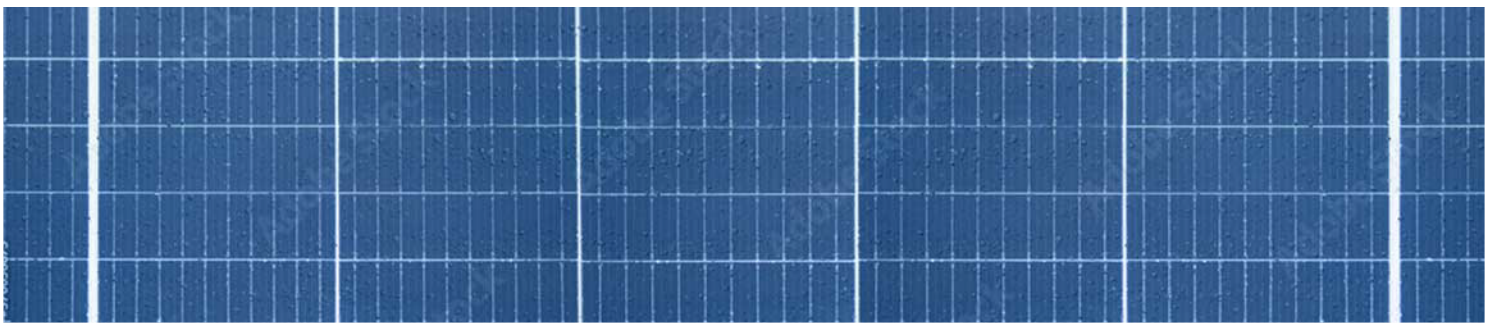
Green homes and the EU Taxonomy

EIENDOMSVERDI'S APPROACH 19 JUNE 2024



About Eiendomsverdi

Since the year 2000, Eiendomsverdi has been collecting, structuring, and refining data on the Norwegian real estate market. Today, Eiendomsverdi has the most comprehensive property database in the Norwegian market and are among the leaders in Europe in advanced statistical value estimation of homes. The company offers a portfolio of products and services to professional players in the real estate market. Eiendomsverdi is also responsible for producing the housing price statistics published by Eiendom Norge.

About Simien

Simien is Norway's leading technology company for energy calculation of homes and commercial buildings. The company develops and delivers energy calculation tools for both commercial buildings and private homes. The company has developed a tool which is used by professional actors to carry out detailed energy calculations and energy certifications of homes and commercial buildings.

Introduction

The EU has developed a classification system known as the EU taxonomy to assess whether economic activities are sustainable. This system also includes the real estate sector. In this document, we have applied the framework of the EU taxonomy to evaluate which Norwegian homes can be classified as green.

There are different viewpoints on what can define a green home. However, the EU taxonomy is a well-established framework that is well-suited to categorise Norwegian homes based on their green characteristics. The taxonomy's classification of green homes is based on the energy performance of the home.

The taxonomy provides three possibilities for classifying a home as green:

1

The home uses at least 10% less energy than a nearly-zero energy building (NZEB)

Homes built after December 31, 2020, that have an energy use that is 10% lower than the national NZEB threshold qualify as green. NZEB is a threshold to be defined at the national level according to directive 2010/31/EU.

2

Energy label A or the top 15% most energy-efficient homes

Homes built before December 31, 2020, must either have an energy label A or be among the 15% most energy-efficient homes in the country to qualify as green.

3

The home has reduced its energy use by at least 30% through rehabilitation

The home has reduced its primary energy demand by 30% through rehabilitation. Measurement of primary energy demand must be taken before and after the rehabilitation.

Energy efficiency is quantified by calculating normalised energy use per square meter per year (kWh/m² per year). In Norway, the calculated energy use is based on the Norwegian Standard NS 3031:2014 Calculations of building energy performance method and data.

Data Sources

Eiendomsverdi has two sources of information for energy efficiency:

1. Energy certificates from Enova
2. Energy calculation model from Simien

Energy Certificates from Enova

Energy certificates from Enova document energy qualities and are usually issued during the sale, rental or completion of homes. An energy certificate includes an energy rating (A to G), based on calculated delivered energy. Delivered energy is practically the energy that must be purchased by the homeowner. Calculated delivered energy is stated in kWh per m² of heated area per year. Additionally, the energy certificate includes a heating rating with a five-part colour scale depending on the energy sources of the heating system, but from an energy efficiency perspective, this colour is not relevant.

The energy scale is used to classify energy efficiency and is reproduced in the tables below for both detached houses and apartment blocks.

FIGURE #1

Limits energy rating - houses

HEATED AREA	A LOWER THAN OR EQUAL TO	B LOWER THAN OR EQUAL TO	C LOWER THAN OR EQUAL TO	D LOWER THAN OR EQUAL TO	E LOWER THAN OR EQUAL TO	F LOWER THAN OR EQUAL TO	G NO LIMIT
50 m²	111,00	152,00	195,00	257,00	321,00	410,00	> F
75 m²	105,67	141,33	178,33	229,67	282,33	356,67	> F
100 m²	103,00	136,00	170,00	216,00	263,00	330,00	> F
125 m²	101,40	132,80	165,00	207,80	251,40	314,00	> F
150 m²	100,33	130,67	161,67	202,33	243,67	303,33	> F
200 m²	99,00	128,00	157,50	195,50	234,00	290,00	> F

Source: Enova

FIGURE #2

Limits energy rating - apartment blocks

HEATED AREA	A LOWER THAN OR EQUAL TO	B LOWER THAN OR EQUAL TO	C LOWER THAN OR EQUAL TO	D LOWER THAN OR EQUAL TO	E LOWER THAN OR EQUAL TO	F LOWER THAN OR EQUAL TO	G NO LIMIT
50 m²	97,00	115,00	140,00	179,00	220,00	280,00	> F
75 m²	93,00	108,33	130,00	164,33	200,00	253,33	> F
100 m²	91,00	105,00	125,00	157,00	190,00	240,00	> F
125 m²	89,80	103,00	122,00	152,60	184,00	232,00	> F
150 m²	88,75	101,25	119,38	148,75	178,75	225,00	> F
200 m²	88,00	100,00	117,50	146,00	175,00	220,00	> F

Source: Enova

The efficiency calculation is designed to assess how well a home utilises energy based on its built-in features and technical solutions, regardless of the home's location and usage. The efficiency calculation is thus independent of the temperature and climate where the home is located. Furthermore, the use of the home is standardised so that the number of people using the home, the indoor temperature they maintain, and other factors do not affect the calculation. This creates comparability for all homes in Norway. Actual energy use will vary with usage and location.

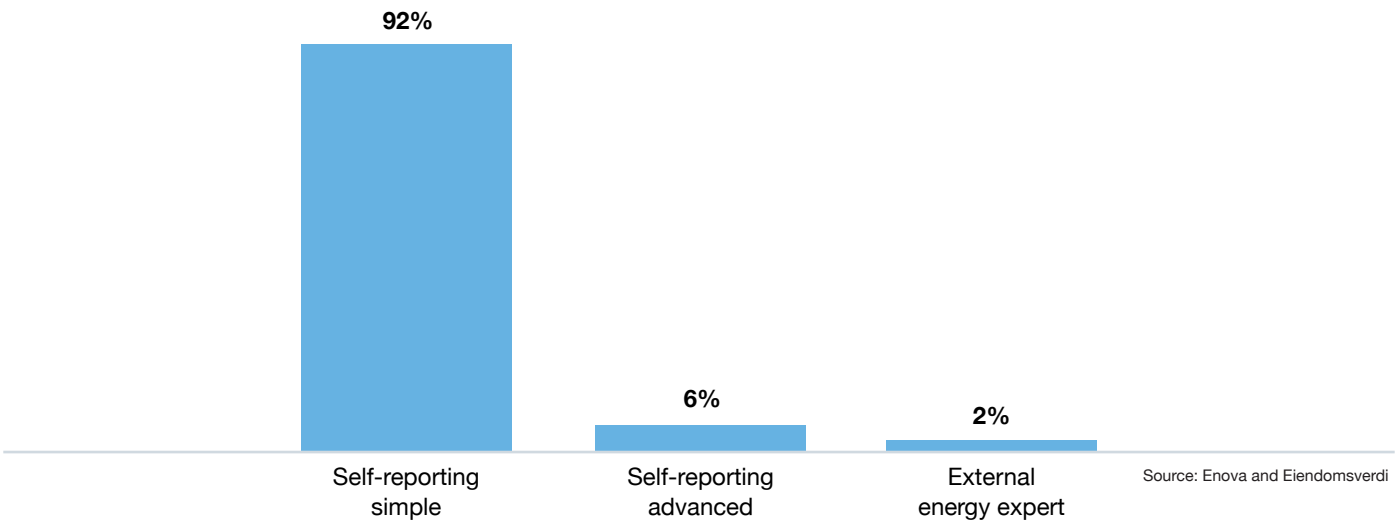
Data

Energy certificates are based on input data. The input data can be reported by homeowners through self-reporting, with varying levels of detail, or by experts with comprehensive details, including measurements of leakage through the building envelope. New homes must have energy certificates performed by experts.

In the energy labeling system up to 2023, there were two variants of self-reporting: simple and advanced. In the simple method, one reported the year of construction, type of housing, usable area, heated area, and heating sources. In the advanced method, there were many information elements to be filled out, much of which was unavailable to non-building experts. This has resulted in a very large proportion of energy certificates being issued based on simple self-reporting. Figure 3 shows the distribution of energy certificates and the basis of the information on which they were issued.

FIGURE #3

Information level in energy certificates from Enova



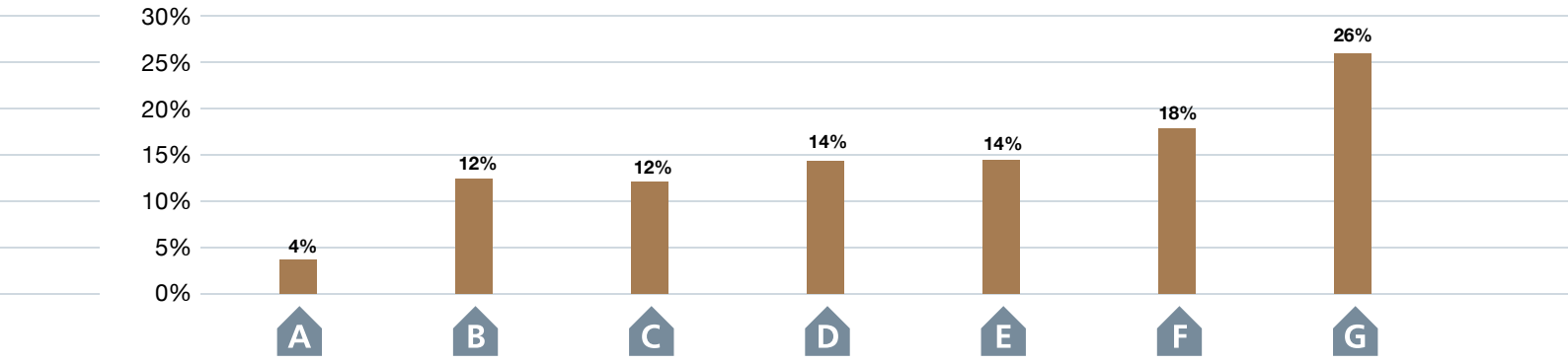
When self-reporting, the model will assume conservative choices for missing information. For example, if a home was built in 1920 and the user does not provide additional information, the model will assume that the technical standard is also from 1920. This helps ensure that the energy certificates reflect a cautious assessment of the home's energy standard but can also lead to some homes' energy efficiency being underestimated if they have been upgraded without this being specifically reported. This effect is amplified by the age of the home; the older the home, the more conservative the values will be, and the likelihood that the home's characteristics have changed increases. For newer homes, technical standards ensure that the characteristics of the home are better known, and the likelihood of changes is lower.

Distribution and Coverage

The distribution of energy certificates in Norway by energy ratings is shown in Figure 4, where we see a large predominance of energy certificates with lower energy ratings.

FIGURE #4

Distribution of energy certificates



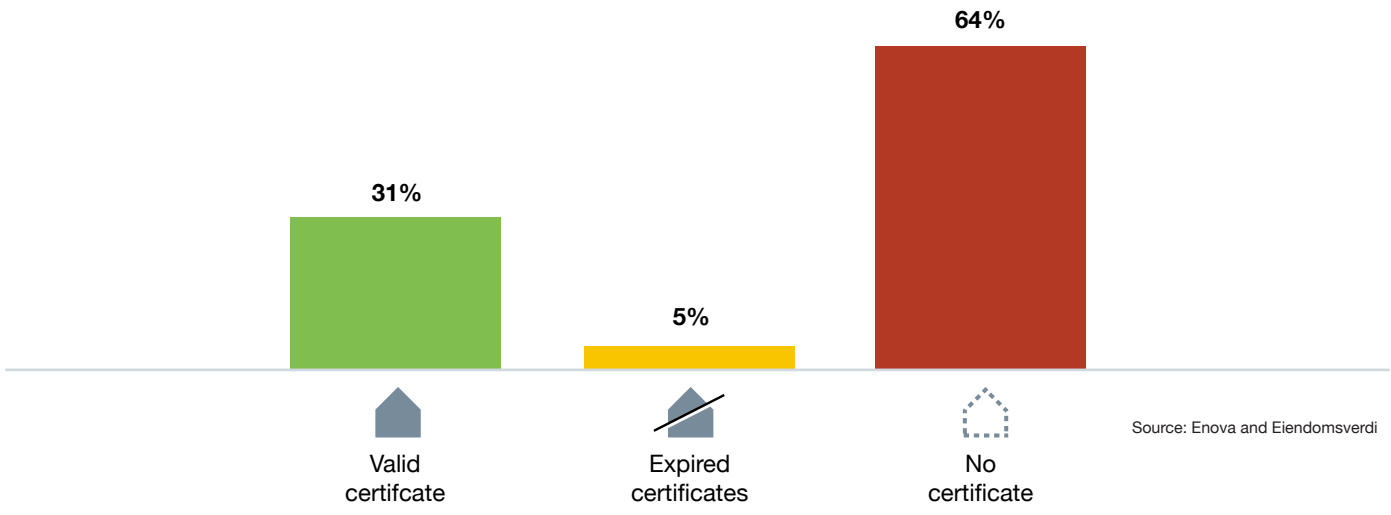
Source: Enova and Eiendomsverdi

Eiendomsverdi has access to data from energy certificates from ENOVA, including the exact energy efficiency in kWh/m² per year. The energy labelling scheme has existed since 2010. There is however varying quality in identifying which property, building, or part of a building the certificate actually applies to. ENOVA only makes available those energy certificates they have identified with a clear connection to a known cadastral unit, a building number, or a usage unit. Eiendomsverdi has linked these energy certificates to 717,120 homes. Where there are multiple energy certificates per home, the most recent energy certificate is chosen.

This means that a large proportion of Norwegian homes do not have energy certificates. At the same time, energy certificates are valid for 10 years, so some of the certificates are not formally valid. The distribution of energy-labelled homes is shown in Figure 5.

FIGURE #5

Share of Norwegian homes with energy certificate



Source: Enova and Eiendomsverdi

We see that we lack valid energy certificates for approximately 70% of the Norwegian housing stock.

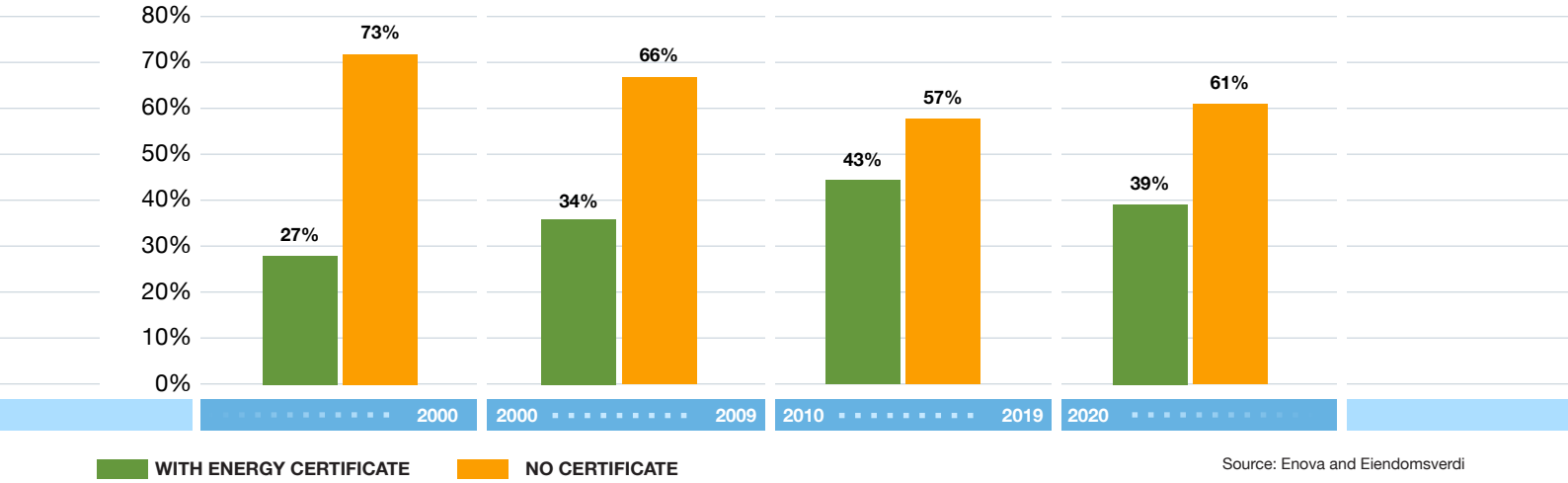
Most homes with energy certificates have either been sold, rented out, or completed since 2010. Therefore, Eiendomsverdi is uncertain whether homes with energy labels are representative for the Norwegian housing stock. We see two reasons for this:

1. Overrepresentation of newer homes (completed since 2010)
2. Homes that are sold have a higher technical standard than homes that are not sold

Figure 6 shows a significant overrepresentation of newer homes in the housing stock that has an energy certificate.

FIGURE #6

Homes with energy certificates per construction era



Source: Enova and Eiendomsverdi

It is also reasonable to assume that homes which are sold and thus have an energy certificate, are often renovated and upgraded after they are purchased. In this way, these homes will likely have a higher standard than homes that are not energy-labelled, and at the same time, the energy certificate may no longer be representative of the home's energy efficiency.
An article from October 2022 by Prognosesenteret, which conducts surveys and analyses the renovation, remodelling, and extension market (ROT), underscores this:

> «Naturally, several factors influence whether a household renovates or not. One of the most important factors is a home changing ownership. Those selling a home often spruce up the surfaces before putting it up for sale, and buyers usually carry out a lot of ROT work (rehabilitation, rebuilding and extension) after they have taken over the home. First, interior work, then exterior.»
>
> Source: Prognosesenteret

Due to the uncertainty related to the representativeness of Enova's data, the recognition that the energy efficiency presented in the energy certificates can often be lower than the actual efficiency, and the fact that a very low proportion of Norwegian homes have energy certificates, we have identified the need for an alternative calculation of energy efficiency.

Energy Calculation Model from Simien

The company Simien has developed a model to calculate energy use, energy labels, and CO2 emissions for homes in Norway. It can serve as a supplement to the existing energy certificates and for identifying energy-efficient homes where no energy certificates have been issued.

Simien's calculation model is based on the same standard as official energy labels, the Norwegian standard for energy calculation of buildings (NS 3031). The model is approved according to this standard and is implemented in a digital tool used by professional actors when preparing energy calculations and energy certificates for buildings. The model has several degrees of freedom, including features of the home.

Simien's model requires a minimum of the following information to estimate: Location (municipality), Year of construction, Type of housing and Usable area (BRA). The model can also take into account additional information such as heated usable area, energy sources (e.g., heat pump, wood stove, etc.), floor information, basement, roof type, ventilation, insulation.

It is also possible to input various assumptions related to the use of the home (average indoor temperature, number of occupants, etc.) and climate adjustment. The model can also calculate values for assumed normal renovation, based on Enova's publication "Potential and Barrier Study: Energy Efficiency of Norwegian Homes" (Source: Enova). This is particularly relevant for insulation and window replacement.

The choices made depend on what the model is to be used for. If we aim to calculate the most accurate energy use, information about climate and usage should be included, but if we attempt to estimate the home's energy efficiency (like Enova), climate and usage should be standardised.

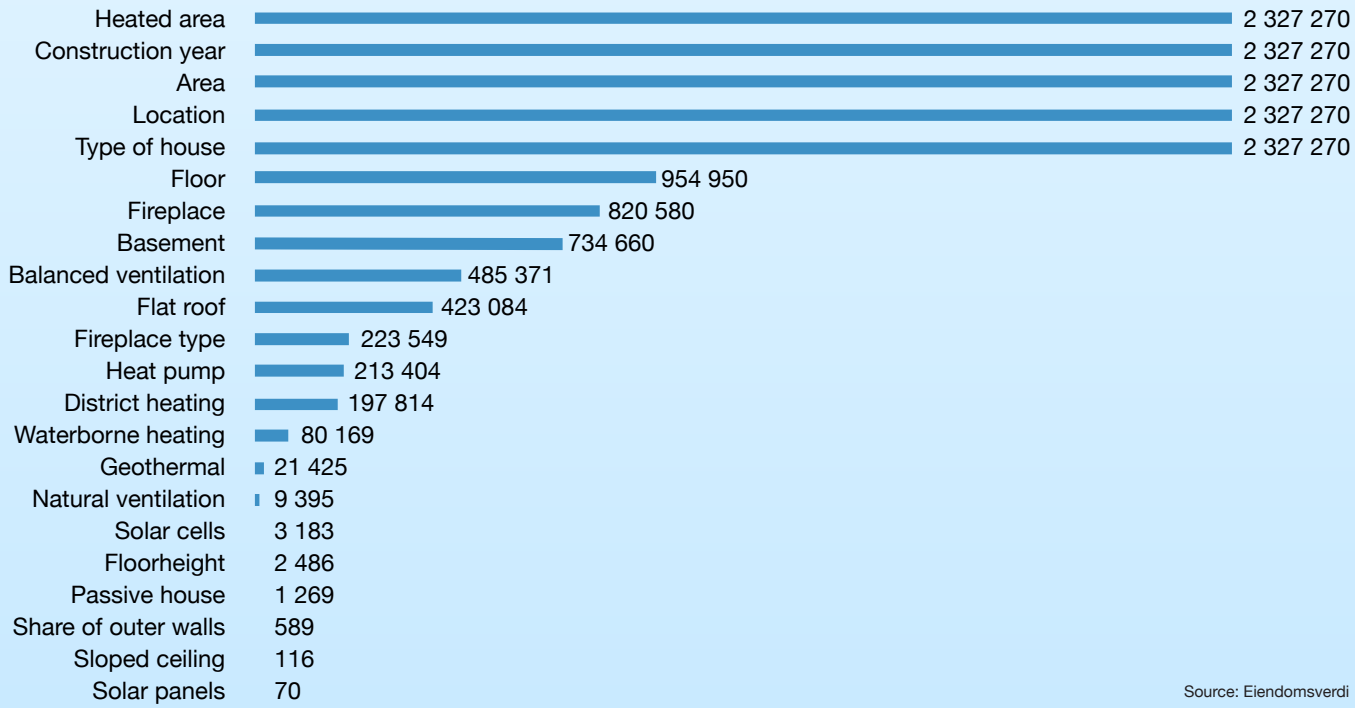
Data

To perform accurate calculations, it is essential that the model receives good input data. Eiendomsverdi has the most complete real estate database in Norway, which provides a good basis for conducting accurate calculations. By combining Eiendomsverdi's database, with detailed information on Norwegian homes, and Simien's model, it is possible to calculate energy use and energy ratings.

Figure 7 provides an overview of available data for various attributes included in the model and shows the number of homes where information is available for each attribute as of June 2024. Eiendomsverdi is continuously working to find new sources of information, and data is manually registered from a variety of sources. The amount of data is thus constantly evolving.

FIGURE #7

Volume of information used in energy calculation



Source: Eiendomsverdi

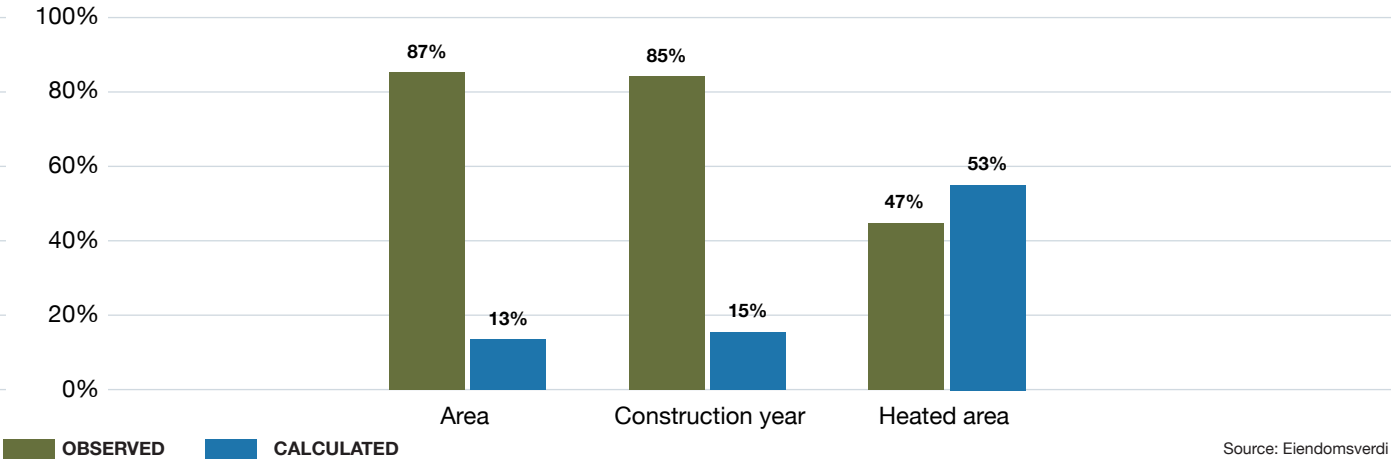
Eiendomsverdi has data on all Norwegian homes regarding the four basic elements: location, housing type, year of construction, and usable floor area (BRA). For year of construction and area, calculated values are used where there are no observable data sources with this information.

We also use our own data on heated area in the model for all homes. Where we have known primary area (PROM), this is used as a proxy for heated area, and where this is missing, we have good conversion models to estimate PROM based on BRA.

Figure 8 shows the proportion of information elements that are calculated.

FIGURE #8

Share of calculated information used in energy calculations



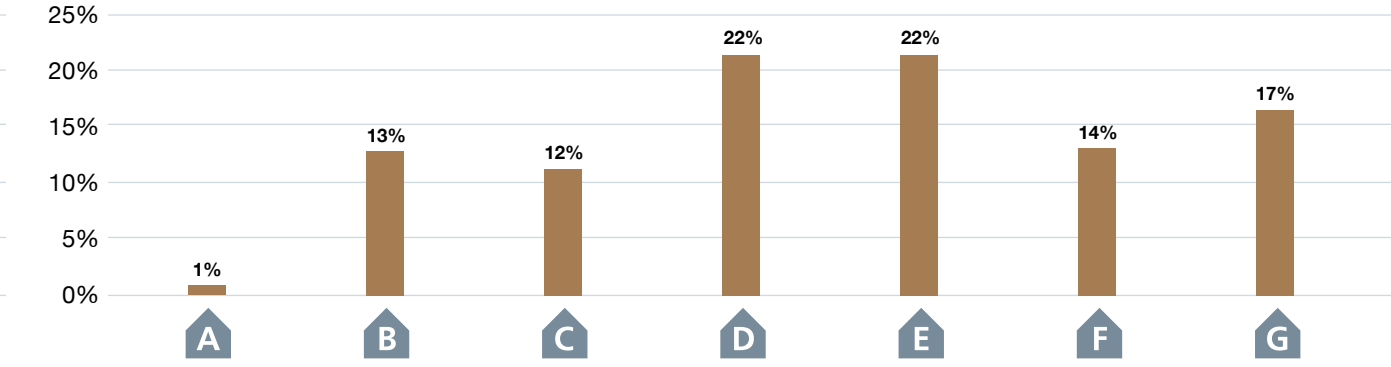
Source: Eiendomsverdi

Distribution and Coverage

In contrast to the energy ratings from Enova, it is possible, based on Simien's model and Eiendomsverdi's database, to calculate energy efficiency for all Norwegian homes. Based on calculations from Simien with information from Eiendomsverdi, we obtain a distribution of calculated energy ratings for all homes in Norway as shown in Figure 9.

FIGURE #9

Calculated energy ratings



Source: Simien and Eiendomsverdi

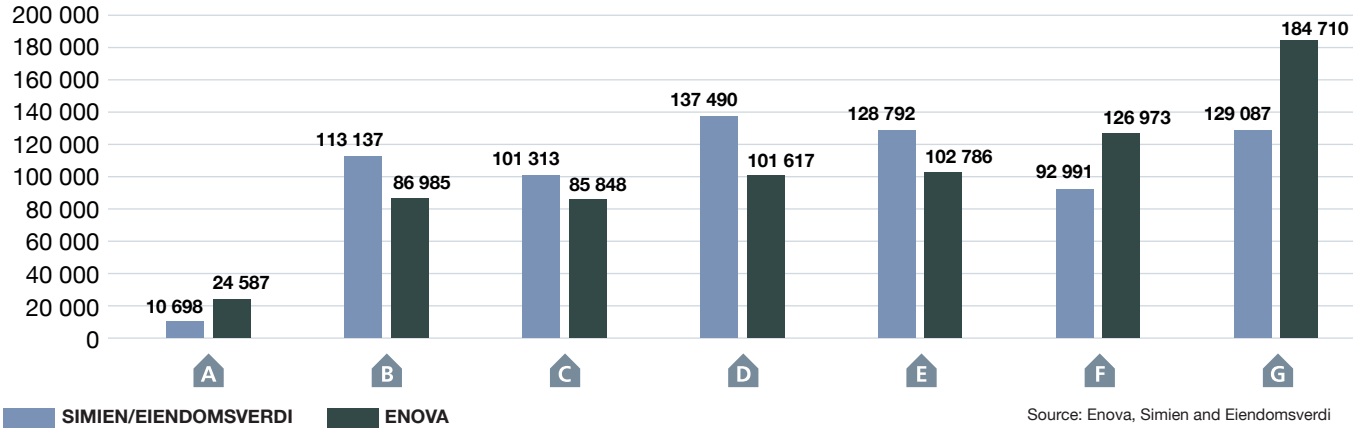
It is worth noting that the Enova dataset contains more homes with energy ratings of A than we calculate. This is because Enova's ratings, especially for the energy-efficient homes, are based on more comprehensive information about the homes than we have access to. On the other hand, we also have more information about many homes than Enova does. This may be where the homeowner has not filled in more than the minimum required information.

Comparison of Energy Calculations between Simien/Eiendomsverdi and Enova

To assess the energy efficiency in the calculations from the two sources against each other, it is easiest to compare the energy ratings, which are a classification of energy efficiency. Figure 10 shows aggregated numbers for energy ratings for Simien and Enova respectively for the same dataset.

FIGURE #10

Distribution of energy certificates Simien/Eiendomsverdi vs Enova



Source: Enova, Simien and Eiendomsverdi

The matrix in Figure 11 shows the distribution for each home, where we compare the energy rating from Enova and the rating calculated by Simien/Eiendomsverdi.

FIGURE #11

Distribution of energy certifcates property-by-property Enova vs Simien/Eiendomsverdi

Source: Enova, Simien and Eiendomsverdi

ENOVA \ SIMIEN / EIENDOMSVERDI	A	B	C	D	E	F	G	
A	2 408	13 342	6 379	2 104	140	94	120	**24 587**
B	5 624	50 669	18 865	7 755	1 860	1 045	1 167	**86 985**
C	1 905	33 911	28 322	15 226	2 645	2 015	1 824	**85 848**
D	589	11 288	32 683	34 138	10 463	7 148	5 308	**101 617**
E	97	1 280	9 157	36 982	29 715	14 706	10 851	**102 788**
F	37	710	3 222	29 338	43 909	26 061	23 696	**126 973**
G	38	1 937	2685	11 947	40 060	41 922	86 121	**184 710**
	10 698	**113 137**	**101 313**	**137 490**	**128 792**	**92 991**	**129 087**	713 508

The colour scale in the figure shows that there is a correlation between the two calculations, with a higher correlation in the lower energy ratings. However, if we specifically look at energy rating A from Enova, we see that the majority of these are estimated to B or C by Simien. Eiendomsverdi does not have access to the input data behind Enova's energy ratings, but it is natural to assume that Enova estimates higher energy efficiency for homes because they have more information than we do. For example, knowing if a home has solar panels.

At the other end of the scale, where Enova has an energy rating of G, we see that Simien/Eiendomsverdi has a large proportion with energy ratings E and F. We know that if the homeowner does not fill out information when the home receives an energy rating from Enova, the model will make very conservative choices. We therefore believe that Simien estimates homes to be more energy-efficient for two reasons: Eiendomsverdi and Simien have more information about the home than Enova, and the Simien model assumes that the homes have been renovated regularly.

Eiendomsverdi's choice

Although it is challenging to find a definitive answer for energy efficiency, access to two separate sources, Enova and Simien, gives us the opportunity to compare and analyse how different input data affect the results. By exploring and comparing what the different models show based on their input data, we hope to identify the strengths and weaknesses of both methods. This will allow us to take advantage of the best of both worlds.

This means that in the dataset from Simien, we use a calculation based on standardised use and no climate adjustment. Based on the recognition that we do not have complete information about the homes, and that many homes have a higher standard than what the information about the year of construction would suggest, we choose to use the model's ability to calculate assumed normal rehabilitation.

We know that Enova has information we do not have for the most energy-efficient homes, and we know that we have information Enova does not have for those with low energy efficiency. Based on the validation and compilation of the two models, we believe that the best estimate for energy efficiency is to choose the lowest calculation of energy efficiency from Enova and Simien's model respectively.

Green homes

1 2 3

The three options for implementing the classification of green homes according to EU taxonomy

1 The home uses at least 10% less energy than a nearly zero-energy building (NZEB)

On behalf of the Ministry of Local Government and Modernisation, The Directorate for Building Quality has created a guide for calculating nearly zero-energy buildings and primary energy requirements. This guide is available on regjeringen.no. The guide is based on values from NS3031:2014, but energy items for technical equipment and lighting should be excluded for building categories such as detached houses and apartment blocks.

The ratio between primary energy and delivered energy is set to 1. The thresholds to be defined as a nearly zero-energy building are summarized in Figure 12.

FIGURE #12

Treshold for nearly-zero energy buildings (NZEB) for homes

BUILDING CATEGORY	NEARLY-ZERO ENERGY BUILDING [KWH/M² HEATED AREA PER YEAR]
Houses	76 kWh/m² + 1 600 kWh
Apartment blocks	67 kWh/m²

Source: regjeringen.no

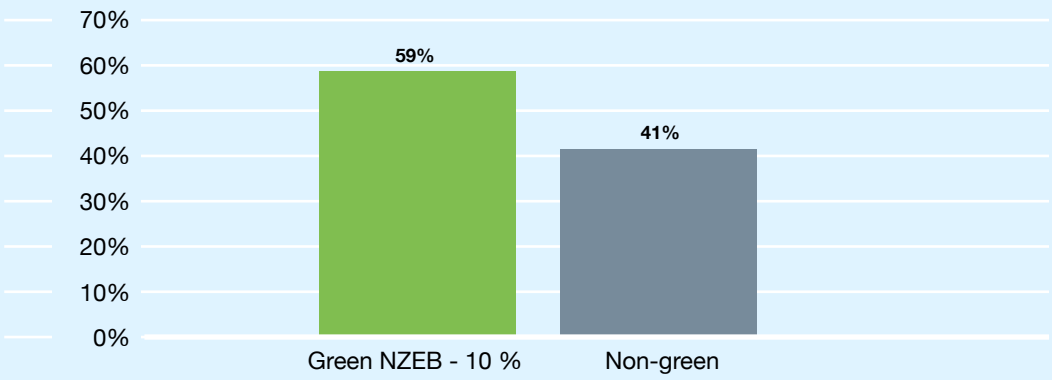
Eiendomsverdi has developed tools in accordance with this guidance for homes (houses and apartment blocks). Here, we only use calculated energy efficiency from Simien, as we do not have detailed energy items in the energy certificates from Enova. Homes built after December 31, 2020, and which have at least 10% lower energy use than NZEB, will be defined as green in Eiendomsverdi.

Results

Newer Norwegian homes generally have a high standard. Although there is no requirement for new buildings to meet the NZEB -10% criteria, it turns out that 59% of all homes built after December 31, 2020, meet this requirement (Figure 13).

FIGURE #13

Share of green homes built after 31 december 2020



2 Energy Label A or Top 15% Most Energy-Efficient Homes

For homes built before December 31, 2020, the taxonomy defines a home as green if one of the following criteria are met:

- Energy Label A
- Top 15% most energy-efficient of the national or regional housing stock expressed in primary energy terms. In Norway, equivalence between primary energy and delivered energy has been chosen. The taxonomy requires adequate evidence that the home is actually among the top 15% most energy-efficient homes by comparing energy efficiency with the national or regional housing stock built before 2021. The comparison should be made with relevant buildings, and there should be a minimum distinction between residential and other buildings.

To identify which Norwegian homes have an energy rating of A or are among the top 15% most energy-efficient, we conduct the following step-by-step analysis:

Data

Collect data on the energy efficiency of homes, including energy rating and estimated energy usage data (kWh/m² per year).

Threshold values to qualify as top 15%

Establish a reference norm for the top 15% most energy-efficient homes based on available data. This involves analysing energy usage data for a large group of homes and identifying the threshold for the top 15%.

Categorisation

Homes with an energy rating of A qualify directly. For the remaining homes, we use energy efficiency data to identify those within the top 15% in terms of energy efficiency.

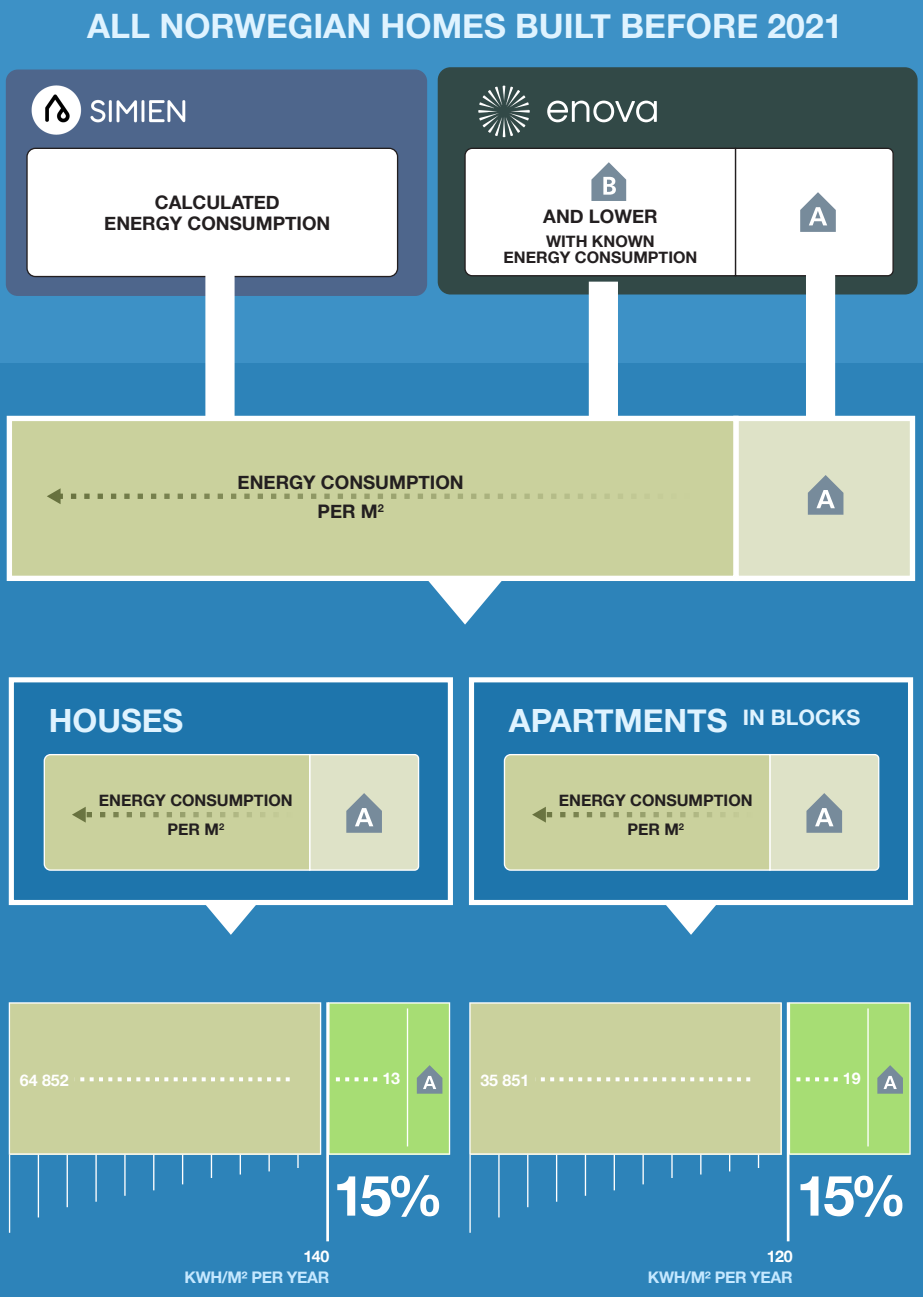
EU has published an "EU Taxonomy Navigator" (FAQ (europa.eu)) In this, the EU states that in the absence of official energy ratings, a technical study can be conducted to estimate threshold values for the top percentiles of the building stock. This allows for the use of calculated energy ratings as a basis to establish a reference norm for the most energy-efficient homes, and to directly use them as an indicator to classify a home as part of the top 15%.

Threshold values to qualify as top 15%

Figure 14 illustrates how we combine energy ratings from the Enova dataset and simulated energy ratings to identify the top 15% most energy-efficient homes. We select all certificates with an energy rating of A from Enova. For all other homes, we choose the lowest calculated energy use per square meter from Enova and Simien/Eiendomsverdi. Where energy certificates are not available, we rely solely on data from Simien/Eiendomsverdi.

FIGURE #14

Schematic process for calculating tresholds for the top 15% most energy-efficient homes in Norway

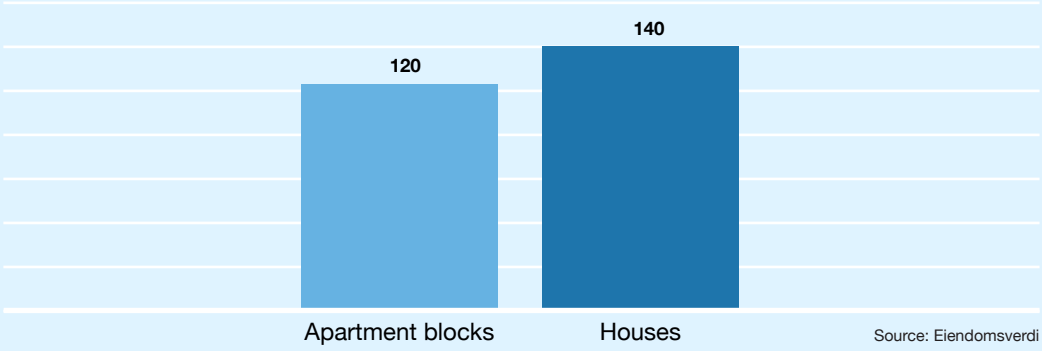


Now that we have a combined dataset of energy usage from both Enova and Simien/Eiendomsverdi, the next step is to determine the threshold values that define the top 15% most energy-efficient homes. The metric we use is normalised energy use per heated area in square meters per year (kWh/m² per year). These threshold values will form the basis for establishing the criteria that determine which homes fall within the top 15%. We establish threshold values for both houses (semi-detached, detached and row houses) and apartment blocks (apartments in blocks). It's important to note that all homes with an energy rating of A are included in the top 15% category.

The thresholds we have identified are 140 kWh/m² per year for houses and 120 kWh/m² per year for apartment blocks.

FIGURE #15

Tresholds for top 15% most energy-efficient homes



Source: Eiendomsverdi

It is natural to assume that the Norwegian housing stock in the coming years will become more energy-efficient. This is due to the construction of new buildings with higher energy efficiency than existing housing stock, as well as political directives, regulations, and incentives influencing Norwegian homeowners to undertake energy efficiency measures. Eiendomsverdi will also gather more information about individual homes over time, which could affect the calculation of threshold values. Therefore, it is natural to update the thresholds for green homes on a regular basis. Eiendomsverdi aims to update these thresholds annually, next scheduled for early 2025.

Results

This means that a total of 15% of Norwegian houses and 15% of Norwegian apartment blocks will be classified as green in this category. This totals 343,329 homes as of June 2024.

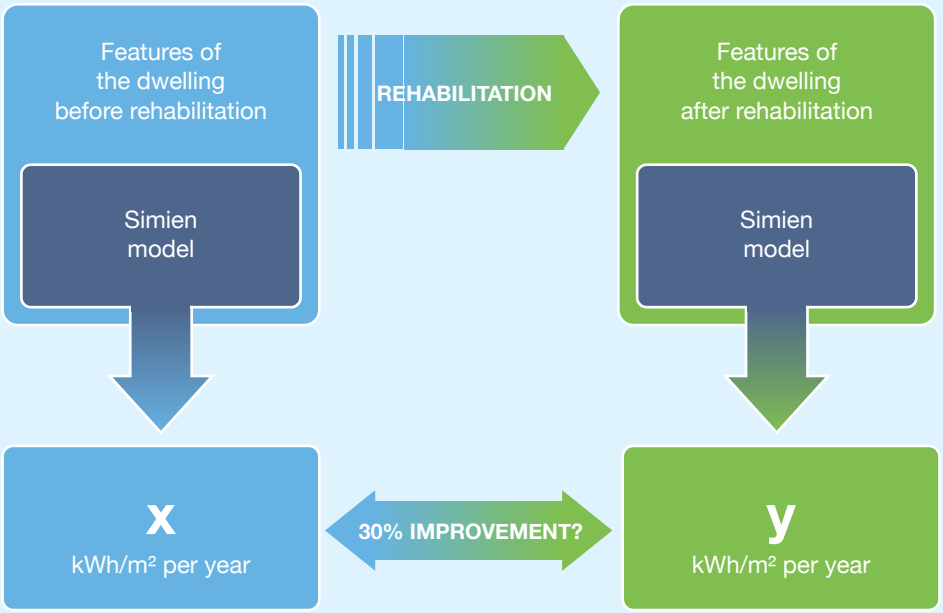
3 The home has reduced its energy consumption by at least 30% through renovation

To promote energy efficiency measures in existing building stock, a home will be classified as green if it increases energy efficiency by at least 30 percent. This provision recognises that significant improvements in energy efficiency can be as valuable as achieving top-level efficiency in absolute terms. By including this option, homeowners and investors are encouraged to implement energy-saving measures that can lead to substantial reductions in energy consumption and thereby contribute to reduced environmental impact.

Calculating the home's energy usage by examining its properties before and after renovation will allow for determining the percentage reduction in energy consumption. Calculated energy usage can be based on the same methodology, using the Simien model as previously described in this document.

FIGURE #16

Reduction in energy use in connection with rehabilitation



Results

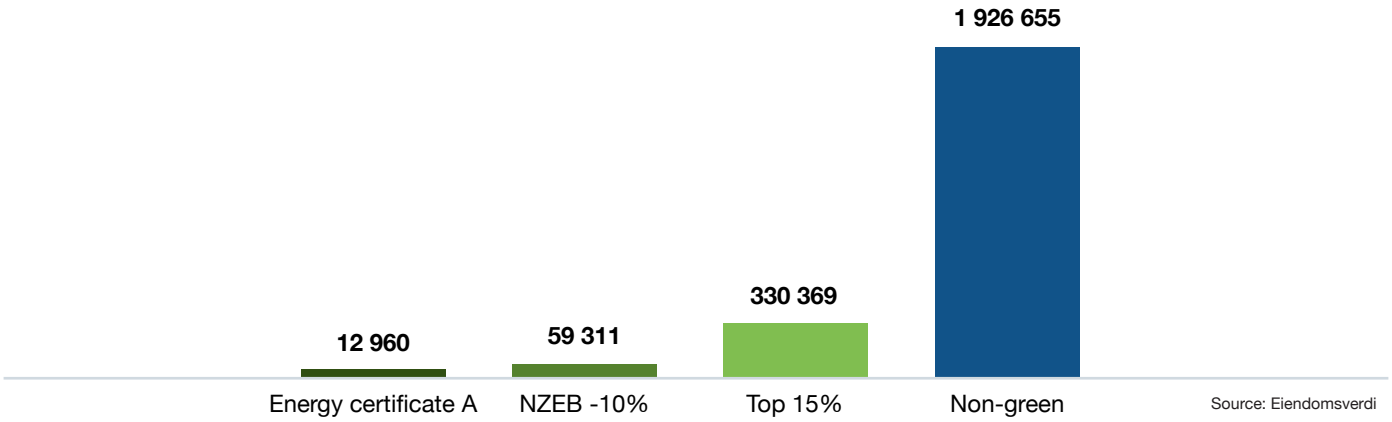
These are homes that are not initially classified as green but become green through changes made to them. Therefore, there are no specific figures available on how many homes can be classified as green in this category.

Green homes in Norway summarised

Out of the total housing stock, we have identified that approximately 17% of the homes are classified as green. The majority achieve this classification due to the "Top 15%" criterion. Distribution and volumes can be seen in Figure 17.

FIGURE #17

Distribution of green homes

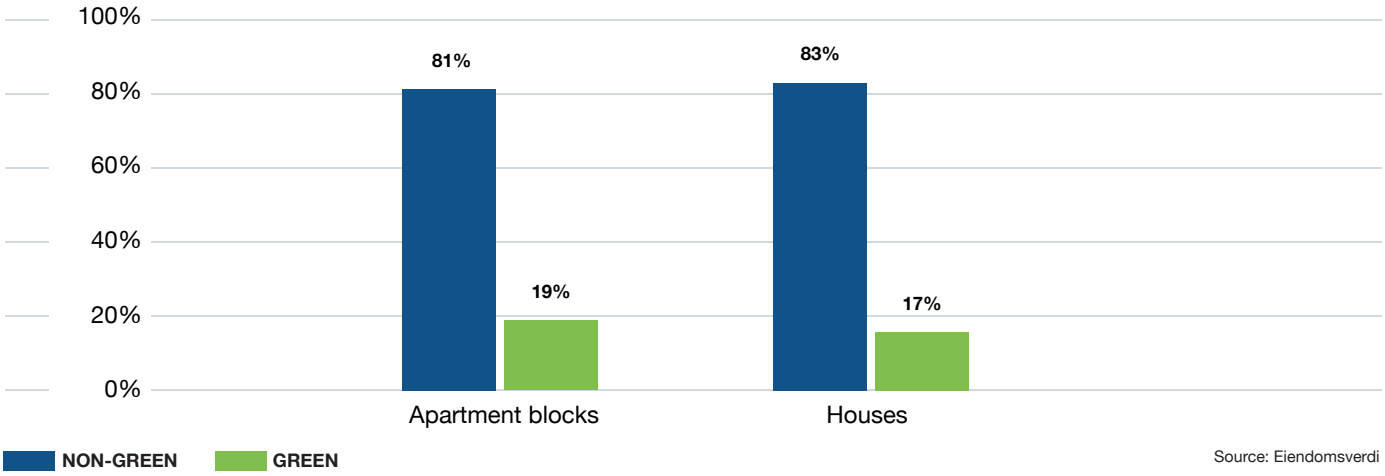


Source: Eiendomsverdi

Figure 18 shows the distribution within each building category, where we observe a slightly larger proportion of apartment blocks classified as green compared to houses.

FIGURE #18

Distribution of green homes - building category

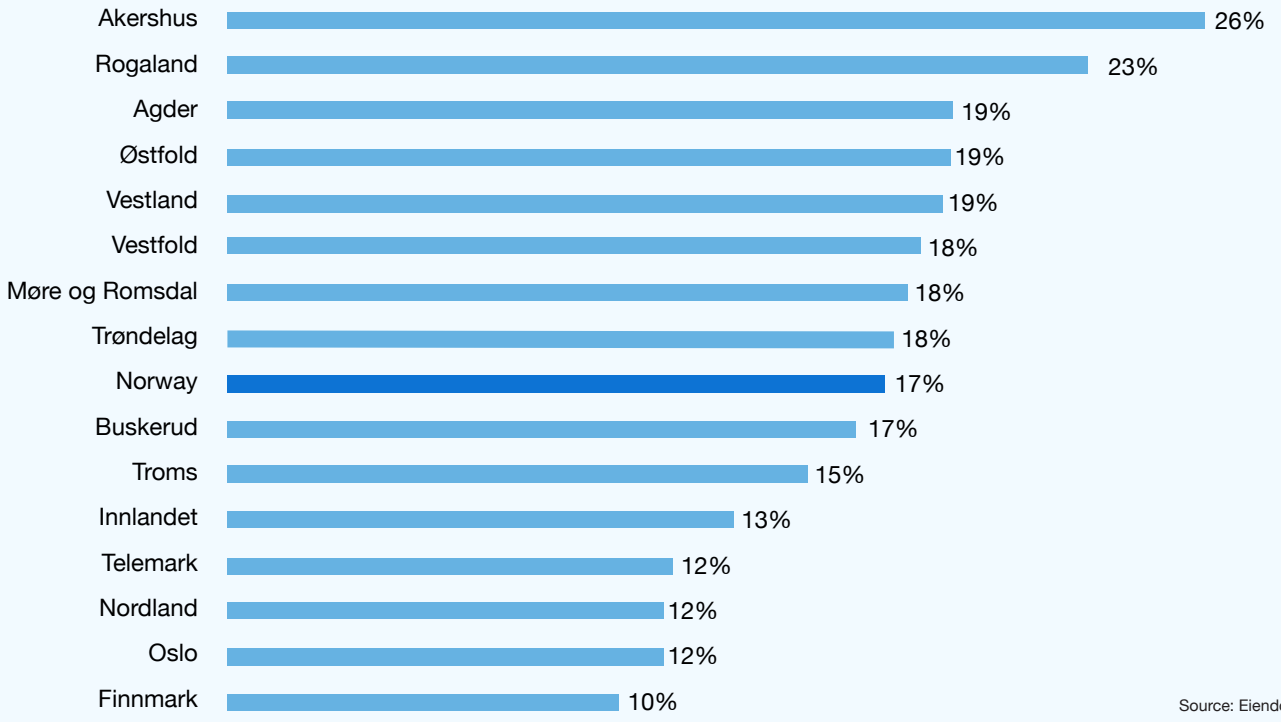


Source: Eiendomsverdi

It is also interesting to investigate the geographical context. Since we have not adjusted for climatic conditions, this will be based on the characteristics of the housing stock in different areas. Figure 19 shows the proportion of green homes within each county.

FIGURE #19

Distribution of green homes - by counties

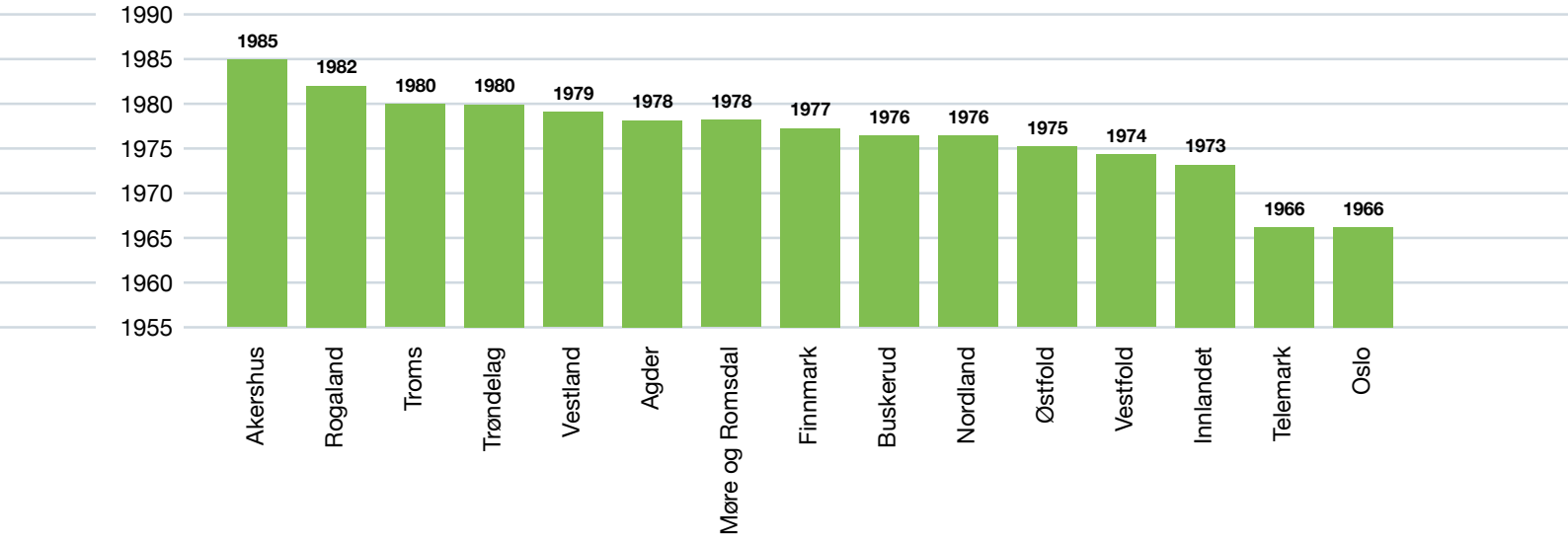


Source: Eiendomsverdi

Akershus and Rogaland are the counties with the highest proportion of green homes, while Oslo has the lowest proportion. A likely explanation is that these counties have a higher percentage of newer homes, as shown in Figure 20.

FIGURE #20

Average construction year per county



Appendix A

Definition of homes and building categories

The energy labelling scheme in Norway categorises homes into building categories: houses and apartment blocks. We define the building category apartment blocks as apartments in blocks. Apartments in single-family homes, row houses, detached houses, and terraced houses fall under the houses category. Houses also includes detached houses, semi-detached houses, and row houses. The houses category in the energy labelling scheme also includes vacation homes, but Eiendomsverdi's methodology currently does not encompass vacation homes.

FIGURE #21

Building category and type of house

BUILDING CATEGORY	TYPE OF HOUSE
Apartment blocks	Apartment ..... in blocks
Houses	Detached
	Semi-detached
	Row house
	Apartment ..... in detached
	Apartment ..... in semi-detached
	Apartment ..... in houses
	Apartment ..... in terraced houses

NS 3031

The Norwegian Standard NS 3031:2014 "Calculations of energy performance for buildings - Method and data" conflicts with the European standard NS-EN ISO 52000-1 "Energy performance of buildings - Overall energy use and definition of energy ratings." As a result, NS 3031:2014 was formally withdrawn on February 1, 2018. NS 3031 is currently under revision to align with the content of NS-EN ISO 52000-1 and the EPBD (Energy Performance of Buildings Directive) standards. As of June 2024, the standardisation committee has not yet completed this work. In the absence of a valid version of NS 3031, NS 3031:2014 is therefore used.