

The background of the slide is an aerial photograph. The top half shows a dense city skyline with numerous skyscrapers, likely Amsterdam, under a hazy, overcast sky. The bottom half shows a vast, flat agricultural landscape with green fields, a central canal, and some industrial or farm buildings in the distance.

# Climate financial risk stress testing

Remco van der Molen  
MNB-OMFIF Financial stability conference  
27 May 2022

Views expressed do not necessarily reflect those of De Nederlandsche Bank or the Eurosystem

**DeNederlandscheBank**

EUROSYSTEEM

# Based on three studies

## **Energy transition stress test**

Vermeulen et al. (2021). The heat is on: A framework for measuring financial stress under disruptive energy transition scenarios. Ecological Economics 190 (107205).

[\[link\]](#)

## **Flood stress test**

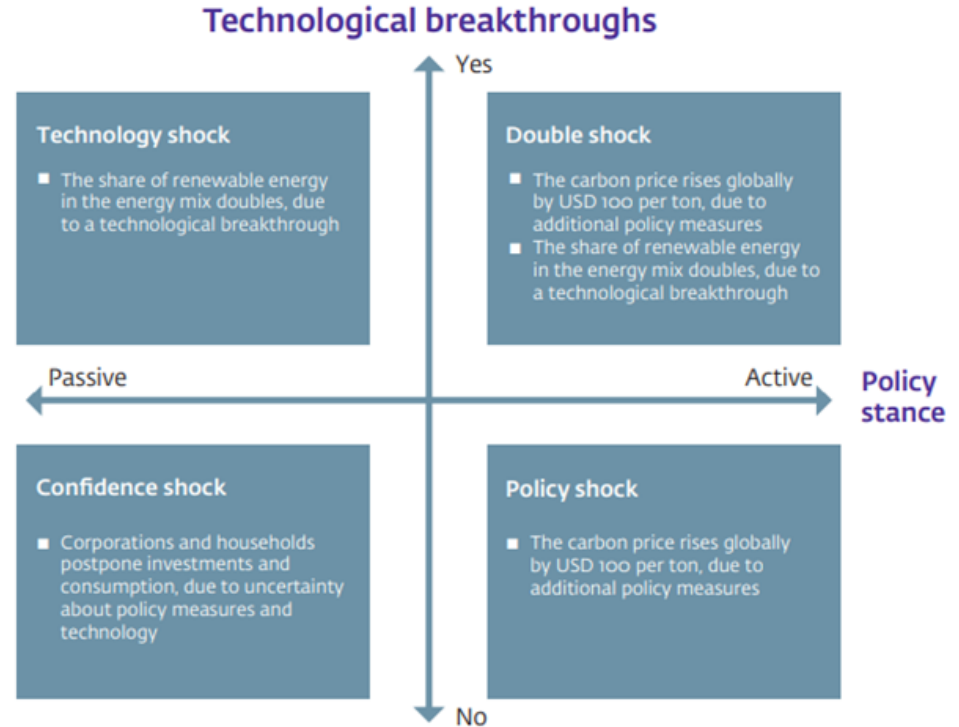
Caloia and Jansen (2021). Flood risk and financial stability: Evidence from a stress test for the Netherlands. DNB Working Paper no. 730. [\[link\]](#)

## **Real estate and climate transition risk**

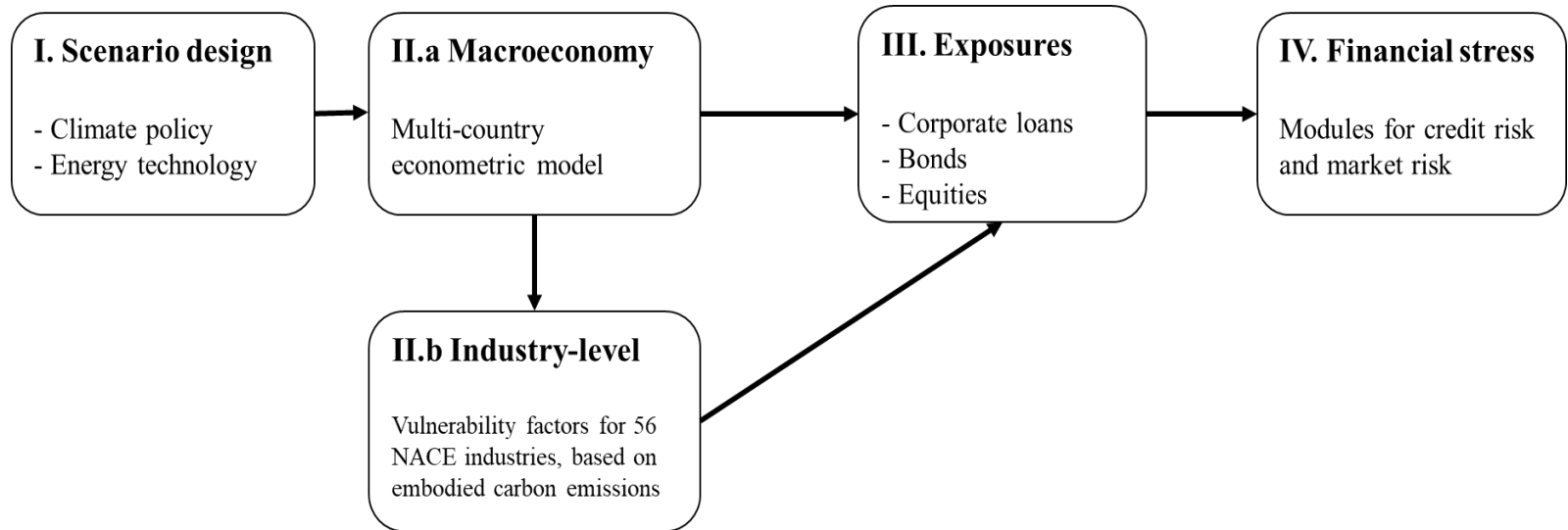
Caloia et al. (2022). Real estate and climate transition risk: A financial stability perspective. DNB Occasional Study 19/4. [\[link\]](#)

# Energy transition stress test

- First attempt to quantify energy transition risk for the financial system
- Scenario's based on two risk drivers: climate policy and energy technology
- Macroeconomic and industry-specific modelling

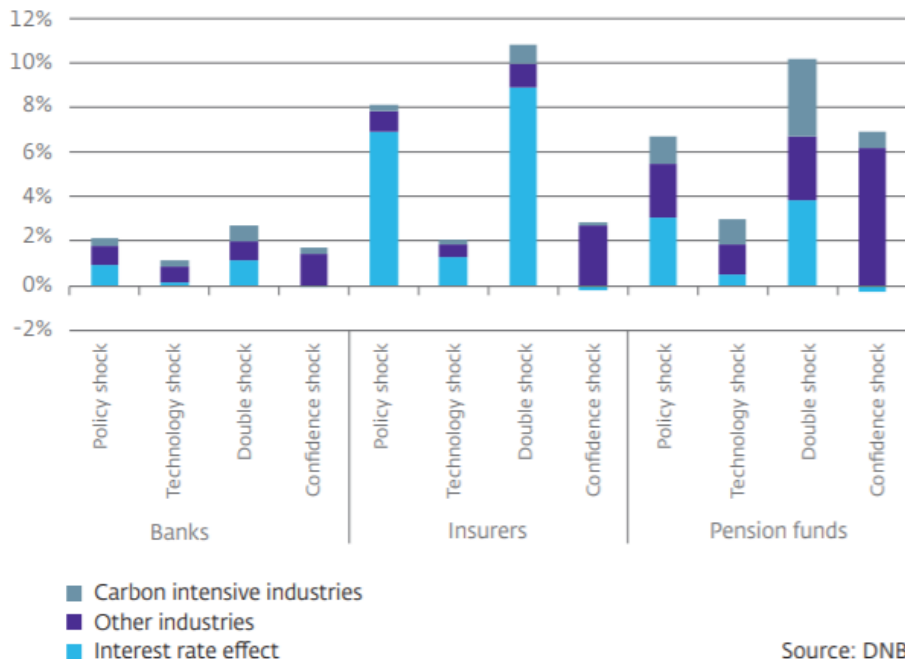


# Energy transition stress test (cont.)



# Energy transition stress test (cont.)

## Losses from energy transition on asset positions



Source: DNB

## Main results:

- Impact differs between scenarios and sectors
- Large impact of macrofinancial factors, on top of carbon sensitivity
- Impact on supervisory ratios seems manageable

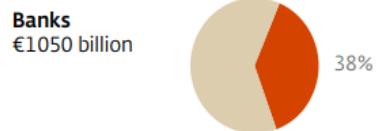
# Climate financial risks and real estate

## Why real estate?

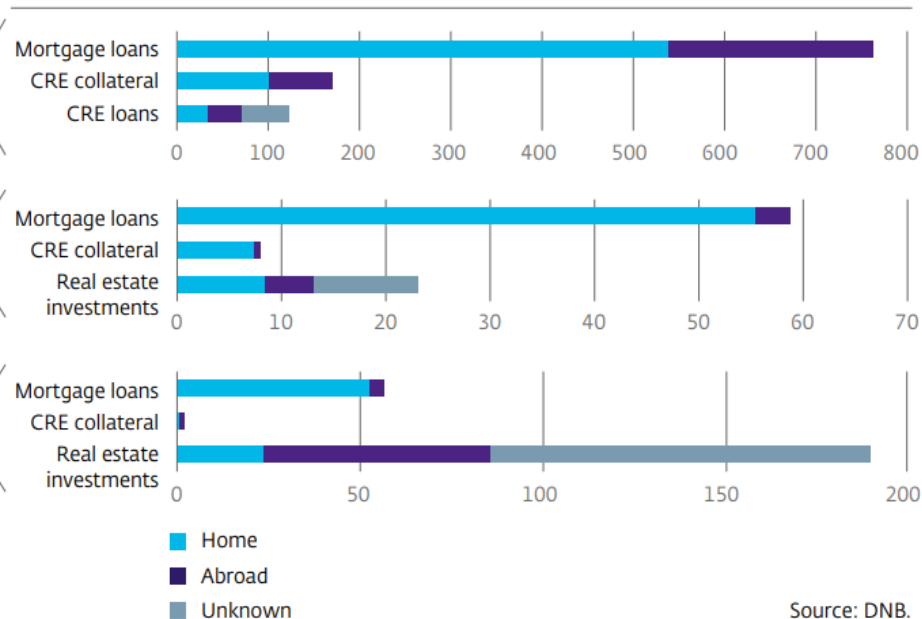
- Large RRE and CRE portfolios of Dutch financial institutions
- Properties and mortgages form large part of household balance sheets
- Real estate has a sizeable carbon footprint
- Vulnerable to both physical and transition risks

# Real estate exposures of Dutch FIs

Exposures to real estate as a proportion of total assets



Exposures to real estate by type and location



Source: DNB.

# Data

Need for granular data on RE financial assets, underlying properties and households (owners)

## *Supervisory data*

- Loan level data on RRE and CRE loans
- Solvency II line by line reporting by insurers and pension funds
- Ad hoc data collection for 20 pension funds and 6 insurers

*Administrative data:* Building and household characteristics: CBS Statistics Netherlands

*Expert knowledge:* PBL Netherlands Environmental Assessment Agency, Carbon Risk Real Estate Monitor, Deltares



# Transition risk

Main question: to what extent are the RE exposures of the Dutch financial sector vulnerable to climate transition risks?

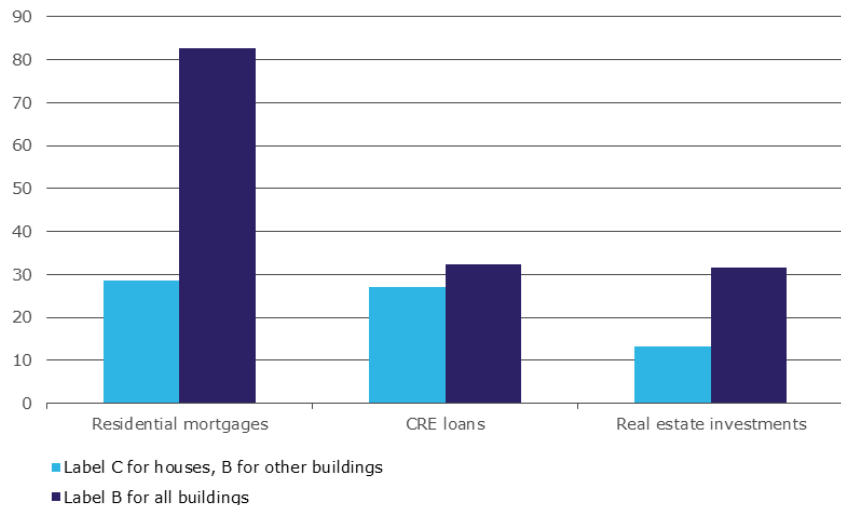
How to translate transition risk to financial risk?

- Identify exposures 'at risk'
- Methodology #1: required investments in retrofitting
- Methodology #2: costs of excess carbon emissions

We use different scenarios for energy transition.

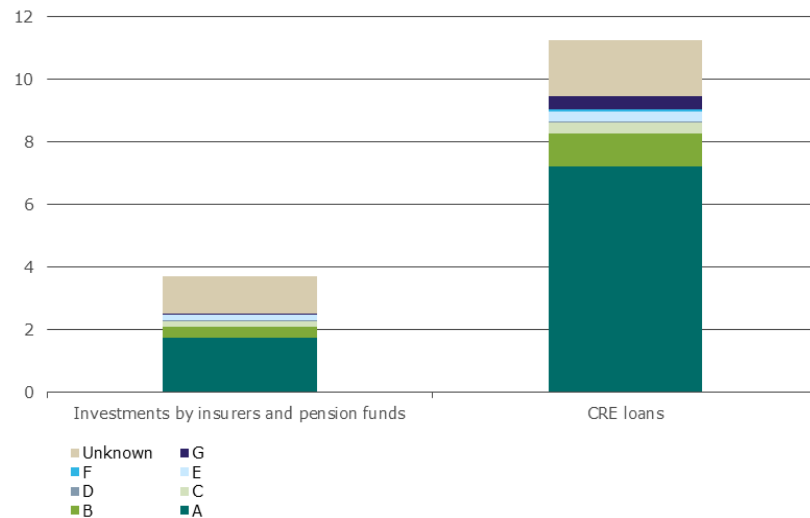
# Domestic perspective: exposure 'at risk'

Domestic exposure 'at risk' (%)  
in different policy scenarios



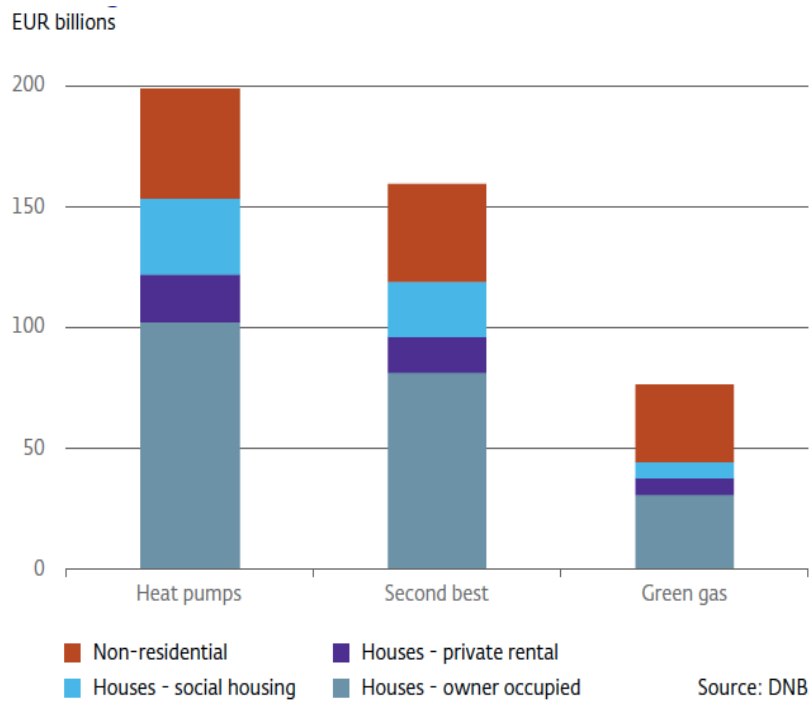
Source: DNB.

Exposures to office buildings (bln euro)



Source: DNB.

# Domestic perspective: Retrofitting investments



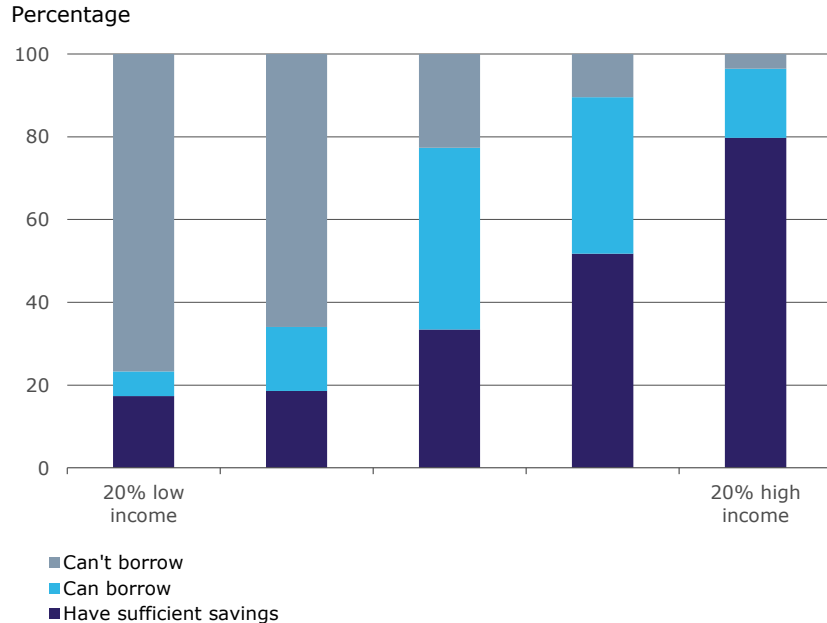
Building owners need to make substantial retrofitting investments

Impact on property value is uncertain

Around 50% of homeowners have insufficient own funds

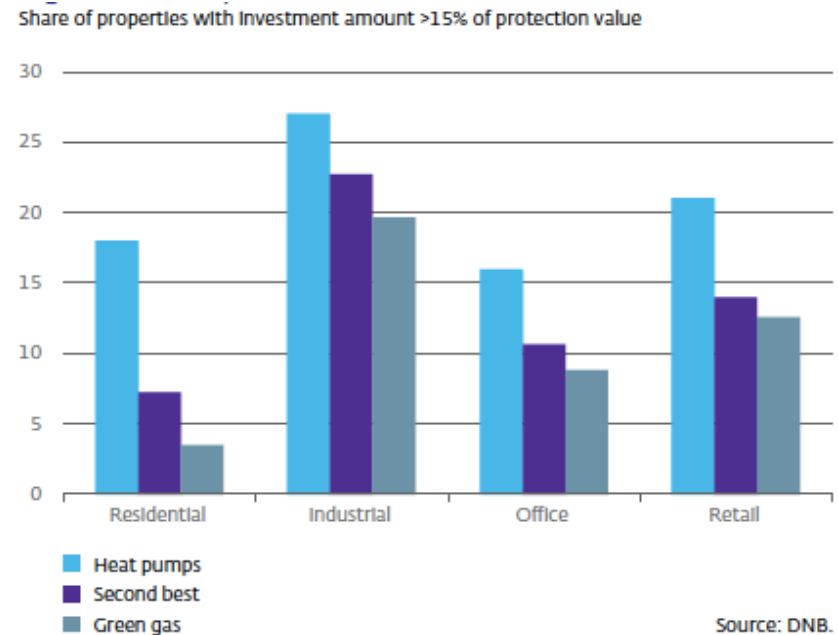
# Domestic perspective: Financing problems?

20% of homeowners is not able to finance



Source: DNB.

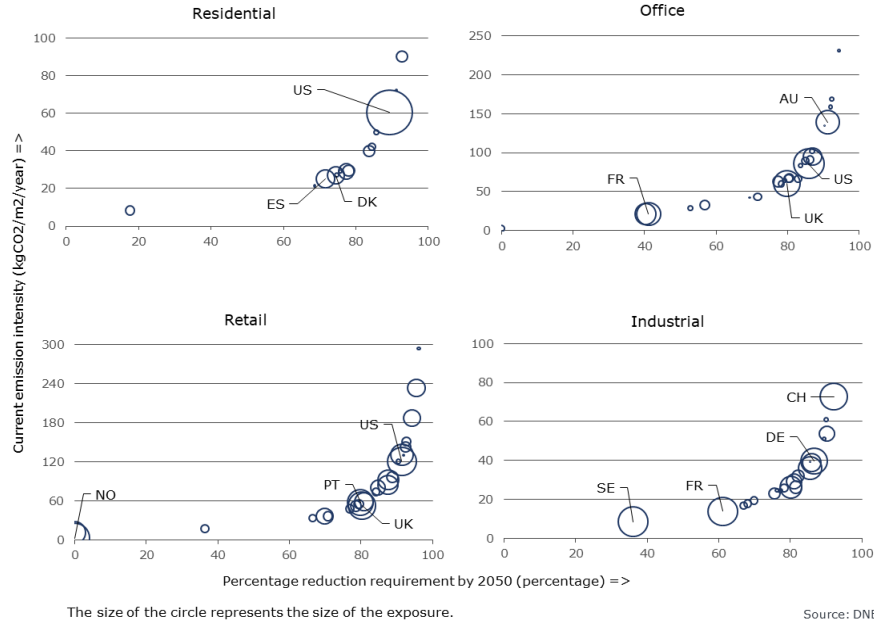
Commercial property owners may also face problems



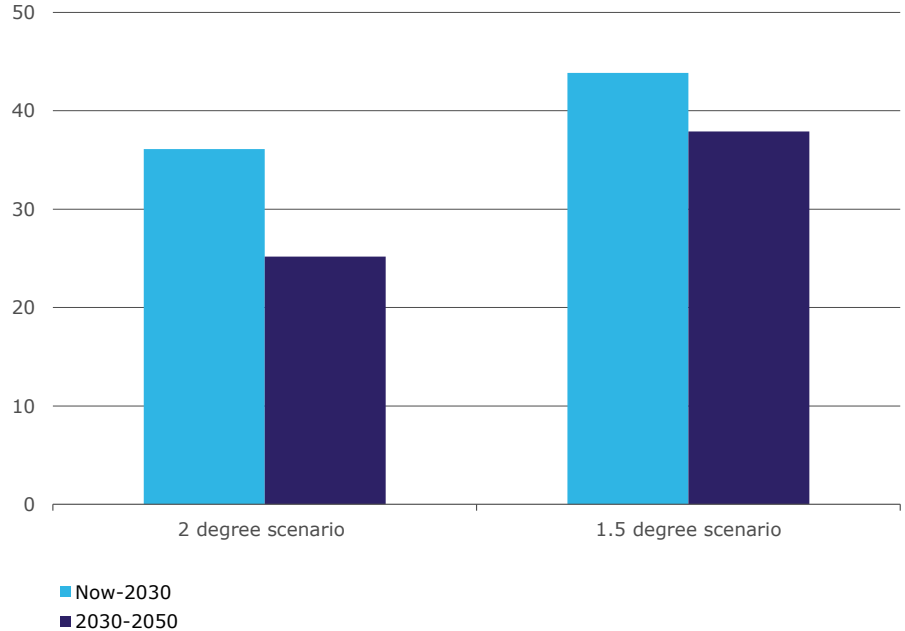
Source: DNB.

# International perspective: Paris (mis)alignment

Large exposures in countries facing potentially large reduction requirements

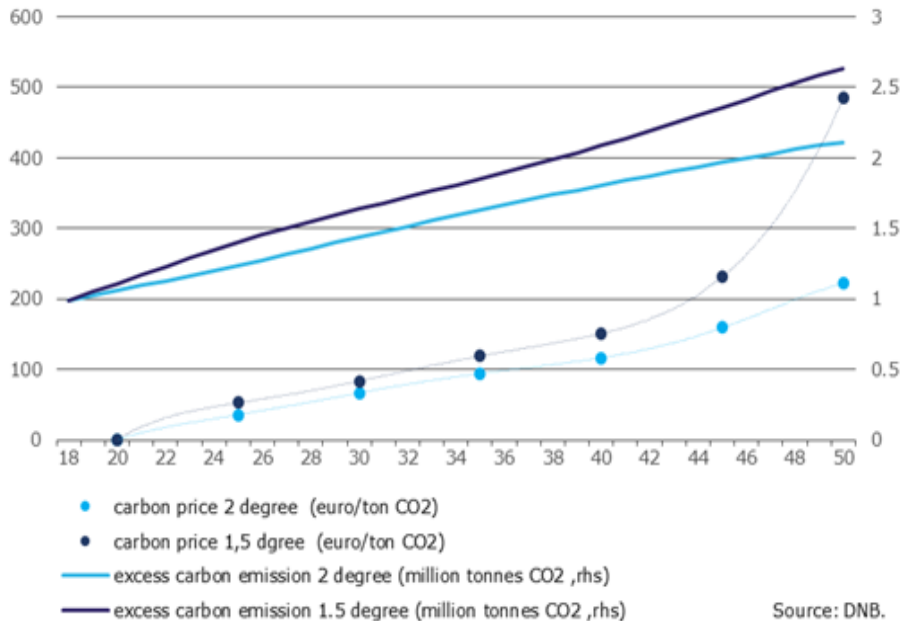


Share of exposures that will not be Paris proof



Based on the carbon risk real estate monitor (CRREM)

# International perspective: excess emissions



Not meeting reduction targets will lead to excess emissions

Both amount and price of excess emissions increases in more ambitious scenario

NPV of excess carbon costs can be sizeable (35-60% of property value)

# Flood risk and financial stability



Areas at risk

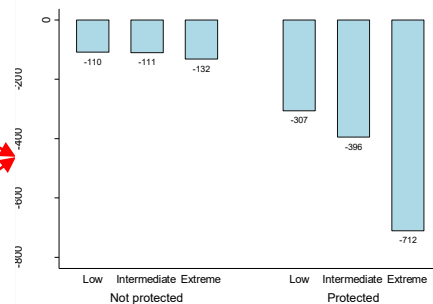
Match on ZIP codes



Property damages  
(microdata/modules for PD/LGD)

Macrofinancial context  
(Literature/NiGEM)

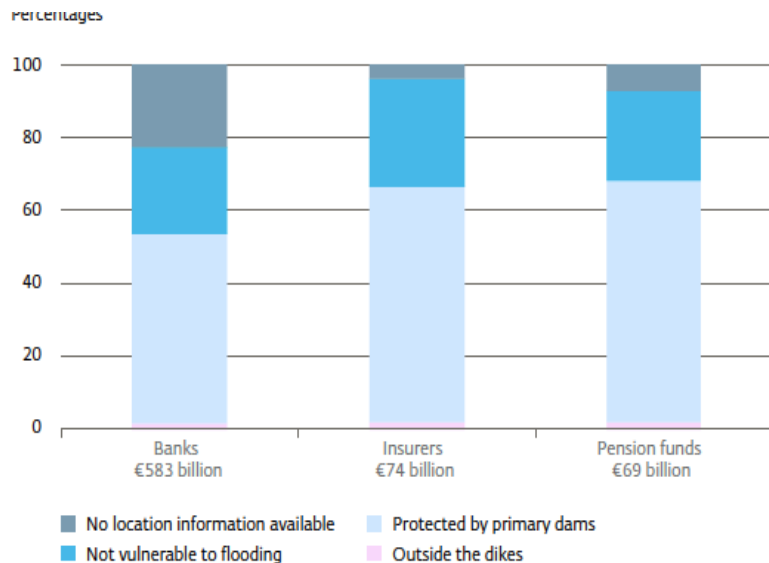
Combination of various models



Top down stress test results  
(via credit risk, market risk, NII, ...)

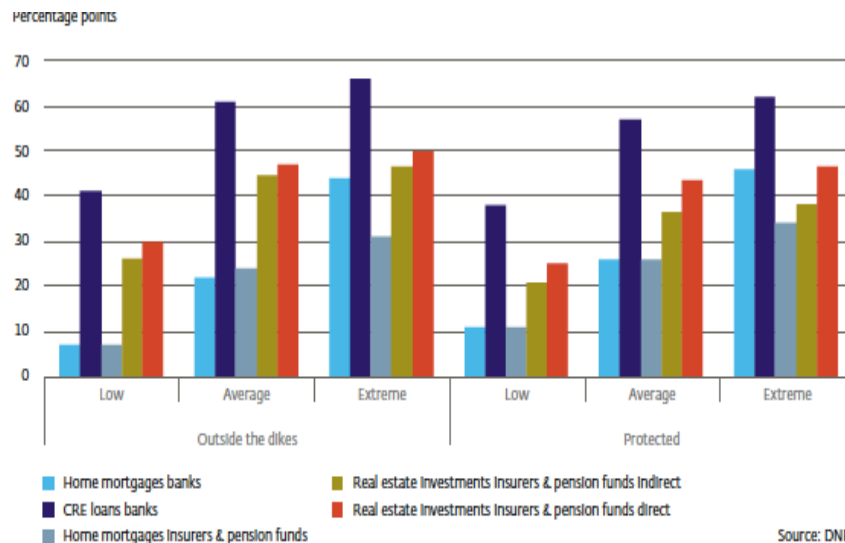
# Flood risk and financial stability

## Flood risk and Dutch real estate



Notes: A part of the Dutch real estate exposures is missing, as DNB does not have data on the level of individual loans or buildings for this.

## Loss of value of real estate in stressed scenarios



Note: Calculations by DNB based on granular data used to compile Figure 21. This shows the estimated decrease in value of real estate in percentage points for two types of flood, in each case with three levels of water stress (low, average, extreme).



# Main take-aways

- Scenario analyses and stress testing are valuable tools, given fundamental uncertainties in climate change, transition policy, technology.
- Data gaps: detailed information needed for risk assessment and management is often not available.
- Identifying exposures at risk is a first step; assessing the impact on asset valuations is challenging.
- We combine various models and approaches rather than using a single 'best' model.
- Development of more comprehensive methodologies (e.g. full-fledged stress tests) is needed, but should not lead to 'black box'.

An aerial photograph showing a city skyline in the background, partially obscured by a large purple rectangular overlay. In the foreground, there are green agricultural fields with a white canal or road running through them.

Thank you!

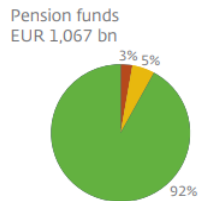
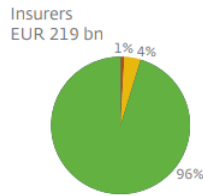
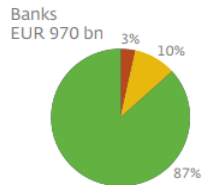
Contact details: [r.m.van.der.molen@dnb.nl](mailto:r.m.van.der.molen@dnb.nl)

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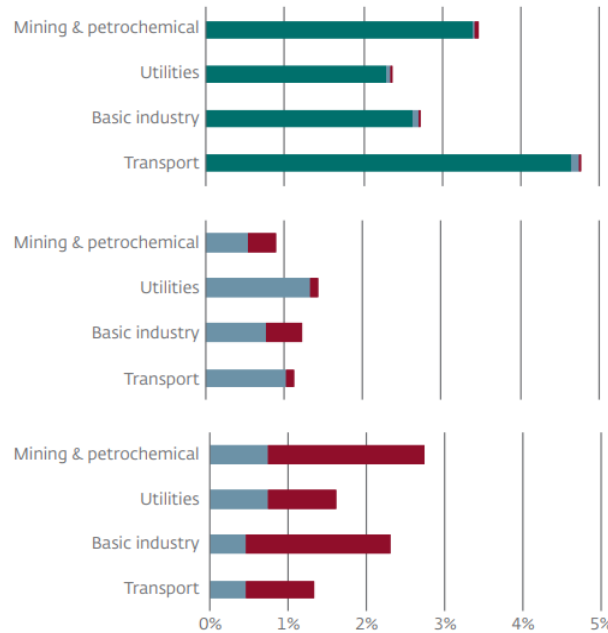
# Transition stress test: Data on exposures

assets in sample



- Mining and petrochemical
- Other carbon intensive
- Non-carbon intensive

Exposures broken down by financial sector and asset class



- Corporate loans
- Bonds
- Equity

Source: DNB.

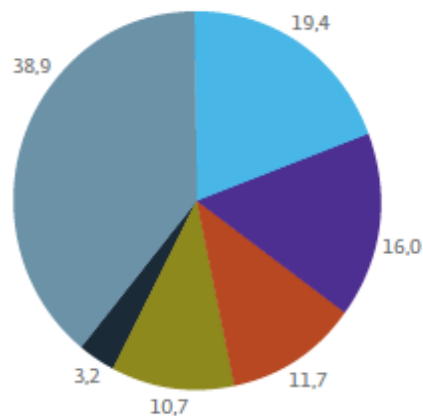
EUR 2.3 trillion in assets for 80+ Dutch financial institutions

# Characteristics of RE investments

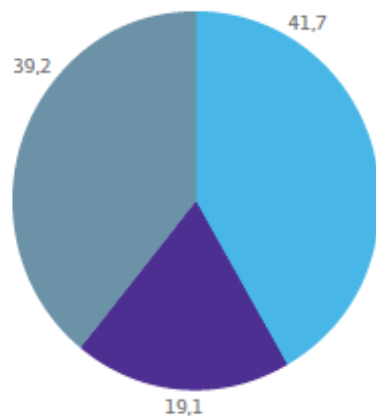
Figure A.3 Real estate investments of pension funds and insurers by continent

Percentages

Pension funds



Insurers

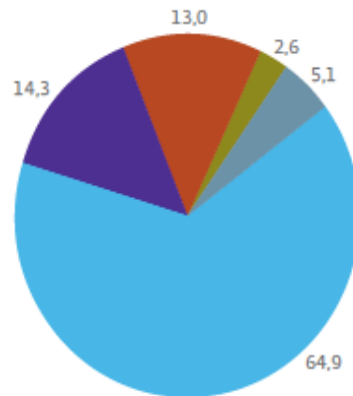


Source: DNB.

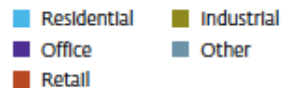
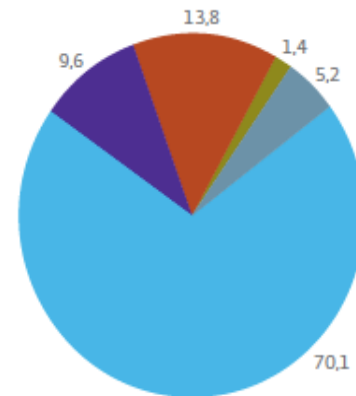
Figure A.4 Domestic real estate investments of pension funds and insurers by real estate type

Percentages

Pension funds



Insurers



Source: DNB.

# Calibration

	Water stress:	Flood type					
		Low	A			B	
		Intermediate	Extreme	Low	Intermediate	Extreme	
<b>Flood</b>							
Inundation depth		1	3	5	1	3	5
Incidence (1:x)		50	500	>2000	50	500	>2000
<b>Macrofinancial</b>							
GDP growth		-0.5	-1	-2	-1	-3	-10
Unemployment level		0.2	0.3	0.5	0.25	1	2.5
Funding costs		0.2	0.4	0.5	0.5	1	2
Stock market return		-0.1	-1.25	-2	-1.5	-3.5	-8

- A/ B = at risk
- A = unprotected
- B = protected
- Increasing flood severity

- Shocks over 1-year horizon
- Generated using NiGEM
- Calibrated using shocks to housing wealth, net exports, investment and risk premia

# Contributions to CET1-depletion

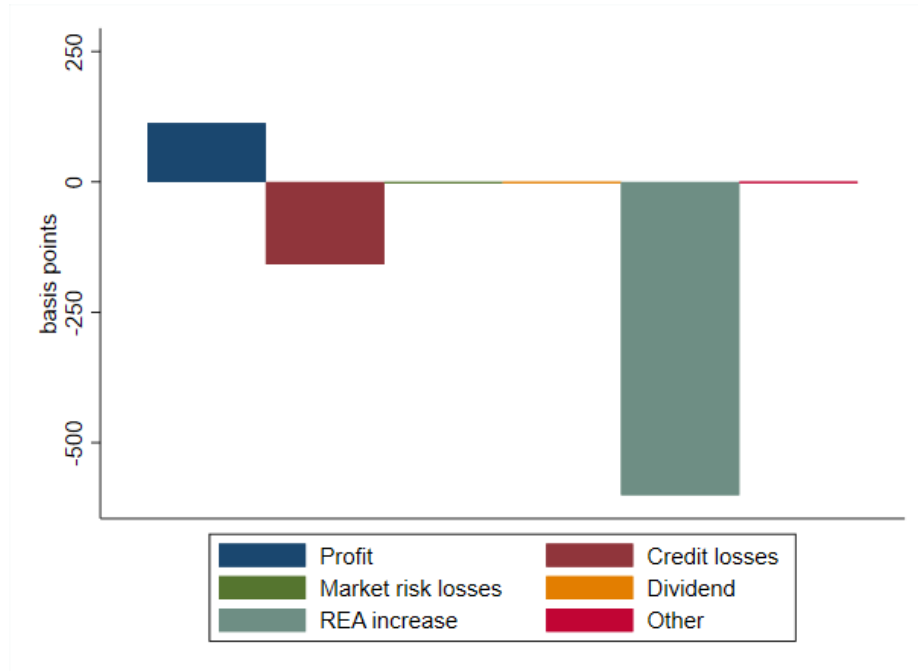


Illustration for most severe scenario.

- Largest effect from collateral damage

# Decomposition in terms of scenario components

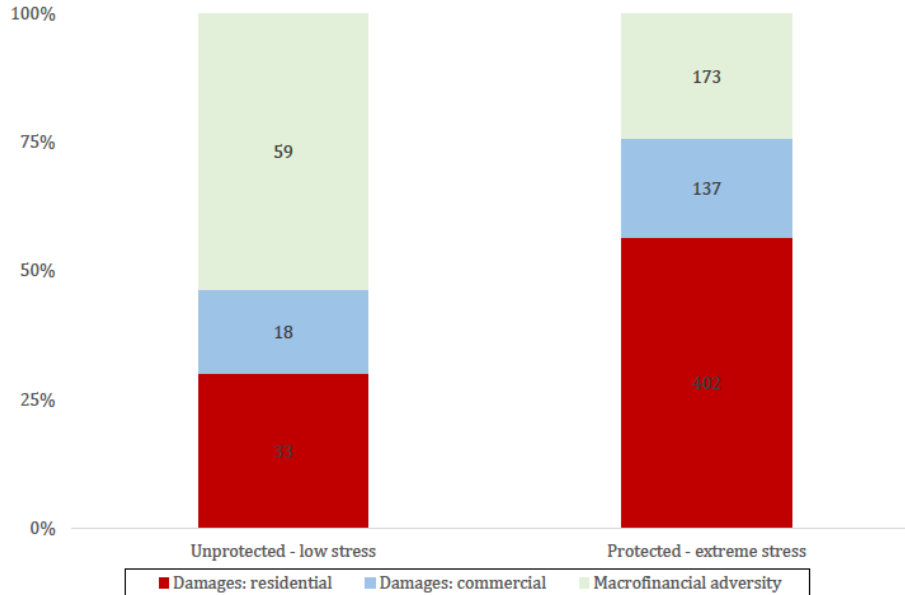


Illustration for mildest stress scenario (lhs) and most severe flood scenario (rhs).

- In latter case, largest effect comes from damage to RRE collateral