



Climate scenario for the European Insurance and Occupational Pensions Authority's EU-wide pension fund stress test in 2022

1. Introduction

In accordance with its mandate, the European Insurance and Occupational Pensions Authority (EIOPA), in cooperation with the European Systemic Risk Board (ESRB), initiates and coordinates EU-wide stress tests to assess the resilience of institutions for occupational retirement provision (hereafter “pension funds”) to adverse developments. This year’s pension fund stress test by the EIOPA focuses on climate risk. Reflecting this, the European Central Bank (ECB) worked with the ESRB to develop the narrative and the methodology and calibrated a climate scenario. These elements are presented in this document, which has been approved by the ESRB General Board and sent to the EIOPA.

The individual risk factors of the climate scenario presented in this document are calibrated on the basis of the scenarios developed by the Network for Greening the Financial System (NGFS).¹ These scenarios explore the impact of climate change and climate policy actions and provide macroeconomic and environmental projections. Their aim is to establish a common reference framework for analysing climate risks to the economy and the financial system. They are built on targets to limit the increase in temperatures, which define the reduction in emissions required to contain global warming. Once the required level of reduction is determined, the scenarios estimate the carbon price needed to achieve it.

One of the scenarios developed by the NGFS assumes a delay in the policy actions to transition to a green economy. This leads to an abrupt carbon price increase, which triggers the materialisation of a high transition risk affecting the entire economy (hereafter “delayed transition scenario”). The climate scenario submitted to the EIOPA by the ESRB considers the first three years of this delayed transition scenario. Given this short time horizon, the scenario does not include the subsequent economic recovery and the benefits

¹ See the phase II release of the [NGFS Climate Scenarios Database \(June 2021\)](#).

stemming from the green transition. For the same reason, the climate scenario set out in this document does not consider physical risks as they do not fully materialise in the period covered. The scenario provided by the ESRB assumes “no policy change”, which means neither monetary policy nor fiscal policy actions are considered to counteract the impact of the scenario. Lastly, due to the cut-off date for this exercise, the most recent developments related to the Russian invasion of Ukraine are not reflected in the scenario, which therefore maintains its focus on the implications of an abrupt carbon price increase.

Section 2 outlines the narrative of the disorderly transition scenario and Section 3 presents the main assumptions and calibration of the scenario.

2. Narrative

The climate scenario explores high transition risk due to policies being implemented late. Specifically, the scenario assumes that new climate policies are not introduced until 2030. Therefore, stronger policies are subsequently needed to limit global warming to below 2°C in line with the Paris Agreement.² This results in higher carbon prices, which aim to achieve a greater reduction in carbon emissions to compensate for the delay in implementing policy actions.

The availability of carbon removal technologies is assumed to be low, pushing carbon prices even higher in an effort to curb emissions. As a result, emissions exceed the carbon budget temporarily but decline more rapidly after 2030 – in line with the delayed introduction of climate policies – to ensure a 67 % chance of limiting global warming to below 2°C. This leads to higher transition risk compared with an orderly transition scenario. The abrupt implementation of policies affects the energy sector, including its mix of sources, and the aggressive carbon pricing has an impact on several areas of the real economy. Overall, the risk drivers of this disorderly transition are inherently different from other risk scenarios (e.g. a market downturn or a liquidity crisis).

² The goal of the Agreement is to limit global warming to well below 2 degrees Celsius, preferably to 1.5 degrees Celsius, compared with pre-industrial levels.

The increase in carbon prices leads to a strong price increase in fossil fuels and therefore energy prices. Conceptually, such cost-push shocks affect carbon dependent sectors more. The general economic outlook worsens, which also has an impact on financial markets. Equity markets fall, especially in carbon intensive sectors. Similarly, corporate credit spreads for brown industries rise sharply, mirroring the perceived difficulties of specific industries to decarbonise quickly or face the rising emission permit costs. The cost of issuing sovereign debt also increases with yields rising across jurisdictions. A limited degree of uncertainty is also felt in real estate markets, where downward corrections are mild. The transition causes downward adjustments or subdued growth in these markets,³ as tangible assets experience a slowdown in value growth because of the transition-induced stress.

3. Assumptions and calibration

The environmental and energy variables estimated by the REMIND-MAgPIE model⁴ are used as input by the National Institute Global Econometric Model (NiGEM), which provides macroeconomic projections. The methodological approach taken when calibrating this climate scenario is to stay aligned with the NGFS models' estimates. This ensures the integrity of the climate scenario described in the previous section and the consistency with the models' output. In addition, the geographical breakdown available in the NGFS allows for a breakdown by country, except for a few countries for which relevant cross-filling has been performed.

The overlays and additional calibrations have been performed to tailor the scenario to the specific needs of the pension funds stress test exercise. For all the variables, the calibration consists of frontloading the effect of the first three years of the delayed transition scenario from NiGEM (2031-2033) in 2022. The impact of the scenario presented in this

³ The growth is dampened when compared with the baseline scenario, where constant growth in all geographic areas is forecast.

⁴ The Regional Model of Investment and Development-Model of Agricultural Production and its Impact on the Environment (REMIND-MAgPIE) is a comprehensive integrated assessment model framework within the NGFS environment that simulates, in a forward-looking fashion, the dynamics within and between the energy, land-use, water, air pollution and health, economy and climate systems.

document differs substantially in nature from previous exercises, both in terms of the sectoral dimension and the severity of the outlook. Any comparison with previous stress test scenarios should take account of these differences.

The interest rate curve is determined through the short-term interest rate and the long-term interest rate variables available in NiGEM. These two serve as given points on the maturity ladder of 3 months and 10 years maturity, respectively. Given the modelling approach of NiGEM, which estimates country specific long-term interest rates, these rates can be used as a good approximation for sovereign yields. For the EU, the effects on the German Bund can be regarded as a good approximation of the effects on the risk-free rate.

The house price variable in NiGEM serves as the direct basis for residential real estate (RRE) prices. The commercial real estate (CRE) prices are estimated leveraging the forecasts for RRE and using the historical country-specific sensitivity between RRE and CRE prices. Oil, gas and coal price developments are provided directly by NiGEM. Their sharp increase is a consequence of the increase in carbon prices. The latter are also provided as a variable and expressed in monetary terms.

Furthermore, equity prices and corporate credit spreads are provided with a sectoral breakdown. The NACE sectors⁵ are chosen on the basis of their contribution to annual GDP and coverage of greenhouse gas emissions. They represent approximately 80% of gross value added and 80% of greenhouse gas emissions. The selection includes both green and brown sectors. The residual “Other” category includes sectors not explicitly indicated which represent roughly 20% of both GDP and emissions.

Equity price shocks are also based on NiGEM projections. To achieve a sectoral breakdown of the equity prices by NiGEM, the modelling infrastructure of the economy-wide climate stress test⁶ is used. Specifically, the infrastructure is used to project firm profitability at a micro level. Firms’ profitability is then aggregated up to the sectoral level

⁵ Statistical classification of economic activities in the European Community.

⁶ See [ECB Economy wide climate stress test](#).

and used to break down NiGEM's equity price projections for the different sectors, relying on the assumption that equity prices will reflect the discounted projected profitability of each sector.

Values for corporate bond spreads are not provided by NiGEM. Shocks are therefore derived through an adjustment to the ECB economy-wide climate stress test model. The proxy for corporate bond spreads is calculated based on the projections of probability of default of firms weighted by their projected level of debt and the starting level of corporate bond spreads for each sector. The ratio between equity prices and the proxy for corporate credit spreads is calculated at the sectoral level. The sensitivity of the most affected sector is also used to extrapolate corporate credit spreads for the remaining sectors based on their respective equity price shocks. This ensures a degree of conservatism in the corporate spread shock and a higher level of consistency between equity price and corporate bond shocks. Lastly, the economy-wide climate stress test is based on European firms and hence an assumption is made that European firms' probabilities of default can be successfully extrapolated to the rest of the world.

4. Annex

Table A.1: Short-term and long-term interest rates

Short-term interest rates percentage per annum			Long-term interest rates basis points per annum		
Geographic area	Country	3M	Geographic area	Country	10Y
EU	Austria	0.06	EU	Austria	132
EU	Belgium	0.06	EU	Belgium	138
EU	Cyprus	0.06	EU	Cyprus	170
EU	Germany	0.06	EU	Germany	98
EU	Estonia	0.06	EU	Estonia	147
EU	Spain	0.06	EU	Spain	177
EU	Finland	0.06	EU	Finland	129
EU	France	0.06	EU	France	140
EU	Greece	0.06	EU	Greece	214
EU	Ireland	0.06	EU	Ireland	116
EU	Italy	0.06	EU	Italy	214
EU	Lithuania	0.06	EU	Lithuania	158
EU	Luxembourg	0.06	EU	Luxembourg	100
EU	Latvia	0.06	EU	Latvia	139
EU	Malta	0.06	EU	Malta	187
EU	Netherlands	0.06	EU	Netherlands	119
EU	Portugal	0.06	EU	Portugal	169
EU	Slovenia	0.06	EU	Slovenia	149
EU	Slovakia	0.06	EU	Slovakia	132
EU	Euro area	0.06	EU	Euro area	143
EU	Czech Republic	4.31	EU	Czech Republic	230
EU	Denmark	0.19	EU	Denmark	117
EU	Croatia	3.11	EU	Croatia	172
EU	Poland	1.48	EU	Poland	267
EU	Sweden	0.56	EU	Sweden	110
EU	Hungary	2.78	EU	Hungary	347
EU	Romania	1.49	EU	Romania	397
EU	Bulgaria	0.77	EU	Bulgaria	170
Advanced economies	Norway	1.34	Advanced economies	Norway	284
Advanced economies	Iceland	2.90	Advanced economies	Iceland	451
Advanced economies	Switzerland	-0.14	Advanced economies	Switzerland	96
Advanced economies	Liechtenstein	-0.14	Advanced economies	Liechtenstein	96
Advanced economies	United Kingdom	1.44	Advanced economies	United Kingdom	154
Advanced economies	United States	1.68	Advanced economies	United States	168
Advanced economies	China	1.28	Advanced economies	China	383
Advanced economies	Japan	0.48	Advanced economies	Japan	105
World	Rest of the World	4.64	World	Rest of the World	395

Table A.2: Sovereign yields

Sovereign yields basis points per annum		
Geographic area	Country	10Y
EU	Austria	132
EU	Belgium	138
EU	Cyprus	170
EU	Germany	98
EU	Estonia	147
EU	Spain	177
EU	Finland	129
EU	France	140
EU	Greece	214
EU	Ireland	116
EU	Italy	214
EU	Lithuania	158
EU	Luxembourg	100
EU	Latvia	139
EU	Malta	187
EU	Netherlands	119
EU	Portugal	169
EU	Slovenia	149
EU	Slovakia	132
EU	Euro area	143
EU	Czech Republic	230
EU	Denmark	117
EU	Croatia	172
EU	Poland	267
EU	Sweden	110
EU	Hungary	347
EU	Romania	397
EU	Bulgaria	170
Advanced economies	Norway	284
Advanced economies	Iceland	451
Advanced economies	Switzerland	96
Advanced economies	Liechtenstein	96
Advanced economies	United Kingdom	154
Advanced economies	United States	168
Advanced economies	China	383
Advanced economies	Japan	105
World	Rest of the World	395

Table A.3: Carbon prices

Carbon prices in EUR, USD*		
Geographic area	Country	
EU	Austria	321
EU	Belgium	321
EU	Cyprus	321
EU	Germany	321
EU	Estonia	321
EU	Spain	321
EU	Finland	321
EU	France	321
EU	Greece	321
EU	Ireland	321
EU	Italy	321
EU	Lithuania	321
EU	Luxembourg	321
EU	Latvia	321
EU	Malta	321
EU	Netherlands	321
EU	Portugal	321
EU	Slovenia	321
EU	Slovakia	321
EU	Euro area	321
EU	Czech Republic	321
EU	Denmark	321
EU	Croatia	321
EU	Poland	321
EU	Sweden	321
EU	Hungary	321
EU	Romania	321
EU	Bulgaria	321
Advanced economies	Norway	321
Advanced economies	Iceland	321
Advanced economies	Switzerland	321
Advanced economies	Liechtenstein	321
Advanced economies	United Kingdom	321
Advanced economies	United States	439
Advanced economies	China	201
Advanced economies	Japan	473
World	Rest of the World	192

* Carbon prices are reported in EUR for the 27 Member States, European Free Trade Association countries and the United Kingdom and in USD for other geographic areas.

Table A.4: Residential and commercial real estate prices

Residential real estate prices y-o-y percentage change			Commercial real estate prices y-o-y percentage change		
Geographic area	Country		Geographic area	Country	
EU	Austria	-0.6	EU	Austria	-0.3
EU	Belgium	-0.6	EU	Belgium	-0.3
EU	Cyprus	0.8	EU	Cyprus	0.8
EU	Germany	1.5	EU	Germany	0.7
EU	Estonia	0.8	EU	Estonia	0.4
EU	Spain	-2.0	EU	Spain	-0.7
EU	Finland	-1.1	EU	Finland	-0.6
EU	France	-0.5	EU	France	-0.3
EU	Greece	3.7	EU	Greece	3.1
EU	Ireland	-0.5	EU	Ireland	-0.6
EU	Italy	0.7	EU	Italy	0.4
EU	Lithuania	0.8	EU	Lithuania	0.4
EU	Luxembourg	0.8	EU	Luxembourg	0.4
EU	Latvia	0.8	EU	Latvia	0.4
EU	Malta	0.8	EU	Malta	0.4
EU	Netherlands	0.1	EU	Netherlands	0.1
EU	Portugal	-1.4	EU	Portugal	-0.8
EU	Slovenia	0.8	EU	Slovenia	0.4
EU	Slovakia	0.8	EU	Slovakia	0.4
EU	Euro area	0.8	EU	Euro area	0.4
EU	Czech Republic	0.8	EU	Czech Republic	0.3
EU	Denmark	-1.3	EU	Denmark	-1.4
EU	Croatia	0.8	EU	Croatia	0.4
EU	Poland	0.8	EU	Poland	0.4
EU	Sweden	0.8	EU	Sweden	0.4
EU	Hungary	0.8	EU	Hungary	0.5
EU	Romania	0.8	EU	Romania	0.4
EU	Bulgaria	0.8	EU	Bulgaria	0.4
Advanced economies	Norway	0.3	Advanced economies	Norway	0.2
Advanced economies	Iceland	0.3	Advanced economies	Iceland	0.2
Advanced economies	Switzerland	2.9	Advanced economies	Switzerland	1.6
Advanced economies	Liechtenstein	2.9	Advanced economies	Liechtenstein	1.6
Advanced economies	United Kingdom	0.5	Advanced economies	United Kingdom	0.4
Advanced economies	United States	2.8	Advanced economies	United States	1.5
Advanced economies	China	7.0	Advanced economies	China	3.8
Advanced economies	Japan	1.1	Advanced economies	Japan	0.6
World	Rest of the World	1.0	World	Rest of the World	0.5

Table A.5: Commodity prices

Commodities y-o-y percentage change				
Geographic area	Country	Oil	Gas	Coal
EU	Austria	275	239	1294
EU	Belgium	275	239	1294
EU	Cyprus	275	239	1294
EU	Germany	275	239	1294
EU	Estonia	275	239	1294
EU	Spain	275	239	1294
EU	Finland	275	239	1294
EU	France	275	239	1294
EU	Greece	275	239	1294
EU	Ireland	275	239	1294
EU	Italy	275	239	1294
EU	Lithuania	275	239	1294
EU	Luxembourg	275	239	1294
EU	Latvia	275	239	1294
EU	Malta	275	239	1294
EU	Netherlands	275	239	1294
EU	Portugal	275	239	1294
EU	Slovenia	275	239	1294
EU	Slovakia	275	239	1294
EU	Euro area	275	239	1294
EU	Czech Republic	275	239	1294
EU	Denmark	275	239	1294
EU	Croatia	275	239	1294
EU	Poland	275	239	1294
EU	Sweden	275	239	1294
EU	Hungary	275	239	1294
EU	Romania	275	239	1294
EU	Bulgaria	275	239	1294
Advanced economies	Norway	275	239	1294
Advanced economies	Iceland	275	239	1294
Advanced economies	Switzerland	275	239	1294
Advanced economies	Liechtenstein	275	239	1294
Advanced economies	United Kingdom	275	239	1294
Advanced economies	United States	271	235	1271
Advanced economies	China	128	107	580
Advanced economies	Japan	291	253	1368
World	Rest of the World	120	100	542

Table A.6: Equity prices and corporate credit spreads by NACE sector code

Equity prices y-o-y percentage change		Corporate credit spreads basis points change	
NACE Sector code		NACE Sector code	
A01	-11.5	A01	143
A02-A03	-11.8	A02-A03	146
B05-B09	-37.8	B05-B09	467
C10-C12	-12.3	C10-C12	152
C13-C18	-10.9	C13-C18	134
C19	-32.2	C19	397
C20	-12.7	C20	157
C21-C22	-11.1	C21-C22	137
C23	-20.4	C23	252
C24-C25	-15.3	C24-C25	189
C26-C28	-11.1	C26-C28	138
C29-C30	-11.2	C29-C30	139
C31-C33	-9.8	C31-C33	121
D35	-23.0	D35	284
E36-E39	-13.1	E36-E39	162
F41-F43	-11.5	F41-F43	143
G45-G47	-13.4	G45-G47	165
H49	-22.6	H49	279
H50	-12.7	H50	157
H51	-14.2	H51	176
H52-H53	-10.8	H52-H53	133
L68	-12.0	L68	148
Other	-14.3	Other	177

NACE sector code descriptions	
NACE code	
A01	Crop and animal production, hunting and related service activities
A02-A03	Forestry and logging; Fishing and aquaculture
B05-B09	Mining and quarrying
C10-C12	Manufacture of food products, beverages and tobacco products
C13-C18	Manufacture of textiles; Manufacture of wearing apparel; Manufacture of leather and related products; Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials; Manufacture of paper and paper products; Printing and reproduction of recorded media
C19	Manufacture of coke and refined petroleum products
C20	Manufacture of chemicals and chemical products
C21-C22	Manufacture of basic pharmaceutical products and pharmaceutical preparations; Manufacture of rubber and plastic products
C23	Manufacture of other non-metallic mineral products
C24-C25	Manufacture of basic metals; Manufacture of fabricated metal products, except machinery and equipment
C26C28	Manufacture of computer, electronic and optical products; Manufacture of electrical equipment; Manufacture of machinery and equipment not elsewhere classified
C29-C30	Manufacture of motor vehicles, trailers and semi-trailers; Manufacture of other transport equipment
C31-C33	Manufacture of furniture; Other manufacturing; Repair and installation of machinery and equipment
D35	Electricity, gas, steam and air conditioning supply
E36-E39	Water collection, treatment and supply; Sewerage; waste collection, treatment and disposal activities; materials recovery; remediation activities and other waste management services
F41-F43	Construction
G45-G47	Wholesale and retail trade and repair of motor vehicles and motorcycles; Wholesale trade, except of motor vehicles and motorcycles; Retail trade, except of motor vehicles and motorcycles
H49	Land transport and transport via pipelines
H50	Water transport
H51	Air transport
H52-H53	Warehousing and support activities for transportation; Postal and courier activities
L68	Real estate activities
Other	Activities not captured by the list of NACE sectors above. Specifically, this refers to NACE sectors I, J, K, M, N, O, P, Q, R and S.