



Analysis of carbon footprint of proprietary assets

NN Group N.V.
Report 2020



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Introduction

To tackle climate change we need to accelerate the transition to a low-carbon economy. NN Group wants to play our part in this global effort. We are committed to transition our proprietary investment portfolio to net-zero greenhouse gas emissions by 2050.

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All main asset categories are now included in our carbon footprint analysis

Climate change represents an urgent and potentially irreversible threat to livelihoods and the well-being of society. To mitigate the worst effects, we must transition to a low-carbon economy, limiting the global temperature to 1.5°C as part of the 2015 Paris Agreement. The latest science shows that emissions will need to reach net-zero around 2050 to meet this goal and prevent the worst impacts of climate change.

As a financial institution, NN recognises that we have an important role to play in promoting the low-carbon transition especially through our investments. This recognition of responsibility is also reflected in our support of various pledges and commitments. Most recently, our commitment to strive for a net-zero greenhouse gas emissions portfolio by 2050. This is a key initiative under our strategic commitment Society: we contribute to the well-being of people and the planet.

Our climate change strategy broadly consists of decarbonising our portfolio in line with trajectories consistent with the Paris goals and increasing our allocations to green investments. Engagement with issuers will be an important instrument in our approach as we believe this is key to ensuring decarbonisation in the real economy. We worked together with other investors to help develop the IIGCC Net-Zero Investment Framework. We are now using this framework as a guide to create asset class specific strategies for our investment portfolio in a step-by-step matter. As part of our strategy, climate-related disclosures and risk and opportunity analysis as recommended in the Taskforce Climate-related Financial Disclosures (TCFD) are important cornerstones, which are disclosed in this report.

About this report

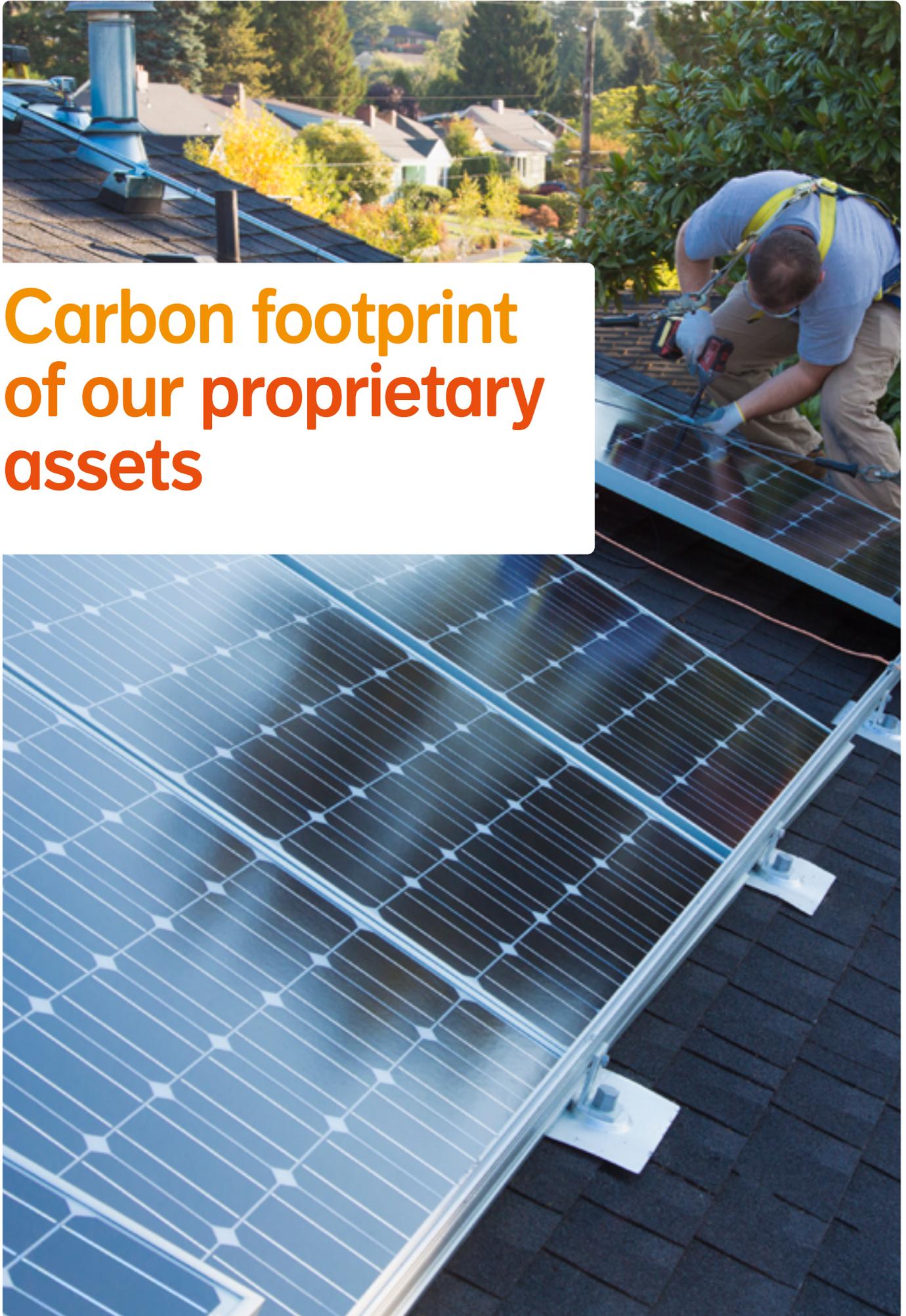
This is NN's fourth carbon footprint report covering 80% of NN's total asset portfolio. The scope of our analysis has been extended to cover NN's non-listed real estate investment portfolio. Combined with the already established analysis of government bonds, residential mortgages, corporate fixed income investments and listed equity, all our main asset categories are now included in the footprint report.

The main difference with last year's report, next to the inclusion of real estate, is that we included a chapter on the climate-related scenario analysis that we performed for our proprietary investment portfolio. Since 2017, NN Group is integrating disclosures in accordance with the TCFD framework in our Annual Report. One of the key recommendations of the TCFD is to perform forward-looking assessments of climate impacts. NN started to develop climate-related scenario analysis in 2019 for our main asset categories, which we finalised in 2020.

Generally, the climate-related scenario analysis that we performed, focused on both physical and transition risks, provided us with the insights that depending on the final temperature rise or speed of transitional measures to limit global warming, the immediate risks to our investment portfolio seem low but could significantly increase over the medium to longer term. As NN's investment portfolio has a bias towards Europe and especially the Netherlands, we believe the transition risks are the pronounced ones. Nevertheless, we believe it is important to continuously monitor new insights in physical climate developments as well as the governments' execution on planned climate adaptation plans and measures.

We hope that this report is helpful for stakeholders who wish to know more about our journey to understanding and addressing the impact of climate change on our investments. We welcome your feedback on the report as it helps us to improve our disclosure and practices.





Carbon footprint of our proprietary assets

Carbon footprint of our proprietary assets

In 2020, we extended the carbon footprint measurement to include the real estate portfolio. Combined with the already established analysis of government bonds, residential mortgages, corporate fixed income investments and listed equity, the total assessed amount is now EUR 175 billion. This represents 80% of the asset portfolio on our balance sheet, which comprises general account assets of the insurance entities, and the assets of NN Bank and NN Group.

Refer to the pie chart for the breakdown of assessed assets. The main asset categories that were not in scope of this carbon footprint analysis include cash, derivatives, and (a relative modest allocation to) investments in private equity funds.

The table below shows the results of the analysis. Since the methodologies for carbon footprint measurement of fixed income and equity are distinctive from the mortgage and real estate portfolio, we discuss the results separately in the next two sections.

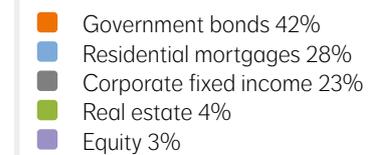
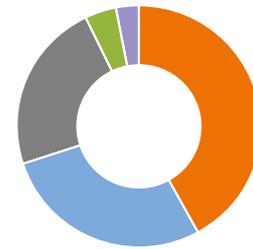
It should be noted that the temporary reduction in global emissions caused by the Covid-19 pandemic is not yet reflected in the carbon footprint analysis. This is because the carbon emissions data we obtain from data service providers has a delay. For instance, this is up to two years for the corporate portfolio and one year for the real estate portfolio.

Carbon footprint of fixed income and listed equity

The carbon footprint of the fixed income and listed equity holdings was measured as per 31 December 2020, and is based on the latest available emissions data for governments and companies. This data is retrieved from ISS-Ethix Climate Solutions, an external provider that primarily uses the data for all the greenhouse gases in accordance with the Greenhouse Gas Protocol (GHG Protocol) converted to carbon dioxide equivalent (CO₂e).

The graph in the Appendix provides an illustration of how the GHG Protocol categorises emissions in three scopes. The figures for corporate emissions in this report do not include scope 3 emissions. This is because data quality is still largely based on estimations, making consistent reporting not yet possible. The PCAF¹ recognises this shortcoming, but recommends in its 2020 Global Standard report to apply a phased-in approach towards disclosing scope 3 emissions (e.g. starting with the oil, gas, and mining sectors). These scope 3 emissions are then to be disclosed separately to allow for transparency and avoiding double counting (the scope 3 emissions for one entity are the scope 1 and 2 emissions of another entity). We are considering this recommendation for next year's reporting.

Breakdown assessed assets



The coverage, or the percentage of (assessed) portfolio assets for which (actual or estimated) emissions and financial data were available is: 89%. The data availability however differs between security types. At present, the data availability is the lowest for asset-backed securities and loans. However, these asset classes represent a relatively small portion of the corporate fixed income portfolio (the majority of which is corporate bonds).

Carbon footprint of NN Group's Proprietary Assets

	2020	2019
Assessed Assets under Management (in EUR billion)	175	165
Fixed income	113	113
Equity	6	5
Residential mortgages	49	47
Real estate investments	7	
Carbon Footprint (tCO ₂ e/EURm invested)	72	73
Fixed income	97	93
Equity	112	130
Residential mortgages	19	19
Real estate investments	6	

¹ The PCAF is a coalition of Dutch financial Institutions, whose objective is to develop a standard that enables financial institutions to consistently measure carbon emissions. The PCAF developed the 'Global GHG Accounting and Reporting Standard for the Financial Industry', published in November 2020.

Carbon footprint of our proprietary assets continued

Types of analysis

We performed two types of analysis:

- The carbon footprint (ownership) approach highlights an investor's exposure to carbon emissions through its investments. It aims to answer the question: 'How much of a company's or country's emissions have we financed with our portfolio?'
- The intensity approach seeks to describe the carbon efficiency of underlying entities in the portfolio, by linking the emissions to revenue. We used the 'Weighted Average Carbon Intensity' metric, which is the main metric recommended by the TCFD. It aims to address the question: 'What is the exposure of a portfolio to carbon intensive companies?'

For more background on how we calculated the metrics, please see the Appendix.

Results and insights

Generally, our carbon footprint and intensity remained stable compared to 2019. This is mainly driven by a stable result of the government bonds portfolio which has a large weight (representing 65% of the total fixed income portfolio). For both corporate fixed income and equity, the carbon intensity has reduced compared to last year.

Within corporate fixed income, the highest emitting sectors are Utilities and Basic Materials. Combined, these sectors account for 69% of the corporate fixed income portfolio carbon footprint, whereas in terms of portfolio weight, they only account for 19% of the corporate fixed income portfolio. In the utilities sector, we are implementing a phase-out strategy for thermal-coal exposed corporate bond investments which will reduce the carbon intensity of our sector exposure over time.

To get some insight into the emissions performance of the underlying companies, we compared the emission of the top 10 contributors in terms of financed emissions of both the corporate fixed income and equity portfolio with 2016 data. The companies decreased their absolute emissions by 14% and 17%, for the corporate fixed income and equity portfolio respectively.

Uses and limitations

The analysis helps us to understand carbon and climate change-related risks, identifying the high-carbon securities in our investment portfolio. It is also useful to inform our engagement with investee companies. However, there are limitations with respect to the quality and availability of CO₂ emissions data. Furthermore, carbon footprint relies on historical data. NN is exploring various emerging metrics and forward-looking models to help analyse the alignment of investment portfolios to the 1.5°C Paris Agreement target. We anticipate to share our insights and experiences using these tools in next year's report.

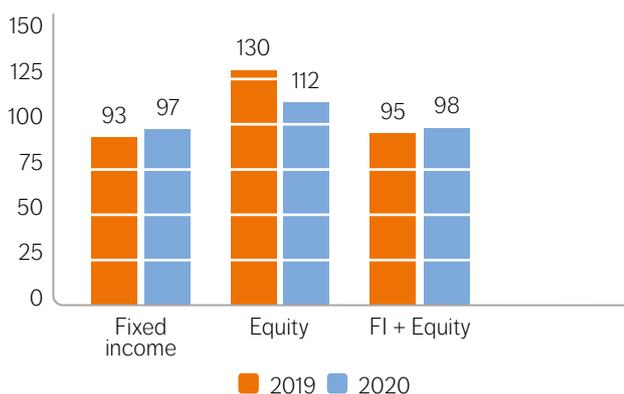
Carbon footprint of mortgages

The total amount that we included in our carbon measurement was EUR 48.7 billion, or 227,151 houses. This represents the total portfolio on the NN Group balance sheet of Dutch mortgages originated and/or serviced by our own banking business. Within this portfolio, the large majority of mortgages were originated under the Nationale-Nederlanden or former Delta Lloyd brands. NN also has approximately EUR 4.1 billion of residential mortgages on the balance sheet from external mortgage originators which are not included in this analysis. We are looking to include this for next year's analysis. Finally, NN has approximately EUR 4.6 billion in off-balance sheet mortgages which are not included because the scope of this analysis is assets on the balance sheet.

Emissions are calculated using the energy efficiency labels of houses, based on which we estimate gas and electricity consumption. In line with the PCAF recommendations, this method covers both scope 1 and 2 emissions related to the energy use of the property financed through the mortgage (i.e. the energy consumed by the building occupant). These emissions are 100% attributed to NN as the provider of the mortgages. In the 'Global GHG Accounting and Reporting Standard for the Financial Industry', published by the PCAF in November 2020, it was recommended that a loan-to-value (LTV) approach be used to attribute emissions to the financial institution. We have not yet reflected this in the 2020 carbon footprint analysis, but are considering it for next-year.

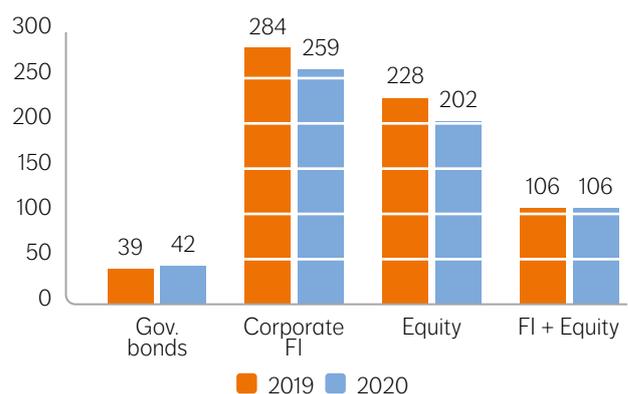
Carbon Footprint

(tCO₂e/EURm invested)



Weighted Average Carbon Intensity

(tCO₂e/EURm of revenue)



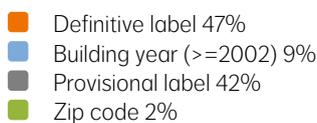
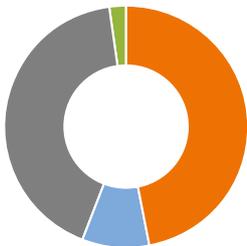
Carbon footprint of our proprietary assets continued

Energy label distribution

To derive the energy labels for our portfolio, we matched the NN mortgage portfolio to addresses in the EP-Online database (managed by the Netherlands Enterprise Agency (RVO)). The figure shows the energy label distribution of the NN's mortgage portfolio. Compared to 2019, the share of label A in our portfolio increased to 27% from 25%, labels B or C remained unchanged, labels D, E, F and G taken together declined to 34% from 36%, and 0.1% remained unknown.

As shown in the pie chart, about 47% of matched addresses have a definitive energy label. If no definitive energy label is present, we looked at the building year of the property. For houses with a building year of 2002 or later, we assume the energy label is A. For the rest of the mortgage portfolio, we matched the addresses with a provisional label, or if no label exists, we assumed that the energy label is the same as the average of the zip code. For a very small part (0.1%) we could not make a match at all due to missing information. These mortgages were not assessed in this analysis.

NN Portfolio: Basis of label choice



Average energy consumption

The average gas and electricity consumption per energy label was researched and published in 'Cijfers over wonen en bouwen 2013' (Figures on living and buildings in 2013) from the Dutch government. The average energy consumption per household can be converted into CO₂ emissions using grid emission factors. Within the Netherlands, www.co2emissiefactoren.nl gives a list of grid emission factors that are regularly updated to reflect changes in the Dutch electricity mix. For 2020 measurements the following emission factors are used: 0.405 kg CO₂/kWh for electricity of unknown origin, and 1.785 kg CO₂/m³ for natural gas. Compared to 2019, the emission factor for electricity is higher which reflected a methodology change made by the provider of this data. The resulting average CO₂ emissions per energy label are shown in the figure on the next page.

Financed emissions

We calculate the emissions associated with the NN mortgage portfolio by multiplying the number of houses per energy label with the average CO₂ emissions per energy label. In 2020, the absolute portfolio emissions amounted to a total of 929,452 tonnes CO₂. (Note this calculation does not yet adjust for LTV ratios). This total portfolio emissions number was 5% higher compared to last year. However, the aforementioned methodology change for the emission factor for electricity had a large impact. If last year's number is restated for this change in grid factor, the total portfolio emissions increased by 1% mainly reflecting the larger number of houses due to portfolio growth. We also calculated relative emissions. These remained stable compared to 2019 and amounted to 19 tonnes CO₂ per EUR million invested and 4 tonnes CO₂ per house.

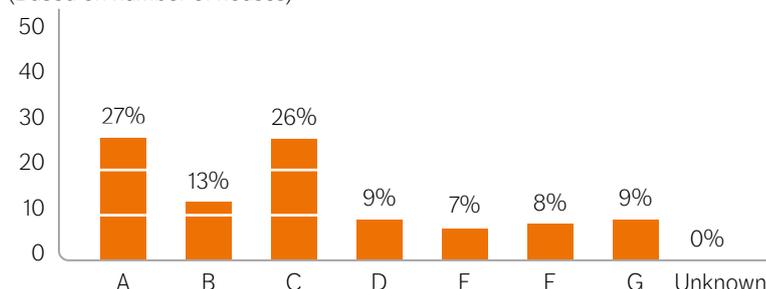
Changes in energy labelling in Netherlands

An energy label shows the energy performance of buildings and provides insight into the potential for sustainability measures. The label classes run from A to G, with A being the most energy-efficient buildings and G being the least energy-efficient buildings. The Netherlands Enterprise Agency (RVO) registers all energy labels in the Netherlands.

Starting in 1-1-2021, the energy performance of a building is determined using the new NTA8800 determination method. The method is based on the European CEN standards. Another change is that from 1 January 2021, an energy label can only be obtained if an energy consultant visits the home to inspect the specifications for an energy label. We are evaluating what these changes mean for our carbon footprint and methodology going forward.

NN Portfolio: Energy label distribution

(Based on number of houses)



Carbon footprint of our proprietary assets continued

Limitations

The method we used is based on theoretical average consumption data. These theoretical consumptions will differ from actual consumption because they are based on physical housing quality and not on household usage. Similar houses may show large differences in energy consumption depending on the number of occupants and their behaviour. As such, working with actual consumption data, for instance directly from grid operators, is preferred by the PCAF. The Dutch financial institutions that are part of the PCAF including NN are looking into ways to either obtain this actual consumption data or improve the estimation method.

Contributing to a low-carbon society

We believe that we can play a role to help our customers improve the energy efficiency of their homes. In 2019, NN launched Powerly, a web-based platform that provides customers with tailored advice on energy efficiency measures, and helps execute these measures by connecting them to partners. In August 2020, NN's banking business, which sources most of the loans on the NN Group balance sheet, launched Woonnu, a new mortgage label. Woonnu's consumer mortgage loans reward steps taken by the consumer to reduce their carbon footprint by improving the energy efficiency of their property. By encouraging sustainable housing, NN aims to contribute to the realisation of the objectives of the Dutch climate agreement. Refer to the case box.

Carbon footprint of real estate investments

We included our measurement of NN's real estate portfolio for the first time. NN invests in non-listed real estate properties directly and indirectly via non-listed real estate funds, all for the longer term. The portfolio is spread over sectors and regions in Europe.

Data collection

For NN Group's direct investments in real estate (approximately 31% of our total real estate portfolio), our real estate manager CBRE collects and monitors all emissions data, and reports them directly to NN Group as well as through the GRESB Real Estate Assessment. The emissions data for our indirect investments, or fund portfolio, are all gathered from the GRESB Real Estate assessment. For more information on GRESB, refer also the case box on the next page.

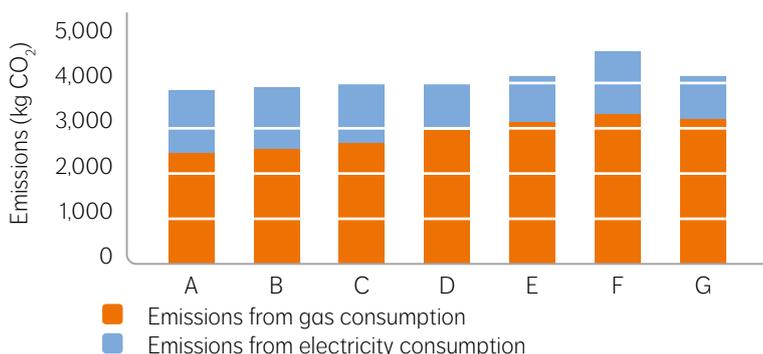
Emission scopes

In the carbon footprint analysis of our real estate investment portfolio, three scopes are relevant. Scope 1 and 2 emissions are under the control of the owners of the buildings: energy consumption of common areas in the buildings and energy consumption of tenants whereby energy contracts are controlled by the owners. The owners have the ability to introduce and implement operating and/or environmental policies and measures. However, often the energy contracts are held directly by the tenants. In that case, the energy consumption of the tenants falls under scope 3 (the owner has no 'operational control'). Considering that the energy consumption of tenants is dominant for the overall energy consumption of a building, especially scope 3 is important for real estate but not all fund managers have yet access to this information.

New mortgage provider Woonnu stimulates sustainable housing market

Lowering their energy bill and increasing the value of their home are important reasons for Dutch consumers to become more sustainable. In practice, saving on energy bills often turns out to be an uncertain factor. Woonnu relieves uncertainty for consumers and mortgage advisers with our sustainability check. Through this check, consumers can see at a glance the options, investment and payback time before taking out a mortgage on Woonnu.nl. They can also receive a tailor-made advisory report from an independent sustainability partner, with guarantees about the exact investment and the energy label they can achieve. The partner can implement the measures and offer assistance with applying for subsidies and arranging the new energy label. Woonnu also offers an interest discount. This applies from energy label B for the entire term and for the entire mortgage. With Woonnu, our banking business is also responding to the increasing demand for platforms through which institutional investors can invest directly in the sustainability transition of the Dutch housing market. Nationale-Nederlanden is also an investor in these loans.

CO₂ emissions per house per energy label



Carbon footprint of our proprietary assets continued

As a consequence, in our emission scope, we initially include scope 1 and 2. We aim to in the future also include scope 3, potentially separately, when the reporting upon this further develops. With respect to the scope 3, GRESB now includes tenant emissions but does not yet require reporting from other categories such as emissions from construction of the building, which is also relevant. This might also develop further in the future, as we note that the PCAF suggests a phased-in approach towards disclosing scope 3 emissions as data quality is expected to improve over the coming years. Also, it recommends that future scope 3 disclosures are best given separately.

Assessed assets

The total assessed amount was EUR 7.3 billion, or approximately 92% of the total non-listed real estate investment portfolio. The 8% non-assessed assets represent fund investments where we either had no GRESB disclosure or no scope 1 and 2 emissions in GRESB. The reasons for having no GRESB disclosure could be because the funds are still in a 'grace-period' for first-year reporting or are the funds are in wind-down and did not report anymore.

Methodology and results

When calculating the carbon footprint of our real estate investments portfolio, we attribute a real estate fund's annual emissions based on NN's share in the fund. To determine the attribution factor, we used the outstanding investment amounts (Net Asset Value, or NAV) for the numerator. For the denominator, we use Gross Asset Value (GAV) of the funds as reported to us by our real estate managers. All investment amounts are per end of 2019. We multiply the attribution factor with the latest available reported emissions in the GRESB Real Estate assessment (which are the emissions over 2019) to calculate the total portfolio carbon footprint. The resulting portfolio emissions amounted to 43.823 tonnes CO₂, or 6 tonnes per EUR million invested.

Insights and limitations

This is the first year, that we applied this methodology to calculate the carbon footprint of our real estate portfolio. This exercise has helped to improve our understanding and insight in the emissions of the individual funds, which we can use in our dialogue with the real estate managers going forward. It should be noted that these carbon footprint results might not yet provide the complete picture of carbon footprint of our real estate investment portfolio as data quality as well as coverage is expected to improve further in the future. Nevertheless, we have decided to start publishing these outcomes to provide transparency and help further best practices in the market.

Benchmarking our real estate portfolio on sustainability

We believe that integrating sustainability and ESG aspects in the management of all our real estate investments helps to enhance returns and preserve value. We use the framework of GRESB to monitor progress in sustainability.

GRESB assesses the environmental, social, and governance (ESG) performance of real estate assets worldwide. The GRESB Assessments are guided by what investors and the industry consider to be material issues in the sustainability performance of real asset investments and are aligned with international reporting frameworks, goals and emerging regulations.

NN Group has participated in the GRESB Real Estate Assessment since 2017. We require all real estate and fund managers to report in GRESB. In the 2020 GRESB Assessment, 97% of NN's non-listed real estate portfolio was measured in the reporting tool. The NN portfolio had a (value-weighted) score of 83 (on a scale of 1 to 100), well above the European non-listed real estate benchmark average of 70. (Note that the scores are not comparable to last year's due to significant benchmark changes). The total portfolio was granted 4 stars in the GRESB Rating, which is a relative evaluation of the overall GRESB score among global participants (with 5 stars being the highest).

For the 'direct' part of our real estate portfolio (accounting for 31% of the total real estate portfolio value), NN received a 5-star rating for the second consecutive year. This is the highest GRESB rating possible and is recognition for being an industry leader.



Assessing investment risks and opportunities related to climate change

At NN, we aim to understand and manage the transition and physical risks and opportunities of climate change in our investment portfolio. The knowledge developed through these analyses can help us in managing our portfolio towards the Paris Agreement objectives.

Assessing investment risks and opportunities related to climate change

The TCFD recommends scenario analysis as an important process that organisations should deploy, both for understanding the strategic implications of these climate-related risks and opportunities, and for informing stakeholders about how the organisation is positioning itself in light of these risks and opportunities.

Scenarios are plausible alternative views of how the future could evolve, such as the transition pathway to a low-carbon economy, or how physical climate change could play out globally with growing greenhouse gas (GHG) emissions. Scenarios are not market forecasts, nor are they sensitive to any one specific variable. Rather, scenarios take into consideration a variety of factors that could drive a future outcome.

The TCFD recommends applying scenarios to assess the following key categories of climate-related risks and opportunities:

A. Transition: Policy & Legal

Policy changes including measures to achieve national climate commitments such as implementation of carbon pricing, shifting energy use to lower emission sources, and lowering energy demand through energy efficiency measures. Legal liabilities and litigation risk against organisations are associated with their actual/perceived failure to mitigate the impacts of climate change, failure to adapt to changing climatic conditions and/or insufficient disclosure of related financially material risks.

B. Transition: Market & Technology

Technological improvements or innovations that support the transition to a low-carbon economy could impact the competitiveness of an organisation, their production and distribution costs, and ultimately the demand for their products and services from end users.

The two categories of transition risks and opportunities are intrinsically linked. Policy is often the initial driver of technology developments and market uptake. As technologies and markets evolve, policy is typically revised, for example, through the reduction of subsidies.

C. Physical

These include climate change impacts that are event driven (acute – e.g. cyclones/hurricanes, floods, etc.) or longer-term shifts (chronic – e.g. changes in sea level, temperatures, etc.) in climate conditions.

Where relevant data sets and scenarios were available, we considered different time horizons and climate change transition scenarios: a business-as-usual (BAU) scenario (which trends towards 3.7°C of average global warming by 2100); and a low carbon transition scenario (which results in around 2°C of warming by the end of this century), which aligns with the TCFD recommendations. For the short-term horizon, 2022 was chosen to make it closely aligned with the planning horizon in our strategic asset allocation. Where possible, we used 2030 and 2040 as the medium and longer-term horizons.

Overview of the scenario analysis

In order to obtain more insight into specific drivers of climate-related risk and opportunity which may impact investment performance, NN has worked on scenario analysis for our proprietary assets. ERM, a specialist consultant focusing on environmental risks, supported the development of various distinctive analyses and models, focused on the largest asset categories on the NN Group balance sheet: (i) government bonds (approximate 34% of total balance sheet assets), (ii) residential mortgages (26%) and (iii) non-financial corporate exposures (12%). We started this work in 2019, and finalised it in 2020.

Overview and summary of the scenario analysis

Non-financial corporate investments

Sectoral scope:

15 non-financial corporate sectors

Risk scope:

Both transition risk and physical vulnerability

Government bonds

Geographic scope:

Netherlands, Germany, France, Belgium, Spain and Japan

Risk scope:

Transition risk¹

Residential mortgages

Geographic scope:

Netherlands only

Risk scope:

Primarily physical climate change risks, with light touch transition risk analysis

¹ To gain some insights on physical vulnerability, we additionally analysed the government bond portfolio using the Notre Dame ND Gain index.

Assessing investment risks and opportunities related to climate change continued

Non-financial corporate investments

Summary of analysis:

- **Risks:** transition risks and physical vulnerability
- **Scenarios:** a BAU scenario and 2°C scenario
- **Time horizons:** 2022, 2030, and 2040
- **Regional segmentation:** 15 non-financial corporate sectors, global

NN invests in corporate (non-financial) issuers mainly through corporate bonds, but also through listed equity and loans. For these assets, NN developed a 'Climate Portfolio Screen' to identify segments of the portfolio where there are, at a high level, likely to be greater potential transition and physical climate-related risks and opportunities. The horizons considered were 2022, 2030 and 2040.

The portfolio of corporate exposures is global and diversified; in total 15 sectors were determined to be most relevant for the portfolio (with sector weights ranging from 11% for telecom to 2% for manufacturing). For each sector considered, a key climate-related factor ('climate factor') has been proposed by ERM and validated by a group of sector analysts and portfolio managers from NN Investment Partners. These climate factors are considered to have the potential to drive material risk and/or opportunity within the segments selected for assessment.

The climate factors for transition risks concern both risks and opportunities in the area of: Policy & Regulations (for example carbon pricing, lower energy demand through energy efficiency measures) and Technology & Market (such as the introduction of clean alternatives, and shifting consumer demand to lower-carbon products).

The analysis of transition risks and opportunities is based on the comparison between two scenarios: a BAU scenario (IEA Current Policies Scenario, which trends towards 3.7°C of average global warming by 2100) and a 2°C scenario (IEA Sustainable Development Scenario, which trends towards 1.7 to 1.8°C of warming, - supplemented with specific information from the IEA Energy Technology Perspectives).

To assess the potential physical climate change vulnerability and opportunity (resilience), we identified for each sector the physical climate factor (for example, consequences of changing weather patterns, water stress and droughts). This assessment was not driven by specific physical scenario data sets, but was based on informed expert judgement, ERM's past experience working with businesses in the relevant segments, and desk research of publicly available disclosures (such as CDP) and industry reports.

Results and insights

For each of the sectors, in each of the time horizons, the Climate Portfolio Screen depicts both the transition risk and opportunity as well as the physical vulnerability and opportunity as 'Low', 'Moderate', or 'High'. This rating is determined by the difference in the value of the key climate factor (selected for the specific sector) between the BAU and the 2°C scenario in the specific time horizon. The larger the difference between those values, the larger the risk or opportunity.

The scenario analysis shows that for a global and diversified portfolio, the effects of climate change are moderate in the short term, but can be more prominent in the longer term. Before 2030, we foresee large transitions in, for example, the construction and chemical sectors which present both risks and opportunities (refer to the case box on the chemical sector). Furthermore, the number of sectors that are vulnerable for transition are seen to increase towards 2040. Next to the construction and chemical sectors, these include oil & gas, utilities, automotive, and manufacturing. When looking at physical vulnerability the assessed sectors either show 'Low' or 'Medium' impact, with a few sectors also showing opportunities for the physical impact of climate change: food and beverage, construction, healthcare and manufacturing.

Most of our exposures are corporate bonds, and as such the maturity profile is important to consider when looking at the medium to longer-term horizons. As a supplementary analysis, we mapped the relative exposures within the non-financial corporates in 2022, 2030 and 2040. This provided us additional insights. For instance, whilst by 2040, the numbers of sectors that may be impacted by high transition risk (and opportunity) is increasing, NN's relative portfolio exposures to these sectors are moderate, as our investments are running off before that date. This gives us the opportunity to steer new investment decisions towards the companies that are likely to be best positioned for the transition to a low-carbon economy.

Limitations and future work

We have limited this initial analysis to a single climate factor which is likely to drive material risk and opportunity. In reality however, the investment risk/opportunity will be determined by multiple complex and interconnecting drivers. Nevertheless, the Climate Portfolio Screen is useful to highlight potential segments of highest risk and/or opportunity which helps us to inform prioritisation of further analytical work and other actions.

Furthermore, the physical risks of climate change have only touched upon physical vulnerability of an industry, giving its specific activities, products or services. Key factor determining the risk for individual investments is typically location based, and since our analysis was performed on a global level, the location of assets within the portfolio has not been considered.

Finally, our analysis did not determine financial impact, but rather a qualitative assessment of potential climate-related risk/vulnerability and/or opportunity. It should be noted that the extent to which the portfolio is vulnerable to climate risks might not depend only on the underlying sector or regions, but also on the risk characteristics of the particular asset class. Our corporate portfolio is mainly invested in corporate bonds. This could be a further area for future analysis.

Assessing investment risks and opportunities related to climate change continued

Assessing transition risk/opportunity for the chemicals sector

The chemicals sector is the third largest industry subsector in terms of direct CO₂ emissions. Carbon pricing regulations such as the European Union Emissions Trading System (EU ETS) are projected to become more widespread globally and more stringent in their financial implications, representing risk to companies within the chemicals segment. In the 2°C scenario, the price of carbon in advanced economies reaches \$140 by 2040, almost 10 times more than the current EU ETS market price. This increase in carbon pricing is significantly higher than in the BAU scenario. In order to align with the 2°C scenario, the chemical sector emissions need to peak and subsequently return to 2017 emissions level by 2030. Decarbonising the chemicals sector will require the development and deployment of innovative technologies such as Carbon capture, utilisation and storage (CCUS).

The chemicals sector can also be expected to see large opportunities related to the transition. While single use plastics could see significant risk with recycling uptake, other chemicals could see a significant rise in demand reflecting their role to deliver low-carbon transition. An example is chemicals demand for the automotive plastics market. With limited market data, the global automotive plastics market size has been estimated, using low carbon Light Duty Vehicle (LDVs) sales as a proxy for uptake in chemicals, in order to understand the size of the opportunity. Demand for alternative fuel vehicles, including electric vehicles, which require more plastic than traditional internal combustion engines, is projected to see a significant increase in a 2°C scenario compared to BAU.

The opportunity represented by the global automotive plastics market size is exemplary for many other opportunities for the chemicals sector. Other examples include the opportunities associated with decarbonisation of the construction sector and associated materials, for example insulation in order to improve energy efficiency in buildings, and the replacement of carbon intensive materials (such as steel) with biodegradable or recyclable plastics and polymers. Also, the chemicals industry can reduce its feedback and operational costs, for example through energy efficiency measures and use of green hydrogen or biomass as a feedstock which would protect against fossil fuel price rises and improve security of supply. As these technologies mature and the costs reduce, they could offer a significant opportunity to the industry.

Outcome example chemicals sector

Potential Impact (BAU vs. 2°C)	2022	2030	2040
Climate factor for transition risk:	Low risk	High risk	High risk
Carbon pricing (global)			
Carbon price used as scenario indicator			
Climate factor for transition opportunity:	High opportunity	High opportunity	High opportunity
Chemicals demand - uptake of chemicals which help deliver low-carbon transition			
Sales of LDVs used as scenario indicator			

Assessing investment risks and opportunities related to climate change continued

Government bonds

Summary of analysis:

- **Risks:** transition risks
- **Scenarios:** a BAU scenario and a 2°C scenario
- **Time horizons:** 2022 and 2030
- **Geographic scope:** France, Germany, the Netherlands, Belgium, Spain and Japan

Government bonds are typically assessed on the ability and willingness of a government to honour debt obligations. Climate and energy policies are one of a number of factors which could influence the ability of a government to repay debt. In particular, there is a potential that climate and energy policies drive a substantial transformation of key emitting sectors. These typically play an important role in the economy, and therefore significant negative impacts could reduce government revenues. However, governments generally seek to mitigate negative impacts to these sectors by supporting the low-carbon transition with public spending, e.g. government support for R&D, low-interest loans for technology deployment. Increased government spending may increase public debt level - another risk factor for government bonds.

Methodology

To analyse transition risk, we focused on six countries that together account for more than 70% of our government bond portfolio. We used a two-step approach. First, we assessed the difference between energy-related CO₂ emissions under a BAU scenario (International Energy Agency's IEA Current Policies Scenario, 3.7°C) and a 2°C scenario (IEA Sustainable Development Scenario, which results in 1.7 to 1.8°C warming). Energy-related CO₂ emissions typically account for about 80% of a country's total greenhouse gas emissions (GHG) emissions. The difference between the business-as-usual and 2°C scenario is indicative of the potential magnitude of the transformation required for a country transition to a low-carbon economy, and the outcome is allocated to a corresponding risk level: 'high', 'moderate' or 'low': The larger the difference, the larger the risk. We looked ahead to 2022 and 2030.

As the IEA WEO scenarios do not have pathways on an EU member state level, but rather on an EU-wide level, we complemented this quantitative analysis with a review of overall climate and policy framework per country in scope, including long-term policy ambition and planned policies as well as economic impact assessments. Evidence of long-term planning towards meeting the 2°C objective reduces the likelihood that governments implement policies which have negative impacts to the economy. This is because long-term planning provides governments with the opportunity to plan an orderly, more cost-effective decarbonisation path.

Findings

Based on the outcomes of the quantitative assessment, we classify the transition risks for all countries as 'low' in the short-term, which means that the total effort required to lower CO₂ submissions, based on calculating the change between the BAU scenario and the 2°C scenario, is relatively limited. For 2030, transition risks for all countries are classified as 'high', which indicates that the effort required is substantial. Based on the findings of the complementary qualitative analysis, we amended the risk assessment for France, Spain, and the Netherlands from 'high' to 'low'. For Japan, Germany and Belgium, the classification of transition risks remained high, as - at the time of our analysis - we found that these countries needed to further work out more detailed and/or more ambitious plans to manage transition risks to a lower-carbon economy. Other countries have plans in place, although execution and overall expected cost levels need to be further monitored to assess impact on macroeconomic level.

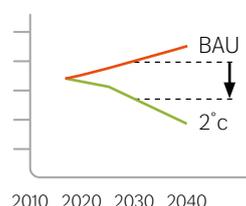
Limitations and future work

In this analysis, we assumed that countries that have a long-term strategy to transform to a low-carbon economy in line with the Paris Agreement are less likely to face disruptive transition risks, which could impact their economy. The analysis therefore represents an initial view on the potential policy-related transition risks associated with government bonds. However, there are other transition risk drivers such as market and technology changes which are intrinsically linked to policy. A more detailed analysis is needed to fully understand the impact of transition risks related to government bond investments. In addition, climate-related transition risks are only one factor among many which can impact a country's ability to repay debt. It is unclear how material climate-related risks are compared to other macro-economic factors. Nevertheless, we believe that the analysis provided us with useful insights which we can use to further develop criteria for our investment strategies (refer to the case box on the next page).

Energy-related CO₂ emissions*

Energy-related CO₂ emissions typically account for 80% of a country's GHG emissions

*Source: IEA World Energy Outlook 2018. BAU scenario is the Current Policies Scenario and 2°C is the Sustainable Development Scenario



Delta in 2022 and 2030

An initial indicator of scale of change and hence investment potentially required

Assessing investment risks and opportunities related to climate change continued

Embedding climate data in our investment process

One of the learnings of this scenario-based assessment was that analysing the countries' plans and policies took a lot of time and effort, and is ideally done by local experts. This makes it difficult to regularly update and expand to all the sovereign issuers in our portfolio. We therefore looked for a data provider that is able to provide us with relevant climate assessments that contains forward-looking elements and covers a broad universe of countries. We found that the CCPI published by Germanwatch and the NewClimate Institute is able to provide us with these requirements. The CCPI evaluates 57 countries and the European Union, and includes both quantitative and qualitative assessments. For the latter, they make use of a network of around 400 local experts in the countries. We tested the data for our portfolio and decided to take the CCPI into account in the portfolio management for the sovereign bonds.



Measuring physical climate vulnerability for sovereign bonds

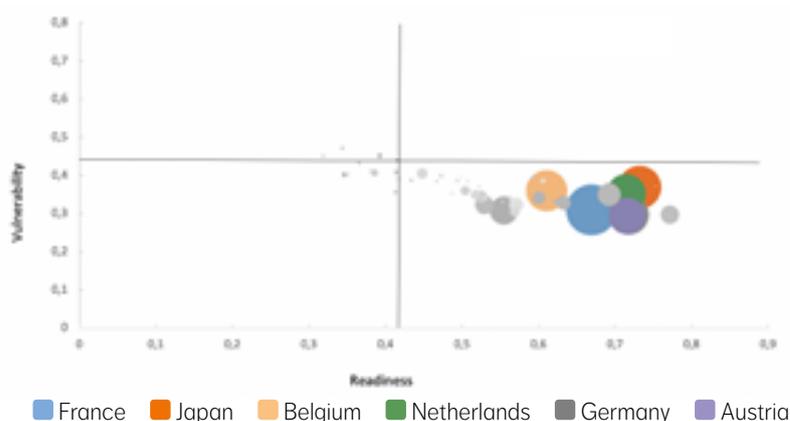
Climate change is expected to increase the risk of extreme weather events, including droughts, flooding and heatwaves. There is a growing body of studies that suggest that countries deemed highly vulnerable to climate change are more likely to face higher sovereign borrowing costs. To measure our sovereign holdings exposure to climate related risks and opportunities, we have used the Notre Dame Global Adaptation Initiative (ND-GAIN) Country Index. This brings together 45 indicators to measure vulnerability and readiness of over 191 countries. When considering readiness, economic, governance and social aspects are considered.

We have plotted NN's sovereign bond holdings in a matrix that ND-Gain developed (see chart below). The vertical axis shows the score of vulnerability and the horizontal axis the readiness score. Most of our sovereign exposures are in

developed markets, in particular the Eurozone and Japan. These countries are all in the lower-right quadrant which indicates that physical climate change risk is less likely to have very severe implications. For instance, one of our largest sovereign bond exposures is the Netherlands (colored green in the matrix). The country has a low vulnerability score and high readiness score. Adaptation challenges still exist, but the ND-Gain score suggests that the Netherlands is well positioned to adapt. NN Group has no significant exposure to countries highly vulnerable to climate change. Going forward, we will include this analysis as part of a Sovereign Bond dashboard we are building to monitor climate-related sovereign risk. Furthermore, as part of our new strategy for Paris Alignment, we expect our portfolio managers to take physical risk into consideration in their investment due diligence for sovereign bonds.

NN's sovereign bond holdings plotted in ND-Gain matrix

(Bubbles showing the size of the exposures).



These colored bubbles represent the largest exposures. Note that bubble representing Germany is behind the bubble for Austria.

Residential mortgages

Summary of analysis:

- **Risks:** physical risks
- **Scenarios:** +2°C increase in average by 2050 (and +4°C increase in average by 2100, aligned with a BAU trajectory), the KNMI WH climate scenario
- **Time horizons:** Baseline and 2050
- **Regional segmentation:** Netherlands

Physical risks for mortgages in the Netherlands are amongst other related to property damage caused by natural events, which could either lead to a value decrease of collateral and/or impact the ability of homeowners to (re)pay their mortgage. Natural events include amongst others floods, drought and windstorms. For this assessment, we used data from local institutions that have projected flooding hazards, which is one of the main risks given how the Netherlands is geographically situated (partly below sea level, with several river estuaries). By comparing the climate data to geographical properties of NN's mortgage portfolio, we assessed which regions and properties have a high(er) flooding risk, both in a baseline and future scenario. Furthermore, we took into account more specific data that gives an indication of the financial ability of homeowners to cope with potential damages as a result of flooding.

As scenarios, we have used:

- The Royal Netherlands Meteorological Institute (KNMI) 2014 W_H climate scenario, from 'Klimaat-effectatlas' (Climate Impact Atlas); a more severe scenario that results in a +2°C increase on average by 2050 (and +4°C increase on average by 2100, aligned with a business-as-usual trajectory). The W_H scenario is based on the RCP8.5 emission and land use scenarios of the IPCC. For the flood hazard in the Klimaat-effectatlas it is assumed that for primary flood defenses all necessary improvements will be made so that the defenses comply with the protection levels defined in the Dutch Water Act. Potential improvements to regional defenses are however not considered.
- A baseline scenario, where we have considered the 'Risicokaart' maintained by the provincial governments. The flood hazard in this dataset is presented for two types of areas: those that are protected by primary or regional water defence structures, and those that are not. Furthermore it considers: (i) Elevated water levels at sea or in rivers, due to natural events; (ii) Breakthrough of primary dykes or water defences along the main water system (large rivers and sea) and; (iii) Breakthrough of regional dykes or water defences along smaller rivers.

We used comparable data points from both scenario datasets to inform on probability and impact on water depth levels: >0.8 metres for baseline and >0.5 metres for future scenario; and 1 in 100 years for baseline, and '1 in 30 till 1 in 300 years' for future scenario.

The analysis shows potential impact for individual properties situated in regions with increased risk for flood events. However, this impact is not significant for NN as a whole given the geographical properties of the mortgage portfolio. Whilst keeping in mind that datasets need to further evolve, we carefully concluded that the risks of flood events did not seem to increase in the future scenario taking into account the planned investments in the flood risk schemes in the Netherlands.

When considering the homeowners where loan-to-value or loan-to-income metrics are in in the highest category of our internal risk categorisations, we see that there are some pockets of risks in the medium to high flood hazard areas. As such, we believe this is an aspect that we need to include in our future monitoring of our clients as well as the stress tests that we conduct for our risk management. This also takes into consideration that these households may also face a financial burden related to the energy transition (refer to box on this page).

Another important insight is that we need to continuously monitor these physical climate risks. Shortly after we finalised the analysis, some updates to the local datasets became available. Furthermore, in the second half of 2021 the KNMI is expected to publish the KNMI Climate Signal '21 sharing a first interpretation of the upcoming publication of the KNMI '23 Climate Scenarios, incorporating the newest scientific insights on climate change based on the 6th assessment of the IPCC. Therefore we can anticipate that the national climate data sources that we have used will be adjusted according to these insights. Further, it is important that we monitor the Dutch government's policies and protection schemes as it is a key assumption in this assessment that for primary flood defences, all necessary improvements will be made in accordance with the protection levels defined in the Dutch Water Act.

Initial analysis on transition risk for mortgages

We worked on an initial analysis for potential transition risks associated with NN's Dutch mortgage portfolio. The realisation of the Dutch government's ambition to decarbonise the housing market will require strong incentives and policy regulation. Such policies are drivers of transition risk, as they could require borrowers to make upfront investments in new heating systems or energy efficiency improvements. We took the energy label as a simple indication of the likelihood that a homeowner will be required by regulation to make energy efficiency improvements. In some circumstances, this additional cost could compromise the ability of some borrowers to repay their mortgage. We therefore combined the energy label categories of our mortgage book with indicators of credit risk to evaluate transition risk levels in 2030 and 2040. This analysis provides us with a starting point for further refinements, and furthers our internal discussion on how we can help support our customers in making their homes more energy-efficient over the coming decades.

Appendix

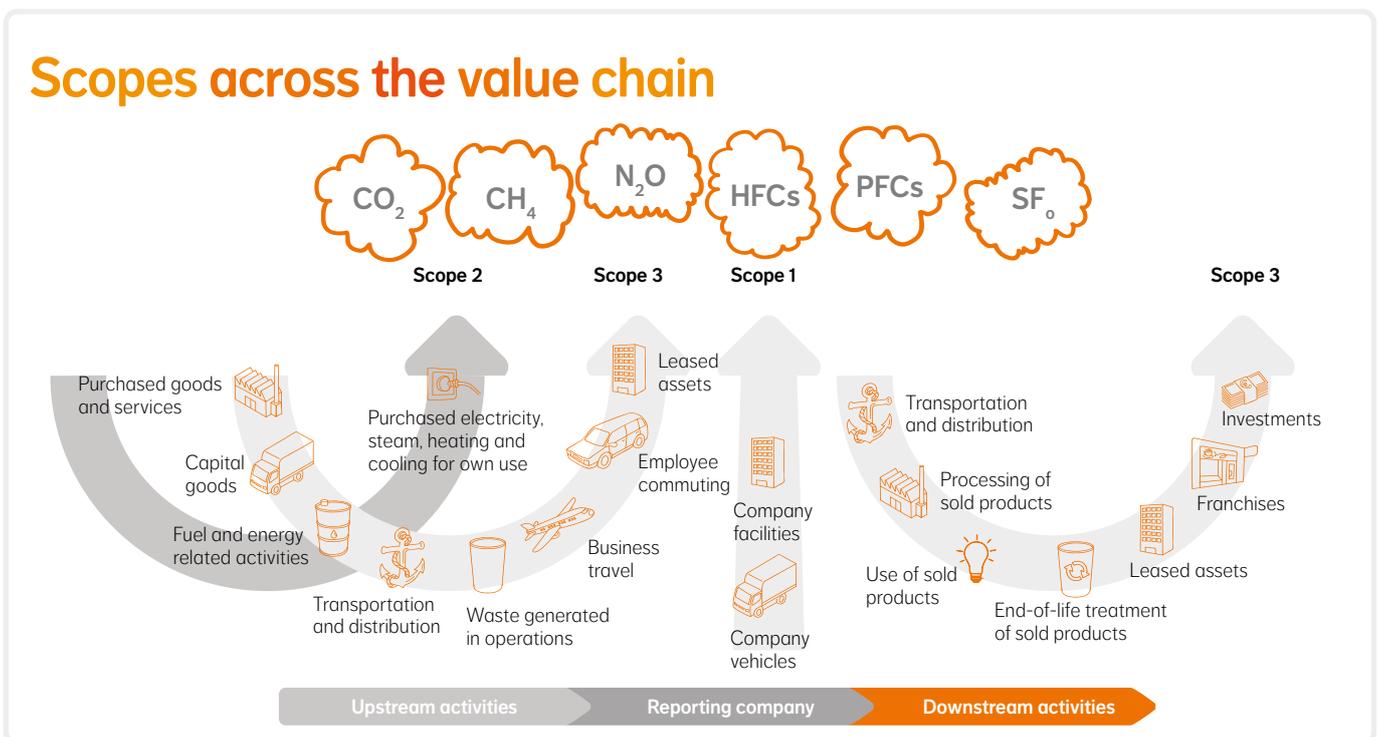


Appendix 1: GHG Protocol scopes 1, 2 & 3

Greenhouse Gas Protocol

The Greenhouse Gas Protocol (GHG Protocol) defines three emission scopes, as illustrated in the graph below:

- Scope 1 emissions refer to all direct greenhouse gas emissions from sources that are owned or controlled by the organisation itself.
- Scope 2 emissions are all indirect greenhouse gas emissions stemming from the consumption of purchased electricity, steam, or other sources of energy generated upstream.
- Scope 3 emissions are all other indirect greenhouse gas emissions resulting from an entity's operations. This includes both upstream and downstream supply chains, such as the extraction and production of purchased materials and fuels, flight emissions, waste disposal, investments, etc. Scope 3 forms the largest part of most corporate carbon footprints



Source: GHGProtocol.org

Appendix 2: Methodology for listed equity and fixed income

Methodology for corporate fixed income and listed equity

We use two different metrics: carbon footprint, or portfolio financed emissions, and carbon intensity.

Carbon Footprint

The Carbon Footprint metric, also referred to as portfolio financed emissions, is based on the ownership logic. This means that it follows the reasoning that if an investor has 1% of a company's market value, 1% of the company's emissions are allocated to the investor. However, this overlooks the position of the debt holders. For that reason, we prefer the current company's enterprise value as denominator to attribute emissions to both equity and debt positions within our proprietary portfolios. Enterprise value is defined as a company's total market capitalisation plus total debt outstanding (based on book value).

By aggregating the investor-financed emissions across all companies in the portfolio, we obtain the total carbon footprint for the portfolio. Next, we divide this outcome by the portfolio's value to arrive at the carbon footprint in tonnes of CO₂ per EUR million euro invested.

Formula:

$$\frac{\sum_n^i \left(\frac{\text{current value of investment}_i}{\text{issuer's enterprise value}_i} \times \text{issuer's Scope 1 and Scope 2 GHG emissions}_i \right)}{\text{Current portfolio value (EUR million)}}$$

For the government bonds portfolio, the amount of carbon emissions of an individual government that we 'financed' as an investor was calculated based on how much of the country's debt we own, relative to the total debt outstanding of the country. We allocate emissions to a government bond by looking at the emissions it generates by the public sector. This means that we reflect the emissions that are directly caused by the government's own activity (scope 1, 2 emissions as defined by the GHG Protocol), as well as the emissions from government financing in other sectors within a country (scope 3).

Weighted Average Carbon intensity

The Weighted Average Carbon Intensity metric seeks to describe the portfolio's exposure to carbon-intensive companies, expressed in tonnes of CO₂ per EUR million in revenue. Each company's emissions are divided by its revenues to obtain the carbon intensity of each holding. The results are averaged using company weights in the portfolio to obtain the overall carbon intensity of the portfolio.

Formula:

$$\sum_n^i \left(\frac{\text{current value of investment}_i}{\text{current portfolio value}} \times \frac{\text{issuer's Scope 1 and Scope 2 GHG emissions}_i}{\text{Issuer's EUR million of revenue}_i} \right)$$

Methodology for government bonds

For the government bonds portfolio, the same approach is applied as for corporate issuers, but instead of revenues we use Gross Domestic Product (GDP) as the denominator. We note that the denominator reflects all domestic production of goods and services within a country, while the nominator reflects a more narrow scope of emissions allocated to the government. We are looking into improvements, but have not yet found a good alternative approach.



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