REPORT

DNB Green Covered Bond

CLIENT

DNB Bank ASA

SUBJECT

Green residential buildings

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Multiconsult

REPORT

PROJECT	**DNB Green Covered Bond**	DOCUMENT CODE	10204816-TVF-RAP-001
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1 Introduction

Assignment

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

Energy

Apart from this criterion, we also want to stress that residential buildings in Norway are heated mostly with renewable energy. The energy consumption of Norwegian residential buildings is predominantly electricity, with some district heating and bioenergy. The share of fossil fuel is very low and falling.

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 residential buildings has declined since. In 2020, all use of fossil oil is banned from use in residential buildings. The fuel mix in Norwegian district heating production in 2016 included only 5.4 % from fossil fuels (oil and gas) (Fjernkontrollen[1]). In 2016, the Norwegian power production was 98 % renewable (NVE[2]).

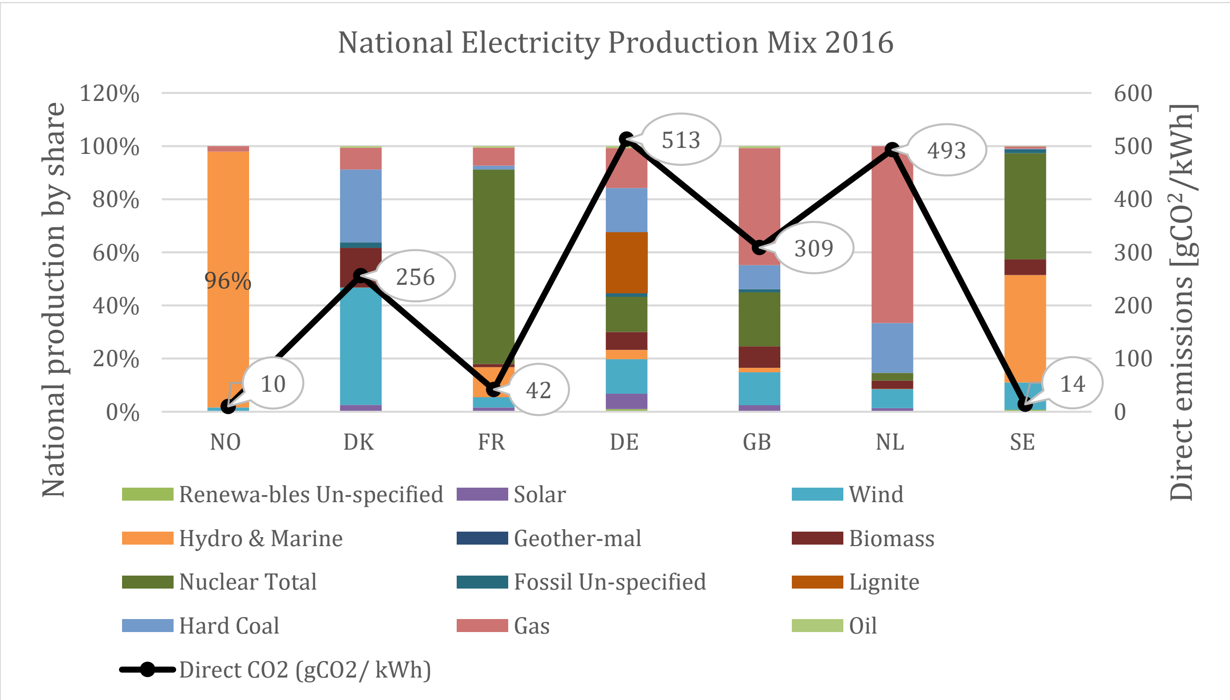


Figure 1 National electricity production mix in some relevant countries (European Residual Mixes 2016, Association of Issuing Bodies[3])

[1] http://fjernkontrollen.no/
[2] https://www.nve.no/reguleringsmyndigheten-for-energi-rme-marked-og-monopol/varedeklarasjon/nasjonal-varedeklarasjon-2016/
[3] https://www.aib-net.org/documents/103816/176792/AIB_2016_Residual_Mix_Results.pdf/6b49295b-ad99-a189-579e-877449778f62

As shown in figure 1, the Norwegian production mix gives resulting emissions of 10 gCO_2/kWh. However, taking into account the international trade, the consumption is not necessary equal to production. The environmental classification system for buildings, BREEAM, uses in its Norwegian version an emission factor of 132 g CO_2/kWh. Using BREEAM factors and the energy mix in Norwegian residential buildings[4], the resulting CO_2- factor is on average 126 g CO_2/kWh.

2 Loan Portfolio Analysis DNB

The Green loan portfolio of DNB will consist of residential buildings that meet the criterion as formulated below.

2.1 Eligible buildings

Multiconsult has investigated a sample of DNB's portfolio and can confirm that the reviewed residential buildings have been identified as eligible for green bonds according to DNB's eligibility criterion.

2.2 Availability of data to identify other eligible buildings

Energy performance data for residential buildings are not easily available for lenders or investors. The Energy Performance Certificate (EPC), a possible source of data, is at the present not publically available.

National regulations (Energimerkeforskriften §20) specify that data from the register shall be available for science and statistical purposes. But personal ID-numbers, organization numbers or individual buildings shall not be possible to identify. It is still, as of today, possible to look up the EPC of a specific address individually on the EPC homepage energimerking.no. However, this is done manually address by address. It is not possible for the bank to link a portfolio of addresses or individual dwellings to energy certificates automatically, based on publically available data.

Enova, entity owned by the Norwegian Ministry of Petroleum and Energy responsible for the EPC system, aims to make the register publically available and accessible, and several banks and other financial interests have already initiated this for the Ministry. However, an amendment of today's regulations will be necessary. Therefore, the publication of the database is uncertain and will probably prolong, depending on other considered changes in the regulation.

When permission is granted to access and utilise the full database, it will be possible to link the individual residences to the register, and give the energy certificate results for individual dwellings, based on some key information:

- Address- street and number, postal code
- Apartment number (if applicable)
- Building identifiers GNR (Gårdsnummer) and BNR– (Bruksnummer)

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

3 Eligibility criteria

Multiconsult has studied the Norwegian residential building stock and identified three solid eligibility criteria for Green Bonds on energy efficient buildings. The criteria have been adjusted in coordination with the Climate Bonds Initiative (CBI) and will be published as a CBI baseline for Norwegian residential buildings. The criteria that derive the baseline are similar to the CBI methodology already used in similar markets. Criteria 1 identifies the top 8 % most energy efficient residential buildings countrywide. The CBI baseline methodology also includes criteria using data from Energy Performance Certificates when available and according to CBI taxonomy, residential buildings may also qualify after being refurbished to a standard resulting in more than a 30 % reduction in energy demand. Criteria 2 and 3 are not included in DNB's Green Covered Bond Framework for the time being.

Eligible Residential Green Buildings for DNB must meet the following eligibility criterion:

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 % of the residential building stock. A two year lag between implementation of a new building code and the buildings built under that code must be taken into account in most cases[5].

3.1 New or existing Norwegian residential buildings that comply with the Norwegian building code of 2010 (TEK10) or later codes: 7 %

Changes in the Norwegian building code have consistently over several decades resulted in more energy efficient buildings. As of 2017, 7 % of Norwegian residential buildings are eligible according to the DNB criterion; residential buildings built according to TEK10 and TEK17 are eligible for Green Bonds as they are within the top 7 % most energy efficient buildings in the country.

The methodology is based on Climate Bonds Initiative (CBI) taxonomy, where the top 15 % most energy efficient buildings are considered eligible. The CBI baseline methodology for energy efficient residential buildings for Norwegian conditions are to be published in spring 2018 and are in line with DNB's criterion, but do also include houses, not apartments, built under the code of 2007 (TEK07).

[5] TEK10 was implemented in July 2010, however since the energy requirements were unchanged from TEK07 to TEK10 it is a very robust assumption that all buildings finished in 2012 or later have used energy requirements according to TEK10.

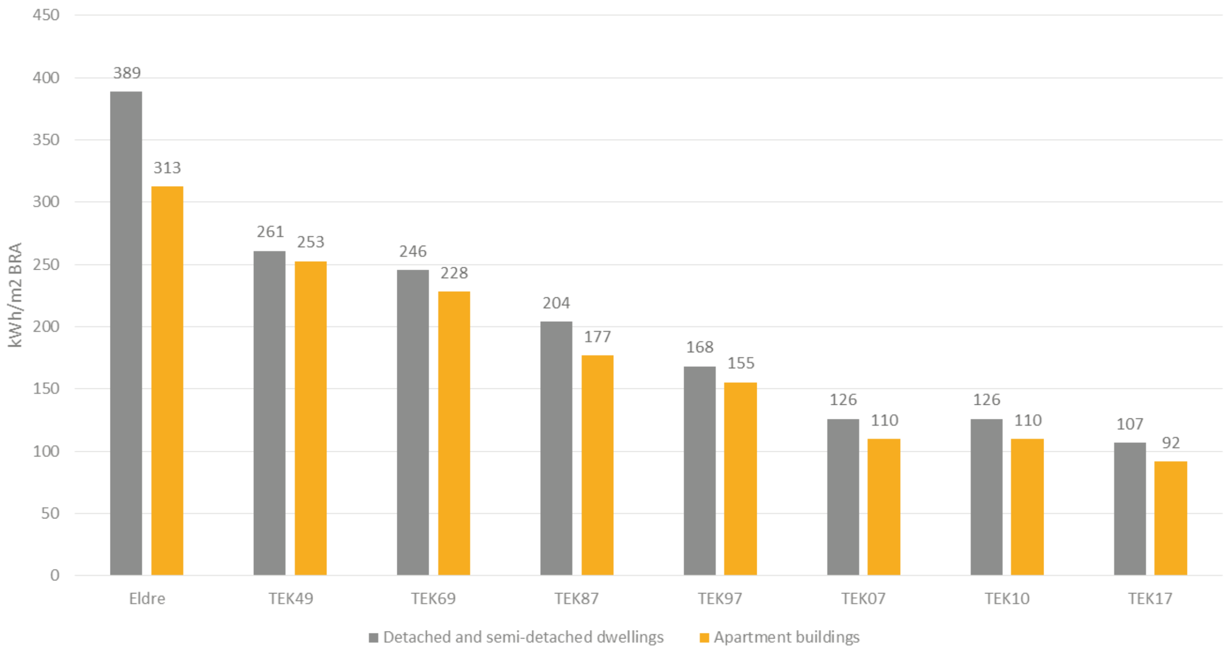


Figure 2 Development in calculated specific net energy demand based on building code and building tradition, (Multiconsult, simulated in SIMIEN)

Net energy demand is calculated for model buildings used for defining the building code (TEK7/TEK10/TEK17). The result presented in figure 2 illustrates how the calculated energy demand declines with decreasing age of the buildings. From TEK07 to TEK17 the reduction is about 15 % and the former shift from TEK97 to TEK07 was no less than 25 %. Note that, for dwellings, there was no change between TEK07 and TEK10 with respect to energy efficiency.

The figure gives theoretical values for representative models of an apartment and a detached and semi-detached residential dwelling, calculated in the computer programme SIMIEN and in accordance to Norwegian Standard NS 3031:2014 *Calculation of energy performance of buildings. Method and data*, and not based on measured energy use. In addition to the guiding assumption in Norwegian Standard NS3031:2014, experience with building tradition is included. For older buildings the calculated values tend to be higher than the actual measured use, mostly because the ventilation air flow volume is assumed as high as in newer buildings, but no heat recovery. Indoor air quality is assumed not to be dependent on building year. This is the same methodology as used in the EPC-system.

Building code	**Specific energy demand apartment buildings (model homes)**	**Specific energy demand other dwellings (model homes)**
TEK 10	110 kWh/m^2	126 kWh/m^2
TEK 17	92 kWh/m^2	107 kWh/m^2

Table 1 Specific energy demand calculated for model buildings

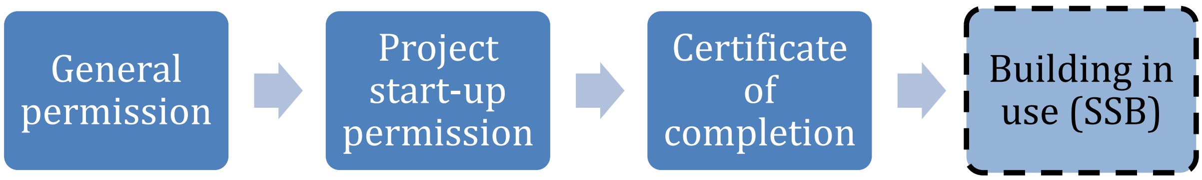
Table 1 includes the specific energy demand calculated by using the standard model buildings for the building codes relevant for identifying the top 7 % most energy efficient residential buildings in Norway.

The building codes are having a significant effect on energy efficiency. An investigation of the energy performance of buildings registered in the EPC database younger than 1997 show a clear improvement in the calculated energy level for buildings finished after 2008/2009 when the building code of 2007 came into force. The same observation on improvement can be done from 1997 to 1998 when the building code of 1997 came into force.

In the period between 1998 and 2009, a period when there was no change in the building code, it is difficult to see any clear changes, however a small reduction of energy use might have taken place in the latest years. This might be due to an increased us of heat pumps in new buildings, and to a certain degree better windows.

3.1.1 Time lag between building permit and building period

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



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

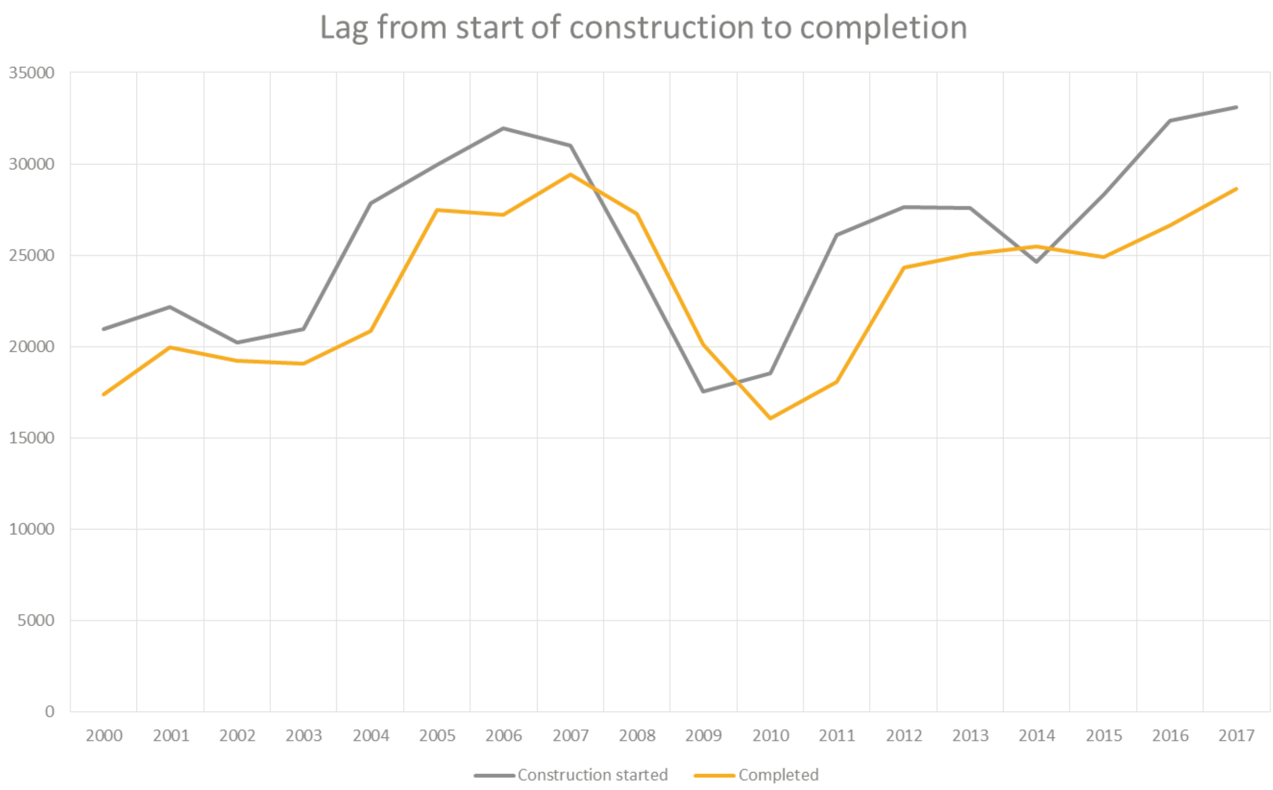


Figure 3 Project start-up and completion (Statistics Norway, bygningsarealstatistikken)

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

3.1.2 Building age statistics

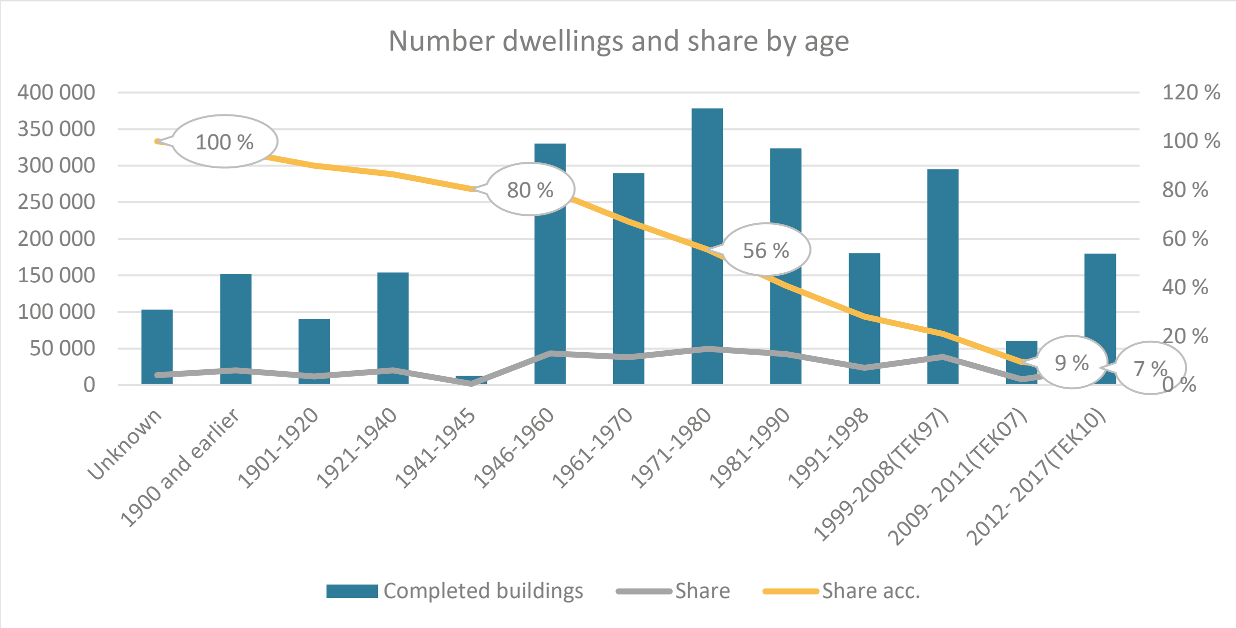


Figure 4 Age and building code distribution of dwellings (Statistics Norway[6] and Multiconsult)

Figure 4 above shows how the Norwegian residential building stock is distributed by age. The same statistics are adjusted by new intervals available by using statistics on building area (Bygningsarealstatistikken). The figure shows how buildings finished in 2012 and later (and built according to TEK10) amount to 7 % of the total stock. Based on theoretical energy demand in the same building stock, the same 7 % of the stock makes up for only 3 % of the energy demand in residential buildings and 2 % of the related CO_2- emissions.

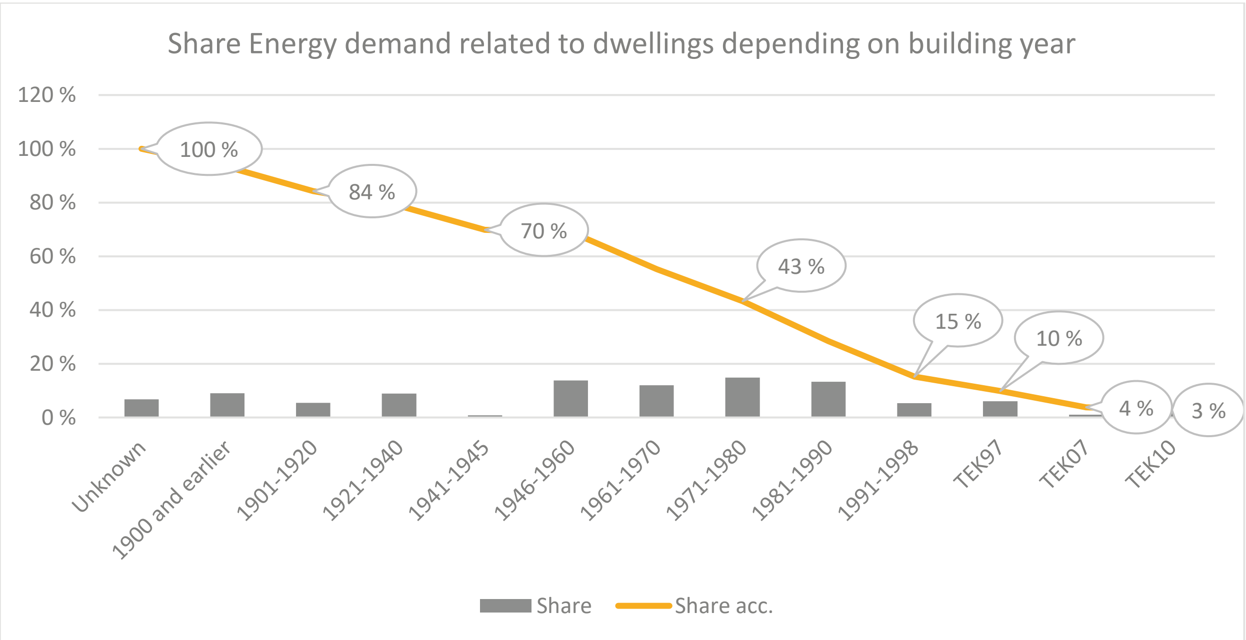


Figure 5 The building stock's relative share of energy demand dependent on building year and code (Statistics Norway and Multiconsult)

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

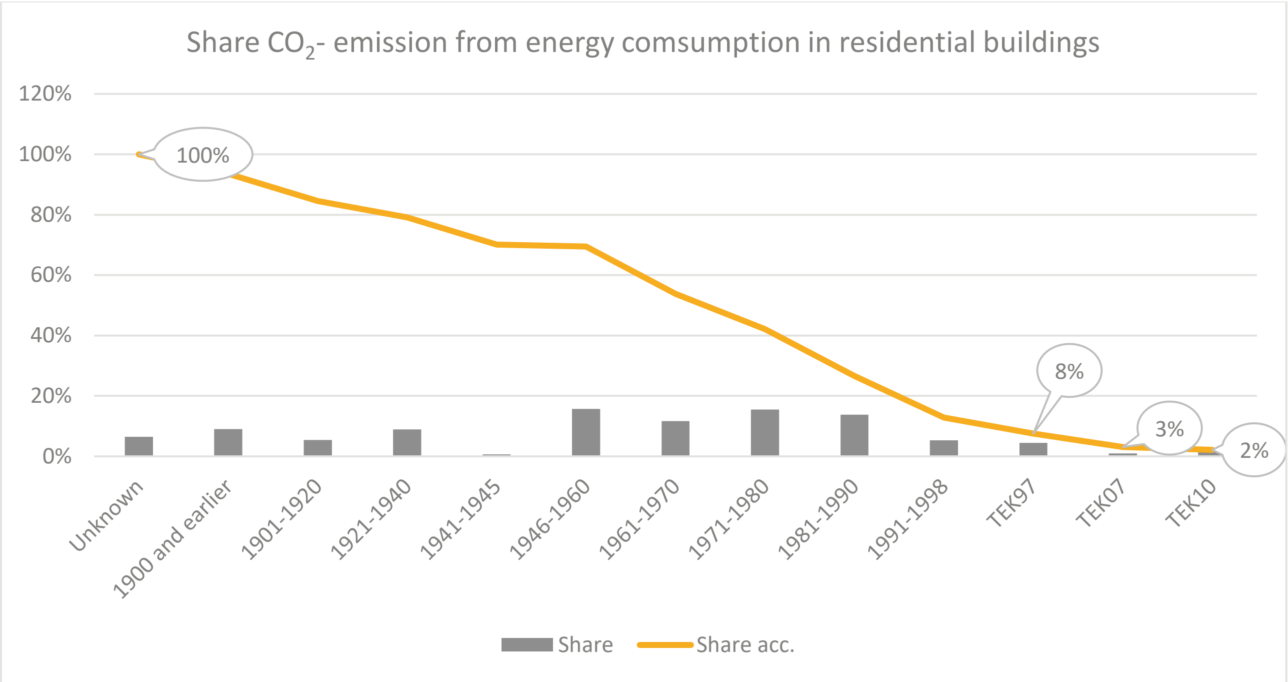


Figure 6 The building stock's relative share of CO_2 –emissions related to energy demand dependent on building year and code (Statistics Norway and Multiconsult)

3.1.3 Eligibility under DNB's criterion

Over the last several decades, the changes in the building code have pushed for more energy efficient residential buildings. The building stock data indicates that 7 % of the current residential buildings in Norway were constructed using the 2010 code or a younger code with even more energy efficient solutions.

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

Hence, compared to the average residential building stock;

- the building code TEK10 and TEK17 gives a calculated specific energy demand reduction of 53 %

4 Impact assessment

Impact is calculated for the criterion in the earlier sections.

The grid factor in Norway is set at an average of 132 g CO_2eq/kWh for the 60 year period from 2010 to 2070. (The expected life of a building from 2010 is 60 years.) This is in line with the grid factor used by the environmental certification system for buildings, BREEAM-NOR. This factor is based on a trajectory from the current grid factor to a close to zero emission factor in 2050.

The grid factor in 2010 is set at European production mix and an optimistic trajectory, as shown in the figure below, require political will and capacity to reach the Two-degree target.

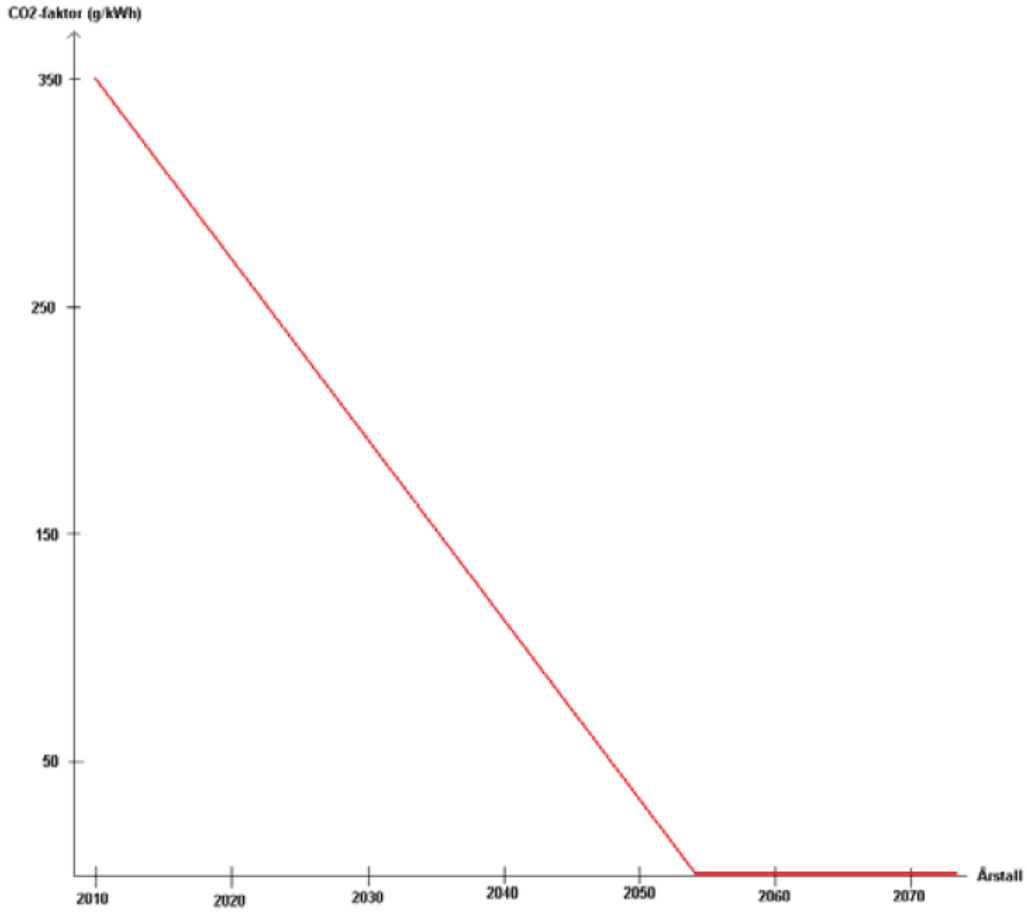


Figure 7 Simulated and extrapolated specific CO2-emission from the European electricity system from 2010 to 2070 (typical lifetime of a new building constructed in 2010). (Source: The Research Centre on Zero Emission Buildings, "Proposal for CO2-factor for electricity and outline of a full ZEB-definition" May 2011)

To calculate the impact on climate gas emissions the trajectory is applied to all electricity consumption in all residential buildings. Electricity is the dominant energy carrier to Norwegian residential buildings but the energy mix includes also bio energy and district heating, resulting in a total specific factor of 126 g CO_2eq/kWh. A proportional relationship is expected between energy consumption and emissions.

A reduction of energy demand from the average 256 kWh/m^2 of the total residential building stock to 126 kWh/m^2 (TEK07/TEK10) or 103 kWh/m^2 (TEK17) dependent on building code can then be multiplied to the emission factor and area of eligible assets to calculate impact.

4.1 DNB's criterion - New or existing Norwegian residential buildings that comply with the Norwegian building code of 2010 (TEK10) or later codes

The eligible buildings in DNB's portfolio is estimated to amount to 2.2 million square meters. Due to the fact that the bank does not have area per object available, the area is calculated based on the assumption that the residents are representative of the total Norwegian residential building stock. Statistics have been taken from Statistics Norway[7]. The values in the column [area per unit] in the table below are calculated from these statistics.

	Number of objects	Area per unit [m^2]	Area total [m^2]
Apartments	10,970	72	786,574
Undetached houses	1,030	104	106,623
Detached houses	6,209	170	1,056,279
Semi-detached houses	2,172	125	271,852
Sum	20,381		2,221,329

Table 2 Eligible objects and calculated building areas

Based on the calculated figures in table 3 the energy efficiency of this part of the portfolio is estimated.

The calculated average specific energy demand for the eligible assets is 120 kWh/m^2. This is 54 % lower than the calculated average of the total residential building stock.

All these residential buildings are not included in one single bond issuance. The table below indicates how much more energy efficient the eligible part of the portfolio is compared to the average residential Norwegian building stock, and much lover CO_2-emissions these residents directly and mostly indirectly this same energy efficiency results in.

	Area	Reduced energy compared to baseline	Reduced CO_2-emissions compared to baseline
Eligible buildings in portfolio	2.2 Million m^2	**304 GWh/year**	**38,000 tons CO_2/year**

Table 3 Performance of eligible objects compared to average building stock

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