



Climate financial risk stress testing

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MNB-OMFIF Financial stability conference
27 May 2022

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

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EUROSYSTEM

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

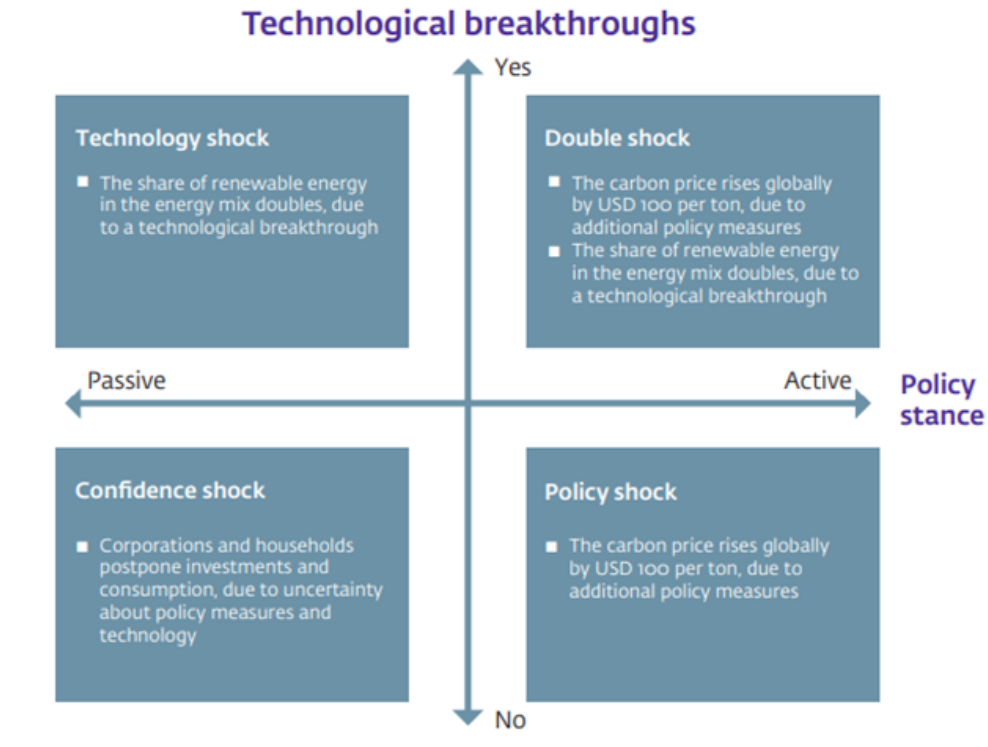
Caloia and Jansen (2021). Flood risk and financial stability: Evidence from a stress test for the Netherlands. DNB Working Paper no. 730. [\[link\]](#)

Real estate and climate transition risk

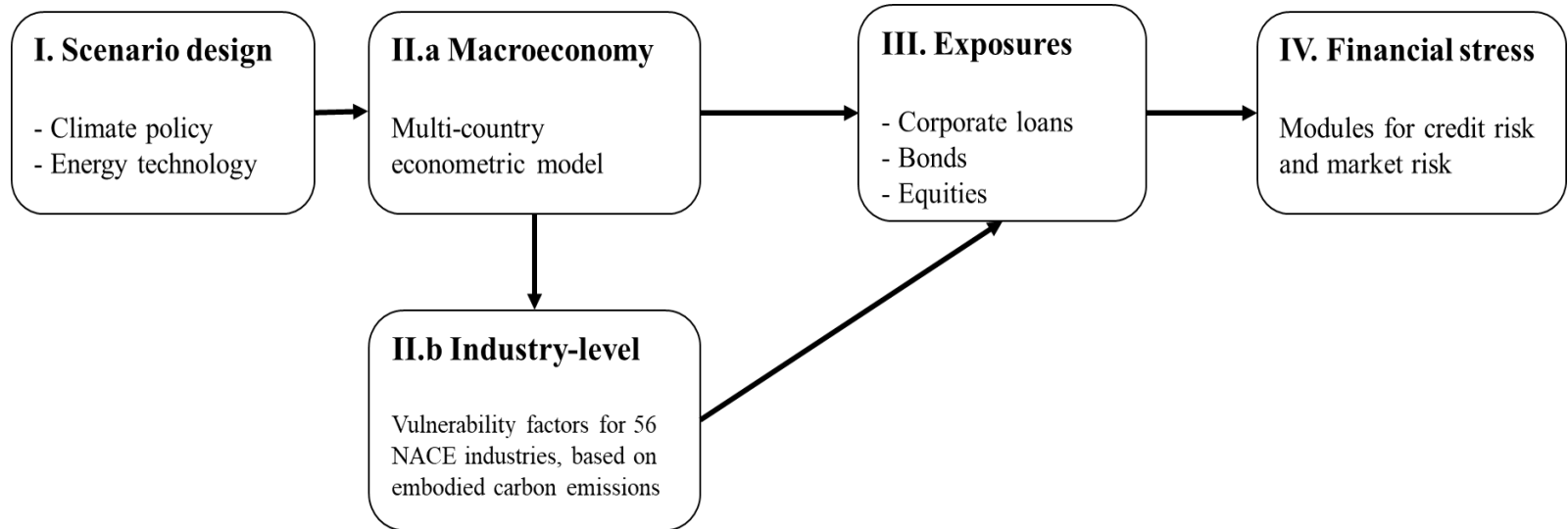
Caloia et al. (2022). Real estate and climate transition risk: A financial stability perspective. DNB Occasional Study 19/4. [\[link\]](#)

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

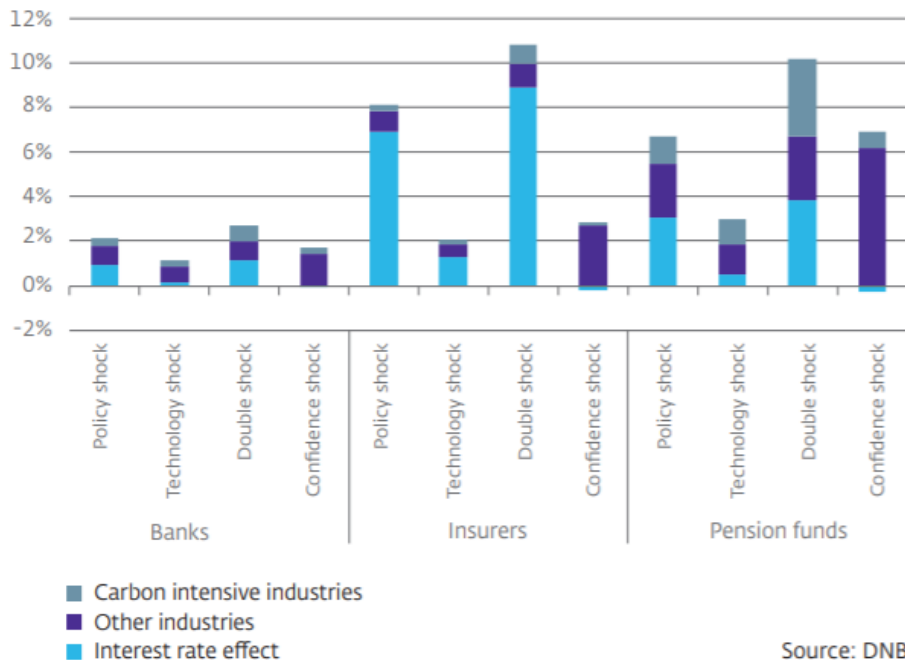


Energy transition stress test (cont.)



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

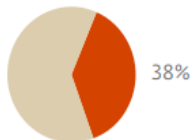
Why real estate?

- 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

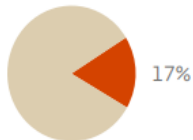
Real estate exposures of Dutch FIs

Exposures to real estate as a proportion of total assets

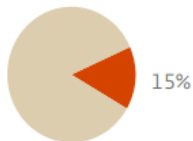
Banks
€1050 billion



Insurers
€90 billion



Pension funds
€250 billion



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?

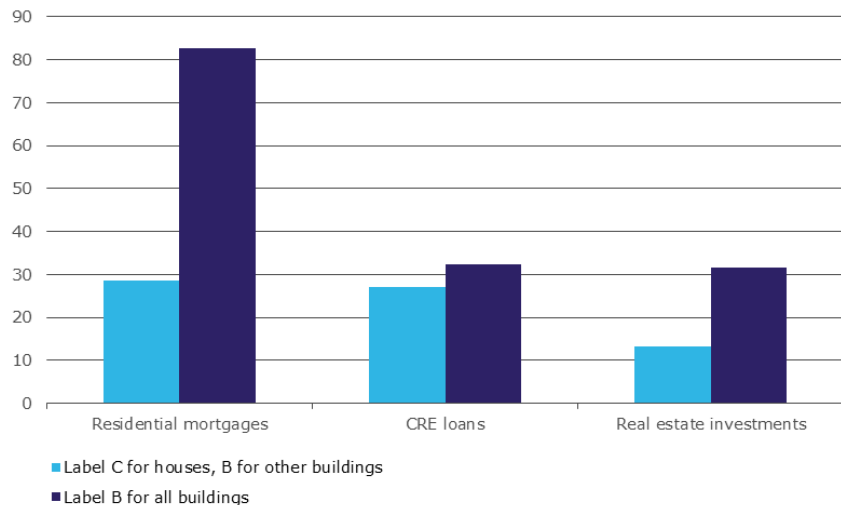
How to translate transition risk to financial risk?

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

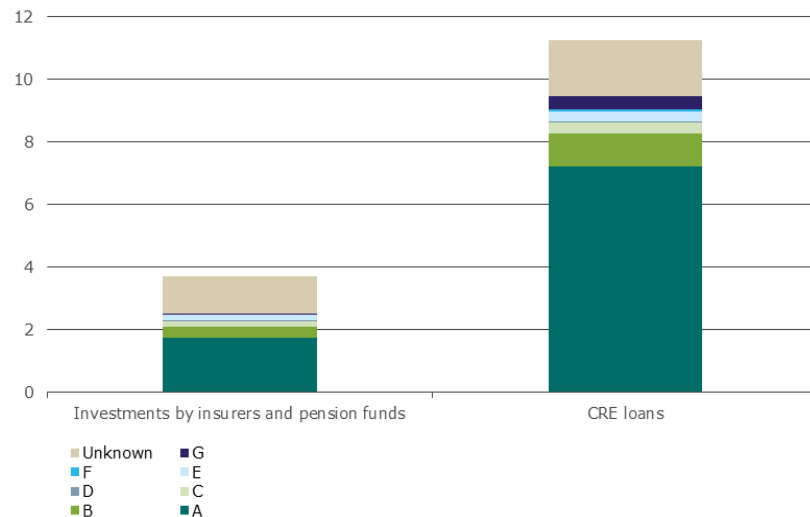
We use different scenarios for energy transition.

Domestic perspective: exposure 'at risk'

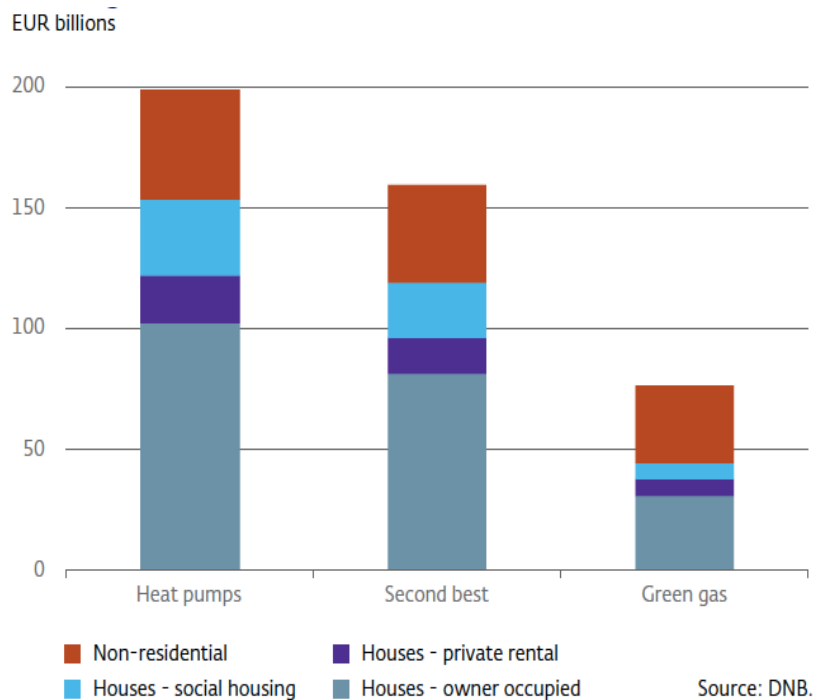
Domestic exposure 'at risk' (%)
in different policy scenarios



Exposures to office buildings (bln euro)



Domestic perspective: Retrofitting investments



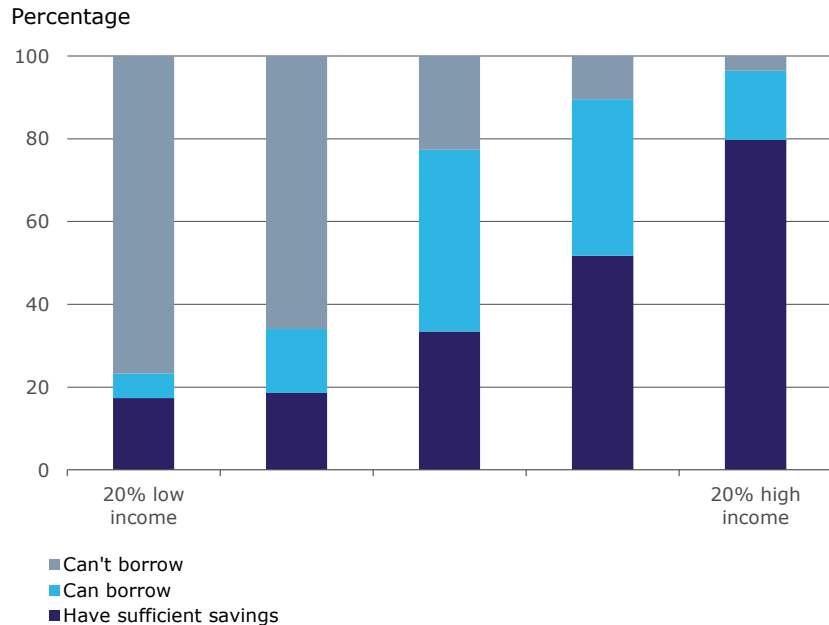
Building owners need to make substantial retrofitting investments

Impact on property value is uncertain

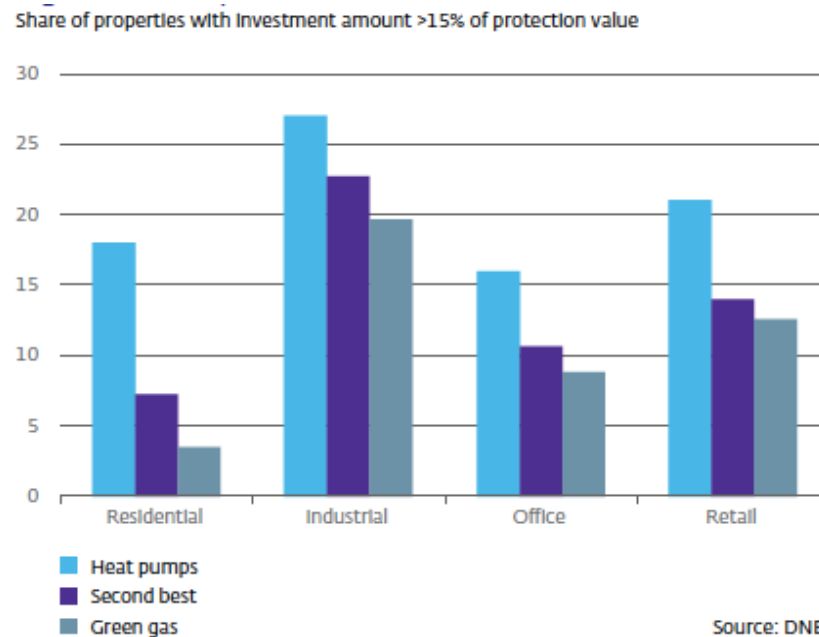
Around 50% of homeowners have insufficient own funds

Domestic perspective: Financing problems?

20% of homeowners is not able to finance

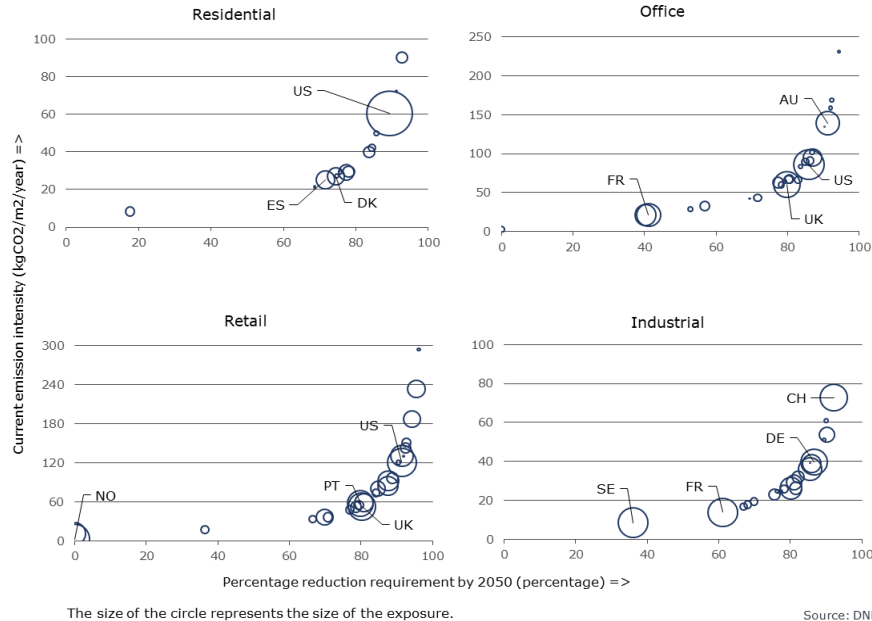


Commercial property owners may also face problems



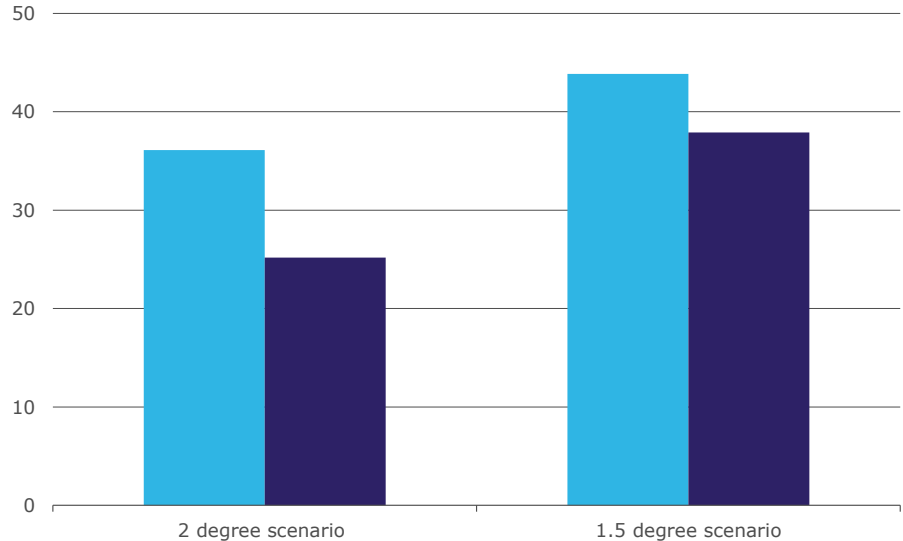
International perspective: Paris (mis)alignment

Large exposures in countries facing potentially large reduction requirements



Source: DNB.

Share of exposures that will not be Paris proof

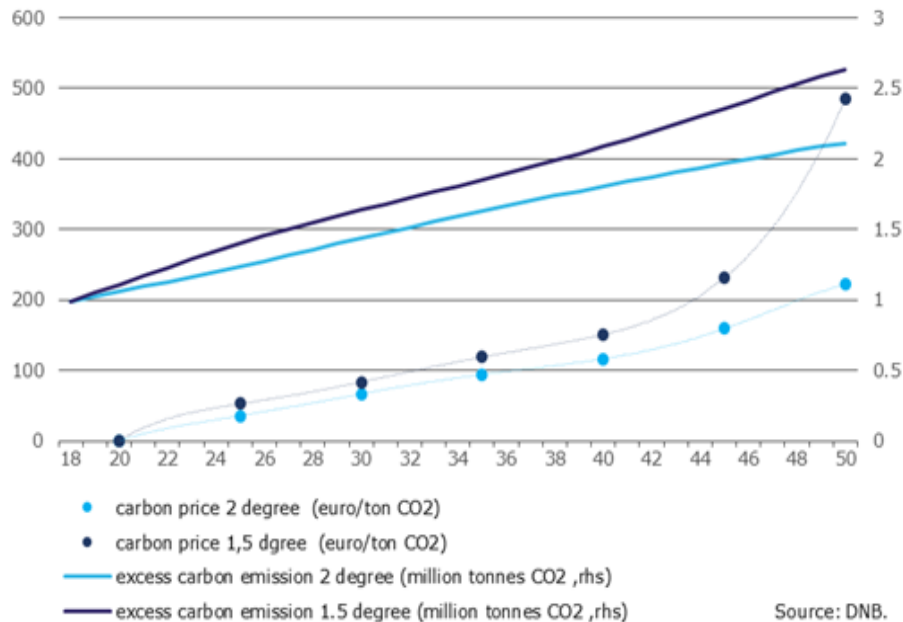


■ Now-2030
■ 2030-2050

Source: DNB.

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

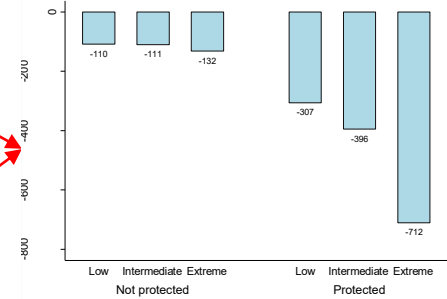
Match on ZIP codes



Property damages
(microdata/modules for PD/LGD)

Macrofinancial context
(Literature/NiGEM)

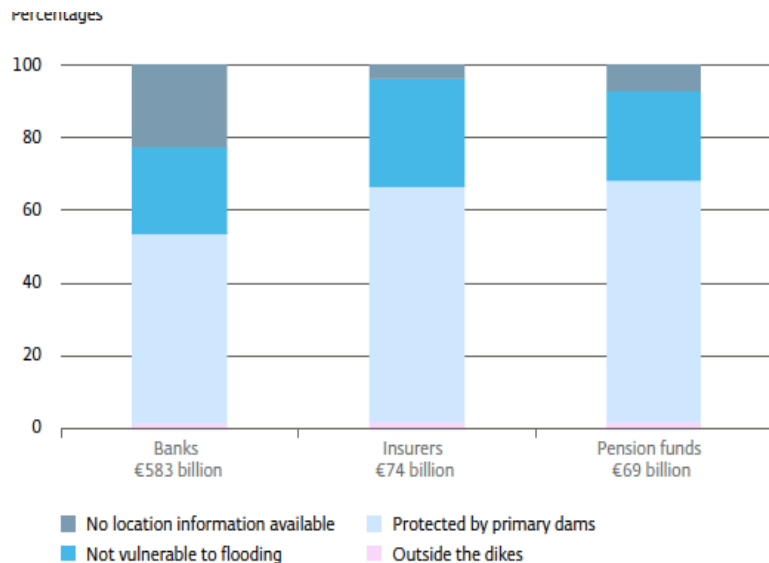
Combination of various models



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

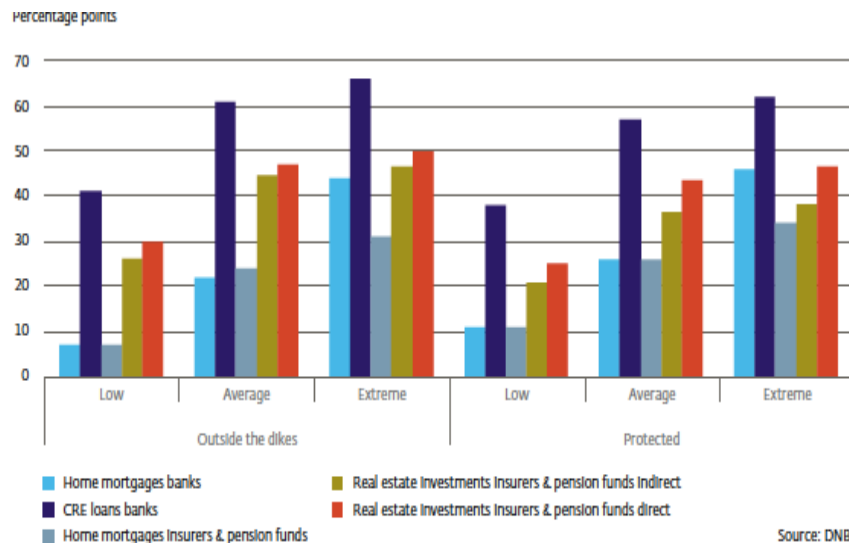
Flood risk and financial stability

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).

Source: DNB.

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'.

The background of the slide is an aerial photograph. The top half shows a hazy city skyline with various skyscrapers. The bottom half shows a green agricultural field with a straight canal running through it.

Thank you!

Contact details: r.m.van.der.molen@dnb.nl

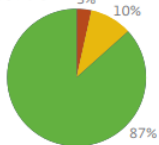
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EUROSYSTEEM

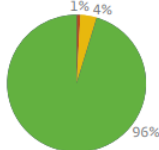
Transition stress test: Data on exposures

assets in sample

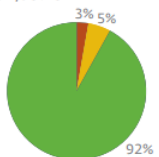
Banks
EUR 970 bn



Insurers
EUR 219 bn

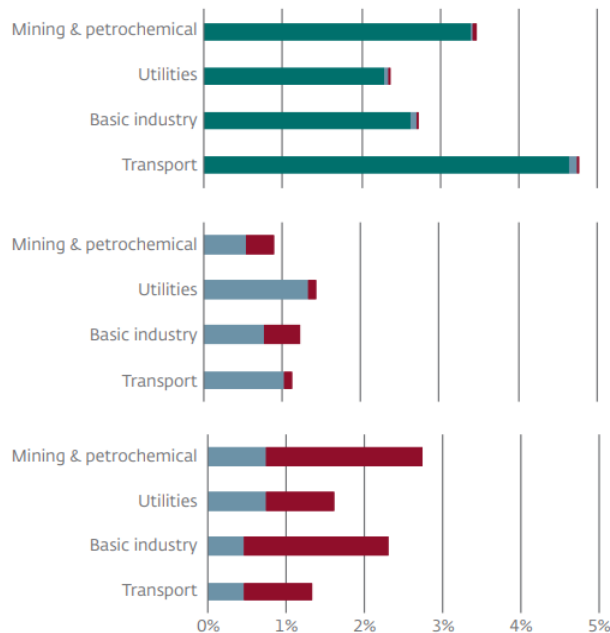


Pension funds
EUR 1,067 bn



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

Exposures broken down by financial sector and asset class



■ Corporate loans
■ Bonds
■ Equity

Source: DNB.

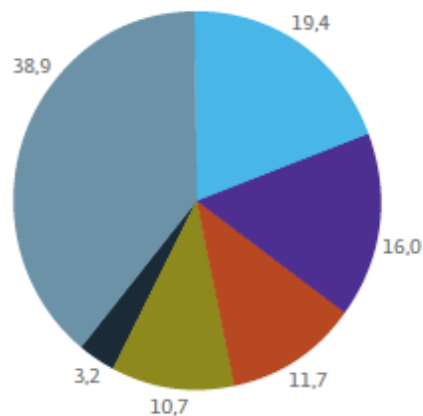
EUR 2.3 trillion in assets for
80+ Dutch financial
institutions

Characteristics of RE investments

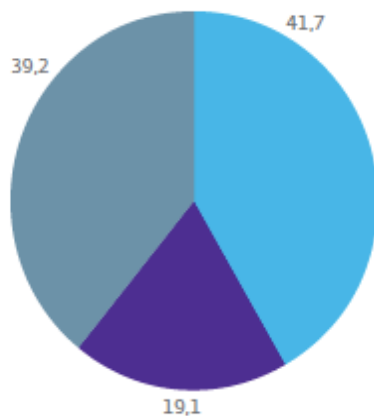
Figure A.3 Real estate investments of pension funds and insurers by continent

Percentages

Pension funds



Insurers



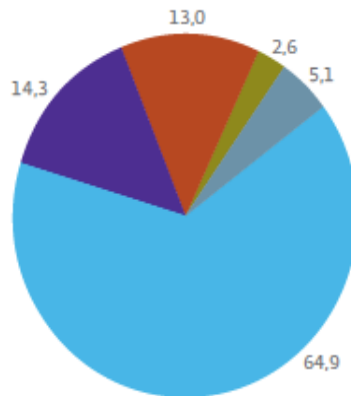
■ The Netherlands
■ Europe
■ North America
■ Asia
■ Other
■ Unknown

Source: DNB.

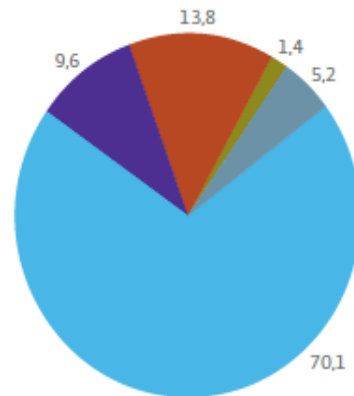
Figure A.4 Domestic real estate investments of pension funds and insurers by real estate type

Percentages

Pension funds



Insurers



■ Residential
■ Office
■ Retail
■ Industrial
■ Other

Source: DNB.

Calibration

	Water stress:	Flood type					
		A			B		
		Low	Intermediate	Extreme	Low	Intermediate	Extreme
Flood							
Inundation depth		1	3	5	1	3	5
Incidence (1:x)		50	500	>2000	50	500	>2000
Macrofinancial							
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

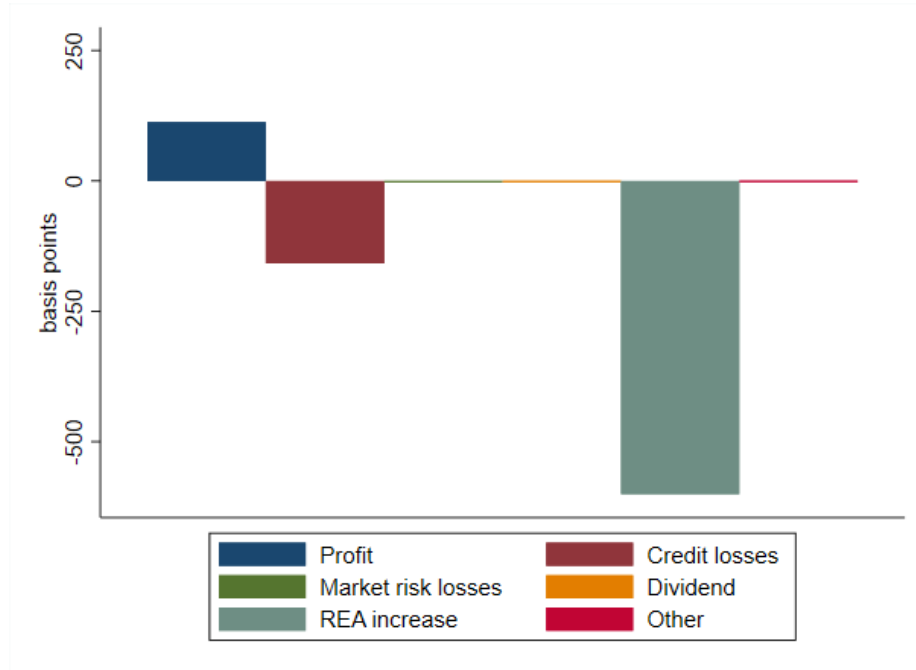


Illustration for most severe scenario.

- Largest effect from collateral damage

Decomposition in terms of scenario components

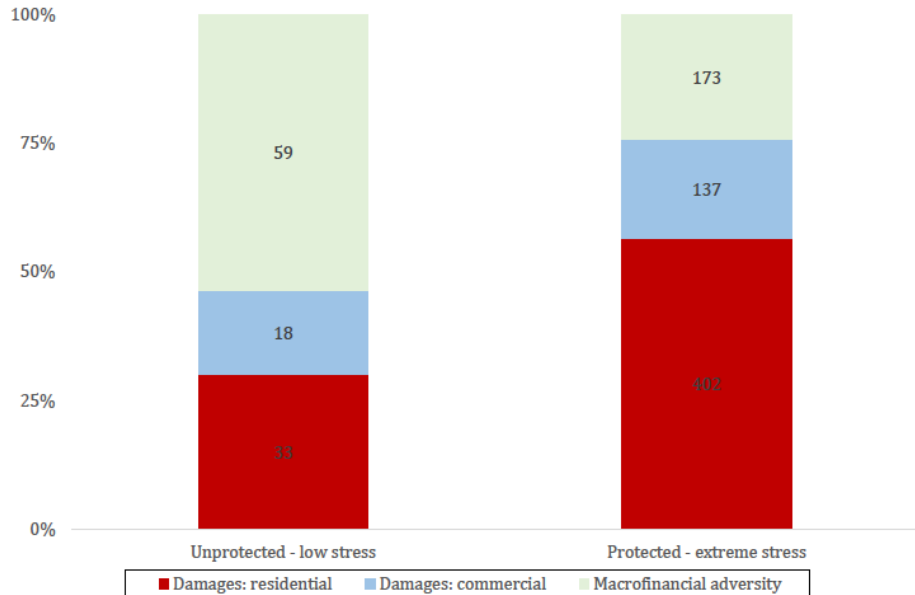


Illustration for mildest stress scenario (lhs) and most severe flood scenario (rhs).

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