Scenarios and main assumptions of the 2023 ACPR insurance climate exercise

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1 Introduction

The stakes are high for issues related to climate change in the financial sector, which faces the dual pressure of addressing a significant increase in the financial risks linked to global warming, while playing a decisive role in financing the transition toward a low-carbon economy.

In this context, the mission of the Autorité de Contrôle Prudentiel et de Résolution (ACPR) is twofold:

- On the one hand, it aims at safeguarding the stability of the financial system by ensuring that financial institutions have clearly identified the climate change-related risks to which they are exposed and that they have implemented appropriate governance and methods to manage those risks;
- On the other hand, it contributes to the implementation of favourable conditions for the financing of an orderly transition to a balanced and sustainable economy in order to fight global warming efficiently. This notably entails greater transparency from financial institutions regarding their exposures, as well as the control and assessment of their public commitments[11] aiming to ensure the sound and optimal allocation of funding and capital.

In line with these objectives, the ACPR conducted a first pilot climate stress-testing exercise in 2020-2021. This pioneering initiative involved French banks and the main French insurance groups. It had two main objectives: firstly, making French financial institutions aware of the financial risks associated with climate change and enhancing their ability to analyse and manage these risks; and secondly, obtaining an initial order of magnitude of the risks and vulnerabilities to which these institutions are exposed.

This pilot exercise provided a first estimate of the exposure of French banks and insurers to transition risk using scenarios developed by the NGFS, the Network of Central Banks and Supervisors for Greening the Financial System, and their exposure to physical risk through the estimation of its impact on insurers' liabilities (in conjunction with the *Caisse Centrale de Réassurance* or CCR, the French central reinsurance fund). It concluded that the overall exposure of French banks and insurers to the risks associated with climate change was "moderate"[22].

This pilot exercise was carried out on a voluntary basis, and mobilised 9 banking institutions (representing 85% of the total assets for France) and 15 insurance groups (comprising 22 insurance undertakings sharing 75% of insurers' balance sheet total and underwriting reserves).

Since the launch of this pilot exercise, several authorities have conducted similar ones, including the Bank of England in 2021 and the European Central Bank (ECB) for banks in 2022.

In this context, the ACPR has decided to carry out a second climate exercise in 2023, this time restricting its scope to the insurance sector. Preparatory work was carried out with insurers throughout 2022 in the context of a market-wide working group that aimed to draw conclusions from the first stress-testing exercise and make certain improvements or supplementing analyses.

[1] Which is the role assigned to the Climate and Sustainable Finance Commission of the ACPR, a Commission established in October 2019 (https://acpr.banque-france.fr/sites/default/files/medias/documents/20191015_cp_commission_climat_finance_durable_acpr_en.pdf)

[2] *Analyses et synthèses* No 122: Les principaux résultats de l'exercice pilote climatique 2020 | Banque de France (banque-france.fr)

This iteration of the climate risk exercise, which will take place in the second half of 2023 (refer to the timeline provided in Section 1.4), is based on:

- **Two long-term scenarios**, the first one based on the NGFS' "Below 2°C" orderly scenario and the second one based on the delayed and disorderly transition scenario ("Delayed Transition"), which leads to a similar temperature target by 2050. The impact of these scenarios is measured in terms of their deviation from a fictitious baseline scenario developed by the National Institute of Economic and Social Research (NIESR), which excludes both physical and transition risks.
- **A short-term scenario developed by the ACPR in conjunction with the Banque de France teams** covering the 2023-2027 period, and which combines acute physical risk shocks (droughts/heatwaves followed by a localised flooding peril), and a financial shock on the asset side linked to market awareness following these extreme events, in anticipation of transition policies that are then considered inevitable.

1.1 Background of the 2023 climate risk exercise

Following the publication of the results of its pilot exercise in May 2021, the ACPR continued its work with the industry and launched (i) an initial working group to improve the scenarios and further specify the required set of macro-financial and climate variables and (ii) a working group dedicated to physical risk.

This second group brought together insurance undertakings on a voluntary basis, through 6 sessions held over the course of 2022. These sessions provided an opportunity for participants to discuss a wide range of topics with a view to preparing for the next climate risk exercise.

Considering physical risk was the main focus of these sessions. Discussions touched on the challenges associated with physical risk modelling, the scope of information provided by the supervisor, and the inclusion of uninsurable risk in long-term projections. A number of priorities emerged, such as improving the granularity of damage projections and introducing a short to medium-term scenario.

Other topics were also covered, either for their own sake or due to their relevance to improving the way in which physical risk is taken into account: life and health risks, as well as market risk.

1.2 Main objectives of the exercise

1.2.1 Refining and supplementing the methodological framework used for the pilot exercise

In line with the ambitions of the pilot exercise, the 2023 exercise seeks to improve the insurers' capacity to integrate climate risks in their measurement, assessment and day-to-day management of financial risks, especially as insurance undertakings are now required to include sustainability risks in their Own Risk and Solvency Assessment (ORSA). This exercise is also intended as an opportunity for the ACPR to upgrade the assessment tools it uses to measure the consequences of climate change on the stability of institutions as well as that of the financial system as a whole.

Following the pilot exercise, the aims of this year's iteration include:

- Taking better account of physical risk, primarily through (i) the integration of chronic physical risk into insurers' assets, as the new scenarios developed by the NGFS now incorporate the impact of physical risk in macroeconomic scenarios more satisfactorily than their first scenarios; (ii) a more refined physical risk analysis on the liabilities side, obtained by distinguishing between the various factors that increase loss experience on the liabilities side (hazards, changes in terms of stakes insured), by offering more granular damage projections, and by taking into account the way policyholder demand responds to premium increases;

- Taking short-term scenarios into account, analysing the occurrence of extreme events both from (i) an acute physical risk perspective - which, given its magnitude in France, affects life insurance risk - and (ii) in terms of transition risk, through an asset valuation shock linked to an abrupt adjustment in financial markets.

Another expected output of this exercise is an analysis of the changes observed since the pilot exercise in the measurement tools, models and data available of the insurance undertakings involved. These tools will be analysed through the methodological notes submitted by participants.

1.2.2 Ongoing work to further the strategic integration of climate risk

The pilot climate exercise was designed to raise awareness of both the risks associated with climate change and their financial consequences for the French banking and insurance sectors, in particular by encouraging industry stakeholders to incorporate a longer-term view in their strategic decision-making.

The dynamic balance sheet assumption, which serves this purpose, has been retained for the long-term scenarios included in this exercise. This assumption enables insurers to take management actions and adapt their balance sheet to address climate risks. It also allows the ACPR to assess the extent to which insurers are fulfilling the commitments they have made in the fight against climate change or as part of their voluntary transition plans, and to measure their robustness, particularly in adverse scenarios.

With regard to insurers' liability management measures, the ACPR provides ad hoc assumptions on the reaction of policyholder demand to premium increases, in order to take into account the insurance gap risk, both qualitatively and quantitatively.

In addition, this exercise explores a short-term horizon, in line with the insurers' desire to articulate physical and transition shocks on a horizon compatible with that of their strategic planning.

1.2.3 Updating vulnerability assessment

The 2023 exercise should make it possible to update the assessment of French insurers' vulnerabilities to the risks associated with climate change.

It is based on the latest generation of NGFS scenarios published in September 2022, therefore benefitting from their methodological advances, such as the inclusion of chronic physical risk on the asset side. The macroeconomic assumptions of these scenarios – on which the financial assumptions rely – have been updated with the latest NIESR projections, in order to factor in a less favourable macroeconomic environment arising from the war in Ukraine and its consequences, particularly in terms of inflation.

In addition to these changes, the 2023 exercise incorporates a new feature, in that projections are also provided for a fictitious baseline scenario with no physical nor transition risk, based on the NIESR projections. It is against this scenario that the financial and physical shocks in the various long and short-term scenarios are assessed. For the long-term scenarios, this methodological shift compared with the previous exercise paves the way for a common agreement on a counterfactual, for which insurers will also have to provide projections, and thus have to estimate the impact of the physical and transition risks included in the orderly scenario compared with the fictitious scenario, as well as the additional costs associated with deviating from this fictitious scenario.

1.2.4 Conducting an initial assessment of impact on the solvency of financial institutions

While it is in the long term that the impacts of climate change will be most material, studying the impact of ad hoc short-term scenarios brings us closer to the conventional rationale behind stress-testing exercises, which consists of measuring the impact of highly adverse events over a short to medium-term horizon, and with unchanged balance sheets.

The pilot exercise did not assess impacts on the solvency of financial institutions: this was both because the models, metrics and methodologies used were new, and because the 30-year projection horizon and dynamic balance sheet assumption were not particularly well aligned with that goal.

In the 2023 iteration of the exercise, the short-term horizon will provide an initial estimate of the impact of climate risk on insurers' solvency, based on a static balance sheet assumption that is consistent with the standard approach used in stress-testing exercises conducted by the European Insurance and Occupational Pensions Authority (EIOPA).

1.3 Rules for participation

As was the case for the pilot exercise, participation in this climate risk assessment exercise organised by the ACPR remains voluntary, albeit strongly encouraged. Indeed, one of the ACPR's objectives is to draw up a valuable exercise for financial institutions and the supervisor alike. In addition to the institutions that participated in the working group during 2022, the exercise is also open to any insurance undertaking that wishes to get involved.

The ACPR teams can be reached through the following address and can provide additional information and further details on the exercise: 2771-CLIMAT-ASSURANCE-UT@acpr.banque-france.fr

1.4 Timeline of the exercise

The timeline set for the exercise is shown in the Graph 1 below.

This main assumptions' document is published alongside a technical guide as well as Excel files containing quantitative assumptions and reporting templates.

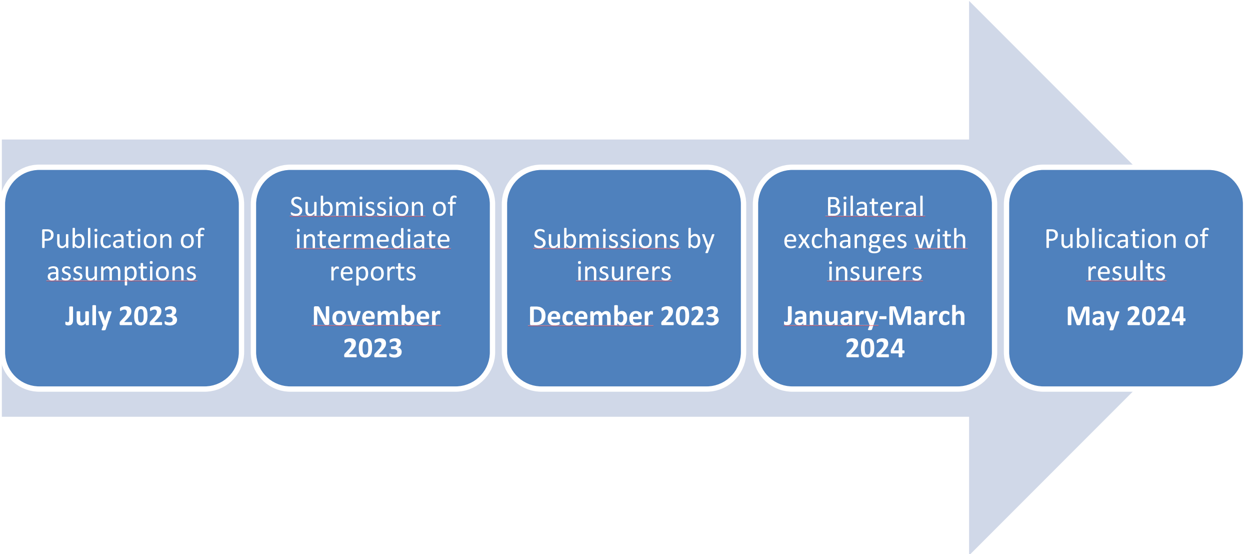
Insurers will have until the end of the second half-year 2023 to assess the impact of these assumptions and scenarios on their balance sheet and provide the associated measurements by filling in the templates provided for this purpose, a brief presentation of which is included in section 5 of this document.

The intermediate reports to be submitted before the 30th of November 2023 will provide an initial view of the consistency of the management actions in terms of asset reallocations.

Participants will be asked to have their intermediate and final submissions checked by their administrative, management or supervisory body (AMSB).

The analysis of the outcomes by the ACPR teams, from January to March 2024, will also rely on bilateral exchanges with participating undertakings. The main results of the stress-testing exercise will be published in May 2024.

Graph 1: Timeline for the 2023 climate stress-testing exercise organised by the ACPR



2 Main framework of the exercise

The 2023 insurance climate exercise is based on the main framework used for the 2020 pilot exercise for long-term scenarios; the main modifications concern the introduction of short-term scenarios.

2.1 The time horizons and geographical areas concerned

The temporal dimension of the 2023 exercise differs from that of the pilot exercise due to the introduction of a short-term scenario. For the long-term scenarios, the assumptions used in the exercise are provided to participants by the ACPR and Banque de France teams in the form of projections of climate, macroeconomic and financial variables in 5-year increments, from 2025 to 2050. The scenarios include climate policy measures in the form of a carbon tax increase set in 2025 for the orderly scenario, and in 2035 for the disorderly scenario. For the short-term scenario, variables are provided for each year from 2023 to 2027.

The geographical scope of the 2023 stress-testing exercise is in line with that of the pilot exercise. As a reminder, the pilot exercise covered the exposures of banks and insurance companies in the following geographical areas: France, Europe (including the United Kingdom) excluding France, and the United States. An additional geographical area (Rest of the World) was taken into account to cover at least 80% of the geographical exposures of banks and insurance companies[3].

[3] The first three geographical areas (France, Europe excluding France and the United States) alone generally cover between 75 and 80% of the exposure of French insurers.

The provided macroeconomic and financial variables will remain for the most part calibrated to the four geographical areas mentioned above[4]. The scope covered in this exercise still targets more than 80% of the entities' exposure.

For the analysis of acute physical risk on the liabilities side, the approach used in long-term scenarios remains international, with the possibility of using the services of the CCR for selected property damage exposures in France (river flooding, coastal flooding, subsidence, cyclonic storms). This solution is encouraged in order to ensure the consistency and comparability of results. Developments in terms of available data and resources will allow for better consideration of impacts excluding France. The technical guide published alongside this document provides links to examples of publicly available resources.

In the short-term scenario, the analysis of acute physical risks will be limited to France (for the drought/heatwaves event), and to an area delimited by a set of INSEE/postal codes for the dam failure event.

2.2 The sectoral dimension

This exercise offers a sectoral breakdown of financial shocks, which has undergone changes since the pilot exercise in terms of equity shocks in the long-term scenarios.

This iteration therefore offers a higher level of granularity for a number of sectors likely to be the most sensitive to financial shocks. Conversely, sectors that were identified as less sensitive during the pilot exercise have been grouped into aggregate categories. With this in mind, while the pilot exercise presented shocks for all 55 NACE sectors in the WIOD[5] database, shocks are presented for 22 groups of NACE sectors[6] in this iteration.

Due to methodological differences in their design, a lower level of granularity (12 sectors) is expected for bond spread shocks in the long and short-term scenarios, as well as for the equity shocks in the short-term scenario.

2.3 The static and dynamic balance-sheet assumptions

The 2023 exercise includes different balance sheet assumptions for the long-term and short-term scenarios:

- For the long-term scenarios, the projections will be provided under a dynamic balance sheet assumption over the entire period, from 2025 to 2050, in 5- or 10-year increments, based on the balance sheet observed on the 31/12/2022;
- For the short-term scenario, the projections will be provided under a static balance sheet assumption based on the balance sheet observed on the 31/12/2022, every year from 2023 to 2027.

As in the pilot exercise, the dynamic balance sheet assumption should enable insurers to incorporate management actions, which will allow them to adjust their balance sheets according to the climate change scenarios adopted. Similarly to the pilot, the aim will still be to assess how insurers would react to the materialisation of climate risks and how they would implement and amend their strategies and meet their public commitments in the fight against climate change.

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[4] Excluding sovereign risk variables and corporate spread shocks, provided for the following countries: France, Germany, Italy, Spain, UK, Euro area, Rest of Europe, USA, and Japan. The variables included in the short-term scenario also offer a slightly different geographical breakdown.

[5] World Input-Output Database (http://www.wiod.org/home).

[6] Derived from the re-aggregated data from the 200 sectors included in the Exiobase database (Exiobase - Home).

A harmonisation process should make it possible to ensure the consistency of asset management actions, through an intermediate submission step set in November: checks carried out on such intermediate submissions should make it possible to ensure that insurers' asset reallocation decisions remain compatible with the sectoral and geographical structure of the economy as projected in the various scenarios in 2050.

2.4 The risks included in the scope of study

2.4.1 Market risk

As in the pilot exercise, the assessment of the impact of climate change risks on the insurers' assets covers market risk.

This aims to capture the financial impact of the depreciation of certain assets in the context of transition policies or in anticipation of such policies, while also taking account of specific indirect impacts of physical risk.

In accordance with the Solvency 2 principles, the insurers' portfolios are marked-to-market. Insurers will have to revalue their bond and equity portfolios at fair value for each of the proposed scenarios using asset-pricing projections per sector, changes in sectoral credit spreads and information on government bonds.

In addition, the decrease in financial income resulting from shocks to assets issued by sectors most vulnerable to transition risk will be taken into account when calculating the best estimate of liabilities.

Insurers will therefore have to assess their asset portfolios according to the various long-term and short-term scenarios, taking into account asset pricing trends per sector, as opposed to solely using aggregate indices. They will provide a breakdown of their assets by security type and investment sector. They will include asset reallocation decisions based on the dynamic (in the long-term scenarios) or non-dynamic (in the short-term scenario) nature of the projections.

These elements are further specified in the technical guide appended to this document.

2.4.2 Analysis of the acute physical risk on the liabilities side of insurer balance sheets

The risks associated with an increase in the frequency and cost of extreme weather events, including the subsequent increase in mortality rates and vector-borne epidemics or tropical diseases, have a direct impact on the liabilities of insurance organisations and drive the pricing of insurance policies. Furthermore, the increase in the frequency and cost of extreme weather events can also raise the longer-term issue of the uninsurable nature of certain risks, along with its potential ramifications in terms of public policy.

These risks are mainly induced by the acute physical component of climate change risk, which is analysed here according to the IPCC's scenario based on an RCP 4.5 pathway for the various non-life lines of business; this scenario follows a temperature trajectory aligned with the scenarios studied for market risk. This differs from the choice made for the pilot exercise, which considered a scenario aligned with the IPCC’s RCP 8.5 pathway scenario for physical risk on the liabilities side, but included scenarios aligned with lower temperature trajectories for transition risk on the assets side.

2.4.2.1 *Property damage and motor insurance activities*

The property damage and motor insurance lines of business are the ones most affected by an increase in the frequency and intensity of natural disasters caused by climate change.

- For exposures floods, droughts, coastal floods and cyclonic storms located in mainland France and overseas French territories, insurers will be able to call on the assistance of the *Caisse Centrale de*

Réassurance (CCR) to assess changes in their loss experience. Compared with the pilot exercise, the CCR offers to present the outcome of its projections with a finer level of granularity, and with a clear distinction made between effects related to changes in insured stakes (demographic and activity projections) and effects linked to climate change risk developments and their impact on loss experience.

- Participants will also be required to take into account, on a best effort basis, the impact of perils likely to be exacerbated by climate change, that are significant for them and are not covered by the natural disaster compensation scheme (CatNat) (such as the effects of drought on crop insurance, hail, etc.) in their non-life underwriting results.
- For exposures located outside of France, insurers may rely on the freely available models and data listed for reference in the technical guide.

Whether or not they choose to benefit from the CCR's assistance, insurers will be required to comply with a few chronic physical variable paths – which are appended to the technical guide to allow for comparability across projections.

As for the **reaction of policyholder demand**, insurers are asked to incorporate any management actions they might make. Failing that, the assumption retained will be that of fixed market shares at the municipal and departmental levels. To provide a framework for these management actions, assumptions on the reaction of policyholder demand to premium increases are included. These assumptions focus on the property damage activity, expressed as termination thresholds above a given premium to insured value ratio set according to the type of property considered. These assumptions are explained further in section 3.3.2.

2.4.2.2 Health insurance activities

The analysis of the impacts of climate change on the health insurance business carried out in the pilot exercise in conjunction with AON, a reinsurance broker, is repeated for the present one. The main change brought since is a switch to a scenario based on an RCP 4.5 pathway to ensure that it remains consistent with the study carried out on the impact on the property and motor insurance activities.

Climate change will potentially accelerate the spread of vector-borne diseases or pandemics (such as Dengue and Zika) that are insect-borne (the most notable carriers being mosquitoes). These diseases are liable to generate additional mortality rate increases, but also a rise in healthcare costs (related to the increased need for medical consultations and hospital stays) and an increase in the number of temporary disability and permanent disability claims.

Climate change also has a recognised impact on air quality, especially in major urban areas. Air pollution exacerbates existing respiratory pathologies such as asthma, allergies and severe acute respiratory syndrome (SARS).

Based on the RCP 4.5 scenario, and in conjunction with AON, the ACPR provides insurers with assumptions on the evolution of mortality rates, that of healthcare costs and additional work stoppage over the entire French territory. Assumptions are also provided for the largest conurbations (see also section 3.2.2.2).

3 Long-term scenarios

The long-term analysis includes two scenarios proposed by the NGFS, one of which represents an orderly transition scenario and the other a disorderly transition scenario. The only differences between them can be found on the asset side:

- both scenarios measure the impact of climate risks on **assets**, in terms of chronic physical and transition risks, by comparing them to a fictitious baseline scenario without physical or transition risk;

- for both scenarios, the impact of acute physical risk on **liabilities** is measured based on the RCP 4.5 pathway (section 3.2.1).

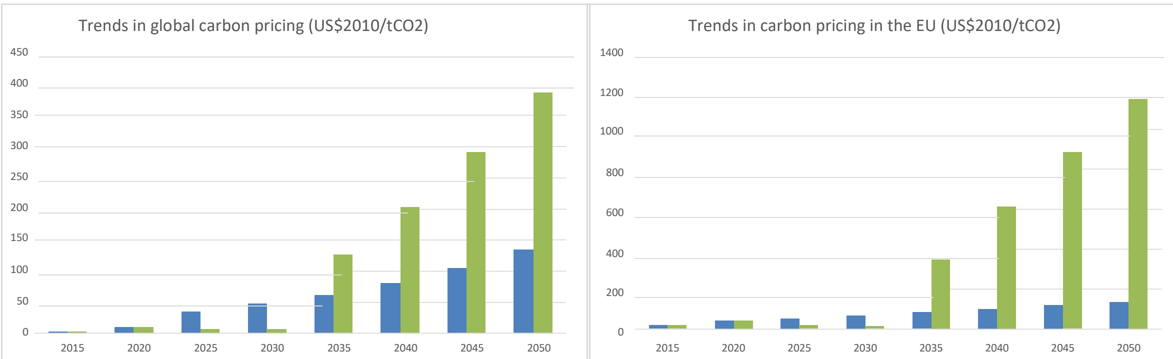
3.1 Assessment of the physical and transition risks on the asset side of insurers' balance sheets: Below 2°C and Delayed transition scenarios

3.1.1 Selection of the Below 2°C and Delayed transition scenarios

Contrary to the pilot exercise, which used an orderly transition scenario as its baseline scenario, the 2023 exercise takes the projected changes from the NIESR Baseline scenario as a reference. This latter is a fictitious scenario in which the economy is neither exposed to physical risk nor to transition risk, that consequently does not give rise to any climate change policy.

Adverse scenarios are based on the Below 2°C and Delayed Transition scenarios derived from the NGFS's phase III that was published in September 2022[7]. This iteration differs from previous versions in that it takes into account the national commitments made at COP26, as well as the latest technological advances in the field of renewable energies. More specifically, the new version of the scenarios published by the NGFS in phase III benefits from the improvements made to the modelling of physical risks, which now rely on the damage function designed by Kalkuhl & Wenz[8] (2020), and is used to extrapolate observed damage and obtain an estimate of the effects of chronic physical risks by 2100. For instance, in phase III of its scenarios, the NGFS's macroeconomic projections estimate GDP losses in Australia reaching -6% by 2050, and -18% by 2100[9].

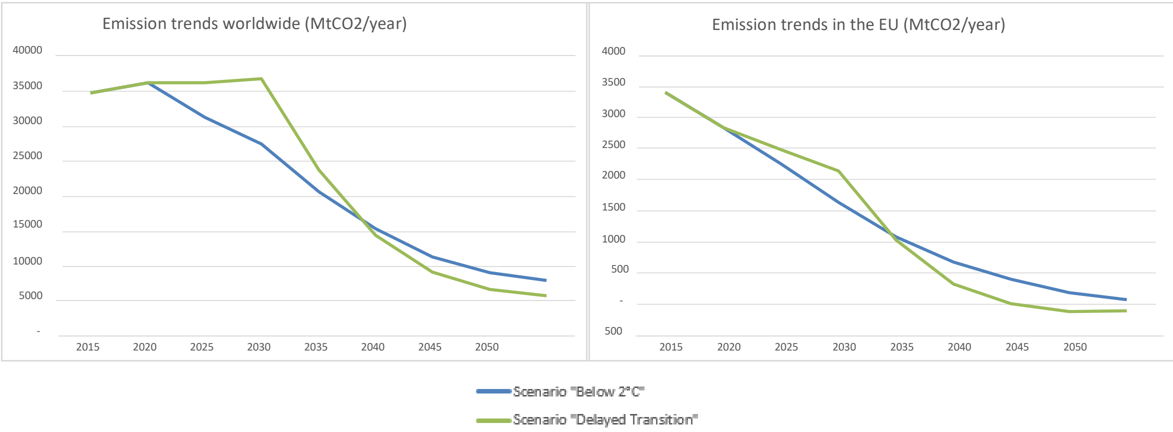
Graph 2: Changes in carbon prices and CO2 emissions in the EU and worldwide under the Below 2°C and Delayed Transition scenarios



[7] Link to the presentation of the NGFS phase III scenarios: https://www.ngfs.net/sites/default/files/medias/documents/ngfs_climate_scenarios_for_central_banks_and_supervisors_.pdf.pdf

[8] The impact of climate conditions on economic production. Evidence from a global panel of regions | Elsevier Enhanced Reader

[9] It should be noted that the macroeconomic projections considered in this exercise cover a time horizon up to 2050.



Reading aid: the emission paths are taken from the REMIND-MAgPIE model and are represented continuously, but the NGFS scenarios only provide values in 5-year increments.

The Below 2°C and Delayed Transition scenarios have similar levels of exposure to physical risks and they are calibrated so that the probability of reaching a temperature below 2°C in 2100 stands at 67%. They do differ significantly, however, in their exposure to transition risks, as the Delayed Transition scenario features delayed and more disorderly measures than the below 2°C scenario. These differences between the two scenarios in terms of transition risks are mainly attributable to changes in the carbon price variable: the Below 2°C scenario assumes a gradual increase of the carbon price (Graph 2), whereas the Delayed Transition scenario features a sharp increase in the variable in 2035, with prices rising from US$15 to US$345/tCO2 and from US$6 to US$127/tCO2 in Europe and the rest of the world respectively over the time horizon covered by the exercise.

Under the Below 2°C scenario of the NGFS, global warming is kept below 2°C throughout the century. The physical and transition risks remain fairly low up to 2100, thanks to a growing awareness that has led to the adoption of early environmental regulations including increasingly coercive measures with no significant disparities between the various regions and countries considered. Additionally, in conjunction with the introduction and gradual increase of carbon prices in line with the transition objectives set from 2025 onwards, the technological advances and techniques used for atmospheric carbon dioxide removal[10] allow for a noticeable decrease in global greenhouse gas emissions as early as 2025 (Graph 2).

In the Delayed Transition scenario, and notably due to delayed action taken, transition risks are higher than in the Below 2°C scenario[11]. Indeed, in this scenario, without the introduction of additional and stronger carbon regulations, the average carbon price suddenly increases in 2035 as a way to promptly compensate for the inaction in the years prior to that hike. Because of the disorderly nature of the measures taken, and due to the geographical disparities in the technological advances that enable atmospheric carbon dioxide

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[10] The term used for the elimination of atmospheric carbon dioxide, Carbon Dioxide Removal, covers all the ways carbon dioxide in the atmosphere can be captured and sequestered. They include methods that take advantage of natural processes (such as reforestation and changes in agricultural practices) as well as technology-based ones (such as bioenergy with carbon capture and storage -BECCS-, or direct air capture -DAC- technologies that captures carbon dioxide directly from the air.[11] It should be noted that, in the long-term, the two variants have similar levels of physical risk and that the main differences between the scenarios lie in their exposure to transition risks.

[11] It should be noted that, in the long-term, the two variants have similar levels of physical risk and that the main differences between the scenarios lie in their exposure to transition risks.

removal, global emissions do not significantly start reducing before 2040. However, as the measures adopted from 2035 onwards are both hasty and drastic, the NGFS's projected emissions for the Delayed Transition scenario decrease at a faster rate than those of the Below 2°C scenario (Graph 2; from 2040 onwards, emissions in the Delayed Transition scenario fall to a lower level than those of the Below 2°C scenario: 16,860 Mt CO2 / year and 18,069 Mt CO2 / year respectively).

3.1.2 Macroeconomic impacts of long-term scenarios

The macroeconomic data presented below for the various scenarios reflects the paths published by the NGFS in September 2022, updated with the data published by the NIESR in February 2023. These trajectories take into account the effects -mainly inflationary pressures- of the war in Ukraine.

Table 1 below shows the main macroeconomic variables that will be used in the 2023 exercise, as well as the variations from the scenario used as a baseline for the two adverse variants retained. While GDP projections in the Baseline scenario -in which both physical and transition risks are excluded- reflect steady growth until 2050, the two adverse scenarios are marked by decreasing GDP levels until the end of the projection horizon, in contrast with the baseline scenario.

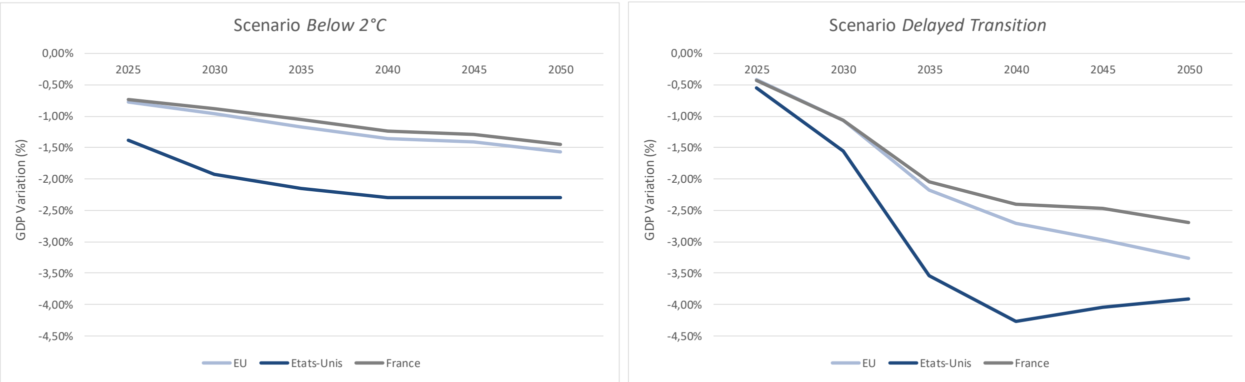
Table 1: Main macroeconomic variables in the baseline scenario and effects of a disorderly transition on the adverse scenarios

	2025	2030	2035	2040	2045	2050
NIESR baseline scenario						
GDP - RoEU	3.2%	1.7%	0.9%	0.6%	0.5%	0.6%
GDP - US	2.5%	2.0%	1.5%	1.3%	1.2%	1.0%
GDP - France	1.7%	1.3%	1.6%	1.6%	1.7%	1.7%
Inflation - France	2.0%	1.8%	1.8%	1.9%	2.1%	2.1%
Unemployment rate - France	7.6%	8.6%	8.9%	9.0%	9.1%	9.1%
Adverse variant 1 - Below 2°C scenario						
GDP - France	-0.7%	-0.9%	-1.1%	-1.2%	-1.3%	-1.4%
Inflation - France (p.p.)	0.2%	0.0%	0.1%	0.1%	0.1%	0.1%
Unemployment - France (p.p.)	0.0%	-0.1%	-0.1%	-0.1%	0.0%	0.0%
Adverse variant 2 - Delayed Transition scenario						
GDP - France	-0.4%	-1.1%	-2.0%	-2.4%	-2.5%	-2.7%
Inflation - France (p.p.)	0.0%	-0.1%	0.6%	0.3%	0.1%	0.0%
Unemployment - France (p.p.)	0.0%	0.1%	0.0%	-0.1%	-0.1%	0.0%

Table 1 shows the GDP projections for France, the rest of Europe and the United States under the baseline scenario of the NGFS. Following steady GDP growth expected until 2030 for all the regions covered, the GDP curve would stabilise at around 1% in the baseline scenario until 2050. Moreover, under the same scenario, unemployment in France would rise over time, reaching 9% in 2040 before eventually stabilising at 9.1% at the end of the projection period used for this exercise. In contrast, after falling to 1.8% in 2035, inflation would then increase until the end of the projection horizon, stabilising at 2.1% from 2045 onwards.

The projected fluctuations in GDP levels provided by the NGFS differ from one scenario to the other, reflecting the fact that mitigation measures are implemented at different stages, more or less belatedly depending on the scenario considered. While the variations in GDP level included in the first variant remain contained and do not fall below -2.5% in all the geographical areas covered by the exercise, they are more significant in the Delayed Transition scenario, under which they drop as low as -4.8% in the United States in 2040 and reach -3.3% in Europe by 2050 (Graph 3).

Graph 3: Variation path of the GDP curve under the two scenarios retained by the ACPR



In the short-term, in particular, the effects of physical and transition risks on the French GDP are significantly milder in the Delayed Transition scenario than in the Below 2°C scenario (respectively -0.4% and -0.7% in 2025). However, starting in 2030, the assumption of a sharp increase in carbon prices in the European Union (from USD 15.04/t CO2 in 2030 to USD 345.02/t CO2 in 2035) in the Delayed Transition scenario would trigger lower GDP and activity levels compared to the baseline scenario. As a result, the macroeconomic impacts of the Delayed Transition scenario would be more substantial than those of the Below 2°C scenario as of 2030: at the end of the horizon, the drop in GDP would amount to -2.7% in the Delayed Transition scenario compared with -1.4% in the Below 2°C scenario, when compared with the baseline scenario.

3.1.3 Sector-specific developments

The sectoral shocks were determined using the methodology developed for the pilot exercise (see Allen et al., 2020), by calibrating the Banque de France's multi-sectoral general equilibrium model in order to align it with the GDP projections derived from NGFS scenarios.

However, this new exercise introduce two developments.

The first one relates to the sectoral model itself, and to its calibration data; the latter is no longer based on the 55 NACE activity sectors taken from the WIOD[12] database, but on the 200 sectors identified in the Exiobase database, which notably makes it possible to assess sensitive sectors with increased granularity. Once the sectoral shocks have been obtained using the Exiobase nomenclature, they are converted into NACE sectors. Ultimately, the shocks are provided for 22 NACE[13] sectors, using a more granular approach for the sectors most sensitive to transition risk (for instance, the gas extraction and oil extraction sectors are differentiated), whereas they are intentionally aggregated for the sectors that have been identified as less sensitive as a result of the pilot exercise.

The second development concerns the inclusion of chronic physical risk in the projections. The latest generation of NGFS scenarios, published in October 2022, takes into account the impact of chronic physical risk per country.

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[12] World Input-Output Database (http://www.wiod.org/home).

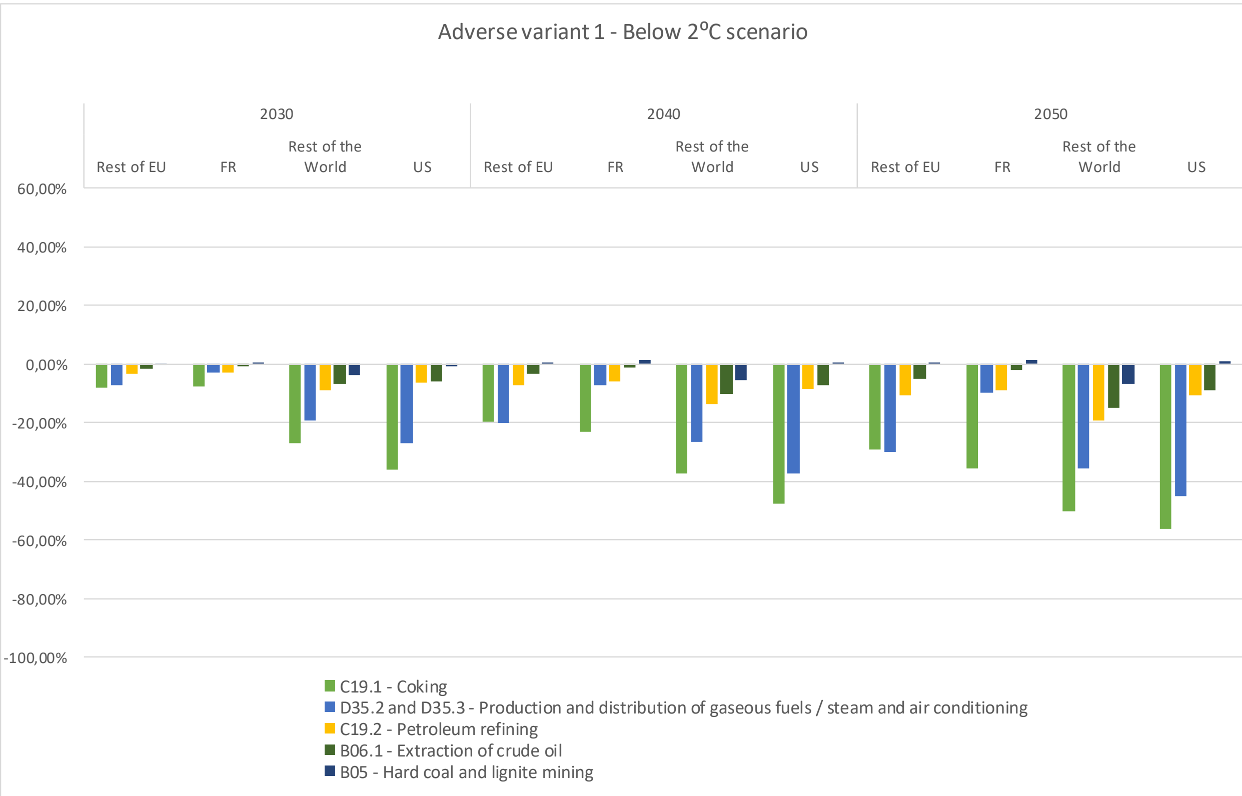
[13] The detailed list of sectors is available in the provisional table presenting the provided variables. This table is included in the provisional assumptions document.

In order to break down these impacts according to a sectoral approach, the ACPR has incorporated productivity shocks into the multi-sectoral general equilibrium model that are partially differentiated per sector as follows:

- To take account of the sectoral impact of rising temperature levels on outdoor labour productivity, the ACPR used differentiated shocks for each macro-sector on the basis of an assessment made by the International Labour Office (ILO)14, linking them to the "Labour Productivity due to heat stress" variable of the Climate Impact Explorer; this approach had already been used as part of the ECB's 2022 climate stress test.
- In addition, chronic physical risk shock on GDP in the NGFS scenarios is based on a macroeconomic damage function that captures effects on labour, but also on capital and total factor productivity (Kalkuhl & Wenz 2020). The resulting productivity shocks would be greater than those solely explained by the specific impact of heat waves; an additional productivity shock, this time undifferentiated between sectors, has therefore been incorporated into the sectoral model.

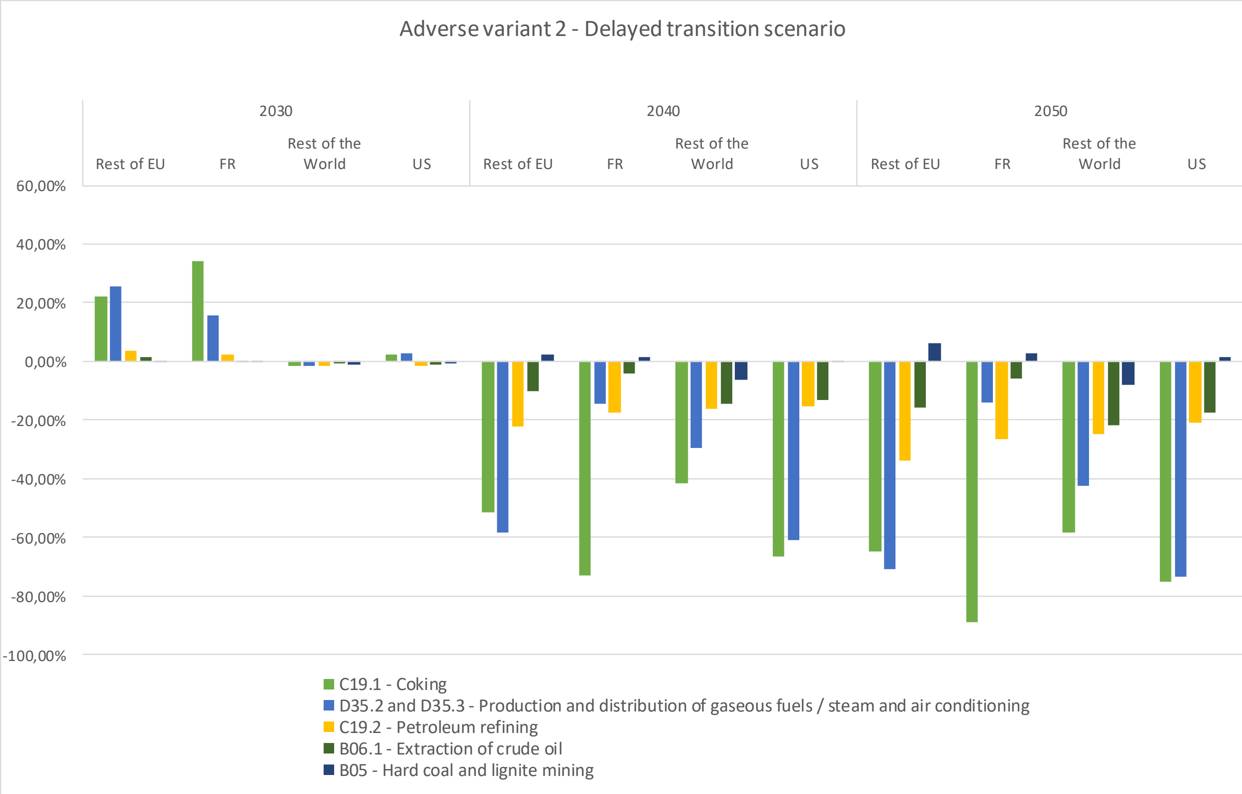
The value-added trajectories resulting from the application of the sectoral model are presented in Graphs 4 and 5 below. These impacts reflect the cumulative effect of chronic physical risk and transition risk.

Graph 4: Sectoral impacts - Variant 1 (deviation from the baseline scenario)



[14] Working on a warmer planet: The impact of heat stress on labour productivity and decent work (ilo.org)

Graph 5: Sectoral impacts - Variant 2 (deviation from the baseline scenario)



The gap between sectoral figures is mainly attributable to transition risk, and it reflects the cost increases and substitution mechanisms arising from the rise in the carbon prices. This is reflected in changes in the relative prices of the various types of energy and to a substitution phenomena between inputs in each productive sector. The rising price of carbon-based energy means that the associated energy producers are less competitive, thereby leading to a drop in demand[15]. Extractive industries are the most affected, as a matter of course. The increase in the price of fossil fuels also has a direct effect on the production costs and value added of the sectors that are most dependent on these energy sources, an effect that is offset by the potential substitution effects.

Contrary to the findings of the pilot exercise, and despite the fact that these industrial sectors are highly carbon-intensive, their added value does not appear to be disproportionately affected compared to the rest of the economy. Conversely, the service industry is more affected than it was in the pilot exercise. This more even distribution between macro-sectors can also be explained by the inclusion of chronic physical risk, which causes a less differentiated impact depending on the sector.

3.1.4 Financial assumptions

The main financial assumptions provided to insurers include, in addition to the international macroeconomic assumptions provided for the various analysed scenarios and geographical areas covered, the following elements:

[15] The trajectory of developments in the use of energy inputs in the Below 2°C and Delayed Transition scenarios compared to the baseline scenario can be provided with the final assumptions (refer to the provisional Excel table).

- the projection of the risk-free interest-rate term structure provided by EIOPA (European Insurance and Occupational Pensions Authority)[16], specifically to allow for the discounting of insurers' liabilities;
- the projections of sector-specific stock market indices obtained using a valuation model based on discounted future dividend flows (Dividend Discount Model - DDM), for the 22 NACE sectors or sector groups considered and for each of the main geographical areas covered (France, Europe (excluding France), United States, Rest of the World);
- the projection of corporate credit spreads, with maturities ranging from 1 to 5 years, for each geographical area (France, Germany, Italy, Spain, the United Kingdom, Euro area, the United States and Japan) and broken down by economic sector according to the 12-sector BICS nomenclature[17].
- the projection of sovereign rates, with maturities ranging from 6 months to 1 year, broken down by geographical area (France, Germany, Italy, Spain, United-Kingdom, Euro area, United States and Japan).

3.1.4.1 Assumptions provided by EIOPA for the term structure of risk-free interest rates

The estimate and projection of the term structure of the risk-free interest rates provided by EIOPA has been carried out using a Gaussian affine model with macro-financial variables inspired from Joslin, Priebsch and Singleton (2014, JF)[18] and estimated according to the methodology by Adrian, Crump and Moench (2013, JFE)[19]. The database used for the estimation of this model is based on the EIOPA risk-free interest rates on maturities ranging from 1 year to 20 years over a period going from January 1999 to December 2022. It should be noted that the risk-free rate data provided monthly by EIOPA only cover the period from December 2015 to December 2022, whereas interest rates for January 1999 to November 2015 are obtained using interest rate swaps curves adjusted to account for the credit risk component according to the same principle adopted by EIOPA.

Therefore, this database, extended using the EIOPA risk-free interest rates, enables the adopted model to include interest-rate levels other than the -very low- level observed over the 2010-2020 period. The variables of the model used for this exercise are the first three main components obtained over the estimation period, completed by two macroeconomic variables (the growth rate of the GDP and the inflation rate harmonised with the index of consumer prices (HICP) for the Euro area). The projections are obtained by forecasting the interest-rate term structure, conditional on the trajectories of the two macroeconomic variables taken from the NiGEM model for each scenario, from 2023 to 2050.

Graphs 6 and 7 below show structural variations for each maturity compared with the baseline scenario, for each scenario and for all the time increments of interest in the exercise (2025, 2035, 2040 and 2050). They show that, while the risk-free rate curves of the Below 2°C scenario remain relatively close to the Baseline scenario for the time period considered, the risk-free rate curves of the Delayed Transition scenario are around 30 bps lower than in the Baseline scenario in 2025, before an upward trend brings them +30 bps higher than the Baseline scenario in 2050 (graph 7).

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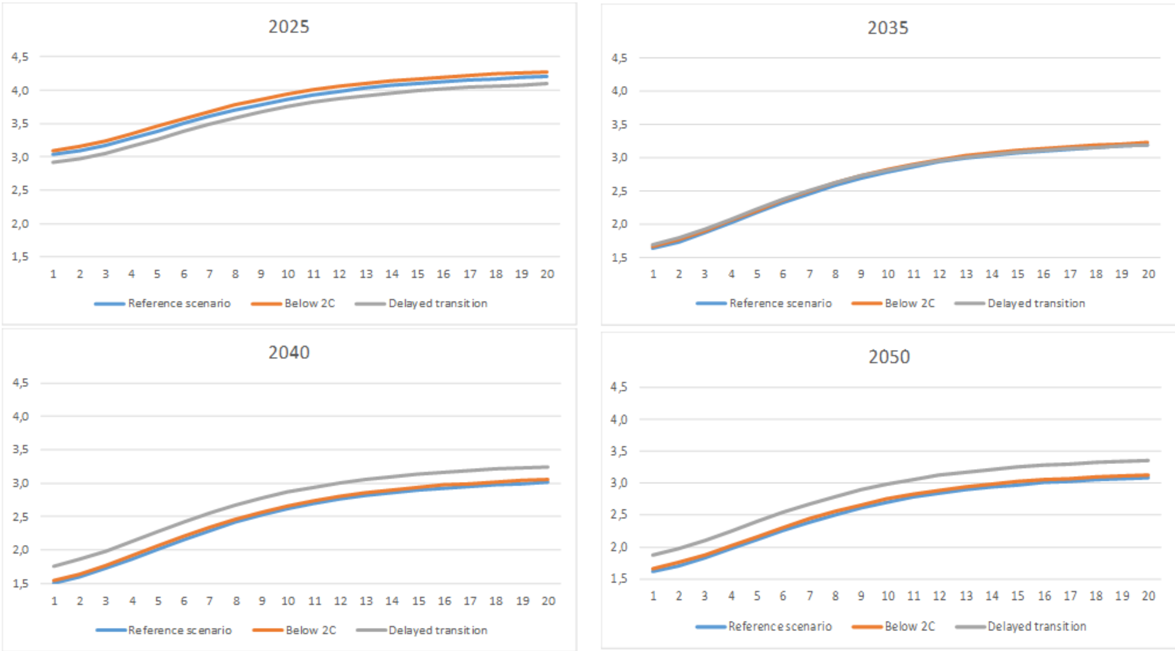
[16] Refer to https://www.eiopa.europa.eu/tools-and-data/risk-free-interest-rate-term-structures-0_en

[17] According to the Bloomberg Industry Classification Standard (BICS), using the database of the Risk Management Institute (rmicri.org).

[18] Joslin, S., Priebsch, M., & Singleton, K. (2014, June). Risk premiums in dynamic term structure models with unspanned macro risks. *The Journal of Finance*, 69 (3), 1197-1233.

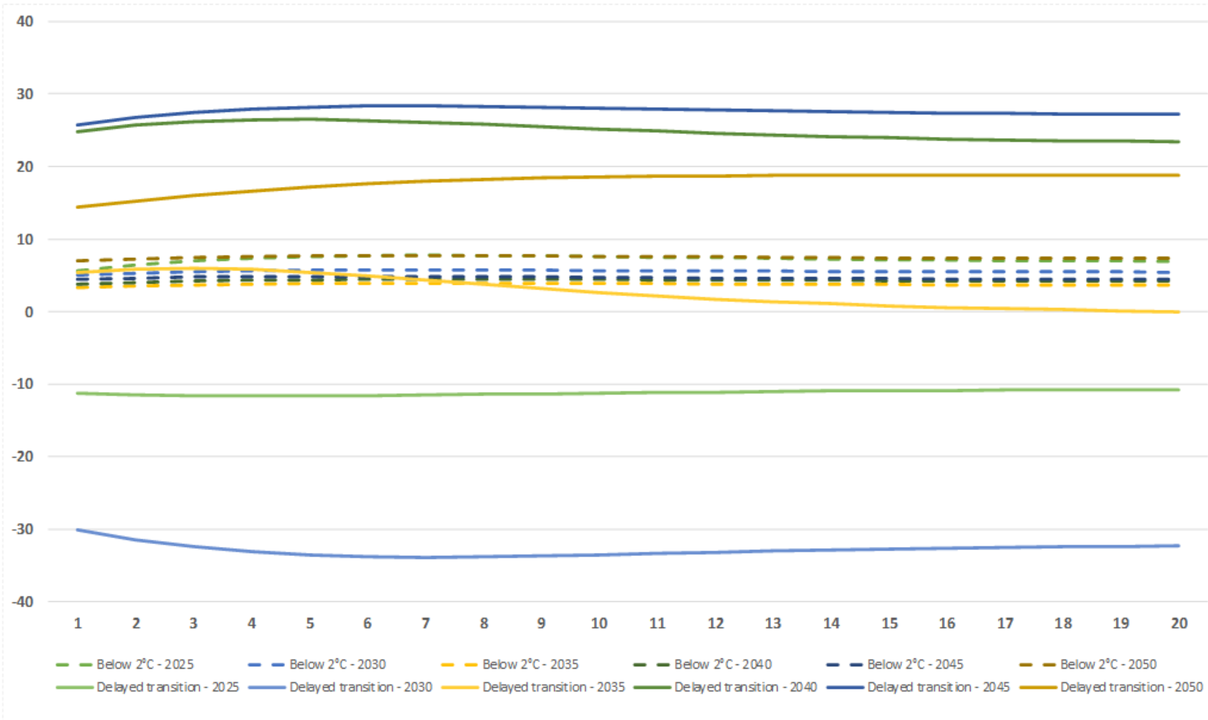
[19] Adrian, T., Crump, R., & Moench, E. (2013). Pricing the term structure with linear regressions. *Journal of Financial Economics*, 110 (01), 110-138.

Graph 6: Projections provided by EIOPA for the term structure of risk-free interest rates in 2025, 2035, 2040 and 2050.



Reading aid: anticipated variations of term structures for the risk-free interest rates provided by EIOPA for the years 2025, 2035, 2040 and 2050, contingent on economic activity and inflation scenarios and without volatility adjustment. Maturities are expressed in years and rate variations in bps (on an annual basis).

Graph 7: Projected variations in the term structure of EIOPA risk-free interest rates in 2025, 2030, 2035, 2040, 2045 and 2050 compared with the Baseline scenario



Reading aid: Maturities expressed in years and interest rate variations in bps (on an annual basis).

3.1.4.2 Assumptions pertaining to the evolution of stock market indices by activity sector

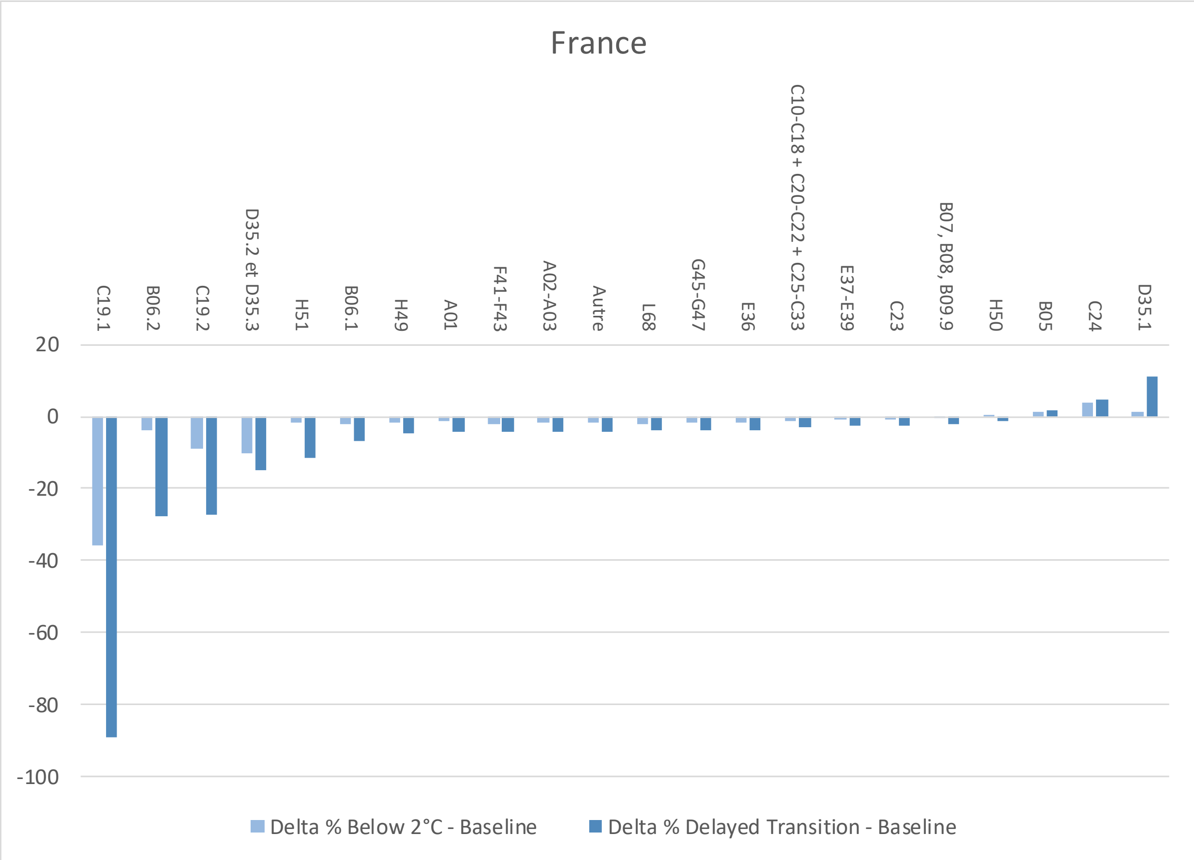
The projections of variations of stock market indices from the reference scenario, contingent to the analysed scenarios, are obtained by combining the results of (i) the simulations of the NiGEM model, (ii) the general sectoral equilibrium model of the Banque de France and (iii) a valuation model based on discounted future dividend flows.

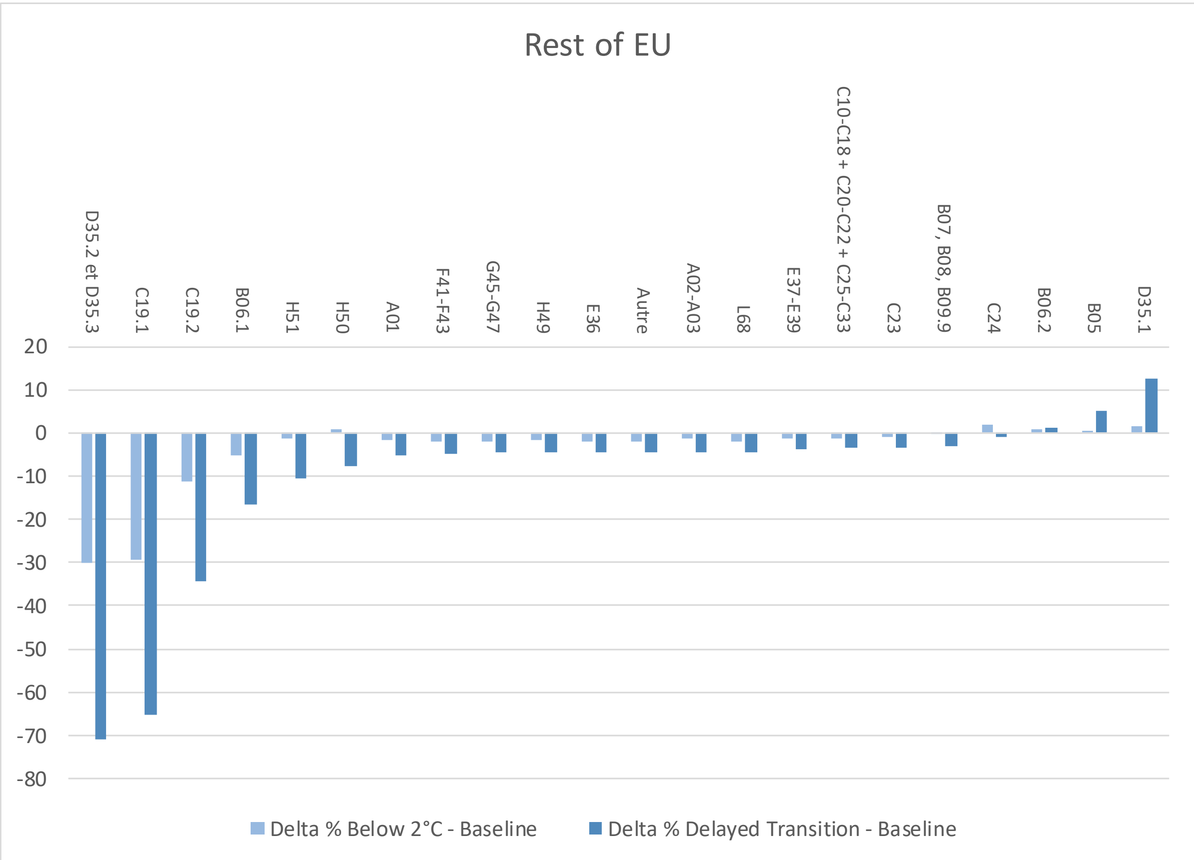
Using the NiGEM projections and the sectoral model of the Banque de France, we get, for each scenario, over all the geographical areas considered and for the 22 NACE sectors or sector groups, added value (VA) projections between 2025 and 2050. We then calibrate an actualisation model for the discounted flows of future dividends by first retaining the assumption of a fixed dividend distribution rate representing 33% of VA[20]. The dividend flows thus obtained for each country and sector considered are then discounted using a sectoral return rate average on benchmark stock price indices for each geographical area.

Graph 8 below shows, for risk-sensitive sectors, the anticipated stock market variations (in %, measuring elasticity), for France and for the year 2045, between each of the two scenarios considered for the exercise and the Baseline scenario. Orders of magnitude of the shocks vary significantly across geographical areas.

[20] This assumption is based on INSEE data, which shows that between 1993 and 2020, French financial and non-financial institutions distributed dividends averaging 16.7% of value added.

Graph 8: Elasticity projection of sector-specific stock indices in France and in the Rest of Europe (2045) compared with the Baseline scenario





3.1.4.3 *Assumptions pertaining to the evolution of credit risk (spreads)*

Assumptions pertaining to corporate credit spreads are provided for each geographical area (France, Germany, Italy, Spain, United Kingdom, Euro area, US and Japan) and for each of the 12 activity sectors included in the Bloomberg Industry Classification Standard (BICS).

These spreads were built using the probabilities of default published on the website of the Risk Management Institute (RMI) of the National University of Singapore on a monthly basis, using the credit spread formula of the Merton model (1974)[21] and assuming a 40% recovery rate and a Sharpe ratio at 0.22 (see Chen et al. 2009[22] for the empirical evidence behind that assumption). The default probabilities used relate to time horizons ranging from 1 to 5 years, years, and are calculated based on the methodology of Duan, Sun and Wang (2012)[23] which is based on a generalisation of the approach presented by Duffie, Saita and Wang (2007)[24].

For France, 1-year default probabilities (and therefore, credit spread projections) by 2050, calculated for each scenario and each economic sector, are obtained using an intra-sectoral model from the Corporate Governance Directorate of the Banque de France.

Given the future trajectories set for these 1-year credit spreads regardless of sectors and scenarios, credit spread projections for other maturities and for all sectors (for each scenario) are obtained using a Gaussian VAR model that considers the following as state variables: spreads (maturities ranging from 1 to 5 years), sovereign yields (maturities ranging from 6 months to 10 years), GDP growth rates and inflation rates (see Allen et al. (2020) for further information).

3.1.4.4 *Assumptions pertaining to sovereign interest rates*

For sovereign interest-rate projections (maturities ranging from 6 months to 10 years) obtained using the methodology presented in the previous subsection, variations (in an alternative scenario such as Below 2°C or Delayed Transition scenario, compared to the NIESR's reference scenario) are mostly positive (upward curve) for France, Italy, Spain and the Euro Area, while negative variations or a change in the slope of the curve are observed for Germany, the UK, the US and Japan.

3.1.5 Residential real estate shocks

The residential real estate shocks forecast for the purposes of this climate risk exercise are based on national real estate price trends as defined in the NGFS assumptions for the Below 2°C and Delayed Transition scenarios[25].

It should be noted that between 2030 and 2040, the shocks projected by the NGFS in the Delayed Transition scenario are more severe than those predicted in the Below 2°C scenario for all the areas considered. Conversely, from 2040 onwards, the projections of the second adverse variant would lead to a positive revaluation of property up to the end of the exercise (Graph 9).

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[21] Merton, R. C. (1974). On the Pricing of Corporate Debt: The Risk Structure of Interest Rates. Journal of Finance, 29:449 - 470.

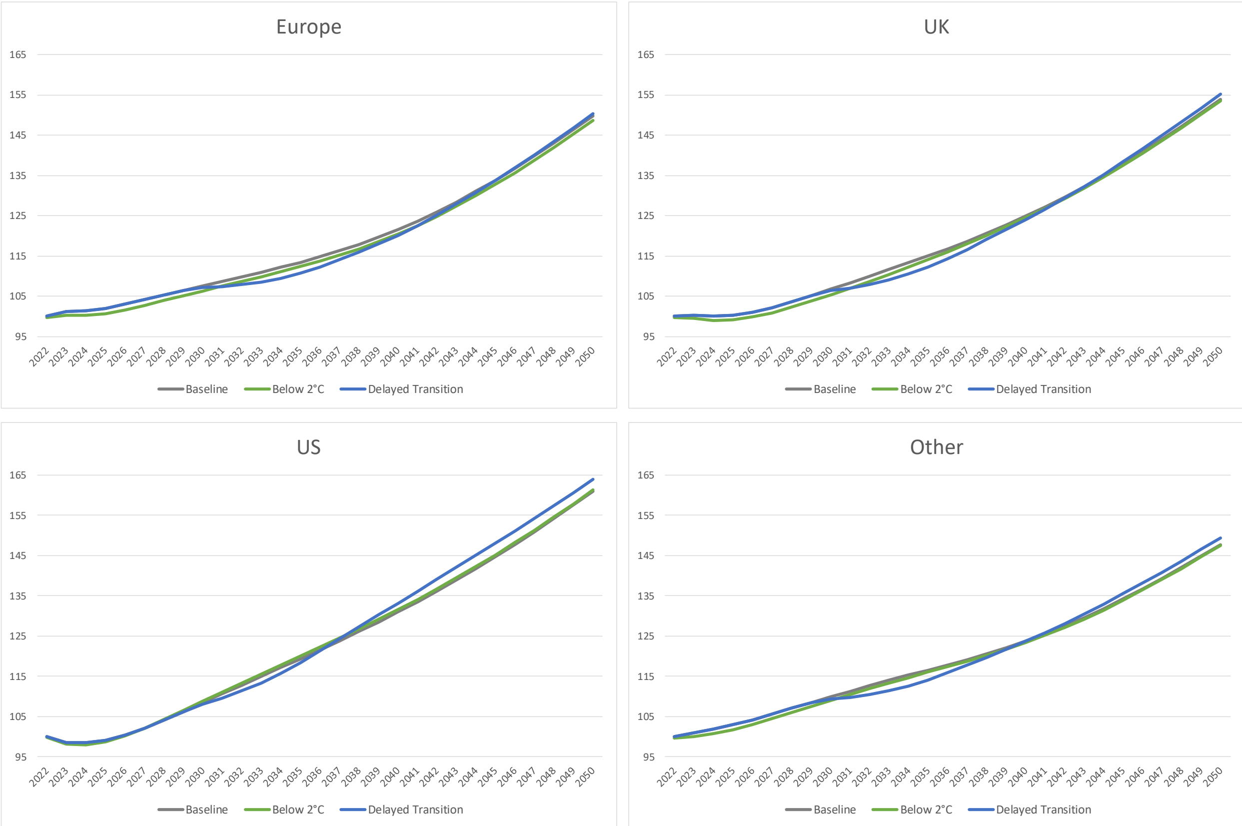
[22] Chen, L., Collin-Dufresne, P., and Goldstein, R. (2009). On the Relation Between the Credit Spread Puzzle and the Equity Premium Puzzle. The Review of Financial Studies, 22(9):3367 - 3409.

[23] Duan J.-.C., J. Sun, Wang T. (2012). Multiperiod corporate default prediction – a forward intensity approach, *J. Econom*., 170 (2012), pp. 191-209.

[24] D. Duffie, L. Saita, K. Wang (2007). Multi-period corporate default prediction with stochastic covariates, *Journal of Financial Economics*, 83, pp. 635-665.

[25] NGFS – Variable house price

Graph 9: House price variation trajectories according to the two adverse scenarios of the NGFS

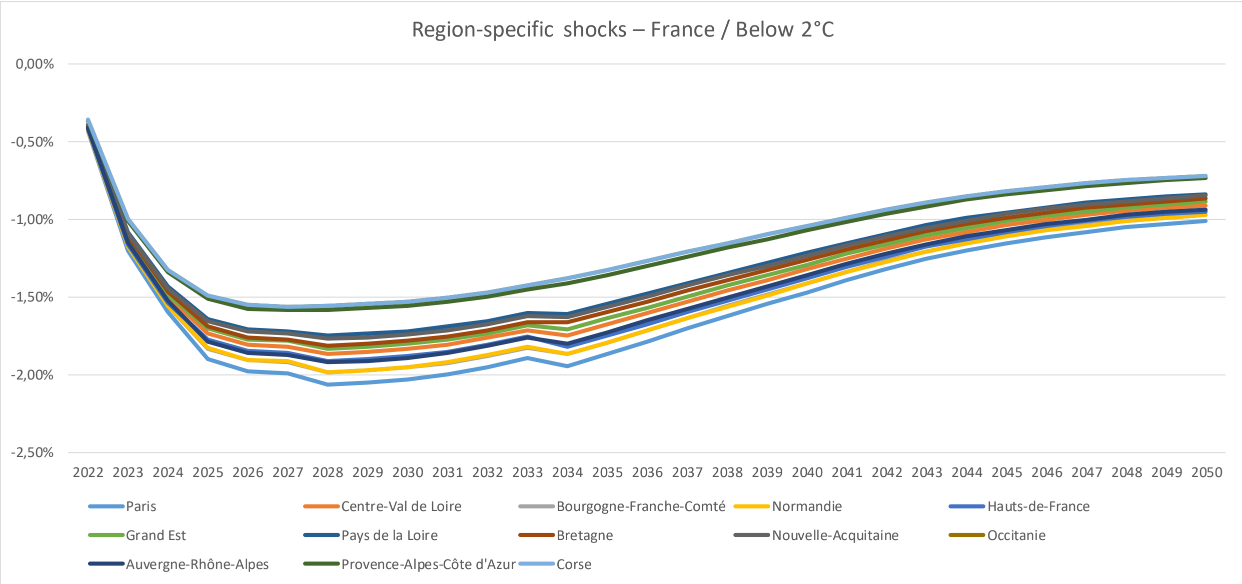


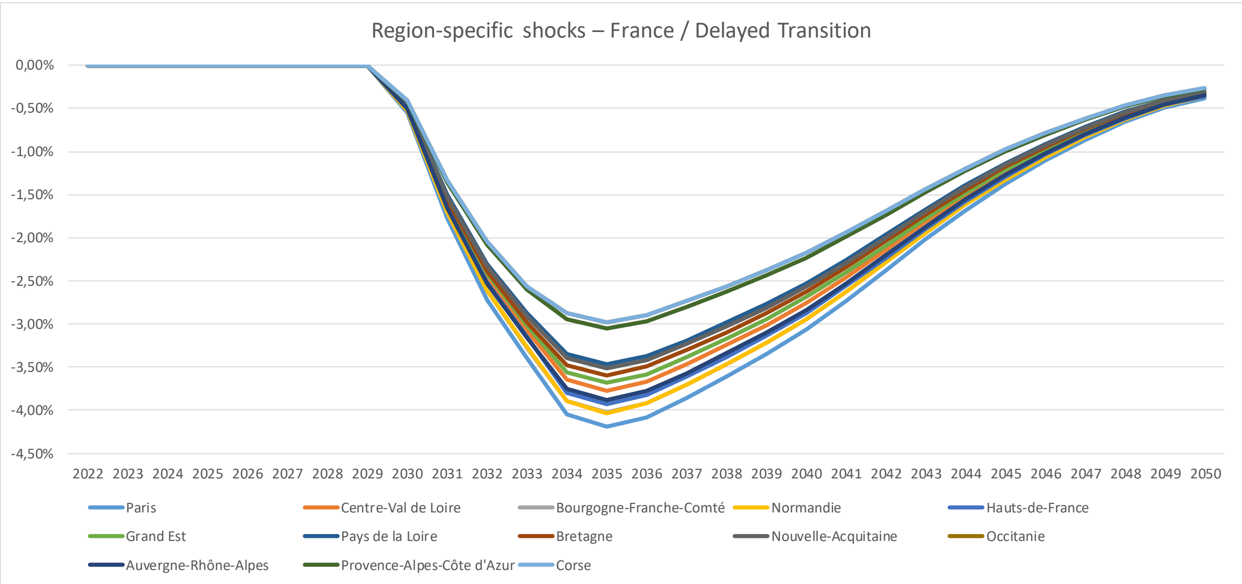
Note: The "Other" region includes Australia, Canada, Norway, Switzerland and Japan.

In addition, in order to take into account the effects of the Climate and Resilience Law[26] coming into force in France, and to reflect the impact of transition risk on the loss of value of property covered by this law, additional region-specific shocks have been applied to the NGFS shocks, taking into account the variation in the relative proportion of homes with energy performance certificates (in French, DPE) rated E, F and G for each geographical area considered[27] (Graph 10).

[26] The Climate and Resilience Law provides for a gradual ban on the rental of poorly insulated housing, starting with properties rated G in 2025, followed by housing rated F in 2028 and E in 2034.
[27] Data provided by ADEME – ADEME – DPE Observatory – Audit (Diagnostic de Performance Énergétique Audit Énergétique)

Graph 10: Trends in house price variations broken down by region



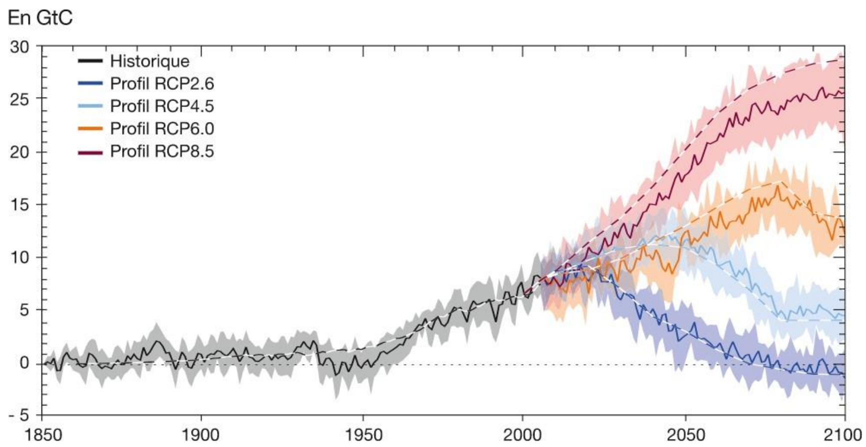


3.2 Assessment of acute physical risk on the liabilities' side

3.2.1 Selection of a RCP 4.5 pathway

Acute physical risk is assessed based on the "RCP 4.5" scenario provided by the Intergovernmental Panel on Climate Change (IPCC). This constitutes a divergence from the pilot exercise, in which the physical risk on the liabilities side was assessed based on the RCP 8.5 scenario, which reflected the assumption of an increase in temperature comprised between 1.4°C and 2.6°C in 2050 (compared with one comprised between 0.9°C and 2.0°C in 2050 according to the RCP 4.5 scenario over 2046-2060[28]).

Graph 11: Fossil fuel emission projections according to four GHG evolution patterns provided by the IPCC[29]



The 2023 exercise is based on the RCP 4.5 for the following reasons:

- The RCP 4.5 pathway offers more consistency with the temperature trajectories of the NGFS's Below 2°C and Delayed Transition scenarios by 2050. The median value for temperature increase is +1.7°C in France in 2050 for the Delayed Transition scenario, compared with +1.4 °C for RCP 4.5; this temperature gap, measured at 0.2 or 0.3°C, is found across all geographical areas[30];
- The observed differences are limited between the RCP 4.5 and 8.5 (and the intermediate RCPs) by 2050, including with regard to the occurrence of extreme climate-related hazards. In terms of river flooding, RCP 4.5 appears equally adverse for France in 2050 compared to the RCP 8.5 (refer to Graph 11). For the other perils considered (coastal floods, subsidence, storms) and in the 2050 horizon, the RCP 8.5 scenario remains slightly more adverse.
- More adverse effects can be considered within the framework of a single emission trajectory. In order to assess natural disaster-related loss experience covered by the compensation scheme for natural disasters (CatNat) in France, the CCR will offer damage projections matching both the median of the RCP 4.5 scenario and the 95th percentile of damage associated with this trajectory, which will make it possible to consider potentially more adverse impacts with a constant socio-economic trajectory (see next section).

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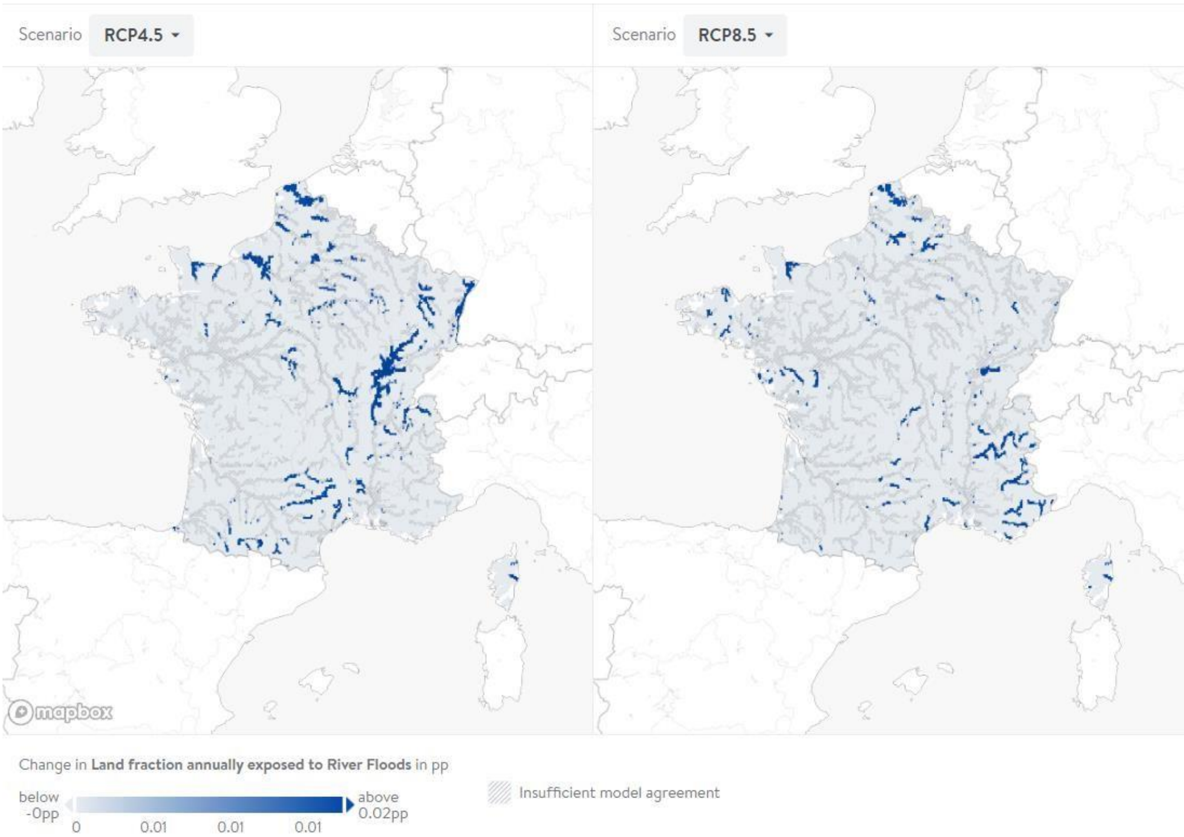
[28] Refer to the SPM.2 table included in the Summary for Policymakers section of the IPCC report issued following their first Working Group: WG1AR5_SPM_FINAL.pdf (climatechange2013.org)
[29] IPCC, 1st working group, 2013
[30] Climate Analytics — Climate impact explorer

- More broadly speaking, RCP 8.5 is subject to controversy surrounding its realization, mainly due to the assumptions regarding the evolution of fossil fuel use on which it is based. Consequently, its relevance as a business as usual scenario is questionable[31].

Graph 12: Projection of the portion of the French territory exposed to river flooding on an annual basis and according to the RCP 4.5 and 8.5 scenarios (France, 2050)[32]



Reading aid: the differences in losses between RCP 4.5 and RCP 8.5 are not significant given model uncertainty.

3.2.2 Physical risk variables

In line with the objectives of the pilot exercise, this year's scope of analysis includes the assessment of the long-term impact of acute physical risk on the property damage and health and life insurance business lines.

These activities are mainly affected by the physical risk arising from climate change, on the one hand through an increase in the frequency and intensity of natural disasters, and on the other hand through the potential effects of environmental degradation on the health of the population. It is to be noted that the tested trajectory will be the same for both the Below 2°C and Delayed Transition scenarios, which is defined by the IPCC's RCP 4.5 scenario by 2050.

[31] Refer to the following for a discussion on the associated stakes: Explainer: The high-emissions 'RCP8.5' global warming scenario (carbonbrief.org)

[32] *Climate Analytics — Climate impact explorer*

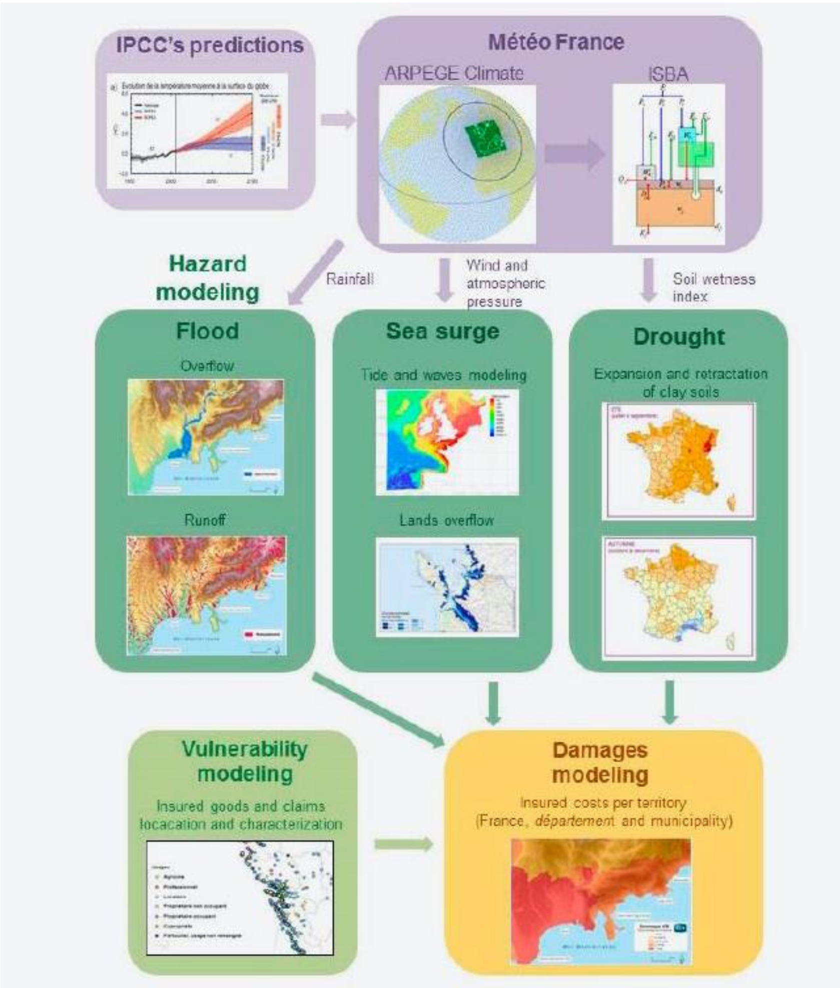
3.2.2.1 *Property insurance*

The impact of changing natural disaster patterns on the insurers' property damage business (individuals, corporate, automotive) will be assessed with the *Caisse Centrale de Réassurance* (CCR), based on the work published in September 2018[33] and that had already been used in the course of the pilot exercise.

The characteristics of this model are outlined below, and the elements that have been amended for the purpose of this exercise compared to the 2020 pilot exercise are identified in bold.

This work is based on projections made by *Météo France* using its *Arpège Climat* model, which generated projections for 400 potential years with the current climate, and projections for another 400 years with a 2050 climate. *Météo France* also used its SAFRANISBA-MODCOU (SIM2) hydrometeorological model for mainland France and Corsica. This local model is fed with around ten meteorological parameters derived from climate simulations and interpolated with an 8-km resolution. The outputs of this model include the soil wetness index (SWI) that is required to study drought risks, as well as various other parameters relating to soil conditions and stream flow. The soil wetness index, which was calculated using a SIM2 configuration with uniform clay soil concentration over France, fed the CCR model used to calculate the damage incurred to buildings due to geotechnical drought (see Graph 13 below). For the purposes of the 2023 exercise, modelling was carried out for an RCP 4.5 scenario, instead of the RCP 8.5 that was previously used.

Graph 13: Climate modelling chain implemented by *Météo France* and integrated by the CCR[33]



[33] CCR (2018) - Consequences of climate change on the cost of natural disasters in France by 2050

Demographic projection scenarios provided by INSEE (the French National Institute for Statistics and Economic Research) were used to estimate the number of risks for individuals (meaning for residential property) in 2050. The central scenario uses the national trends observed for net migration, fertility and increased life expectancy and scales them down to department level. Departmental data was then used to determine an average annual growth rate, which was then applied at the municipal level. For occupational risks (namely industry, services and farming activities), changes in active labour force were taken into account using demographic projections in conjunction with observed economic shifts.

Insurers are invited to contact the CCR directly to estimate the damage incurred over the 2025-2050 period. Preferably, the requested information specified below should be communicated on a municipal basis (wherever possible) or on the department-level where the former is not available. The same guideline applies for **the amount of damages to be covered provided by the CCR, which will be broken down per type of peril considered. Insurers will be provided with median loss estimates, as well as loss estimates for the 95% quantile of damage estimated by the CCR.** Moreover, insurers are invited to incorporate and communicate on their potential management actions (changes in premiums as well as developments in terms of insured stakes) **taking into account the reaction of policyholder demand included in the assumptions detailed in section 3.3.2.** Failing that, the assumption retained will be that of fixed market shares at the municipal and departmental level.

The information to be provided by insurers should cover the following elements in particular:

- The number of risks insured per municipality: distinguishing between individuals and professionals; failing that, the total number of risks;
- Insured values broken down by municipality: distinguishing between individuals and professionals; failing that, the total insured value;
- The natural disaster compensation scheme (CatNat) premiums issued broken down by municipality: distinguishing between individuals and professionals; failing that, the total amount of natural disaster-related premiums.
- The INSEE code used to identify municipalities, where applicable, or the department number used to identify departments.

Lastly, in the case of coinsurance, the information required is equal to the quota share of the participating insurer. Information must be provided in ".csv" file format.

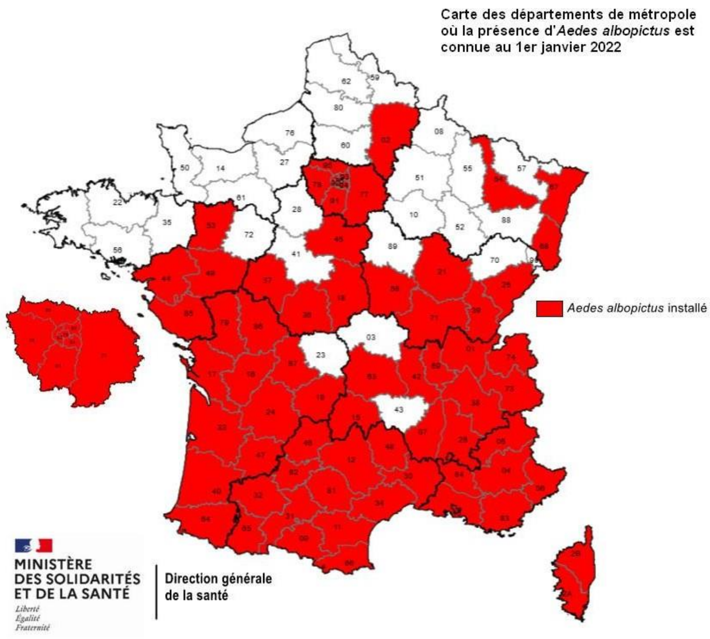
3.2.2.2 Healthcare costs and mortality rates

Climate change is also affecting the emergence of exotic diseases or chronic pathologies linked to the exposure to extreme heat or to the increase in the level of particles in the air.

The assumptions include the expected trends in healthcare costs and changes in life tables associated with the IPCC's RCP 4.5 scenario. This development is linked to:

- The assumption of an increase in the probability of occurrence of pathogen transmission (viruses, bacteria, parasites...): such probability varies depending on the geographical location where insured populations live and on their vulnerability to vector-borne diseases. By way of illustration, Graph 14 shows the evolution and breakdown by department of the dengue-carrying tiger mosquito's (*Aedes albopcitus*) presence since 2004.
- The development of pathologies related to the deterioration in air quality in urban areas or the increased frequency and intensity of heat waves. The population groups identified as being most vulnerable to this type of event are the elderly and young children. The portfolios of insurers should be segmented accordingly.

Graph 14: Geographical presence of the *Aedes albopictus* dengue vector in mainland France in 2022[34]



In order to assess the impact of the development of these pathologies within the framework of this exercise, AON provides assumptions on the evolution of life tables and healthcare costs broken down by geographical areas and age groups concerned for each of the cited channels (pollution and vector-borne diseases). Average shocks applied to the entire French territory are also provided so that an impact can be calculated without having to segment insurers' liability portfolios.

3.3 Management actions

3.3.1 Submission of intermediate reports: global consistency of exposures with the financing needs of the economy

As part of the intermediate submissions expected in November 2023, participating insurers are asked to make asset composition projections for long-term scenarios. This ensures that the ACPR teams are able to check that the submissions are consistent, at an aggregate level, with the structure of the financing needs of the economy.

[34] https://www.santepubliquefrance.fr/maladies-et-traumatismes/maladies-a-transmission-vectorielle/dengue

3.3.2 Liability management actions

Due to the increased frequency and cost of extreme weather events, insurance premiums could rise significantly, making insurance cover unaffordable for a considerable number of households and companies as well as for some business activities.

The climate exercise adopted both a qualitative and quantitative approach to risk assessment.

Qualitative approach:

The aim of the exercise is to assess how participants are likely to modify their business models in order to mitigate the physical risk associated with global warming.

Insurers are invited to use a questionnaire to explain the management actions made to address the materialisation of the physical risk, such as changes made to their underwriting, pricing and reinsurance policies.

The qualitative analysis will cover all the policies included in their property insurance portfolio, be it on the individual or the professional policyholders.

Quantitative approach:

In order to make a quantitative assessment on the issue of insurance gap risk, *ad hoc* assumptions on the reaction of policyholder demand are provided in an Excel file.

Since home insurance is compulsory for tenants but optional for homeowners, only policies taken out by homeowners (whether they occupy the premises or not) will be taken into consideration when assessing the impact of changes in insurance premiums on the coverage of physical risks for insurers.

An indicator has been determined for each department, specifying the threshold at which homeowners are liable to terminate their home insurance contract, should the cost of this policy be deemed too high.

The variable used to define this termination threshold corresponds to the ratio between the premium of the basic insurance policy covering property, as set in article L. 125-2 of the French Insurance Code, and the total value covered by the home insurance policy:

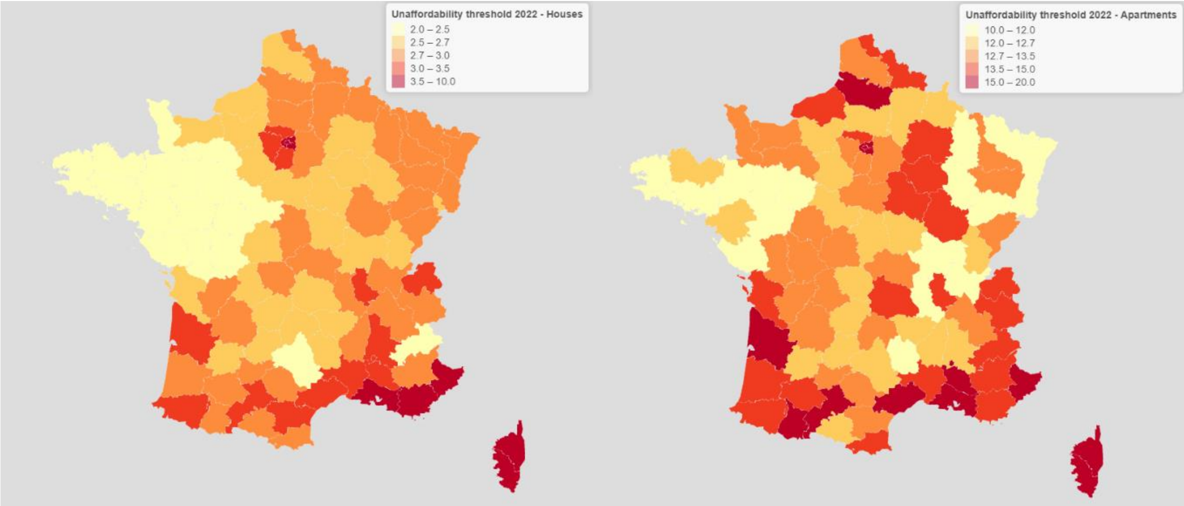
$$\frac{Basic\ \text{“}property\ damage\text{”}\ premium}{Total\ value\ insured\ (expressed\ in\ thousands\ of\ €)}$$

Termination threshold data, broken down by department and type of real estate, are filled in for each time interval projected as part of this exercise, in a separate Excel file.

Methodology for the modelling of policyholder demand:

1) Identify individual contracts where the insured is the owner of the insured property;
2) Identify, for this segment, and for each projection interval set by the exercise (2025, 2030, 2035, 2040 and 2050), the contracts for which the amount of the basic premium written under the “Property Damage” policies in relation to the total value insured (expressed in € thousands) exceeds the affordability threshold;
3) Model, at the end of each projection interval, the withdrawal of the previously identified contracts from the portfolio.

Graph 15: Breakdown by department of the termination threshold assumption for contracts concluded with individual homeowners



Reading aid: the breakdown on the houses is on the left-hand side of the figure and for the apartments on the right-hand side.

4 Short-term scenario

The short-term scenario is based on a chronological succession of acute, partially localised physical perils whose effects combine in such a way as to amplify the losses from the market shock linked with the transition risk.

Accordingly, - at first - acute physical perils (drought/heatwaves and localised flooding shock) occur from 2023 to early 2025, causing losses that mainly affect insurers' liabilities.

Then, the market shock materialises in the second quarter of 2025, and takes the form of an asset valuation shock that particularly affects assets in the most carbon-intensive sectors.

This short-term scenario is designed to factor in the risk that insurers may underestimate the effects of climate change on their balance sheets in the short-term, while taking into account a time horizon that matches that of their strategic planning.

These shocks also serve other specific purposes. Indeed, the assumption of a dam burst included in this scenario, which would materialise after extreme rainfall events - the effects of which are amplified following a prolonged drought -, will allow insurers to consider the methodological implications of an extreme but plausible peril, one that is localised and which simultaneously affects both life and non-life activities. This major extreme event, which occurs at the same time as a series of similar occurrences around the world and in Europe (Northern and Central Europe in 2021, Northern Italy in May 2023), heightens market awareness to climate risks, leading to substantial impairment losses on assets exposed to transition risk. The magnitude of the market shock is intended to gauge the sensitivity of the insurers' balance sheets to sudden value adjustments, as well as to eventually measure the impact of these various shocks on the solvency of insurers.

4.1 A sequential acute physical risk scenario with compounding effects

4.1.1 Severe drought events in 2023 and 2024

In the first two years of the scenario, 2023 and 2024, the drought and heatwave events observed in 2022 will recur.

- For non-life insurance activities (natural disaster-related drought peril, agricultural insurance), insurers will be able to apply a loss experience level in line with that observed or estimated in 2022;
- For life insurance activities, AON provides the mortality and healthcare costs assumptions associated with the heatwaves of 2022.

4.1.2 Localised flooding peril leading to dam failure in early 2025

The **flood peril localised** in the PACA region is associated with the assumption of the failure of the Serre-Ponçon embankment dam in the first quarter of 2025, following a historic flood of the Durance River, which would materialise the overflow risk to which this type of dam is exposed.

This flood would be caused by exceptionally heavy rainfall coupled with high temperatures at high altitude (accelerating snowmelt). The severe drought of the previous three years would contribute to exacerbating the risk of occurrence and the impact of this flooding.

These extreme events would ultimately have consequences for both life and non-life loss experience.

4.1.2.1 Narrative and link with climate change

Presentation of the Serre-Ponçon dam and consequences of a dam burst:

The Serre-Ponçon dam is located in the municipalities of Rousset (05) and La Bréole (04). The dam is 123.50 meters high; it stores 1,200 million m³ of water over a surface area of 28.2 km².

In the event of the Serre-Ponçon dam bursting, a wave of water higher than a house would propagate along the riverbed of the Durance all the way to the Bouches-du-Rhône department. The height and speed of the water would only reach moderate levels around Tarascon. 17 municipalities of the Hautes-Alpes department, all located on its south-eastern border, would be affected should this dam and the ones located downstream (Espinasses and La Saulce dams) burst: Espinasses, Jarjayes, Lardier-et-Valença, Lettret, Monetier-Allemont, Le Poet, Remollon, Ribiers, Rochebrune, Rousset, la Saulce, Tallard, Theus, Upaix, Valserres, Ventavon, Vitrolles.

According to AON, the loss experience in the life insurance market attributable to this event would amount to €1.3bn.

Influence of climate change on dam burst risk:

The existence of a risk of dam failure in absolute terms

Handling a flood, in the case of an embankment dam such as that of Serre-Ponçon, entails maintaining water level below the high-water mark and ensuring that the volume of water released does not exceed the volume that flows in. The spillways of the Serre-Ponçon dam can accommodate water flow up to 3200 m3/s; beyond this volume, water is stored above the maximum flood level set at 788m, which represents the critical overflow threshold.

This threshold has already been exceeded in 1843 (millennial flood), 1856 (5200 m3/s) and 1886 (6700 m3/s). The assessments carried out with regard to the Durance river as part of the flood risk prevention plan of the lower Durance valley[35] have confirmed that dam failure, dam burst and overflow risks could not be ruled out for the majority of the structures located on the Durance River.

Effect of climate change on this risk

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[35] rp_ppri-durance_bv_9-communes.pdf (vaucluse.gouv.fr)

Because of an increased rainfall during the winter, climate scenarios (Hydro-CH2018 hydrological scenarios) suggest that winter water flow could increase by 10 to 50% by the end of the century. The first studies conducted by the National Centre for Climate Services (NCCS) on the impact of climate change also reveal that, in the case of the Alps, climate change could alter the seasonal distribution of rainfall on the one hand, and increase air temperatures on the other.

It is therefore considered likely that climate change could (i) increase the risk of extreme flooding events that exceed the standard design limits associated with this type of infrastructure and consequently (ii) increase the risk of overflow and therefore that of failure.

4.1.2.2 Assessing the impact of dam bursts on the balance sheet of insurers

Insurers will assess the impacts of the dam burst on the damages in the life insurance sector at the department level and by using the mortality assumptions provided by AON. Indeed, the insurers should be able to simulate their losses using their number of policyholders and gross reinsurance capital at risk.

The impact of the dam burst on loss experience in the non-life sector will be assessed by the CCR, using the same methods as those applied to calculate flood-related loss experience in the long-term scenario.

4.2 Combination with a transition shock on financial markets

4.2.1 Narrative and macroeconomic shock

It is assumed that the extreme events affecting France, similarly to the ones recorded in Northern and Central Europe in 2022 and in Italy in May 2023, would be followed by an abrupt adjustment in financial markets, as the latter would anticipate the swift implementation of carbon regulation in several major economies (EU, USA).

This scenario is based on a so-called "polar" trajectory, in other words a standard trajectory for climate-related financial shocks, so the shock assumptions are based on a limited set of variables. The narrative below illustrates the nature and scale of the financial shocks that could affect the asset side of the insurers' balance sheets over a three-year horizon[36].

The announcement of the implementation of carbon regulations in several major economies (EU, USA) could affect both the companies located in the relevant jurisdictions and those that export to these countries (notably the UK and Japan). Within the European Union, these regulations could lead to tighter financing conditions for companies belonging to the most carbon-intensive sectors. To date, however, the markets have taken little notice of this transition risk when valuing assets. The assumption retained here is that the occurrence of a series of extreme weather events, the effects of which combine to such an extent that they affect major infrastructure involved in the production of energy and the management of water resources, would have a catalysing effect on market expectations.

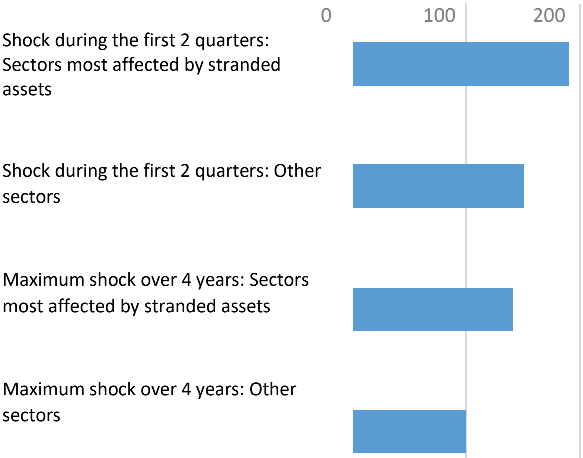
Under this assumption, the cost of corporate financing in the most carbon-intensive sectors would rise sharply (corporate spread shock, calibrated according to Seltzer et al., 2022[37]). The most carbon-intensive sectors would therefore face corporate finance shocks that would exceed shocks experienced by other sectors by around 40 basis points.

Contagion mechanisms would lead to an increase in interest rate spreads across all sectors (systemic shock due to a generalised climate of uncertainty). This would result in an initial increase in credit spreads by 150 basis

[36] The rationale retained is that of stranded assets.
[37] Climate Regulatory Risk and Corporate Bonds, Lee H. Seltzer, Laura Starks & Qifei Zhu, 2022

points during the first two quarters following the announcement -namely Q2 2025 and Q3 2025- reflecting immediate market pressure. This shock would then would then converge towards an increase by around 100 basis points until the end of the period (Q4 2027). In line with these credit spread shocks, equity would plummet as a result of a widespread increase in market volatility across all business sectors.

Graph 16: Credit spread shocks (bps)



Source: calculations by the authors

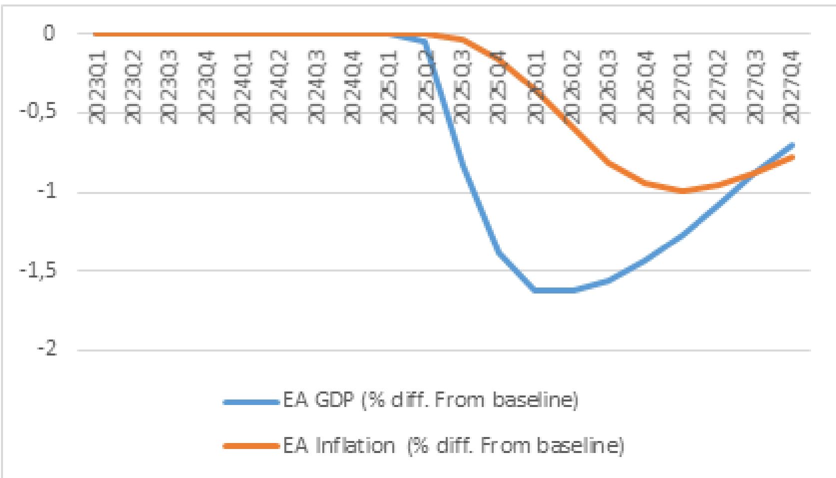
Table 2: distinction between the most affected BICS sectors (in brown) and the others (in green)

Communications
Consumer Cyclical
Banks
Insurers
Other Financial Institutions
Technology
Basic Materials
Consumer Non-cyclical
Energy
Industrial
Utilities
Real Estate

Macroeconomic and financial impacts

This scenario would lead to a relatively sudden fall in the Euro area GDP by around -1.6% (relative to the baseline scenario) as early as the end of the first year following the shock. This shock would then be gradually absorbed, but it would still subsist at the end of the period. This scenario would be disinflationary, with the Euro area inflation falling by around 1 percentage point year-on-year after two years (see Graph 17).

Graph 17: Impacts on Euro area GDP and inflation



4.2.2 Financial impacts

This section is designed to quantitatively assess the impact of the transition shock described above on financial markets (for a country or economic area of interest) and, more particularly, its impact (i) on the sector-specific stock market index performance, as well as (ii) on the sovereign interest rates and sector-specific corporate credit spreads, taking into account potential contagion effects.

The impacts on stock market indices are based on the Dividend Discount Model methodology (DDM, which is outlined in section 3.1.4.2). More specifically, dividend trajectories (discounted for each of the two scenarios presented in the next paragraph) are obtained from the profit trajectories generated by the NiGEM model (from which the other macroeconomic GDP and inflation variables used by the model are also derived). In addition, sovereign rates and corporate spreads are obtained using a Gaussian VAR model (described in section 3.1.4.3).

Assumptions are provided for France, the United States, the Euro area and Japan (the latter may be used as a proxy for Asia).

The following two scenarios have been identified in order to allow these assessments to be carried out:

- A **reference scenario** (Baseline) characterised by 5-year GDP growth rate and inflation rate trajectories (starting at the beginning of 2023 and up until the end of 2027), in line with the NIESR Baseline scenario for each country or economic area under analysis (France, for instance);
- An **alternative scenario** in which GDP and inflation trajectories start deviating from the baseline scenario in Q2 2025, as do corporate credit spreads, according to the parameters described above. In the alternative scenario, the most carbon-intensive sectors of the economy ("brown" sectors) are hit by a shock amounting to +150 bps in Q2 2025 and Q32025 (relative to their value in Q1 2025), followed by +100 bps during the subsequent quarters. The other sectors are faced with a financing shock that is 40 bps lower (that is, +140 bps for the first two quarters, then +100 bps).

Then, for each scenario (in other words, for each fixed set of future paths), all corporate credit spreads (at all maturities and for all sectors) are projected 5 years forward, in the same way as with the return rates on sectoral stock market indices and sovereign rates. The projection gap in the alternative scenario, as compared to the baseline scenario, provides a quantitative assessment of the impact of the abovementioned transition shock. The considered countries and areas are France, Germany, Italy, Spain, the United Kingdom, the Euro area, the USA and Japan.

For corporate credit spreads, the shock in terms of basis points brought on by the financial shock scenario compared with the Baseline scenario starting in 2025 is more significant for the “brown” sectors, for all the geographical areas concerned (Table 3).

Table 3: Variations of corporate credit spreads in bps (alternative - Baseline), on average over 2025-2027 and across all maturities, broken down by geographical area

	France	Euro area	US	Japan
Average for *“brown”* sectors	95	101	95	31
Average for *“green”* sectors	81	85	74	13

This pattern, which is particularly marked in the 'brown' sectors, is also reflected in the **variations in stock market returns.** There is also a certain degree of variability between regions:

- In the Euro area, in France and in the US, recorded elasticity for "brown" sectors stands at around -40%, while “green” sectors -30% for "green" sectors. The energy and utilities sectors are affected the most;
- In Japan, due to profit trajectories (and therefore dividends) being more severely affected in the alternative scenario, elasticity reaches -57% for “brown” sectors, and -46% for “green” ones.

Table 4: Elasticity of the monthly stock returns (as a %, of the alternative scenario compared with the baseline scenario) forecast in 2025, broken down by geographical area

	France	**Euro area**	**USA**	**Japan**
Elasticity percentage for *"brown"* sectors	-40%	-40%	-41%	-57%
Elasticity percentage for "*green*" sectors	-31%	-31%	-32%	-46%

Lastly, the **sovereign yield curves** of most of the countries studied (France, Germany, Italy, Spain, Euro area and the US) show a sharp upward variation over the period from 2025 to 2027. In addition, and in line with the transition shock outlined at the beginning of section 4.2, the United Kingdom (downward variation of the yield curve) and Japan (slight upward variation) being the only exceptions. The adverse effect of carbon regulations on UK and Japanese exports to the European Union and the United States leads (all other things being equal) to a depreciation of the GBP or the Yen against either USD or EUR, which is consistent with a decrease (or a very marginal upward variation) of sovereign interest rates in these two countries.

5 Delivery formats

Quantitative submissions should be supplemented with a methodological note. This will allow the participating insurers to outline their results and explain the assumptions and simplifications they retained to obtain them, as well as to elaborate on the impact of their management actions (with a particular focus on the insurers' investment reallocation decisions on the assets' side, and on the pricing and reinsurance strategy decisions on the liabilities' side) on their results.

The statements to be submitted are expected to include a simplified balance sheet and a limited number of *ad hoc* statements, both of which being similar to the requested delivery format used for the long-term scenarios included in the pilot exercise. The short-term scenario includes specific features that are notably linked to the expected level of sectoral granularity of the asset list and the physical risk shocks set for that scenario.

Table 5 below summarises the main quantitative elements to be included in the template.

Table 5: Statements requested from insurers

Risk category	Type of risk studied	Exposures concerned	Geography	Portfolio segmentation	Projected values
Market risk	Revaluation of the portfolio based on market values	Asset portfolio	Segmentation by country or geographical area if country not available: France, Europe excluding France, US, RoW *(or significant exposures sensitive to transition risk)*	Sectoral segmentation for equity and credit spread risk and more aggregated segmentation for other risk factors including sovereign	Market value of the portfolios for 2025, 2030, 2035, 2040 and 2050 for the long-term scenarios and 2023, 2024, 2025, 2026 and 2027 for the short-term scenarios
Health Risk	Evolution of the main components of the income statement (premiums, claims, financial balance, reinsurance balance)	Health portfolio	**French Exposures:** distinction possible by major agglomerations if available in the information systems of the undertakings, whole France otherwise **Foreign Exposures:** by country or geographical area	Segmentation between health costs and other personal injury (incapacity/disability)	Value of the profit and loss account for 2025, 2030, 2035, 2040 and 2050 for the long-term scenarios and 2023, 2024, 2025, 2026 and 2027 for the short-term scenarios
Life technical risks	Evolution of the main components of the income statement (premiums, claims, financial balance, reinsurance balance, revaluation rate, DBP)	Life wallet		Segmentation by life business lines (life insurance, savings, temporary deaths and others)	Value of the profit and loss account for 2025, 2030, 2035, 2040 and 2050 for the long-term scenarios and 2023, 2024, 2025, 2026 and 2027 for the short-term scenarios
Non-life technical risks (excluding health)	Evolution of the main components of the income statement (premiums, claims, financial balance, reinsurance balance)	Non-life portfolio		Segmentation by non-life business lines (personal injury, motor vehicle, property damage, natural disasters)	Value of the profit and loss account for 2025, 2030, 2035, 2040 and 2050 for the long-term scenarios and 2023, 2024, 2025, 2026 and 2027 for the short-term scenarios
	Evolution of the main exposures (number of insured risks, number of terminated risks because prices are inaccessible for the long term, insured values, CAT NAT premiums, CAT NAT claims)	Non-life portfolio impacted by natural disasters	**French Exposures:** distinction may be made by department if available in the information systems of the undertakings, whole France otherwise **foreign Exposures:** by country or geographical area	Segmentation by type of perils (droughts, floods, marine Ssbmersions,tropical cyclones)	Value of the profit and loss account for 2025, 2030, 2035, 2040 and 2050 for the long-term scenarios and 2023, 2024, 2025, 2026 and 2027 for the short-term scenarios

6 Annex – Detailed assumptions for health and life insurance activities

6.1 Long-term scenario: an increase in vector-borne diseases

This scenario illustrates the consequences of climate change through the spread of vector-borne (insect-borne) diseases between 2020 and 2050. This phenomenon is explained in the report published by Drif, Roche, Valade[38]. Its consequences are considered in terms of impacts on:

- Death benefit guarantees;
- Healthcare expenses coverage;
- Work stoppage coverage.

These phenomena are modelled according to the geographical implantation of various mosquito species, for which data is available at the regional level. In order to ensure that the scenarios are applied in a way that is more consistent with the industry models, this scenario is available according to four granularity levels:

Granularity level	All age groups	Specification per age group
Mainland France	The easiest level	Includes the age factor for exposures
Regional	Includes a geographical breakdown of exposures	Includes both the age factor and the geographical distribution of exposures

Companies may choose the scenario according to the granularity of their portfolio information. They do not have to apply the scenario at both granularity levels.

[38] Conséquences du changement climatique pour les maladies à transmission vectorielle et impact en assurance de personnes.

Impacts on mortality rates (all age groups)

		2024	2025-2029	2030-2039	2040-2049	2050
National granularity level	Additive factor	0.002%	0.003%	0.003%	0.003%	0.004%
	Multiplier factor		3.8%	2.7%	2.7%	
Regional granularity level						
Auvergne-Rhône-Alpes	Additive factor	0.005%	0.005%	0.005%	0.005%	0.0055%
	Multiplier factor		0.3%	0.2%	0.2%	
Bourgogne-Franche-Comté	Additive factor	0.0003%	0.0003%	0.0004%	0.000%	0.001%
	Multiplier factor		4.2%	8.6%	8.6%	
Bretagne	Additive factor	0.002%	0.002%	0.0023%	0.002%	0.002%
	Multiplier factor		3.033%	1.1%	1.1%	
Centre-Val de Loire	Additive factor	0.003%	0.003%	0.005%	0.005%	0.005%
	Multiplier factor		11.0%	1.1%	1.1%	
Corse	Additive factor	0.02%	0.02%	0.025%	0.025%	0.027%
	Multiplier factor		2.2%	1,3%	1.3%	
Grand Est	Additive factor	0.0003%	0.0003%	0.0004%	0.0004%	0.0006%
	Multiplier factor		3.2%	8.6%	8.6%	
Hauts-de-France	Additive factor	0.001%	0.001%	0.00%	0.00%	0.00%
	Multiplier factor		1%	1%	1%	
Ile-de-France	Additive factor	0.001%	0.001%	0.001%	0.001%	0.001%
	Multiplier factor		1.3%	1.3%	1.3%	
Normandie	Additive factor	0.005%	0.005%	0.006%	0.006%	0.007%
	Multiplier factor		1.4%	1.5%	1.5%	
Nouvelle-Aquitaine	Additive factor	0.003%	0.003%	0.005%	0.005%	0.005%
	Multiplier factor		11.0%	1.1%	1.1%	
Occitanie	Additive factor	0.006%	0.006%	0.006%	0.006%	0.007%
	Multiplier factor		0.6%	1.3%	1.3%	
Pays de la Loire	Additive factor	0.001%	0.001%	0.001%	0.001%	0.001%
	Multiplier factor		4.2%	1.3%	1.3%	
Provence-Alpes-Côte d'Azur	Additive factor	0.005%	0.005%	0.006%	0.006%	0.007%
	Multiplier factor		1.3%	3.4%	3.4%	

Impacts on mortality rates <16 years old

		2024	2025-2029	2030-2039	2040-2049	2050
National granularity level	Additive factor	0.002571%	0.003%	0.004%	0.004%	0.005%
	Multiplier factor		3.8%	2.7%	2.7%	
Regional granularity level						
Auvergne-Rhône-Alpes	Additive factor	0.007%	0.007%	0.007%	0.007%	00070%
	Multiplier factor		0.3%	0.2%	0.2%	
Bourgogne-Franche-Comté	Additive factor	0.0004%	0.0005%	0.0006%	0.001%	0.001%
	Multiplier factor		2.5%	8.6%	8.6%	
Bretagne	Additive factor	0.0002%	0.0002%	0.0030%	0.003%	0.003%
	Multiplier factor		2.5%	1.1%	1.1%	
Centre-Val de Loire	Additive factor	0.004%	0.00%	0.006%	0.006%	0.006%
	Multiplier factor		11.0%	1.1%	1.1%	
Corse	Additive factor	0.028%	0.03%	0.033%	0.033%	00035%
	Multiplier factor		2.2%	1.3%	1.3%	
Grand Est	Additive factor	0.0004%	0.0005%	0.0006%	0.0006%	0.0008%
	Multiplier factor		3.2%	8.6%	8.6%	
Hauts-de-France	Additive factor	0.001%	0.00%	0.00%	0.00%	0.00%
	Multiplier factor		1%	1%	1%	
Ile-de-France	Additive factor	0.001%	0.001%	0.001%	0.001%	0.001%
	Multiplier factor		0.6%	1.3%	1.3%	
Normandie	Additive factor	0.007%	0.007%	0.008%	0.008%	0.008%
	Multiplier factor		1.4%	1.5%	1.5%	
Nouvelle-Aquitaine	Additive factor	0.004%	0.004%	0.006%	0.006%	0.006%
	Multiplier factor		11.0%	1.1%	1.1%	
Occitanie	Additive factor	0.007%	0.008%	0.008%	0.008%	0.008%
	Multiplier factor		0.6%	1.3%	1.3%	
Pays de la Loire	Additive factor	0.001%	0.001%	0.001%	0.001%	0.001%
	Multiplier factor		4.2%	1.3%	1.3%	
Provence-Alpes-Côte d'Azur	Additive factor	0.007%	0.007%	0.008%	0.008%	0.009%
	Multiplier factor		1.3%	3.4%	3.4%	

Impacts on mortality rates 16 – 65 years old

		2024	2025-2029	2030-2039	2040-2049	2050
National granularity level	Additive factor	0.001780%	0002%	0.003%	0.003%	0.001780%
	Multiplier factor		3.8%	2.7%	2.7%	6.3%
Regional granularity level						
Auvergne-Rhône-Alpes	Additive factor	0.005%	0.005%	0.005%	0.005%	0.005%
	Multiplier factor		0.3%	0.2%	0.2%	0.00%
Bourgogne-Franche-Comté	Additive factor	0.0003%	0.0003%	0.0004%	0.000%	0.0003%
	Multiplier factor		2.5%	8.6%	8.6%	3.9%
Bretagne	Additive factor	0.0001%	0.0002%	0.0021%	0.002%	0.0001%
	Multiplier factor		2.5%	1.1%	1.1%	3.9%
Centre-Val de Loire	Additive factor	0.003%	0.00%	0.004%	0.004%	0.003%
	Multiplier factor		11.0%	1.1%	1.1%	0.6%
Corse	Additive factor	0.019%	0.02%	0.023%	0.023%	0.019%
	Multiplier factor		2.2%	1.3%	1.3%	0.9%
Grand Est	Additive factor	0.0003%	0.0003%	0.0004%	0.0004%	0.0003%
	Multiplier factor		3.2%	8.6%	8.6%	3.9%
Hauts-de-France	Additive factor	0.001%	0.00%	0.00%	0.00%	0.001%
	Multiplier factor		1%	1%	1%	0.0%
Ile-de-France	Additive factor	0.001%	0.001%	0.001%	0.001%	0.001%
	Multiplier factor		0.6%	1.3%	1.3%	0.0%
Normandie	Additive factor	0.005%	0.005%	0.005%	0.005%	0.005%
	Multiplier factor		1.4%	1.5%	1.5%	1.5%
Nouvelle-Aquitaine	Additive factor	0.003%	0.003%	0.004%	0.004%	0.003%
	Multiplier factor		11.0%	1.1%	1.1%	0.1%
Occitanie	Additive factor	0.005%	0.005%	0.005%	0.005%	0.005%
	Multiplier factor		0.6%	1.3%	1.3%	0.6%
Pays de la Loire	Additive factor	0.001%	0.001%	0.001%	0.001%	0.001%
	Multiplier factor		4.2%	1.3%	1.3%	0.0%
Provence-Alpes-Côte d'Azur	Additive factor	0.005%	0.005%	0.005%	0.005%	0.005%
	Multiplier factor		1.3%	3.4%	3.4%	1.4%

Impacts on mortality rates >65 years old

		2024	2025-2029	2030-2039	2040-2049	2050
National granularity level	Additive factor	0.002175%	0.003%	0.028%	0.028%	0.004%
	Multiplier factor		3.8%	2.7%	2.7%	
Regional granularity level						
Auvergne-Rhône-Alpes	Additive factor	0.006%	0.006%	0.048%	0.048%	0.0059%
	Multiplier factor		0.3%	0.2%	0.2%	
Bourgogne-Franche-Comté	Additive factor	0.0003%	0.0004%	0.0038%	0.004%	0.001%
	Multiplier factor		2.5%	8.6%	8.6%	
Bretagne	Additive factor	0.0002%	0.0002%	0.0209%	0.021%	0.003%
	Multiplier factor		2.5%	1.1%	1.1%	
Centre-Val de Loire	Additive factor	0.003%	0.00%	0.042%	0.042%	0.005%
	Multiplier factor		11.0%	1.1%	1.1%	
Corse	Additive factor	0.024%	0.02%	0.225%	0.225%	0.029%
	Multiplier factor		2.2%	1.3%	1.3%	
Grand Est	Additive factor	0.0003%	0.0004%	0.0038%	0.0038%	0.0007%
	Multiplier factor		3.2%	8.6%	8.6%	
Hauts-de-France	Additive factor	0.001%	0.00%	0.01%	0.01%	0.00%
	Multiplier factor		1%	1%	1%	
Ile-de-France	Additive factor	0.001%	0.001%	0.009%	0.009%	0.001%
	Multiplier factor		0.6%	1.3%	1.3%	
Normandie	Additive factor	0.006%	0.006%	0.054%	0.054%	0.007%
	Multiplier factor		1.4%	1.5%	1.5%	
Nouvelle-Aquitaine	Additive factor	0.003%	0.003%	0.042%	0.042%	0.005%
	Multiplier factor		11.0%	1.1%	1.1%	
Occitanie	Additive factor	0.006%	0.006%	0.054%	0.054%	0.007%
	Multiplier factor		0.6%	1.3%	1.3%	
Pays de la Loire	Additive factor	0.001%	0.001%	0.009%	0.009%	0.001%
	Multiplier factor		4.2%	1.3%	1.3%	
Provence-Alpes-Côte d'Azur	Additive factor	0.006%	0.006%	0.052%	0.052%	0.007%
	Multiplier factor		1.3%	3.4%	3.4%	

The various components of the scenario are as follows:

- The **Additive factor** corresponds to an additive increase of the annual mortality rates, e.g. an additive factor equal to 0.002% increases the mortality rate by 0.03% to 0.032%.
- The **Multiplier factor** corresponds to the yearly rate of widening of the gap between mortality rate tables; e.g., a multiplier factor set at 2% results in a shift in mortality rates by 0.002% in the first year, by 0.002% x 1.02 in the second year, by 0.002% x 1.02 x 1.02 in the third year, etc.

$$Shocked\ mortality\ rate_{(A)} = Base\ mortality\ rate\ _{(A)} + additive\ factor_{(A)} \times \prod_{i=1}^{A}(1 + multiplier\ factor_{(i)})$$

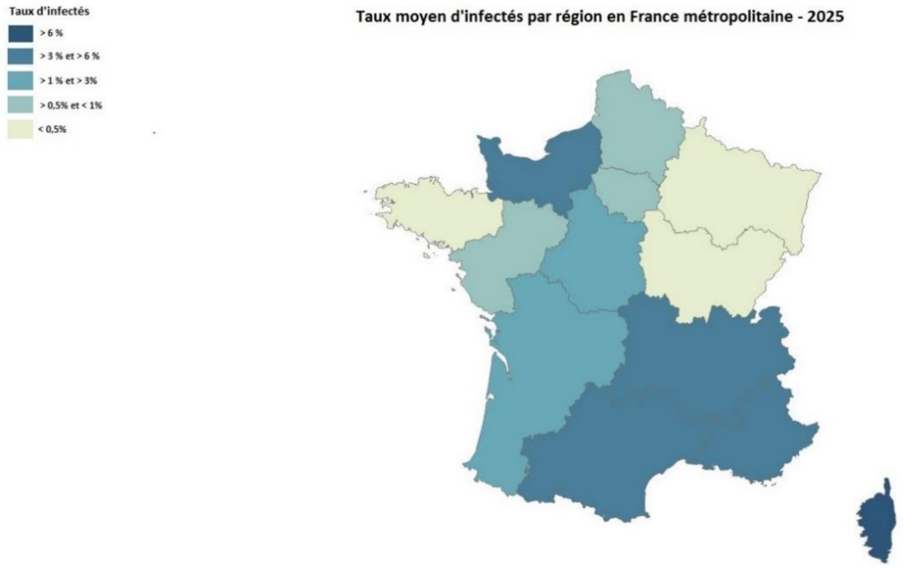
Impacts on healthcare expenses and work stoppages

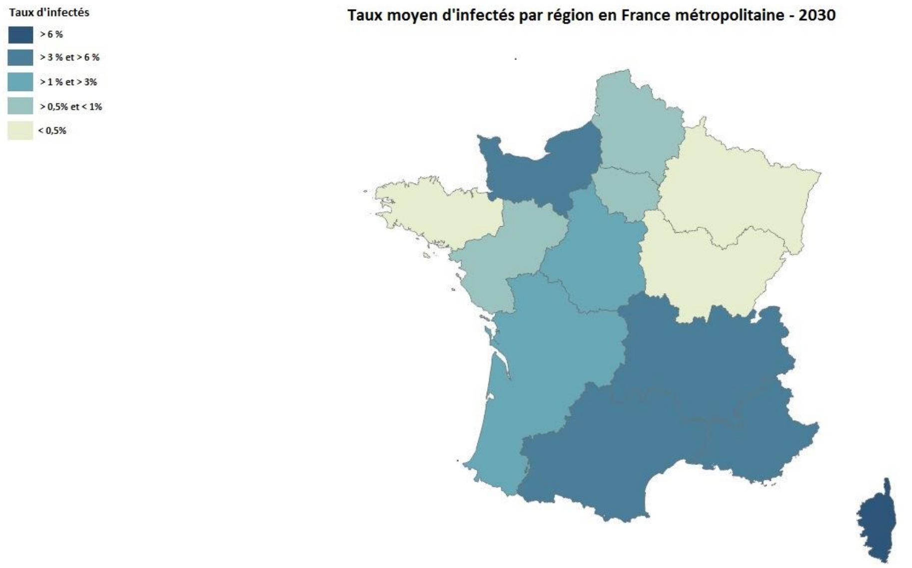
		2024	2025-2029	2030-2039	2040-2049	2050
National granularity level	Medical consultation / ER visit	0.7911%	1.0407%	1.2408%	1.4108%	1.7142%
	Temporary work incapacity (day)	0.0198%	0.0260%	0.0310%	0.0353%	0.0429%
Regional granularity level						
Auvergne-Rhône-Alpes	Medical consultation / ER visit	2.1094%	2.1094%	2.1441%	2.1615%	2.1959%
	Temporary work incapacity (day)	0.0527%	0.0527%	0.0536%	0.0540%	0.0549%
Bourgogne-Franche-Comté	Medical consultation / ER visit	0.1221%	0.1458%	0.1694%	0.2424%	0.3546%
	Temporary work incapacity (day)	0.0031%	0.0036%	0.0042%	0.0061%	0.0089%
Bretagne	Medical consultation / ER visit	0.0611%	0.5985%	0.9272%	0.9780%	1.0747%
	Temporary work incapacity (day)	0.0015%	0.0150%	0.0232%	0.0245%	0.0269%
Centre-Val de Loire	Medical consultation / ER visit	1.1600%	1.1970%	1.8543%	1.9560%	2.1493%
	Temporary work incapacity (day)	0.0290%	0.0299%	0.0464%	0.0489%	0.0537%
Corse	Medical consultation / ER visit	8.6167%	9.0000%	10.0000%	10.6315%	11.8236%
	Temporary work incapacity (day)	0.2154%	0.2250%	0.2500%	0.2658%	0.2956%
Grand Est	Medical consultation / ER visit	0.1221%	0.1458%	0.1694%	0.2424%	0.3546%
	Temporary work incapacity (day)	0.0031%	0.0036%	0.0042%	0.0061%	0.0089%
Hauts-de-France	Medical consultation / ER visit	0.3221%	0.0320%	0.3904%	0.4152%	0.4620%
	Temporary work incapacity (day)	0.0081%	0.0008%	0.0098%	0.0104%	0.0116%
Ile-de-France	Medical consultation / ER visit	0.3221%	0.0134%	0.3904%	0.4152%	0.4620%
	Temporary work incapacity (day)	0.0081%	0.0003%	0.0098%	0.0104%	0.0116%
Normandie	Medical consultation / ER visit	2.0800%	2.2400%	2.4000%	2.5800%	2.9165%
	Temporary work incapacity (day)	0.0520%	0.0560%	0.0600%	0.0645%	0.0729%
Nouvelle-Aquitaine	Medical consultation / ER visit	1.1899%	1.1970%	1.8543%	1.9560%	2.1493%
	Temporary work incapacity (day)	0.0297%	0.0299%	0.0464%	0.0489%	0.0537%
Occitanie	Medical consultation / ER visit	2.2780%	2.3484%	2.4188%	2.5719%	2.8609%
	Temporary work incapacity (day)	0.0570%	0.0587%	0.0605%	0.0643%	0.0715%
Pays de la Loire	Medical consultation / ER visit	0.3221%	0.1458%	0.3904%	0.4152%	0.4620%
	Temporary work incapacity (day)	0.0081%	0.0036%	0.0098%	0.0104%	0.0116%
Provence-Alpes-Côte d'Azur	Medical consultation / ER visit	2.0276%	2.1733%	2.3190%	2.7149%	3.4060%
	Temporary work incapacity (day)	0.0507%	0.0543%	0.0580%	0.0679%	0.0851%

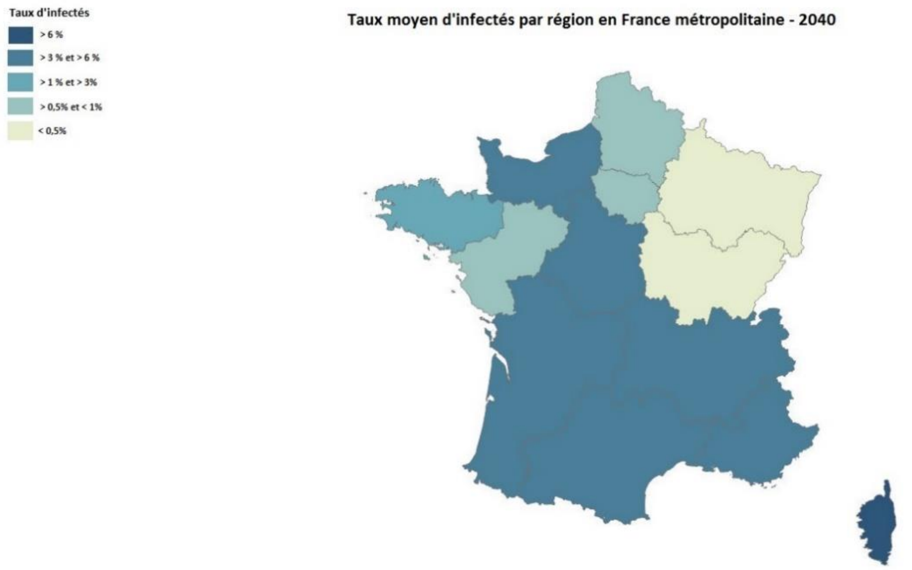
The various components of the scenario are as follows:

- The **Medical consultation / ER visit factor** corresponds to the proportion of policyholders with healthcare cost coverage who, each year, need to seek medical attention either in the form of a medical appointment or an emergency room visit as a result of the vector-borne pandemic factor. *E.g., a medical consultation/emergency visit rate at 0.06% corresponds to the fact that 0.06% of policyholders each year will generate additional claims due to a consultation or a visit to the emergency room.*
- The **Work stoppages factor** corresponds to the proportion of policyholders with work stoppage coverage who are required to stop working temporarily each year. Of these policyholders, 80% are off work for 8 calendar days and 20% for 20 calendar days due to an infection. *E.g., a Work stoppages rate at 0.003% for 10 days corresponds to the fact that 0.003% of policyholders each year will generate additional work stoppages claims. 0.0006% will be issued work stoppage for 20 days and 0.0024% will be issued work stoppage for 8 days.*

To illustrate the phenomenon of increasing rates of contagion, the following maps show the projected rates of contagion by region for the years 2025, 2030 and 2040:







6.2 Long-term scenario: increasing pollution in urban areas

This scenario illustrates the consequences of climate change through urban pollution phenomena in the time horizon from 2025 to 2050 under the RCP 4.5 scenario (without a decrease in emissions). These projections are further explained in the report published by Drif, Messina, Valade[39]. Its consequences are considered in terms of impacts on:

- Death benefit guarantees;
- Healthcare costs coverage;
- Work stoppage coverage.

These phenomena are modelled according to the increase in ozone (O_3) concentration, nitrogen dioxide (NO_2) concentration and concentration in fine particles measuring 2.5 micrometres (PM 2.5) and 10 micrometres (PM 10) for the main French conurbations. Exposure considers both fine particle concentration and pollution peaks, which are intensified by high temperatures and are tending to increase in both duration and frequency.

Pollution caused by:

- **Ozone** is a greenhouse gas that occurs naturally both in the atmosphere and on the ground. This gas causes respiratory problems when exposed to sunlight, and is the main cause of emergency room visits for respiratory distress (asthma, reduced lung function, etc.) and deaths from cardiovascular disease and respiratory problems.
- **Nitrogen dioxide** is a gas produced by combustion. This gas can cause lung irritation and reduced lung function, leading to hospital admissions, short-term leave from work, asthma or bronchitis in children, and death.
- **PM 2.5** are fine particles that can pass through the entire respiratory system and into the bloodstream via the pulmonary alveoli. The consequence of these particles is respiratory problems, but particularly deaths from lung cancer, chronic obstructive pulmonary disease and cardiovascular events.
- **PM 10** are fine particles that accumulate in the lungs, and are the main cause of chronic bronchitis, bronchitis in children, asthma and death.

In order to ensure that these scenarios are applied in a way that is more consistent with the industry's models, this scenario is available at four levels of granularity:

Granularity	All age groups	Specification per age group
Mainland France	The easiest level	Includes the age factor for exposures
Broken down by agglomeration	Includes a geographical breakdown of exposures	Includes both the age factor and the geographical distribution of exposures

Companies should use a single level of granularity, based on relevance, control of their risk profile and availability of information.

[39] « Conséquences du changement climatique sur la pollution de l'air et impact en assurance de personnes »

Impacts of pollution (all age groups)

		2024 - 2030	2031-2040	2041-2050
Granularity level: global	Death	0.02%	0.02%	0.02%
	Healthcare costs	0.84%	1.04%	1.35%
	Work stoppages	0.07%	0.08%	0.11%
Granularity level : detailed				
Bordeaux	Death	0.01%	0.01%	0.02%
	Healthcare costs	0.68%	0.85%	1.11%
	Work stoppages	0.06%	0.07%	0.10%
Ile de France	Death	0.02%	0.03%	0.03%
	Healthcare costs	1.09%	1.35%	1.72%
	Work stoppages	0.08%	0.10%	0.14%
Lille	Death	0.02%	0.02%	0.03%
	Healthcare costs	1.00%	1.24%	1.59%
	Work stoppages	0.08%	0.10%	0.13%
Lyon	Death	0.02%	0.03%	0.03%
	Healthcare costs	1.09%	1.35%	1.72%
	Work stoppages	0.08%	0.10%	0.14%
Marseille	Death	0.02%	0.03%	0.03%
	Healthcare costs	1.09%	1.35%	1.72%
	Work stoppages	0.08%	0.10%	0.14%
Montpellier	Death	0.02%	0.02%	0.03%
	Healthcare costs	0.72%	0.91%	1.19%
	Work stoppages	0.05%	0.07%	0.09%
Nantes	Death	0.01%	0.01%	0.02%
	Healthcare costs	0.68%	0.84%	1.10%
	Work stoppages	0.05%	0.06%	0.09%
Nice	Death	0.01%	0.01%	0.02%
	Healthcare costs	0.68%	0.85%	1.11%
	Work stoppages	0.05%	0.06%	0.09%
Strasbourg	Death	0.01%	0.01%	0.02%
	Healthcare costs	0.68%	0.85%	1.11%
	Work stoppages	0.05%	0.06%	0.09%
Toulouse	Death	0.01%	0.01%	0.02%
	Healthcare costs	0.68%	0.85%	1.11%
	Work stoppages	0.06%	0.07%	0.10%

The various components of these scenarios are as follow:

- The **Death** factor corresponds to the additional mortality rate that annually increases the insurer's mortality assumptions for each of the projection years. E.g., *a mortality rate at 0.03% means that for the years 2021 to 2050, a company that would normally apply a mortality rate at 0.3% will increase it to 0.33%.*
- The **Healthcare costs** corresponds to the additional proportion of policyholders who, for each year included in the projection, will generate healthcare cost claims due to increased pollution. Of these policyholders, 3% will be hospitalised for an average of 6 days and 97% will require a medical consultation. *E.g., a 1.02% rate applied to the healthcare costs of a portfolio of 150,000 policyholders means that, each year, in addition to the Best Estimate for loss experience, 1,530 policyholders (150,000 x 1.02%) will generate additional healthcare costs. Of these policyholders, 46 (1,530x3%) will be hospitalised for 6 days and 1,484 (1,530 x 97%) will generate the costs associated with a medical consult.*
- The **Work stoppages** factor corresponds to the additional proportion of policyholders who, for each projection year, will be off work for an average of 6 days. *E.g., for a portfolio of 150,000 policyholders, a 0.08% rate of Work Stoppages will result in 120 Work Stoppages (150,000 x 0.08%) each year with an average duration of 6 days, in addition to the Best Estimate loss experience.*

Impacts of pollution <19 years old

		2024 - 2030	2031-2040	2041-2050
Granularity level: global	Death	0.01%	0.02%	0.02%
	Healthcare costs	0.88%	1.09%	1.42%
	Work stoppages	0.00%	0.00%	0.00%
Granularity level : detailed				
Bordeaux	Death	0.01%	0.01%	0.02%
	Healthcare costs	0.71%	0.92%	1.22%
	Work stoppages	0.00%	0.00%	0.00%
Ile de France	Death	0.02%	0.02%	0.03%
	Healthcare costs	1.15%	1.46%	1.90%
	Work stoppages	0.00%	0.00%	0.00%
Lille	Death	0.01%	0.02%	0.02%
	Healthcare costs	1.05%	1.33%	1.75%
	Work stoppages	0.00%	0.00%	0.00%
Lyon	Death	0.02%	0.02%	0.03%
	Healthcare costs	1.15%	1.46%	1.90%
	Work stoppages	0.00%	0.00%	0.00%
Marseille	Death	0.02%	0.02%	0.03%
	Healthcare costs	1.15%	1.46%	1.90%
	Work stoppages	0.00%	0.00%	0.00%
Montpellier	Death	0.01%	0.02%	0.02%
	Healthcare costs	0.76%	0.98%	1.31%
	Work stoppages	0.00%	0.00%	0.00%
Nantes	Death	0.01%	0.01%	0.02%
	Healthcare costs	0.71%	0.91%	1.21%
	Work stoppages	0.00%	0.00%	0.00%
Nice	Death	0.01%	0.01%	0.02%
	Healthcare costs	0.71%	0.92%	1.22%
	Work stoppages	0.00%	0.00%	0.00%
Strasbourg	Death	0.01%	0.01%	0.02%
	Healthcare costs	0.71%	0.92%	1.22%
	Work stoppages	0.00%	0.00%	0.00%
Toulouse	Death	0.01%	0.01%	0.02%
	Healthcare costs	0.71%	0.92%	1.22%
	Work stoppages	0.00%	0.00%	0.00%

Impacts of pollution 19-64 years old

		2024 - 2030	2031-2040	2041-2050
Granularity level: global	Death	0.02%	0.02%	0.02%
	Healthcare costs	0.88%	1.09%	1.42%
	Work stoppages	0.00%	0.00%	0.00%
Granularity level : detailed				
Bordeaux	Death	0.01%	0.02%	0.02%
	Healthcare costs	0.71%	0.89%	1.16%
	Work stoppages	0.00%	0.00%	0.00%
Ile de France	Death	0.02%	0.03%	0.03%
	Healthcare costs	1.15%	1.41%	1.81%
	Work stoppages	0.00%	0.00%	0.00%
Lille	Death	0.02%	0.02%	0.03%
	Healthcare costs	1.05%	1.30%	1.67%
	Work stoppages	0.00%	0.00%	0.00%
Lyon	Death	0.02%	0.03%	0.03%
	Healthcare costs	1.15%	1.41%	1.81%
	Work stoppages	0.00%	0.00%	0.00%
Marseille	Death	0.02%	0.03%	0.03%
	Healthcare costs	1.15%	1.41%	1.81%
	Work stoppages	0.00%	0.00%	0.00%
Montpellier	Death	0.02%	0.02%	0.03%
	Healthcare costs	0.76%	0.95%	1.25%
	Work stoppages	0.00%	0.00%	0.00%
Nantes	Death	0.01%	0.02%	0.02%
	Healthcare costs	0.71%	0.88%	1.16%
	Work stoppages	0.00%	0.00%	0.00%
Nice	Death	0.01%	0.02%	0.02%
	Healthcare costs	0.71%	0.89%	1.16%
	Work stoppages	0.00%	0.00%	0.00%
Strasbourg	Death	0.01%	0.02%	0.02%
	Healthcare costs	0.71%	0.89%	1.16%
	Work stoppages	0.00%	0.00%	0.00%
Toulouse	Death	0.01%	0.02%	0.02%
	Healthcare costs	0.71%	0.89%	1.16%
	Work stoppages	0.00%	0.00%	0.00%

Impacts of pollution >65 years old

		2024 - 2030	2031-2040	2041-2050
Granularity level: global	Death	0.02%	0.02%	0.02%
	Healthcare costs	0.94%	1.17%	1.51%
	Work stoppages			
Granularity level : detailed				
Bordeaux	Death	0.01%	0.02%	0.02%
	Healthcare costs	0.76%	0.95%	1.24%
	Work stoppages			
Ile de France	Death	0.02%	0.03%	0.04%
	Healthcare costs	1.22%	1.51%	1.93%
	Work stoppages			
Lille	Death	0.02%	0.02%	0.03%
	Healthcare costs	1.12%	1.38%	1.78%
	Work stoppages			
Lyon	Death	0.02%	0.03%	0.04%
	Healthcare costs	1.22%	1.51%	1.93%
	Work stoppages			
Marseille	Death	0.02%	0.03%	0.04%
	Healthcare costs	1.22%	1.51%	1.93%
	Work stoppages			
Montpellier	Death	0.02%	0.02%	0.03%
	Healthcare costs	0.81%	1.02%	1.33%
	Work stoppages			
Nantes	Death	0.01%	0.02%	0.02%
	Healthcare costs	0.76%	0.94%	1.24%
	Work stoppages			
Nice	Death	0.01%	0.02%	0.02%
	Healthcare costs	0.76%	0.95%	1.24%
	Work stoppages			
Strasbourg	Death	0.01%	0.02%	0.02%
	Healthcare costs	0.76%	0.95%	1.24%
	Work stoppages			
Toulouse	Death	0.01%	0.02%	0.02%
	Healthcare costs	0.76%	0.95%	1.24%
	Work stoppages			

6.3 Sort-term scenario: heatwaves

This scenario illustrates the consequences of climate change through heat waves as experienced in 2022. This phenomenon is explained in the French public health bulletin for the summer 2022. Its consequences are considered in terms of impacts on:

- Death benefit guarantees;
- Healthcare expenses coverage;
- Work stoppage coverage.

This phenomenon is modelled at the national level for the following age groups: 0-15 years old; 16-44 years old; 45-64 years old; 65-74 years old; >75 years old.

Impacts on mortality rates

Age group	Mortality rate drift
0-15 y.o.	0.00%
15-44	1.97%
45-64	1.13%
65-74	1.83%
>75	5.47%
All age groups	**0.43%**

The **Mortality rate** factor corresponds to a mortality rate to be applied to the population exposed. *E.g., a mortality rate equal to 0.43% is applied to the portfolio of 100,000 policyholders residing in the Alpes-de-Haute-Provence (04) department, equating to 430 deaths.*

Impacts on healthcare costs and work stoppages

Age group	Healthcare costs drift	Work stoppages drift
0-15 y.o.	0.045%	0.044%
15-24	0.038%	0.004%
25-44	0.056%	0.016%
45-64	0.082%	0.072%
65-74	0.085%	0.095%
>75	0.35%	0.30%
All age groups	**0.095%**	**0.092%**

The various components of this scenario are as follows:

- The **Medical consultation / ER visit** factor corresponds to the proportion of policyholders covered by healthcare cost insurance who, each year, have to consult a doctor or go to an emergency room because of a heatwave. *E.g., a consultation/emergency rate at 0.35% corresponds to the fact that 0.35% of policyholders each year will generate additional claims due to a medical consultation or a visit to an emergency room.*
- The **Work stoppages** factor corresponds to the proportion of policyholders benefiting from Work Stoppage cover, who are likely to be off work each year. These policyholders are considered to be on short-term sick leave, with an average of 4 sick leave days following a hospital stay. *E.g., a rate at 0.03%*

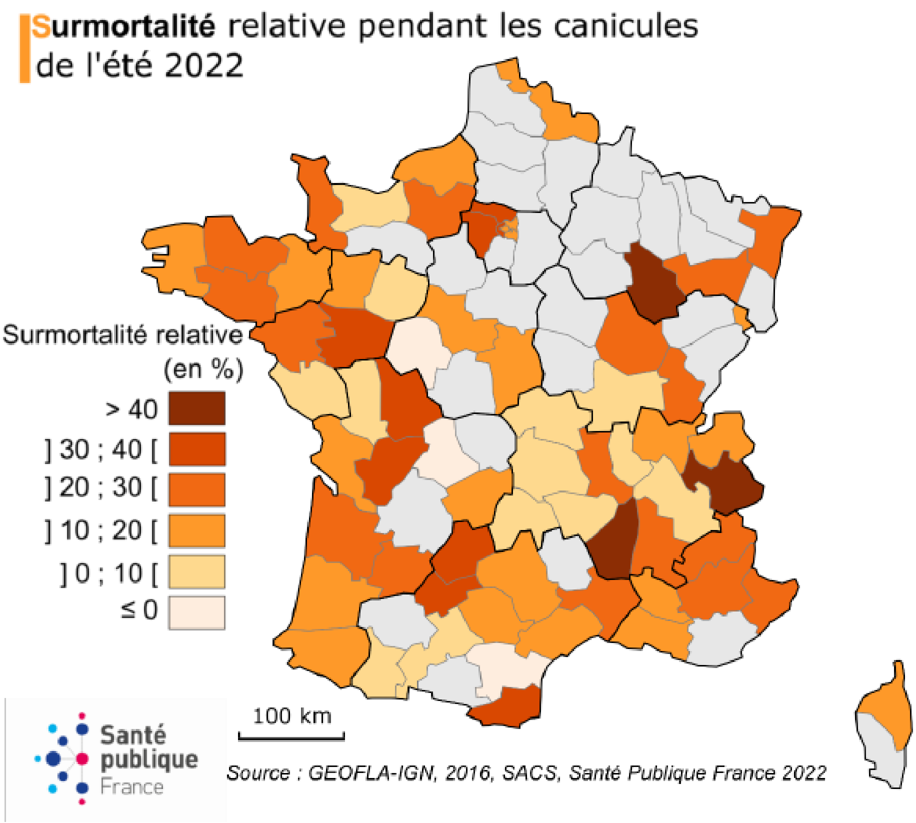
of TWI corresponds to the fact that 0.30% of policyholders each year will generate additional work stoppages claims.

Analysis of yearly mortality rates by department

The effects of the heatwave during the summer of 2022 can also be analysed for each department. The table below shows the annual mortality drift by department for 2022 compared with 2019.

DEP	Mortality rate drift	DEP	Mortality rate drift	DEP	Mortality rate drift	DEP	Mortality rate drift
1	6.50%	**26**	10.90%	**51**	10.00%	**76**	10.10%
2	6.10%	**27**	10.80%	**52**	4.80%	**77**	14.90%
3	3.10%	**28**	12.00%	**53**	10.20%	**78**	7.50%
4	7.80%	**29**	12.80%	**54**	7.60%	**79**	11.30%
5	5.00%	**30**	14.40%	**55**	5.30%	**80**	6.10%
6	10.70%	**31**	8.20%	**56**	10.60%	**81**	12.00%
7	7.80%	**32**	9.80%	**57**	9.40%	**82**	13.30%
8	5.30%	**33**	9.80%	**58**	4.80%	**83**	13.40%
9	11.90%	**34**	12.30%	**59**	9.20%	**84**	9.10%
10	3.60%	**35**	9.20%	**60**	11.00%	**85**	14.50%
11	17.10%	**36**	9.60%	**61**	5.70%	**86**	9.10%
12	11.80%	**37**	7.10%	**62**	9.30%	**87**	6.00%
13	9.60%	**38**	9.70%	**63**	8.90%	**88**	10.20%
14	10.60%	**39**	4.50%	**64**	9.80%	**89**	10.30%
15	9.20%	**40**	15.40%	**65**	13.50%	**90**	9.50%
16	8.10%	**41**	14.40%	**66**	17.60%	**91**	11.90%
17	16.30%	**42**	6.20%	**67**	13.10%	**92**	7.60%
18	3.70%	**43**	7.50%	**68**	10.10%	**93**	7.40%
19	4.40%	**44**	8.00%	**69**	6.40%	**94**	4.30%
20	20.00%	**45**	5.90%	**70**	8.60%	**95**	9.10%
21	9.30%	**46**	2.80%	**71**	7.50%		
22	9.90%	**47**	10.10%	**72**	8.20%		
23	9.60%	**48**	4.70%	**73**	9.30%		
24	15.00%	**49**	11.20%	**74**	10.70%		
25	9.10%	**50**	15.30%	**75**	4.10%		

To illustrate the heatwave phenomena in 2022, the following map shows, for each department, the mortality rates observed in 2022 **solely during heatwaves**.



Note: Relative excess mortality (in %) in France during summer 2022 heatwaves, by department.

6.4 Short-term scenario: Serre-Ponçon dam burst

This scenario models the consequences of a failure of the Serre-Ponçon dam in RCP 4.5 scenario through overflow. This modelling is illustrated in the following Story Map:
https://storymaps.arcgis.com/stories/b8f101be0fa341579f0742b8f8e6d69d

Death benefits are taken into account when assessing losses:

Mortality rate per department

Mortality rate all age groups	
DEP	**% rate**
13	0.0775
30	0.0340
04	0.2367
05	0.2238
83	0.1400
84	0.0899

The **Mortality rate** factor corresponds to the mortality rate to be applied to the exposed population. *E.g., a 0.2367% rate is applied to a portfolio of 100,000 policyholders residing in the Alpes-de-Haute-Provence (04) department, equating to 237 deaths.*