Climate change and the Dutch housing market: Insights and policy guidance based on a comprehensive literature review

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Introduction

Global climate change has local ramifications. This is particularly so in the case of The Netherlands[1]: A considerable coastline, the presence of the Rhine-Meuse-Scheldt river delta, and 59 percent[2] of the land area prone to flooding, all make the country highly exposed to floods[3] from the sea and rivers. The Netherlands also faces other physical climate risks, including waterlogging, heatwaves, and prolonged drought which can cause damage to buildings and other assets. Finally, the Netherlands faces *transition* risks due to both climate mitigation and adaptation policies, which can shift the value of assets affected by these policies.

Climate risks bear implications for the housing market. Some of these implications are hurdles that stand in the way for the housing market to become low-carbon and climate-resilient. And from an economic perspective, these implications are of great importance when designing policies that help the shift towards a low-carbon and climate-resilient housing stock. In this report we provide insight into the impact of climate risks on the Dutch housing market. We focus on the owner-occupied sector, because – in contrast to tenants – homeowners have to act upon climate policies themselves and are also more directly impacted by price effects of climate risks and climate policies.

We take a holistic research approach (figure 1). Based on a systematic literature review (a description of the methodology is included in Appendix 1), we investigated how climate change affects the housing market through three channels of impact: physical climate risks, climate adaptation, and climate mitigation. Climate adaptation refers to the adjustment to the effects of climate change. For some climate risks, homeowners are dependent on the government because there are limited adaptation options they can take on their own. Examples of public climate adaptation measures are reinforcements of primary barriers and changing building regulations. Climate mitigation refers to reducing greenhouse gases emissions into the atmosphere to limit global warming. Examples are insulation measures and installing solar panels on homes. In our impact analyses, we distinguish three different impact levels (households, regions and macro). Impacts on a national level are considered to be macro-level impacts. We recognize that climate change and related policies may have important indirect and self-reinforcing effects too, for instance via the interplay between the housing market and the economy. We limited our research to the direct impacts.

Our aim is to provide insights and recommendations that help the transition to a CO_2-neutral and climate-resilient (owner-occupied) housing stock. This transition should be timely, smooth, fair and cost-efficient. Smooth refers to a gradual adjustment instead of shocks to avoid financial instability. In our previous housing market publication[4], we concluded that the housing market contributes to (wealth) inequality. Building on this conclusion, we consider a transition to be fair and just if it does not increase inequality between households, and between current and future generations. To this end, we have made explicit the trade-offs and practical hurdles related to current, planned, and potential climate policies. For current policies, we took climate policies as laid out in the coalition agreement[5] of the previous (resigning) government as the starting point of our analysis. This policy synthesis presents our main conclusions (in bold). Each conclusion is substantiated with further analysis (in bullets). The methodology used for the systematic literature review is documented at the end of this report, with Appendix 1 providing an overview of channels of impact, (see Appendix 1) and Appendix 2 a 'library' of existing knowledge.

This report is the result of a joint and independent research project conducted by climate economists and housing market economists of the economic research departments of ABN AMRO, ING, and Rabobank. During various stages of the research project, a large group of experts provided us with feedback and knowledge, for which we are really thankful. This includes the following experts: Maarten van Aalst (KNMI), Dorine van Basten (Nederlands Woning Waarde Instituut), Jasja Bos (Nibud), Alexander Carlo (Maastricht University), Nils Dalmeijer (Nederlandse Vereniging van Banken), Ferdinand Diermanse (Deltares), Devin Diran (TNO), Geeke Feiter-van Heuvelen (Verbond van Verzekeraars), Kees van Ginkel (Deltares), Hans Heijnen (Nationale Hypotheek Garantie), Rik Heinen (Ministerie van Infrastructuur en Waterstaat), Andries Hof (Universiteit Utrecht), Bart van den

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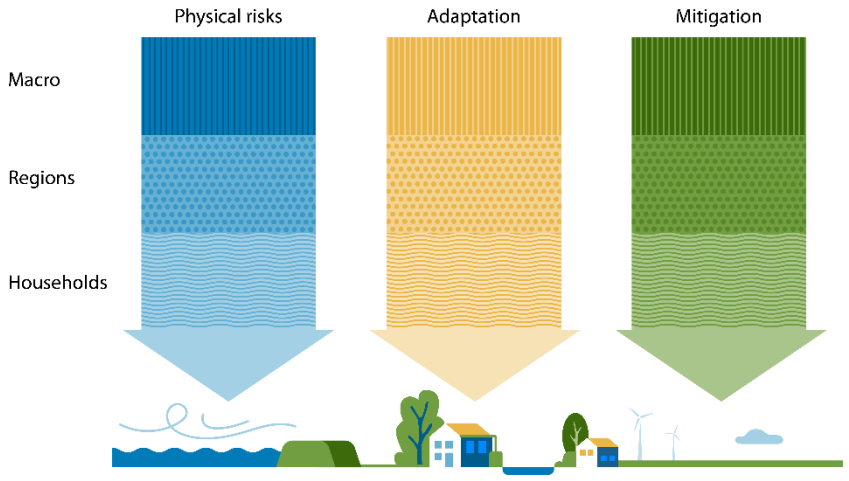
Figure 1. Our impact analysis distinguishes between three different impact levels (macro, regions, households) and three channels of impact (physical climate risks, adaptation, and mitigation).



1. The pace and impact of global climate change have long been underestimated. The uncertainty on how climate change progresses is reflected by a wide range of severe impact scenarios

"Greenland glaciers are melting even faster[6] than predicted". "Dutch Meteorological Institute (KNMI): sea level rising[7] faster than predicted". "American top climatologist: we underestimated the CO_2 problem for forty years". "We are entering an unfamiliar domain[8] regarding our climate crisis". "Exceeding 1.5°C[9] global warming could trigger multiple climate tipping points." These scientific statements and headlines reflect not only great uncertainty about the future climate but also that, so far, the climate is changing faster than expected.

The four main climate scenarios developed by the KNMI (KNMI '23 scenarios[10]) do not incorporate accelerated trends[11] in ice-shelf melting of the West Antarctic Ice Sheet, which might raise the global mean sea-level by 5.3 meters over the coming centuries. Whether these trends will make the four

KNMI climate scenarios “outdated” is not yet known. In any case, extreme scenarios cannot be ruled out.

Our analysis is based on the *KNMI’23* scenarios, which reflect the best available climate information for the Netherlands at this time.

2. Sea-level rise unlikely to be a significant macro-level risk for the housing market until 2100. After this, extreme scenarios are possible

The *KNMI’23* scenarios show increases (up to 124cm in a high emission scenario) in the average sea-level until 2100. The KNMI states that a sea-level rise of up to 2.5 meters in 2100 ‘cannot be ruled out’, but current decision-making does not take extreme scenarios outside of the KNMI’23 scenarios into account.

It is technically feasible[12] to adapt to sea-level rise until at least 2100. In the case of a high global emissions scenario (SSP5-8.5), the Netherlands is able to manage sea-level rise until 2050 (19 to 38 cm) and 2100 (59 to 124 cm). Moreover, the Delta Commissioner and the Ministry of Infrastructure and Water Management assume that a sea-level rise of 3 meters in 2200 is technically possible and would lead to an annual cost that is similar to that of the current flood protection program (HWBP).

The costs of the current climate adaptation strategy to floods from the sea (and rivers) are relatively small until 2050. The national flood safety program will require an estimated EUR 50 per inhabitant per year (annually 0.1% of GDP) until 2050[13]. As a comparison, it is more costly to adapt to other physical climate risks - the estimated cost of protecting the urban environment in the province of South-Holland against waterlogging, heat, and drought annually amounts to 0.2% of provincial GDP[14,15] until 2050.

Hence, we conclude that large macro impacts are unlikely under the current adaptation strategy to sea-level rise as these risks are maintained within the agreed limits[16]. In addition, the adaptation costs also seem manageable on a macro level.

The regional and household-level impacts of adaptation to climate change can be considerable. This is because adaptation can be technically challenging and requires large trade-offs in terms of spatial planning, alongside new problems occurring in the low-lying land behind the dikes. For example, dike reinforcements may require additional horizontal space of up to 90 meters, which is not always available in built-up areas. In some regions, agricultural and industrial land use may no longer be feasible because sea-level rise drives the accumulation of salt in soils (“salinization”).

The short-term need to build more houses should be carefully balanced with the long-term risks in flood-prone areas. Today, it is still possible to build in flood prone areas such as floodplains, and this is justified by law (Raad van State).

Rapid housing construction can lead to "lock-ins", where measures are becoming increasingly costly or even unfeasible:

- More than two-thirds of future housing construction[17] is planned in low-lying areas of the Netherlands, mainly in the Randstad area. This increases the concentration of labor and capital in these areas, which, in turn, requires ramping up flood protection after 2050.
- Housing construction near dikes and major rivers reduces possibilities for dike reinforcements and more room for the rivers, both of which may be increasingly necessary in case of dire climate change.

Short-term considerations for building locations can stand in the way of long-term options for building locations to stay climate resilient. For example, without preventive measures, building on subsiding soils can lead to damages in the long run. **We advise** that lock-ins are more explicitly considered in residential housing planning (see also the advice of the Delta Program Commissioner). This requires knowledge development, which could be done in future initiatives (see, e.g., *Brede Nota Ruimte* and *ReThink the Delta*).

We advise the government to initiate and develop a structured very long-term vision on future flood safety in the Netherlands. This vision should look 50, 100, 150 years ahead and involve various stakeholders (lower-level governments, water boards) and various disciplines (engineering, climatology, economics, psychology).

3. Climate change exacerbates pre-existing foundation problems. This can have a large impact on individual households but the total restoration costs are small compared to current total home value

Foundation problems (pile degradation and differential settlements) are caused by multiple[18] factors, including groundwater management, soil subsidence caused by groundwater management and development of buildings, and climate-induced drought. Foundation problems affect 10% of Dutch properties, mostly in the northern and western parts of the Netherlands, but more often also in other low-lying areas. Increased drought caused by climate change until 2050 increases the risk of differential settlements and could increase total costs by up to 38%.[19]

The estimated costs of foundation restoration amount to a maximum of EUR 60 billion[20] (cumulative costs) until 2050 (for all homes, both owner-occupied and rentals), which is equivalent to an average annual cost of 0.2% of GDP until 2050.

The estimated repair costs vary widely but are likely in the order of EUR 50,000-100,000[21] (~20-25% of average property value) in cases where full restoration is needed. Even higher repair costs have been reported on several occasions. Full restoration is applicable for only 2%-9%[22] of all homes. For approximately 80% of the affected homes, repairs are estimated to cost less than EUR 10,000[23]. A repair of EUR 100,000, however, could have major implications for affected households.

Foundation problems can be prevented or delayed by active groundwater management in 25%-30% of cases[24]. While some measures, e.g., raising or lowering groundwater levels, are taken by the public sector, the materialization and repair costs are borne by either the current or future homeowner. Moreover, active groundwater management can also be used to prevent damage from waterlogging.

The *Fonds Duurzaam Funderingsherstel* (EUR 100 million[25]) offers loans to households that want to restore their foundation but are unable to finance this with a regular mortgage or household savings. The fund is sufficient to provide finance to 1000 homeowners with worst-case foundation issues (assuming a repair cost of ~100,000 per case). The number of eligible homeowners may be much larger – roughly 20% of the worst-case owner-occupied homes are located[26] in areas where average household income and home value is low – but the exact number remains uncertain due to the absence of household-specific data (see Point 6).

Besides the fund size being a potential risk, the availability of labor and length of turnaround time for repair work are also potential risks. There is currently only a limited number of companies that are able to perform such large-scale repair operations.

We advise the national government to investigate how many households are potentially dependent on this fund and, if needed, allocate more funds accordingly. The focus should be on properties that urgently need (costly) full restoration, and whose owner's financial ability to restore is limited. In line with governmental ambitions, the *Fonds Duurzaam Funderingsherstel* should also provide nationwide coverage (beyond the current municipalities[27]). A lot of municipalities with high foundation risk are not yet included.[28] **We also advise** the government to take into account the advice that the *Council for the Environment and Infrastructure* will publish in February 2024. This advice will include recommendations for a nationwide, just and practically feasible approach to foundation problems.

We advise governments and water boards to develop a systemic approach[29], in which the planning process is preceded by monitoring and inspections of the built environment (houses, roads, sewers etc.). Thereafter, the knowledge gained should form the basis for an integral and phased planned approach with close collaboration between residents, businesses, municipalities and water boards. The

technical implementation should make use of scale (i.e. entire residential blocks being addressed simultaneously) in order to keep costs as low as possible.

4. Flood risk is already manageable under current economic conditions, but insurance arrangements can help to avoid large impacts when floods do happen

It is estimated that 48%[30] of all Dutch homes are at risk of direct inundation from rivers and the sea if primary and regional water defense systems fail. Only a fraction of Dutch homes face a high risk of flooding combined with a severe inundation depth.

Both primary and secondary defense systems' flood probability maps provided by LIWO[31] overestimate[32] the actual risk in specific locations due to several conservative modeling assumptions.

An extensive flood scenario analysis conducted by DNB and Deltares[33] suggests that, under current climate conditions (and based on several assumptions), damages to the capital position of Dutch banks are likely limited to between 0.3% and 0.5%. This is because current net positive home equity prevents flood damages from causing home values to drop below the outstanding mortgage for most homes.

Primary flood defense systems are strengthened and upgraded until 2050, according to a national dike reinforcement plan (*HWBP*). This plan ensures that flood safety meets strict safety norms by 2050. It is because of these planned, ongoing improvements of the flood defense systems that flood risks are expected to decline despite sea-level rise. The norms and upgrades for secondary flood defense systems are determined by provinces at a regional level.

Flood damages to properties are dependent on flood height. There is a large difference between ground floor properties and apartments on higher floors. The maximum estimated damage (i.e. when a primary flood defense system fails) for repairing a building amounts to EUR 1,295 per m² and replacing its contents amounts to a maximum of EUR 82,000 per dwelling (SSM2022[34]).

We advise municipalities to communicate clearly how households can limit the impact of floods or waterlogging, by adaptation measures[35] for existing and new housing. The communication should clearly distinguish between adaptation of housing and local infrastructure. Communication and prioritization should be focused on households with the highest flood risk and those who are most dependent on fast damage compensation.

We advise that the government and water boards should communicate clearly about which houses are prone to floods or waterlogging (caused by primary/secondary defense system failures).

Insurance arrangements can help to protect households against large losses by sharing risks among a large number of households.

The majority of households believe[36] they are privately insured against floods or would receive government compensation in case of floods, whereas in reality they aren't. The repair costs after floods are borne by homeowners.

The current *Wet Tegemoetkoming Schade bij rampen* (*WTS*) offers only partial compensation and only under certain conditions. In principle, the *WTS* is only applied if primary flood defence systems along the rivers fail[37]. However, the *WTS* was used in 2021 to compensate damages due to regional flooding and extreme weather in Limburg.

If the government and insurers decide to increase flood insurability, there are many possible insurance arrangements. For example, insurance premiums can be voluntary or mandatory, flat-rate or differentiated, and with or without mandatory excess.

We advise insurers and the Dutch government to decide on the future insurability of flood risk, including in currently uninsurable areas (e.g., "uiterwaarden"), and to communicate the insurance arrangement of choice clearly.

We advise that the government communicates about the possibility of future compensation for homeowners in the case of extreme climate and weather events, and that all insurers provide transparent information about insurance coverage.

5. Other physical climate risks and costs also have limited macro-level impacts, but impacts can be considerable for certain regions or households

Damages from extreme weather events, including from waterlogging (insurance claims amounted to EUR 58 million in 2022[38]), hail (EUR 26 million in 2022) and storms (EUR 784 million in 2022), are relatively small (all events combined <0.1% of national GDP). However, these damages have been on an upward trend in the past decade. Furthermore, the damages from extreme rainfall and hail may double[39] by 2085 (compared to baseline period 1981-2010).

The (increasing) risks of extreme weather and regional flooding (i.e. due to a secondary flood defense failure) will likely be averaged out over homeowners via insurance, depending on the uptake of private insurance for these risks. Roughly 90% of all occurrences of waterlogging and regional flooding are currently insurable[40].

Extreme events do strike affected regions and households. The estimated costs of regional flooding caused by extreme weather in Limburg (2021) amounted to EUR 433 million[41]. Damages constituted almost ~1%[42] of Limburg's GDP.

There is limited evidence of the magnitude of other climate-related risks in the Netherlands, such as heat stress, salinization, and wildfires on the built environment. However, these risks are currently already of influence on agriculture and are further expected to increase in the future, impinging on healthcare, productivity, labor and GDP.

We advise realtors, mortgage brokers and insurers to ensure that climate risk insurance is discussed with homebuyers and homeowners.

6. Due to a lack of accurate property-specific information about *physical* climate risks and costs, they are not fully reflected in house prices and are therefore transferred to future buyers

Some physical climate risks are insurable, such as property damages due to heavy rainfall and flood damages (see also point 5). Other physical climate risks are not insurable, such as damages from floods from the sea and major rivers, foundation damages due to soil subsidence and pole rot, and property damages due to groundwater seepage.

In theory, uninsurable risks reduce the market value of a house. In practice, uninsurable risks are not accurately reflected in market prices:

- Foundation problems are hardly reflected in market prices because 85% of homebuyers[43] are not aware of these problems. There is no price discount for homes with foundation problems unless it is explicitly mentioned[44] in advertisements. However, foundation quality is only mentioned in 2% of home sales advertisements[45].
- Flood risk has been found to cause a 1% market price discount[46] in the Netherlands, and even more in neighborhoods with higher predicted flood water levels. Price discounts increase after a flood event. But over time, the price discount becomes smaller[47] and eventually disappears in the years after the flooding. Moreover, the discount is unlikely to reflect actual risk from all possible causes (e.g., primary and regional water defense failures, extreme rainfall) because 61% of recent homebuyers[48] that are exposed to floods are not aware of that. Also, publicly available flood risk maps are not suitable to inform homebuyers because the underlying data is highly uncertain (uncertainty range of up to two orders of magnitude[49]) and the data is not continually updated to reflect the most up-to-date flood risk levels.

Property-specific information about foundation problems and estimated restoration costs is only available for professional parties. This includes valuers who consider foundation risk in home

valuations[50]. Consequently, homebuyers only gain some insight into potential foundation problems and the estimated costs of repair at a late stage in the sales process.

Climate risk information incentivizes homeowners to take action sooner, thus preventing higher costs or risks in the future. It also helps buyers to incorporate climate risk into bids so that house prices more accurately reflect these risks[51]. The latter reduces the risk that climate damages are shifted to future homeowners. This could be problematic for especially young homebuyers, because they generally have less home equity and a higher loan-to-income, which makes it harder to get an additional mortgage for prevention and restoration.

Once information on climate risks becomes available and is reflected in home prices, homeowners with high risk are likely to see the value of their properties decline. This will not automatically result in negative home equity. Due to the strong rise in house prices in the last couple of years, combined with mortgage repayments, many homeowners now have (a lot of) home equity. Homeowners are estimated to have had on average some EUR 236,000[52] in home equity in 2022, according to figures of Statistics Netherlands. However, there is also a group for whom a price decline can be very painful, for example for young adults who just bought their first home and who still have high loan-to-value ratios.

We advise the government and financial and real estate sectors to jointly develop standardized climate risk information for each property in the Netherlands. This information should encourage preventive action and ensure a better reflection of climate risk in housing prices. The information should be presented in an easily comprehensible format (i.e., a climate label) and consist of multiple risk indicators. To avoid incorrect home price effects, it is a pre-condition that accurate and reliable property-level data is used for each risk indicator. Currently, this pre-condition is not met (e.g., publicly available flood risk information is not suited for this purpose). In the long run, sharing object-related climate risk information should be a mandatory (e.g., through regulation) part of real estate advertisements, valuation reports and mortgage advice.

Currently, there is no consensus on which information should be shared. **We therefore advise** to carefully assess how different options meet various user requirements, and how feasible they are in terms of data needs and funding requirements. For instance, to what extent is a single risk indicator to be preferred over multiple climate risk indicators? Should the risk indicator(s) express a relative risk or an absolute risk, and with or without (climate and weather) uncertainty? For this assessment, lessons can be learned from the knowledge about risk classification developed as part of the Framework for Climate-Adaptive Buildings[53] (Dutch Green Buildings Council) and the user-oriented pilots (Nederlands Woning Waarde Instituut, NWWI).

7. The Dutch housing market needs more climate adaptation in order to become climate-resilient

The current approach to climate adaptation mainly focuses on protecting the existing built environment against floods (i.e., reinforcing dike segments to protect buildings near the coast, along rivers and lakes), and to a lesser degree on waterlogging, heat stress, and drought. Adaptation goals for the latter three climate issues are less concrete[54] than for flood adaptation.

The 2022 "Water en Bodem Sturend[55]*"* Parliamentary letter provides useful guidelines to pay more attention to all aspects of climate adaptation in housing development. National guidance about how to realize climate-adaptive housing ("*Maatlat groene klimaatadaptieve gebouwde omgeving*[56]") became available in 2023, and there is additional guidance[57] coming up ("*Ruimtelijk afwegingskader klimaatadaptieve gebouwde omgeving*"). These guidelines are yet to become standard practice. Climate-proof residential area development is standard practice in few regions[58] only (such as in the province of Zuid-Holland). In most of the Netherlands, urban climate adaptation (e.g., through greening and rainwater management), remains in a nascent stage.

In line with ambitions to legally embed climate-adaptive housing**, we advise** to make the *Maatlat groene klimaatadaptieve gebouwde omgeving* mandatory for new housing construction.

The total costs of making all Dutch homes climate-adaptive are unknown. Anecdotal evidence shows that adaptation of homes owned by housing corporations (e.g., rainwater storage, green walls and gardens) costs the equivalent of about 3% of the average property value (EUR 11,500 per home[59]). It should be noted that adaptation may be more expensive and burdensome for some homeowners.

We advise the government to get a better understanding of the funding gap in making the Dutch housing stock climate-adaptive. This starts with a better understanding of the adaptation costs for different home types (flats, terraced, detached) in different neighbourhoods (inner cities, outskirts, rural areas).

Private adaptation measures by homeowners are also an important part of making the Dutch housing stock climate-resilient. For example, flood damage prevention, such as water-resistant flooring, can reduce flood damages by 20%-50%[60]. However, the willingness[61] of homeowners to take preventive measures depends on expectations about how much action they can take themselves, and what is done by the government.

We advise municipalities to clearly communicate risks and responsibilities to encourage adaptation.

We advise banks, brokers, appraisers, and mortgage advisors to encourage climate adaptation by discussing climate risks and adaptation with clients.

8. The Dutch housing market needs a clear business case for the transition to net-zero

Accelerating the transition to a net-zero housing stock is needed to increase the likelihood of achieving the national emissions reduction goals for the built environment by 2030 (as stated in the "Kamerbrief over voorjaarsbesluitvorming Klimaat[62]"). With current mitigation policies (implemented, planned and stated) the built environment will only reach the 2030 target[63] in the most positive scenario and only if external factors move in the most favorable direction.

Currently, around 28% of existing owner-occupied homes with an energy label has label A, while the share of homes in line with the *Nearly Zero Emission Buildings (NZEB*, or in Dutch: *BENG)* norm is estimated to be around 3%[i]. The required investments in energy efficiency are highest for homes built before 1992.

By 2050, the government aims for a net zero carbon built environment. This implies investments in home insulation and the phasing out of natural gas for heating. The estimated costs of upgrading the total existing Dutch housing stock according to the *Nearly Zero Emission Buildings (NZEB*, or in Dutch: *BENG)* norm are approx. EUR 235 billion in 2018[64]. In today's prices, this translates into approx. EUR 285 billion, or 1% of GDP annually until 2050[65]. The step from energy label C to *NZEB* is by far the most costly, accounting for about 90%[66] of the total cost.

To enable the phasing out of natural gas, all existing dwellings must eventually meet a minimum insulation standard (In Dutch: isolatiestandaard[67]), as defined by the national government in 2021. How the insulation standard relates to a home's energy label is not straightforward. From 2021, every newly issued energy label states whether a home meets the insulation standard. However, homeowners are not yet required to meet this insulation standard.

Policy makers should be aware of the multiple financial and non-financial hurdles faced by homeowners, market players, and (local) governments when making new mitigation policies:

I. <u>The financial business case of the renovation of homes is still lacking:</u>

- Based on expected energy cost savings, initial investments in home insulation typically have a (very) positive financial return[68]. It also holds that improving the energy-efficiency of homes generally pays off for homes up to and including energy label C[69].

i Estimated as the sum of new home production in 2022 and 2023, divided by the total housing stock. From 1 January 2021, permit applications for all new construction, both residential and non-residential, must meet the NZEB requirements.

- "The last mile", i.e. renovation to the *BENG* standard, is on average not financially beneficial for existing homes. Here the initial investment costs exceed the expected energy costs savings by far. The business case is also mixed when looking at insulation up to the level of the insulation standard; the investment currently seems to pay off for only for 47% of all owners of homes built before 1992[70ii] (ca. 65%-75%[71] of all owner-occupied homes). The remainder of owner-occupied homes (built after 1992) mostly already meet the insulation standard.
- However, aside from the expected energy cost savings, investing in energy efficiency also increases home values[72]. Home buyers are generally willing to pay more for energy efficient homes due to the expected energy costs savings, higher living comfort and the avoided hassle of future renovation efforts needed to comply to stricter climate standards. In addition, the price premium of energy efficiency on the housing market has increased recently[73].
- The financial business case will change over time due to both market and policy developments. For example, the vast increase in energy prices has significantly improved[74] the financial business case for renovation, due to the higher expected energy cost savings.
- **We advise** policy makers to improve the financial business case of energy efficiency investments via a mix of stricter climate standards, subsidies and pricing policies. The focus should be on the implementation of stricter standards, and less on higher energy taxes, to avoid inequality effects between low and high income households (see Point 9).

II. <u>The financial business case is unclear for many homeowners.</u> Key explanations are:

- The renovation business case varies[75] between types of homes and households.
- Future market developments are uncertain: the general consensus is that energy prices will remain structurally higher than the period before 2021, but to what extent is very uncertain. And although the investment costs of renewable heating systems are expected to decline, a hike in demand for contractors may increase renovation costs.
- Uncertainty around future policies is causing homeowners to delay renovation efforts. Still, in the longer term, there is a trend towards stricter EU norms, such as the expected revision of the *Energy Performance of Buildings Directive (EPBD)*[iii] and the planned introduction of the Emissions Trading System 2 (ETS2)[76,iv] in 2027. Implementation of these policies will make the financial business case of renovating measures more clear.
- It is difficult for homeowners to include the present value of the expected home value increase in their business case decision for renovation, since it depends on future energy prices, renovation costs, interest rates, the availability of subsidies etc. – future parameters that are all unknown at the time of investment.
- **We advise** policy makers to bring speed, more stability and clarity on future mitigation policies (standards, pricing, subsidies) as soon as possible. Opportunities to anticipate future expected EU policies should be exploited (that is: if the terms of these expected policies already seem sufficiently clear). We also **advise** policy makers to consider a faster implementation of stricter, enforced climate norms, instead of pricing policies. This replaces complicated cost-benefit calculations with clearer "black and white" norms.
- **We advise** municipalities to explore how they can provide homeowners with more tailored information on the business case of potential energy efficiency measures, and to more actively promote the possibility for homeowners to gain (free) tailored advice on energy efficiency measures via so-called "*energy fixers*" (in Dutch: Energieloketten).

ii More specifically, the study looks at homes built before 1992 and with natural gas heating.

iii The provisional agreement was reached on 7 December 2023 and commits to a reduction target for the primary energy use of residential buildings of 16% by 2023 and 20%-22% by 2035 (compared to 2020 energy use). Moreover, 55% of national measures will have to focus on decreasing the energy use of the worst performing buildings, which is defined as the 43% of buildings with the lowest energy performance in the national building stock.

iv ETS2 covers among other things the CO2 emissions from fuel combustion in buildings and will eventually increase energy prices for households.

III. **Lacking financial means:** around 14% of homeowners[77] have insufficient savings and borrowing capacity to make their home energy efficient (i.e. energy label B and with a hybrid heat pump). About one-third of homeowners have insufficient savings, but can borrow the amount needed for renovation. However, loan aversion may be an important hurdle[78] for this group to invest in energy efficiency.

- **We advise** policy makers to target financial support (existing or new subsidies and attractive financing options) more at financially vulnerable homeowners. We also see an opportunity for mortgage providers to more actively promote the possibility for low-income households to obtain an interest-free loan for energy efficiency measures ("*Energiebespaarlening*") and other existing subsidy programs.
- **We advise** policy makers to provide more targeted non-financial support to financially vulnerable homeowners: for example, energy coaches ("fixers") can help households implement low-cost energy efficiency improvements, which improve living comfort and lower energy costs[79].
- The differentiation of the Debt-Service-to-Income norms[80] by energy label, from 2024, (based on the annual advice by *Nibud*) already provides additional financing options for the renovation of homes with energy label E, F, and G[v].
- **We advise** the financial sector to center its client communication with respect to the financing of energy-efficiency improvements around its goal[81] (realizing energy-efficiency improvements), rather than on the (additional) financial loan. This can help to overcome the hurdle of loan aversion, given that the attitude towards home renovation measures is positive for the majority of homeowners. This implies that financing advice should be combined with (technical) advice on the best suitable investment measures, and may require the sector to team up with energy efficiency experts.
- **We advise** the financial sector to explore options to further reduce the handling costs for small renovation loans, for example by means of standardization. This will help to provide liquidity for renovation measures to homeowners with insufficient savings, but sufficient borrowing capacity.

IV. **High transaction costs and hassle:**

- Homeowners need to make substantial efforts to renovate their homes but their possibilities are limited in terms of time and knowledge. The information costs of identifying the best renovation measures are high. Homeowners also dread the reduced living comfort[82] during renovation (see also SCP[83]) and there is a lack of transparency about contractor quality. Disagreements[84] among the members of Homeowners' Associations (*VvE*) pose an additional hurdle for apartment owners. These non-financial costs deteriorate the business case for energy efficiency measures.
- **We advise** a chain approach (e.g. government, financial sector, real estate agents, energy efficiency experts etc.) for unburdening homeowners with regard to the renovation of their homes. The establishment of 'one-stop-shops' is one potential solution. There is much to learn from existing 'one-stop-shops', that exist in many forms (e.g., public/private, advice-only/full service), each with its own advantages and disadvantages1[85,86].
- The announced policy agenda[87] ("*VvE-versnellingsagenda*"), is aimed at extending support for renovation where homeowner associations are involved, and help reduce transaction costs and hassle for apartment owners. **We advise** an evaluation of how these policies speed up the transition, and extend and/or adjust the policies accordingly.

V. **Lack of insights into actual household energy consumption:** mortgage providers currently lack insights into the actual energy consumption of their clients – this limits their ability to steer on energy targets. **We advise** the financial sector and energy suppliers to explore how they can better

v The new, differentiated norms allow for additional finance of up to EUR 20,000 for a list of specified energy-efficiency measures for homes with energy label E, F and G.

help their clients to implement energy efficiency measures. This may require more exchange of energy use data, subject to data privacy rules.

9. Climate mitigation policies will affect inequality mostly via energy prices, home equity plays limited role

Higher energy taxes help to speed up progress towards the carbon target for the built environment, but increases (disposable) *income* inequality between low and high income households. This is because lower-income households (both renters and owners) are more vulnerable to higher energy prices[88], given that they spend a higher share of their disposable income[89] on energy. To illustrate: a hypothetical tax increase on natural gas by EUR 0,01 per m^3 increases the the share of household income spent on energy in the lowest income decile by approx. +0.1%-point, compared to approx. +0.03%-point for households in the highest income decile[vi] (all else equal).

To speed up the transition, the comprehensive government inventory (IBO) proposes to gradually increase the energy tax on natural gas with a minimum natural gas price of EUR 1.50/m^3 (Annex 2, p. 61[90]). The disadvantage is that this mainly affects low income households, often tenants[91], and whose options to improve the energy efficiency of their home (in order to lower energy costs) is therefore limited.

From an inequality perspective, it may therefore be preferable to first focus on stricter energy efficiency norms. These force landlords to improve the energy efficiency of rental homes, which as such helps to lower the energy bill of low-income tenants. And even if landlords pass on part of the investment costs to tenants by increasing their rents, the net effect on tenants' housing costs is not likely to be negative.

Stricter norms will (just like higher energy taxes) lower the *relative* price of less energy-efficient homes via the extra compliance costs. As such, these norms affect the distribution of (housing) wealth via house price effects. At the micro level, this will be painful for existing homeowners in less energy-efficient homes. But the macro effect on *wealth* inequality between low and high income households is likely to be limited. This is because home ownership among low income households is low (only 3.3%[92] of owner-occupied homes are owned by low-income households[vii]), and approximately 4.0% of owner-occupied homes with a bad energy label (labels D to G) are owned by low-income households.

We advise policy makers to primarily focus on the implementation of stricter energy efficiency norms (incl. insulation norms for homebuyers[viii]) for speeding up the transition to a net-zero housing stock, supplemented by subsidies and higher energy taxes to ensure a timely transition of the housing stock.

10. The transition towards net-zero and climate-resilient housing/neighborhoods requires more planning and resources than currently available – both can compromise the achievement of the set targets and may delay new construction

Grid congestion poses a serious constraint for home electrification in virtually every region of the Netherlands[93]. A lack of available grid capacity can delay housing construction as new homes can no longer be connected to the net. This is expected to happen in at least three provinces after 2026. A lack of grid capacity also renders norms and taxes to reach climate goals for the built environment less effective.

vi Based on actual energy consumption and as %-point of median standardized disposable income.

vii Standardized disposable income up to EUR 18,871 per year, or 130% of the low-income threshold (CBS).

viii The negative impact of these stricter norms on the accessibility of the housing market is likely to be limited, as: 1) to the extent that the expected / planned renovation costs are not yet reflected in house prices, this will lower the house prices of less energy efficient homes; and 2) the maximum Loan-to-Value and Debt-Service-to-Income ratios for renovation recently increased for less energy efficient homes.

We advise policy makers to limit grid congestion by taking action in line with the *Actieagenda netcongestie laagspanningsnetten*[94].

If the national government sets stricter energy efficiency norms and increases energy taxes, this will increase power demand and demand for renovation measures. However, grid capacity and the number of renovators are limited. **We therefore advise** policy makers to take capacity constraints into consideration when setting these energy taxes and norms.

Municipalities currently lack concrete plans[95] and mandate for the transition to natural gas-free heating of neighborhoods. A law to assign this mandate to municipalities is currently under development ("*Wet Gemeentelijke Instrumenten Warmtetransitie*[96]"). In addition, one of the aims of the proposed "*Wet Collectieve Warmtevoorziening"*[97] is to accelerate the roll-out of collective heat grids through more public control. **We advise** policy makers to speed up the implementation of these laws – although the recommendations of the Council of State should be taken into account. This is because policy uncertainties for the sector and local governments currently hinder the scaling-up of heat networks.

Municipalities do not have sufficient funding to implement climate adaptation on a local level. In 2018, the national government earmarked EUR 300 million[98] in adaptation subsidies to municipalities, provinces, and water boards (including the "*Tijdelijke impulsregeling Klimaatadaptatie"*). However, this funding is insufficient for mainstreaming climate-adaptive housing development. The earmarked subsidies are small compared to the cost of making the built environment climate-adaptive. **We advise** the national government to explore how municipalities can be financially supported.

The high costs of climate adaptation – for example, it would cost EUR 12.4 billion[99] to make the urban areas in the province of South Holland climate-adaptive in 2050 (with additional costs after that) – can prevent adaptation from getting started. **We advise** to explore to what extent households that benefit from adaptation measures can financially contribute to cover the costs of public climate adaptation measures. We recommend exploring possible policy options as outlined by CPB Netherlands Bureau for Economic Policy Analysis[100], including increasing local property taxes and introducing a residence tax.

In principle, climate adaptation can be financed through sustainable capital markets because it is covered by the environmental objectives under leading green bond principles[101] *(ICMA*) and the *EU taxonomy*[102]. The role of sustainable debt has so far been limited for financing climate adaptation by the Dutch public sector (green, blue, and water bonds have been issued to finance climate adaptation to the cumulative amount of ~EUR 11 billion[103] (equivalent to ~2% of national debt)).

Capitalizing on future benefits can aid the collection of the necessary funds. **We advise** to explore whether municipalities can fund adaptation by means of pre-financing the adaptation costs by the municipality and property owners. The idea being that property valuations ('WOZ'-values) will increase on a neighborhood level, benefitting both property owners and municipalities (through higher property tax), analogous to the BIZ in which entrepreneurs are charged to raise funds for improvements in public areas.

In some cases, homeowners may be less willing to invest in private adaptation because the benefits also accrue to others – e.g., installing a green roof reduces the risk of sewage overflows for adjacent homes too. For these cases, **we advise** the government to explore how to stimulate individual homeowners to invest in private adaptation measures and to support citizen initiatives aimed at adaptation ("*burgerparticipatie*").

11. The accumulation of climate risks and costs can have large impacts for certain households and regions and therefore contributes to growing inequality

Many homeowners have a low loan-to-value (median: 0.37 in 2022) and loan-to-income ratio (median: 1.5 in 2022[104]), which provides them with a financial buffer to incur property value losses and/or extend their mortgage loan, even in the case of extreme foundation damages (~EUR 100,000).

Not all homeowners have sufficient means to incur multiple climate risks and costs at once. Based on average values per neighborhood, recent research showed that there are 90 neighborhoods[105] (less than 3% of all neighborhoods) facing two or more climate risks and in which a considerable proportion of the households is expected to be financially vulnerable. These households have a low income, little financial buffer, high loan-to-value ratio, and/or high debt-service-to-income ratio.

Currently, there are no accurate estimates of the number of these households. **We advise** the national government to explore if it can take the lead in developing a data structure that bundles disaggregated data with regard to climate risks and costs. This data structure should incorporate property-level climate risk and cost data. If the government aims to provide targeted compensation, this data structure could support this endeavor by also incorporating financial data to identify the financially most vulnerable households.

Lower-income households are more likely to buy homes that are not yet energy efficient or that are exposed to larger physical climate risks. These homes are cheaper than (new or renovated) homes that are energy efficient and climate-adaptive. This can lead to '*climate segregation'* (or 'climate gentrification'[106]). **We advise** the government to ensure that the internalization of physical climate risks and climate policies in home prices does not deteriorate the accessibility of the housing market for lower-income households through housing market policy.

12. Fair and just climate policies require an explicit assessment of the distribution of direct and indirect costs

Climate change and climate policies come at a cost to Dutch households and this goes hand in hand with the question how these costs are distributed and whether that distribution is fair. Some examples include:

- Higher energy taxes hit lower-income owners and renters harder as they spend relatively more of their income on energy.
- Raising groundwater levels prevents nature degradation and foundation problems while it negatively affects farmland suitability.
- Urban greening increases home prices, which makes areas less accessible for lower-income households (‘green gentrification’).
- The pricing-in of climate risks/costs can reduce overall climate risks/costs but potentially creates financial hardship for recent homebuyers with a high loan-to-value ratio.
- Higher groundwater levels can reduce foundation problems in some homes while damaging the crawl space insulation in the same or other homes.

Even though the extent to which a distribution is considered to be fair differs between measures, in general, Dutch citizens consider a distribution based on the principles of cost-bearing capacity and solidarity as the most ‘just’ and ‘fair’ (WRR[107]). In line with this, and building upon the notion that the housing market contributes to (wealth) inequality[108], we consider a transition to be fair if it does not increase undesired forms of inequality between households (low and high incomes) and between current and future generations.

However, solidarity is subject to change[109], influenced by climate change and is not unconditional. For example: to what extent do people keep on showing solidarity with those who deliberately choose to buy a home on a (more prone to floodings) floodplain because they valued the scenery more than the potential risks?

Currently, little attention is paid to the distribution of climate costs and to the question whether this distribution is fair. This should change, because a fair distribution is crucial to receive and maintain public support for climate policy.

We advise more explicit attention for the direct and indirect costs of climate measures. An assessment and an open discussion about ‘fairness’ should be an integral part of policy decision-making by central and decentral governments. For example, is fairness defined by the amount of possible losses, by financial resilience, or by the co-occurrence of several negative impacts at the same time? Is green gentrification considered acceptable? These are all questions that require answers to determine whether collective (redistributive) action is needed. To formulate these answers, the ten principles for fair distributions as outlined by the WRR provide a useful guideline (see also WRR 2023[110]).