Network for Greening the Financial System

2025 Explanatory notes on NGFS long-term scenarios Cover Note

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NGFS
Central Banks and Supervisors
Network for Greening the Financial System

Notice to readers on physical risk estimates in Phase V of NGFS long-term scenarios

The NGFS long-term climate scenarios are a set of forward-looking pathways designed to explore how the global economy and financial system might evolve under different levels of climate policy ambition and physical climate impacts over the rest of the 21st century. They were developed by the Network for Greening the Financial System (NGFS) to provide a consistent analytical basis for assessing climate-related financial risks and opportunities.

The academic paper underpinning the physical risk estimates in Phase V of NGFS long-term scenarios (released in November 2024), Kotz *et al.* (2024), has received academic critiques (see first and second Matters Arising) as part of the post-publication review process at Nature.

Therefore, users should be aware of this academic debate pertaining specifically to the Phase V physical risk methodology when interpreting and applying Phase V results, alongside the broader limitations of physical risk estimates already detailed in NGFS documentation.

It should be noted that the long-term scenarios outputs which do not incorporate physical loss estimates from Kotz *et al.* (2024) remain unaffected[1]. Also, the outputs of NGFS short-term scenarios are not impacted, as they do not rely on the Kotz *et al.* (2024) paper.

It cannot be excluded that the economic effects of climate change might turn out to be more severe than anticipated in the NGFS scenarios, for instance, if certain tipping points are reached. Thus, users should also take into account the tail risks of climate change, along with other risks such as nature-related ones, which are not necessarily captured by these scenarios.

The NGFS is constantly working to further improve the scenarios, including with regard to physical risks. Users are reminded that neither the NGFS, nor its member institutions, nor any person acting on their behalf, is responsible or liable for any reliance on, or for any use of the NGFS scenarios and/or supplementary documentation. This also applies to the use of the data produced under the scenarios – see section 5 in https://data.ene.iiasa.ac.at/ngfs/#/license. Thus, while the NGFS climate scenarios are certainly a helpful tool, they do not alleviate the responsibility of users, including banks and other (financial) organisations, to design and implement their own risk management frameworks.

1 The affected variables are those reflecting physical loss estimates from Kotz *et al.* (2024) in Phase V of NGFS long-term scenarios. This includes: all outputs of "Integrated Physical Damages" scenarios by REMIND-MAgPIE, all "physical" and "combined" (*i.e.* combined physical and transition damages) outputs by NiGEM, as well as post-processed or downscaled outputs for GDP damages from the damage function (i.e. GDP change and Net GDP variables referring to "Kotz-Wenz"). All other variables from Phase V, the physical risk estimates as presented in the Climate Impact Explorer, as well as outputs from previous phases of NGFS long-term scenarios, remain unaffected.

2025 Explanatory notes on NGFS long-term scenarios – Cover Note

The **NGFS long-term climate scenarios** are a set of **forward-looking pathways** designed to explore how the global economy and financial system might evolve under different levels of climate policy ambition and physical climate impacts by the end of the century. They were developed by the **Network for Greening the Financial System (NGFS)** to provide a **consistent analytical basis for assessing climate-related financial risks** and opportunities. The latest update of these scenarios was released in November 2024 (Phase V).

User feedback has highlighted the need to improve the clarity of the assumptions and narratives underpinning the NGFS scenarios to foster a better understanding and broader adoption of these scenarios. Although the technical documentation provides an in-depth explanation of the modelling framework, the NGFS is today releasing complementary documentation designed to support users in applying its climate scenarios more effectively.

Overall, this additional documentation enhances the accessibility and interpretability of the NGFS scenarios, further solidifying their position as a global reference framework for evaluating climate-related financial risks.

The complementary resources include:

1) **A set of explanatory notes designed to enhance transparency regarding the assumptions and narratives underlying the NGFS long-term climate scenarios,** thereby enabling a more informed, contextualized application of the scenarios and assisting users in selecting the scenario that best aligns with their needs.
2) **Additional resources on physical risk,** including a) a 2025 update of the NGFS Climate Impact Explorer, accompanied by a note discussing the underlying methodology update and exploring acute physical risk narratives, and b) a note on climate tipping points, which offers a scientific perspective on critical tipping elements and evaluates their implications for climate risk assessments, with a particular focus on their relevance within the NGFS framework.

This cover note provides a brief overview of these documents. The next vintage of NGFS long-term scenarios (Phase VI), to be released in 2026, will incorporate updated climate and economic data as well as modelling improvements.

1) Notes on assumptions & narratives in Phase V of NGFS long-term scenarios

Note on key assumptions of NGFS long-term scenarios Phase V

The note is designed to improve transparency on the assumptions underlying the long-term scenarios.

The NGFS long-term scenarios are developed using a suite of models, including three Integrated Assessment Models (IAMs), a macroeconomic model (NiGEM), and tools for projecting climate impacts. The note provides a clear explanation of the key modelling assumptions that shape the scenario outcomes, focusing on transition risks, physical risks, and macroeconomic impacts. It features both a summarized and detailed version.

Report on selected scenario narratives and key findings of NGFS long-term scenarios Phase V

The report offers an in-depth exploration of the narratives underpinning the NGFS long-term scenarios and their manifestation in the resulting outcomes. It focuses on three distinct scenarios – Net Zero 2050, Current Policies, and Fragmented World – which represent contrasting narratives and risk combinations.

The report outlines the foundational narratives and key quantitative features of each scenario, including:

i) A high-level description of the projected futures, enabling users to contextualize each scenario in terms of climate-related risks and alignment with climate policy objectives;
ii) The key quantitative characteristics that shape the extent of transition and physical risks, as well as their macroeconomic impacts on the economy and financial sector; and

iii) In-depth analyses of specific topics of relevance within each scenario, complementing the quantitative assessment of the key findings.

The report explores three distinct scenarios, each reflecting different climate policy trajectories and associated risks:

- **Current Policies Scenario:**
  This scenario illustrates the consequences of the limited ambition inherent in currently implemented policies to mitigate climate change, highlighting the resulting macroeconomic risks and instability. It assumes that no additional policies are introduced, leading to persistently high CO_2 emissions and approximately 3 °C of global warming by the end of the century. Such an outcome entails severe physical risks and irreversible biophysical changes. As the least ambitious scenario within the NGFS framework, it serves as a critical benchmark for central banks and supervisors to assess the long-term physical risks associated with a "hot house world" trajectory.

- **Fragmented World Scenario:**
  This scenario emphasizes the systemic inefficiencies and inequities stemming from delayed and regionally divergent climate actions. Categorized under the "Too little, too late" narrative of the NGFS framework, it reflects a late and uncoordinated transition that fails to adequately contain physical risks, with global warming projected to reach approximately 2.4 °C by the end of the century. The scenario assumes uneven climate policy ambition across countries: jurisdictions with net-zero targets achieve only about 80% of their goals, while others maintain their current policies. As a result, both physical and transition risks remain elevated.

- **Net Zero 2050 Scenario:**
  This scenario showcases the benefits of an immediate and ambitious transition to ensure long-term socio-economic stability and significantly reduce climate damages. It envisions limiting global warming to 1.5 °C by 2100 through the timely implementation of stringent climate policies and technological advancements, achieving global net-zero CO_2 emissions by mid-century. The scenario assumes limited yet sustainable reliance on carbon sequestration technologies, providing at least a 50% probability of staying below 1.5 °C, with a temporary overshoot of up to 0.2 °C around 2050. Physical risks are relatively low, while transition risks range from medium to high. The Net Zero 2050 scenario represents a transition that is "as orderly as still possible."

Note on energy investments in the NGFS long-term scenarios Phase V

While the primary use case of the NGFS scenarios is risk assessment, the Integrated Assessment Models – used to deliver the NGFS long-term scenarios – also provide detailed insights into how the energy transition may unfold. This is particularly relevant for users seeking context on the financing of the transition. The note offers an in-depth analysis of the investments required to achieve net-zero transition goals. It evaluates global and regional energy investment needs under the NGFS Phase V long-term scenarios, benchmarking them against historical data from the International Energy Agency (IEA) and BloombergNEF (BNEF).

The note delivers forward-looking comparisons of investment trajectories to guide central banks, financial institutions, and policymakers on the structural and regional allocation of capital necessary to achieve climate objectives aligned with the Paris Agreement. Key findings reveal that current total energy investment levels are insufficient to ensure a Paris-aligned transition. However, the recent and rapid scaling-up of clean energy investments demonstrates that several sectors and regions have already reached the required pace of investment. Further acceleration is critical, particularly in lower-income regions and electrified transport solutions.

Achieving a net zero–aligned scenario will necessitate a significant reallocation of capital, especially toward electric vehicles (EVs), power grids, and renewable energy sources. The global investment gap is projected to reach up to USD 5 trillion by 2050 compared with 2025 levels.

2) Physical risks

Note on Tipping Points in the Earth System in the context of the NGFS physical risk assessment

The note offers context on the significance of tipping points within the NGFS scenarios, addressing a limitation the NGFS has long recognised in its physical risk analyses. Tipping point impacts often unfold over extended timescales, spanning centuries, and frequently exceed the time horizon of the NGFS long-term scenarios. Due to their prolonged timescales and significant uncertainties, these impacts are not explicitly modeled within the NGFS scenarios.

However, the Earth System Models that underpin the NGFS physical risk assessments do incorporate key dynamic processes in the atmosphere and ocean, such as the Atlantic Meridional Overturning Circulation (AMOC) and Arctic Sea ice loss. These processes provide important insights into the evolving risks associated with climate change.

This note reviews the current state of scientific understanding of tipping points and identifies potential pathways for enhancing their representation in future iterations of the NGFS scenarios. These efforts aim to better capture the long-term physical risks tied to tipping point dynamics and improve the understanding of climate risks.

Note on Physical risks in the updated Climate Impact Explorer

The Note provides key insights into acute physical risks from climate change, utilizing data from the Climate Impact Explorer (CIE), an open-access tool developed in collaboration with the NGFS and updated in 2025. These indicators are distinct yet complementary to the macroeconomic estimates derived from the NGFS long-term scenarios. The CIE offers globally consistent, scenario-based projections of 45 physical risk indicators – including heat, drought, extreme precipitation, fire weather, freshwater availability, labour productivity, and agriculture – at provincial, national, and continental scales by 2100.

The 2025 update introduces significant enhancements, including improved climate data inputs, an upgraded methodology for addressing uncertainty and non-linear impacts, revised indicators, and a new framework for communicating confidence levels. Building on these advancements, the note focuses on three priority indicators – heat, drought, and extreme precipitation – to highlight the acute physical risks associated with NGFS scenarios.

Under the Net Zero 2050 scenario, physical risks remain elevated for decades due to the climate system's inertia but are significantly lower compared to the Current Policies scenario. For instance, the frequency of high heat risk days in Western Europe may be three times greater by the end of the century under the Current Policies scenario compared to the Net Zero scenario.

Additionally, the note introduces a "high climate response" variant of the Current Policies scenario, which explores the potential for even higher physical risks if the climate system proves more sensitive to emissions than current best estimates suggest. This variant underscores the importance of accounting for uncertainties in climate sensitivity when assessing physical risks.


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