

Waterproof?

An exploration of
climate-related
risks for the Dutch
financial sector

DeNederlandscheBank

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Waterproof? An exploration of climate-related risks for the Dutch financial sector

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Summary

4 Financial institutions must increasingly factor in the consequences of a changing climate and the transition to a carbon-neutral economy. This report further explores the impact of climate-related risks on the Dutch financial sector, which can already be increasingly felt in a number of areas. As the supervisory authority, DNB intends to embed climate-related risks more firmly in financial supervision with the aim of ensuring sustainable financial stability.

In this report we look at climate risks that are relevant to the Dutch financial sector and the consequences of these risks for supervisory authorities, financial institutions and policymakers. We examined two types of risk categories: (1) physical risks arising from climate-related damage such as storm, hail and flooding and (2) transition risks resulting from the transition to a carbon-neutral economy. Within these two categories, we explored four themes that are of specific relevance to the Dutch situation. We examined the consequences of climate change for insurers, the impact of large-scale flooding on the financial sector, the risks arising from carbon-intensive investments and the risks related to green finance.

Insurers are likely to experience a rise in claims burdens as a result of changing weather patterns. This will put an upward pressure on insurance premiums, which could moreover lead to shock-induced price increases. Also, climate change is making it increasingly difficult to estimate the likelihood of extreme weather. We found that insurers rely to a significant extent on catastrophe models supplied by external parties, and that these models do not explicitly address climate change trends that are relevant to the Netherlands. This could lead to a potential underestimation of risks. Some insurers have tightened their reinsurance programmes in order to address such model uncertainties.

Not all climate-related losses are insured. This in particular applies to flood risk, a risk which is very relevant to the low-lying Netherlands. In the Netherlands, damage caused by flooding is hence primarily borne by the government, households, the private sector and other organisations. If flooding occurs, the financial sector may incur losses through their exposures to these parties. Scenario analysis shows that floods with a probability between 1/200 and 1/1000 years (which is in line with norms for shocks in financial supervisory frameworks) could lead to losses ranging between EUR 20-60 billion, with at least several billions being absorbed by the balance sheets of financial institutions.

The transition to a carbon-neutral economy is also likely to affect the financial sector. Abrupt climate policy measures and rapidly advancing carbon-neutral technology could lead to write-downs of loans to and investments in companies with carbon-intensive production processes or products with high CO₂ emissions. Our survey shows that the financial sector has considerable exposures to such high-emission sectors, and that these exposures slightly increased compared to 2015. Real estate portfolios too are exposed to transition risks, with increasingly tightened sustainability requirements posing specific risks to the Dutch office market. An investigation of a sample of commercial real estate portfolios revealed that a large share of the buildings used as collateral scores poorly in terms of their energy labels.

Green finance is emerging in the wake of the Paris climate agreement. Besides positive effects and opportunities, this development may also give rise to new risks that must be taken into account. Technological transitions in the past have sometimes led to bubble creation, as financial markets' expectations about new technologies and firms were too optimistic. Investors and lenders must beware of such risks in the course of the energy transition. And as green financial products are gaining popularity, institutions must also guard against the risk of greenwashing: if green products are less green than they appeared to be or were said to be, this could cause reputational damage and potential liability risks.

As the prudential supervisory authority we believe it is important that climate risks be identified and controlled appropriately. We therefore expect financial institutions to have a thorough understanding of the risks that are relevant to their own balance sheets. One way of achieving this is to further develop forward-looking risk management methods. Financial institutions must make better use of relevant available data in assessing risks, including by having an overview of the energy labels of their real estate exposures. We found that insurers already pay substantial attention to physical climate-related risks. However, we believe there is still room for improvement in the extent to which insurers take climate change into account in their risk management, and more specifically in their risk modelling, in cooperation with relevant external modelling parties.

In addition, supervisory authorities and policymakers have an important role in identifying and mitigating climate-related risks. A timely, clear and gradual transition is needed to limit transition risks to the financial sector. Official bodies should also work towards improving reporting standards for climate-related risks and ensure that supervisory frameworks remain risk-neutral. DNB intends to embed climate-related risks more firmly into the supervisory approach and will continue to develop and implement climate stress tests. Last but not least, DNB will continue to contribute to international exchange of knowledge about climate-related risks between supervisory authorities.



1 Climate risks affecting the Dutch financial sector

There is consensus among scientists that the Earth is getting warmer and the climate is severely changing. The Paris climate agreement aims to limit global warming to well below two degrees Celsius. Both climate change and the activities undertaken to limit it pose risks to the financial sector. This chapter describes the risk channels and identifies potential consequences for the balance sheets of Dutch financial institutions.

There is virtually unanimous scientific consensus that the Earth's temperature is rising, with severe consequences for human and natural systems. The Intergovernmental Panel on Climate Change (IPCC), a body under the auspices of the United Nations, evaluates scientific evidence for climate change.¹ The IPCC's conclusions in 2014 were as clear as they were alarming: the Earth's temperature is rising due to increasing greenhouse gas emissions, in particular as a result of human activity. We can already observe the effects of this on a large scale, including increases in extreme weather patterns such as droughts, storms and floods, as well as rising temperatures and sea levels. Furthermore, the authors of the report conclude that without any mitigating measures, we face grave, widespread and irreversible consequences to the Earth's climate system.

The Paris climate agreement aims to limit global warming to well below two degrees Celsius.

The international community is increasingly aware of the urgent need to curb greenhouse gas emissions, the source of global warming. This is reflected in various developments, most prominently the signing of the Paris agreement in 2015. Technological progress can support these climate goals.

For example, the combination of electric motoring, improved energy storage and the increase in wind and solar energy generation offer alternatives to the internal combustion engine and energy generated from fossil fuels, which are main sources of CO₂ emissions.²

It is now accepted that these developments may also have a considerable impact on the financial sector. The Financial Stability Board, the G20, as well as the Australian, UK, French, Italian and Dutch central banks have issued warnings about the potentially destabilising effects of climate change. Bank of England Governor Mark Carney has referred to the financial markets' incapacity to duly price in the long-term impact of climate change.³ Carney considers that this tragedy of the horizon could lead to the consequences of climate change being acknowledged only after it is too late, resulting in severe financial shock. In our report, Time for Transition, we indicated that the transition to a carbon-neutral energy system is one of the greatest challenges facing the Dutch economy and financial sector.⁴

1 IPCC (2014)

2 In this report, CO₂ covers all relevant greenhouse gas emissions.

3 Bank of England (2015a)

4 DNB (2016)

This chapter explores how climate-related risks can affect the Dutch financial sector. We make a distinction between the physical risks arising as a result of increased climate-related losses and damage, and the risks resulting from the transition to a carbon-neutral economy. Both categories are described in more detail below, followed by an overview of connected risks.

1.1 Physical risks

Physical risks for the financial sector arise as a result of increased damage and losses from natural phenomena including high temperatures, storms, precipitation, drought and flooding. When the damage and losses are covered by insurance, it has direct consequences on insurers' business models and risk management. When there is no insurance coverage, these losses have to be borne by households, businesses and/or governments. This can have consequences for financial institutions' exposure to these parties, through for example mortgages, corporate loans, shares or bonds.

Traditionally, insurers are well equipped to determine the consequences of extreme weather. They are familiar with the consequences that extreme weather can have for the balance sheet, and have for a long time been faced with rare but high claims resulting from natural disasters. Being unable to properly estimate the risk of natural disaster can have major consequences for insurers. This was for example shown in 2016, when several Dutch insurers

suffered losses after being surprised by a major hailstorm in the south of the country: the resulting damage considerably exceeded the estimates generated in their disaster models.

It is likely that climate-related claim burdens will increase as a result of climate change. For Dutch non-life insurers, domestic climate developments are most relevant, as they issue over 95% of their policies in the Netherlands. The Royal Netherlands Meteorological Institute (KNMI) predicts that weather phenomena, such as hail and rainfall, will in the coming decades increase in frequency and/or intensity as a result of climate change. If circumstances do not change, this will lead to an increase in claims burdens, and as estimates indicate, higher premiums for insurance products.

Investors and lenders could also be hit by the effects of climate change. Investment and loan portfolios could, for example, incur losses following a major disaster, if insurers and/or the government do not provide full compensation. In addition to these direct consequences of uninsured damage, institutions could face all sorts of secondary effects such as lower economic growth, political instability due to rising migration, and increased mortality as a result of heatwaves. It is difficult to determine exactly how these developments will affect Dutch financial institutions' assets. However, if we look at the regional distribution of assets, it shows that the Dutch financial sector only has a limited exposure to the areas in the world that are most vulnerable to climate change (see box 1).

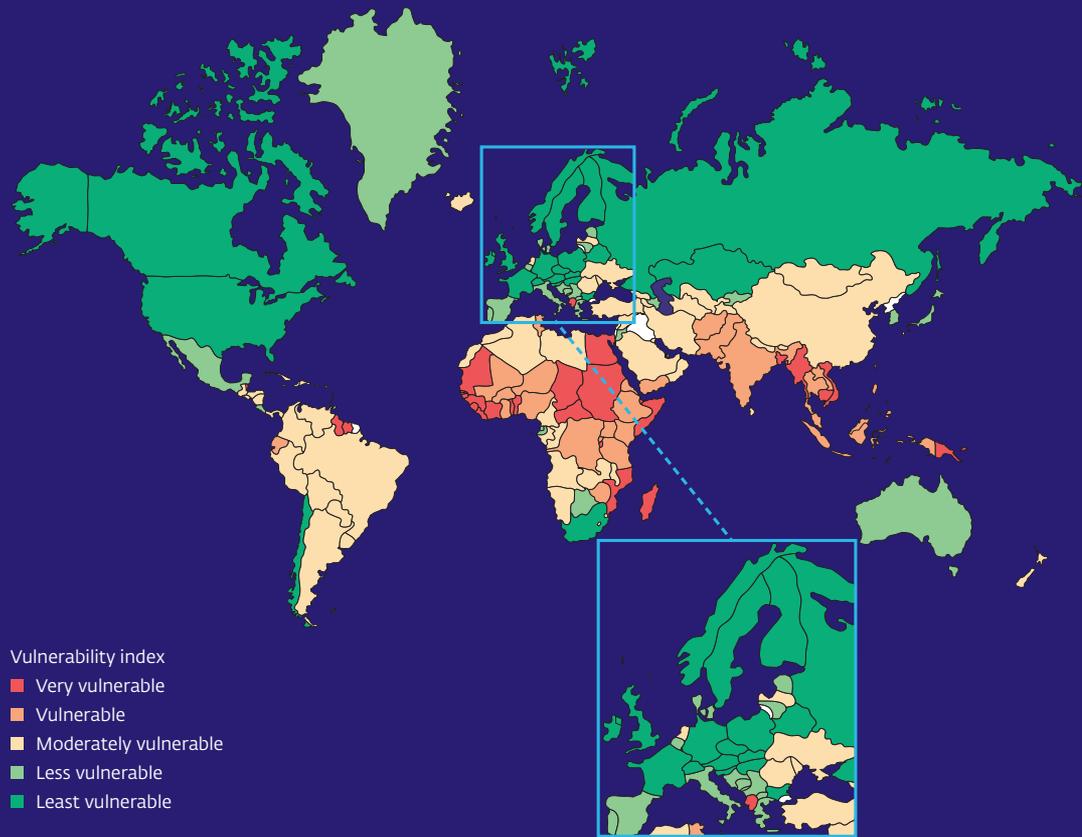
The greatest climate-related losses in the Netherlands can occur through flooding, which is often uninsured and is only partly compensated by the government. The Netherlands is vulnerable to rising sea levels. Although there is only a small likelihood of flooding in the Netherlands, the potential consequences are severe. In serious but not inconceivable scenarios flooding could result in losses of up to EUR 60 billion. Some of these losses could, through various channels, be incurred by financial institutions

Box 1 Dutch financial institutions appear to have only limited exposures in countries that are most vulnerable to climate change

To gain a greater insight into the vulnerability of Dutch banks, insurers and pension funds we have applied a vulnerability index to the geographical distribution of their assets. The overview in figure 1 is based on a vulnerability index which makes use of different variables that take into account both the effects of climate change, as well as a country's economic resilience. The higher a country scores on this indicator, the more vulnerable it is to the consequences of climate change.

The overwhelming majority of the Dutch financial sector's foreign assets are in countries that are relatively well positioned to deal with climate change. In terms of assets outside the Netherlands, the highest exposures are in the United States (16.5%), Germany (8.6%) and the United Kingdom (6.1%). These countries all score low on the various vulnerability indicators, mostly due to the resources they have to mitigate the effects of climate change. Nevertheless, (parts of) better-scoring countries could still be hit by substantial climate-related damage, as recently became clear following several major tropical storms and hurricanes in the United States and the Caribbean.

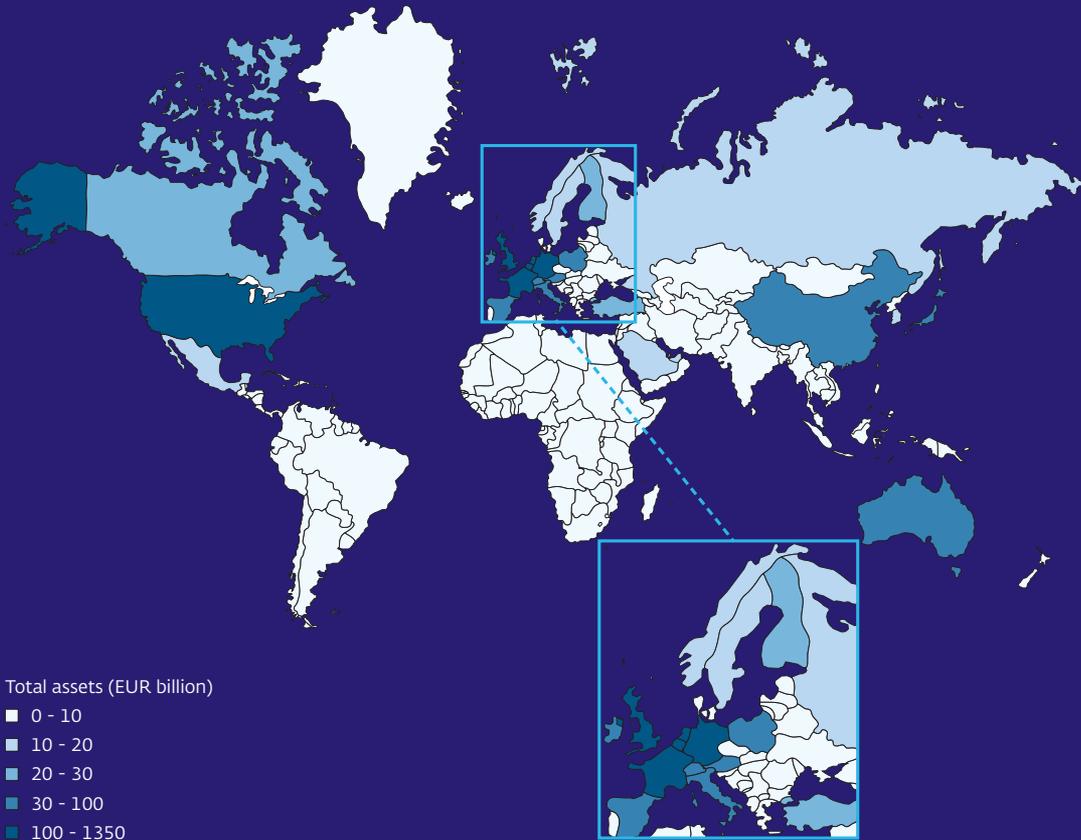
Figure 1 Climate change vulnerability index



Source: DNB, Standard & Poors, Notre Dame University, World bank.

Note: This overview is based on a vulnerability indicator used by Standard & Poor's to determine country risks resulting from climate change and updated by DNB. The indicator is based on the following three parameters: (1) The Notre Dame University Global Adaptation Index (ND-Gain Index). This index comprises a total of 36 variables, which in determining the impact take into account both the effects of climate change, as well as the economic resilience of countries. (2) The percentage of the population that lives in areas where elevation is below 5 metres, as an indicator of the vulnerability to rises in sea level and flooding. Derived from World Bank data. (3) Agriculture as a percentage of gross domestic product. Derived from World Bank data.

Figure 2 Total assets of the Dutch financial sector



Source: DNB.

Note: The chart at the top shows the geographical distribution of the value of assets based on the combined balance sheets of banks, insurers and pension funds. The three smaller charts show the geographical distribution of asset values by type of institution.

1.2 Transition risks

Transition risks arise as a result of the transition to a carbon-neutral economy.

Climate policy, technological developments or changing consumer preferences can result in premature write-downs of loans and investments related to sectors and assets which emit high levels of greenhouse gasses.

The carbon bubble hypothesis is a well-known theory about how climate change can affect financial institutions. To achieve the objectives of the Paris agreement, a large proportion of the current oil, coal and gas reserves must remain unused. The carbon bubble hypothesis posits that the value and credit quality of fossil fuel producers, which is partly based on the level of reserves they now have, is actually lower than the present market value. When this suddenly becomes apparent, e.g. as a result of more stringent climate regulation, it could lead to shocks on the financial markets.

In our report *Time for Transition*, we concluded that the carbon bubble also has implications for exposures to sectors besides fossil fuel producers. The process of transition towards a carbon-neutral economy implies that production means and processes must change in those sectors which emit high levels of CO₂, such as energy, transport, heavy industry and agriculture. Home and office property owners could also be affected, as a part of this CO₂ reduction must come from energy-saving measures. In all these areas of the economy, there is a risk that

carbon-intensive assets will have to be prematurely written off as a result of stricter climate policy or rapid technological developments which render earlier, more polluting technologies obsolete.

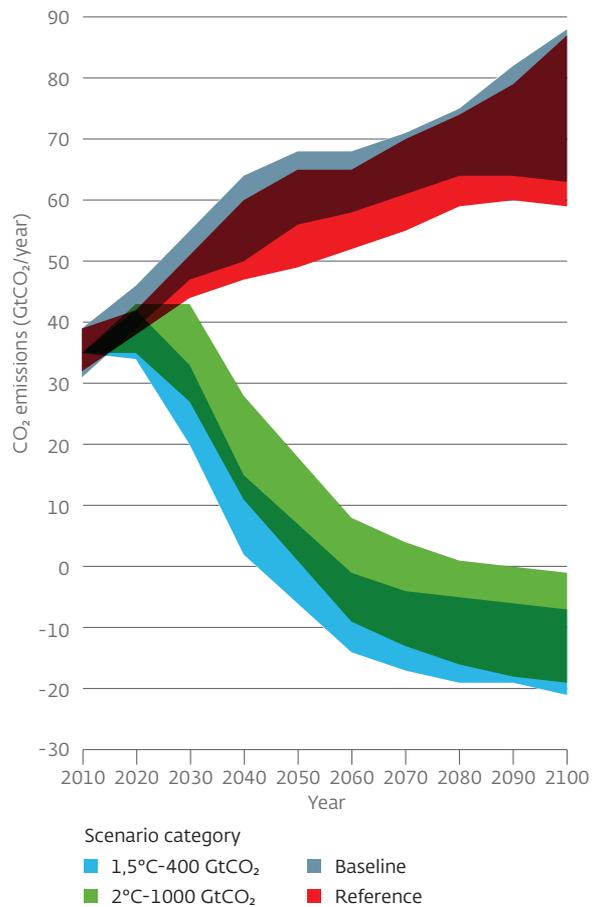
1.3 Scenarios

The speed of the energy transition has a key impact on how climate risks will materialise. Several scenarios are conceivable in this respect. When businesses are able to gradually adjust to reduced levels of greenhouse gas emissions, this will limit the risk of premature write-downs for financial institutions. The adjustment costs will be much higher, however, if the transition has to take place quickly. Limiting global warming to 2 degrees Celsius requires a very steep transition and with the current measures is not feasible, let alone what this entails for a transition to limit global warming to 1.5 degrees (see Chart 1). It is therefore possible that governments will take stricter measures over the coming years, with increased transition risks as a result.

If no or insufficient action is taken to reduce greenhouse gas emissions, the physical consequences of climate change will almost certainly increase. In that case the Netherlands Environmental Assessment Agency estimates that the Earth's temperature will rise by between three and four degrees Celsius by the end of this century. With these higher temperature rises, the scientific literature expresses concerns about tipping points:

events which are often difficult to forecast, but which at the same time can seriously exacerbate the negative consequences of climate change.⁵ An example includes large-scale greenhouse gas emissions resulting from thawing in permafrost areas. It is possible that new insights in tipping points may lead to a sudden revaluation of financial assets.

Chart 1 Projected CO₂-emissions



Source: Netherlands Environmental Assessment Agency

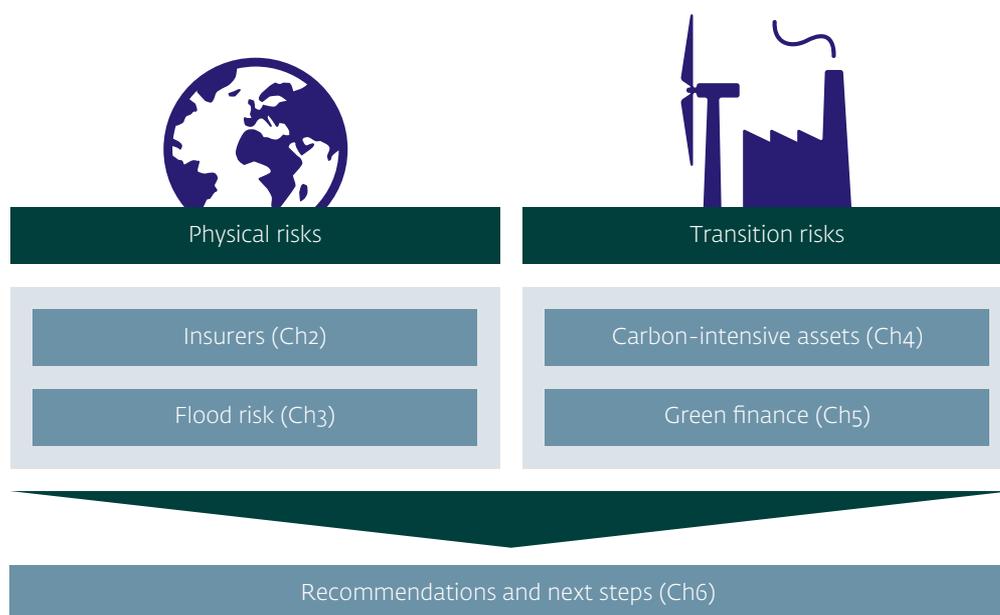
Note: the figure shows projected annual greenhouse gas emissions in gigaton CO₂ equivalents (GtCO₂) for different climate scenarios until 2100. In the baseline projection, governments do not take any measures, and temperatures will rise to an expected 3-4 degrees above pre-industrial levels. The reference projection includes current energy-saving measures until 2030; after 2030 it is assumed no new policies are introduced. The 2 degrees projection is linked to the Paris climate agreement and is based on the assumption that from 2010 onwards no more than 1,000 GtCO₂ may be emitted to achieve a certainty of 66% of remaining below 2 degrees. The 1.5 degrees projection is based on the assumption that from 2010 onwards no more than 400 GtCO₂ may be emitted. The projected CO₂ emissions are based on calculations using the IMAGE model, with added bandwidths to show that the use of other models may result in different projections.

1.4 A closer look at four themes

In the next chapters of this study, several climate risks affecting the Dutch financial sector will be examined in greater depth. Chapter 2 studies the impact of climate change on insurers. Chapter 3 focuses on the risk of flooding in the Netherlands. Chapter 4 looks at the risks connected to the transition to a carbon-neutral energy system and

sets out how this energy transition will affect the financial sector. Chapter 5 focuses on the financing of the energy transition, and the potential new risks associated with the development of new products, such as green bonds and mortgages. The final chapter of this report discusses the implications and recommendations for the sector, supervision and policymakers. See also Figure 3.

Figure 3 Structure of the report





2 Consequences of climate change for insurers

In the Netherlands, much of the damage caused by extreme weather is covered by insurance. This puts insurers on the front line of climate change. Increasing climate-related claims can lead to higher premiums. Moreover, climate change is making it more difficult for insurers to adequately estimate the risks connected to extreme weather.

The hailstorm that hit the south-east of the Netherlands in 2016 brought home once again that climate-related damage can have a significant impact on insurers. The storm resulted in over EUR 600 million in insured losses, which was considerably higher than predicted in the insurers' models. Although it is impossible to attribute any individual severe weather event to climate change, several scenarios suggest that some types of extreme weather are likely to increase in terms of frequency or intensity, or possibly both, in the decades ahead. In this chapter we look at how changing climate-related risks affect insurers, taking the climate scenarios of the Royal Netherlands Meteorological Institute (KNMI) as a basis.

2.1 Impact on insurers' liabilities

Dutch non-life insurance liabilities mostly cover objects within domestic borders.

More than 95% of all non-life insurance policies are issued in the Netherlands, with by far the largest number of insured objects, e.g. homes, equipment and vehicles, located in the Netherlands. Dutch non-life insurance liabilities hence will mainly be affected by regional climate change in the Netherlands. Non-life insurers cover most of the economic damage caused by storms, hail and rain. Potential flood damage is typically excluded under Dutch insurance policies, including homeowners' insurance.⁶ Damage that is not covered by insurance can still affect the financial sector through other channels, however, as will be elaborated upon in Chapter 3.

According to the KNMI, climate change effects in the Netherlands include higher temperatures, rising sea levels, and increased and heavier precipitation. Higher temperatures mean milder winters, warmer summers and possibly prolonged periods of drought in the summer months. The Netherlands is likely to face more heavy rainfall in the summer, with increased intensity of showers and a greater likelihood of hail and gusts. In addition to changes in the weather pattern, sea levels along the Dutch coast will rise. This increase is expected to be between 30 to 100 cm by the next turn of the

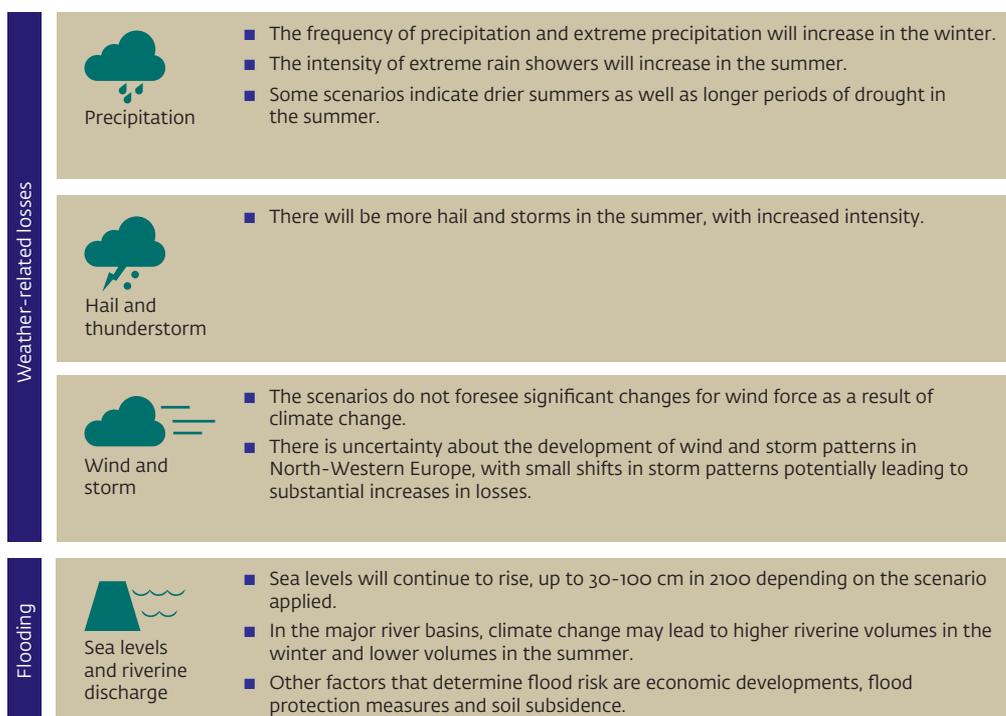
⁶ Flood risk is covered as part of some types of business and car insurance. There is also one insurance undertaking that offers complementary flood insurance for homeowners.

century. Last but not least, wind and storm patterns may also change as a result of climate change, although no clear trends can as yet be discerned here. Figure 4 below summarises these trends.

Based on the KNMI scenarios, the number of climate-related claims for insurers is set to increase in the future, and may even more double by 2085. About 22% of the claims in private homeowner's

insurance policies relate to storm, hail and rain (see chart 2a). Looking at the trends for rain and hail identified by KNMI, the number of climate-related claims could increase substantially over the next decades (see chart 2b). The projected claims increases may be partly reduced by converting to more climate-resilient building methods and taking preventive measures. Of course, these measures also carry additional costs.

Figure 4 Climate change trends relevant to the Dutch insurance sector



Sources: KNMI (2015); stakeholders interviews.

Increasing claims burdens over time could lead to additional pressure on premiums, and may cause shock-induced price rises. Due to the long-term nature of climate change, the average annual premium rise seems to be manageable: if the estimated increase in claims were passed on fully to policyholders of homeowner's insurance policies,

premiums would rise between 2 and 23 basis points annually. Some more basis points may be added as a result of other costs also rising (e.g. the costs for reinsurance and costs for processing claims). The impact on specialised insurance policies, for example in the agricultural sector, may be greater due to the larger proportion of climate-related

Chart 2a Estimated climate-related claims burden as a proportion of premiums in 2016

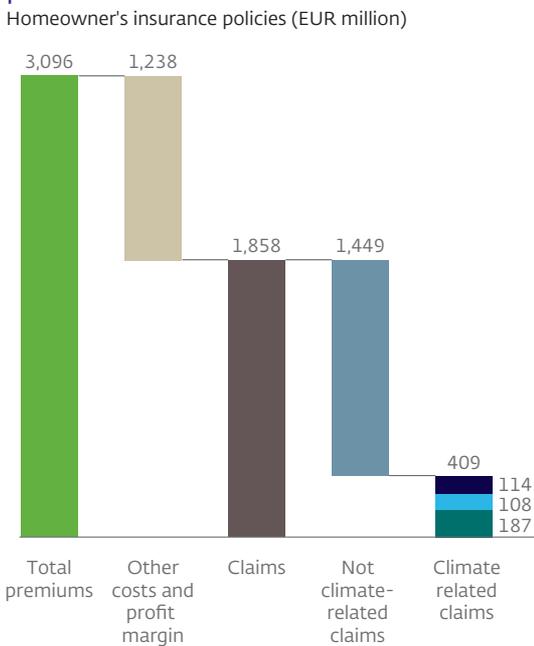
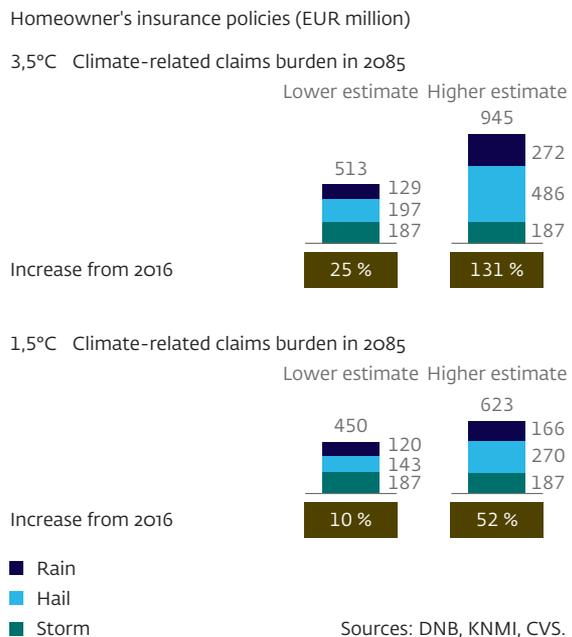


Chart 2b Estimated climate-related claims burden in 2085



Note: we requested the estimated climate-related claims figures from non-life insurers. These were mostly calculated on the basis of averages over previous years. The estimated claims burden is used for premium setting; the actual claims burden in 2016 turned out to be higher than the estimated figures. The estimates for a 3,5 degrees temperature rise in 2085 are based on the KNMI Wh and Wl scenarios, and the estimates for a 1,5 degrees temperature rise in 2085 on the KNMI Gh and Gf scenarios. These lower and higher estimates reflect the substantial uncertainty about the increase in frequency and intensity of various types of weather. Climate-related claims in 2085 have been calculated under the assumption that the vulnerability of objects and the exposures in policies for storm, rain and hail remains unchanged.

claims in this sector. There could also be shock-induced price rises in premiums, since adjustments are often made in the wake of very rarely occurring events involving high claims.

Changes in the intensity or frequency of extreme weather can also affect capital requirements and reinsurance programmes. Changes in the intensity or frequency of extreme weather are relevant to insurers' risk management, since adequate amounts of capital need to be available to meet obligations to policy holders even in very extreme cases (see Box 2). If the intensity or frequency of extreme weather increases, this may lead to higher capital requirements for disaster risk and/or related costs

for reinsurance programmes. This not only applies to the future: climate change that occurred in the past may already have an impact on current actuarial risks.

In recent decades, insurers have significantly improved their risk management of weather-related events. However, they often do not explicitly take climate trends into account in their models. Insurers use catastrophe models provided by a number of globally-operating external parties to estimate the claims burden resulting from extreme weather. These models are used to determine the expected claims burden in a given year as well as the potential loss amount levels in (very) extreme cases. The latter

Box 2 Extreme weather and capital requirements

- Insurers must take claims as a result of extreme weather into account within the Solvency II framework. One of the main challenges with respect to insuring extreme weather is that this involves conceivable events in which insurers must pay out vast sums of money. In these cases, too, insurers must be able to meet their obligations. Solvency II stipulates that insurers must hold sufficient capital to cover the consequences of extreme weather events with a 1/200-year probability. Including reinsurance, Dutch insurers can, based on their capital requirements, absorb losses to the amount of EUR 5 billion for storm and EUR 500 million for hail.
- Individual insurers are typically unable to bear extreme losses in full on their own balance sheets, which is why they often pass on part of their risk to reinsurers. Insurers can take out reinsurance in the international market. Reinsurers take on part of the claims burden for very incidental extreme events in exchange for a premium. To do so they manage a vast amount of capital, which is often employed globally to underwrite reinsurance contracts.

form the basis for setting capital requirements. At this point in time, the external modelling parties often do not explicitly include climate change trends in their models, at least not for the Dutch situation.⁷ One frequently cited reason for this is that insufficient historical data is available to estimate specific trends with an adequate level of certainty.⁸

[Climate change can also have an impact on the claims burden within other forms of insurance.](#)

Various consequences of climate change can have an impact on the liabilities of life and health care insurers, such as an increased likelihood of heat waves and natural disasters resulting in casualties. Insurers may also have to deal with claims through liability insurance policies, for example as a consequence of non-appropriate prevention measures and possible liability of insured individuals or organisations for causing climate change.⁹

2.2 Consequences for risk management

[Many consequences of climate change can be adequately addressed by adjusting insurance products, such as premiums or policy conditions.](#)

This especially applies to the non-life insurance sector, where contracts usually only have a one-year

term. Products can be adjusted in order to bring them into line with changing underlying risks as a result of climate change. This is in principle at the insurers' discretion to do so, although at a societal level it may lead to a potential increase in uninsured households or companies. For longer-term insurance policies such as life insurance and liability insurance, it is important to assess the potential impact of climate change on the magnitude of claims during the term of the products. Insurability issues are addressed in the National Climate Adaptation Strategy of the Dutch Ministry of Infrastructure and the Environment.¹⁰

[Insurers should address climate change in their risk management by explicitly taking climate change trends into account in their risk modelling.](#)

In recent decades, insurers have strongly improved their risk management regarding natural disasters. The sector as a whole is also increasingly aware of climate change.¹¹ Nevertheless, we still see room for improvement in the area of addressing climate change trends in risk modelling. Climate change trends are as of yet not explicitly factored in these external risk models, which could lead to an underestimation of risks. A potential way forward is to make more use of a range of alternative risk estimates in catastrophe modelling, based on a range of plausible underlying assumptions.

7 Lloyd's (2014); conversations with the relevant external parties

8 AIR (2017)

9 Bank of England (2015b)

10 Ministry of Infrastructure and the Environment (2016)

11 Dutch Association of Insurers (2017)



3 Flood risk in the Netherlands

With much of its land mass below sea level, the Netherlands is vulnerable to climate change. Flood disasters are unlikely to happen, but can nevertheless not be fully disregarded. Damage as a result of river or coastal flooding is typically not insured and is therefore not a major liability risk for insurers. Flood damage can nonetheless find its way onto the balance sheets of financial institutions as owners of loans and investments. This risk should be taken into account by banks, insurers and pension funds.

Despite extensive investments in flood protection, severe flooding in the Netherlands cannot be disregarded. For centuries, the Netherlands has had to deal with the consequences of being situated in a river delta. About 60% of the land mass in the Netherlands is susceptible to flooding, with 26% of it actually lying below sea level and 34% only being at risk of riverine flooding. This vulnerability has led to substantial investment in flood protection, for example through the Delta programme. Recently introduced flood safety policies aim to further reduce flood risk in the next few decades, despite climate change.¹² However, flooding scenarios are already conceivable today which could result in extensive damage.

3.1 Flood scenarios

We examined the potential impact of severe flooding scenarios on the financial sector. Of all natural disasters, floods are likely to cause the highest potential losses in the Netherlands. This is one reason why flood risk is usually excluded from insurance policies. As a consequence, the actual impact of flooding on the Dutch financial sector is less clear than that of other natural disasters such as hail and storm. It is likely however that part of the economic losses are passed on to the balance sheets of financial institutions through various channels. This chapter provides a preliminary projection of the potential impact of flood risk on the Dutch financial sector. It should be noted that this is a snapshot of the current situation: the level of flood risk in an area changes over time, e.g. as a result of economic development, targeted flood defence projects and national flood security programmes.

Conceivable flood scenarios differ widely in nature and size. The National Flood Risk Analysis for the Netherlands (Veiligheid Nederland in Kaart – VNK), a multi-year project commissioned by the Ministry of Infrastructure and the Environment, the Provinces and the water boards, contains a comprehensive number of flood scenario analyses. The level of economic damage from flooding depends on the water level, the breaching point and the economic

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activities within the affected area. An example of flooding with relatively limited damage involved the Wilnis (Utrecht) dyke breach in 2003. The economic losses amounted to some tens of millions of euros. In a worst-case scenario, with multiple breaches in defences on the west coast, causing significant parts of the Randstad conurbation to flood, estimated economic losses could rise as high as EUR 120 billion.¹³ However, the likelihood of such a scenario materialising is very small.

While more severe floods are conceivable, more plausible scenarios may already result in losses ranging between EUR 20-60 billion. We selected two scenarios from the National Flood Risk Analysis which are in line with the standards for financial shocks in supervisory frameworks (e.g. Basel 3 and Solvency 2). They involve breaching events with a probability in the order of magnitude of 1/200 and 1/1000 years. More specifically the scenarios deal with flooding of the River Waal near Nijmegen (Scenario 1 – Rivierenland region) and of the River Lek near Wijk bij Duurstede (Scenario 2 – Kromme Rijn region). Total economic losses are estimated to be between EUR 20-60 billion, i.e. ranging between 15% and 50% of the damage estimated in a worst-case scenario (see Figure 5).

Climate change either leads to considerable costs for protection measures or to increased flood risk.

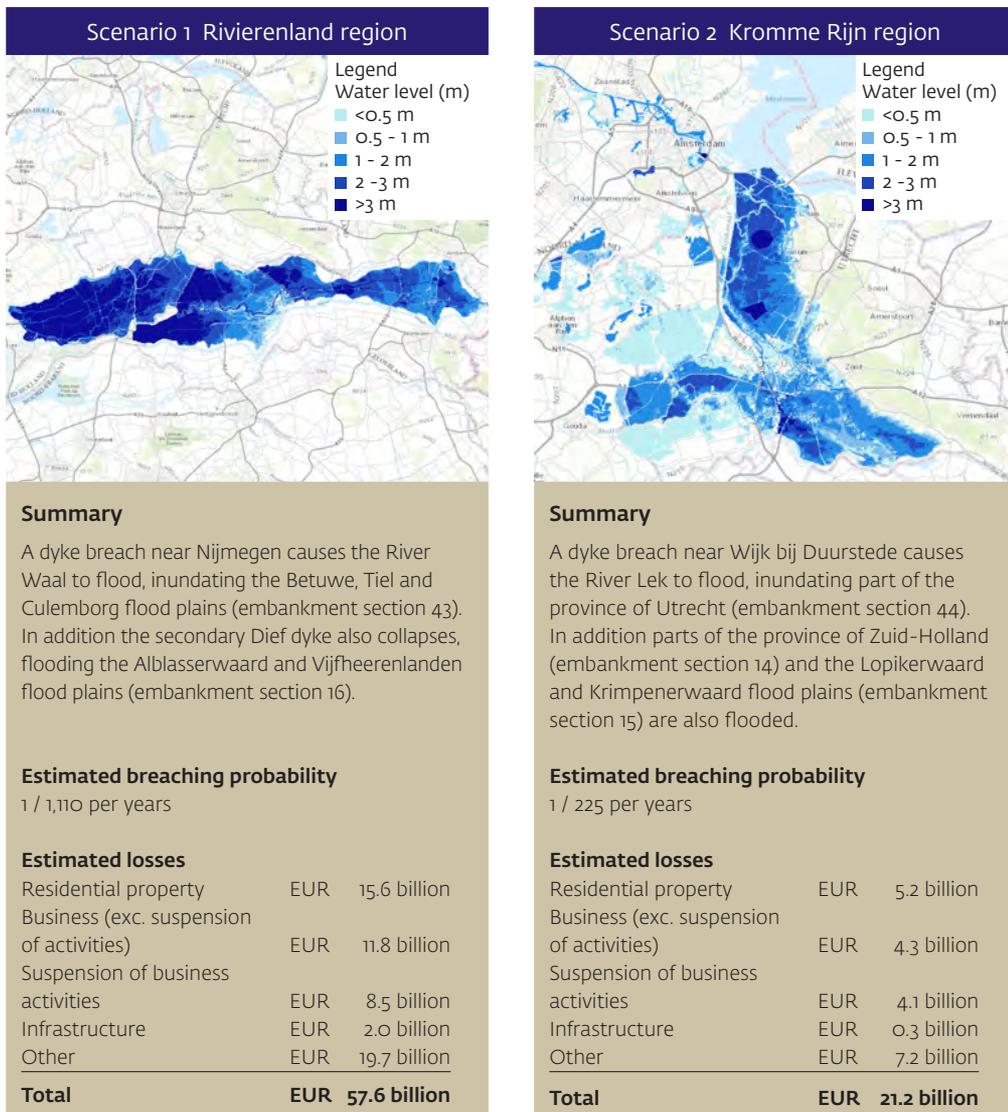
Climate change results in rising sea levels, as well as higher riverine discharge levels in winter. Substantial investments are needed to face these changes and achieve new flood security norms in 2050. With a budget of over EUR 7 billion, flood security will likely see significant improvements in the period up to 2028 under the Delta programme.¹⁴ The programme takes rising sea levels into account. However, there is uncertainty in scientific models about how fast sea levels are rising. Recent studies shows that this might be progressing at a faster pace than expected, with levels potentially rising up to 2-3 metres in 2100.¹⁵ This would consequently entail higher costs to achieve the same level of flood safety, in line with flood security norms, or an increase in flood risk.

¹³ Ministry of Security and Justice (2016)

¹⁴ Based on the 2016 Delta programme fund budget.

¹⁵ DeConto and Pollard (2016), Le Bars, D., Drijfhout, S. and De Vries, H. (2017)

Figure 5 Selected flood scenarios¹⁶



16 Calculations are performed by the Deltares water research institute, commissioned by DNB. They are based on VNK data and the SSM2017 standard Dutch flood damage assessment model, and include damage to goods as well as losses resulting from suspension of business activities. The estimated losses are based on outer water levels corresponding to an estimated breaching probability of 1/1250 for Scenario 1 and 1/125 for Scenario 2. The "other" category includes damage to public goods, means of transportation, emergency services expenses and cleaning expenses..

3.2 Impact on the financial sector

Damage from flooding is often excluded from insurance policies and is primarily borne by those directly affected and the government. From a national solidarity principle, a significant part of the damage is likely borne by the government, in particular through the Calamities Compensation Act (Wet tegemoetkoming schade bij rampen – Wts). However, the government is not expected (nor obliged) to compensate all of the damage and is relatively free to determine the level of compensation under the Wts. Part of the damage will therefore have to be borne by households, businesses and other organisations (e.g. housing associations). Non-life insurers may have to deal with (limited) claims for material damage, while life and health care insurers may face claims on their respective policies due to personal injuries and casualties.

Eventually, financial sector assets too may be affected by damage resulting from flooding. This may be directly, e.g. in the form of damage to office buildings and payment infrastructures, or indirectly through credit and investment portfolios. We can discern three relevant channels for the latter category:

1. **Financial institutions may face losses through exposures within the area affected.** Flooding can cause considerable damage to commercial and residential buildings, and may lead to suspension

of business activities. In the scenarios selected, the losses amounted to EUR 35.9 billion in Scenario 1 and 13.6 billion in Scenario 2. Financial institutions' loans and investments within the affected area will be subject to increased credit losses and lower market values. This involves mortgages, commercial real estate and SME loans, for example.

2. **Financial institutions may be affected by downward revaluation of Dutch sovereign bonds.** Direct damage to public infrastructure, emergency services costs and the implementation of the Wts will lead to substantial public costs. At the same time, the government may receive less tax revenues. According to a Standard & Poor's estimate, the Dutch government's rating can fall by half a credit quality step for each EUR 30 billion of damage.¹⁷ This will affect the owners of Dutch sovereign bonds, including Dutch banks, insurers and pension funds. In 2016, they held Dutch sovereign bonds worth EUR 120 billion.
3. **Financial institutions may experience secondary effects, such as deteriorating economic conditions and higher spreads due to flood risk in their Dutch assets.** Large-scale flooding can lead to higher unemployment and lower economic growth. Moreover, losses for the financial sector will eventually affect credit risk modelling, which may lead to higher borrowing or lending costs within a broad range of Dutch assets.

Even if no actual flooding occurs, advancing insights about rising sea levels and flood risk could have an impact on the value of financial assets. There is much uncertainty about the extent of future climate change and the consequences for rising sea levels. If the expectations about flood risk have to be adjusted considerably in the future, this may have an impact on the value of real estate in flood-prone areas, and possibly on the attractiveness of (parts of) the Netherlands in which to live or locate business activities.

3.3 Consequences for risk management

The future level of flood risk and impact on Dutch financial institutions largely depends on the design and implementation of government policy. A new statutory framework for flood protection standards entered into effect on 1 January 2017 as part of the 2016-2021 National Water Plan. The economic risks of flooding may decrease significantly as a result of working towards these new flood protection standards in 2050.¹⁸ However, achieving these standards is not a given under all circumstances. If sea levels were to rise more quickly than currently expected, this would likely lead to higher costs or lower levels of flood protection. Besides the level of flood risk, losses for financial institutions resulting from flooding depend on the level of government compensation to households and businesses.

Individual financial institutions should examine whether they have concentrated exposures within flood risk areas. While severe flood scenarios could result in significant losses for Dutch society as a whole and losses for financial institutions, they do not seem to be so substantial as to warrant immediate concerns about financial stability. At the same time, institutions with relatively concentrated exposures within specific areas may be hit harder than other institutions. These institutions should consider whether their current exposure to flood risk actually matches their risk appetite and capital position.

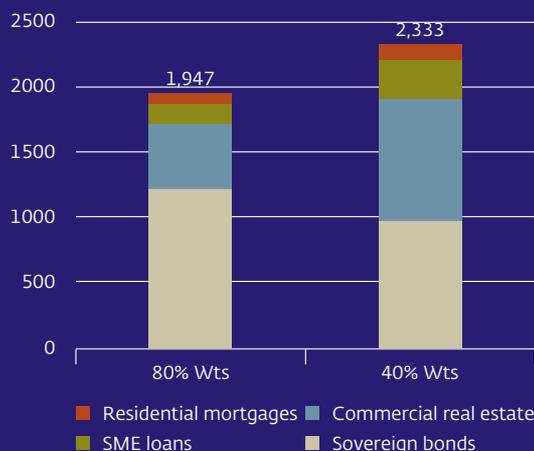
Box 3 Exploratory estimation of losses for financial institutions

We made a preliminary analysis of the possible consequences of two flood scenarios for banks, insurers and pension funds by linking the estimated damage to residential buildings and businesses to financial institutions' exposures. We assumed that the number of corporate bankruptcies in the area affected will double in the two years following the event. We also assumed a structural downward revaluation of the Dutch sovereign bonds rating of half a credit quality step for each EUR 30 billion of damage. The impact on businesses and households depends on the level of compensation by the government (% Wts), which is uncertain. Based on the above data we expect that in the selected scenarios, one to several billions euros will fall onto the balance sheets of the financial sector. These amounts could be substantially higher if additional asset classes and/or secondary effects are included.

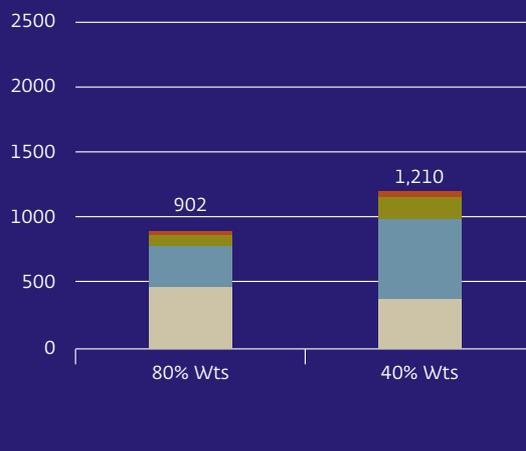
Chart 3 Estimated impact of flooding on credit losses in the area affected and the value of Dutch sovereign bonds.

EUR million

Scenario 1: Rivierenland region



Scenario 2: Kromme Rijn region



Note: DNB estimates based on loan-level data for residential mortgages, commercial real estate and SME loans for banks, insurers and pension funds. % Wts indicates the fraction of damage compensated by the government, using the formula $Expected\ Loss\ (EL) = Loss\ Given\ Default\ (LGD) \times Probability\ of\ Default\ (PD) \times Exposure\ at\ Default\ (EAD)$. We determined the EAD and impact on collateral value for each postcode in the affected area. We assumed that the PD will double and that credit losses will be higher in the two years following the event. We based our assumptions on interviews with experts and a literature review of the impact of floods from the past (mainly international cases). We also assumed a structural downward revaluation of the Dutch sovereign bonds rating of half a credit quality step for each EUR 30 billion of damage. The estimated amounts show the additional credit losses and value changes compared to the situation in which no flooding occurred.

Box 4 Flood risk insurance

Climate change has fuelled a debate about extending the provision of flood risk insurance in the Netherlands. In recent decades, the insurance sector made several attempts to set up large-scale, mandatory flood risk insurance schemes to replace the system of compensation through a public safety net. To date, these attempts have not been successful, although the sector still appears to have an appetite to develop the Dutch flood insurance market. To a very limited extent flood risk is currently available as a separate product to complement homeowners' insurance, and in some cases as part of corporate and car insurance policies. From a supervisory perspective, DNB has a role to ensure that the actuarial risk related to flood risk insurance is well managed and that individual institutions can cope with potentially large losses.

From a broader, social perspective, a private market for flood risk insurance is not necessarily preferable over a public safety net. Coverage structures involving the insurance sector are conceivable in many shapes and sizes.¹⁹ The government will continue to play a role in virtually all of these, given that the potential damage in some very severe scenarios exceed the international reinsurance market's capacity for this risk. The benefits of private insurance include the option of spreading risks between entities and internationally, as well as contractually agreed certainty about the level of compensation. On the other hand, the costs of private insurance constructions are not by default lower than those of a public safety net, while in some private approaches there is less political discretion about the distribution of costs between the different risk groups. It may also be beneficial to place the responsibility for prevention and damage compensation with a single party.

¹⁹ Swiss Re (2016), European Commission (2013)



4 Anticipating the transition to a carbon-neutral economy

A radical transition to a carbon-neutral economy is vital in order to limit the physical consequences of climate change. This will expose the Dutch financial sector to transition risks, such as potential write-downs of loans and investments in transition-sensitive sectors. The Dutch market for office buildings is already facing such risks, as owners and lenders are forced under statutory regulations to make their buildings more sustainable within the next few years. Other carbon-intensive sectors must also prepare for the transition. In this chapter, we focus on these transition risks, as we believe it is essential that financial institutions identify transition risks to their balance sheets in good time and take appropriate mitigating measures where necessary.

Almost 200 countries expressed their commitment to keeping global warming below the threshold of 2° C in December 2015. The transition to a carbon-neutral economy requires a significant reduction of greenhouse gas emissions. As a large part of these emissions are caused by the use of fossil fuels, the transition threatens the earnings model of fossil fuel producers. The transition also requires reforms in other sectors that are dependent on the use of fossil fuels or responsible for emitting high levels of greenhouse gases, such as the energy and transport sectors, the built environment, heavy industry and

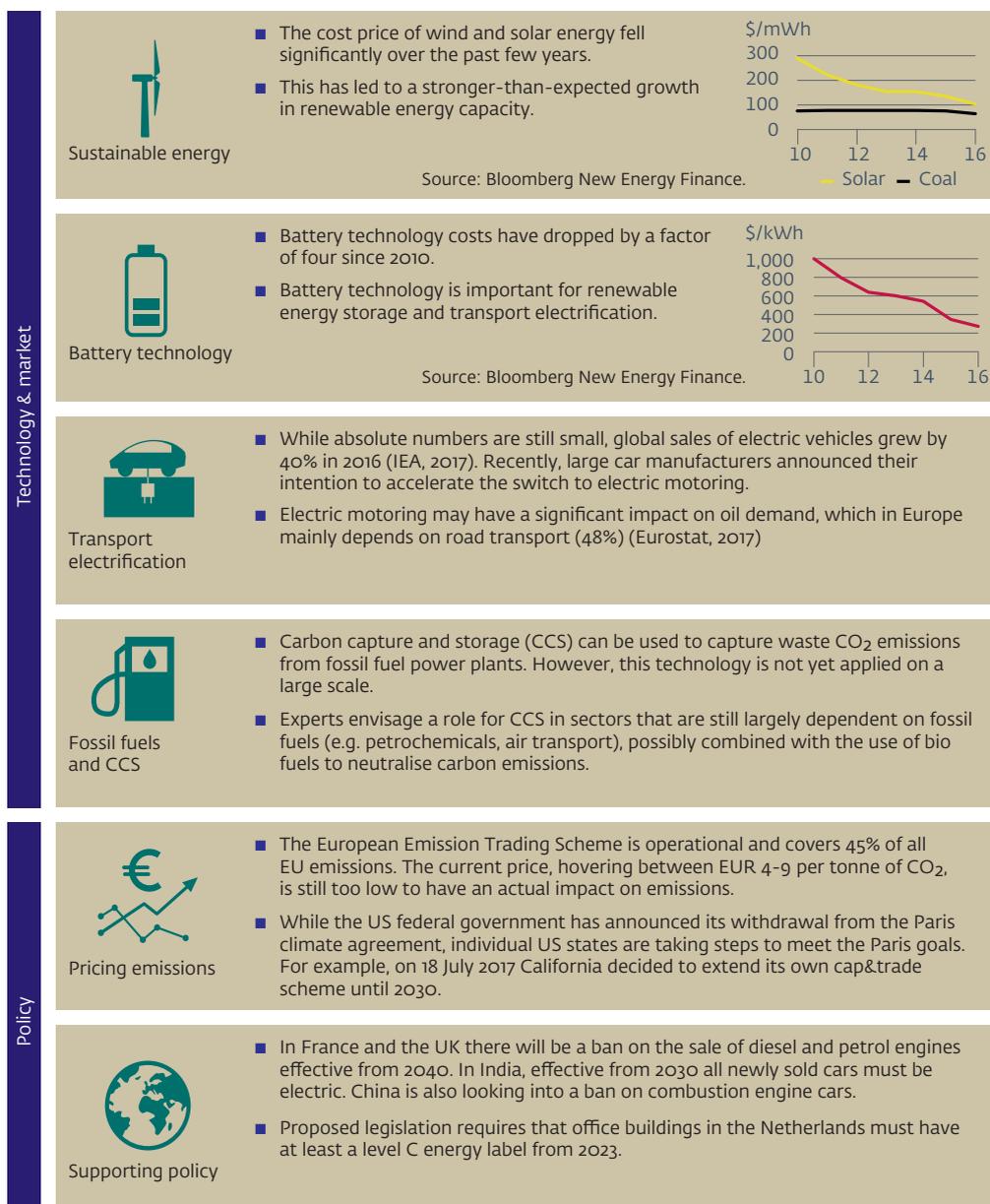
agriculture. Moreover, it may depress the debt position of countries that are heavily dependent on income from fossil fuels, including large parts of the Middle East.

Multiple trends are indicating that the energy transition is under way. For example, the cost price of wind and solar energy has been falling significantly over the past few years. According to the International Energy Agency (IEA), this has led to much faster than expected global renewable energy growth.²⁰ And despite the imminent US withdrawal from the Paris climate agreement, an increasing number of national and regional governments have expressed their commitment to the Paris goals. For example, the UK and France have announced a ban on the sale of diesel- and petrol-driven cars effective from 2040. Norway will impose such a ban already in 2025. Figure 6 gives an overview of current important technological and policy-related trends.

4.1 The risks of the energy transition for the financial sector

In the transition to a carbon-neutral economy, the financial sector is exposed to transition risks. These include potential write-downs of loans and investments as a consequence of the transition process. There are several ways in which these risks could materialise. For example, the profitability of companies in the above-mentioned sectors could decline as a result of the transition, with an adverse

Figure 6 Examples of key technological and policy-related trends in the transition to a carbon-neutral economy



impact on the value of their shares and corporate bonds, and on the credit ratings of their loans. Other risks could emerge with respect to the sovereign bonds of countries or regions with governments that strongly depend on income from fossil fuels. An abrupt energy transition could lead to higher energy prices and consequently lower consumer spending and lower investments by non-energy companies, and hence could have a negative impact on economic growth.

Whether the energy transition will result in substantial losses for the financial sector depends *inter alia* on the speed with which it progresses, which in turn depends on government policy, technological innovation and consumer behaviour. A gradual transition will allow the economy and the financial markets to adjust their business processes and prevent losses, while an abrupt transition is likely to mean that many capital goods will have to be depreciated and that significant losses could occur in various parts of the economy. Government policy, technological developments and consumer behaviour all play an important role in the actual pace of the transition. If governments suddenly decide to introduce new legislation and demand compliance from companies and households in the very short term, this will lead to substantial adjustment costs. At the same time, disruptive technological

developments could contribute to an abrupt transition, for example a rapid growth in renewable energy generation or electric vehicles. Finally, consumers too can impact the speed of the transition by purchasing sustainable products and services. This could lead to write-downs of businesses who fail to adopt their business models in time.

4.2 Exposures to carbon-intensive companies

To gain a better understanding of the potential risks, we analysed financial institutions' exposures to transition-sensitive sectors in early 2017. We held a survey among the three largest banks, six insurers and six pension funds. Together, these institutions represent about 75% of the cumulative balance sheet total of the Dutch financial sector. We focused on exposures to those sectors that, together with the built environment (see Section 4.3), are responsible for the bulk of CO₂ emissions. These sectors include fossil fuel producers and suppliers as well as the following carbon-intensive sectors: energy generation, heavy industry (chemical, steel, mining, paper, cement), transport and agriculture. This selection corresponds to the selection of sectors for an earlier survey we held in late December 2015.²¹

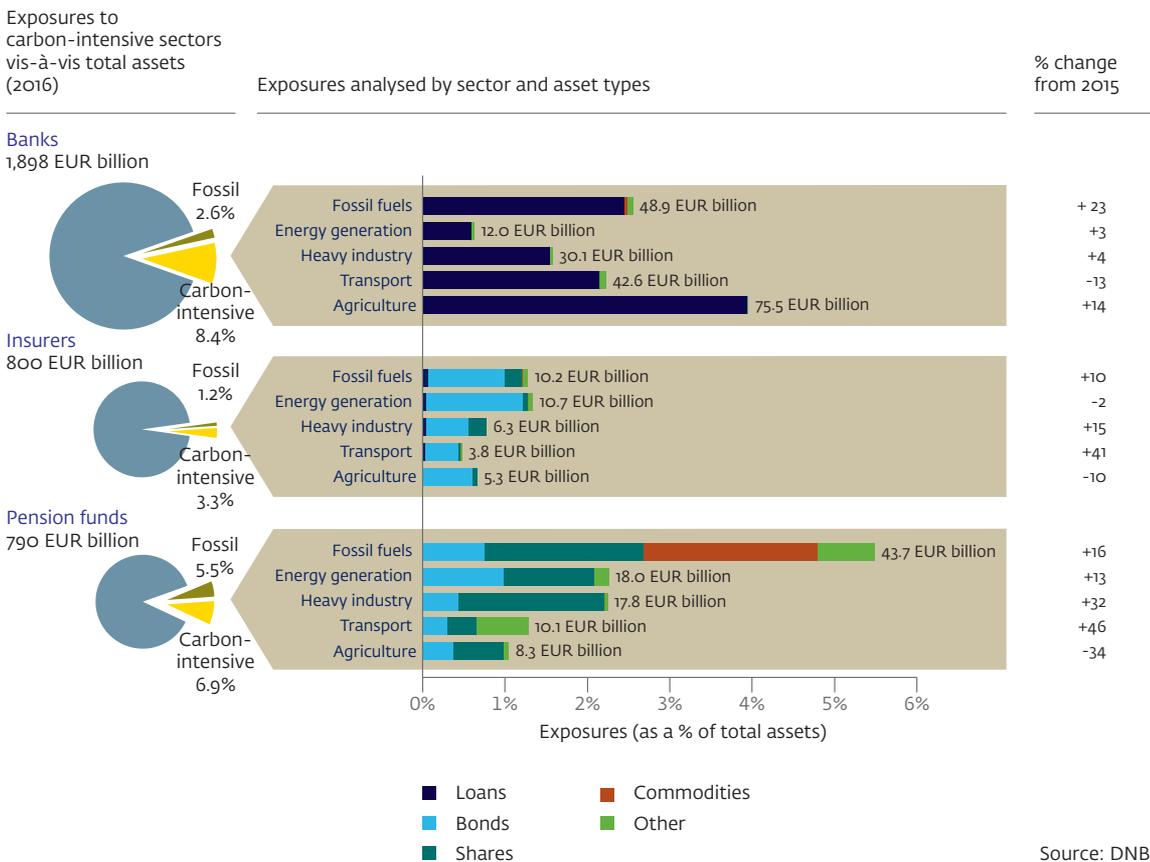
The survey shows that Dutch financial institutions have significant exposures to sectors with increased transition risks. Chart 4 shows the exposures for a selection of carbon-intensive sectors by asset category. For banks, 11% of their balance sheet is tied to carbon-intensive sectors. The corresponding percentage for pension funds is 12.4%. Exposures for insurers seem to be less substantial at 4.5%.

Compared with the end of 2015, the total exposure volume increased slightly. This is partially due to a 23% increase in bank loans to fossil fuel producers combined with slightly contracting bank balance sheets. A possible explanation is that the oil and gas market recovered in 2016 from an oil price low in 2015. This led to an increase in new loans and to better utilisation of existing credit facilities. Pension funds' exposures to the fossil fuel sector went up EUR 6 billion, but remained roughly the same in terms of the balance sheet percentage.

Pension funds and insurers are mainly exposed through shares, bonds and commodities, which makes them vulnerable to market fluctuations. Pension funds have the largest exposures, as they primarily invest in shares and commodities, which run a higher risk of sudden write-downs compared to bonds. A survey among 28 financial institutions (see Section 4.4) revealed that virtually all of them were of the opinion that transition risks are not fully priced in at the moment, which means there is a risk of sudden downward shocks with the event of new measures or technological developments.²² In certain sectors, however, the markets seem to be increasingly prepared to take the energy transition into account. Box 5 shows how the market values of US coal and renewable energy producers reacted to the news about the ratification of the Paris climate agreement and the US announcement of withdrawal from that agreement.

22 See CISL (2016), for a study into the consequences of abrupt market sentiment changes with respect to climate-related risks. According to the authors, substantial risks may materialise in investors' portfolios even in the short term once market participants' awareness of the potential risks of climate change and the energy transition starts to increase.

Chart 4 Exposures to carbon-intensive sectors vis-à-vis the balance sheet total and broken down by sector and asset type



Notes to the sectors: The fossil fuels sector comprises exposures to oil, gas and coal producers as well as direct suppliers (e.g. offshore industry) and service providers, direct distribution channels (pipes) and fossil fuels traders; The energy generation sector comprises exposures to fossil fuel-based electricity generation; The heavy industry sector comprises exposures to the chemical, cement, metal and wood/paper industries; The transport sector comprises exposures to air, road and maritime transport (rail transport is not included, as its CO₂-intensity is low); The agriculture sector comprises exposures to agricultural (arable and livestock farming) producers and packaged foods producers (fishery is not included, as its CO₂-intensity is low).

Notes to the asset categories: The loans category comprises traditional corporate loans as well as trade finance to parties trading in fossil fuels; The shares category comprises investment in shares, equity investment funds and derivatives; The bonds category comprises corporate bonds and bonds issued by state-owned enterprises; The commodities category comprises direct commodity investments, futures contracts and commodity plan assets; The 'other' category primarily comprises investments in private equity, hedge funds and public/private infrastructure investments.

Box 5 Responses from the financial markets to climate news

Using news item analysis it is possible to measure the extent to which investors take climate-related risks into account in their capital allocations. The figures below show how the rates of green (S&P 500 renewable energy index) and brown (STOWE Global Coal Index) companies responded to two climate-related news items: i) the ratification of the Paris climate agreement and ii) the US announcement of withdrawal from the Paris climate agreement.

Chart 5 Ratification of the Paris climate agreement

The green index rises more strongly



Chart 6 US withdrawal from the Paris climate agreement

The indices react in opposite directions



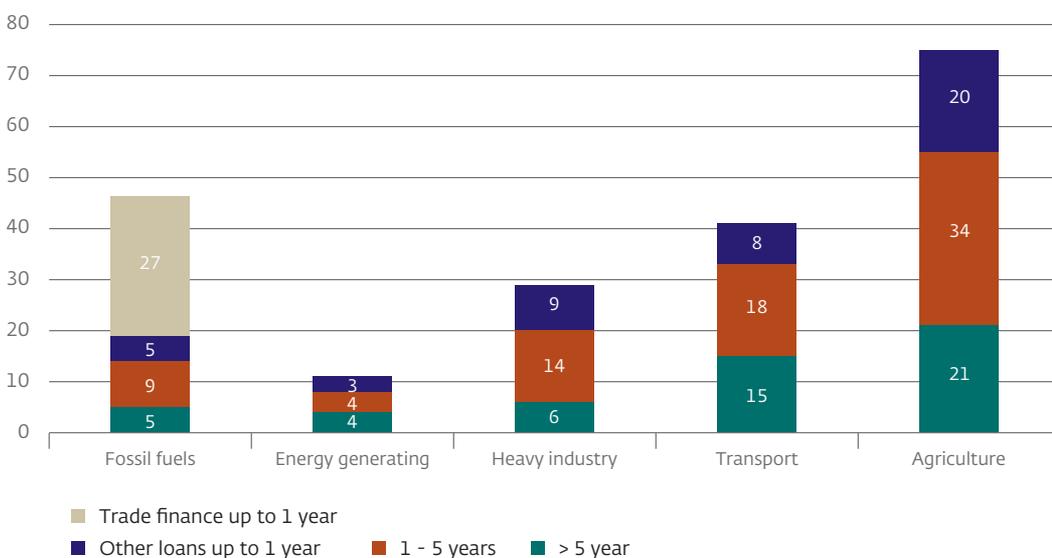
Source: DNB Market Intelligence, Bloomberg.

The figures show a significant yield differential between the green and brown indices, which indicates that investors are indeed considering the financial implications of climate-related news. The returns are measured using the cumulative abnormal return (CAR²³) formula, a regular method for gauging the impact of news on market movements.

The positive news (Chart 5) leads to improved performance of the green index compared to the brown index, with the green index CAR exceeding the brown index CAR by 6.2%. The negative news (Chart 6) yields the opposite effect, with the brown index CAR exceeding the green index CAR by 2%. The yield differential for both climate-related news items between the green and brown indices is statistically significant with a confidence level of more than 99%.

Chart 7 Loans of banks to carbon-intensive sectors by maturity

EUR billion



23 CAR is defined as the sum of returns in the five days following the event, adjusted for average returns in the 90 days preceding the event. The methodology is based on the Constant Mean Return Model, a standard approach to perform news item analysis (see MacKinlay, 1997).

At first sight, the risk of write-downs in carbon-intensive sectors seems to be manageable for Dutch banks. Banks' exposures mostly comprise loans, which makes them less sensitive to market fluctuations. Most of these loans have maturities of less than five years (see Chart 7). For loans to fossil fuel producers, which mostly involve trade commodity finance, the maturities are generally even less than one year. These short-term maturities should provide banks with sufficient scope to anticipate changes, especially if the transition is more gradual in nature.

However, risks to banks may still emerge in some subsectors, as differences in exposures to these sectors vary considerably between banks. Tightened regulations and technological developments within sectors may hit individual institutions with concentrated portfolios exceptionally hard. Moreover, banks are the main source of funding for SME companies, for which it is difficult to assess the risk profile due to a lack of sustainability information. Last but not least, it is also possible that sectors are hit that were not included in the survey, e.g. the car industry, where the transition to electric motoring could have a significant impact on both manufacturers and suppliers. Uncertainty about which companies will be hit in the energy transition – i.e. the winners and losers – makes it more difficult to estimate the exact impact.

4.3 Exposures to non-sustainable real estate

The built environment also plays an important role in CO₂ emissions and is therefore sensitive to the energy transition. In 2015, the built environment was responsible for 12.5% of all CO₂ emissions and 40% of total energy use.²⁴ Saving energy and hence reducing CO₂ emissions is one of the key components of the Energy agreement on sustainable energy concluded between the Dutch government and some forty organisations in 2013. Their common ambition is to achieve a level A energy label for buildings by 2030. As part of our study into transition risk, we examined exposures to non-sustainable real estate in greater detail.

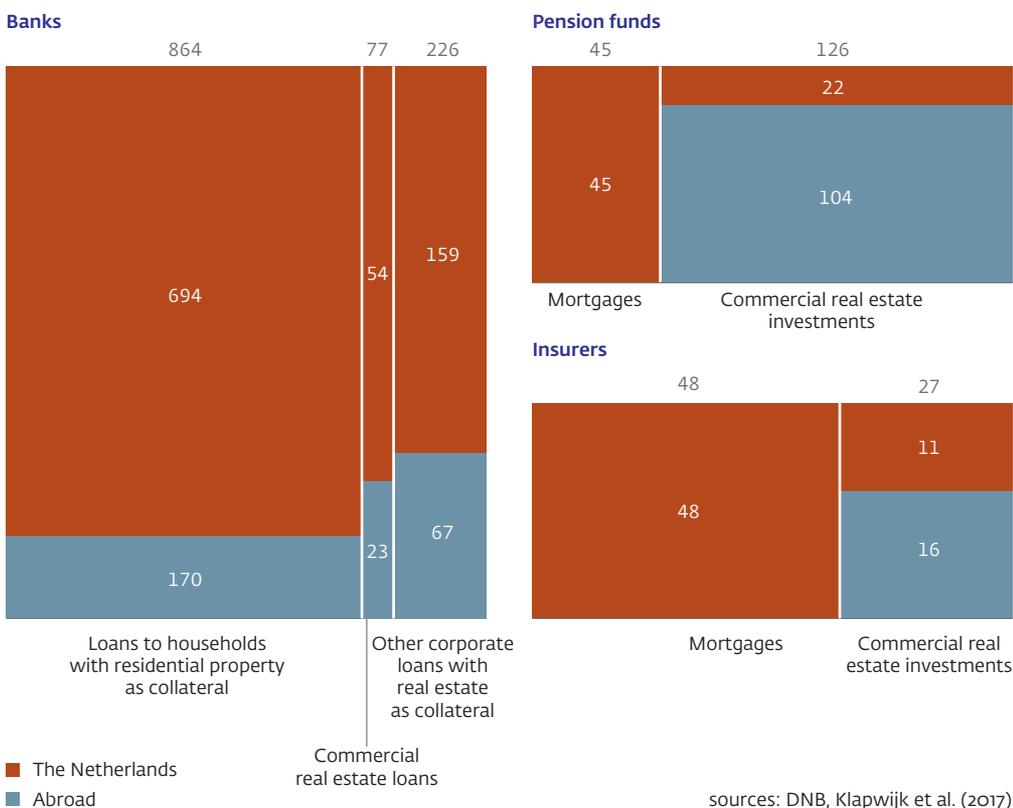
Dutch financial institutions have significant exposures to the built environment. As Chart 8 shows, banks' exposures can be divided into three categories: loans to households with residential property as collateral (mainly mortgages); corporate loans to commercial real estate companies which generate direct income through letting real estate that at the same time serves as collateral; and corporate loans to other businesses with real estate as collateral. The investments of pension funds and insurers can be broken down into mortgage loans and real estate investments, with the latter comprising both direct investment in real estate (i.e. ownership of buildings) and investment through real estate funds. The banks' total mortgage portfolio amounts to more than one third of the cumulative balance sheet, while commercial real estate loans and other corporate

loans with real estate as collateral account for 9% of the banking balance sheet. Pension funds have invested 9% and insurers 4% in commercial real estate, respectively. The mortgage portfolios of pension funds and insurers continue to grow.

Given the size of these exposures, tightened sustainability requirements for the built environment could lead to risks for the Dutch financial sector. If the owners of residential, office, retail and other buildings have to invest

Chart 8 Loans and investments related to residential, commercial and business real estate

EUR billion



sources: DNB, Klapwijk et al. (2017).

Note: Insurers also have collateralised corporate loans on their balance sheets, but these are not included in the figure. At present we cannot derive the exact size of these exposures from our internal data. Based on our survey, we estimate that the commercial real estate loan portfolio of insurers amounts to approximately EUR 9 billion. The national/international distribution of this portfolio is unknown, as is the share of other collateralised corporate loans.

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in sustainability measures, this could put their repayment obligations for related loans under pressure. The value of unsustainable real estate may fall if these buildings become more difficult to sell or let as a result of tightened sustainability requirements or changing consumer preferences.²⁵

Recently, a new sustainability requirement for Dutch office buildings was announced. Effective from 1 January 2023, all office buildings must have at least a level C energy label, or else they must be taken out of use.²⁶ This may have consequences for investments by pension funds and insurers and bank loans related to such buildings. The actual impact depends on the number of buildings that must be made more sustainable, the associated costs and real estate owners' capacity to bear these costs.

We do not have a comprehensive overview of the label distribution of all office building-related investments and loans. For example, we do not know which share of the banks' EUR 226 billion in corporate loans with real estate as collateral concerns office buildings, nor are we aware of the label distribution of these buildings. Through

a survey we gained partial insight into the label distribution of bank loans to commercial real estate companies and of insurer and pension fund investments in commercial real estate in the Netherlands. The survey revealed that financial institutions are aware of the label distribution for less than half of their loans and investments.²⁷ These loans and investments do however not only relate to office buildings but also to other lettable real estate, such as retail space and rental homes.

The available data shows that 46% of bank loans, 17% of pension fund investments and 19% of insurer investments related to commercial real estate in the Netherlands involve collateral with lower-range energy labels (i.e. from D – mediocre – to G – poor). This is presented in Chart 9. The label distribution related to bank loans is of substantially poorer quality than the label distribution related to pension fund and insurer investments. Moreover, the exposures of pension funds and insurers are less substantial. However, as the owners of these buildings, pension funds and insurers are directly responsible for investing in sustainability measures.²⁸

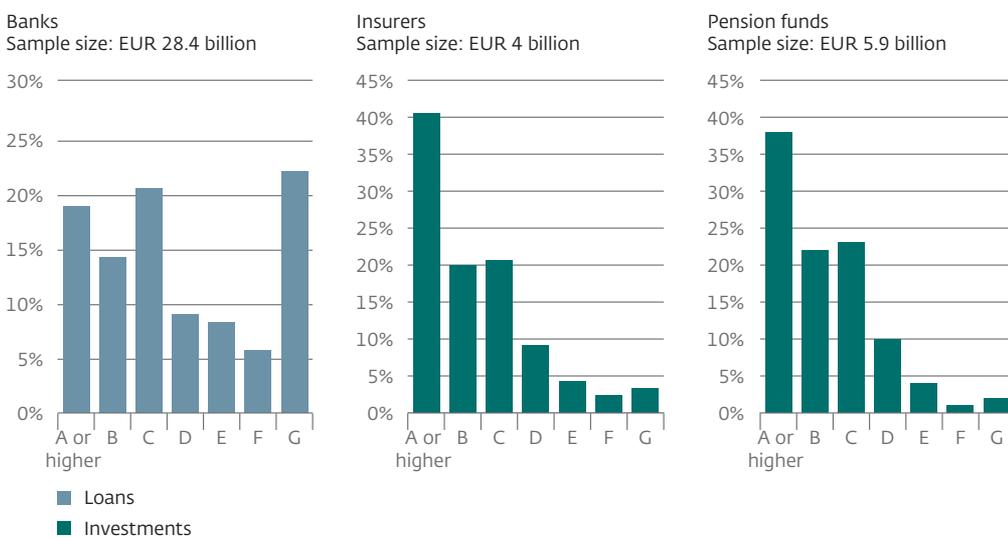
25 A study conducted by ING and Maastricht University (2017) showed that energy-efficient office buildings yielded higher rental and market values than non-energy-efficient office buildings in 2015 and 2016.

26 This is a proposed statutory requirement, which is awaiting approval by the Council of Ministers and the Council of State at the moment of publication. Various terms and conditions apply to this requirement, e.g. the requirement only applies to office buildings with a surface area exceeding 100m².

27 With respect to the other loans and investments, the label is either unknown or not applicable (approx. 6.5%).

28 Institutional investors, and pension funds in particular, mostly have an international investment portfolio. At the international level too, they are investing in sustainable buildings, many of which hold internationally accepted sustainability certification such as GRESB, Green Star and BREEM.

Chart 9 Label distribution of commercial real estate loans and investments in the Netherlands



The label distribution of bank loans in particular is a point for concern. We know that about 23% of banks' exposures to commercial real estate relate to office buildings, and that the label distribution of these offices corresponds to the percentages in Chart 9. This means just under EUR 6 billion of commercial real estate loans will be subject to the tightened sustainability requirements.²⁹ While this is

a substantial amount, it seems to be manageable as the additional investments in sustainability measures are regarded as feasible.³⁰ The following comments should be taken into consideration, however. First, some real estate owners may run into difficulties even if the investments to be made are relatively low. The commercial real estate market is a high-risk market, as some real estate owners have high debt levels

29 The total commercial real estate loans portfolio comprises EUR 54 billion, 23% of which (EUR 12.4 billion) relates to office buildings. We know from our sample check on commercial real estate loans that about 46% of these buildings have a lower-level (mediocre to poor) label, and we expect this label distribution also to apply to office building loans. If we multiply EUR 12.4 billion by the latter percentage, we get EUR 5.7 billion.

30 Commissioned by the Ministry of the Interior and Kingdom Relations, the Economic Institute for Construction and Housing (EIB) and the Energy research Centre of the Netherlands (ECN) conducted an exploratory study into the costs associated with mandatory label level requirements (EIB and ECN, 2016; EIB, 2017). The researchers found that 52% of the current office building stock, i.e. 67,000 buildings, do not meet the level C label requirement. According to EIB estimates, to make these buildings more sustainable up to at least level C, real estate owners will have to make additional investments worth EUR 1 billion, on top of the investments required in connection with the Environmental Management Act (Wet Milieubeheer – Wm). Under this Act, all building-related sustainable energy measures with a return time of five years or less are deemed compulsory.

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in order to maximise their returns. Moreover, many office buildings are in less attractive locations that are difficult to let, even in economically favourable times. Especially where these buildings are concerned it remains to be seen whether the investments can be recouped. Second, we found that about 22% of bank loans are related to buildings with a level G label (the lowest level), and that concentrations differ between banks. This may lead to elevated risks in concentrated portfolios. Third, most institutions do not have a comprehensive overview of their portfolio label distribution and hence are unable to adequately estimate the related risks.

Our analysis does not provide an insight into the label distribution of bank loans to other businesses with real estate as collateral. While businesses are required to make the buildings under their own management more sustainable, we have no

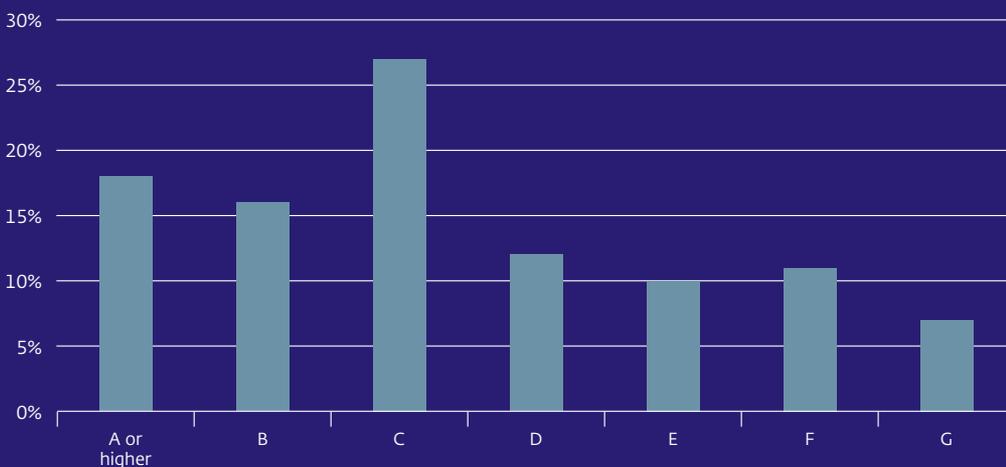
comprehensive overview of the exact size and label distributions of these exposures. Moreover, it is very well possible that requirements will also be tightened for other real estate categories. For example, the government has announced its intention to investigate the options to make non-residential buildings (e.g. schools, care facilities, retail and hospitality buildings and production halls) more sustainable. Financial institutions may be faced with tightening sustainability requirements in different parts of their real estate portfolios. The housing stock and related loans are also exposed to the energy transition (see Box 6).

Box 6 Private real estate and the energy transition

Based on the Energy agreement ambitions, residential buildings will also have to be made more sustainable. Changes in the housing market resulting from climate-related policy may also have an impact on financial institutions. This especially applies to the banks' large mortgage portfolios. A sample check revealed that the banks are aware of the label distribution of about 50% of their mortgages. Of these, some 40% relate to mortgages for buildings with a label level below C (see Chart 10).

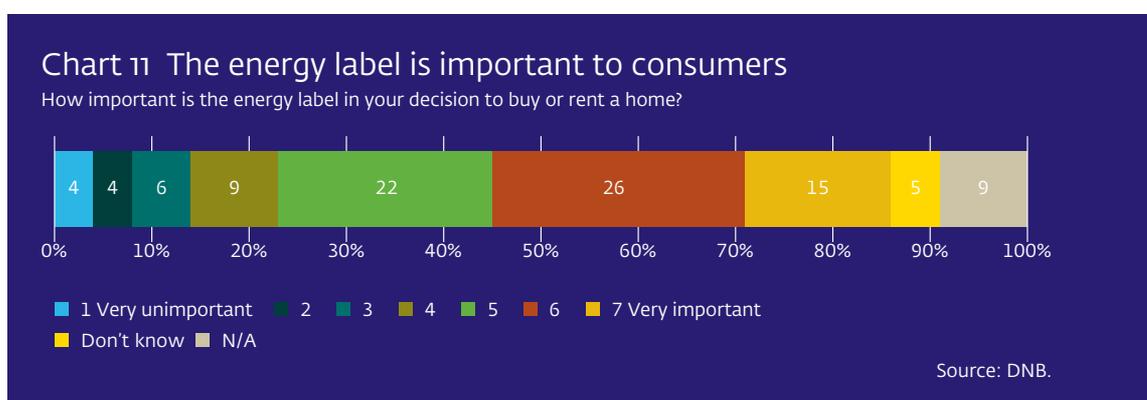
Chart 10 Label distribution of mortgages on the banking balance sheet

Sample size: EUR 328 billion.



Note: the sample check was based on the mortgage portfolios of the three largest Dutch banks, jointly totalling EUR 634 billion at the end of 2016. The label is known for a share of the portfolio worth EUR 328 billion. For most of these mortgages the remaining term to maturity is more than five years.

The impact of the energy transition on private real estate is not yet clear. However, banks have indicated they do expect the energy transition to have an impact on their mortgage portfolios. Even without tightened regulations, the value of homes with lower-level labels may be affected as a result of consumer preferences. DNB's household survey shows that 63% out of 2500 participants attach above-average importance to the energy label when buying or renting a new home (see Chart 11).



4.4 Dealing with transition risks

To gain insight into how institutions are dealing with transition risks, we held a survey and additional interviews among 28 institutions.³¹ The survey revealed that about 75% of institutions perceive the energy transition as a relevant risk to their own balance sheet and that they are building up expertise on this subject. Several institutions have identified their exposures to carbon-intensive sectors and some have estimated the potential risks to parts of their portfolios with the help of scenario analyses. Some front-runners have even developed monitoring systems such as heat maps or climate risk indicators to identify risks by asset category or sector. Only a very limited number of institutions have indicated they see no or only limited transition-related risks for their organisation. Some of these institutions do not regard such risks

to be important at all, other institutions do not expect transition risks to apply to the sectors their organisation is financing.

Institutions increasingly consider transition risks in their regular investment decisions. A number of banks indicate that they consider the energy transition as a factor in credit applications from companies in particular sectors, such as the fossil fuels and energy sectors. One bank requires the total energy mix of the energy companies in its portfolio to be in line with the International Energy Agency's 2° C scenario effective from 2020, and also requires companies in the energy sector to have carbon reduction plans in place. Most banks also apply an exclusion policy for certain sectors, such as the coal industry. As a consequence of new regulations, the large banks are requiring office buildings in their portfolio to have at least a level C label by the end

³¹ This concerns the 12 largest pension funds, the 10 largest banks and the 6 largest insurers. We conducted additional interviews with 9 institutions. The survey thus includes more institutions compared to the request for data.

of this year, or to have a plan in place setting out how they intend to meet this requirement in order to qualify for refinancing. Institutional investors too are increasingly taking energy transition risks into account in their investment decisions, often as part of broader corporate sustainability policy. This is reflected for example in strategic choices to invest in certain sustainable sectors or businesses. Various pension funds and insurers are indicating that they expect their asset managers to manage these risks. Many institutional investors are engaging in dialogue on the energy transition theme with the largest polluters in their portfolios.

However, dealing with transition risks is not yet fully embedded into the institutions' systems. Many institutions are still in the exploratory phase with respect to examining the impact of the energy transition on their organisation. In many cases, energy transition considerations are only taken into account in specific areas, such as real estate or the fossil fuel industry. Pension funds and insurers in particular often seem to limit their energy transition considerations to their equity portfolios in active management, while a more holistic approach regarding their total balance sheet is in most cases lacking. At present, financial institutions have insufficient information about the impact of the energy transition on the companies they are financing, which is a source of concern. Many companies do not disclose their CO₂ emissions, or only to a very limited degree.³² Moreover, data on

CO₂ emissions alone are insufficient to estimate the transition risks that companies may be exposed to. The availability of low-carbon alternatives and company transition strategies also play a role. In those cases where sustainability data is available, e.g. in the form of energy labels for buildings, institutions are often unable to adequately manage risks due to inefficient data organisation.

It is important that institutions make more efficient use of available data to further improve their transition risk management. Institutions must be aware of the relevant exposures to carbon-intensive assets on their own balance sheets. To effectively manage the risks related to the office building market and potentially emerging risks related to other commercial real estate and residential buildings, they must have an adequate understanding of the label distribution of their portfolio – something which is currently lacking, as can be read in Section 4.3.

The government must urge companies to disclose relevant data. Institutions need more information from the companies they are financing in order to perform proper risk assessment. Companies should not just disclose their CO₂ footprint, but also provide more insight into how they may be affected by climate change and the energy transition. It is therefore essential that as many companies as possible implement the recommendations of the Financial Stability Taskforce on Climate-related

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Financial Disclosures, to enable financial institutions to improve their risk assessments (see Box 7).

We advise institutions to apply more forward-looking risk management methods. In several sub-sectors, risks can arise for financial institutions as a result of the energy transition. It depends on the pace of progress and the design of the energy transition whether this will involve losses, and to what extent. That is why it is important that institutions consider how additional regulatory requirements and market developments may affect them. To do so, they should apply more forward-looking risk management methods, such

as performing scenario analyses and developing indicators to estimate the resilience of companies and investments during the energy transition. We acknowledge that it is rather difficult to incorporate climate risks in scenario analyses, as it is not clear which variables and correlations the scenarios must comprise, or who should be responsible for creating the scenarios. Investors prefer companies to use and apply the same scenarios, to enable comparison. On the other hand, companies may wish to focus on specific issues within these scenarios. To address these challenges, we promote knowledge building and information exchange between the various stakeholders.

Box 7 FSB Taskforce on Climate-related Financial Disclosures

In response to a request from the G20, the Financial Stability Board (FSB) set up a Taskforce on Climate-related Financial Disclosures (TCFD) in December 2015, with the aim of drawing up recommendations for more transparent and consistent information on climate risks to be provided by financial and non-financial companies. The TCFD is headed by Michael Bloomberg and consists of 32 representatives of large listed companies, consultancy agencies, rating agencies, banks, insurers and pension funds.

In June 2017, the TCFD published its final report with recommendations to improve reporting standards for climate-related risks and opportunities.³³ The recommendations can be grouped under the following four themes: governance, strategy, risk management and measures. The TCFD advises organisations to address these themes in their regular public financial reports. The TCFD has also drawn up supplementary guidelines for each of these overarching recommendations, to help organisations in implementing them.

Globally, some 100 companies have indicated they intend to implement the recommendations, including a significant number of Dutch organisations such as multinationals Shell, Philips Lighting, Unilever and DSM, and financial institutions including ABP, APG, Aegon, ING, MN, NN, PFZW, PGGM, PME and PMT.



5 Green finance: gaining momentum

In the wake of the Paris climate agreement green finance is moving up agendas worldwide as financial institutions seek to leverage the opportunities emerging from the energy transition. Institutions must, however, be wary of new risks that may emerge from green bubbles and reputation damage resulting from greenwashing. For this and other reasons, we believe it is important that no exceptions are created for this type of investment in supervisory frameworks.

Whereas we discussed carbon-intensive financing in the previous chapter, here we will analyse the trends in the investments market that contribute to the transition to a carbon-neutral economy and identify risks that may emerge as this market matures.³⁴

5.1 Trends in the market for green finance

The green finance market is booming. Global investment in renewable energy has increased more than tenfold over twelve years, growing from USD 26 billion in 2004 to USD 287 billion in 2016. They are investments in biomass, wind farms, energy efficiency measures, hydrogen technology and carbon emission markets.³⁵ While exact figures are unavailable, indications suggest that Dutch financial institutions are also stepping up their green investments. Our survey among Dutch banks, insurers and pension funds shows that investments in pure play renewables, which are energy companies offering exclusively green energy, had gone up by 59% in 2016 compared with 2015. Bank loans show a particularly strong upward trend, having grown by 81%.³⁶

The current expansion in the market for green finance appears to be driven by the fact that financial institutions are increasingly spotting investment opportunities. Interviews we held with banks revealed that they see opportunities for supporting customers with their financial products within the context of programmes aimed at making the built environment and industry

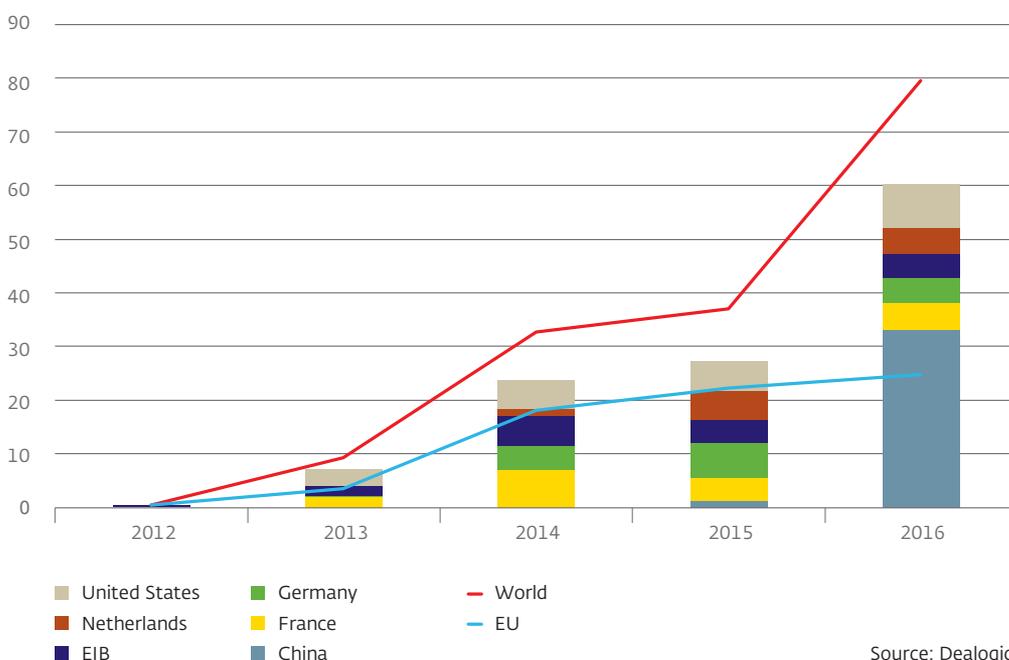
³⁴ In this chapter, we will refer to such investments collectively as "green finance." This definition of green finance is narrower than that of "sustainable finance", in which considerations regarding the environment and social and governance aspects commonly play a part.

³⁵ Bloomberg New Energy Finance (2016)

³⁶ In absolute amounts, investments in pure play renewables increased from EUR 6.4 billion to EUR 10.2 billion. Bank loans in particular increased sharply, from EUR 4.1 billion to EUR 7.5 billion.

Chart 12 Market for green bonds shows rapid growth

Green bond issuance (EUR billion)



Source: Dealogic.

more sustainable. Likewise, sustainability is gaining prominence in the business and marketing strategies of Dutch major banks and some insurers. Lastly, Dutch pension funds increasingly make targeted investments in wind farm operators and solar panels providers.

Ethical considerations also seem to play a role.

Many financial institutions told us they wish to contribute to achieving the Paris climate goals and disclose their own climate impact, no doubt encouraged by their stakeholders. For example, the

surveys that pension funds regularly conduct among their members show that the latter increasingly want their contributions to be invested in line with sustainability principles. A consumer survey we held confirms this (see Box 8). Our survey among financial institutions revealed that two-thirds measure the carbon footprints of some or all of the businesses they finance in order to demonstrate their own climate impact. More than half seek to reduce the carbon footprints of their investments in the next few years.

The wish to capitalise on the opportunities presented by the energy transition fuels the development of green financial products.

For example, many banks provide green mortgage loans, which consumers can use to purchase homes carrying a favourable energy label or to greenify their homes. Interest rates are typically slightly lower and consumers may fund up to 106% of the value of their home, rather than up to 101%.

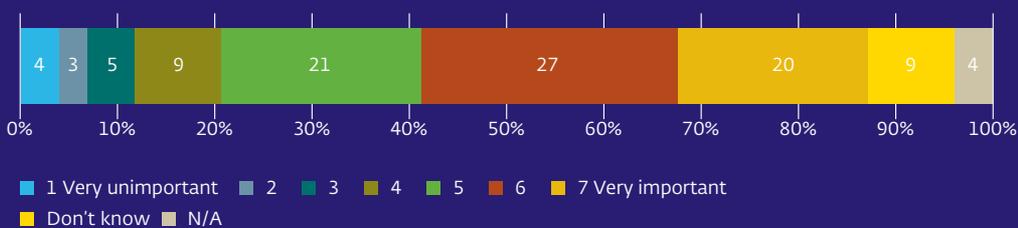
Likewise, under the Green Projects Regulation, banks offer consumers savings and investment schemes that carry slightly lower interest rates but offer tax benefits. At the same time, the banks use the funds they raise under this regulation to offer loans at favourable terms for green projects undertaken by entrepreneurs that have obtained a green certificate from the government. Similarly, asset management firms, including

Box 8 Households attach great importance to sustainable investment of their savings and pension assets

As part of our annual consumer survey on trust in the Dutch financial sector, we polled the Dutch public on the importance they attach to sustainable investment of their savings and pension assets. We held our Dutch Household Survey (DHS) among a representative sample of the Dutch population in April 2017.³⁷ The outcome shows that 68% of the respondents found it important that pension assets and savings were invested in ways that contribute to a sustainable society, e.g. by countering the consequences of climate change and social inequality (see Chart 13).

Chart 13 Households attach great importance to sustainable investment

To what extent do you believe it is important that your pension assets are invested in ways that contribute to a sustainable society, for example by countering climate change and social inequality?



Source: DNB.

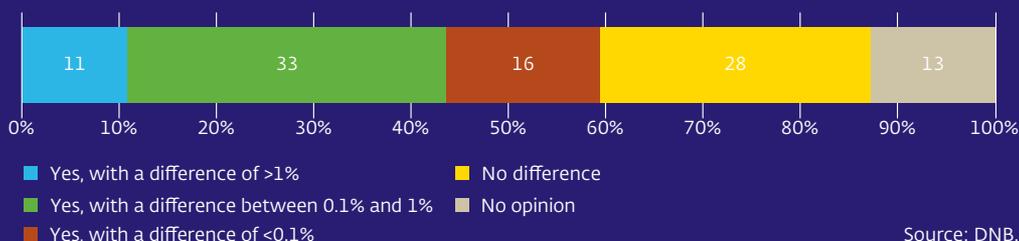
37 The questionnaire was submitted to 3,024 panel members aged 16 and up. It was completed by 2,594 respondents.

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When subsequently asked whether they were prepared to receive a smaller amount of interest in return, 28% stated there ought to be no difference with traditional investments. Around 60% of the households said they were prepared to receive less interest (see Chart 14). This outcome points to a trend also suggested by the growth seen in saving products offered by banks with a markedly green profile. There is, incidentally, much debate in the financial sector on the question whether sustainable investment actually goes at the expense of returns, and the consensus that seems to emerge is that this need not necessarily be the case. The European Fund and Asset Management Association analysed over 200 studies on this subject, concluding that overall sustainable investment neither entails lower returns nor produces extra returns.³⁸

Chart 14 Willingness to receive less interest from a sustainable bank

Are you prepared to receive less interest on a savings account that invests in projects countering climate change and social inequality?



Not only did the majority of the households say they valued sustainable investments, 44% of the respondents stated that such investments could have a positive impact on their trust in the sector. 11% disagreed with the statement that sustainable investments contribute positively to their trust in their own financial institution.

insurers and pension administrators, increasingly offer investment funds whose strategies include sustainability considerations. Providers of market indices also include sustainability in their products to an increasing extent. Institutional investors use market indices to benchmark the performance of their investments or to have their investments track these indices in the event of passive investment. Market indices with sustainability considerations are not yet widely used among Dutch financial institutions, however.

One of the green products that has been on the rise recently is the green bond. This is a bond that commits the issuer, often a bank, to use the proceeds to finance green projects and businesses. Dutch banks increasingly issue green bonds and have been leaders in developing the market for such instruments. Chart 12 shows that issuance of these bonds is growing across the globe. Pension funds and insurers consider them useful investment opportunities for meeting their sustainability targets that also allow them to be transparent about the impact of their investments.

5.2 Points for attention in relation to supervision

We identify three risks that could emerge as the market for green finance matures. They are green bubbles, reputational risks due to greenwashing, and relaxed regulatory requirements aimed at promoting climate-related investments. As with any other type of investment, financial institutions must identify and control the first two risks of green finance on a timely basis.

Technological revolutions may cause bubbles in financial markets. The internet revolution of the 1990s drove up the US stock market index NASDAQ Composite to unprecedented heights. From around 2,000 points in early 1999 it peaked at over 5,000 points in 2000, only to fall back 78% in the following 30 months. Bubbles that result from technological revolutions are a phenomenon of all times, however. After the first railway in the United Kingdom was opened in 1830, a Railway Mania developed, and new railway companies soon mushroomed across the nation. Many of them proved unable to survive, and the bubble deflated in 1846, causing thousands of families to lose their savings.

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The energy transition could cause a similar, green bubble. As investors move their funds to new technologies en masse, investments may become overvalued. Rosy profit forecasts may have to be adjusted if promising innovative new entrants prove unable to deliver on their promises or if incumbent market parties move more swiftly than expected to modify their products. According to several financial institutions we spoke to, competition for investments in green projects and green bonds has increased sharply.

In addition to the risk of a green bubble, financial institutions must also be aware of the risk of reputational damage due to greenwashing. While green products, such as green bonds, appear to make a positive contribution to society, that contribution is not always clear. A good case in point is a green bond issued by a European oil company to fund energy efficiency measures in its refinery.³⁹ If consumers or green bond investors later find out that their funds were invested along less sustainable lines than they initially thought, issuing institutions may suffer reputational damage. This suggests a need for more unambiguous standards that define green investments, allowing financiers to account for their actions more clearly and to prevent them from suffering reputational damage later.

Like all other types of finance, green finance involves risks. Therefore, we believe that supervisory rules should not be relaxed to promote sustainable finance. We have noticed that some parties are calling for such action at national and international fora, often arguing that capital requirements imposed on sustainable finance should be lowered. They postulate that lowering capital requirements will make it more attractive for financial institutions to finance sustainable projects and businesses. We take the view that capital requirements must not be lowered to realise social objectives. The purpose of maintaining capital is to absorb unexpected losses, which is why capital requirements should adequately reflect risks, because more capital must be maintained if an investment involves more risk. If this risk-based principle were disregarded merely to encourage a specific type of investment, the financial system would in fact run the risk of becoming undercapitalised if risks are not properly quantified. Amending capital requirements could only be considered if and when research shows that green investments involve consistently lower risks or brown investments involve consistently higher risks.

Moreover, there are better ways to promote sustainable investment. Financial institutions tell us one of the reasons why sustainable investments are currently lagging behind is that they do not always find the balance between risk and reward attractive enough.⁴⁰ However, governments can make the returns on such investments relatively more attractive by putting an adequate price on negative external factors. This will ensure that businesses that cause more pollution incur higher costs, thereby making investments in more sustainably operating firms relatively attractive. Similarly, governments can reduce risks associated with sustainable projects by pursuing consistent sustainability policies. Naturally, governments can also scale up their own investments in sustainable alternatives. These options would seem to be more efficient and effective than lowering capital requirements.

40 See DNB (2017)



6 Recommendations and next steps

This report shows that climate change and the transition towards a carbon-neutral economy entail risks for the Dutch financial sector and that these risks may increase in the years ahead. It is likely that financial institutions will increasingly be confronted with risks resulting from ongoing global warming and increasing political will to achieve the goals of the Paris climate agreement. For example, tightened sustainability requirements for office buildings may put the credit quality of related loans under pressure, and insurers are facing a growing claims burden as a result of extreme weather. And the increasing importance of green financial products also carries risks to be considered.

As the supervisory authority we believe it is important that institutions identify and manage climate-related risks appropriately. Addressing and controlling climate-related risks in the earliest possible stage will limit the potential impact of climate change and the energy transition on the financial sector. While many stakeholders, including financial institutions, already recognize the problem and have taken first steps, further steps must still be taken. This is why we present the following recommendations for financial institutions and policymakers and outline our next steps, with the ultimate aim of promoting sustainable financial stability.

6.1 Recommendations for financial institutions

We expect financial institutions to be aware of climate scenarios that are relevant to them and to take appropriate action should they threaten to materialise. The course of the energy transition and the consequences of climate change at the national and local level are as yet uncertain. Financial institutions must therefore work towards applying forward-looking risk management, for example with the help of scenario analysis. Amongst others, scenarios to be considered include tightened government policy, technological disruption of markets and potential unexpected (and more severe) consequences of climate change.

Financial institutions must also take a few specific steps in order to address already materializing climate-related risks. It is important that financial institutions make efficient use of relevant and available data to assess these risks. For example, they should be aware of the label distribution for the types of real estate exposures in their portfolios, and be aware of their exposures to carbon-intensive sectors. In addition, life insurers should take climate change better into account in their risk management and risk modelling, in cooperation with relevant external modelling parties.

6.2 Recommendations for policymakers

To safeguard financial stability, policymakers should delineate a clear transition path. We support drawing up a Climate Act setting out clear agreements concerning the transition path towards a low-carbon economy. This will allow the economy and thereby also financial institutions to take appropriate action and make adjustments at an early stage. At the same time, this allows the financial sector to play a catalysing role in the implementation of climate policy. For example, in response to newly announced office market regulations, some banks now impose additional requirements on real estate owners, demanding that they make their buildings more sustainable prior to the new rules taking effect.

The government should also work towards improving the disclosure standards for climate-related risks. Financial institutions and financial markets must have access to sufficient information in order to adequately identify, price and manage climate-related risks. Policymakers could encourage financial and non-financial corporations to be more transparent about climate-related risks, possibly supported by legislation. In this context we are supportive of the recommendations issued by the FSB's Task Force on Climate-related Financial Disclosures (TCFD).

Finally, we believe it is important that supervisory frameworks remain risk-neutral. The question whether supervisory frameworks should assign a preferred status to green asset classes is increasingly being discussed, also at a European level. However, green investments also bear risks which could lead to financial losses if they are not addressed appropriately. To safeguard the soundness of financial institutions it is therefore important to not give a preferential status to certain asset classes. Moreover, DNB believes more effective and efficient options are available for achieving climate goals, such as pricing negative externalities and using fiscal incentives.

6.3 Our next steps

DNB intends to take additional steps to embed climate-related risks more firmly into the supervisory approach. We will incorporate climate-related risks in our assessment frameworks and address them as well in our interviews with supervised institutions. Also we will continue to work on the implementation and further development of climate stress tests. We are currently conducting a climate-related stress test at non-life insurers and we are working on a stress test for transition risks, focused on the impact of an energy transition from a macroeconomic and macro-prudential perspective.

We also aim to build our knowledge base and promote international exchange of best practices. We are chairing the national Sustainable Finance Platform, which has a working group focusing on climate-related risks. At a global level, several supervisory authorities are investigating climate-related risks for the financial sectors, including the Chinese, UK, French, Italian, Australian and Californian authorities. We endeavour to develop internationally acknowledged best practices to help supervisory authorities in addressing climate-related risks. To achieve this, we actively participate in the EU High Level Expert Group on Sustainable Finance, the Sustainable Insurance Forum and the G20 Green Finance Study Group.

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