REPORT

Danske Bank Finland - Green Buildings Portfolio

CLIENT

Danske Mortgage Bank Plc

SUBJECT

Finnish Energy Efficient Buildings- Green residential buildings

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EXECUTIVE SUMMARY

Multiconsult and VTT have studied the Finnish residential building stock and identified five solid eligibility criteria for Green Bonds financing of energy efficient buildings. The criteria that derive the baseline are similar to the Climate Bonds Initiative (CBI) methodology already used in comparable markets.

Energy requirements in The National Building Code have become increasingly stricter over the last decades, where the overall energy consumption (E-values) is calculated using the politically set energy form factor. These E-values are also calculated when establishing an Energy Performance Certificate (EPC). Even though only a smaller portion of all residential buildings have an EPC, the database is a reliable data source for establishing a baseline and for qualifying buildings both on energy grade and E-value.

Eligible Residential Green Buildings must meet one of the following five eligibility criteria:

1. New or existing Finnish residential buildings that comply with the Finnish building code of 2010 and later codes have significantly better energy standards and account for only 9.1% of the residential building stock. This makes it a robust eligibility criterion as the comparable CBI and EU taxonomy threshold is top 15%. A conservative two-year lag between implementation of a new building code and buildings finished built under that code is taken into account, hence only buildings finished in 2012 or later qualify.
2. Energy efficient buildings may be identified using data from the EPC database. As existing certificates originate from two versions of the EPC systems, the criterion is separated in two:
   - Residential buildings with version 2013 EPCs, qualify with an A or B.
   - Residential buildings with version 2018 EPCs, qualify with an A.

   These criteria have a longevity as even all Cs (2013 version) and Bs (2018 version) would qualify if a bond's midterm occur in 2023.
3. Energy efficient buildings may be identified using the calculated E-value inherent in the EPC calculations and available in the EPC database. A trajectory for the E-value has been established towards a decarbonized building sector in 2050. This makes it possible to identify a threshold value dependent on the bond's term. As existing certificates originate from two versions of the EPC systems, the E-value criterion is separated in two; buildings with version 2013 EPCs, and buildings with version 2018 EPCs.
4. Refurbished residential buildings with at least a 30% improvement in energy efficiency in terms of E-value.
5. New buildings built after 2021 with energy demand 20% lower than the national Nearly zero-energy buildings (NZEB) requirements based on Finland's adoption of the Energy performance of buildings directive, also expressed in terms of E-value.

The Danske Bank Finland residential buildings portfolio has been matched against the building code criterion and 380,000 m^2 of qualifying assets have been identified. These buildings are calculated to perform 25 GWh/yr and 5 300 tons CO_2/yr better than the average residential buildings in Finland.

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1 Introduction

Assignment

On assignment from Danske Mortgage Bank Plc (Danske Bank Finland), Multiconsult and VTT have developed criteria and a methodology to identify the most energy efficient residential buildings in Finland, to be used with respect to a potential green bond issuance. In this document we describe Danske Bank Finland's identification criteria, the evidence for the criteria and the result of an analysis of the loan portfolio of Danske Bank Finland.

Energy sources in the Finnish energy system

Apart from these criteria, we also want to make notice that residential buildings in Finland are to a very large degree heated with renewable energy. The energy consumption of Finnish buildings is predominantly electricity, district heating and bioenergy. The share of fossil fuel is low and declining.

Space heating of residential buildings and domestic hot water (DHW) consumed 51 TWh of energy in 2018[1]. The most common sources of energy for heating indoor spaces were district heat (37%), wood (22%) and electricity (24%). The next most common energy source was heat harvested by heat pumps (11%).

The use of heat pumps for heating has grown significantly from the start of the millennium. This is visible in both the growth of heat pump energy extraction and electricity use of heat pumps. Heat pump energy refers to the energy extracted with heat pumps from the environment. The electricity use of heat pumps is included in electricity consumption of heating in the statistics on energy consumption in households.

Finland has, in 2019, passed legislation (Laki hiilen energiakäytön kieltämisestä (416/2019)) to phase out the use of coal in energy production by 2029. The current Government Programme also foresees i.a. a stepwise phase-out of the use of oil for heating by the beginning of the 2030s and a halving of the use of peat in energy production by 2030[2]. In 2019, Finnish power generation was based 50% on renewables, and 82% of all generation was carbon dioxide free (Finnish Energy[3]). The Ministry of Economic Affairs and Employment has estimated the emission factor for power production to be 65 gCO_2/kWh. The domestic consumption in Finland is, however, substantially larger than the production, and in 2019 23% of the consumption was imported. Electricity is mainly imported from Sweden (61%) and Russia (35%)[4] . The production mix in Sweden is about 50% renewable, 40% nuclear and 10% fossil, and in Russia it is about 15% renewable, 20% nuclear and 65% fossil.

The fuel mix in Finnish district heating production in 2019 included a wide range of energy sources, including bioenergy, heat recovery, peat, gas, coal and oil. 53% of the production mix in 2019 can be regarded as climate neutral (renewables + heat recovery) [5].

[1] http://www.stat.fi/til/asen/index_en.html
[2] http://julkaisut.valtioneuvosto.fi/handle/10024/161977
[3] https://energia.fi/files/4381/Energy_Year_2019_-_Electricity.pdf https://energia.fi/files/1414/a_Sahkontuotannon_kk_polttoaineet_Helmikuu.pdf
[4] Energy supply and consumption https://www.stat.fi/til/ehk/index_en.html
[5] https://energia.fi/files/4516/Energy_Year_2019_DistrictHeating_STATISTICS.pdf

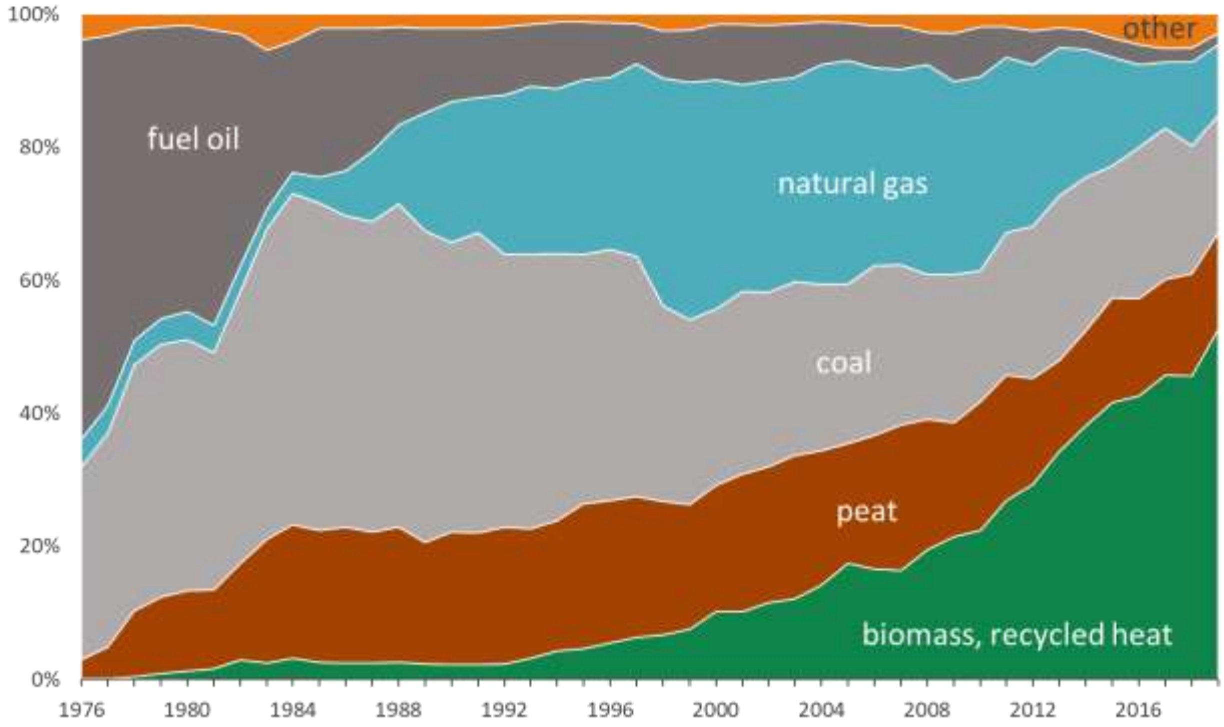


Figure 1 Historic development of Finnish district heating production mix (Finnish Energy, 2020[6])

Finnish residential building stock

The total number of dwellings is 3.0 million, of which 1.2 million are single family houses (detached houses) and 1.8 million are multiple-dwelling buildings[7]. The housing construction of the 1970s and 1980s is the result of strong rural-urban migration. Migration has accelerated again since 2010. Due to this long-standing urbanisation, approximately 15% of dwellings constructed before 1970 and 10% of dwellings constructed after 1970 have been left empty. Of the housing stock, 11% is not permanently occupied. Projections indicate that the population will decrease in many locations and that the number of empty dwellings will grow further in the coming years.

Private households own 80% of all dwellings, either directly or through the Ltd housing company system[8]. Private households have the highest share of ownership in detached houses (90%) and through the housing company system in terraced houses (75%) and in apartment buildings (70%). The rest of the dwellings are owned by social housing companies or the commercial real-estate sector.

[6] https://energia.fi/files/4516/Energy_Year_2019_DistrictHeating_STATISTICS.pdf
[7] http://www.stat.fi/til/asas/index.html and http://www.stat.fi/til/ras/index.html
[8] A limited liability housing company is a limited liability company whose purpose, provided in its Articles of Association, is to own and control at least one building or part thereof in which at least half of the combined floor area of the apartment or apartments is reserved in the Articles of Association for use as residential apartments possessed by the shareholders (https://www.finlex.fi/fi/laki/kaannokset/2009/en20091599_20100547.pdf)

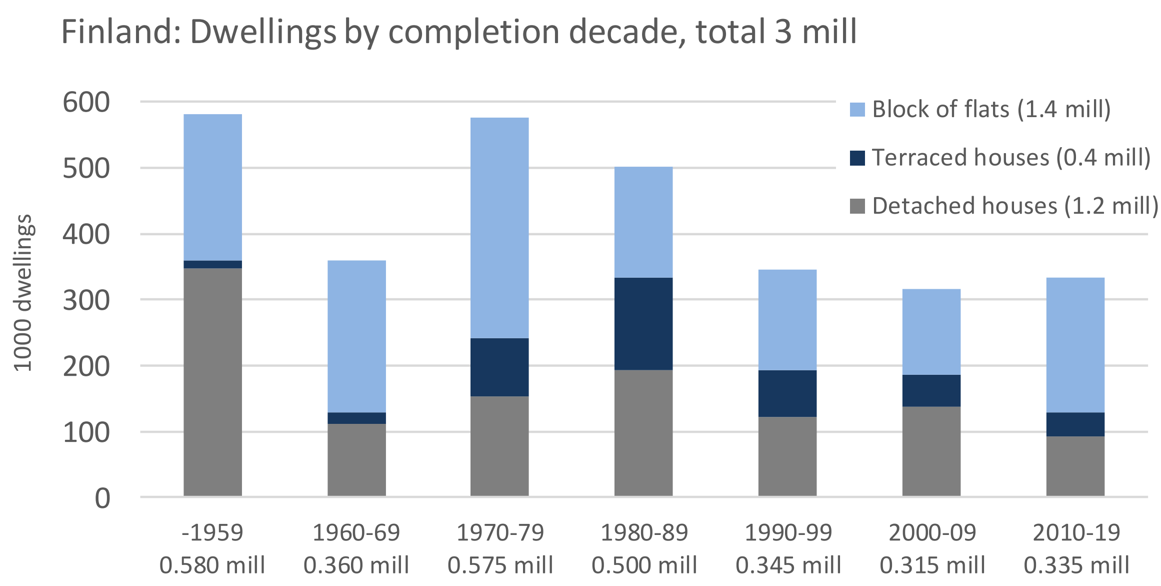


Figure 2. Age structure of the housing stock. Detached houses include a total of 1.2 million dwellings, terraced house 0.4 million dwellings and apartment buildings 1.4 million dwellings. The total number of dwellings is 3.0 million, of which 10% are not permanently occupied.

Energy efficiency requirements

In Finland the present minimum energy performance requirements for new buildings have been set on the basis of the EPBD (Directive 2010/31/EU and its amendment 2018/844/EU). The approach is based on overall energy consumption, which takes the energy source (primary energy factor) into account. The current minimum performance calculations for new buildings are based on a national calculation method that follows the main principles of CEN standards. Requirements are given as a fixed E-value (kWh_E/m^2).

The National Building Code of 2017 defines maximum values for overall energy consumption (E-values) calculated using the primary energy factor. The maximum values depend on the building type and, for detached houses, on the floor area of the building. The new building code does not exclude any heating sources; however, the code encourages the use of RES and district heating, which have better primary energy factors (0.5) than electricity (1.2) or fossil fuels (1.0).

Minimum energy performance requirements have also been developed for existing buildings undergoing renovations and/or retrofitting that are subject to a building permit, when the use of a building is altered, or technical systems are repaired. Improvement of the E-value in detached house and terraced house undergoing e.g. renovation have to be 20% and in apartment buildings it must be 15%. The improvement requirement is building specific as it is calculated from each building's initial E-value.

2 Eligibility criteria- Residential buildings

Multiconsult and VTT have studied the Finnish residential building stock and identified five solid eligibility criteria for Green Bonds financing of energy efficient buildings. The criteria have been aligned with the Climate Bonds Initiative (CBI) and will be published as a CBI baseline for Finnish residential buildings. The criteria that derive the baseline are similar to the CBI methodology already used in similar markets e.g. in the Netherlands, Poland and Belgium. Criterion 1 identifies the top 9.1% most energy efficient residential buildings countrywide based on energy efficiency requirements in historic building codes. The CBI baseline methodology also includes criteria using data from Energy Performance Certificates (EPC) when available, and according to CBI criteria, residential buildings may also qualify after being refurbished to a standard resulting in at least a 30% reduction in energy demand[9]. In Finnish regulation energy efficiency is calculated in terms of E-value dependent on primary energy factors. Available data allows this E-value to be used as a separate criterion in parallel to the EPC-criterion. In line with the EU taxonomy, a new build criterion is included for buildings built after 2021.

Eligible Residential Green Buildings for Danske Bank Finland must meet one of the following eligibility criteria:

1. New or existing Finnish residential buildings that comply with the Finnish building code of 2010 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.
2. Energy efficient buildings may be identified using data from the EPC database. As existing certificates originates from two versions of the EPC systems, the EPC criterion is separated in two:
   - Residential buildings with version 2013 EPCs, qualify with an A or B.
   - Residential buildings with version 2018 EPCs, qualify with an A.
3. Energy efficient buildings may be identified using the calculated E-value inherent in the EPC calculations and available in the EPC database. A trajectory for the E-value towards a decarbonized building sector in 2050 makes it possible to identify a threshold value dependent on the bond's term. As existing certificates originates from two versions of the EPC systems, the E-value criterion may be separated in two; buildings with version 2013 EPCs, and buildings with version 2018 EPCs.
4. Refurbished residential buildings with at least a 30% improvement in energy efficiency in terms of E-value.
5. New buildings built after 2021 with energy demand 20% lower than the national NZEB requirements based on Finland's adoption of the Energy performance of buildings directive.

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

2.1 New or existing Finnish residential buildings that comply with the Finnish building code of 2010 or later codes: 9.1%

Over several decades, changes in the Finnish building code have consistently resulted in more energy efficient buildings (see table).

Table 1 Tightening of energy efficiency requirements for new buildings since 1976.

Thermal conductivity W/(K·m²)	Older	Code of 1976	Code of 1978	Code of 1985	Code of 2003	Code of 2007	Code of 2010	Code of 2017
Facade	0,81	0,7	0,35	0,28	0,25	0,24	0,17	0,17
Roof	0,47	0,35	0,29	0,22	0,16	0,15	0,09	0,09
Basement	0,47	0,4	0,4	0,36	0,25	0,24	0,16	0,16
Windows	2,8	2,1	2,1	2,1	1,4	1,4	1	1
Heat recovery from exhaust air	0	0	0	0	30 %	30 %	45 %	55 %

As of 2020, 9.1% of Finnish residential buildings are eligible according to the Danske Bank Finland criterion. The methodology is based on Climate Bonds Initiative (CBI) criteria, where the top 15 % most energy efficient buildings are considered eligible. In comparison the criterion in TEG final report on the EU taxonomy with Technical annex, the 15% applies to buildings completed before 2021.

The net energy demands in figure 3 are samples from the EPC database sorted by building code. The figure illustrates how the calculated energy demand declines with newer buildings.

Tables 2 and 3 include the specific energy demand determined on the basis of the EPC samples for identifying no more than the top 15% most energy efficient residential buildings in Finland.

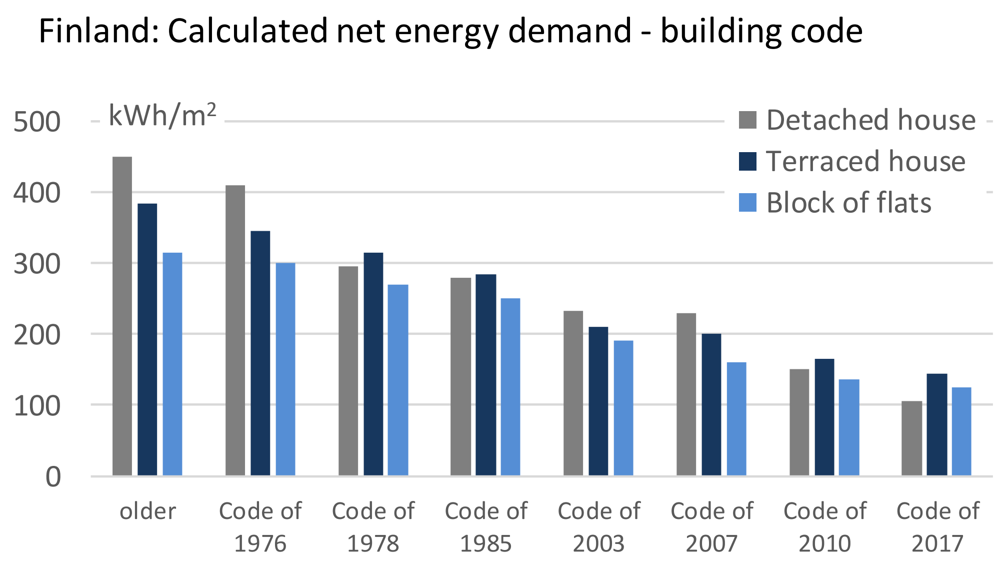


Figure 3 Development in calculated specific net energy demand based on building code and building tradition (based on the Finnish EPC database VTT).

Table 2 Average specific energy demand determined on the basis of the EPC samples.

Building code	Detached houses	Terraced houses	Apartment buildings
Code of 2010	100 kWh/m^2	115 kWh/m^2	110 kWh/m^2
Code of 2017	95 kWh/m^2	110 kWh/m^2	105 kWh/m^2

Table 2 shows the average specific energy demand in Finnish residential buildings built according to the two latest building codes. This includes all energy demand. The electricity specific demand, that is, demand that cannot be supplied by any other energy carrier, is the same regardless of building code. Table 3 shows only heating demand, space heating and domestic hot water, where the difference between the codes is evident.

Table 3 Average specific space heating and domestic hot water energy demand determined on the basis of the EPC samples.

Building code	Detached houses	Terraced houses	Apartment buildings
Code of 2010	80 kWh/m^2	95 kWh/m^2	80 kWh/m^2
Code of 2017	75 kWh/m^2	90 kWh/m^2	75 kWh/m^2

2.1.1 Time lag between building permit and building period

After the implementation of a new building code there is a time lag before we see new buildings completed according to this new code. 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 depending on complexity of the site and project, financing and the housing market. Danske Bank Finland only has available data on year of building completion, and only on a yearly basis.

In Finland, changes in regulation are prepared in close co-operation with designers and constructors. For this reason, stakeholders are expected to be quick in implementation. The time-lag is estimated to be one year.

The figure below, based on data from Statistics Finland, indicates that a time from building starts to completed construction of approximately one year is a reasonable assumption for residential buildings. In Finland, changes in regulation are prepared in close co-operation with designers and constructors. For this reason, stakeholders are expected to be quick in implementation. The time-lag from adoption of a new building code to most new buildings are completed according to this code is set to be two years in this analysis, which is considered to be a very robust assumption.

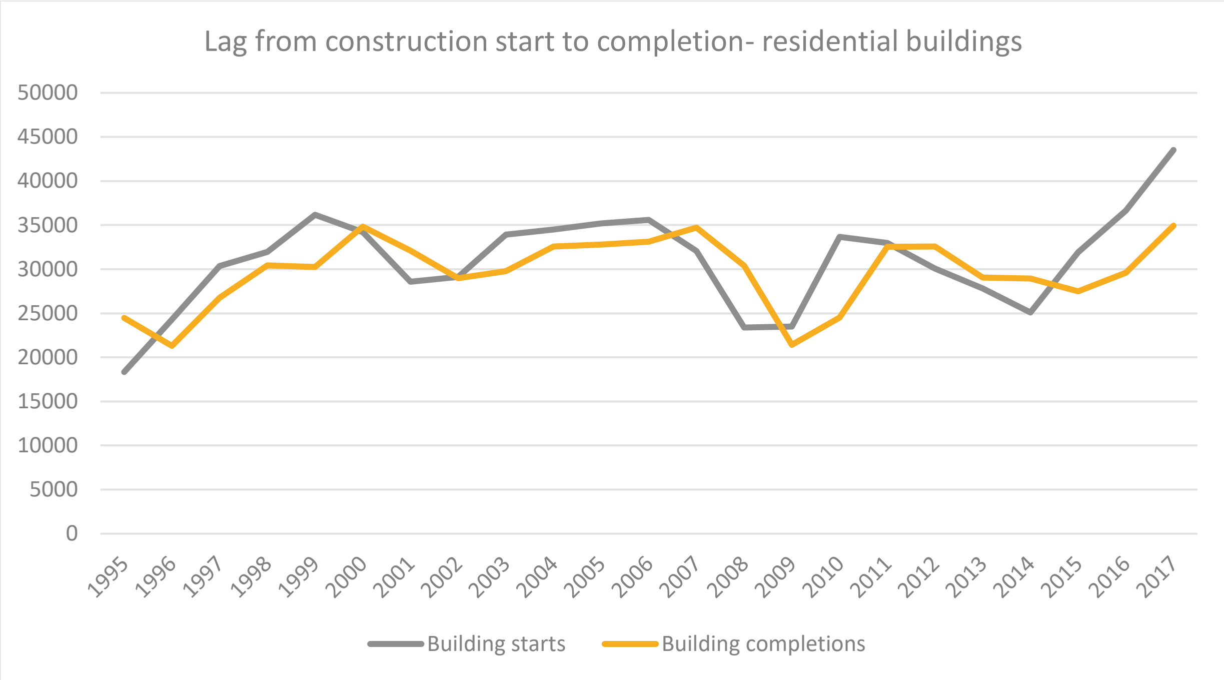
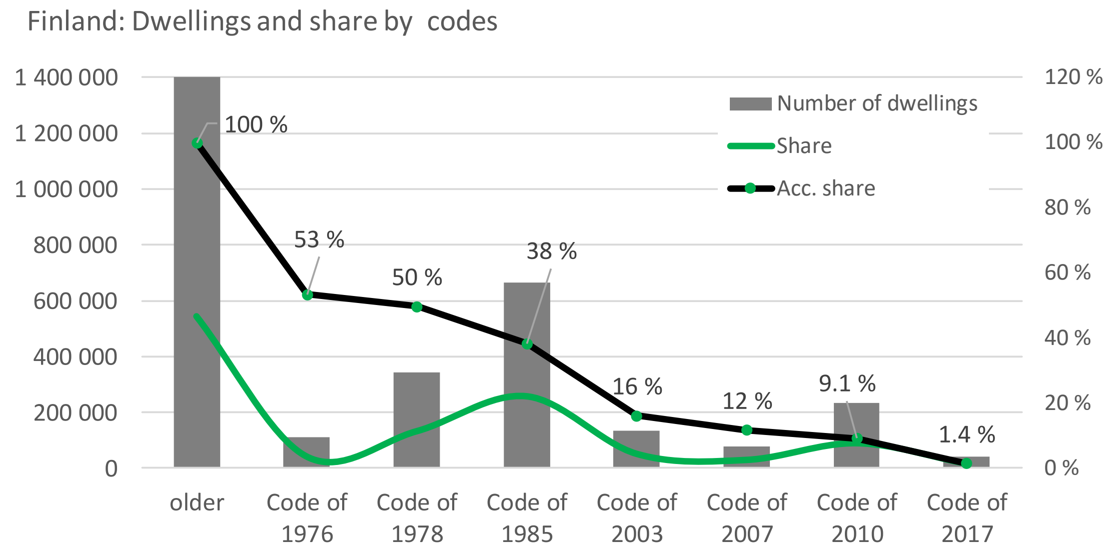


Figure 4 Project start-up and completion (Statistics Finland[10])

2.1.2 Building age statistics

The following figures illustrate the age and building code distribution of the Finnish residential building stock in total and individually for apartment buildings and small residential buildings.



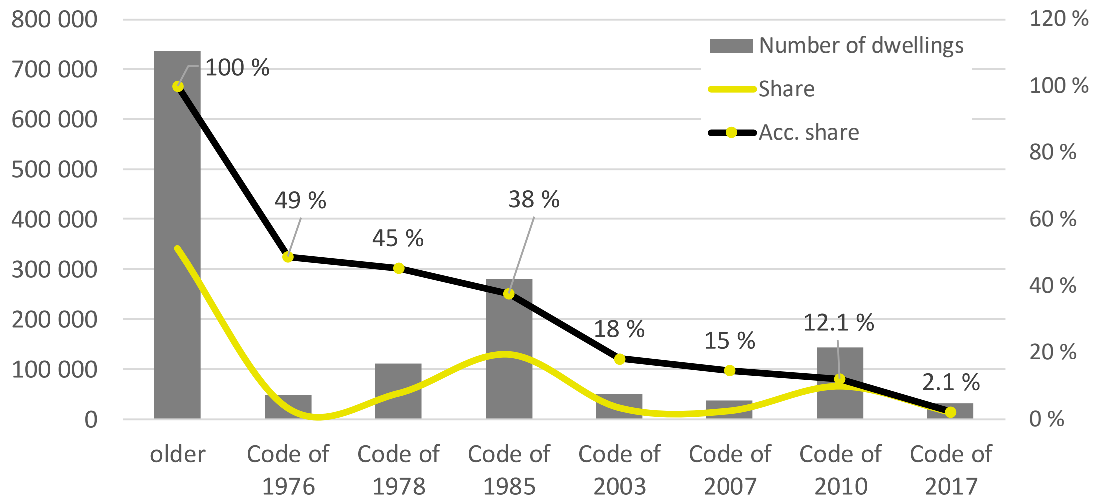
Completion years	-1977	1978-79	1980-86	1987-04	2005-08	2009-11	2012-18	2019

Figure 5 Age and building code distribution of all dwellings in the residential building stock (Statistics Finland[11], VTT)

[10] http://pxnet2.stat.fi/PXWeb/pxweb/en/StatFin_Passiivi/StatFin_Passiivi__rak__ras/statfinpas_ras_pxt_001_201806.px/
[11] http://pxnet2.stat.fi/PXWeb/pxweb/en/StatFin_Passiivi/StatFin_Passiivi__asu__rakke/statfinpas_rakke_pxt_001_201700.px/

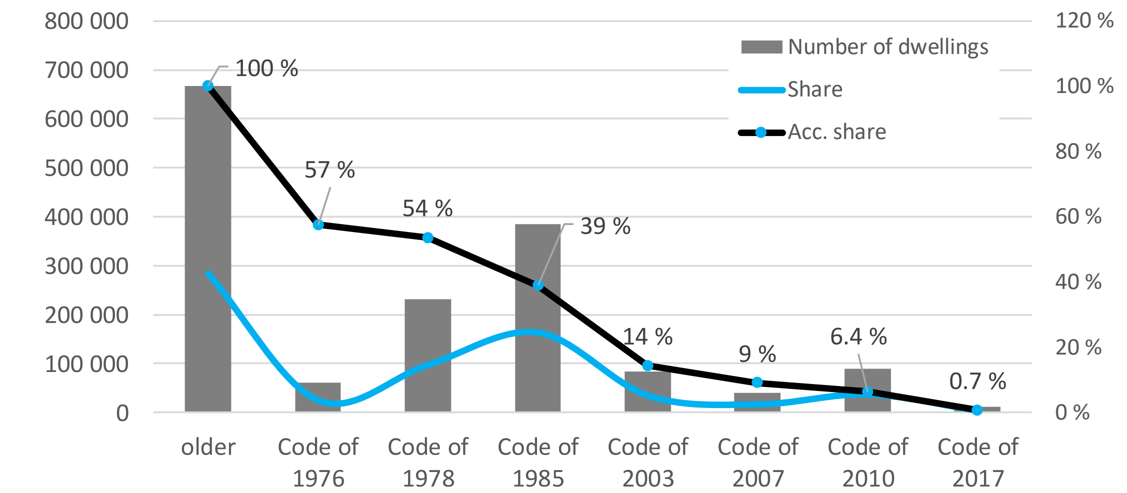
Figure 5 above shows the distribution of the Finnish residential building stock by age and building code. Note that a two-year lag has been applied and that the code of 2017 came into force January 2018. The figure shows how buildings finished in 2012 and later (and built according to code of 2010) amount to 9.1% of the total stock which is well below the 15% threshold. Based on theoretical energy demand in the same building stock, the same 9.1% of the stock accounts for only 3.9% of the energy demand in residential buildings (Figure 9) and 3.6% of the related CO2- emissions (Figure 10). The difference between energy demand and CO2-emissions is due to the slightly less CO2-intensive heating solutions in newer buildings.

Figure 6 and Figure 7 show the distribution of the residential building stock by age and building code split in the sub-categories apartments and small residential buildings. Apartments built in 2012 and later amount to 12.1% of the apartment stock, and small residential buildings built in 2012 and later amount to 6.4% of the small residential buildings stock. Expected building completion rates for apartments and small residential buildings in the years to come indicate, again split in sub-categories, the target of keeping below 15% is valid until 2023 and 2030 for apartments and small residential buildings respectively.



Completion years	-1977	1978-79	1980-86	1987-04	2005-08	2009-11	2012-18	2019

Figure 6 Age and building code distribution of dwellings in apartment buildings (Statistics Finland, VTT)



Completion years	-1977	1978-79	1980-86	1987-04	2005-08	2009-11	2012-18	2019

Figure 7 Age and building code distribution of dwellings in small residential buildings (Statistics Finland, VTT)

Energy consumption is calibrated to the level of official energy statistics taking into account the energy mix. Note that ambient energy is not included in the calculation of specific energy consumption in the EPCs.

Emission factors for 2020 are set at 0 g/kWh for renewable fuels, 263 g/kWh for fossil fuels, 160 g/kWh for district heat and 65 g/kWh for power generation. The emission factors for district heating production and power generation are identical to the factors used by the Ministry of Economic Affairs and Employment in the Finnish National Energy and Climate Plan (NECP)[12]. The NECP also contains the estimation of the emission factors (Table 4). The main source for the estimation is the long-term development of total emissions[13]. The estimation takes into account the legislation banning fossil fuels in both district and building-specific heat production. In addition, the estimation takes into account technological developments, emissions trading prices and fuel taxes that drive towards cost-effective ways to produce energy. The further decarbonisation of energy production in Finland will cut CO_2 in the coming decades. Figure 8 illustrates how abandoning fossil fuels quickly will reduce emissions from the oldest buildings in the stock.

Table 4 Emission factors main energy forms.

	Unit	2020	2030	2040	2050
Renewable fuels	gCO_2/kWh	0	0	0	0
Fossil fuels	gCO_2/kWh	263	263	263	263
District heating	gCO_2/kWh	160	76	64	45
Electricity	gCO_2/kWh	65	31	24	12

[12] http://julkaisut.valtioneuvosto.fi/handle/10024/161977
[13] https://julkaisut.valtioneuvosto.fi/handle/10024/161409

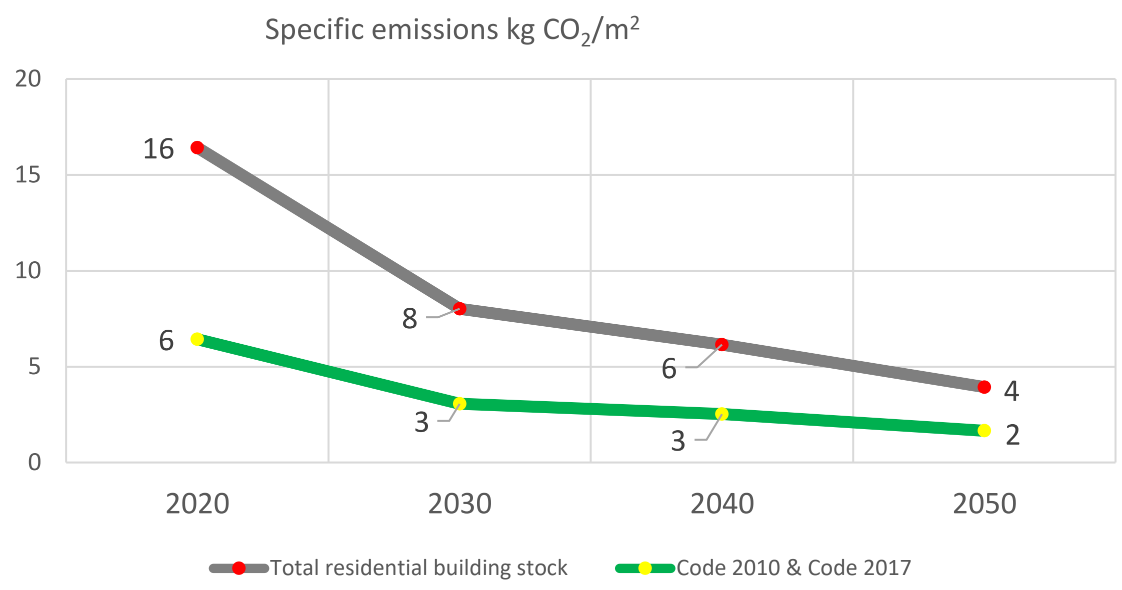
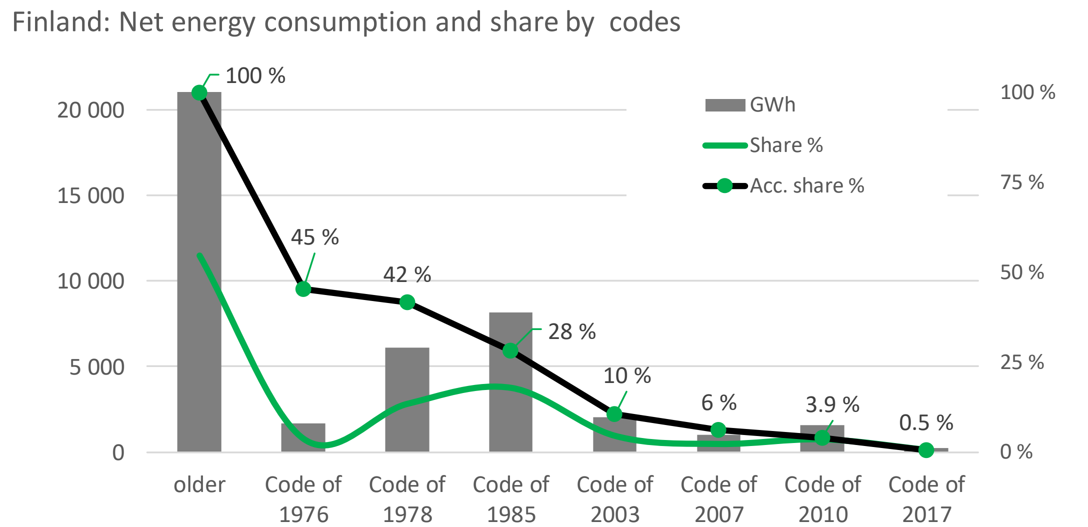


Figure 8 Estimated specific CO_2 –emissions in kg CO_2/m^2 heated floor area in coming decades (VTT).

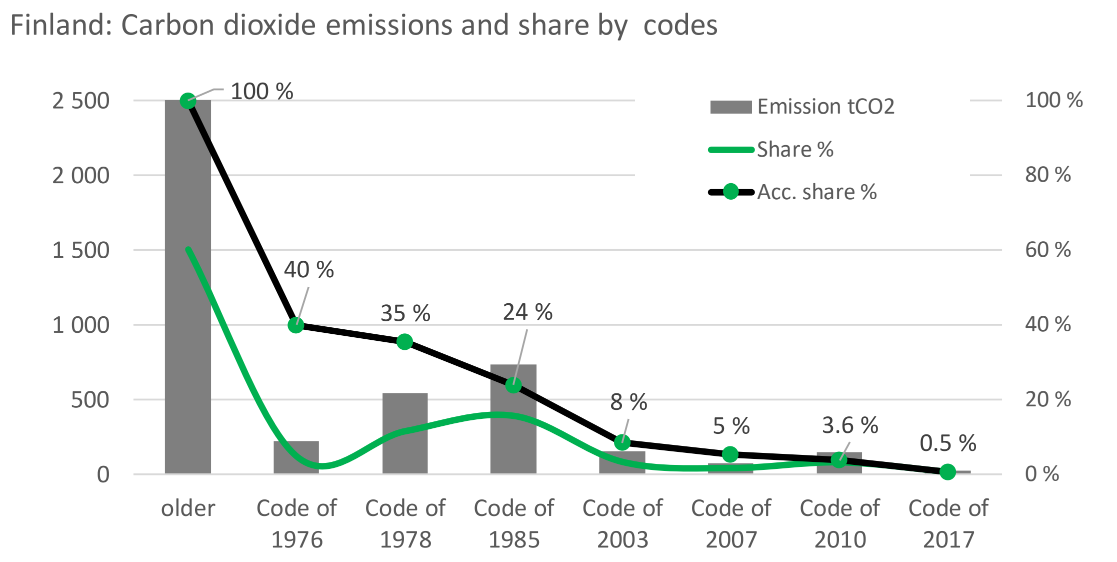
In addition to the above mentioned emission factors, an alternative emission factor for electricity supplied by the grid, in line with Nordic Public Sector Issuers: Position Paper on Green Bonds Impact Reporting (January 2020)[14], has been calculated. For the latter, the average specific emission in 2020 has been calculated to be 27 kgCO_2/m^2 on average for the total residential building stock, and 13 kgCO_2/m^2 for buildings built according to building codes of 2010 and 2017.



Completion years	-1977	1978-79	1980-86	1987-04	2005-08	2009-11	2012-18	2019

Figure 9 The residential building stock's relative share of heating energy demand dependent on building year and code (Statistics Finland, ARA and VTT).

[14] https://www.kuntarahoitus.fi/app/uploads/sites/2/2020/02/NPSI_Position_paper_2020_final.pdf



Completion years	-1977	1978-79	1980-86	1987-04	2005-08	2009-11	2012-18	2019

Figure 10 The residential building stock's relative share of CO_2 –emissions related to energy demand dependent on building year and code (Statistics Finland, ARA and VTT)

2.1.3 Eligibility under criterion 1

Over the last several decades, changes in the building code have resulted in more energy efficient buildings. The building stock data indicates that 9.1% of the current residential buildings in Finland were constructed using the code of 2010 or later.

Combining the information on the calculated energy demand related to building code in figure 3 and information on the residential building stock in figure 5, the calculated average specific energy demand of the Finnish residential building stock is 173 kWh/m^2. Qualifying building codes (2010 and 2017) give an average specific energy demand for existing houses and apartments, weighted for actual stock, of 108 kWh/m^2.

Hence, compared to the average residential building stock;

- The average for qualifying building codes demonstrates a calculated specific energy demand reduction of 38%

2.2 Finnish residential buildings with EPC-labels

2.2.1 EPC labels to identify energy efficient residential buildings

Energy performance certificates, EPCs, are required for all new buildings and for the sale or rental of existing buildings. Legislation to implement the requirements of the EPBD (Directive 2010/31/EU) was adopted at the beginning of 2013 and came into force in June 2013 for multi-family houses. Requirements for older single-family homes (detached houses) came into force on 01.06.2017. EPC extends to the whole building or a significant portion of the building if the building has multiple usage areas. Single apartments are not certified separately.

The EPC is produced by a qualified expert. The Housing Finance and Development Centre of Finland (ARA) is the administrative authority ensuring the quality of certificates and qualified experts, in addition to safeguarding the appropriate preparation and use of the EPCs. As the responsible authority, it can also make compliance checks of issued EPCs.

Energy performance is based on the overall primary energy consumption (annual kWh_E/m^2), taking the energy source (primary resource factor) into account. Primary energy factors for energy sources are fixed in the National Building Code as described previously.

The EPC is always based on calculated energy consumption, which makes it possible to compare different buildings instead of different users. A qualified expert must inspect the renovated building and assess the energy efficiency of the building elements and components as well as the technical systems (external walls, doors, windows, heating and DHW systems, ventilation systems, lighting and other electrical systems, e.g., electrical heating systems). An on-site inspection is required. The qualified expert must suggest targeted cost-effective energy saving measures to be included in the EPC. Savings in kWh_E/year must be calculated in detail for each measure. The EPC is valid for ten years. However, it is recommended, though not required, that the certificate is updated following a major reconstruction of the building envelope or of the technical systems, even if the works take place before the expiry date.

The ARA controls EPCs based on the EPBD (Directive 2010/31/EU), Article 18, Appendix II, and partly checks the input of the building information data, the accuracy of the presented calculations, and the appropriateness of the suggestions given for improving energy efficiency. Due to certified experts and ARA's quality control, the EPC database is the best source for this review. Both specific energy consumption and energy (Figure 3) class distributions by building codes have been calculated using data from the EPC database.

2.2.2 Energy efficiency of residential buildings according to EPC

In summer 2019, there were 92 000 EPCs of residential buildings in the EPC database. Half of them were second generation EPCs (legislation 2013), and the other half, third generation EPCs(legislation 2017, came into force 2018). Since generations have different energy form factors and classifications, they are presented separately.

The distributions have been expanded on the basis of available certificates. Table 5 below shows how the apartment building stock in Finland is distributed by building code, and their certificate label. The top 15% most energy efficient apartment buildings in the stock are defined by:

- Version 2013: classes A, B, C and a part of class D. The threshold E-value is 150.
- Version 2018: classes A, B, and a part of class C. The threshold E-value is 110.

This is valid until 31.12.2022. After that, there will be so many new apartment buildings built, that class D from version 2013 and class C from version 2018 have to be excluded. In the following years, even some class B buildings must be excluded. Most green bond issuances have midterms after 2023, hence this criterion may only include class A buildings from the 2018 version and class A and B from the 2013 version.

Table 5. The distributions of EPCs of apartment buildings in database, extrapolated to cover the total stock.

	EPCs - version 2013			EPCs - version 2018		
	Database	Extension to stock		Database	Extension to stock	
A	0.01 %	0.003 %	0.003 %	2.5 %	0.7 %	0.7 %
B	0.7 %	0.3 %	0.3 %	34.0 %	11.9 %	12.7 %
C	36.1 %	12.0 %	12.3 %	10.7 %	11.4 %	24.0 %
D	6.6 %	5.0 %	17.3 %	26.2 %	37.3 %	61.3 %
E	11.4 %	15.3 %	32.7 %	19.4 %	28.2 %	89.5 %
F	31.6 %	46.8 %	79.4 %	5.8 %	8.4 %	97.9 %
G	13.6 %	20.6 %	100.0 %	1.4 %	2.1 %	100.0 %
Total	100.0 %	100.0 %		100.0 %	100.0 %	

Table 6 below shows how the detached and terraced houses in Finland are distributed by building code, and their certificate label. The top 15% most energy efficient apartment buildings in the stock are defined by:

- Version 2013: classes A, B, C and a part of class D. The threshold E-value is 180.
- Version 2018: classes A, B, and a part of class C. The threshold E-value is 130.

This is valid until 31.12.2023. After that, there will be so many new small residential buildings built, that class C from version 2018 has to be excluded. In the following years, even some class B buildings must be excluded. Most green bond issuances have midterms after 2023, hence this criterion may only include class A buildings from the 2018 version and class A and B from the 2013 version.

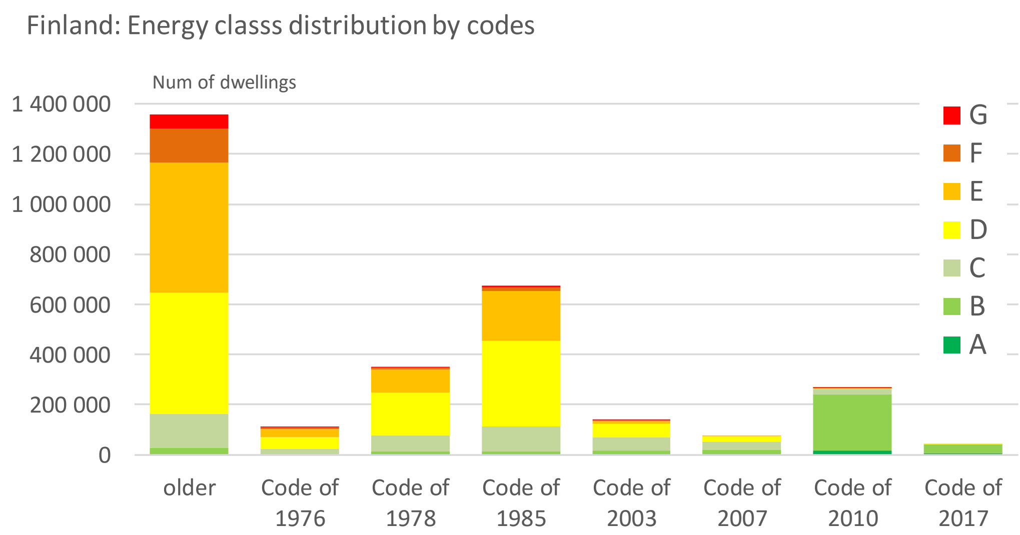
Table 6 The distributions of EPCs of detached and terraced houses in database and extrapolated to cover the total stock.

	Version 2013 EPCs			Version 2018 EPCs		
	Database	Extension to stock		Database	Extension to stock	
A	0.2 %	0.04 %	0.04 %	6.2 %	1.0 %	1.0 %
B	21.4 %	3.0 %	3.1 %	40.2 %	10.6 %	11.5 %
C	30.4 %	7.8 %	10.9 %	11.2 %	14.9 %	26.5 %
D	14.8 %	21.3 %	32.2 %	22.5 %	35.0 %	61.5 %
E	23.6 %	44.1 %	76.3 %	17.2 %	32.3 %	93.8 %
F	6.1 %	13.9 %	90.2 %	1.9 %	4.3 %	98.1 %
G	3.5 %	9.8 %	100.0 %	0.8 %	1.9 %	100.0 %
Total	100.0 %	100.0 %		100.0 %	100.0 %	

The coverage ratio of EPC labels relative to the total building stock is currently equal to only 7 %. Buildings in the database are however considered to be representative for the buildings built under the same building code as the results from each certificate is highly trusted due to strict regulation, competence requirements and quality control. Tables 5 and 6 illustrate the building stock's energy efficiency and how the youngest buildings are over-represented in the EPC database. The data has been extrapolated to cover the total residential building stock. In total 13 % of the Finnish residential buildings are expected to get a B or better. These are buildings that have initially been built, or through refurbishment, attained higher energy efficiency standards than the original building year.

Due to the energy form factor, energy class is closely connected to the type of heating. It has a significant effect on whether district heating (energy from factor 0.5) or electricity (energy form factor 1.2) is used for heating. Most B class multi-family houses are connected to a DH network. A class buildings typically have ground source heat pumps (GSHP). Class A practically always requires on-site electricity generation (PV panels).

The EPC eligibility criterion is based on splitting of data from the two versions. However, as an illustration we include the figures below based on all registered buildings, EPC version 2013 and 2018, where the 2013 certificates are converted to 2018 certificates and data extrapolated to cover the whole residential building stock.



Completion years	-1976	1977-78	1979-85	1986-03	2004-07	2008-10	2011-18	2019

Figure 11 Total volume of residences in Finland distributed per building code and EPC. Based on residential buildings statistics from Statistics Finland and statistics from the EPC database.

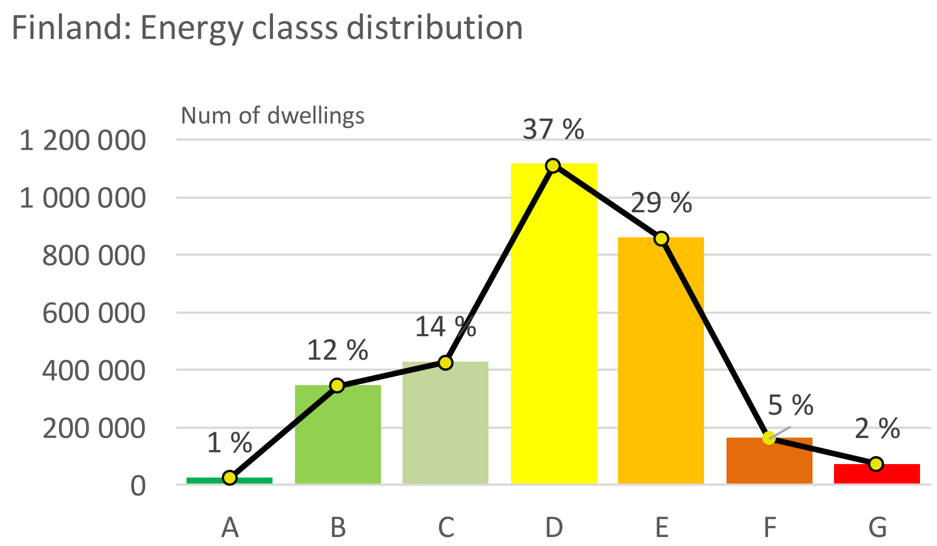


Figure 12 Estimated energy classes of Finnish residential buildings.

2.2.3 Eligibility under criterion 2

An EPC is mandatory for new buildings and existing residential buildings that are sold or rented out. The EPC data indicates that 13 % of the current residential buildings in Finland will have a B or better.

The criterion is separated in two to open up for both versions of the EPC system. As there are relatively few buildings with EPCs, this opens up for qualifying more buildings according to this criterion.

Residential buildings with version 2013 EPCs qualify with an A or B.

Residential buildings with version 2018 EPCs qualify with an A.

2.3 E-value

The minimum energy performance requirements for new buildings in Finland have been set on the basis of the EPBD (Directive 2010/31/EU and its amendment 2018/844/EU). The approach is based on overall energy consumption, which takes the energy source (primary energy factor/ energy form factor) into account. The current performance calculations for new buildings are based on a national calculation method that follows the main principles of CEN standards. Requirements are given as a fixed E-value (kWh_E/m^2) calculated by $\sum$ Energy consumption$_{1..n}$ x Energy form factor$_{1..n}$.

The maximum values depend on the building type and, for detached houses, on the floor area of the building. The new building code does not exclude any heating sources; however, the code encourages the use of renewable energy sources and district heating, which have better energy form factor (0.5) than electricity (1.2) or fossil fuels (1.0). These energy form factors are politically set, and as the Finnish government has not indicated coming changes to the factors, they are kept unchanged in the calculations forming the basis for this criteria.

The E-value is calculated for all new buildings and when calculating the EPC. As presented in the previous section, the EPC currently exist in two versions and the E-value eligibility criterion may be presented dependent on EPC version. As can be seen in the figures below, the E-value target gets progressively lower over time to align to a zero carbon trajectory. The figures depict this trajectory for the two EPC versions and the two building categories, apartments and small residential buildings. If the politically set energy form factors are to change, however, the trajectory and eligibility criteria need to be revisited.

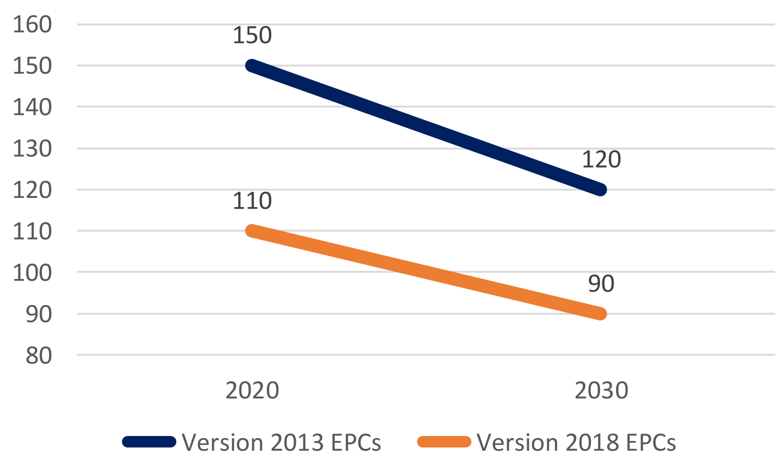


Figure 13 Change in threshold E-value from the 15th percentile of market baseline for apartment buildings due to the zero carbon trajectory. To be noted that the last version 2013 EPCs will expire in 2027.

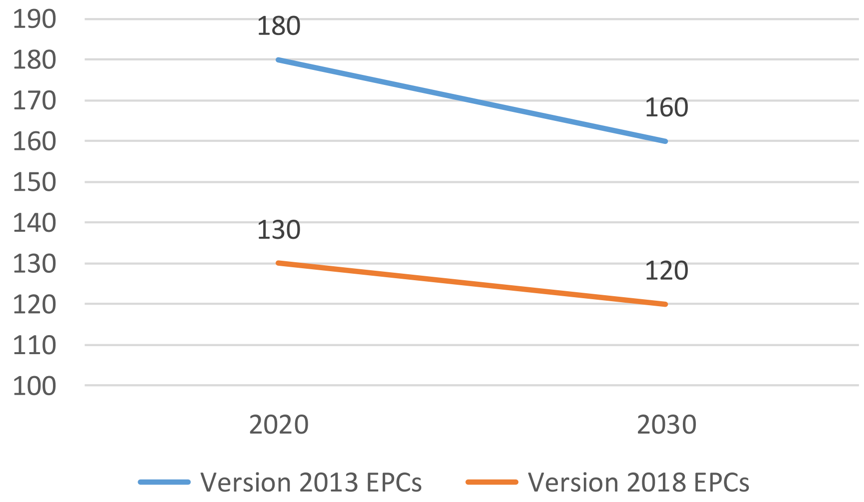


Figure 14 Change in threshold E-value from the 15th percentile of market baseline for small residential buildings due to the zero carbon trajectory. To be noted that the last version 2013 EPCs will expire in 2027.

The trajectory is in line with the Finnish Renovation Strategy, i.e. how Finland will achieve a highly efficient and decarbonised building stock by 2050. This plan has been reported to EU in March 2020 (EPBD 2a obligation).

The decarbonisation of the building stock is highly influenced by the 2050 zero- emission target for the centralized production of electricity and heat. An example of regulatory measures already in place is the ban on use of coal in power production after 2029[15]. The Finnish government also has a program for local heating with a plan to phase out oil heating in public buildings by the beginning of 2030 and in residential buildings by 2050. The change of heating system in residential buildings is subsidized.

2.3.1 Eligibility under criterion 3

As for the EPC, the E-value is calculated for new buildings and existing residential buildings that are sold or rented out.

The criterion is separated in two to open up for both versions of the EPC system. As there are relatively few buildings with EPCs, this opens up for qualifying more buildings according to this criterion.

A building is considered eligible as long as it at issuance is below the limit value half way to maturity date.

For green bond issuance in 2020 with a six year tenure, residential buildings with version 2013 EPCs qualify with an E-value of no higher than 174 for small residential buildings and 141 for apartment buildings.

For green bond issuance in 2020 with a six year tenure, residential buildings with version 2018 EPCs qualify with an E-value of no higher than 127 for small residential buildings and 104 for apartment buildings.

[15] https://www.finlex.fi/fi/laki/alkup/2019/20190416

2.4 Refurbished residential buildings with substantial CO_2 emissions reduction targets

Refurbished buildings with substantial CO_2 emission reduction targets qualify for green bonds against this criterion. However, it is only the cost of the refurbishment that qualify except for buildings that reach a level of energy efficiency in line with qualifying building code. This is in line with CBI's refurbishment criterion in their Property Upgrade Climate Bonds Certification methodology where the carbon reduction targets can be derived using a linear equation between a 30-year bond and a 5-year bond.

The CO_2-emissions related to the operation of residential buildings are dominated by direct and indirect emissions related to energy use where electricity and district heating are dominant.

2.4.1 Eligibility under criterion 4

Refurbished residential buildings with substantial CO_2 emissions reduction targets qualify. The minimum target value is determined by the term of the bond (e.g. 5 year bond > 30%) in terms of E-value.

2.5 Construction of new buildings built after 2021

To adhere to the EPBD (Directive 2010/31/EU) all EU Member States are to establish national 'nearly zero-energy building' (NZEB) requirements and are mandatory for all new buildings from 2021. In Finland, this directive has already been implemented by Building code of 2017. Buildings that are classified to an A in the EPC-system are NZEBs. In practical terms, this only applies to buildings with on-site PV installations or also other types of RES generation. Energy efficiency requirements for class A is about 25% stricter than class B.

It is in the TEG final report on the EU taxonomy introduced a criterion that qualify buildings that outperform the NZEB requirements by at least 20% in primary energy.

This is best presented in terms of E-values with the thresholds presented in the table below.

Table 7 E-value thresholds 20% below Finnish NZEB requirements.

Building category	E-value 20%<NZEB
Detached houses	68 kWh_E/m^2
Undetached and terraced houses	64 kWh_E/m^2
Apartment buildings	60 kWh_E/m^2

2.5.1 Eligibility under criterion 5

New buildings built after 2021 with energy demand 20 % lower than the national NZEB requirements based on Finland's adoption of the EPBD, are eligible.

3 Impact assessment

Impact is only calculated for the building code criterion in the earlier sections, as this is the only criterion planned used in the first green bond issuance.

Impact calculations are heavily influenced by the grid factor (CO_2/kWh) on electricity consumption, however, electricity is far from the only energy carrier to Finnish buildings, and emission factors for district heating, bio energy and others are included. Below we present two emission impact calculations based on two different emission factors for electricity (emission factors for other energy sources are unchanged). The first calculation uses the same emission factors as used by Nordic Public Sector Issuers: Position Paper on Green Bonds Impact Reporting (January 2020)[16]. These factors are based on the European power production mix (EU25+UK+NO). The second calculation is based on the same system boundaries as the Finnish government is using in their climate policy development. These emission factors and calculated specific emissions (CO_2/m^2) are presented in table 4 and figure 8.

3.1 Residential buildings qualifying according to criterion 1 (building code criterion)

Danske Bank Finland's criterion - New or existing Finnish residential buildings that comply with the Finnish building code of 2010 or later codes.

A reduction of energy demand from the average 173 kWh/m^2 of the total residential building stock to 108 kWh/m^2 is multiplied by the emission factor and an area of eligible assets to calculate impact.

The eligible buildings in Danske Bank Finland's portfolio is estimated to amount to approximately 380,000 square meters. The available data include reliable area per object.

Table 8 Eligible objects and calculated building areas

	Number of objects	Area qualifying buildings in portfolio [m^2]
Apartments	1,158	72,802
Undetached houses	644	50,195
Detached houses	1,691	235,397
Semi-detached houses	213	21,113
Sum	3,706	379,507

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

The calculated average specific energy demand for the eligible assets is 108 kWh/m^2. This is 38% lower than the calculated average of the total residential building stock. The calculated specific CO_2-emissions for the eligible assets is 52 % or more below the calculated average of the total residential building stock.

[16] https://www.kuntarahoitus.fi/app/uploads/sites/2/2020/02/NPSI_Position_paper_2020_final.pdf

The table below indicates how much more energy efficient the eligible part of the portfolio is compared to the average residential Finnish building stock. It also presents how much the calculated reduction in energy demand constitutes in CO_2-emissions.

Table 9 Performance in rounded numbers of eligible objects compared to average building stock

<table>
<tr><th></th><th>Area</th><th>Reduced energy compared to baseline</th><th>Basis for emission factor calculations</th><th>Reduced CO_2-emissions compared to baseline</th></tr>
<tr><td rowspan="2">Eligible buildings in portfolio</td><td rowspan="2">379,507 m^2</td><td rowspan="2">25 GWh/year</td><td>NPSI Position Paper</td><td>5,313 tons CO_2/year</td></tr>
<tr><td>Finnish government</td><td>3,795 tons CO_2/year</td></tr>
</table>

About the advisors

Multiconsult is one of the leading firms of consulting engineers and designers in Norway with a substantial international business. Thanks to its 2,850 highly skilled members of staff, the company is able to provide a range of services where operations are split into seven different areas: Buildings & Properties, Industry, Oil & Gas, Transportation, Renewable Energy Water & Environment and Cities & Society.

Multiconsult have over several years provided services to green bond issuers and was instrumental in the first green covered bonds in Norway.

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