Norges Bank

7 | 2024

Staff memo

Home energy conversion can be a net cost for the average household

05.12.2024

Haakon Solheim
Bjørn Helge Vatne
Norges Bank
Financial Stability

Key words
Climate policy
House prices
Household finances
Energy efficiency

ISSN 1504-2596 (online)
ISBN: 978-82-8379-346-8 (online)

The energy transition of homes can be a net cost for the average household*

Haakon Solheim, Bjørn Helge Vatne

Norges Bank, Financial Stability

Abstract

Energy consumption in homes accounts for over 30 percent of annual Norwegian electricity consumption. The government has set targets to reduce energy consumption in the housing sector. Measures that can increase energy efficiency in the housing sector are both known and available, but they will require significant investment. Based on estimated energy consumption per home, we analyse the ability of Norwegian homeowners to finance stricter energy efficiency requirements without public support. The estimate is based on information about homeowners' income, debt and wealth and on homes' estimated current electricity consumption, size and type. We find that around 10 percent of homeowners do not have the financial means to implement the energy efficiency measures required to comply with the requirements. The measures result in lower electricity expenses, but at current interest rates and electricity prices, there is reason to believe that such energy efficiency improvements will be a net cost for the average household. To assess these costs, access to detailed information about a home's energy consumption is key. If energy efficiency improvements are to be debt-financed, this will increase demand for new loans.

*The views and conclusions expressed in this publication are the authors' own and do not necessary reflect those of Norges Bank. This paper should therefore not be reported as representing the views of Norges Bank. We would like to thank Henrik Borchgrevink, Torbjørn Hægeland, Kjersti-Gro Lindquist, Nina L. Midthjell, Carsten Pihl and Norges Bank Conference participants for their input and comments. Any errors or omissions are solely the responsibility of the authors

1. Introduction

If Norway is to meet the targets set out in the Climate Change Act for lower greenhouse gas emissions, energy consumption will have to change. Power currently obtained from fossil fuels must be obtained from other sources. Internal combustion engines need to be replaced with electricity, and more clean energy needs to be produced from sources such as hydropower, solar energy and wind power. At the same time, electricity consumption must be reduced wherever possible so that energy can be used for new purposes.

Norwegian households have low direct greenhouse gas emissions. As early as 2012, 79 percent of household energy consumption came from electricity, which in Norway is mainly produced by hydropower. Sixteen percent of energy consumption came from bioenergy (such as firewood) and only 3 percent from oil and kerosene[1]. Approximately 80 percent of household energy consumption is used to heat and cool homes and for hot water[2].

In many areas, it may be difficult to reduce energy consumption without reducing activity levels. However, the housing sector has considerable potential for reducing energy consumption without necessarily lowering housing standards. There are several known ways to improve the energy performance of homes, such as using air source heat pumps and ground source heat. Another measure is to replace electricity usage with more biofuel usage (district heating from waste incineration, firewood, pellets, etc.). Homeowners can also reduce energy consumption through better insulation (replacing windows, retrofit insulation, etc.)[3].

In light of this, efforts have long been made to implement measures to improve energy performance in the housing sector. Our analysis is based on the premise that Norwegian homeowners may be required to invest to improve the energy performance of their homes in the years ahead. Such requirements could theoretically be implemented at short notice. If homeowners are to meet such requirements without public support, they will have to finance the measures by drawing on existing financial assets or by taking on debt. In isolation, more debt will reduce household disposable income through higher interest expenses. Taking on debt to save energy may breach existing regulations, such as the current Lending Regulations. Some households will not be able to finance this investment and could risk having to sell the home they currently own.

There have long been strict energy-efficiency requirements for new homes. However, the targets to improve energy performance across the entire housing stock mean that new energy-efficiency requirements must also apply to existing buildings. The

[1] Official statistics describing energy consumption by homeowners in Norway are incomplete and were last updated in 2012, see Statistisk Sentralbyrå (2024b).

[2] Note that these are figures from the EU, see European commission (2024), as reliable figures for Norway appear to be unavailable.

[3] The most cost-efficient way to reduce energy consumption in homes is to accept lower indoor temperatures when it is cold and reduce the average living space per household. These are measures that can reduce living quality and occupant utility. We disregard such adjustments in this analysis.

EU issued its first Energy Performance of Buildings Directive (EPBD) in 2010. The latest revised version of the EPBD was implemented in May 2024.[4] The EU's target is now to reduce energy consumption in the housing sector by 16 percent by 2030 and by 20-22 percent by 2035. In 2023, the Ministry of Petroleum and Energy presented its 'Action plan for energy efficiency in all parts of the Norwegian economy'[5], which also discusses energy consumption in buildings. In the action plan, the government requests that the Norwegian Water Resources and Energy Directorate (NVE) investigate a 10 TWh electricity consumption reduction target for the building stock (residential and commercial buildings) by 2030.[6]. In the first eight months of 2024, Norwegian households consumed 26.4 TWh of electricity, which accounted for around 32 percent of total electricity consumption in the period.[7]

Until now, requirements for existing homes have mainly taken the form of "soft" requirements. For example, since 2009, energy labelling has been mandatory in Norway when selling a residential property.[8] Such energy labelling can be provided by the owner using a simplified registration process, or by an expert.[9] For many years, Norwegian authorities have subsidised various energy efficiency measures, such as replacing old wood-burning stoves or installing air source heat pumps. Norway fully phased out oil-fired heating in private homes in 2020.[10]

Should it be possible to achieve the type of goals outlined in the EPBD and in the action plan however, for energy efficiency improvement by 2030, major measures are required within a fairly short time. Although several proposals for new requirements in the EPBD were modified towards the end of the process, there is still a goal of zero emissions: "With a view to achieving the decarbonisation of the building stock by 2050, the recast EPBD also foresees that deep renovation should transform buildings into zero-emission buildings after 2030." (European Commission (2024)).

In this analysis, we examine how homeowners can handle this type of financial shock and what challenges this can create for the financial system. The analysis is based on homeowners' income, debt and wealth at the end of 2023 and the size of their home owned in the same year. The estimated cost of energy-saving improvements is based on an estimate of current energy consumption per home and an estimate of how much it would cost per square metre to bring energy consumption down to a "norm" for a similar type of home in the same area.

[4] See European commission (2024).

[5] See Olje- og energidepartementet (2022).

[6] See Energidepartementet (2016).

[7] See Statistisk Sentralbyrå (2024a) These are figures up to August 2024. Electricity consumption is highly dependent on annual variations in weather and temperature. Household energy consumption in the first eight months of 2024 was 1.7 TWh higher than the corresponding period in 2023 and 2 TWh higher than in the same period in 2022. At the beginning of 2024, Enova pointed out that electricity consumption by homeowners fell in 2022 and 2023, especially in secondary holiday homes that were not covered by the electricity support scheme, see Enova (2022). Note that annual electricity consumption in Oslo is about 9 TWh, see Sentrumsfordel (2024).

[8] See Energidepartementet (2009).

[9] See Enova (2024).

[10] See Miljødirektoratet (2019)

The analysis does not attempt to provide an exact assessment of energy efficiency improvement costs for each individual home but rather estimates what a privately financed solution may entail if implemented quickly. In many homes, the investment we predict will already have been made. For many homes, we will therefore overestimate the need for investment. We assume that the energy efficiency measures must be implemented within one year. In practice, such measures will be carried out over a longer implementation period.

We also disregard that authorities may introduce energy relief measures, such as subsidies or tax deductions to reduce costs. Such support is assumed to be part of the government's action plan but has so far been reflected to a lesser extent in actual allocations and budget priorities. If many energy transition requirements were to be introduced simultaneously, it is also not certain whether the authorities could be as generous as we now often assume. In that case, it may be useful to have considered a possible corner solution.

Measures that affect the cost of owning a home can also affect house prices. This is supported by the literature. Ferentinos et al. (2023) shows that when a general requirement was introduced to implement minimum energy efficiency standards in British homes, the fall in property prices for homes that had not implemented the necessary measures was about equal to the estimated cost of the energy efficiency improvements. After the improvements, the value of homes would rise in response to reduced costs for running these homes. Zancanella et al. (2018) finds that home values increase by 3-8 percent after such energy efficiency improvements, which corresponds to the value of reduced energy consumption.

We find that about 90 percent of current homeowners will be able to meet their financing needs through available financial means, ie income, wealth and available bank credit. At the same time, our results show that homeowners with low income and high levels of debt may find it difficult to meet such requirements. For many homeowners in rural areas, costs will be high compared to current property values. Given our assumptions, the energy efficiency measures will result in reduced liquidity for those needing to invest, even after taking electricity savings into account. If this is to be profitable in the sense of private financial returns, we must assume higher electricity prices and lower interest rates than currently faced by homeowners. Energy efficiency requirements will reduce the value of the housing stock, yet home values will increase once the energy efficiency measures have been carried out. The increase in value will be less than the cost of the energy efficiency measures. The measures must be expected to result in a marked increase in credit demand. Banks will therefore play a key role in the transition process.

In this paper, we first provide an estimate of the cost of energy efficiency improvement requirements for the individual homeowner. We then estimate how many Norwegian homeowners are able to meet such an investment by drawing on their own financial means or by loans secured on their existing homes. Next, we look at the effect of debt-financed investment on household liquidity and discuss possible effects on house prices. Finally, we consider the implications for Norwegian banks.

2. The energy transition of homes will be costly

In this analysis, we use three different sources of fully anonymised data:

- Price and energy consumption estimates for all Norwegian homes obtained from Eiendomsverdi (2024) (a housing appraisal firm). In this analysis, we use the status at the end of 2023.[11]
- Data on who owns the respective homes and data on the size, type and location of the homes obtained from Kartverket (2024) (the Norwegian Mapping Authority).
- Data on the income, debt and bank deposits at the end of 2023 of those listed as owners of the homes obtained from Skatteetaten (2024) (the Norwegian Tax Authority).

In principle, Norwegian homes must have an energy label at the time of sale, although this labelling has largely been obtained through self-reporting by the seller.[12] Eiendomsverdi estimates the energy consumption of all homes using a method that should reflect the way homeowners can obtain energy certificates through self-reporting. This means that easily identifiable characteristics of a home are used to determine energy performance certificates. In practice, this estimate is mostly determined by a home's construction year.[13]. The older a home, the higher the estimated energy consumption. The estimate does not take into account significant home renovation measures and energy efficiency improvements since its construction year. In addition, Eiendomsverdi adjusts the estimate for geographical location, reflecting energy consumption variation due to temperature differences between counties.

Tabell 1: Overview of consumption, norm consumption and potential savings (TWh)

Type of home	**Number of homes**	**Estimated consumption (TWh)**	**Norm consumption (TWh)**	**Potential savings (TWh)**	**%**
Detached houses	758 884	27.9	19.7	8.6	30.9
Flats	567 497	7.3	4.9	2.4	32.6
Terraced houses	102,062	2.1	1.5	0.6	28.7
Semi-detached houses	134,954	3.7	2.4	1.3	36.7
Total	1,563,397	40.9	28.5	12.9	31.6

Sources: Eiendomsverdi, The Norwegian Tax Administration and Norges Bank

[11] See Eiendomsverdi and Siminen (2024) for a description of the data.

[12] Note that in autumn 2024, the Ministry of Energy has circulated for comment a proposal for a new energy labelling system for Norwegian homes.

[13] It can be questioned whether the practice of self-reporting provide the buyer with the necessary information. Cassidy (2023) looks at the introduction of mandatory energy labelling in Austin, Texas. She finds that energy labelling only affected house prices when it provided information that was not observable without expert help. An energy label largely based on the home's construction year - which is also clearly stated in a sales report - provides little additional value.

In total, we have data on almost 1.6 million homes, see table 1. Homes are divided into four different categories: flats, terraced houses, semi-detached houses and detached houses. Detached houses account for 49 percent of homes and 68 percent of total energy consumption, while flats account for 36 percent of homes and 18 percent of energy consumption.

Total energy consumption, based on figures from Eiendomsverdi, is estimated at 41 TWh per year (see Table 1), which is approximately 30 percent higher than household energy consumption reported by Statistics Norway. The difference may partly reflect that Eiendomsverdi's estimation method assumes that the entire home is uniformly heated. In practice, we must assume that this varies widely between different types of homes. In the following, we assume that Eiendomsverdi's estimate is "correct". We thus exaggerate actual electricity consumption somewhat and we also exaggerate potential savings from energy efficiency improvements.

To obtain a reference for the objective of energy efficiency improvements, we establish a norm for energy consumption. Norm consumption is set as the energy consumption of the 15 percent most energy efficient homes per square metre in each housing group.[14]. Since Eiendomsverdi has adjusted energy consumption based on regional factors, we calculate a norm per county. If all households were to reduce their estimated electricity consumption to our estimated norm for each home, total electricity consumption would be reduced by 12.9 TWh.

Homes with higher energy consumption than the norm are divided into three categories: (i) homes with up to 10 percent higher consumption, (ii) between 10 and 20 percent higher consumption and (iii) above 20 per cent higher consumption. The categorisation is intended to take into account that investment cost is probably less affected by whether a home is poorly insulated or very poorly insulated as the insulation must be replaced regardless, which costs the same irrespective of whether the original insulation was very poor or rather poor.

For homes in category (i) energy efficiency costs are set at NOK 1 000 per square metre; for category (ii) NOK 2 000 and for category (iii) NOK 3 000. This is a rough simplification of actual costs based on an assessment using information from various sources concerning energy efficiency costs[15]. Broadly, energy efficiency adjustments for category (i) will be the installation of an air source heat pump and minor measures to improve insulation, for category (ii) it will be the installation of an air source heat pump and new windows, while for category (iii) this is intended to include the installation of an air source heat pump and energy upgrading, the replacement of windows and doors, as well as extensive retrofit insulation. We must emphasise that there is a great deal of uncertainty involved here, and that this is only a starting

[14] The choice of 15 percent is based on the EU's Green Homes Directive target, which is that a home must be among the 15 percent most energy efficient to qualify for green loans. Note that Eiendomsverdi's figures are based on estimated consumption per square metre, not actual consumption - so it is not the case that unoccupied homes will have low consumption.

[15] The most important source is a thorough review of typical examples of energy efficiency improvements in the article "Slik forbedrer du energimerking av boligen" [How to improve the energy labelling of your home] (in Norwegian only), see Axelholm (2024)

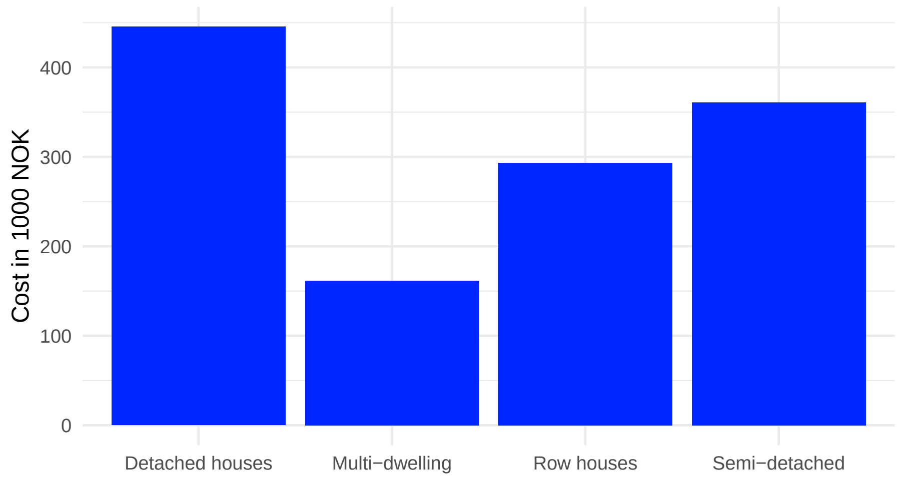
point for further discussion of the correct cost. A majority of homes are in category (iii), see Table **??**. This reflects the fact that 72 percent of the homes in our sample were built before 2000 and 38 per cent were built before 1950.

Tabell 2: Share of housing stock by construction year and energy consumption within each construction year. In percent.

Construction year	**Share of homes**	**Norm**	**Norm + 10%**	**Norm + 20%**	**Over 20%**
After 2010	15	69	20	7	5
2000-2010	13	28	23	29	19
1990-2000	9	2	15	31	52
1970-1990	26	1	4	16	79
1950-1970	19	1	0	0	99
1920-1950	6	0	1	0	99
Before 1920	13	6	3	5	87

Sources: Eiendomsverdi, the Norwegian Tax Administration and Norges Bank

Figur 1: Cost of energy upgrading by type of home. Average estimated cost per housing unit in NOK by type of home.



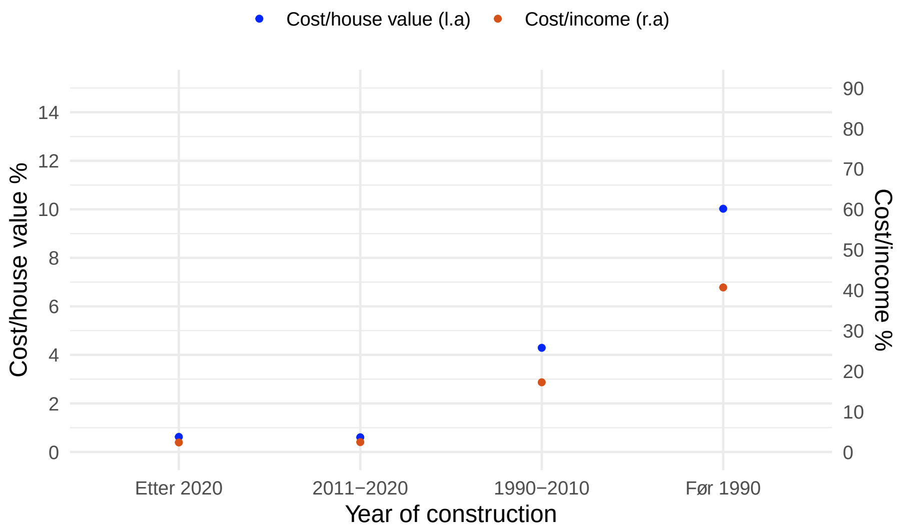
Sources: Eiendomsverdi and Norges Bank

The average cost of energy upgrading a home varies depending on the type of home. We estimate the average cost for a detached house to be approximately NOK 450 000, compared with approximately NOK 160 000 for a flat (Figure 1). On the one hand, these amounts may be seem very large, on the other hand, many homeowners who have tried to improve the energy performance of their homes will likely have found that the final total amount is higher than our estimate. The actual renovation cost is often high, not least because specific changes often necessitate other changes that also entail a cost. In our view, it is more likely that we underestimate the cost of energy efficiency improvements for flats, which will depend on the specific characteristics of the building itself (such as whether it is possible to install district heating), than that we overestimate the cost for detached houses.

For each home, we use an estimated property value from Eiendomsverdi. For most homes, the estimated cost of the energy upgrade is between 8 and 10 percent of this property value. As expected, this cost varies significantly with the construction year, Figure 2. For new homes, the estimated cost of the energy upgrade is low, while for homes built before 1990, the average cost is slightly above 10 percent of the property value. This follows mechanically from the way energy consumption is estimated. As previously mentioned, many old homes will have been upgraded. This is not taken into account in our analysis.

Energy upgrade costs in relation to estimated home value varies widely across counties. This is related to both home value and housing stock composition. Cities and suburban areas (Oslo and Akershus) with smaller housing units and high house prices naturally have rather low energy upgrade costs relative to home value, Figure 3. Counties with a high proportion of detached houses and lower property values have relatively high energy cost-to-house value ratios.

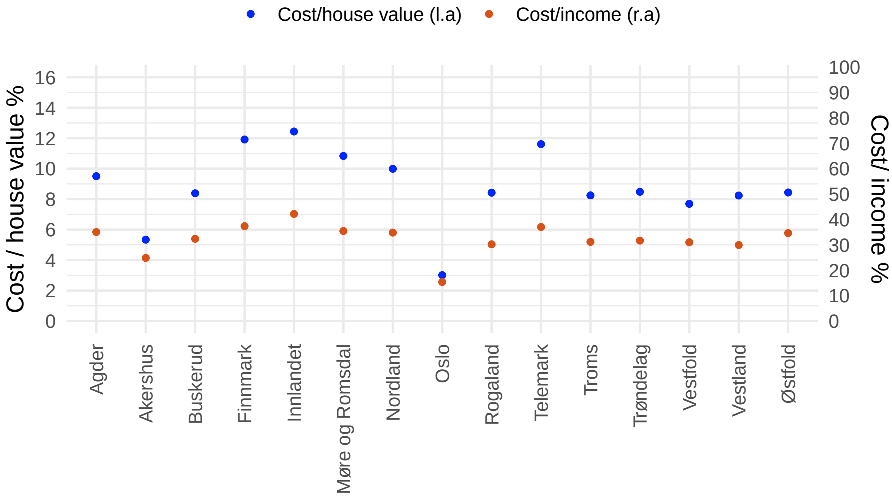
Figur 2: Old buildings will require most investment. Average cost of home energy upgrade relative to home value (lhs) and homeowner income (rhs) by construction year.



Sources: Eiendomsverdi and Norges Bank

We can also examine the energy upgrade in relation to homeowner income. Homeowner income provides an indication of ability to finance the cost of the upgrade. In practice, the distribution of expense over income correlates with the distribution of expense over property value. Oslo and Akershus have the lowest scores for both measures, but there is narrower spread between urban and rural areas when we examine the relationship between expense and income than between expense and property value.

Figur 3: Large differences between urban and rural areas. Average cost of home energy upgrade relative to home value (lhs) and homeowner income (rhs) by county



Sources: Eiendomsverdi, Norwegian Tax Administration and Norges Bank

3. Most homeowners can finance energy efficiency improvements by drawing on deposits or borrowing

In our analysis, homeowners are required to undertake a home energy upgrade, which for most homeowners costs between approximately NOK 100 000 and NOK 600 000, depending on the size of their home. Since few households can finance such an investment with current income, two alternatives remain -they can either draw on savings or they can borrow.

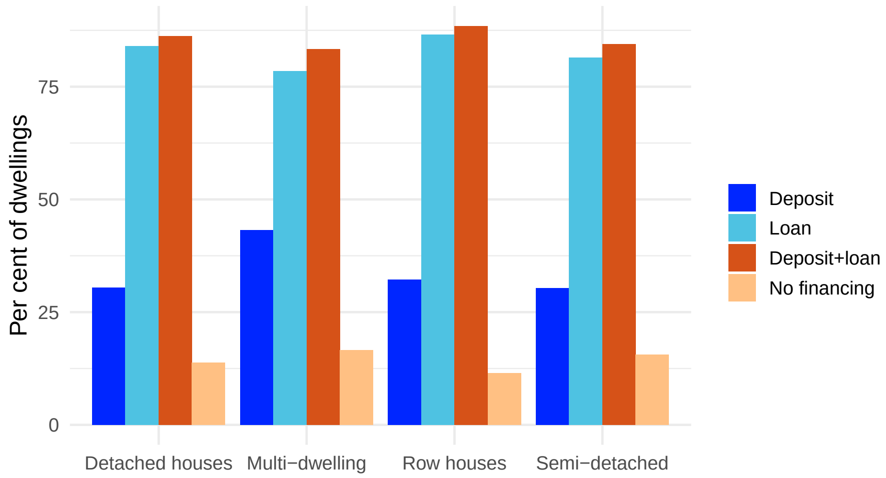
When we calculate the possibility of using bank deposits, we assume that homeowners must have a buffer of two months' income plus NOK 100 000 in their account after they have financed the home energy upgrade. Figures from 2023 indicate that almost 40 percent of homeowners would be able to cover the entire home energy upgrade with bank deposits (Figure **??**. The share is somewhat higher for owners of flats.[16]

The ability to finance an investment with a loan is limited by the Lending Regulations[17] and banks' credit assessments. The borrower must have both collateral that can be pledged as security and sufficient income to service the loan. We assume that the homeowner will obtain a loan for energy efficiency improvements if the household's total debt after this loan is lower than 85 percent of home value and total debt

[16]Note that although the analysis is carried out based on figures from 2023, changes in the key variables are fairly stable in relation to each other over time. In fact, deposits in 2023 are slightly higher and debt-to-income ratios are slightly lower than before the pandemic in 2020-2021, resulting in slightly wealthier households. On the other hand, interest rates are higher, making energy efficiency measures more expensive to undertake.

[17]See Finansdepartementet (2020)

Figur 4: Most households can finance home energy upgrades by drawing on deposits or by borrowing. Share of homeowners able to finance energy efficiency measures by either drawing on deposits or by borrowing, by type of home.



Sources: Eiendomsverdi, the Norwegian Tax Administration and Norges Bank

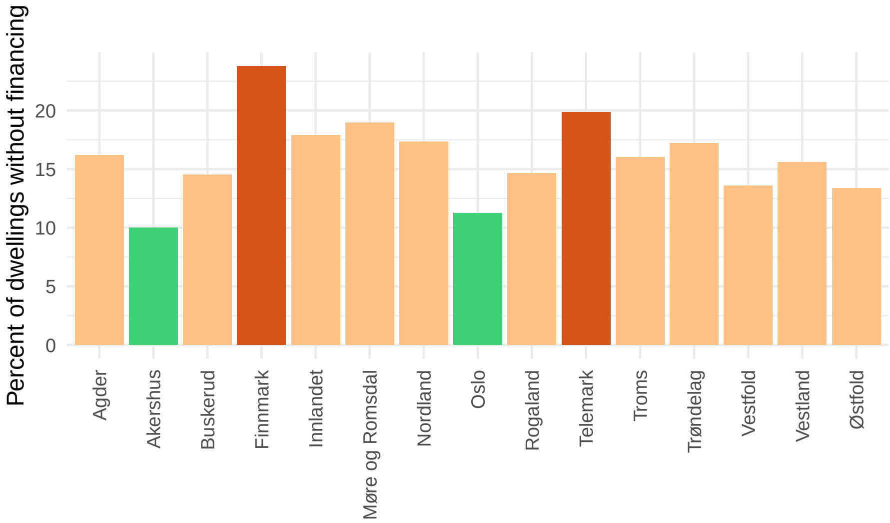
does not exceed five times gross income, as required by the Lending Regulations. Between 80 and 85 percent of homeowners meet these requirements.

The final test is whether homeowners that do not obtain a loan for the full amount have deposits to cover the difference. This increases the share with sufficient financing to 88 percent, leaving around 12 percent of homeowners that neither have sufficient bank deposits nor the ability to borrow to cover such an investment.

Who is in the group that lacks financing? We observed that costs relative to home value were unevenly distributed across counties. In counties where energy costs are high relative to home value and homeowner income, the share of homeowners unable to finance the cost of the upgrade through borrowing is higher. This is confirmed when we look at the county affiliation of homeowners without financial capacity. The counties of Finnmark and Telemark distinguished themselves from the other counties by having the largest share of such homeowners, where approximately 20 percent are unable to finance energy efficiency improvements (Figure 5). The smallest share is in Oslo and Akershus, where less than 10 percent of homeowners lack financial capacity.

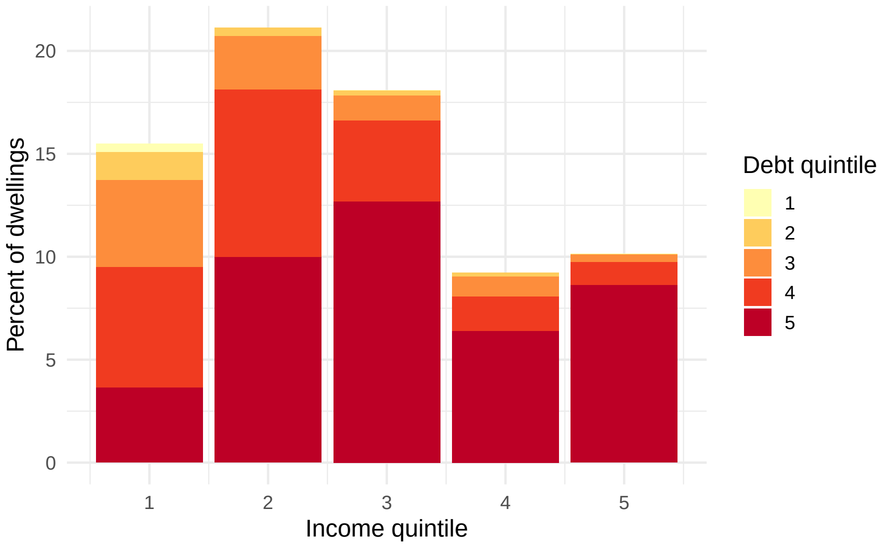
The most significant characteristic of households lacking financial capacity are those with a combination of high debt and middle income levels (Figure 6). We divide all households into five income groups and five debt groups, according to income and debt level. Approximately 57 percent of those lacking financial capacity are in income groups two and three and in debt groups four and five.

Figur 5: The share of those who lack financial capacity are highest among homeowners in rural areas. Share of homes without financial capacity by county.



Sources: Eiendomsverdi, Norwegian Tax Administration and Norges Bank

Figur 6: Those with middle income and high debt are most vulnerable to having insufficient financial capacity. Share lacking financial capacity by income group and debt group



Sources: Eiendomsverdi, Norwegian Tax Administration and Norges Bank

4. Energy saving is not sufficient to cover investment costs

Energy efficiency is a saving measure. Even if a debt-financed investment increases debt-servicing costs, it will also result in reduced energy costs. To understand how homeowners' liquidity is affected, we need to look at the net effect. We assume that following the investment a homeowner has reduced electricity consumption to the norm per square metre, which is a significant reduction in annual electricity consumption for most homes.[18].

We calculate the annual cost of the investment by assuming that the amount is fully debt-financed at an interest rate of 6 percent and with a 30-year repayment period. We assume that the electricity price comprises a fixed component (an electricity distribution charge) of NOK 0.60 per kWh and a variable energy component of NOK 0.70 per kWh. We then conduct a sensitivity analysis with a floating rate of NOK 1.40 and the same distribution charge of NOK 0.60.

The increased expense resulting from borrowing is significant, especially for lower income groups. In the three lowest income groups, the gross cost of such an investment exceeds 6 percent of after-tax income for the average household (Figure 7. This is about the same magnitude as total interest expenses for an average Norwegian homeowner. For the most affluent homeowners, however, the cost share is relatively low, down to about 2 percent of after-tax income.

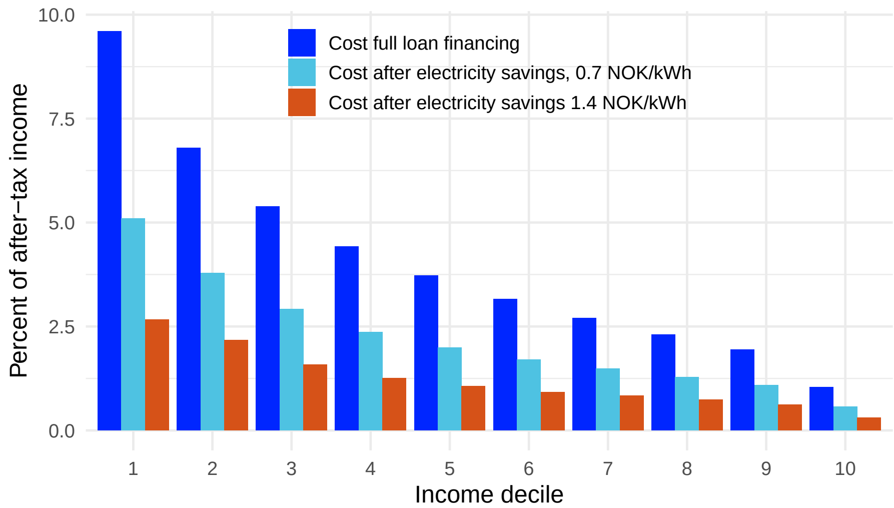
The potential to save electricity is also substantial, and this will significantly reduce the liquidity effect. If the variable energy component costs NOK 0.70, the net expense will be roughly halved. If the variable energy component costs NOK 1.40, the net expense will be reduced to a third of the loan payment. Even with an electricity price that is significantly higher than the threshold at which support is available, a normal homeowner will have higher net expenses. This may explain why many homeowners do not implement energy efficiency measures, despite the fact that they are often relatively easy to implement.

5. Energy efficiency requirements will reduce home value - electricity savings boost home value, but not to the same extent as the cost of the energy efficiency measures

If a homeowner is required to undertake energy efficiency improvements that involve significant investment, home value will be reduced if the home is sold before completion of the investment. Following completion of the investment, home value will increase as home running costs are reduced. We attempt to quantify how the requirements discussed above may affect house prices from when the requirement is announced until completion of the investment.

[18] Note that since estimated total electricity consumption per home does not take into account that homeowners already save electricity in ways that we have no knowledge of (such as reducing the temperature in parts of the home in winter), total electricity savings are overestimated. Nevertheless, this provides an upper estimate of potential savings

Figur 7: Energy efficiency improvements will reduce liquidity even when we take into account electricity savings. Energy efficiency costs before and after electricity savings measured as the average annual share of after-tax income for 10 different income groups based on full debt financing and different electricity price alternatives.



Sources: Eiendomsverdi, Norwegian Tax Administration and Norges Bank

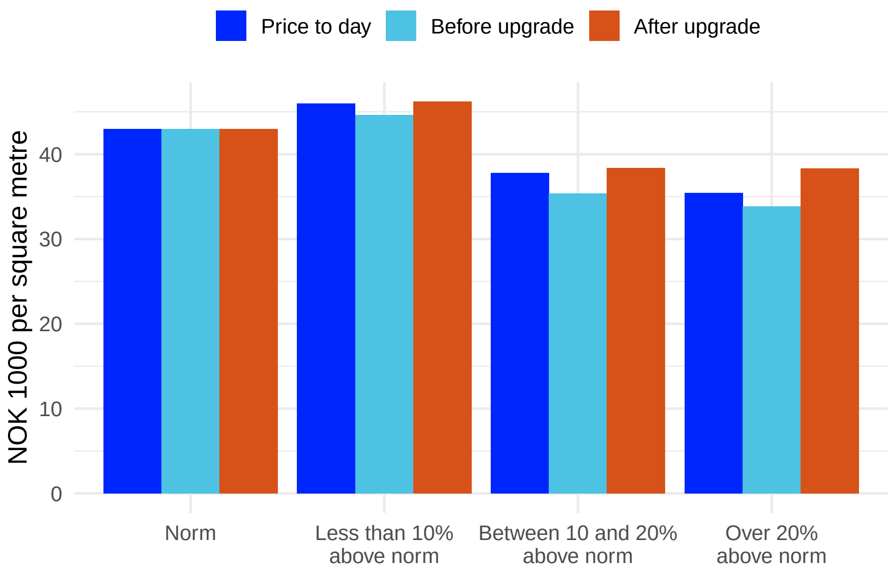
We again assume that all homes with higher electricity consumption than the norm will undertake a debt-financed home energy upgrade. We now assume that home-owners have a long-term financing cost of 4.5 percent. After the investment, as in the previous paragraph, we assume that electricity consumption is reduced due to the home's enhanced energy performance.

Home value can be estimated as "implicit rental income" over the buyer's required rate of return. Implicit rental income is a measure of what it would cost to rent out an equivalent home. When the cost of maintaining the home rises, rental income falls and vice versa. For a home where energy efficiency measures have not been carried out, we assume that the home's implicit rental income is reduced by the net cost of a debt-financed investment less electricity savings. After the energy upgrade investment is completed, living costs are reduced - which drives up implicit rental income.

The required rate of return is the discounting factor the buyer uses when assessing the value of a home, reflecting, among other things, house price appreciation expectations, where a lower required rate of return reflects expectations of a more rapid price appreciation rate. This also results in a larger price effect of a change in implicit rental income. The required rate of return is estimated at 3 percent in Oslo and Akershus, 4 percent for flats outside Oslo and Akershus, and 5 percent for other homes.[19]

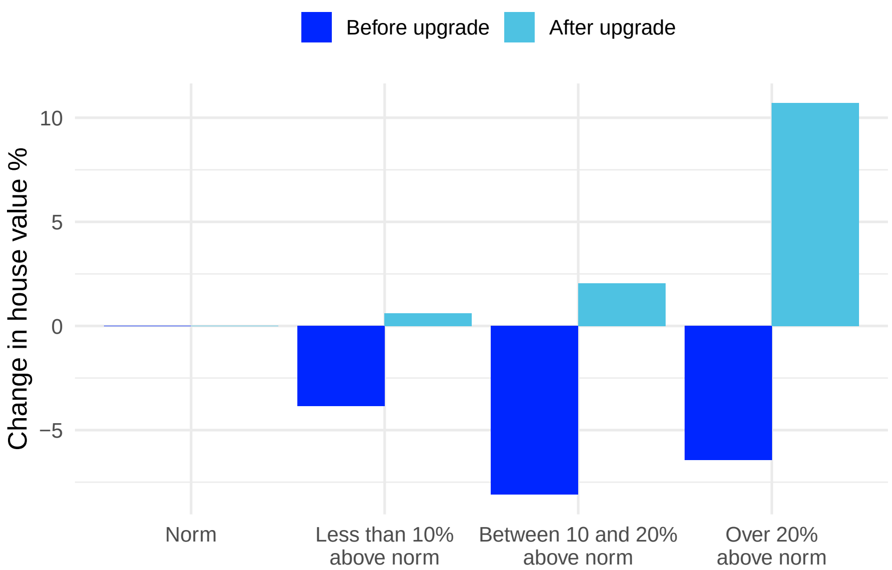
[19]Differences in required rates of return also reflect that house price appreciation expectations vary in different parts of Norway.

Figur 8: Home value after announcement of home energy upgrade requirements are announced and following completion of home energy upgrade. *Current price* is the average price in 2023. *Before home energy upgrade* reflects that the price falls because the buyer knows that additional investment will be necessary. *After home energy upgrade* reflects that the price rises because current energy cost per square metre is reduced as a result of the energy upgrade. In NOK per square metre. At an electricity price of NOK 0.70, plus an electricity distribution charge of NOK 0.60.



Sources: Eiendomsverdi and Norges Bank

Figur 9: Change in home value after announcement of home energy upgrade requirements are announced and after completed energy upgrade. *Before home energy upgrade* reflects that the price falls because the buyer knows that additional investment will be necessary. *After energy upgrade* reflects that the price rises because current energy cost per square metre is reduced as a result of the home energy upgrade. In percent. At an electricity price of NOK 0.70, plus an electricity distribution charge of NOK 0.60.



Sources: Eiendomsverdi and Norges Bank

We report the results broken down by the energy upgrade group of each home. We find that homes in the two classes with the lowest energy consumption - below the norm and below 10 percent above the norm – have the highest price per square metre at the end of 2023. This probably reflects the higher standard of these homes. When the home energy upgrade requirement is announced, the prices of all homes with energy consumption above the norm fall (Figure 8). After completion of the home energy upgrade, the prices of homes with lower energy consumption rise and this rise is most pronounced for homes with the largest energy savings. For homes in the lowest energy class, our estimates indicate a significant increase in value. Homeowners who realise major efficiency gains will roughly break even on their investment - the price per square metre increases by an average of NOK 2 750 per square metre, compared with an investment cost of NOK 3 000 in our analysis.

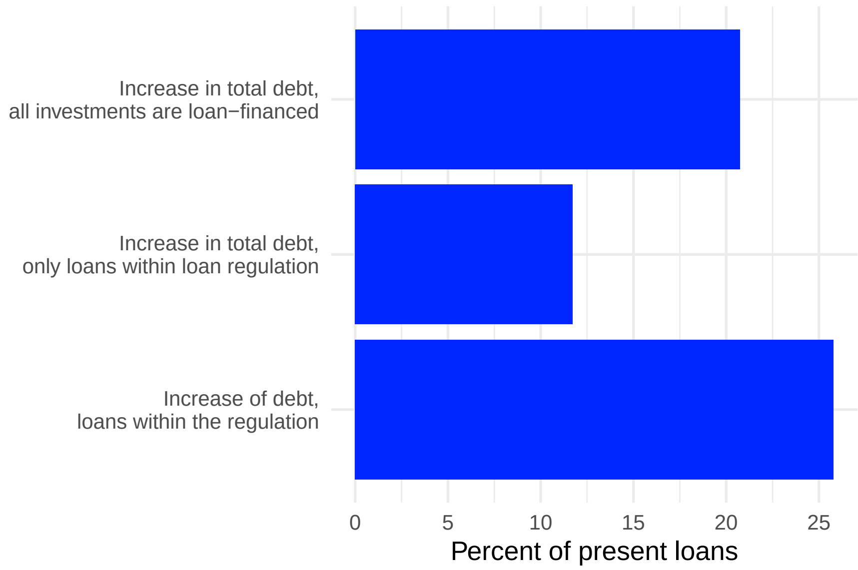
The home energy upgrade requirement reduces the value of homes with higher energy consumption than the norm by between 4 and 6 percent, depending on which of the three categories the home falls under, see figure 9. After the home energy upgrade, we expect that the value of homes with the largest energy efficiency potential may increase by more than 10 percent as a result of lower energy consumption.

6. New investment increases credit demand

Norwegian homeowners predominantly finance home purchases with bank loans. Mortgage lending accounts for about 60 percent of total bank lending.

If all homeowners were to undertake major energy efficiency measures, demand for new loans would increase. If we assume that all investment is debt-financed, this would increase the need for credit by between 10 and 20 percent of current lending to households (Figure figure 10). For those homeowners that then borrow, total debt would increase by 25 percent. For the average homeowner, this would entail a rise in debt burden of between 10 and 15 percentage points from the current level of a little above 200 percent.

Figur 10: Increased demand for new loans if energy efficiency costs are fully debt-financed. In percent of current lending.



Sources: Eiendomsverdi, Norwegian Tax Administration and Norges Bank

If a loan is granted on the provision that it will reduce the cost of living in the home owing to lower energy consumption, it is critical to ensure that this type of loan is actually used for energy efficiency improvements. If homes do not undertake the required home energy upgrade, there may be a fall in home value as potential buyers will price in the required energy efficiency costs when they bid on homes. Sound assessments of the consequences of energy efficiency improvements will require detailed information about the energy rating of each individual home, which will require more comprehensive energy performance metrics than currently available.

Our analysis illustrates a problem that is made even more relevant by climate transition. New regulatory requirements cause the value of existing capital to fall. At the same time, debt-servicing capacity is weakened as owners face higher fixed costs and higher debt burdens. Hjelseth et al. (2024) explores how requirements for emission reductions can affect Norwegian companies. Our analysis examines how energy efficiency improvements of homes may affect Norwegian homeowners. Note also that the same effects will be at stake, for example, in the event of home renovation requirements to mitigate the impact of physical climate change, such as increased precipitation or if insurance premiums were to rise owing to an increased likelihood of natural disasters.

When borrowers' liquidity is reduced, risk in existing lending portfolios increases alongside a significant need for new investment. Many market participants will be able to contribute, but banks - as the dominant credit source for Norwegian households - will most likely play an important role in this process. We are thus in a situation where banks' risk has risen, thus reducing their lending capacity, but demand for new loans is rising markedly. Norges Bank (2024) highlights this as a potential vulnerability for the Norwegian financial system.

7. Conclusion

A large proportion of energy consumption is related to housing, and methods to make homes more energy efficient are well known. Improving the energy performance of homes can be an important contribution to achieving lower and cleaner energy consumption goals. If the targets outlined in the Norwegian government's Action plan for energy efficiency in all parts of the Norwegian economy and the EU's Energy Performance of Buildings Directive are to be achieved, measures must be implemented to make the existing housing stock more energy efficient than it is today.

We have conducted an analysis in which we assume that all Norwegian homeowners are required to undertake an energy upgrade of their existing homes in order to meet low-energy home requirements within one year, without public support. We find that almost 90 percent of Norwegian homeowners will be able to cover such an expense through a combination of drawing on bank deposits and borrowing without breaching the Lending Regulation requirements. At the same time, we note that at current electricity prices, such an investment will not always be cost bearing for the average homeowner. For homeowners in lower income groups in particular, the net cost increase will consume a substantial share of their overall budgets. However, this should not be interpreted to mean that energy efficiency improvements will never be economically viable for private individuals. The relationship between electricity savings and investment costs is not necessarily linear. There is reason to believe that many individual energy efficiency measures can be profitable even at relatively low electricity prices. It is also important to emphasise that even if an energy efficiency measure is not economically viable for private individuals, it may be socio-economically beneficial. In which case, this may be an argument in favour of various forms of public transfers to individual homeowners to contribute to the implementation of energy efficiency improvements.

In our example, extensive energy efficiency requirements will reduce the overall housing stock value before the investment is made. The increase in value after energy efficiency improvements will not fully compensate for the investment cost. If electricity savings are to be profitable, interest rates must fall, and electricity prices must rise from their current level.

There is reason to believe that banks - as households' main credit source - will play an important role in energy efficiency improvements. Credit demand is expected to increase markedly. At the same time, mortgage risk is rising due to borrowers' worsening liquidity position. It will also be necessary to make more information available to better enable lenders to assess the effects of such energy efficiency measures for individual borrowers.

Referanser

Axelholm, L.B., 2024. Slik rykker du en klasse opp på energiskalaen. URL: https://viivilla.no/ovrig/energi/energisparing/slik-rykker-du-en-klasse-opp-pa-energiskalaen/. Vi i Villa.

Cassidy, A., 2023. How does mandatory energy efficiency disclosure affect housing prices? Journal of the Association of Environmental and Resource Economists 19, 655–686. doi:10.1086/722262.

Eiendomsverdi, 2024. URL: https://home.eiendomsverdi.no/.

Eiendomsverdi, Siminen, 2024. Grønne boliger og eu-taksonomien. URL: https://simien.no/wp-content/uploads/Eiendomsverdi_gronne-boliger-juni2024.pdf.

Energidepartementet, 2009. Forskrift om energimerking av bygninger og energivurdering av varme- og klimaanlegg (energimerkeforskriften for bygninger). URL: https://lovdata.no/dokument/SF/forskrift/2009-12-18-1665. Forskrift.

Energidepartementet, 2016. Meld. st. 25 (2015–2016) kraft til endring — energipolitikken mot 2030. URL: https://www.regjeringen.no/no/dokumenter/meld.-st.-25-20152016/id2482952/. Melding til Stortinget.

Enova, 2022. Husholdninger og forbruker i et klimaperspektiv. https://2023.enova.no/markedsutvikling-med-enova/husholdninger-og-forbruker/husholdninger-og-forbruker-status.

Enova, 2024. Energimerking av boliger. URL: https://www.enova.no/energimerking/bolig/.

European commission, 2024. Energy performance of buildings directive. https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings/energy-performance-buildings-directive_en#energy-performance-of-buildings-standards.

European Commission, 2024. Nearly-zero enerry and zero-emission buildings. URL: https://energy.ec.europa.eu/topics/energy-efficiency/energy-efficient-buildings/nearly-zero-energy-and-zero-emission-buildings_en. Comment.

Ferentinos, K., Gibberd, A., Guin, B., 2023. Stranded houses? the price effect of a minimum energy efficiency standard. Energy Economics 120, 106555. doi:10.1016/j.eneco.2023.106555.

Finansdepartementet, 2020. Forskrift om finansforetakenes utlånspraksis (utlånsforskriften). URL: https://lovdata.no/dokument/SF/forskrift/2020-12-09-2648. Forskrift.

Hjelseth, I.N., Johansen, R., Solheim, H., 2024. Foretakenes omstilling til lavere klimagassutslipp og risikoen i norske banker. Staff memo 3. Norges Bank. https://www.norges-bank.no/aktuelt/nyheter-og-hendelser/Signerte-publikasjoner/Staff-Memo/2024/staff-memo-3-24-foretakenes-omstilling/.

Kartverket, 2024. URL: https://www.kartverket.no/.

Miljødirektoratet, 2019. Infopakke om oljefyring. URL: https://www.statsforvalteren.no/siteassets/fm-vestfold-og-telemark/miljo-og-klima/forurensning/dokumenter/2019/infopakke-oljefyr-fra-miljodirektoratet.pdf. PDF-dokument.

Norges Bank, 2024. Finansiell stabilitet 1. halvår 2024. https://www.norges-bank.no/aktuelt/nyheter-og-hendelser/Publikasjoner/Finansiell-stabilitet---rapport/2024-1-finansiell-stabilitet/.

Olje- og energidepartementet, 2022. Handlingsplan for energieffektivisering i alle deler av norsk økonomi. https://www.regjeringen.no/contentassets/76641946084c49e9910bf60cd7df5dd3/no/pdfs/handlingsplan-for-energieffektivisering.pdf.

Sentrumsfordel, N., 2024. Kilowattimer, gigawattimer,terrawattimer og megawattimer, hva er nå det da? URL: https://norsk-sentrumsfordel.no/kilowattimer-gigawattimer-og-terrawattimer-hva-er-na-det-da/.

Skatteetaten, 2024. URL: https://skatteetaten.github.io/api-dokumentasjon/api/summertskattegrunnlag. API.

Statistisk Sentralbyrå, 2024a. Elektrisitet. https://www.ssb.no/statbank/table/10572/.

Statistisk Sentralbyrå, 2024b. Energibruk i husholdningene. https://www.ssb.no/statbank/table/10572/.

Zancanella, P., Bertoldi, P., Boza-Kiss, B., 2018. Energy efficiency, the value of buildings and the payment default risk. URL: https://publications.jrc.ec.europa.eu/repository/bitstream/JRC113215/jrc113215_kjna29471enn_v2_ipo_final.pdf. JRC Science for Policy Report, European Commission.