



**The Coalition  
of Finance Ministers  
for Climate Action**

# **The NGFS's approach to modeling the short-term macroeconomic implications of climate change and the transition**

**Network for Greening the Financial System (NGFS)**

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**Topic:** Addressing the climate policy questions facing Ministries of Finance: the economic and fiscal impacts the green transition

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## Overview

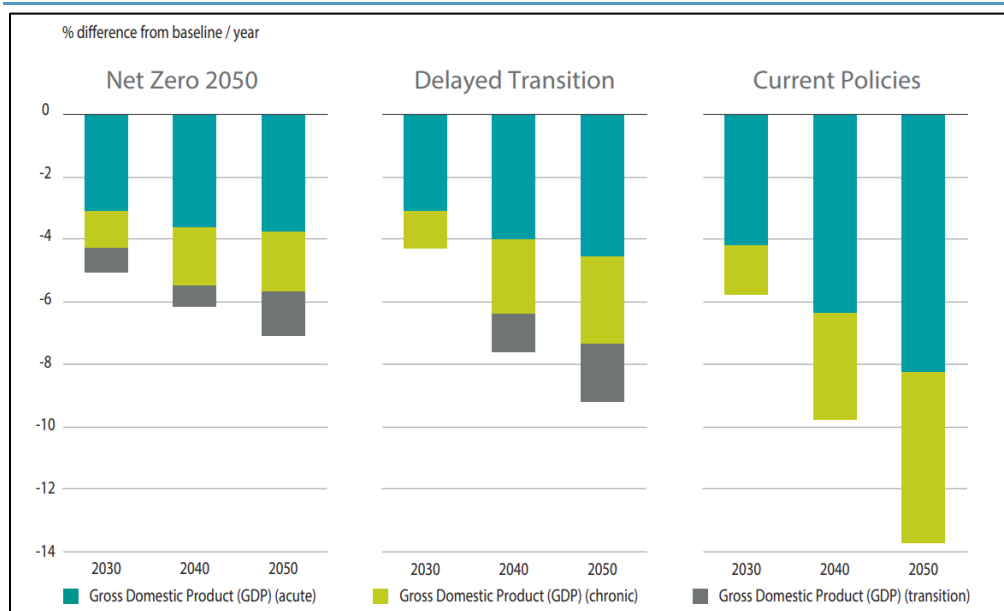
This contribution provides an overview of the ongoing work by the Network of Central Banks and Supervisors for Greening the Financial System (NGFS) on understanding the interplays between short-term macrofinancial dynamics and climate considerations. It mainly builds on the work of the Workstream on Monetary Policy and the Workstream on Scenario Design and Analysis.

The NGFS has been exploring the macroeconomic impacts of climate change for its work on the development of climate scenarios and on the implications for monetary policy. The NGFS Climate Scenarios have mostly focused on long-term dynamics,<sup>1</sup> aiming to unravel the possible structural changes required in the energy system to meet long-term climate objectives as well as the evolution of physical risks under different temperature pathways.

### Long-term scenarios

Long-term scenarios have proved to be very efficient tools to explore the trade-off between different climate targets, demonstrating without ambiguity the benefits of the transition over the status quo, including lower macroeconomic costs. The NGFS scenarios assess the impacts of climate-related risks in two main categories. Transition risks arise from the significant structural changes as countries adjust toward a low-carbon economy. These risks are largely determined by the interaction of policy choices, the impact of disruptive innovations and technological progress, and changes in the preferences of economic agents. Physical risks stem from the increasing severity, frequency and geographic spread of acute climate and weather-related events (e.g., floods, hurricanes, droughts) and chronic shifts in weather patterns (e.g., temperature increases, sea-level rise). The results of the NGFS scenarios clearly call for immediate and ambitious actions to meet the objectives of the Paris Agreement. As displayed in Figure 1, the global GDP losses for the NGFS *Current Policies* scenario, which assumes no additional climate action and thus fails to effectively mitigate climate change, clearly outweigh the potential costs of a transition (14% of GDP loss in deviation from the baseline scenario by 2050 compared with 7% in the NGFS *Net Zero 2050* scenario). Even a disorderly delayed transition (depicted in the NGFS *Delayed Transition* scenario) would be preferable than no further action (9% impact on GDP by 2050).

**Figure 1. Global GDP impact by climate-risk sources (NiGEM model with Remind inputs)**



Source: NGFS (2023b)

<sup>1</sup> <https://www.ngfs.net/ngfs-scenarios-portal/>.

Anticipating broader long-term global impacts to break “the tragedy of the horizon”<sup>2</sup> requires looking beyond the usual time horizon for financial decision-making and strategic planning. This is precisely the perspective that the NGFS long-term scenarios aim to provide.

However, understanding the macrofinancial impacts over a shorter time perspective was identified as also being necessary to assess the financial risks stemming from both transition and physical risks. Understanding these risks over the short-term can be of particular relevance for Ministries of Finance in order to estimate the fiscal costs and economic impact of such risks. The modeling of long-term macroeconomic trends (up until 2050) smooths changes and impacts over time reducing the abrupt and acute nature of possible shocks. The integrated assessment models (IAMs) used by the NGFS compute economic equilibriums over five-year time-steps, which makes them ill-suited to capture short-term frictions. On the acute physical risks, even if substantial progress has been made, the modeling of their economic implications remains subject to many uncertainties and debate.

### Short-term scenarios

To complete its analytical toolkit, the NGFS is developing its first vintage of short-term climate scenarios, to be released in 2025.<sup>3</sup> A first milestone was reached in October 2023 with the publication of the NGFS conceptual note on short-term scenarios (NGFS, 2023a). In this document, five narratives are developed to underpin the short-term dynamics associated with transition and physical impacts. They differ not only in the source of the shocks, but also in their transmission channels and associated policy reactions, which are key to understand the macrofinancial implications of climate change (see Box 1 for details on the development of the NGFS short-term scenarios).

#### Box 1. A forthcoming quantitative tool—the NGFS short-term scenarios

Building on the **NGFS conceptual note on short-term scenarios**,<sup>4</sup> the NGFS is developing a set of short-term scenarios, which will contribute to better understanding the near-term macro-financial impact from both transition and physical risks. This is of particular interest for MoFs to comprehend, *inter alia*, the short-term impacts of these risks on the real economy and the broader financial system, especially given the key role played by fiscal and monetary policy on how climate shocks transmit to the real economy.

Three of the narratives (*Highway to Paris*, *Sudden Wake-up Call* and *Green Bubble*) will focus on the effects of transition risks, exploring a range of plausible futures with different levels of disorderliness and transmission channels. A fourth scenario (*Diverging realities*) will dive into both transition and physical risks by assuming strong discrepancies between regions’ climate ambitions and localized acute weather events in emerging markets and developing economies and low-income countries. Finally, a fifth narrative (*Low Policy Ambition and Disasters*) will delve into catastrophic regional weather events that have substantial macroeconomic impacts.

To calibrate this set of scenarios, a new suite of models is used, with a focus on granular sectoral outputs and the interactions of finance with the real economy. Similarly to the long-term scenarios, the NGFS short-term scenarios are generated through a combination of models. The first modeling component is an IAM, offering a bottom-up representation of the energy sector as well as a detailed sectoral disaggregation of the rest of the economy and a yearly time resolution. This model is then coupled with a stock-flow-consistent macrofinancial model, as well as corporate and sovereign credit risk modules, to provide details on monetary policy reactions and a scenario-contingent valuation of bonds and equity, allowing the incorporation of nominal shocks that are fed back into the IAM through the cost of capital. This new modeling framework will allow users to explore the propagation of transition and physical shocks

2 Breaking the tragedy of the horizon - climate change and financial stability: speech by Mark Carney, Bank of England. <https://www.bankofengland.co.uk/speech/2015/breaking-the-tragedy-of-the-horizon-climate-change-and-financial-stability>

3 Note: The NGFS’s [short-term scenarios](#) were published after this contribution was written.

4 Breaking the tragedy of the horizon, *supra* note 2.

throughout the real economy while taking into account their possible amplification and spillover effects induced by the financial system.

This new dataset will be better fitted to climate stress-testing exercises and macroeconomic assessment on a near-term horizon. With an increased time resolution, these short-term scenarios will allow users to better capture the short-term development of key climate and economic variables. Additionally, credit risk modules will provide a consistent set of risk metrics with which users can perform risk assessments on their portfolios and/or balance sheet. For most of these new scenarios, the calibration of the described narratives will result in rather adverse macroeconomic pathways, more comparable to the trends in scenarios used for stress-testing purposes within the financial sector. The dataset can be divided into three categories: (i) climate-related variables, which include country-level the greenhouse gas emissions and carbon price as well as energy production and power generation; (ii) macroeconomic variables, with country-level GDP, unemployment, sectoral production, investment, population and import/export data; and (iii) financial variables displaying not only corporate and sovereign bond spreads and probability of default adjustments, but also price levels and policy rates.

Transition shocks may arise in the short term in the case of sudden and unanticipated shifts in climate policies, technology, or consumer and investor preferences, and will likely impact a few key sectors (e.g., the energy sector) at first, with spillover effects throughout the economy thereafter. An abrupt policy change in climate ambition to meet emission reduction targets could materialize with steep increases in the relative prices of fossil fuels and fossil fuel-intensive goods, whether through an explicit carbon taxation or other nonprice levers. This change in the price structure will have a direct impact on the overall energy mix. As fossil fuels become increasingly costly, economic sectors relying heavily on them (mostly industrial and transportation sectors) would face higher production costs and suffer capital obsolescence as their profitability declines. A sudden transition could also be driven by rapid shifts in consumer preferences and investment flows, inducing temporary bottlenecks in some sectors. Ultimately, economies will likely experience surges in inflation and volatility as well as stranded assets, hindering economic growth.

In addition to carbon pricing, governments can also deploy other climate policies (namely, public subsidies and environmental standards), which could lead to even shorter-term macroeconomic impacts. Unlike carbon pricing, subsidies can also have a lowering effect on the overall price of energy. However, they can have different negative impacts, such as on public finances in a context of high public debts. Environmental standards and regulation policies can be effective in sectors with low price-sensitivity but induce more brutal changes into the economy, potentially leading to pronounced frictions across sectors.<sup>5</sup>

Countries are already experiencing extreme weather events, compelling regulators and government bodies to study their macroeconomic impacts (NGFS, 2024a). As a result, understanding the potential impacts of extreme hazards has become indispensable for MoFs and other public authorities in charge of ensuring the stability of the economic and financial system. The main transmission channels for physical impacts vary in nature and relative weight with each hazard, but all consist in exogenous negative supply and demand shocks affecting vulnerability points across the economy. On the supply side, extreme events mainly result in the destruction of physical goods, capital, and infrastructure, but they may also disturb the labor market, decrease total factor productivity, and disturb supply chains. On the demand side, extreme weather events can negatively affect households' wealth and disposable income and induce confidence shocks, reducing economic growth and recovery. In addition to the fiscal implications of disasters (e.g., due to the costs associated with replacing damaged infrastructure and assets), governments may also face implicit contingent liabilities due to political and social pressures that could cause them to assume responsibility for

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<sup>5</sup> From an economic or financial perspective, frictions touch upon phenomena that prevent agents from behaving optimally (e.g., asymmetrical information, entry barriers, nominal rigidity, etc.).

damages and costs outside of the standard area of responsibility. The fall in output and tax write-offs for destroyed physical capital may also weaken a country's fiscal position (NGFS, 2024a).

## Considering the financial sector and its role in amplifying climate-related risks is fundamental

While both insurance companies and banks can play a key role in mitigating physical impacts (limiting losses and enabling a faster recovery) and financing the transition, financial institutions contribute to amplifying a localized shock into a systemic threat to the economy via their interlinkages to all sectors. A sudden readjustment in financial markets' expectations can lead to fire sales, asset stranding, and liquidity stress, propagating to the economy through increases in investment premiums, sovereign interest rates, or a credit crunch.

Policymakers (both fiscal and monetary) can significantly alter the magnitude of macrofinancial impacts, but they will face challenging trade-offs in the process. Public spending is the first and main shock absorber, but overreliance on it can lead to perilous public debt levels, especially in uncertain environments with high sovereign premiums. A transition undertaken with carbon pricing policies will generate important fiscal revenues, and recycling these into the economy is crucial with regard to macroeconomic indicators. Carbon revenues can be used to finance subsidies and to counterbalance increases in energy prices, but they can also be transferred to low-income households to address distributional concern and social acceptability of the transition, leading to a surge of demand. The NGFS conducted a sensitivity analysis with regard to the impacts of different recycling options for carbon revenues (Darracq-Pariès et al., 2022). The results indicate, for example, that public investments lead to the most favorable GDP impact while conveying a stronger surge of inflation in the short term compared with the other options (reducing taxes for private agents, increasing transfers to households, or reimbursing public debt). Central banks may also face tough dilemmas with setting their policy rates, as climate shocks can induce an increase in inflation and a decrease in economic growth at the same time. Focusing on their inflation mandate would then amplify the loss in GDP and potentially hinder public intervention and recovery (NGFS, 2024b). While governments will also face tough dilemmas when implementing climate change mitigation policies, they will play a key role in ensuring that such policies are credible and predictable in order to reduce uncertainty and minimize the macroeconomic frictions associated with the transition (NGFS, 2024b).

Assessing the near-term impacts of a transition toward a net zero economy is all the more urgent as the cut-off date for countries' Nationally Determined Contributions approaches (2030), foreshadowing a steep acceleration of climate policies in order to reach emissions reduction targets. With the publication of its first vintage of short-term scenarios and the annual update of its long-term scenarios (Phase V), the NGFS will provide government bodies and the financial community with complementary products, allowing for a sound macroeconomic assessment of climate-related risks. Further improvements will remain necessary, such as enhancing geographical granularity or explicit modeling of climate policies. The NGFS is, however, committed to improving its products to help the financial community grasp the economic implications of climate change.

## Conclusion

- The work of the NGFS in understanding the macroeconomic implications of climate risks produces useful insights for MoFs, as it focuses on common variables of interest, such as trends in GDP, unemployment, or inflation. A key assumption in the narratives is the governments' recycling of carbon revenues into the economy, which will inform policymakers on the macrofinancial implications of various recycling options. The NGFS short-term scenarios will also provide precious insights into public finance risk management, with metrics such as sovereign spreads, bond valuations, or probability of default adjustments.
- As the NGFS scenarios are more targeted toward a risk assessment audience, they often aim to explore tail risks, which may not be as relevant for MoFs. While scenarios developed for monetary policy purposes would explore gradual pathways more consistent with MoFs'

objectives, climate scenarios used for financial stability exercises (e.g., climate stress testing) should, by design, explore adverse yet plausible futures, and therefore do not necessarily reflect the more probable ones.

- The climate policy mix required to steer greenhouse gas emissions reductions remains a government's discretionary choice, and it is not fully captured by the shadow carbon price displayed in the NGFS scenarios. Users should also ensure that the NGFS data effectively reflects their own jurisdiction's particularities and adapt the scenarios if needed.
- Thanks to their regular updates and global coverage, the NGFS scenarios provide policymakers with an efficient comparison tool to keep track of countries' climate ambitions and their latest economic development. The NGFS scenarios are publicly available on the IASA scenario explorer<sup>6</sup> and additional documentation is published on the NGFS scenario portal.<sup>7</sup>

## References

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**Note:** The NGFS's [short-term scenarios](#) have now been published.

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<sup>6</sup> See the latest scenario vintage at <https://data.ene.iiasa.ac.at/ngfs/#/login?redirect=%2Fworkspaces>.

<sup>7</sup> <https://www.ngfs.net/ngfs-scenarios-portal/>.