy labels (Source: www.energimerking.no)
A = heated floor area of the dwelling
Example: a 150 sq. m *small residential building* would have a C qualification limit of 145+2500/150=161.67 kWh/m^2

The grading system and C-label

The C label is defined for residences so that a building built after the building codes of TEK2007 in most cases should get a C.

The limit value for reaching a C is calculated based on a representative model of a small residential building and an apartment, built according to the building code of 2007, with an assumed moderate system efficiency for the building's energy system. Residences built after the building code of 2007, will hence mostly get a C or better, but might also get a D.

Particularly for apartments, the defined limit value between C / D in the grading system is set for an average apartment. An apartment in the top or bottom floors or in the corner of an apartment building will have a higher heat loss, and will most likely get a D, and in some rare cases even an E, even though the building code of 2007 is used. But these apartments are still more energy efficient than apartments with similar locations in older apartment buildings.

Since a large part of the certifications are done by way of simplified registration and not by professionals, a larger share of existing TEK07-buildings do get a D, and in some rare cases even an E. Another reason why some existing houses and apartments built after the code of 2007 get a D, is that the grade scale has been revised and tightened three times between 2011 and 2015. E.g. a small residential building that had a C when it was new in 2012, could have a D if given a new EPC in 2015.

Therefore, most of the poorer grades D (and E) for TEK07-buildings are due to either one or a combination of these factors; the conservative method of calculation in the simplified registration system, unfavourable location of an apartment in apartment buildings, a geometrically unconventional building form with higher energy losses than the representative model, and/or the revised and tightened grading scale. So the building itself is not necessarily less energy efficient.

Figure 5 shows the energy grades in the already granted certificates to Norwegian residential buildings.

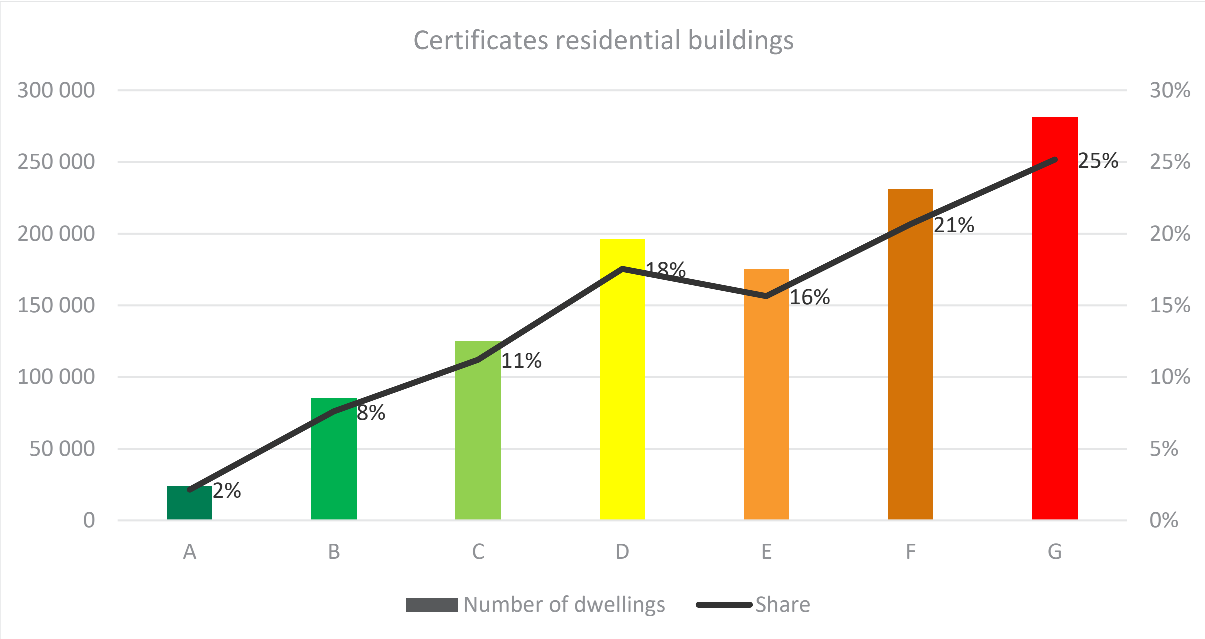


Figure 5 Energy Performance Certificates by grade- residential buildings only, representative only of buildings with EPCs (Source: energimerking.no, December 2020)

The EPC coverage is, however not equally distributed over the building stock. Figure 6 shows the age of the buildings with EPCs and in the building stock, respectively, and how much of the building stock is represented in the EPC database. This illustrates how younger buildings are overrepresented in the EPC database. Note that EPC data is regularly updated and the data behind the figure include almost all new registrations in 2020. Building stock data is, however, only updated on a yearly basis and the figure only include building finished before the end of 2019, hence the misleading coverage ratio for TEK17 buildings.

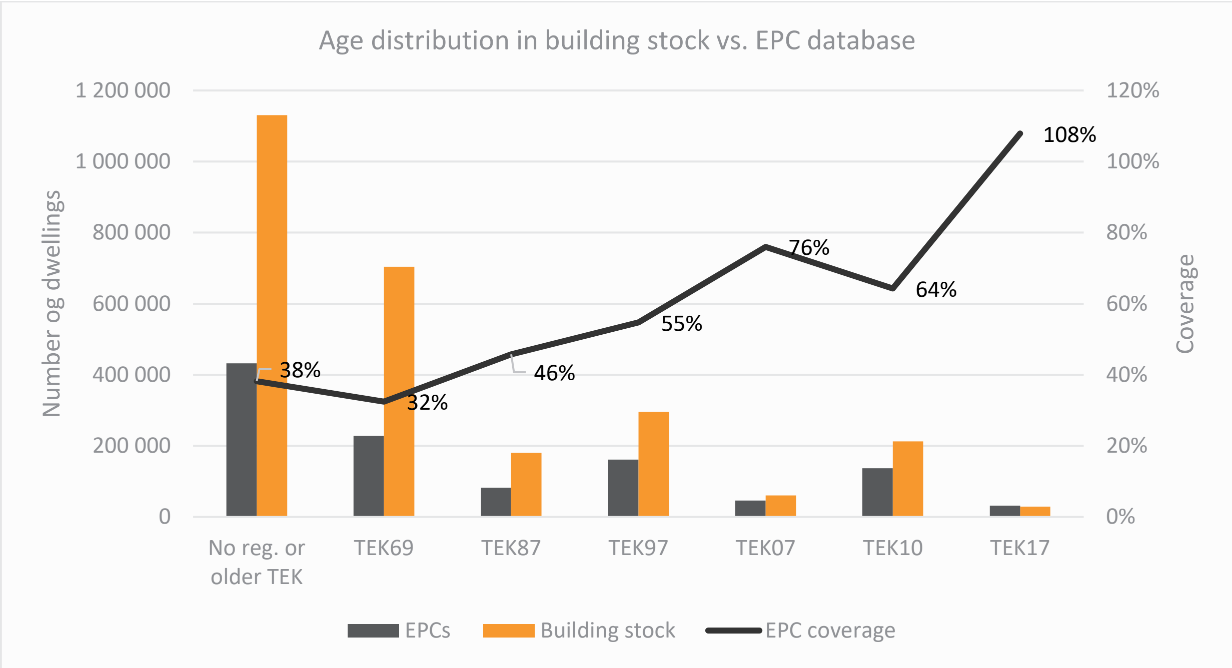


Figure 6 Age distribution in Energy Performance Certificates vs. actual residential building stock and EPC coverage by building year (Source: energimerking.no December 2020 and Statistics Norway April 2020)

Assuming registered EPCs for each time period are representative for the building stock, we are able to indicate what the label distribution would be if all residents were given a certificate. Figure 7 illustrates how EPCs would be distributed based on this assumption. 14% of the residences would have a C or better. 6% of the residences would have a B or better.

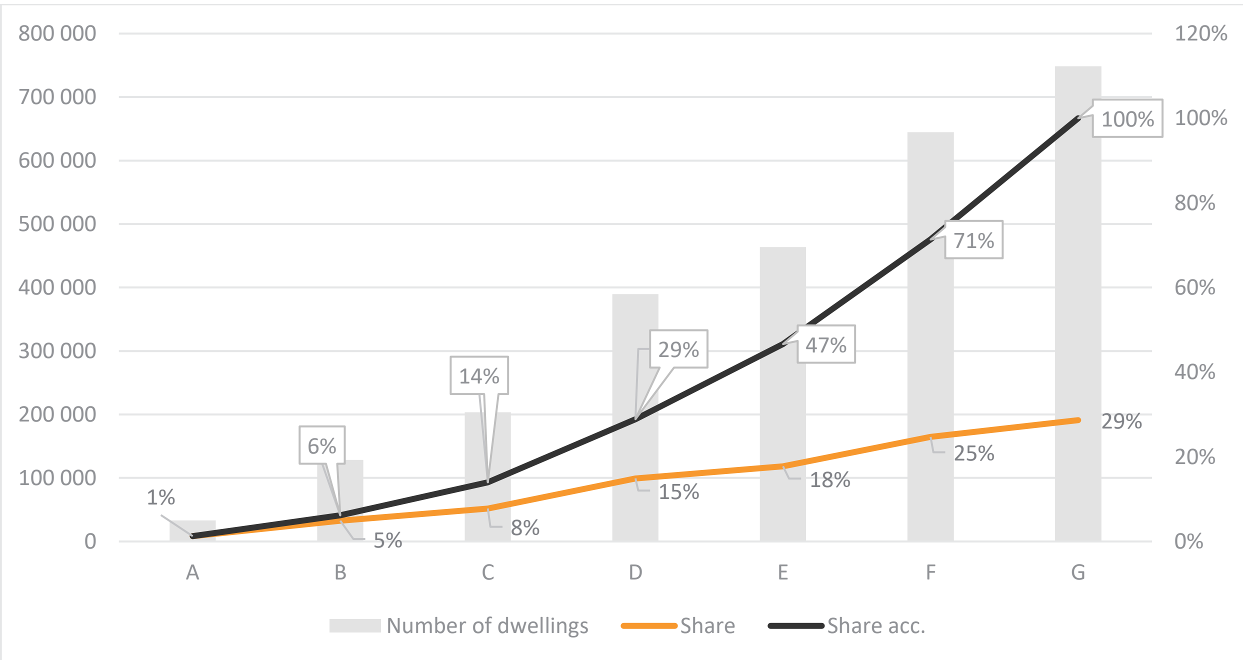


Figure 7 EPCs extrapolated to include the whole residential building stock (Source: energimerking.no and Statistics Norway, Multiconsult)

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

The Energy Performance Certificates have potential to take into account building specific data and illustrate a buildings energy efficiency performance. The bank may obtain relevant information about the financed objects in the EPC database, however this is today limited to energy label and does not include specific energy demand. To calculate the energy demand in buildings, average values derived from table 1 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.

The EPC coverage of about 50% is however very limiting for the bank as half of the dwellings are not to be found in the database. Coming changes in the EPC system may also obscure the picture as existing buildings may have certificates based on either the existing or the coming system. A consistent update of the portfolio's performance will be challenging. For identifying the most energy efficient buildings, however, the changes in the system will not be problematic.

2.4 Building code vs. EPC

The bank's portfolio is dynamic and objects with variable degree of available EPCs will go in and out of the portfolio. Combining EPCs and building code is not recommended as the two solutions have different system boundaries. It is possible to estimate the effect of the different system boundaries, however, these estimates would have to be based on multiple assumptions as detailed information about the individual dwellings is not available.

The EPC coverage is on average about 50% for residential buildings in Norway. The coverage for older buildings, constituting a major part of any bank's portfolio, is even down in the 30's and 40's. This is an evident weakness in using the available EPCs to shed light on the energy efficiency in a large portfolio.

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. 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. This approach has been employed in the following analysis of the complete Sparebanken Sør residential loan portfolio.

3 Energy efficiency in the commercial building stock

The actual energy performance of individual buildings is not publicly available, and a bank cannot request energy data from their clients and expect sufficient data of reliable quality to produce a credible analysis. To describe buildings' energy performance by building area and energy requirements in the current and former national building codes, is considered to be the most reliable option. Data from the Energy Performance Certificate system (EPC) may serve as a potential source, however not for individual buildings as the coverage is poor. EPC data, at the time only available for research purposes, may in time be a source for this kind of analysis.

For commercial buildings, the EPC coverage ranges from 38% combined for office and retail buildings, to below 5% for hotel and restaurant buildings, small industry buildings and warehouses. This is an evident weakness in using the available EPCs to shed light on the energy efficiency in a large portfolio. The bank's portfolio is dynamic and objects with variable degree of available EPCs will go in and out of the portfolio. Combining EPCs and building code is not recommended as the two solutions are calculating energy demand using different system boundaries.

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. This is found to be a robust and consistent approach to monitor a complete portfolio over time and illustrate the buildings' in-use energy demand and related carbon footprint. This approach has been employed in the following analysis of the complete Sparebanken Sør commercial building loan portfolio.

3.1 National building code

Multiconsult has studied sections of the Norwegian commercial building stock; office buildings, retail, hotel and restaurant buildings and industry/warehouses.

To establish a robust methodology, data on number and age of existing buildings are crucial.

National statistics on number of buildings and age in the total stock have good quality in the most recent time periods, but more aggregated for older buildings. Some building categories are only available on an aggregated level, but the necessary splits are made on the basis of data available for the years 2006 and 2018. Building years for older buildings are somewhat uncertain and assumptions on building rate and demolition rate had to be made.

Regarding building area, data is available on new buildings every year from 1983. These data have been supplemented with data in a study on energy efficiency in existing buildings.[3]

Changes in the Norwegian building code have consistently over several decades resulted in more energy efficient buildings. Net energy demand is calculated for model buildings used for defining the building code and the result presented in Figure 17 illustrates how the calculated energy demand declines with decreasing age of the buildings. From TEK10 to TEK17 the reduction is between 14 – 23%. The former shifts from TEK07 to TEK10 was about 10%, and from TEK97 to TEK07 about 20%.

Figure 8 presents theoretical values for representative models of an office building, retail/commercial building, hotel building and industry/ warehouse, calculated in the computer programme SIMIEN and in accordance to Norwegian Standard NS 3031:2014 *Calculation of energy performance of buildings Method and data*, and is not based on measured energy use. In addition to the guiding assumption in

[3] Enova publication "Potensial- og barrierestudie Energieffektivisering i norske yrkesbygg», Multiconsult 2011

Norwegian Standard NS 3031:2014, experience with building tradition is included. Indoor air quality is assumed not to be dependent on building year. By that, it is assumed that older buildings (TEK69 and older) that originally had natural ventilation or mechanical exhaust with relatively small air volumes, have at one time been upgraded to balanced ventilation with satisfactory air volumes - this is assumed to be a necessary upgrade the property owner had to do to meet the tenancy requirements. Many such older buildings underwent such upgrades in the 1980s and 1990s. For these, a minimum allowable airflow from NS 3031: 2014 Table A.6 is used. This is the same methodology as used in the EPC-system.

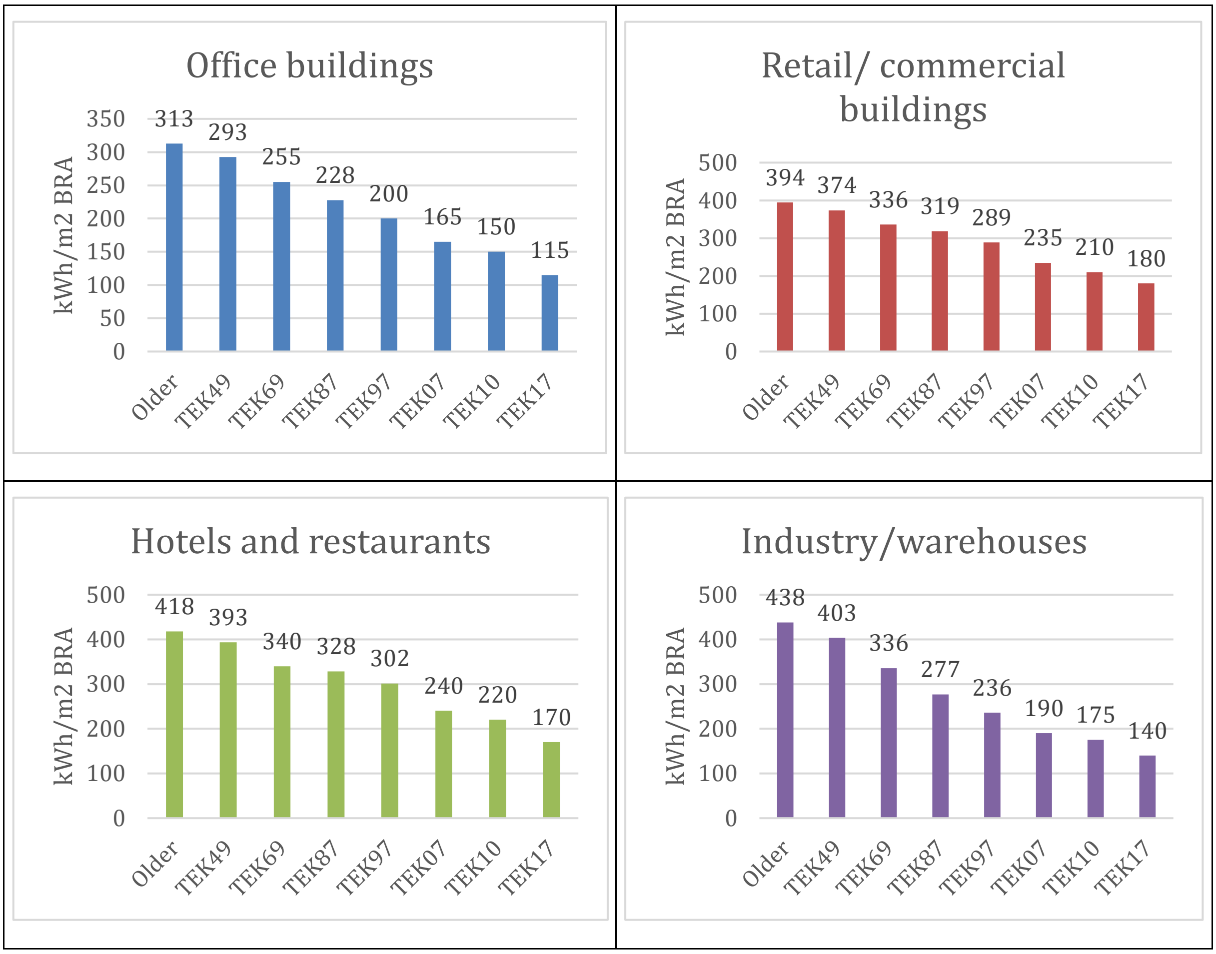


Figure 8 Development in calculated specific net energy demand based on building code and building tradition (Multiconsult, simulated in SIMIEN)

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

3.1.1 Time lag between building permit and building period

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

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

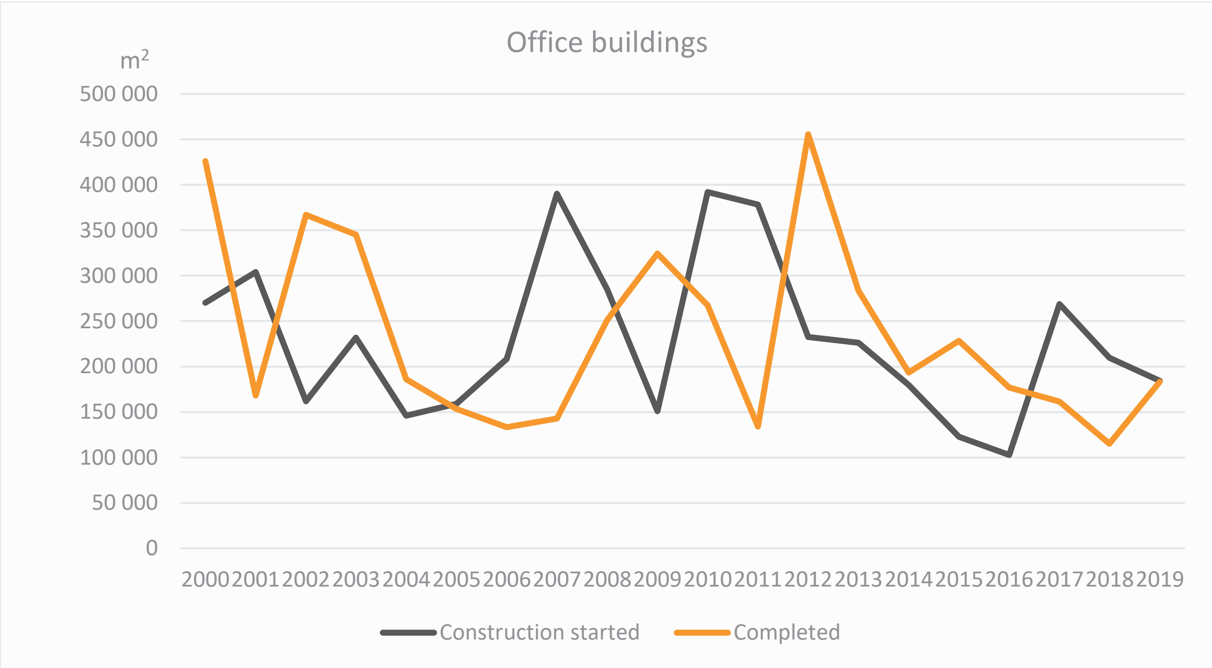


Figure 9 Project start-up and completion (Statistics Norway, bygningsarealstatistikken)

Based on the discussions on time period for design and construction, we regard a time-lag of two years for offices, retail and industry/ warehouses between code implementation and buildings built based on this code to be a robust and conservative assumption. Being more complex buildings, a time-lag of three years is assumed for hotel and restaurant buildings. The data available to the bank on completed construction, is of on no more precision than year.

3.1.2 Building statistics and building year dependent energy demand

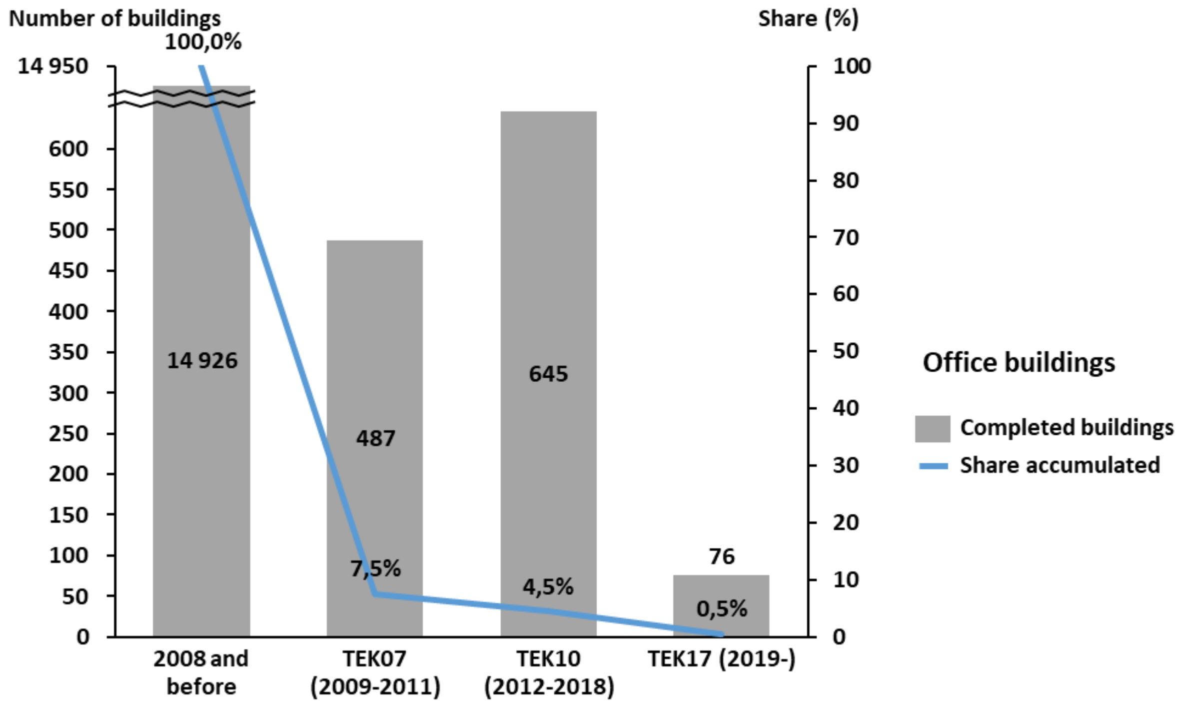


*Figure 10 Age and building code distribution of **office buildings** (Statistics Norway and Multiconsult)*

Figure 10 above shows how the Norwegian office building stock is distributed by age. The figure shows also how office buildings finished in 2012 and later (built according to TEK10 and TEK17) amount to 4.5% of the total stock. The three figures below include the same information for the other three subcategories.

The quality of the commercial building stock data is somewhat flawed, and projections for the future growth in the building stock is highly uncertain. However, assumed that the building stock grows by 1-2% every year, the TEK10 threshold will be valid until around 2028 for office and retail buildings, until around 2024 for hotel- and restaurant buildings, and until around 2023 for small industrial buildings and warehouses. In a few years, these thresholds must be adjusted to TEK17.

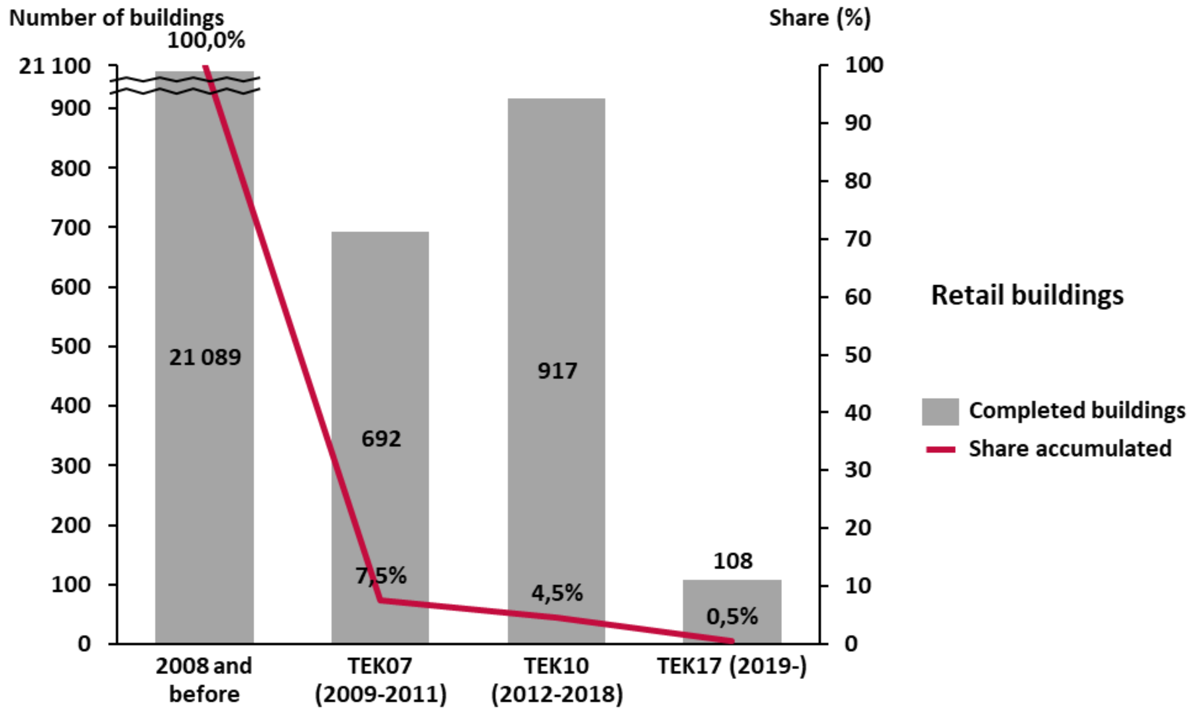


*Figure 11 Age and building code distribution of **commercial/retail buildings** (Statistics Norway and Multiconsult)*

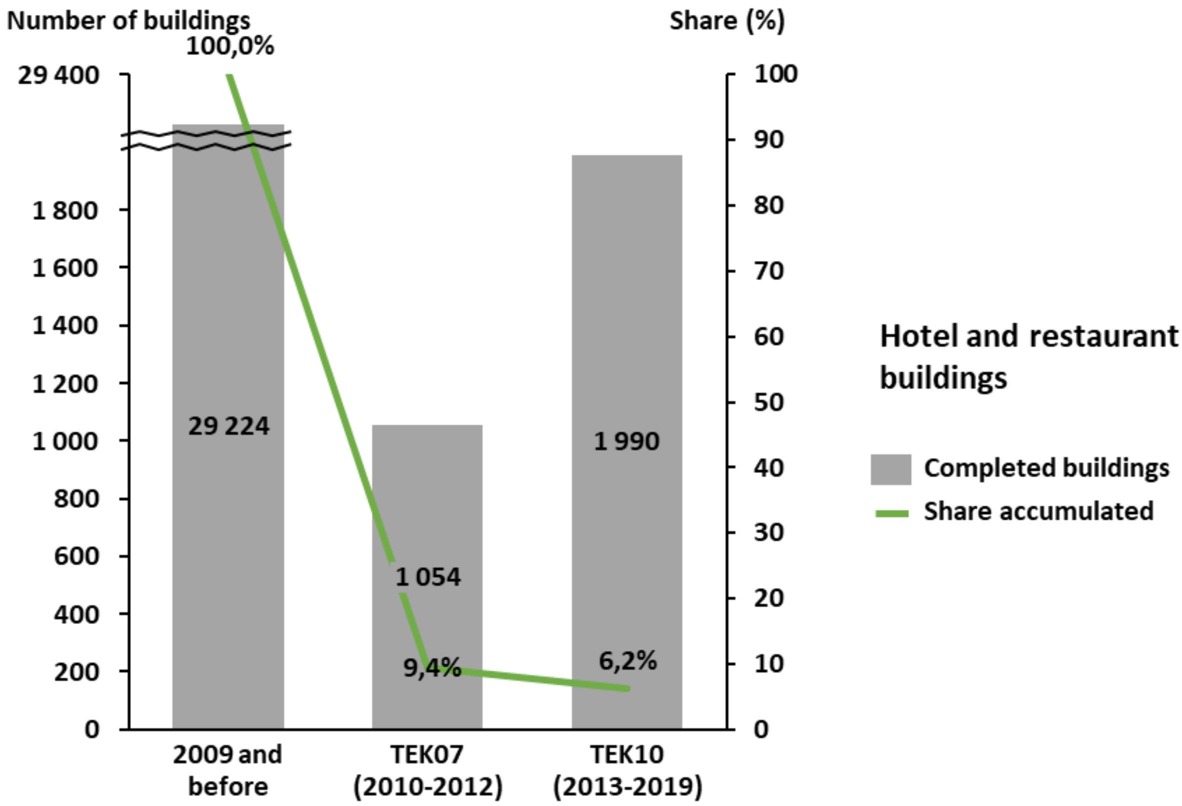


*Figure 12 Age and building code distribution of **hotel and restaurant buildings** (Statistics Norway and Multiconsult)*

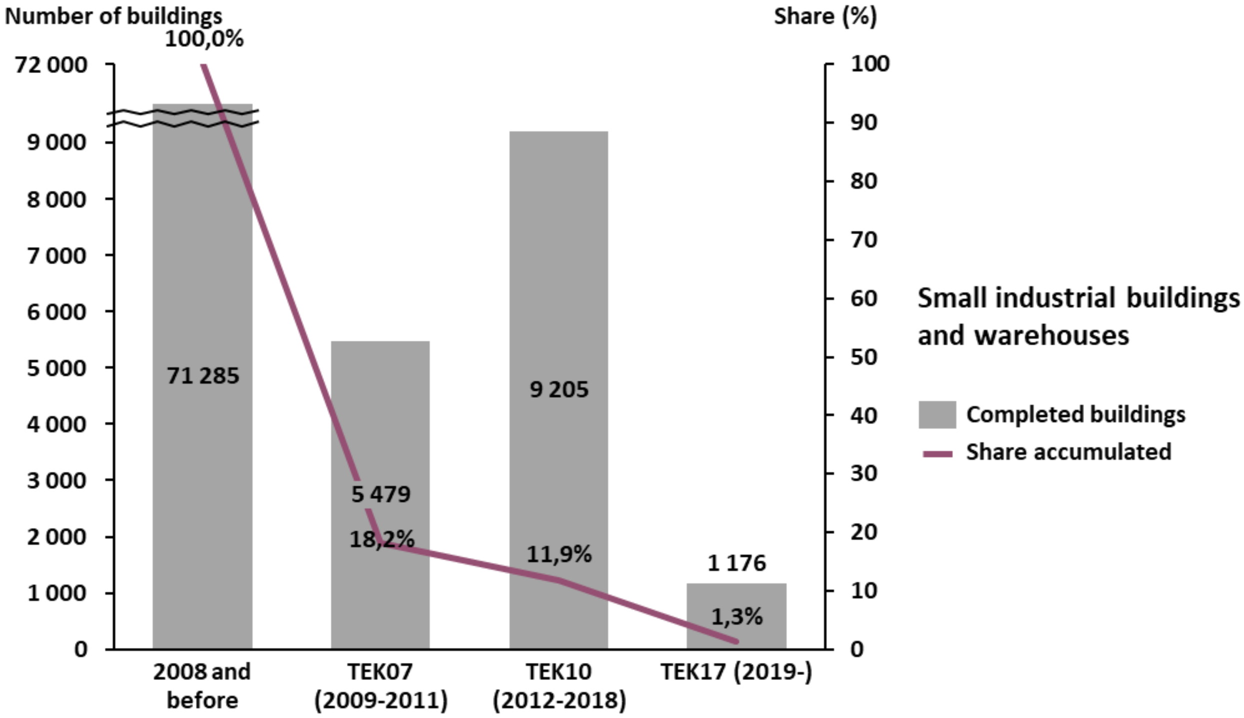


*Figure 13 Age and building code distribution of **small industrial buildings and warehouses** (Statistics Norway and Multiconsult)*

Figure 14 through Figure 17 below show how much, based on theoretical energy demand in the same building stock, the same share of the building stock make up in share of the energy demand in the same subcategories. The same picture is relevant for CO_2- emissions.

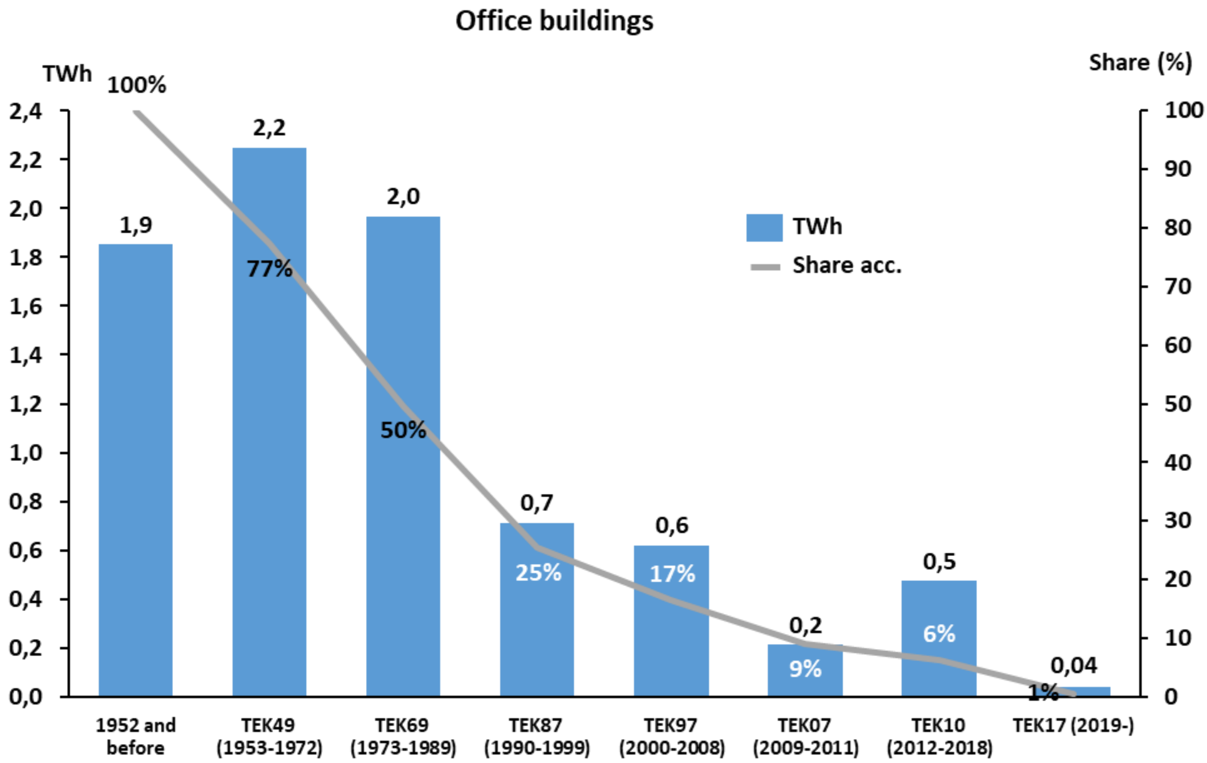


*Figure 14 Share energy demand related to **office buildings** depending on building year*

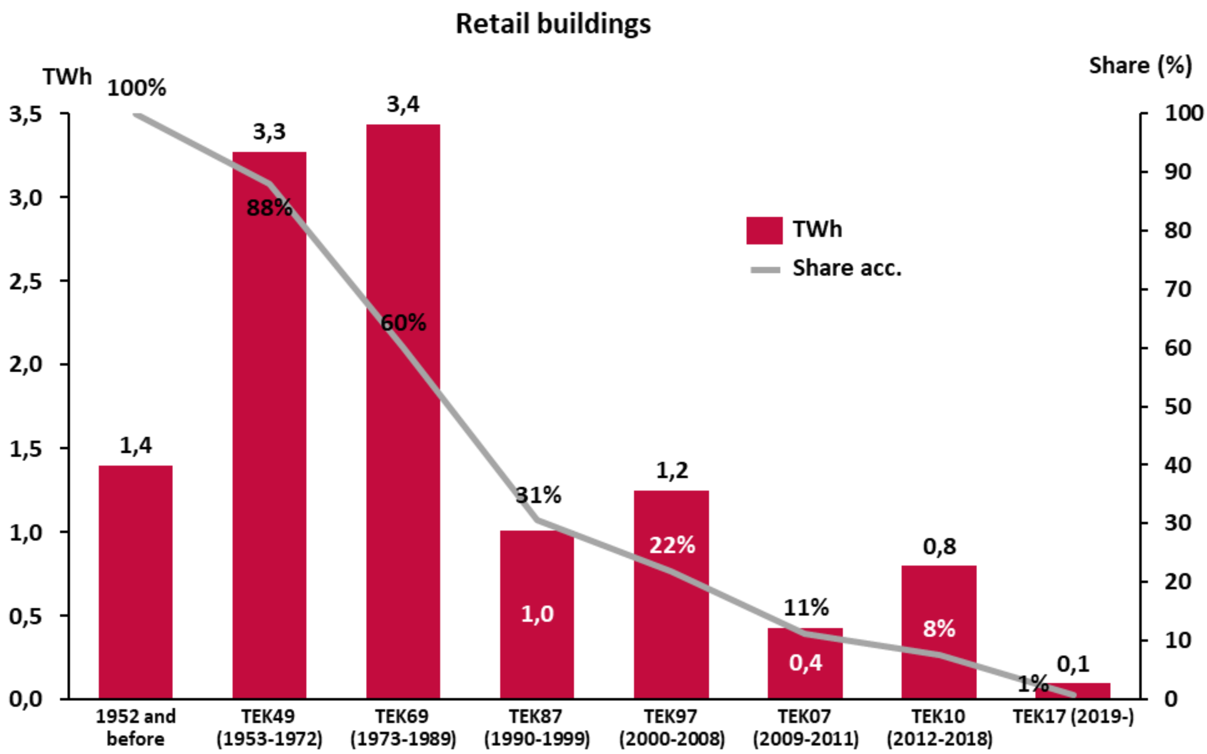


*Figure 15 Share energy demand related to **retail buildings** depending on building year*

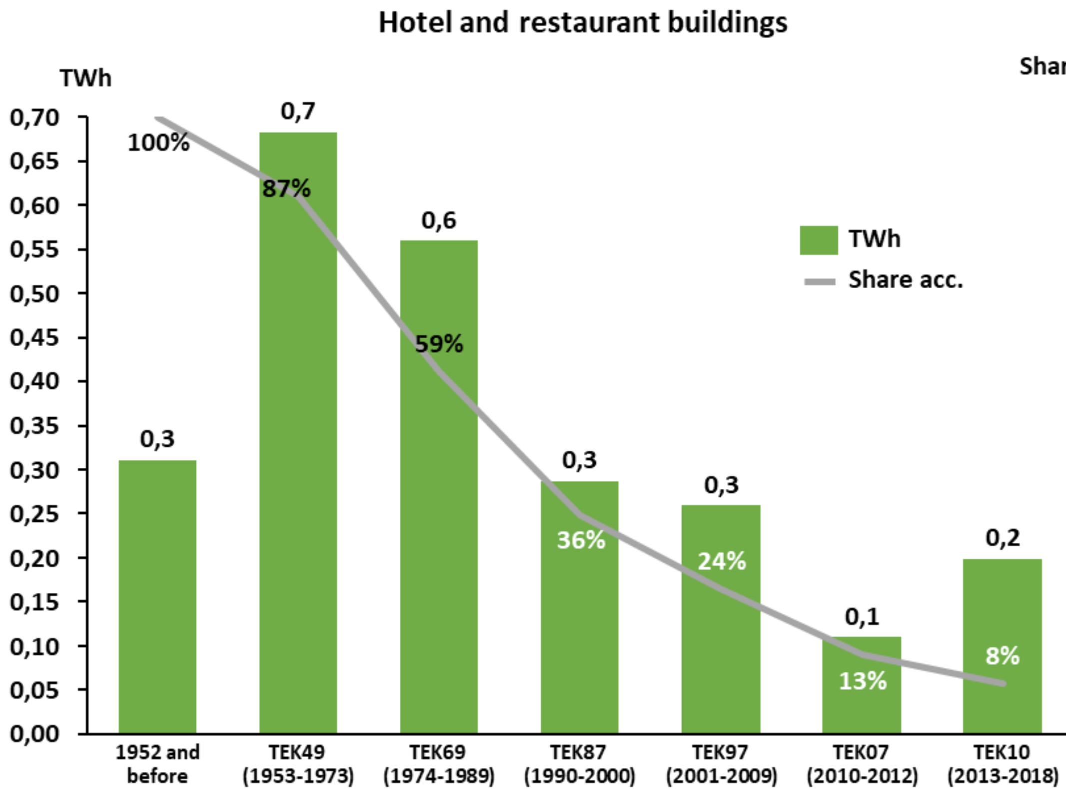


*Figure 16 Share energy demand related to **hotel and restaurant buildings** depending on building year*

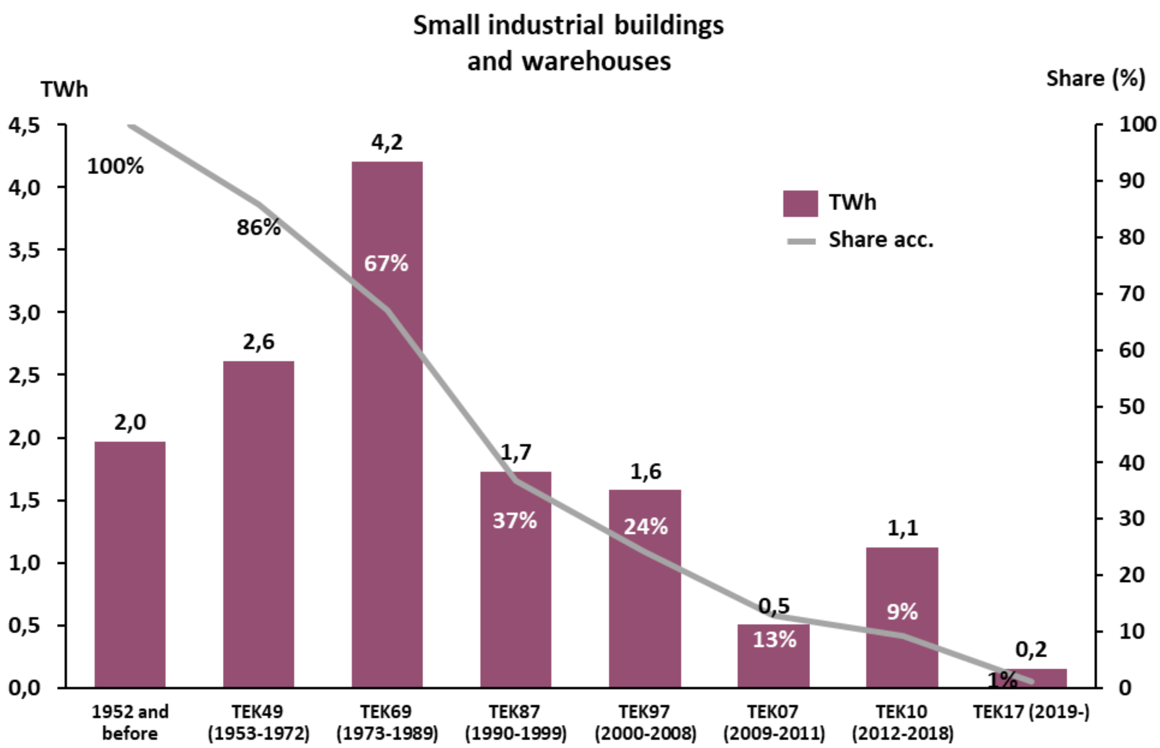


*Figure 17 Share energy demand related to **small industrial buildings and warehouses** depending on building year*

4 Sparebanken Sør Loan Portfolio - Energy demand and climate gas emissions

In this section the energy demand and related climate gas emissions of the total buildings portfolio are assessed. The energy requirements in the building code and building statistics forms the basis for these assessments. The assessments include only in-use energy demand and related emissions of climate gases, and not energy demand in the whole life cycle of the buildings. This excludes climate gas emissions related to construction, renovation, materials use, demolition and disposal.

4.1 CO_2- emission factor related to energy demand in buildings

The energy consumption of Norwegian buildings is predominantly electricity, with some influx of district heating and bioenergy. Statistics Norway made in 2013 a statistic on energy use in Norwegian households. The demand was covered by electricity (79%), fossil oil and gas (4%) and bioenergy etc. (16%). Already in 2007, the building code was in clear disfavour of fossil energy, and the use of fossil energy in buildings has declined since. From 2020, all use of fossil oil is banned from use in buildings. The fuel mix in Norwegian district heating production in 2019 included only 5% fossil fuels (oil and gas) (Fjernkontrollen[4]).

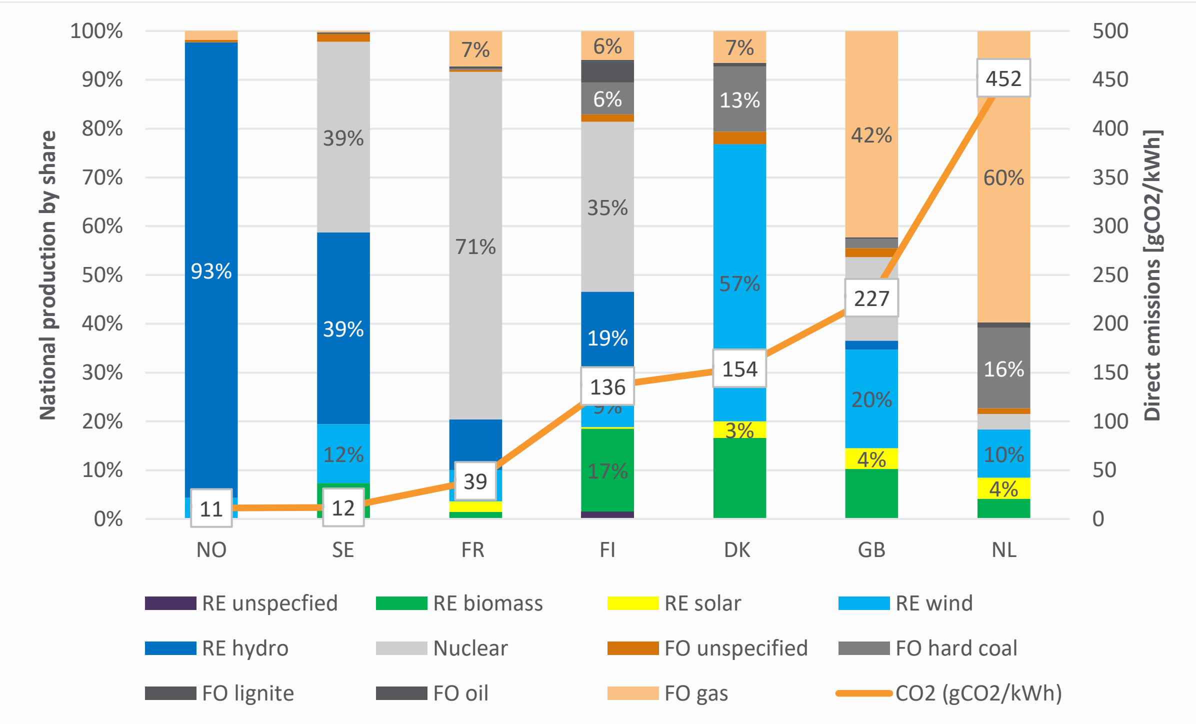


Figure 18 National electricity production mix in some relevant countries (European Residual Mixes 2019, Association of Issuing Bodies[5])

In 2019, the Norwegian power production was 98% renewable (NVE[6]). As shown in Figure 18, the Norwegian production mix in 2019 results in specific emissions of 11 gCO_2/kWh. The production mix is also included in the figure for other selected European states for illustration. Power is, however, 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

[4] http://fjernkontrollen.no/
[5] https://www.aib-net.org/facts/european-residual-mix
[6] https://www.nve.no/energy-supply/electricity-disclosure/?ref=mainmenu

analysis, the Norwegian Standard NS 3720:2018 “Method for greenhouse gas calculations for buildings” take into account international trade of electricity and the fact that consumption and grid factor not necessarily mirrors domestic production. The grid factor, as average in the lifetime of a building asset, is based on a trajectory from the current grid factor to a close to zero emission factor in 2050 and steady until the end of the lifetime. The Norwegian Standard calculates the average CO_2-factor for the next 60 years, a lifetime relevant for buildings, according to two scenarios as described in Table 2.

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

Table 2 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 this table. Using a European mix is in line with Nordic Public Sector Issuers: Position Paper on Green Bonds Impact Reporting (February 2020)[7].

Applying the grid factor based on EU27 + UK + Norway energy production mix, the resulting CO_2- factor for Norwegian residential buildings[8] is on average 124 gCO_2/kWh due to the influx of bioenergy and district heating in the energy mix. This factor is used in the following calculations.

4.2 Retail Market buildings portfolio- energy demand and climate gas emissions

4.2.1 Retail market portfolio information

The portfolio analysis is based on the cut-off date January 2021. The Sparebanken Sør retail market loan portfolio consist of 34,231 objects of which 33,959 are dwellings in small residential buildings and apartments. From the loan portfolio, holiday homes, building registered in the portfolio as second mortgages (no; tilleggssikkerhet) and shared debt in cooperative housing have been excluded from the analysis. These dwellings are excluded due to miscellaneous reasons; as no energy requirements in the building code (holiday homes), missing living area data (cooperative housing) and to avoid double counting as same assets may be included in other portfolios (second mortgages). Figure 19 shows how the remaining assets in the retail market portfolio are distributed by age, indicated by building code, taken into consideration the time lag from time of implementation of a code to most finished buildings adhere 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 area is assumed equal to the average from national statistics per subcategory.

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

[8] Multiconsult. Based on building code assignments for DiBK

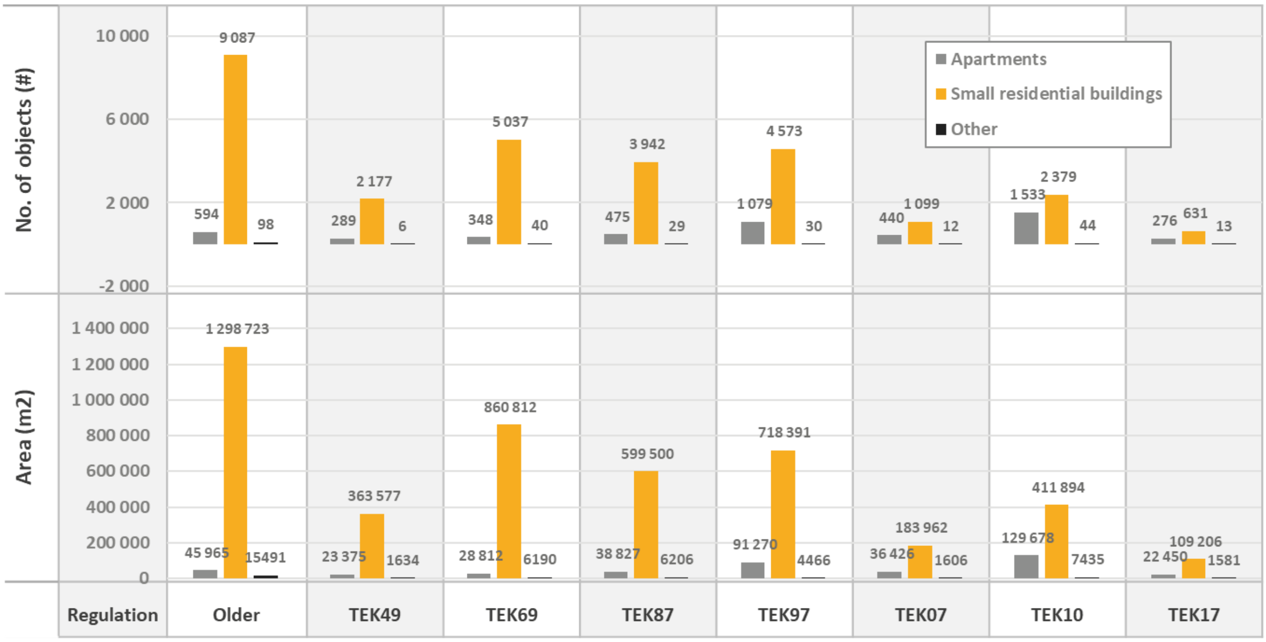


Figure 19 Sparebanken Sør retail market loan portfolio, January 2020 (Source: Sparebanken Sør, Multiconsult)

4.2.2 Calculated energy demand

Combining the age distribution of the living area in the portfolio with calculated energy demand in the building stock dependent on building code, we are able to 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 20 illustrates energy demand in the current portfolio applying information in Figure 2 and Figure 19.

The current portfolio, as of January 2021, include buildings that represents yearly energy demand of 1,222 GWh. Sparebanken Sør's engagement is 47% of the total property value, and only 549 GWh is calculated to be attributed to the bank's loan book.

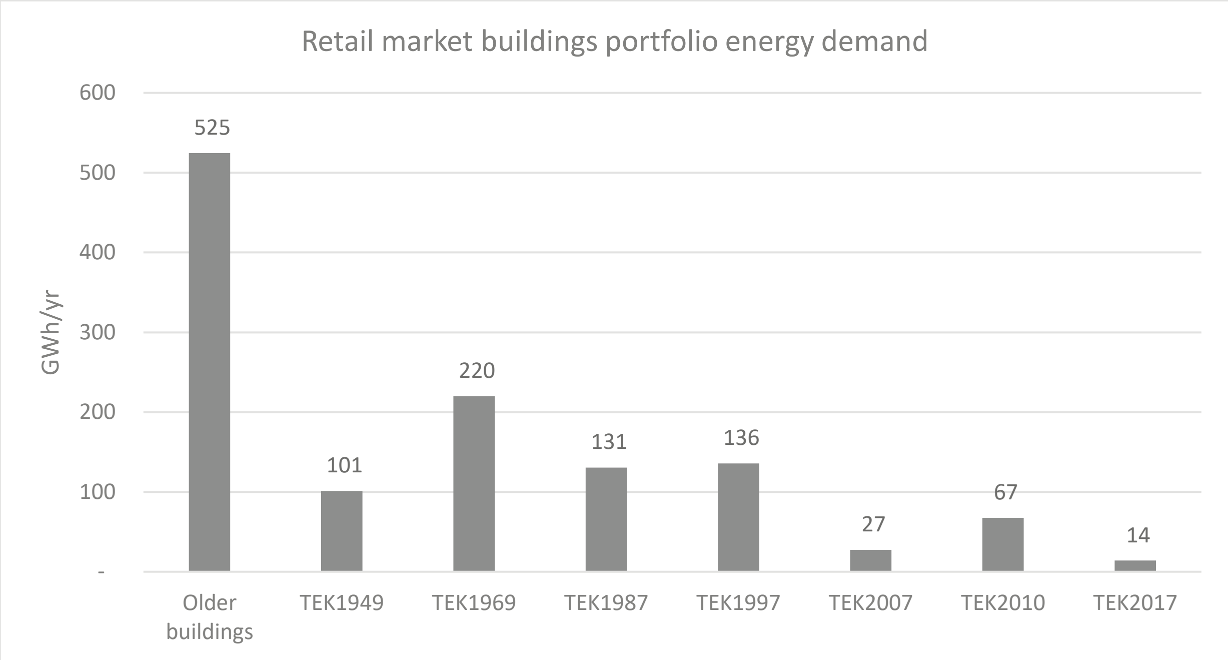


Figure 20 In-use energy demand distributed by age of buildings in the retail market portfolio. Figures are rounded (Source: Sparebanken Sør, Multiconsult)

4.2.3 Calculated CO_2-emissions related to in use energy demand

The CO_2-emissions resulting from in use energy demand in 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, various types of heat pumps, bio energy and district heating. Figure 21 illustrates the specific CO_2-emissions in the Norwegian residential building stock.

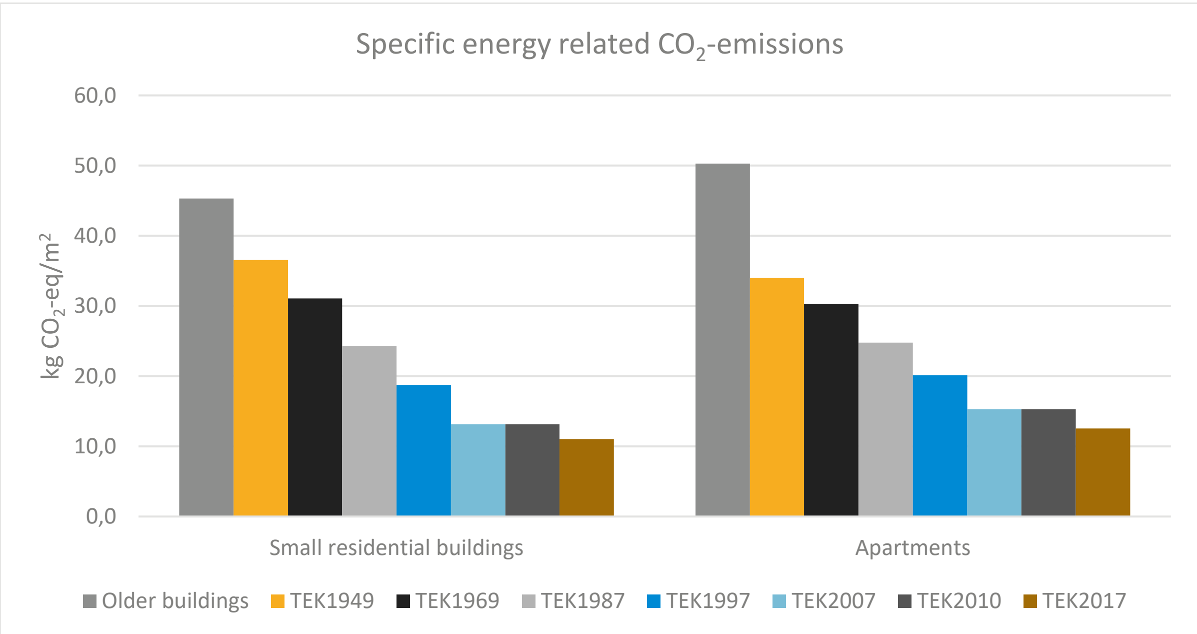


Figure 21 Total Norwegian residential building stock specific CO_2-emissions ($kgCO_2$-eq/m^2) dependent on building category and age of buildings (Source: Multiconsult, DiBK)

The calculated energy demand distributed by age of the buildings in the portfolio, depicted in Figure 20, and the estimated specific emissions in Figure 21, form basis to estimate the CO_2-emissions related to in-use energy demand in buildings in the total Sparebanken Sør retail market portfolio. Figure 22 illustrates the CO_2-emissions in the current portfolio.

The current portfolio, as of January 2021, include buildings that represent yearly emissions of 147,002 tons CO_2eq. Sparebanken Sør's engagement is 47% of the total property value, and only 66,017 tons CO_2eq is calculated to be attributed to the bank's loan book.

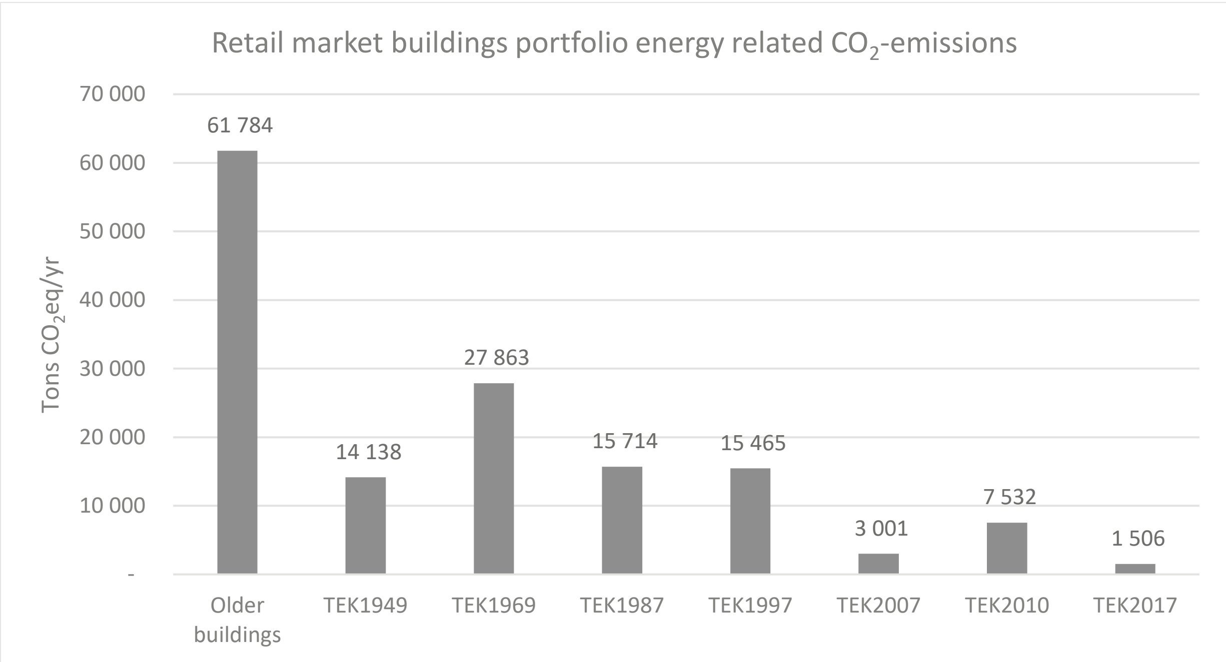


Figure 22 CO_2-emissions related to yearly in use energy demand distributed by age of building in retail market portfolio (Source: Sparebanken Sør, Multiconsult)

4.3 Corporate Market buildings portfolio- energy demand and climate gas emissions

4.3.1 Commercial buildings portfolio information

The portfolio analysis is based on the cut-off date January 2021. The commercial buildings Sparebanken Sør, from the business and private market portfolios combined, consist of 2035 offices, retail buildings and small industry and warehouses. The building category information is lacking accuracy, and some assumptions have been made to make a split in subcategories in this analysis. From the loan portfolio, buildings registered in the portfolio as second priority (no; tilleggssikkerhet) have been excluded from the analysis. These buildings are excluded to avoid double counting as same assets may be included in other portfolios. Figure 23 shows how the remaining assets in the portfolio is distributed by age, indicated by building code, taken into consideration the time lag from time of implementation of a code to most finished buildings adhere to the new code. For objects without building year information, the building is conservatively assumed to fall into the "older" category. For buildings without area information, the category median in the portfolio or size equal to a model building used in the building code development is assumed.

Loans in the business market portfolio are somewhat differently structured, also regarding security in the assets, and the loan-to-value ratio is not as easily applicable to scale the energy demand and related climate gas emissions to reflect the banks engagement. Several loans have security in several buildings without a direct relation between building and loan. The bank informs that it is free to draw on this security between the buildings at its own discretion, hence the calculation assumes the bank to draw on the youngest first and younger buildings are better represented in the calculations of energy and emissions where they are scaled by the bank's engagement.

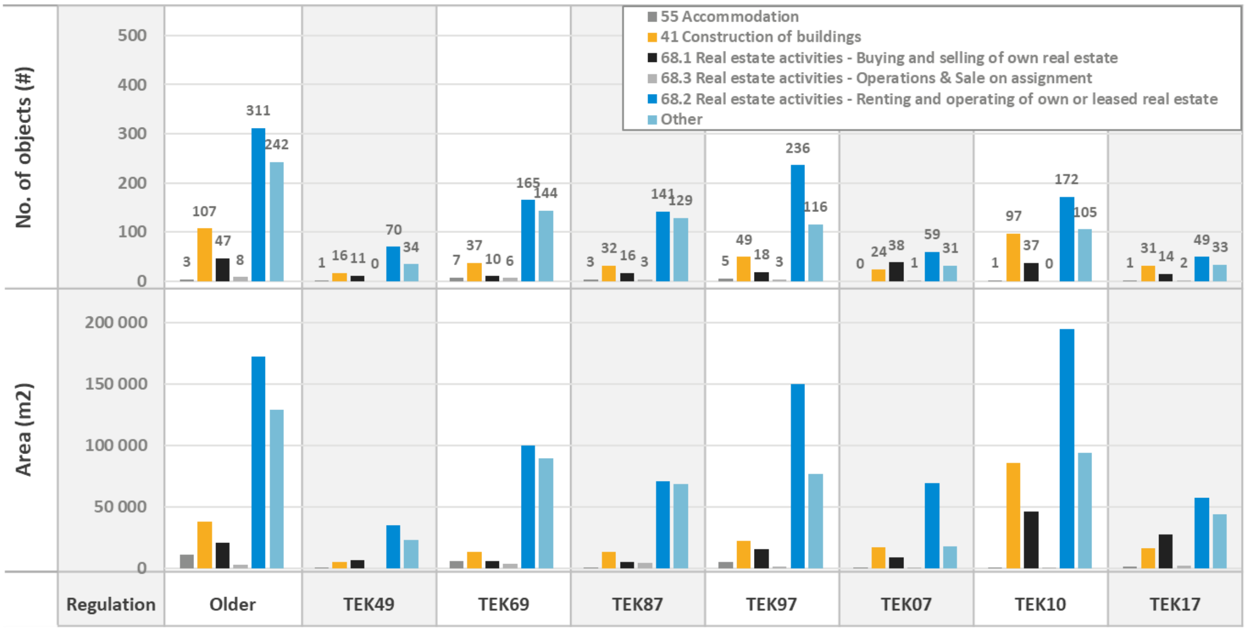


Figure 23 Sparebanken Sør commercial loan portfolio, January 2021 (Source: Sparebanken Sør, Multiconsult)

4.3.2 Calculated energy demand

Combining the age distribution of the living area in the portfolio with calculated energy demand in the building stock dependent on building code, we are able to 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 24 illustrates energy demand in the current portfolio applying information in Figure 23 and Figure 8.

The current portfolio, as of January 2021, include buildings that represents yearly energy demand of 425 GWh. Sparebanken Sør's engagement is 36% of the total property value, and only 101 GWh is calculated to be attributed to the bank's loan book.

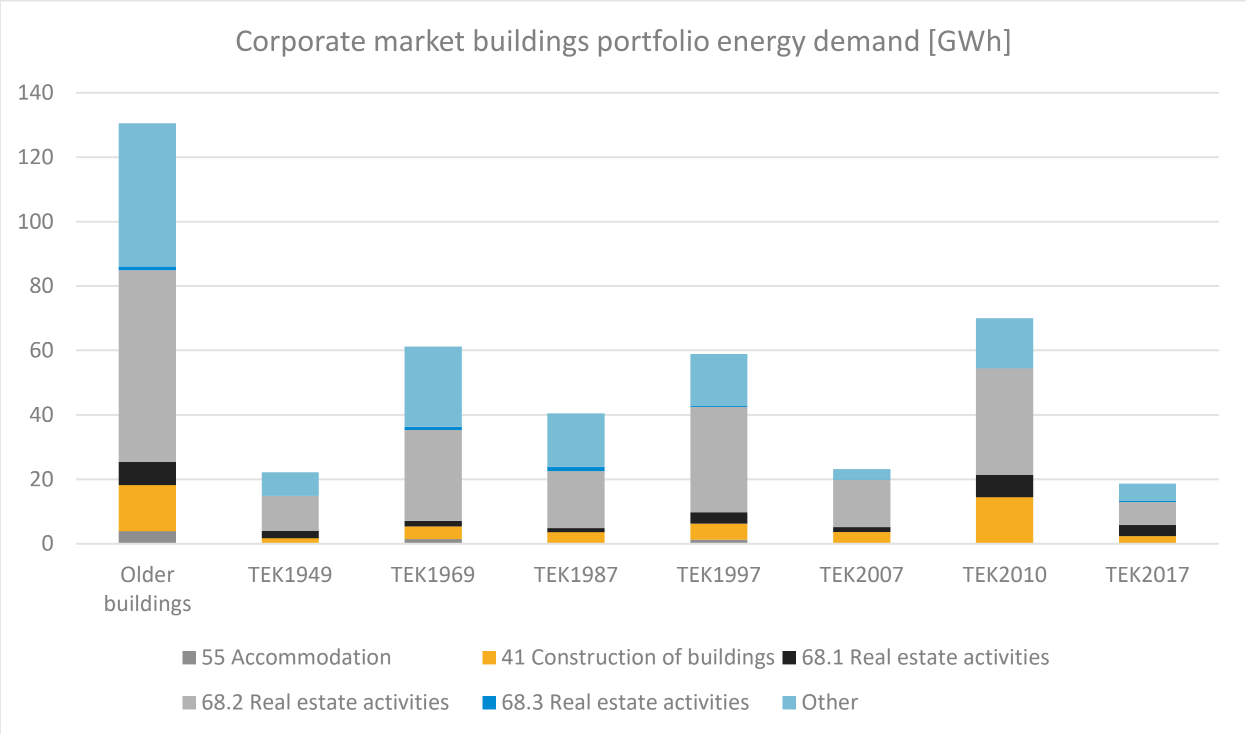


Figure 24 In-use energy demand distributed by age of buildings in the corporate market portfolio (Source: Sparebanken Sør, Multiconsult).

4.3.3 *Calculated CO_2-emissions related to in use energy demand*

The CO_2-emissions resulting from in use energy demand in 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, various types of heat pumps, bio energy and district heating.

To calculate the impact on climate gas emissions the trajectory is applied to all electricity consumption in all buildings. Electricity is the dominant energy carrier to Norwegian buildings, but the energy mix includes also bio energy and district heating, resulting in a total specific emission factor of 124 gCO_2eq/kWh. A proportional relationship is expected between energy consumption and emissions.

The calculated energy demand distributed by age of the buildings in the portfolio, depicted in Figure 24, and the lifetime average specific emission factor, give basis to estimate the CO_2-emissions the total Sparebanken Sør commercial buildings portfolio. Figure 25 illustrates the CO_2-emissions in the current portfolio.

The current portfolio, as of January 2021, include buildings that represent yearly emissions of 52,627 tons CO_2eq. Sparebanken Sør's engagement is 36% of the total property value, and only 12,477 tons CO_2eq is calculated to be attributed to the bank's loan book.

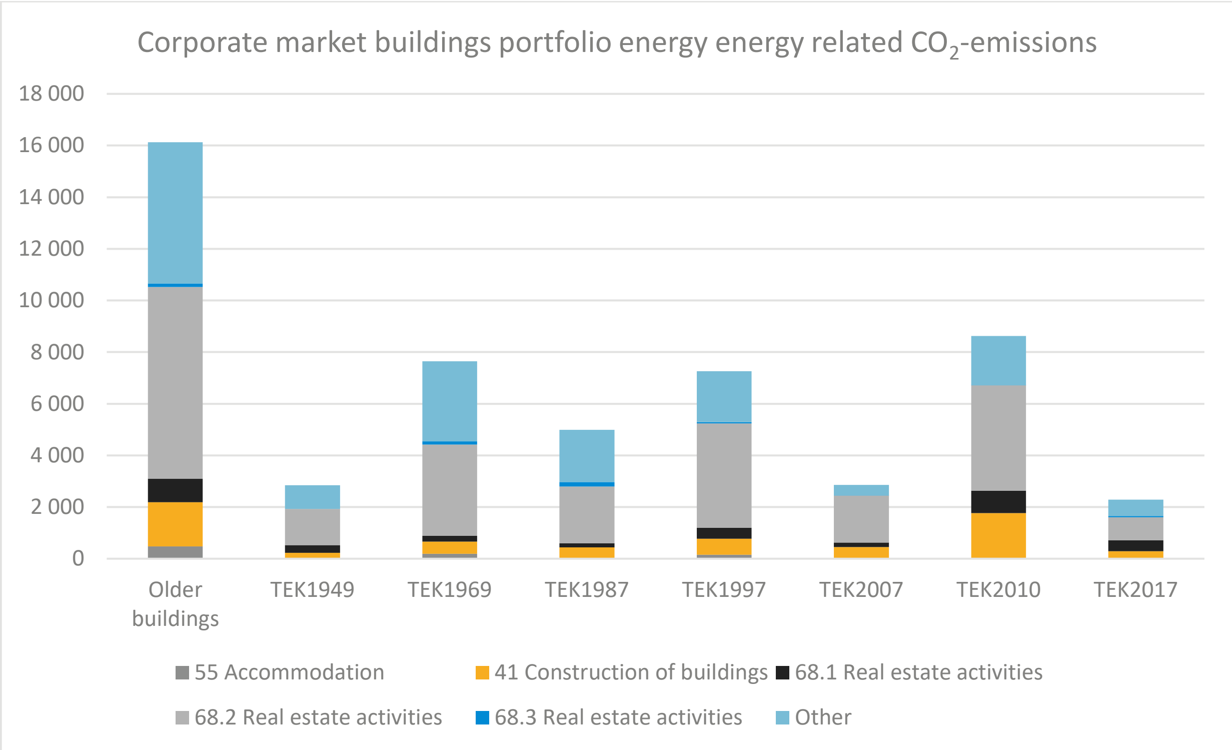


Figure 25 CO_2-emissions related to yearly in use energy demand distributed by age of building in the corporate market portfolio (Source: Sparebanken Sør, Multiconsult)

Table 3 illustrate the CO_2-emissions resulting from in use energy demand in buildings in Sparebanken Sør's Corporate Market portfolio split in business activities of the customers using NACE-code[9].

Economic activity of client	Total for all buildings in portfolio [Tons CO_2]	Scaled by engagement [Tons CO_2]
55 Accommodation	916	36
41 Construction of buildings	5 873	1 607
68.1 Real estate activities	3 481	1 059
68.2 Real estate activities	25 417	6 900
68.3 Real estate activities	534	144
Other	16 406	2 731
Total	**52 627**	**12 477**

Table 3 Climate gas emissions related to buildings in the corporate market portfolio

[9] Nomenclature of Economic Activities (NACE) is the European statistical classification of economic activities. NACE groups organizations according to their business activities.

5 Green bond eligible buildings

5.1 Energy efficient Residential buildings

The Sparebanken Sør eligibility criteria for residential buildings are divided in three, one based on building code, one based on Energy Performance Certifications (EPC), and at last an upgrade criterion.

5.1.1 Building code criterion

Eligibility in this impact assessment for residential buildings in the Sparebanken Sør portfolio is only identified against a building code criterion as formulated below. This criterion is in line with the equivalent CBI's proxy criterion for Norwegian residential buildings.

i. New or existing Norwegian apartments that comply with the Norwegian building codes of 2010 (TEK10) or 2017 (TEK17). Hence, finished in 2012 and later.

ii. New or existing Norwegian other residential dwellings that comply with the Norwegian building codes of 2007 (TEK07), 2010 (TEK10) or 2017 (TEK17). Hence, finished in 2009 and later.

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 256 kWh/m^2. Building code TEK07 (small residential buildings), TEK10 and TEK17 gives an average specific energy demand for existing houses and apartments, weighted for actual stock, of 120 kWh/m^2.

Hence, compared to the average residential building stock;

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

5.1.2 EPC criterion

Existing Norwegian residential buildings built using older building codes than TEK10 for apartments and TEK07 for other residential dwellings with EPC-labels A, B and C.

As only half of all dwellings have a registered EPC, the available data have been extrapolated assuming the registered dwellings are representative for their age group regarding energy label. Then the EPC data indicates that 14% of the current residential buildings in Norway will have a C or better. The average energy performance of a dwelling, according to the EPC system, relates to an energy label E.

The system boundary in the Norwegian EPC system differs from the one used in the building code (EPC uses delivered energy and not gross energy demand). For impact assessments the building code baseline is hence based on the EPC statistics where the average dwelling gets an E. For buildings qualifying according to this criterion, the improved energy efficiency is calculated by factors presented in the table below. All energy labels cover a span and in these calculations the average values are assumed for all dwellings, except for dwellings with energy label A, where the limit value is expected as a conservative approach.

	Apartments	Small residential buildings
Difference between average efficiency to energy label A	93 kWh/m^2	121 kWh/m^2
Difference between average efficiency to energy label B	85 kWh/m^2	106 kWh/m^2
Difference between average efficiency to energy label C	66 kWh/m^2	76 kWh/m^2

Table 4 Difference in energy efficiency between qualifying dwellings and the national average

5.1.3 Refurbishment criterion

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

Refurbished buildings with an improved energy efficiency of at least 30 % or more are eligible for Green Bonds.

As the tables below illustrate, when under this criterion only qualifying buildings with energy label D, the calculated improved efficiency depends on age of the building and building category.

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

Table 5 Eligible small residential buildings

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

Table 6 Eligible apartments

5.2 Energy efficient Commercial buildings

The Sparebanken Sør eligibility criteria for commercial buildings are divided in three, one based on building code, one based on certifications as BREEAM, and at last an upgrade criterion.

5.2.1 Building code criterion

New or existing commercial buildings belonging in the top 15% low carbon buildings in Norway:

Multiconsult has studied sections of the Norwegian commercial building stock and identified solid eligibility criteria for Green Bonds on energy efficient commercial buildings in specific subcategories. Unique criteria have been established for the four subcategories: office buildings, retail, hotel and restaurant buildings and industry/warehouses. The criteria identify no more than the top 15% most energy efficient commercial buildings countrywide based on building code. Eligible Commercial Green Buildings must comply to the following eligibility criteria based on building code:

New or existing Norwegian hotel and restaurant buildings that comply with the Norwegian building code of 2007 (TEK07) or later codes: 9.4 %

New or existing Norwegian office buildings that comply with the Norwegian building code of 2007 (TEK07) or later codes: 7.5 %

New or existing Norwegian retail/commercial buildings that comply with the Norwegian building code of 2007 (TEK07) or later codes: 7.5 %

New or existing Norwegian small industrial buildings and warehouses that comply with the Norwegian building code of 2010 (TEK10) or later codes: 11.9 %

For office buildings, retail buildings, industrial buildings and warehouses a two-year lag between implementation of a new building code and the buildings built under that code must be considered. Hence all buildings finished in 2009/2012 or later qualify. For Hotel and restaurant buildings the equivalent lag is set at three-year due to more complex buildings. Hence all buildings finished in 2010 or later qualify.

Over the last several decades, the changes in the building code have pushed for more energy efficient commercial buildings. Combining the information on the calculated specific energy demand related to building code and information on the commercial building stock, the calculated average specific energy demand on the part of the Norwegian building stock examined is presented in the table below. The table also presents the average specific energy demand for the younger and qualifying part of the building stock and the relative reduction in energy demand.

	Total stock average [kWh/m^2]	Qualifying building years average [kWh/m^2]	Reduction [kWh/m^2]
Office buildings	251	147	42 %
Retail/commercial buildings	323	206	36 %
Hotel buildings	309	184	41 %
Small industry and warehouses	297	169	43 %

Table 7 Average specific energy demand for the building stock; whole stock, part eligible according to criteria and reduction

A reduction of energy demand from the building stock average to the average for eligible building codes is multiplied to the emission factor and area of eligible assets to calculate impact.

5.2.2 *Certification criteria: BREEAM, LEED and Nordic Swan Ecolabel*

New, existing or refurbished commercial buildings which received at least one or more of the following classifications:

i. LEED "Gold", BREEAM or BREEAM-NOR "Excellent", or equivalent or higher level of certification
ii. Nordic Swan Ecolabel

This criterion has not been used to identify eligible buildings in the portfolio.

5.2.3 *Refurbishment criterion*

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

i. Refurbished Norwegian commercial buildings with at least two steps of improvement in energy label compared to the calculated label based on building code in the year of construction
ii. Refurbished Norwegian commercial buildings with at least a 30% improvement in calculated energy efficiency, kWh/m^2 delivered energy to the building, compared to the calculated energy efficiency based on building code in the year of construction.

This criterion has not been used to identify eligible buildings in the portfolio.

Improved energy efficiency of at least 30% is aligned with the CBI taxonomy, where buildings qualify after being refurbished to a standard resulting in a minimum of 30% reduction in energy demand[10]. In this case, we are looking to identify buildings that already have improved energy performance in this scale. To identify relevant buildings, the EPC database is a suited source of data. In addition to only including a small percentage of the total commercial building stock, the database only includes current certificates and does not include historic certificates for the buildings. The historic EPC-labels may, however, be made available at a later stage, so two approaches are included in this criterion;

- one solely based on the EPCs, current and historic, and
- one approach based on the current certificate compared to calculated energy demand for different building code (TEK) periods (shown in Figure 8).

Table 8 below includes limit values for qualifying to the different energy grades in the EPC system[11] that make up the basis for the following calculations. It is important to note that these values are calculated with a different system boundary than the building code requirements.

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

Table 8 Limit values in specific energy demand for energy grades in the EPC system (Source: energimerking.no)

[10] https://www.climatebonds.net/standard/buildings/upgrade
[11] https://www.energimerking.no/no/energimerking-bygg/om-energimerkesystemet-og-regelverket/karakterskalaen/

Table 9 below presents calculated reduction in energy demand for an improvement of two steps on the energy grade scale in the Norwegian EPC system. To be able to include buildings originally only qualifying for a G, the values are calculated based on average values, and the average G-label building is assumed to have a specific energy demand as far off from the limit value for F as the average F is from the limit value for E ($G_{av}=F_{lim}+(F_{lim}-E_{lim})/2$).

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

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

Table 9 Improvement in specific energy demand from a two-step improvement in energy grade in EPC system calculated for average values

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6 Impact assessment - buildings qualifying according to eligibility criteria

To calculate the impact on climate gas emissions the trajectory is applied to all electricity consumption in all buildings. This in line with the approach used in previous sections. Electricity is the dominant energy carrier to Norwegian buildings, but the energy mix also includes bio energy and district heating, resulting in a total specific emission factor of 124 gCO_2eq/kWh. A proportional relationship is expected between energy consumption and emissions.

6.1 Impact assessment - Energy efficient buildings in Retail Market

The eligible buildings in Sparebanken Sør's retail market portfolio is estimated to amount to about 900,000 square meters. The available data include reliable area for most objects. For object where this data is not available, the area per dwelling is calculated on the basis of average area derived from national statistics (Statistics Norway[12]). There are, in addition, some object that qualify according to the rehabilitation criterion not included in this table.

Criterion	Type of dwelling	Number of objects	Area total [m^2]
Criterion 1 (Building code)	Residential buildings	5,918	857,190
	Other	57	9,016
Criterion 2 (EPC)	Residential buildings	211	30,682
Criterion 3 (Rehabilitation)	Residential buildings	43	3,181
Sum		**6,229**	**900,069**

Table 10 Eligible objects and calculated building areas

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

Energy efficiency of this part of the portfolio is estimated based on calculated energy demand dependent on building code.

Error! Reference source not found. indicates how much more energy efficient the eligible part of the portfolio is compared to the average Norwegian building stock. It also presents how much the calculated reduction in energy demand constitutes in CO_2-emissions. The impact is in addition scaled by the bank's engagement calculated by loan share of building value.

The area residential building identified as qualifying according to the residential criteria in this analysis, accounts for 99% of the qualifying residential area in the latest green portfolio analysis of late 2020.

	Area [m^2]	Reduced energy compared to baseline [GWh/yr]	Reduced CO_2-emissions compared to baseline [tons CO_2/yr]
Buildings eligible under the building code criterion- Residential buildings	857,190	114	14,146
Buildings eligible under the building code criterion- Other	9,016	1	148
Buildings eligible under the EPC criterion	30,682	2	259
Buildings eligible under the rehabilitation criterion	3,181	0.2	27
Eligible buildings in portfolio- total	**900,069**	**118**	**14,581**
Impact scaled by bank's engagement		**71**	**8,749**

Table 11 Performance of eligible objects in the portfolio compared to average building stock

6.2 Impact assessment - Energy efficient buildings in Corporate Market

The 542 eligible buildings in Sparebanken Sør's corporate market portfolio is estimated to amount to 678,176 square meters. Specific data on assets including area and building category has been retrieved from public sources. The category information lacks detail, and some assumptions have had to be made. Table 12 indicates the number of objects (counted once and placed in the dominant building category for each building) and the area of each building category making basis for the following impact assessments.

	Number of units	Area qualifying buildings in portfolio [m^2]
Commercial buildings	502	601,658
Residential buildings	157	55,617
Small industry and warehouses	32	20,901
Sum	691	678,176

Table 12 Eligible objects and calculated building areas

Table 13 indicates how much more energy efficient the eligible part of the portfolio is compared to the average Norwegian building stock. It also presents how much the calculated reduction in energy demand constitutes in CO_2-emissions.

	Area	Reduced energy compared to baseline	Reduced CO_2-emissions compared to baseline
Buildings eligible under the building code criterion	678,176 m^2	**76 GWh/year**	**9,385 tons CO_2/year**
Impact scaled by bank's engagement		**25 GWh/year**	**3,118 tons CO_2/year**

Table 13 Performance of eligible objects compared to average building stock