Copenhagen Economics

CLIMATE RISKS AND GREEN MORTGAGES

November 2021

Overview: steps in analysing transition risks for credit institutions

This is "new"

Step	1 Scenario narrative	2 Scenario implications	3 Key step: Real-economy impact	4 Impact on risk variables	5 Output variables
Output variables	**Climate scenarios** (temperature, Co2 emissions) **Pathway assumptions**: LCoE, energy mix composition, etc.	**Policy impact:** Co2 price, ban on energy sources, etc.	**Direct:** on businesses profitability/household finances **Indirect:** Macroeconomic	Probability of default LGD Risk weights Credit spreads Equity/bond prices	Capital requirements Solvency ratio CET1 impact Expected loss
Granularity	**Global scenario** with country specific repercussions	**Country** (potentially regional for physical risks)	**Country and sector**	**Country and sector**	**Per institution**
Tools/ methods	Primarily **public sources**	• **Compliance:** Directly from regulators, e.g. ECB • **Strategic, what-if scenarios:** Global climate model	• **Direct:** partial sector microeconomic model or CGE • **Indirect:** Standard macroeconomic model	Mostly standard corporate finance	Existing stress test framework

A five step approach for mortgages

1. **Scenario**
2. **Energy price**
3. **Collateral value**
4. **Risk weight**
5. **Results**

Our case: average eu mortgage portfolio

- Initial housing value is EUR 200k with an LTV of 70%
- LTI is around 200%
- Average PD and LGD in Europe (based on paper by ECB)
- Energy mix of heating: average in EU

STEP 1
SCENARIO SELECTION

Estimating transition risks: carbon price as a tool

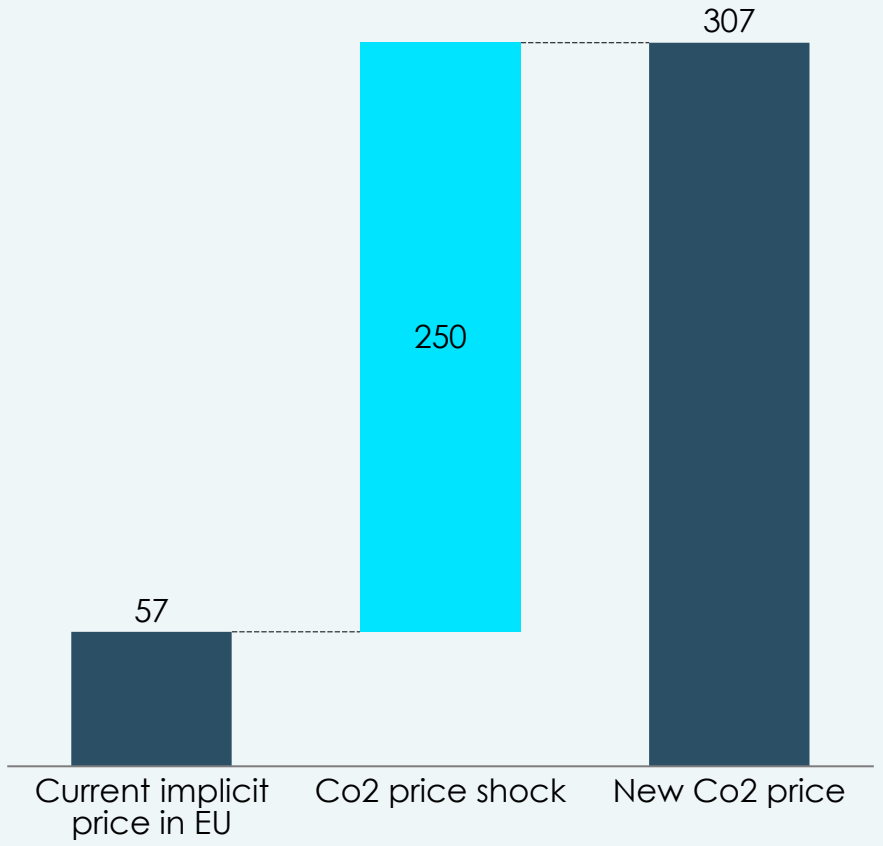
A carbon price scenario encapsulates many climate related risks

- Actual taxes on carbon emission.
- Indirect costs of carbon emissions, e.g. carbon credits, ban of certain energy types.
- Subsidies to low-emission technologies increasing the opportunity costs of emissions.
- Changing consumer behaviour.

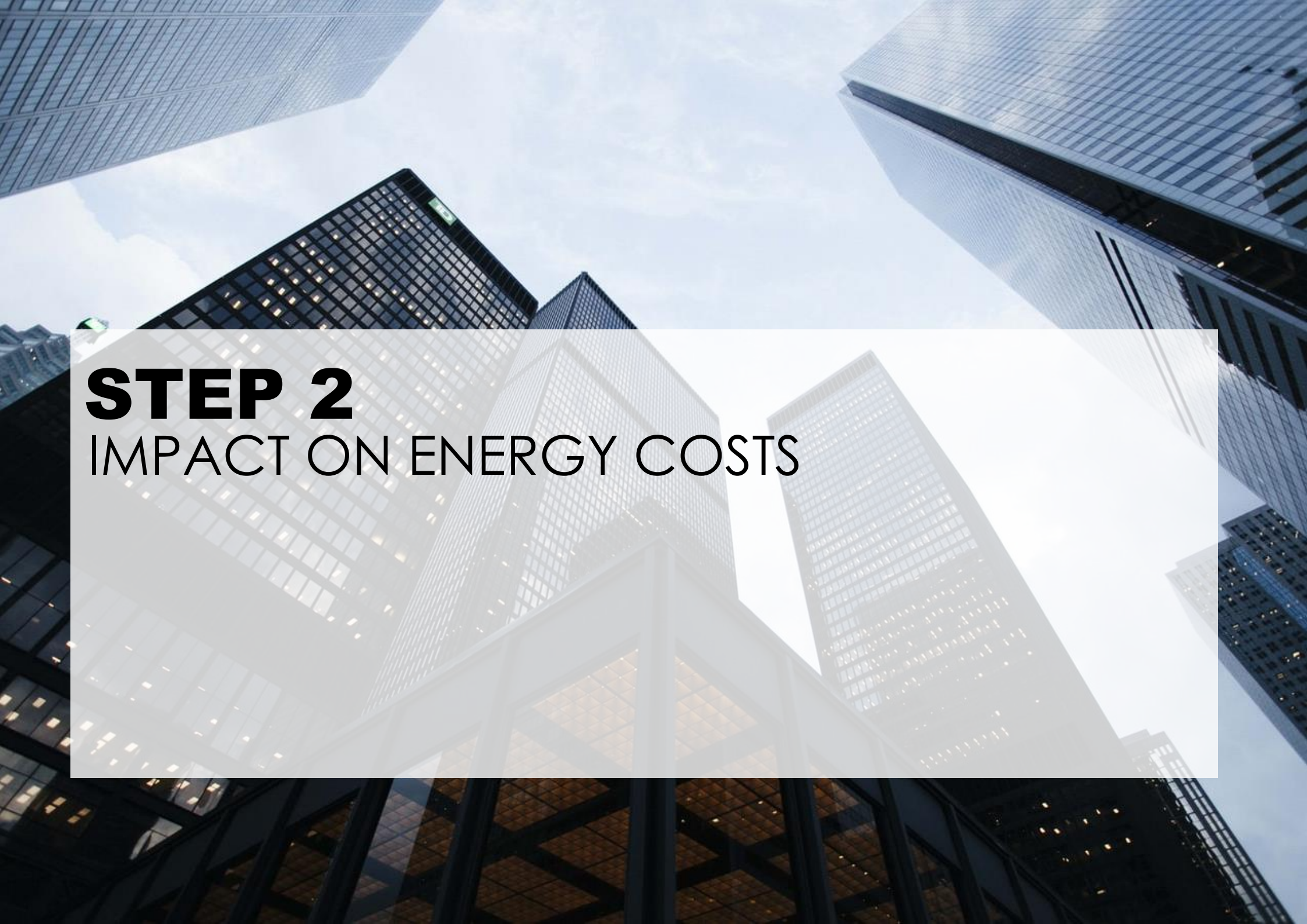
We take starting point in a fixed USD shock in carbon price as in the recently announced ECB climate stress test

CO2 price realisation shock

USD



Source: https://carbonpricingdashboard.worldbank.org/map_data



STEP 2
IMPACT ON ENERGY COSTS

Estimate impact on energy prices

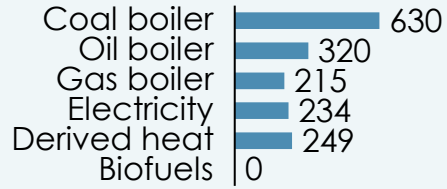
Estimate the impact on energy prices across the relevant energy sources

For mortgages, the relevant credit risk driver under the climate transition is energy costs.

- This can be done at different levels of sophistication.
- No demand and general equilibrium effects in our example.

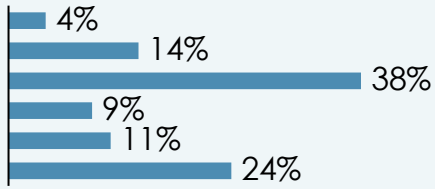
Carbon intensity

g CO2e / kWh



Energy mix

EU average %



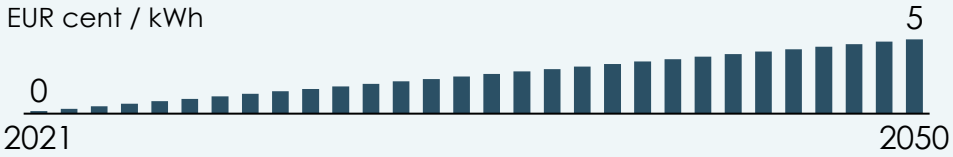
200
Average g CO2e per kWh

×

Carbon tax
For each year given scenario

Scenario impact: Average energy price increase

EUR cent / kWh



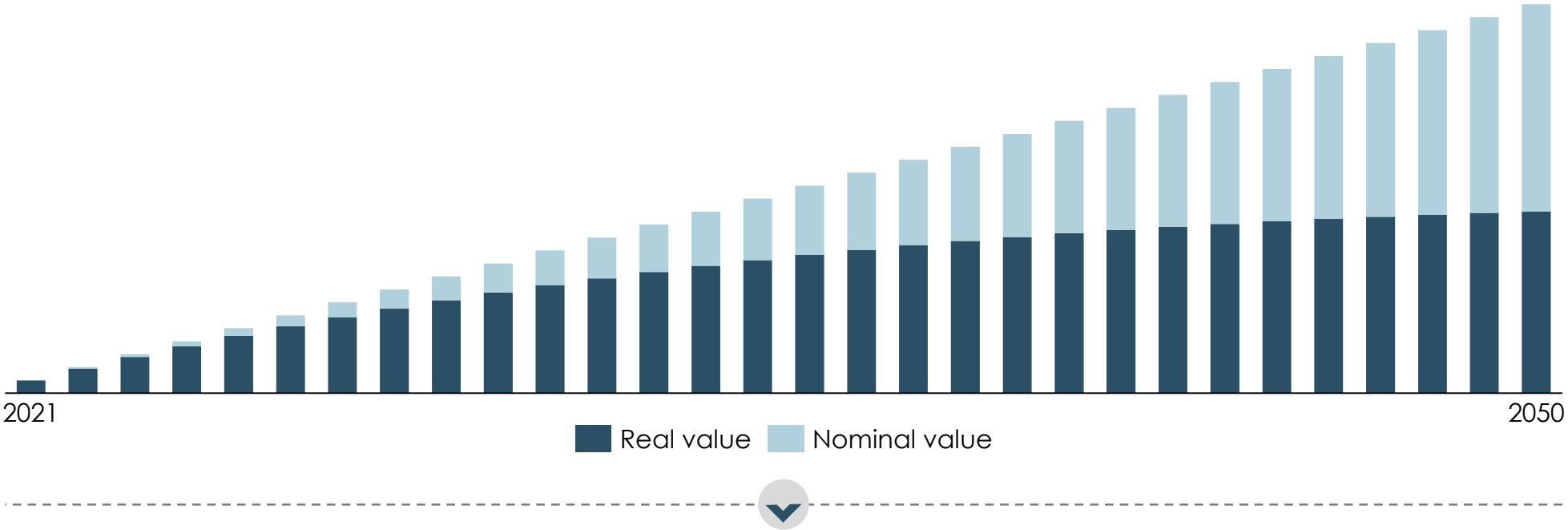
STEP 3

ECONOMICS IMPACT: COLLATERAL VALUES

Estimate energy costs for individual buildings

Forecast increase in energy costs for property owners and discount to present value

Average household energy bill increase
EUR, nominal and discounted to 2021-level

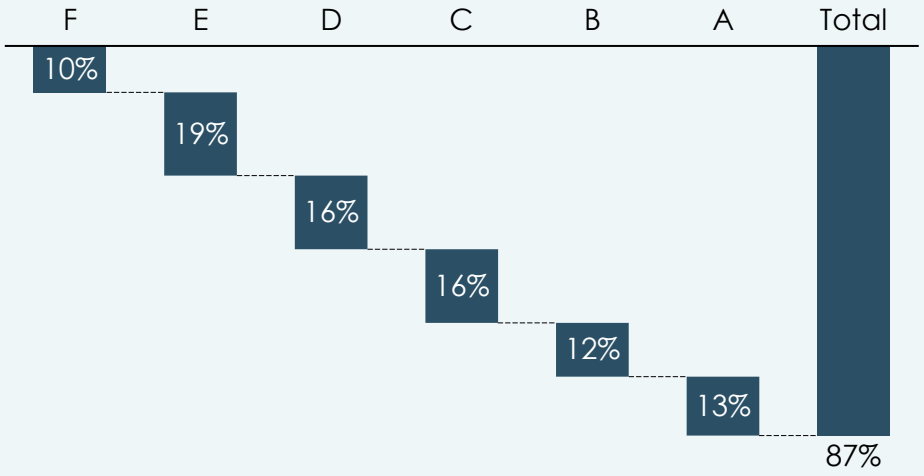


EUR 6,600
Energy price increase over thirty-year horizon from today's perspective for a representative European household

Evidence: there is a clear correlation between energy costs and collateral value

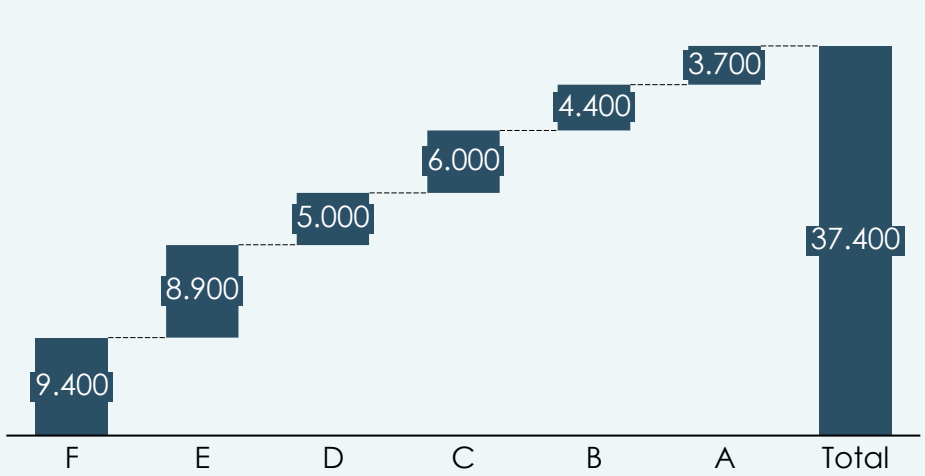
Decrease in energy expenses by reaching the next better energy label

Relative to label G average pre-renovation energy expense, percent, percentage points



Increase in property price by reaching the next better energy label

Relative to label G average pre-renovation house price, EUR



EUR 6,600
Average theoretical price impact

×

58%
Empirical adjustment

=

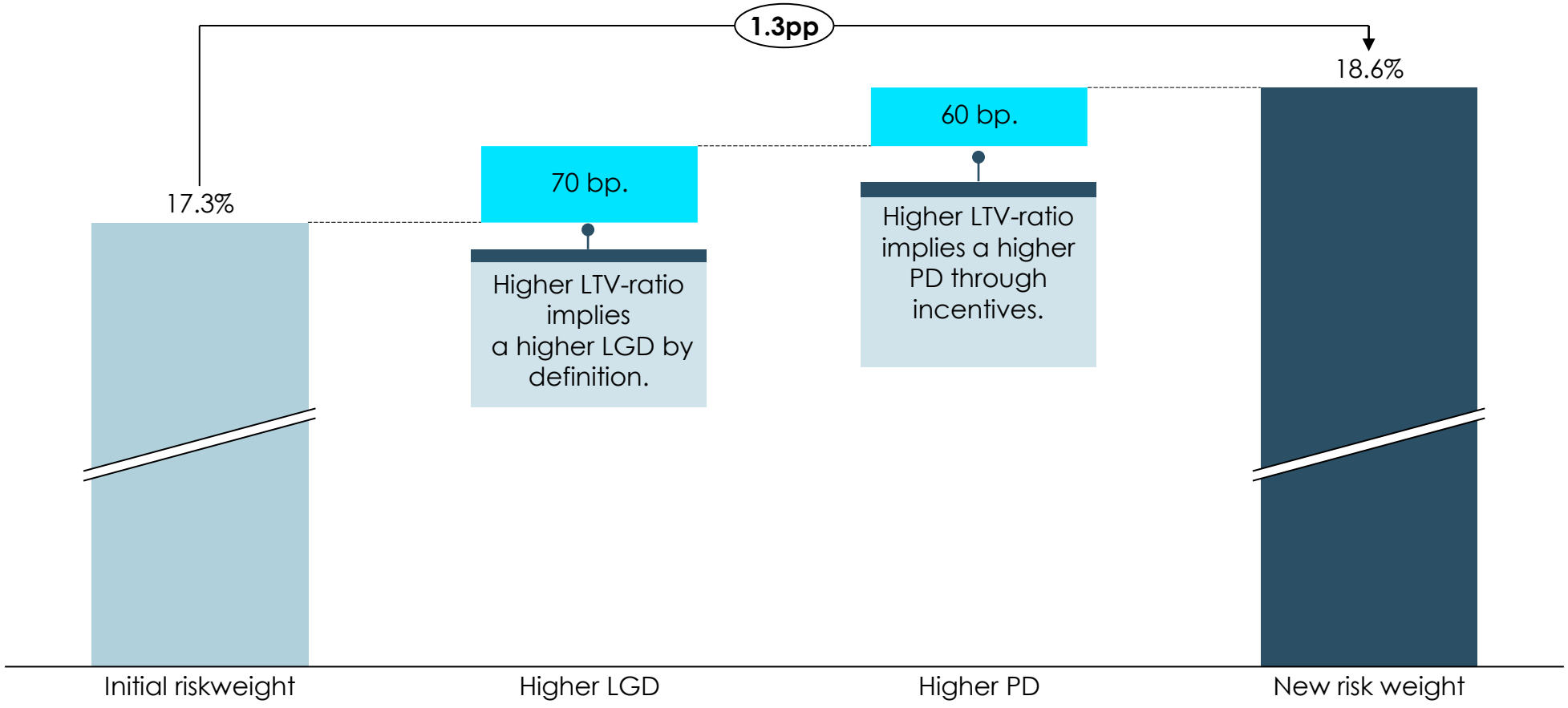
EUR 3,900
Average actual price impact

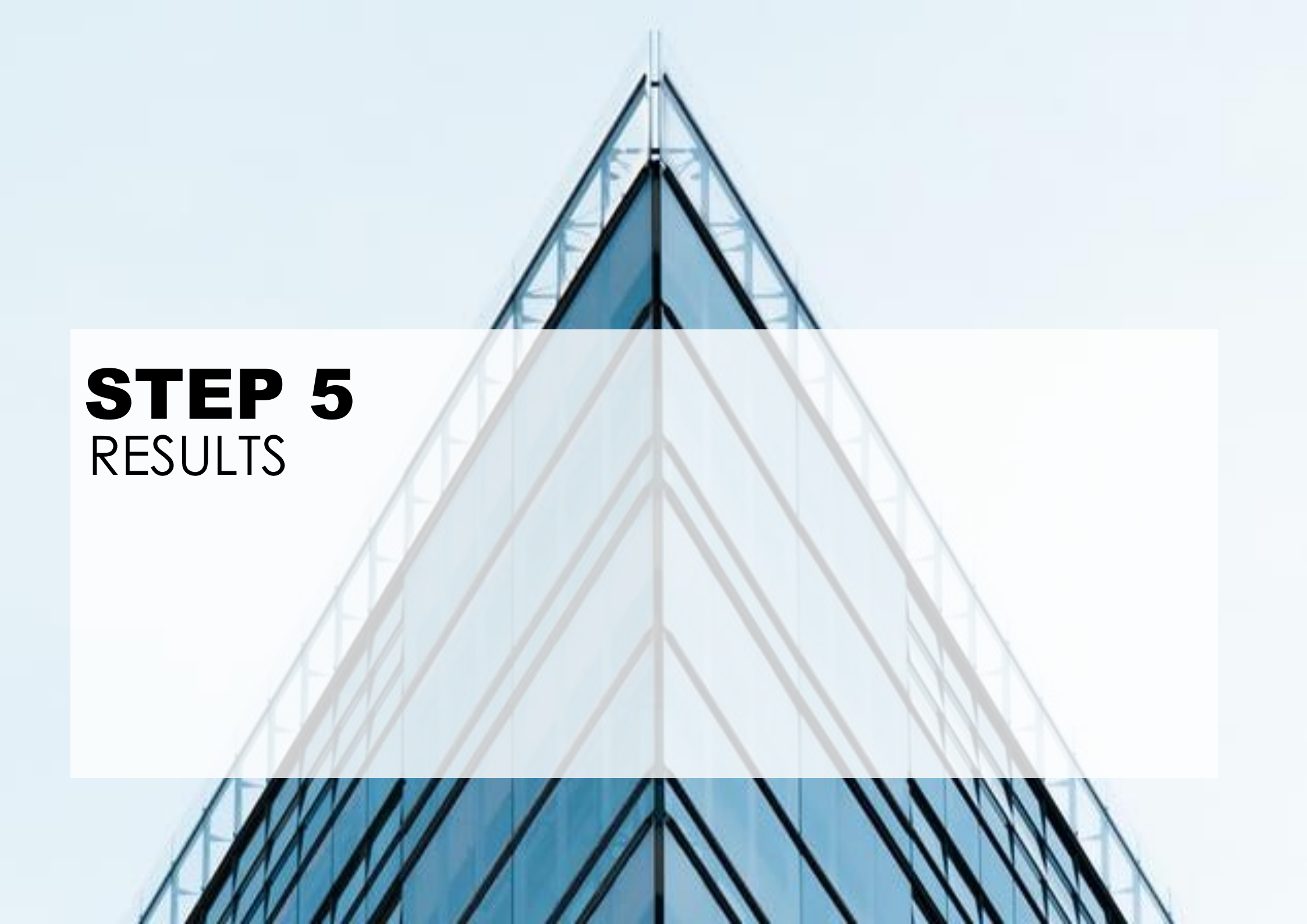
STEP 4
IMPACT ON RISK WEIGHTS

4. Update LTV

Impact on risk weights for IRB banks

% of REA



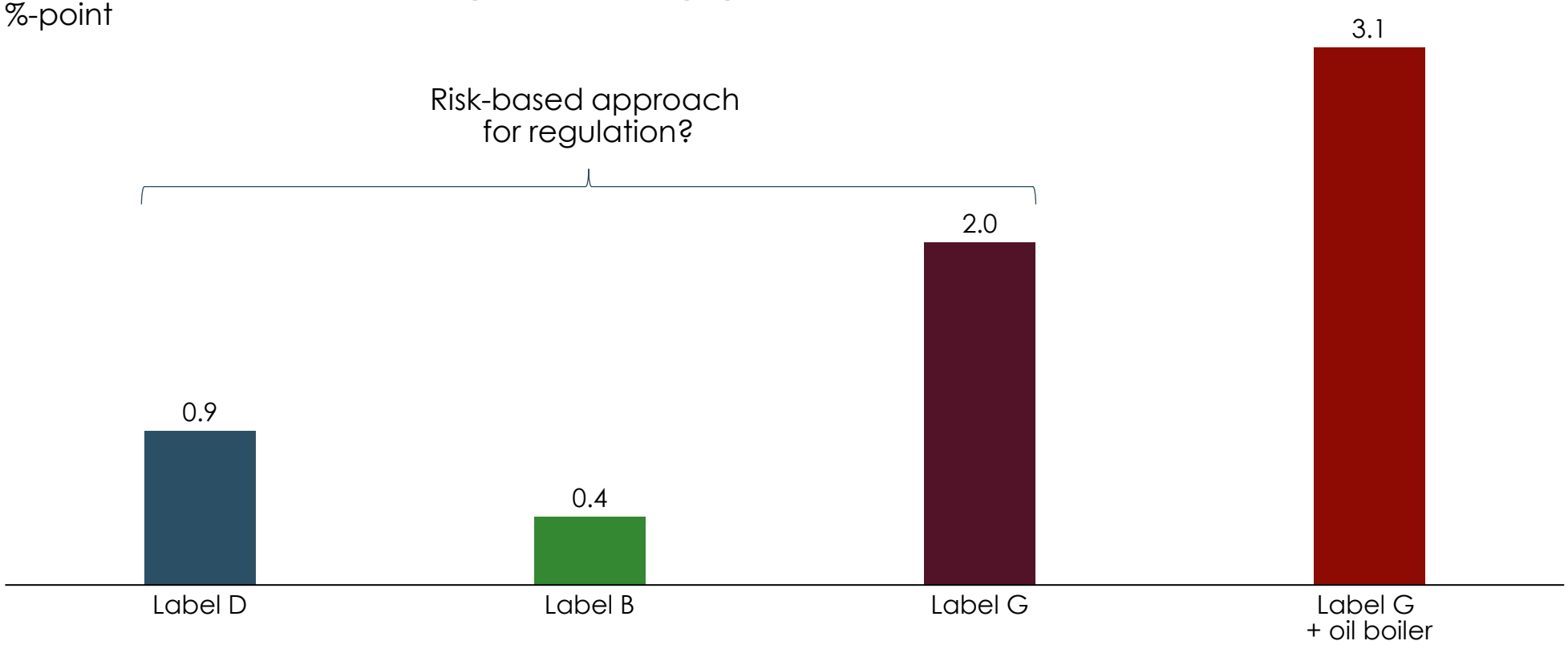


STEP 5
RESULTS

Importance of energy efficiency: impact on capital ratio

Impact on cet1 depends on energy efficiency of the buildings

Decline in CET1 buffer for a generic mortgage institute in transition risk stress



A risk-based approach to integrate climate considerations in prudential regulation?

Current perspective:

One-sided – Higher energy efficiency leads to higher collateral

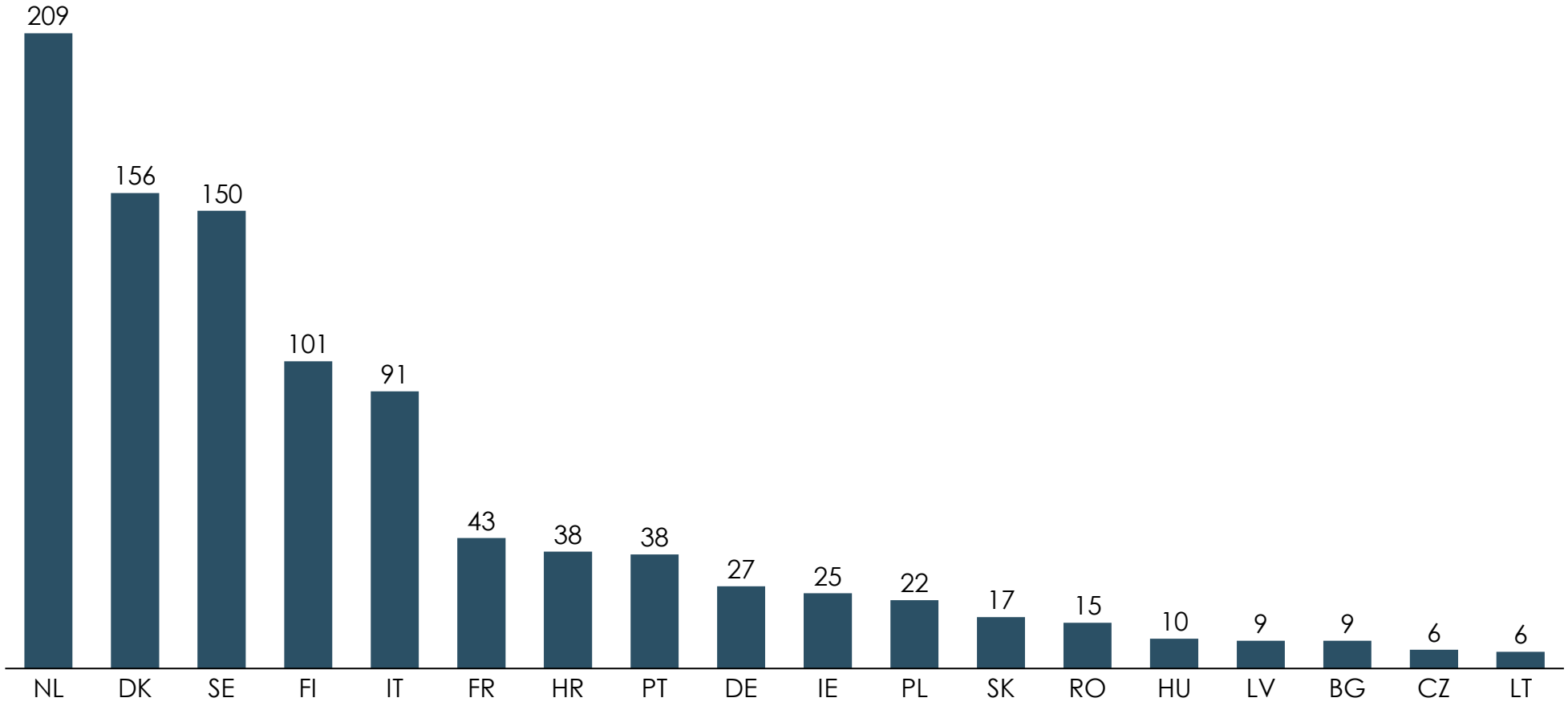
Forward looking perspective:

Two-sided – higher risks for inefficient mortgages – lower for efficient mortgages.

Be cautious with the one carbon price impact approach

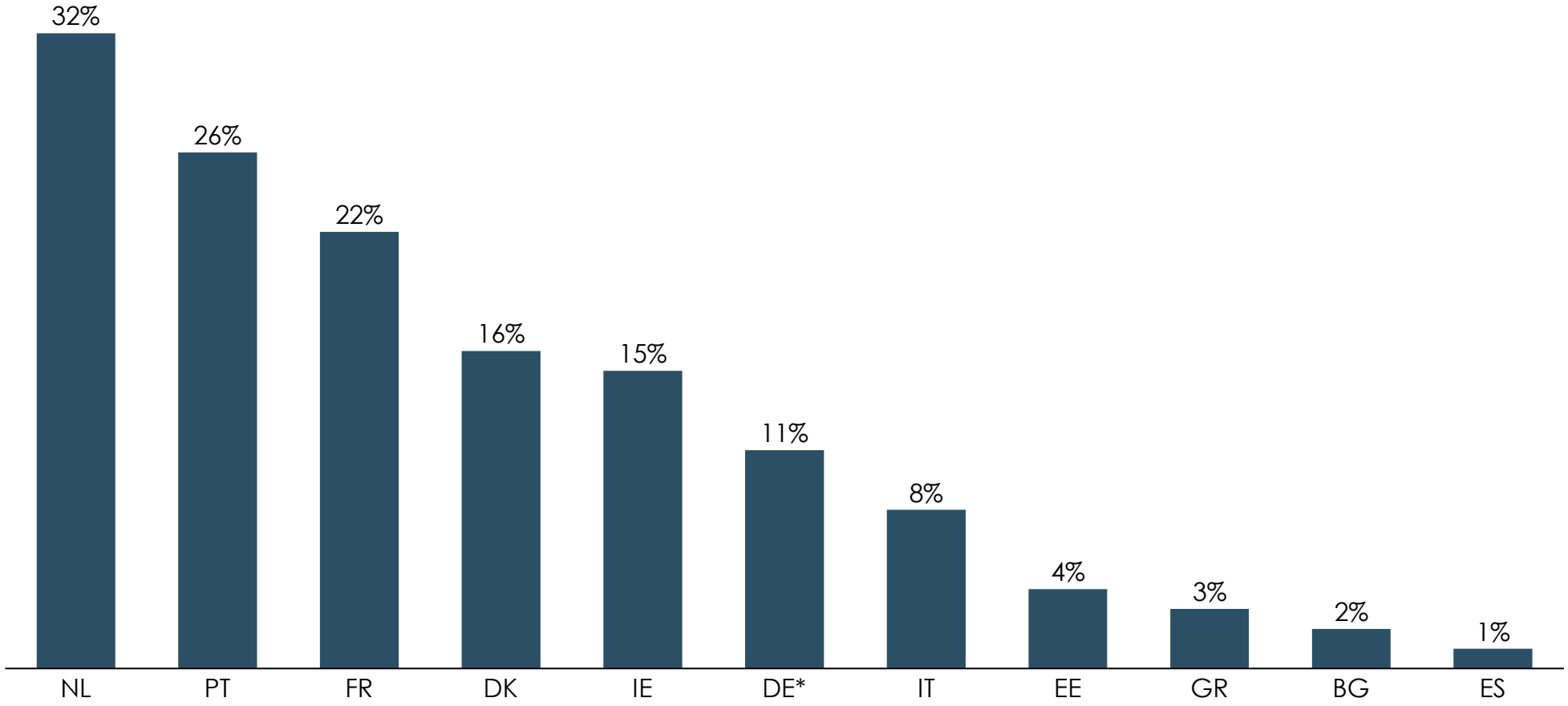
Implicit carbon tax on energy across EU (selected countries)

EUR per ton CO2



Data: Energy mix and energy efficiency are key inputs

Share of energy efficient buildings (label A or B)



Note: Data was only available for a subset of European countries. Data for Germany are from 2014

Source: BPIE (2020); DENA (2016)

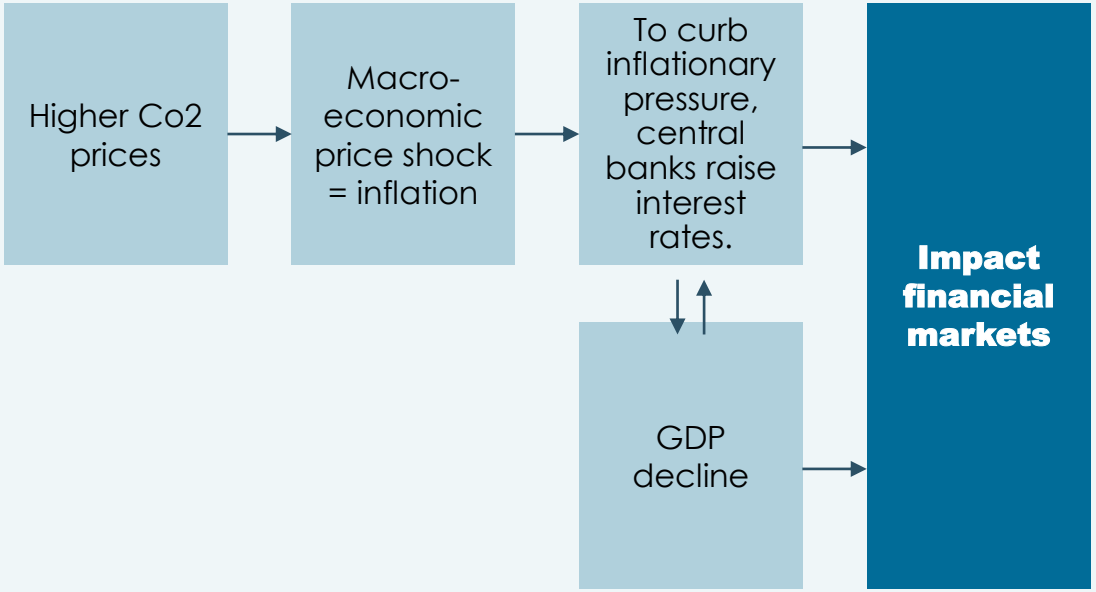
Also worth considering: Macroeconomic transmission channel

A typical macroeconomic stresstest

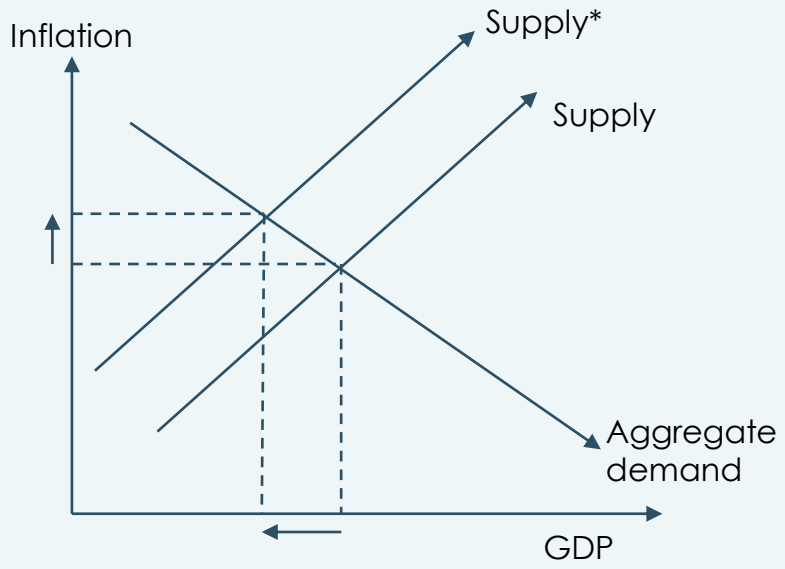
Market participants will also be affected indirectly: higher carbon prices can lead to a macroeconomic shock, which in turn impact financial risk factors.

This is basically a typical stagflation shock:

Can be estimated in a simple macro-economic model or based on parameters from existing papers



Simplified illustration of a macroeconomic Co2 price shock



CONTACT

Jonas Bjarke Jensen
jbj@copenhageneconomics.com

Copenhagen Economics
Langebrogade 1
DK-1411 Copenhagen K

www.copenhageneconomics.com

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