Is Energy Efficiency Credit Relevant?

By Ludovic Thebault, PhD and Usman Jamil, European DataWarehouse

In this article, using a sample of securitised mortgages from France and the Netherlands, we find evidence that the energy efficiency rating of properties is credit relevant to some extent, particularly for borrowers in the lower income categories. We believe that the implementation of the European Parliament's new Energy Performance of Buildings Directive will make it even more so.

The Energy Performance of Buildings Directive (EPBD) aims to decarbonise the European building stock. Considering that *"Buildings account for 40% of final energy consumption in the Union and 36% of its energy-related greenhouse gas emissions while 75% of Union buildings are still energy-inefficient"*,[1] the new EBPD aims to pave the way for a wave of renovations and includes stringent environmental criteria for future new buildings. The most striking goal stated in the EBPD is that *"all new buildings should be zero-emission buildings by 2030, and existing buildings should be transformed into zero-emission buildings by 2050"*. This ultimate drive for energy efficiency follows from a long history starting with the oil shocks in the 1970s, when the main goal was to reduce reliance on energy imports from countries that could become hostile. Social considerations also justify improving energy efficiency, as the poorest households are set to benefit the most from energy savings.[2] One way or another, a substantial and increasing portion of European lending will have to fund these renovations, and the EBPD includes provisions to facilitate this.

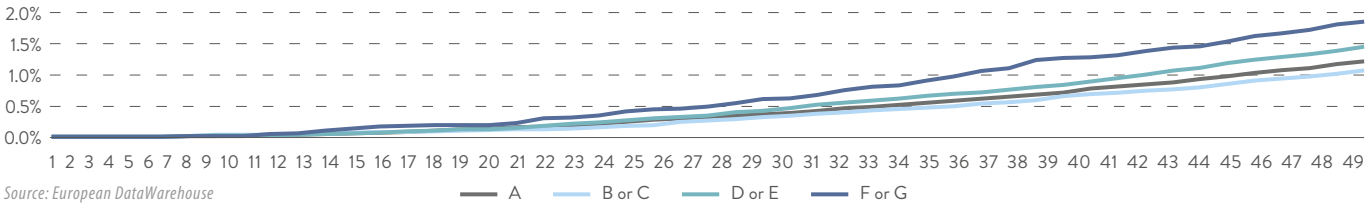
We can expect EU countries to resort to incentives and disincentives that will ultimately force real estate lenders to pay attention. Regarding the incentives, subsidies and guarantees should make renovations more affordable for the poorest property owners.[3] As for the disincentives, increasing constraints will apply to the worst-rated buildings, including letting bans for the most inefficient properties.[4] Letting bans interrupt the stream of income for 'buy to let' properties and force borrowers to borrow an extra lump amount to upgrade the property (a credit negative). Properties' Energy Performance Certificate (EPC)[5] ratings will thus become more relevant when originating new mortgages. In this article however, we argue that EPCs may already have been relevant so far, particularly for the most vulnerable households.

EDW hosts data for European securitised mortgages and recently started to collect EPC ratings.[6] We focus this study on the Netherlands and France, which are the countries where this data is the most available. We did not want to mix EPCs across countries, because the EPC mix can be radically different from one country[7] to the next and because EPCs can have very different meanings across countries; in France, a property with an EPC-A rating can use up to 70 kWh/m2/year vs. up to 160 kWh/m2/year in the Netherlands.[8]

Mortgages with the lowest EPC ratings (F and G in particular) tend to have noticeably worse performance than those financing more efficient properties (A, B and C rated). In Exhibits 1a and 1b below, we show the cumulative percentage of loans originated between 2016 and 2019 in France and the Netherlands that have at some point become delinquent or have defaulted (i.e. payment incidents), up to 48 months after origination. We do not limit the sample to defaults, because for some vintages, this period also covers the COVID years, when measures (payment holidays, moratoria, handouts etc.)[9] were enacted to limit COVID-related defaults.

EXHIBIT 1a | MORTGAGES FINANCING THE LEAST EFFICIENT PROPERTIES PERFORM WORST IN FRANCE

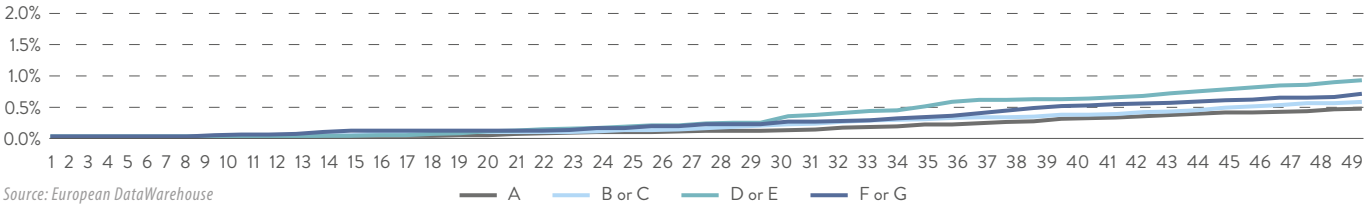
Cumulative delinquencies by EPC (France - Mortgages) — As % of Original Balance, Months after Origination



Source: European DataWarehouse

EXHIBIT 1b | PAYMENT INCIDENTS IN THE NETHERLANDS ARE ALSO MORE COMMON FOR EPC D-G

Cumulative delinquencies by EPC (Nederlands - Mortgages) — As % of Original Balance, Months after Origination



Source: European DataWarehouse

[1] See Energy Performance of Buildings Directive

[2] The EBPD further states *"Buildings are responsible for about half of primary fine particulate matter (PM 2,5) emissions in the Union that cause premature death and illness" and further "Inefficient buildings are often linked to energy poverty and social problems."*

[3] See https://france-renov.gouv.fr/

[4] See ADEME in France:
-Since Jan. 2023: letting ban for G rated properties with energy need exceeding 450kWh/m2/year
-From Jan. 2025: ban on the letting of G rated properties
-From Jan. 2028: ban on the letting of F rated properties
-From Jan. 2034: ban on the letting of E rated properties

[5] EPCs were initially introduced in the Directive 2002/91/EC of the European Parliament; the ratings are letters from A to G, whose definitions typically refer to energy consumption in kwh per square meter per year

[6] See ESMA technical standards – residential real estate; EPC ratings (letters from A to G) are to be reported if available. In practice, EPCs are available for only about 20% of the mortgages in our database. EPC ratings are especially relevant for so-called "green securitisations".

[7] Please note that 1) securitisations are not necessarily representative of the mortgage market they come from and that 2) those for which EPCs are provided are not necessarily representative for the remaining securitisations

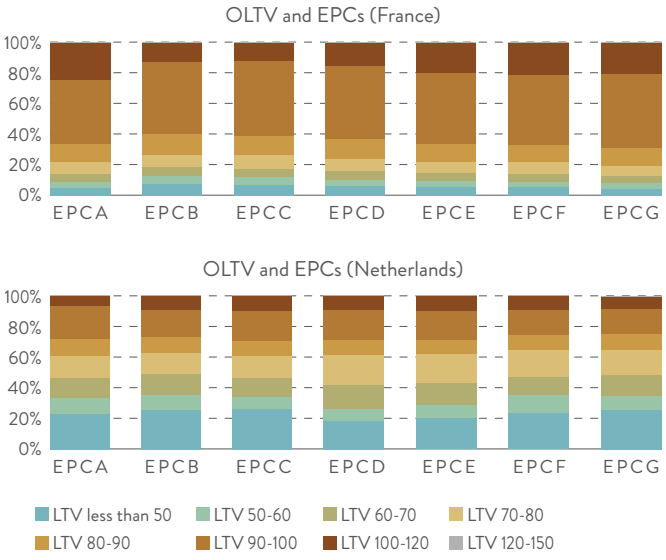
[8] See Revisiting The Babel Tower of EPC Ratings; in the Netherlands, EPC-A ratings are further divided in A+ to A++++ property ratings; this differentiation is not visible in our data

[9] On this topic see also Monitoring Moratoria Through COVID-19

Other studies using retail mortgage data also mention this relationship. Billio et al.,[10] as well as Guin et al.[11] assessed mortgage risk using actual or estimated EPC ratings along with the more common measures of credit risk and concluded that a property's energy efficiency is useful extra information to assess credit risk. Other publications acknowledge the relationship between EPC ratings and loan performance, but point out that this may be because some risk characteristics are correlated with EPC ratings.[12] The following charts compare key performance metrics for mortgages in France and the Netherlands by EPC rating category.

The Original Loan-to-Value (OLTV) is a key predictor of mortgage defaults, often used for mortgage pricing.[13] In Exhibit 2, we show the proportion of the loans of the various EPC rating classes by OLTV. In the case of France, there are some more loans in the "riskier" 100% - 120% OLTV bucket for categories E, F and G than for the categories B, C, and D, but otherwise, the proportions of loans look remarkably even across EPC rating categories. In any case, in France, mortgages with EPC-A have better performance than EPCs E, F and G even though there are more high LTVs for mortgages with an EPC rating of A (EPC-A). In the Netherlands, the proportions are almost identical in all the OLTV buckets.

EXHIBIT 2 | LOAN-TO-VALUE VS EPC RATING IN FRANCE AND THE NETHERLANDS

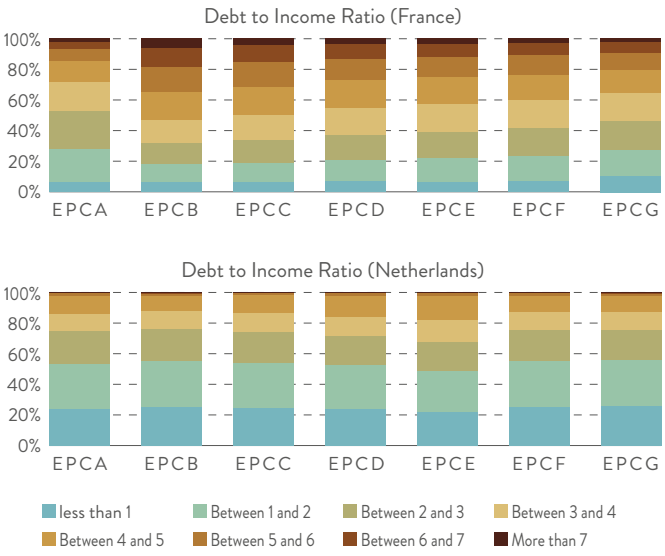


Source: European DataWarehouse

The Debt-to-Income multiple (DTI) values in Exhibit 3 also suggest that the mortgages used to finance the EPC-F/G properties are not riskier. The DTI, defined as the loan amount divided by the yearly income, is another key measure of risk for mortgages. In the case of France, EPC-A mortgages indeed have less risky DTIs than EPC-B mortgages, but the DTIs for the other EPC rating categories appear less risky than those for the EPC-B mortgages. In the Netherlands, the values appear relatively even.

Installment to Income (ITI) is yet another key risk measure that does not seem worse for the least efficient EPC categories. It is also a key performance metric, calculated as the monthly amount of the due instalment as a proportion of the monthly income.

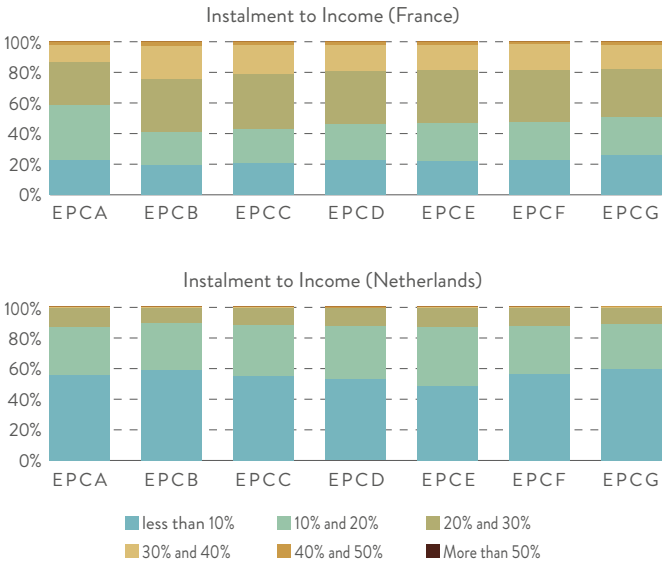
EXHIBIT 3 | DEBT-TO-INCOME MULTIPLES DO NOT INDICATE THAT EPC-F/G PROPERTIES ARE RISKIER



Source: European DataWarehouse

Again, there is no clear evidence in Exhibit 4 to say that the mortgages used to finance the worst-rated properties are riskier on this account. The values in the Netherlands are lower than those observed in France. We understand that this is partially because mortgages in the Netherlands are typically financed with several loan parts, including an interest-only loan part on which only interest is to be paid.

EXHIBIT 4 | INSTALMENT TO INCOME SUGGESTS EPC-F/G PROPERTIES ARE NOT RISKIER



Source: European DataWarehouse

[10] See Building's Energy Efficiency and the Probability of Mortgage Default: The Dutch Case

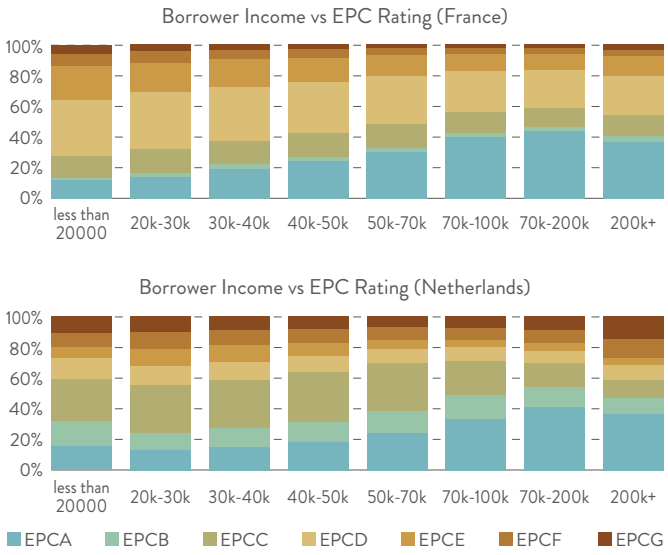
[11] See Risk Differentials Between Green and Brown Assets

[12] See DBRS: Residential EPCs Versus Credit Relevance

[13] Defined as amount of the loan or loan parts as a proportion of the value of the financed property

Borrowers with the highest incomes are more likely to buy energy-efficient properties (Exhibit 5); this is the case both in France and the Netherlands. A difference is that wealthier borrowers in France buy rather less of the EPC-G properties, whereas this is not the case in the Netherlands (Exhibit 5a). The income in absolute terms is not a measure of mortgage risk in itself, but it is known to have some correlation with mortgage risk. This relation is most likely because new or energy efficient properties are typically more expensive (keeping other characteristics equal) and therefore more likely to be bought by the wealthiest borrowers.

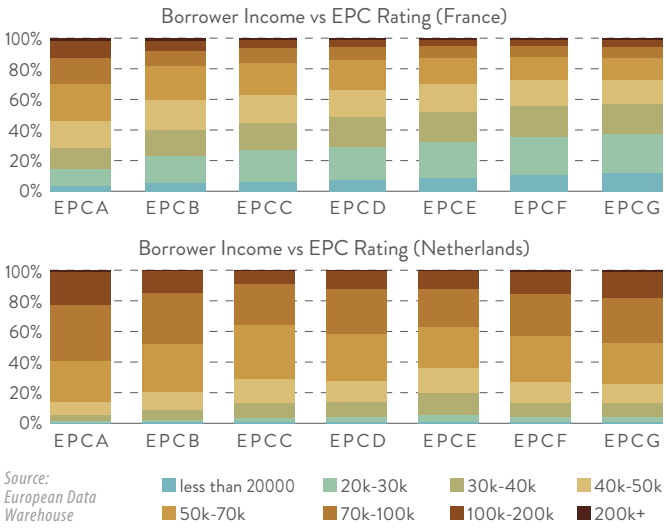
EXHIBIT 5a | HIGH EARNERS ARE MORE LIKELY TO BUY EPC-A PROPERTIES THAN LOWER EARNERS



Source: European DataWarehouse

In France, higher earners are more likely to buy energy-efficient properties, and conversely, as we see in Exhibit 5b, a substantial proportion of the most energy-efficient properties are bought by the wealthiest individuals. This trend is less clear in the Netherlands.

EXHIBIT 5b | THE MOST EFFICIENT PROPERTIES ARE MOST OFTEN BOUGHT BY THE HIGHEST EARNERS



Source: European Data Warehouse

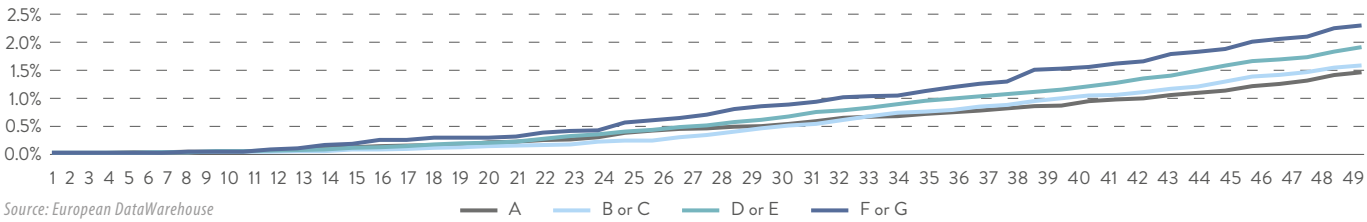
The wealthiest borrowers who can afford to buy the most efficient and typically more expensive properties also typically have a better credit standing. To find out the role played by the income in explaining the relatively better performance of mortgages financing energy-efficient properties, we redo Exhibit 1, using the same subset of mortgages, but grouped by income category. Thus in France:

- For the lowest earners, mortgages associated with inefficient EPCs perform worse and the rank ordering is very clear (Exhibit 6a).
- In the intermediate income category (Exhibit 6b), cumulative delinquencies are lower in all EPC categories than in Exhibit 6a, and the rank ordering is generally the same, although this time, EPC B-C perform better than EPC-A properties.
- In Exhibit 6c, for the highest earners, the picture is different. Delinquency levels are even lower but this time, the EPC-A subset performs somewhat worse than the rest, and the rank ordering for the other categories is less clear.

In the case of France, the EPC seems indeed to be a factor, particularly for the lowest earners.

EXHIBIT 6a | LOWER INCOMES IN FRANCE – EPC-A PERFORM BEST AND EPC-F/G PERFORM WORST

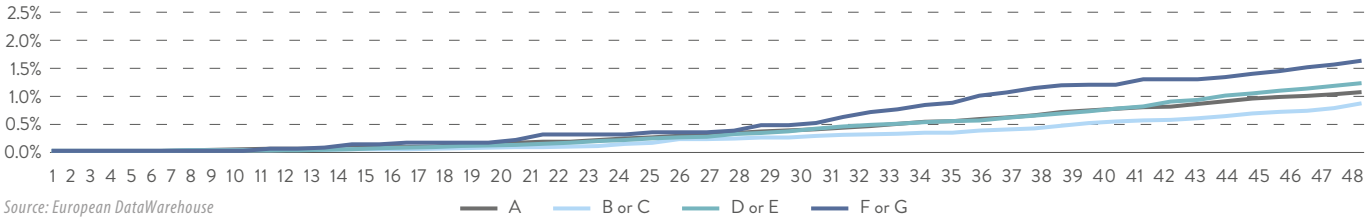
Cumulative delinquencies by EPC (France - Mortgages) – As % of Original Balance, Months after Origination, Borrowers with Annual Income Less than €40,000



Source: European DataWarehouse

EXHIBIT 6b | MIDDLE INCOMES IN FRANCE – STILL A CLEAR RANK ORDERING

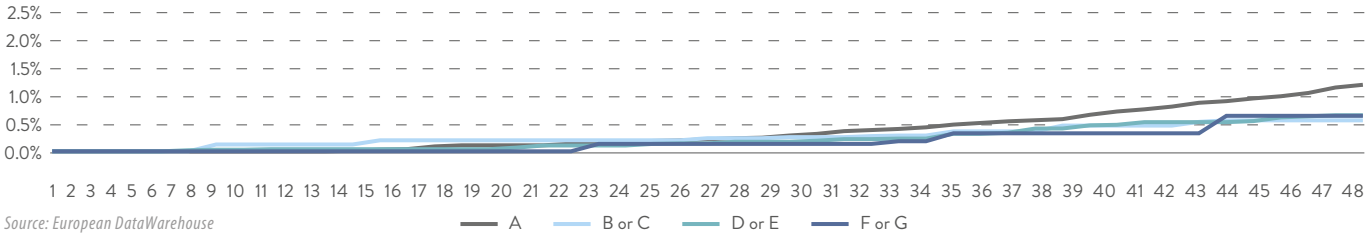
Cumulative delinquencies by EPC (France - Mortgages) – As % of Original Balance, Months after Origination, Borrowers with Annual Income €40,000 - €80,000



Source: European DataWarehouse

EXHIBIT 6c | HIGHER INCOMES IN FRANCE – EPC-A ACTUALLY PERFORM WORST

Cumulative delinquencies by EPC (France - Mortgages) – As % of Original Balance, Months after Origination, Borrowers with Annual Income €80,000+

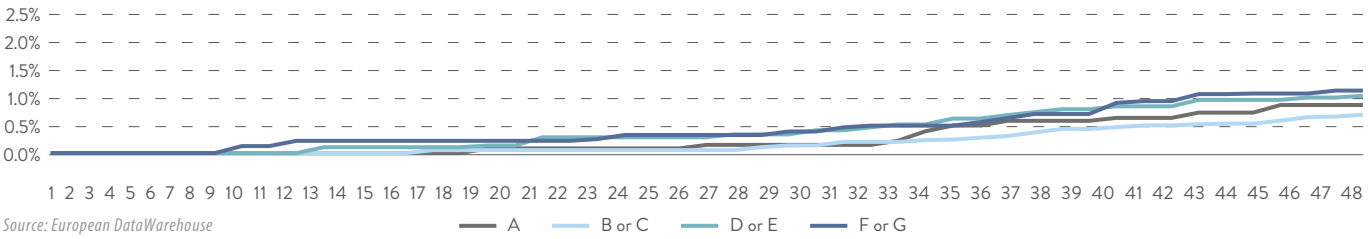


Source: European DataWarehouse

In the Netherlands (Exhibit 7 series) the picture is quite similar, with categories EPC-D/G performing generally worse than EPC categories A-C at all income levels. In the case of the highest income category, the differentiation is not always so clear, reinforcing our impression that the EPC rating is a more meaningful predictor of performance in the lower income categories.

EXHIBIT 7a | LOWER INCOMES IN THE NETHERLANDS – EPC-A/B/C PERFORM BETTER

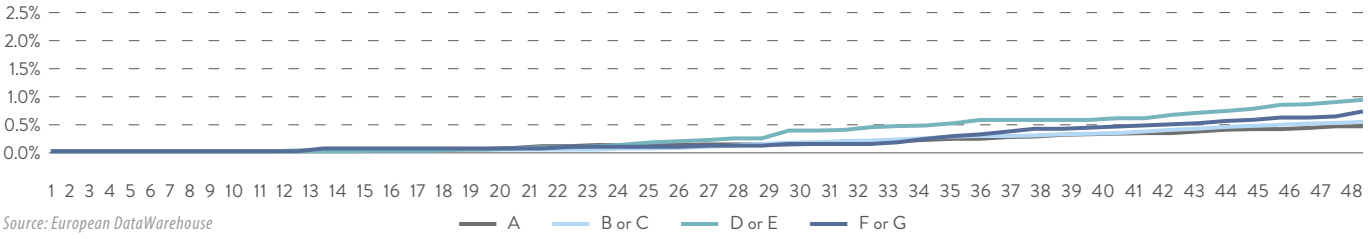
Cumulative delinquencies by EPC (Nederlands - Mortgages) – As % of Original Balance, Months after Origination, Borrowers with Annual Income Less than €40,000



Source: European DataWarehouse

EXHIBIT 7b | MIDDLE INCOMES IN THE NETHERLANDS – EPC-A/B/C ALSO PERFORM BETTER

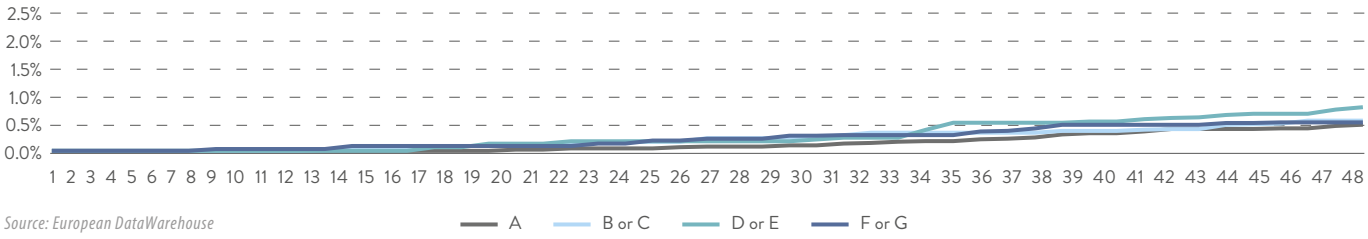
Cumulative delinquencies by EPC (Nederlands - Mortgages) – As % of Original Balance, Months after Origination, Borrowers with Annual Income €40,000 - €80,000



Source: European DataWarehouse

EXHIBIT 7c | HIGHER INCOMES IN THE NETHERLANDS – THE RANK ORDERING IS WEAKER

Cumulative delinquencies by EPC (Nederlands - Mortgages) – As % of Original Balance, Months after Origination, Borrowers with Annual Income €80,000+



Source: European DataWarehouse

The correlation between income and energy efficiency could explain the observations in Exhibit 1. One could think that EPC-A properties perform better because they are purchased by the highest earners, and income would be the main driver explaining these observations. Indeed, higher incomes show a better performance for our data sample.

Nevertheless, as shown in Exhibit 6a and 7a, within an income category, mortgages for the most energy efficient properties perform best and this matters most for the lowest income categories. Exhibit 8 summarises the findings of Exhibits 6 and 7 series. In France, the highest earners generally have lower delinquencies than the lowest earners and only for EPC-A do they perform worse than the intermediate earners. This observation holds as well in the case of the Netherlands. Generally, income appears

to matter within an EPC category. Within the lower and middle income categories, the mortgages financing the most efficient properties perform best.

EXHIBIT 8 | COMPARISON OF CUMULATIVE DELINQUENCIES, 48 MONTHS AFTER ORIGINATION

FRANCE	EPC-A	EPC-B/C	EPC-D/E	EPC-F/G
10k to 40k	1.47%	1.59%	1.92%	2.30%
40k to 80k	1.10%	0.90%	1.27%	1.67%
80k or more	1.24%	0.60%	0.69%	0.68%
All Income Categories	1.21%	1.07%	1.44%	1.84%

NETHERLANDS	EPC-A	EPC-B/C	EPC-D/E	EPC-F/G
10k to 40k	0.87%	0.69%	1.05%	1.15%
40k to 80k	0.47%	0.55%	0.98%	0.76%
80k or more	0.46%	0.54%	0.77%	0.50%
All Income Categories	0.48%	0.59%	0.95%	0.72%

Source: European DataWarehouse; summary of the results of Exhibits 6 and 7 series

Higher earners spend relatively less on energy and are therefore proportionally less affected when energy prices increase. In this respect, there is a channel for higher energy costs to have an impact on loan repayments, depending on borrower income and property efficiency; public policies helping the poorest households to shoulder higher energy costs probably also influence our results.[14]

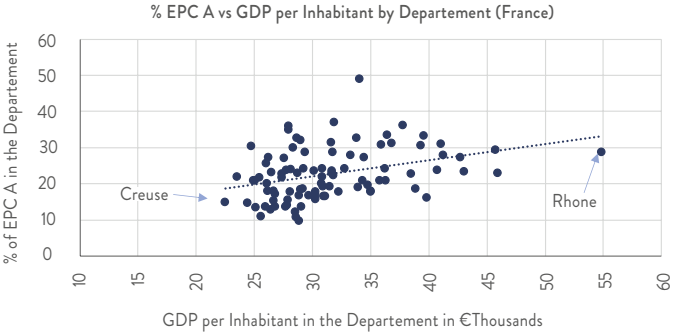
In France in particular, energy poverty also has a regional bias. Exhibit 9 shows that there are somewhat more A and B-rated properties in the wealthier parts of France[15] (as measured by GDP per inhabitant), and more of the F and G in the poorest areas. According to our sample:

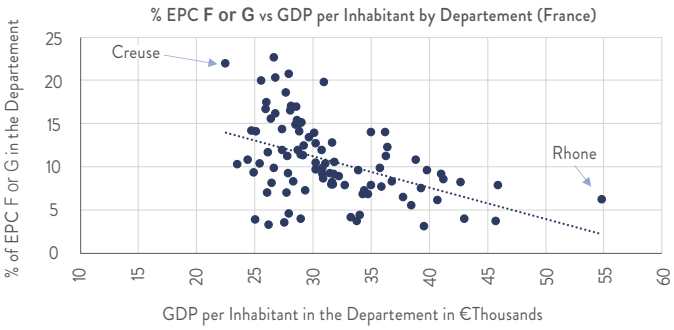
- In the rather prosperous Rhone département (the small region whose capital is Lyon), 32% of the properties are rated A or B vs. 6% F and G rated.
- In contrast, in the comparatively poor Creuse area (whose capital is Guéret), 16% of the properties are rated A or B vs. 22% F and G rated.

The notable exception is Paris (an outlier - not represented on the charts). EPC-A in Paris, France's richest area, represent 19% and EPC F/G 14%. The fact that A and B-rated properties are rather more common in the more dynamic regions can be because this is where more new properties are both needed and built. Loans originated in more dynamic regions also tend to default less.

Until recently, energy performance ratings were not considered credit-relevant by lenders. We understand that this is changing, as constraints are increasing on the owners of inefficient properties. For instance, Woonnu, a Dutch mortgage provider, uses the energy efficiency of the financed property along with the LTV to determine the interest rate of the loans it offers to its clients.[16] The implementation of constraints on energy-inefficient properties as mentioned for France earlier is particularly relevant for buy-to-let properties. Being unable to let the property deprives the owner of rental income and forces the financing of a renovation of the property (or the sale of the property). The recently observed volatility of energy prices and the foreseeable increases in energy prices[17] will further hit the poorest households most, particularly if they live in energy inefficient buildings.

EXHIBIT 9 | THE PROPORTION OF ENERGY-EFFICIENT PROPERTIES TENDS TO CORRELATE WITH GDP





Source: European DataWarehouse

Beyond vulnerability to transition risk, EPC ratings convey other credit relevant information. For instance, EPC-A properties were all either recently built or renovated and thus have characteristics of the "newly built" market. They are in good condition and have higher resale values (a credit positive). Crucially, such properties are less likely to need unexpected expensive repairs, because the property is in better condition or still under warranty (a credit positive). In contrast, EPC-F/G properties were built before the enactment of energy-efficiency regulations. This category includes prestigious Parisian flats (a credit-positive characteristic) as well as derelict houses in scarcely populated areas (credit-negative). These older buildings were not designed to withstand the physical effects of climate change such as *drought-induced subsidence*[18] and were sometimes built in places where building permission would no longer be granted. The EPC rating thus not only reflects transition risk but also to some extent the physical risk from climate change. Over time, this will be even more credit negative. These properties are therefore more likely to need unexpected and expensive repairs, typically financed by consumer loans. These extra repayments, on top of the debt servicing, can instantly and significantly deteriorate a borrower's debt servicing ratio (a credit negative). Last, an ever-increasing supply of energy-efficient properties will make the others relatively less appealing, and ultimately worthless unless they can be renovated (another credit negative).

In theory, a renovation can be credit-positive for a property; in practice, not every property is worth renovating. If the property is poorly located and in bad condition, it is conceivable that the cost of the renovation may exceed the added value to the property. Adding the cost of a renovation to a property immediately deteriorates the LTV (a credit negative). This effect is even more acute if the increase in property

[14] See for instance Energy Allowance in the Netherlands

[15] We mean "département".

[16] See https://adviseurs.woonnu.nl/over-ons/actuele-rentestanden/ ; Woonnu is a bank operating in the Netherlands and is a subsidiary of Nationale-Nederlanden Bank N.V.

[17] Which includes a substantial tax or" carbon price "component

[18] See for instance "A crack in the wall of your home [..]" (SwissRe – an Insurer) and also "Most buildings were designed for an earlier climate" (World Economic Forum)

value is less than the cost of the renovation. For instance, if a borrower borrows EUR 80,000 to purchase a property worth EUR 100,000, the OLTV is 80%. If the borrower borrows an extra EUR 30,000 to renovate the property, the new LTV can be 85%, assuming the property value increases by the amount of the renovation (if it is worth EUR 130,000). For the LTV to remain stable at 80%, the upgrade should increase the property value by more than the cost of the renovation. In this case, to EUR137,500 instead.

The overall effect on the debt servicing ratio depends on whether the lower energy costs exceed the renovation loan instalments. This is more likely to be the case if a renovation can be financed as a mortgage "top up" (i.e. a new loan part) characterised by a low interest rate and to be repaid over a long period (as in the Netherlands); conversely, this is less likely if the renovation must be financed with a consumer loan with a higher interest rate and to be repaid over a shorter period with higher instalments.[19]

The EBPD is aware of the difficulties of *vulnerable households* (mentioned 24 times in the EBPD),[20] which are the ones for which financing and implementing a renovation is the most difficult, but which stand to benefit the most from such renovations. Renovation mortgages and "pay as you save" schemes could be the answer and be more palatable than more constraining policies such as letting bans, which France's Rassemblement National has promised to abolish should it come to power.

REMARKS ON DATA AND METHODOLOGY:

This study is based on a sample of French and Dutch securitised mortgages for which EPC ratings are available, which may not be fully representative of the broader mortgage universes of these two countries. The French sample includes ca. 140,000 loans worth EUR 20 billion at origination whereas the Dutch sample includes ca. 120,000 loans and loan parts worth EUR 15 billion at origination.

Exhibits 1, 6 and 7 series show cumulative delinquency or default amounts as % of the original loan amounts, up to 48 months after loan origination. We flag the loans the first time they become one month in arrears or when they become defaulted, considering their outstanding amount at that point.

We selected a sample of loans originated from 2016 to 2019 for which sufficient data was available. Each index line is therefore made of loans originated within this period and for which there is historical data for 48 months. A loan originated in December 2019 will therefore be at point 48 in December 2023, where our data sample stops; it will therefore reflect the impact of COVID and the energy price increases following the invasion of Ukraine. In contrast, a loan originated in January 2016 will have the last data point as of January 2020, before these events occurred. The indices are therefore a weighted average of loans from several vintages that have endured various stresses at various times.

Please note also that these results may be affected by the specific characteristics of the securitisations the data was sourced from; origination criteria, loan management and reporting may also play a role in explaining the actual performance and credit metrics observed.

[19] For the sake of comparison, a 25-year EUR 100,000 mortgage at 3.5% costs a monthly EUR 500, less than a consumer loan at 7.5% over 7 years to finance a EUR35,000 renovation. If these EUR 35,000 were financed as a loan part at 3.5% over 25 years also, the cost of the renovation drops to a monthly EUR175; it is not unrealistic to think that it could be paid for with the energy savings, particularly if energy prices are set to increase.

[20] Defined as "[…] households in energy poverty or households, including lower middle-income households, which are particularly exposed to high energy costs and that lack the means to renovate the building that they occupy;" (EBPD p17)