

Sustainable Finance Research Platform
Policy Brief – 5/2021

**Scenario Analysis as a Tool for Companies, Investors, and Regulators
on the Path to Climate Neutrality**

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Summary

The structural transformation necessary for achieving climate neutrality is characterized by many interdependent changes. Shaping the transition to a zero-emissions economy cannot be based on past data alone, but also requires the definition of future scenarios that are as consistent as possible. The aim of these scenarios is to show how companies are prepared for transformation processes and burdens associated with achieving climate neutrality, both against the backdrop of current climate policy reduction targets and measures (core scenario) and in the event that existing targets are tightened in line with the Paris Climate Agreement (policy scenario “Climate Neutrality 2035”).

Ideally, the scenarios and corporate reporting based on them can fulfil a number of important functions. They are a tool for strategy development and decision-making at the corporate level, they enable clearer communication between the real economy, the financial sector, and regulators, and they provide comparable and robust information to adequately address transformation opportunities and risks.

However, to actually fulfil these functions, comparability across actor groups and application areas should be ensured when defining scenarios. While some comparability is provided in the core scenario by referring to current policy goals and measures, such comparability should also be sought in more extreme policy scenarios that serve as the basis for stress testing. As such, the information can be used in quantitative risk management systems and the reporting burden is minimized. Further, the corresponding scenario can also be used in internal decision-making processes of companies in the real economy. This Policy Brief aims to contribute to the design of such a standardized policy scenario.

¹ The authors would like to thank all the participants at the discussion rounds “From Climate Neutrality Strategy to Scenario Analysis,” especially from the Sustainable Finance Advisory Council, and Marco Wilkens, for many discussions and much feedback.

Scenario Analysis as a Tool for Shaping Structural Change

In its final report, the Sustainable Finance Advisory Council recommends that the German government imposes binding forward-looking reporting obligations in accordance with the framework of the Task Force on Climate-related Financial Disclosure (TCFD). In order to ensure comparability and to minimize reporting effort, two reference scenarios are recommended. A core scenario corresponding to the current and credible expected policy measures targets, and a policy scenario titled “Climate Neutrality 2035” for the use in stress tests at the financial institution and financial market level, in which the achievement of the goal of climate neutrality is already envisaged by policy measures in 2035.²

Originating in theatre, the term and concept of scenario was coined in Cold War military planning and popularized in the 1960s by a book on the year 2000 by Herman Kahn and Anthony Wiener. Kahn and Wiener (1967)³ define a scenario as "a hypothetical sequence of events constructed for the purpose of focusing attention on causal processes and decision points."

In its conclusions, the TCFD identified scenario analysis as a tool that economies, and in particular the financial market, can use to deal with the challenges and uncertainties surrounding the structural transformation required to achieve climate neutrality⁴. Building on this, in November 2020, the European Central Bank published guidelines for banks on managing climate and environmental risks.⁵ Those guidelines called on banks to conduct a self-assessment of their climate-related risks in 2021, while announcing that climate risks will be a focus of the next stress test in 2022.

Multiple benefits for different stakeholders

In the following, we will first describe how corporates and providers of financial services can benefit from scenario analyses. Then we will show the purpose of the creation of climate scenarios thus far, in order to discuss against this background how, in addition to a core scenario, a comparable stress test scenario “Climate Neutrality 2035” could be defined.

² https://sustainable-finance-beirat.de/wp-content/uploads/2021/02/210224_SFB_-Abschlussbericht-2021.pdf

³ Kahn and Wiener (1967) *The Year 2000: A Framework for Speculation on the Next Thirty-Three Years*. MacMillan, New York 1967

⁴ <https://www.tcfdhub.org/scenario-analysis/>

⁵ <https://www.bankingsupervision.europa.eu/press/pr/date/2020/html/ssm.pr201127~5642b6e68d.de.html>

Scenario analysis as a tool for forward-looking corporate management

Larger companies in the real economy - which are for the moment the focus of the considerations - commonly already have several internal scenarios, which are the basis for evaluating strategic decisions. For a company to credibly report on the perspective of a stress test scenario “Climate Neutrality 2035”, such a stress test scenario would have to correspond to one of the internally used scenarios. Thus, such scenarios are valuable not only as a reporting tool, but also as a strategic management tool for the company.

Using a scenario in which achieving climate neutrality becomes necessary as early as the 2030s, companies could answer the following questions:

- What innovations and technologies would be key and what investments would be needed?
- How can energy needs be switched to renewable electricity and hydrogen and how can energy demand be made more flexible and reduced?
- What are the expectations on the recycling share and increasing quality?
- Which markets will grow and which products will be expanded, which ones will be discarded (classification of products)? How is the behaviour of the most important competitors assessed?
- What are the consequences for upstream value chains?
- What incentive systems are there for management?

Two points show that, on the one hand, the respective steps are often very different from the company's perspective:

- Special features and resulting necessities of a sector: In the case of basic materials such as cement, steel or aluminium, there is much less focus on a differentiated view of product markets than, for example, in the chemical sector. Furthermore, the investment cycles (and payback periods) in the various sectors sometimes differ greatly.
- Specific strategy of a company: Even within a sector, options seem to be prioritized very differently, not only with regard to individual technologies, but also other issues, such as the flexibilization of production processes to use renewable energies or the design of recycling processes.

For some key assumptions, on the other hand, a unified perspective is necessary for the comparability, and thus usability, of information at the corporate level and for risk management in the financial sector.

Figure 1 illustrates some of the challenges: Climate change and the policy response are giving rise to new business models, but they also appear as drivers of different risks that materialize differently in companies in the real economy. It is plausible that - even with a high level of detail in climate scenarios and climate policy measures- some of the consequences in the real economy can be mapped better, others only inadequately or almost not at all. While scenarios on the development of raw material prices, for example, are quite common, operational disruptions, such as those recently experienced due to supply bottlenecks of individual components in the automotive industry, can hardly be predicted, at least from outside the company given the current availability of data.

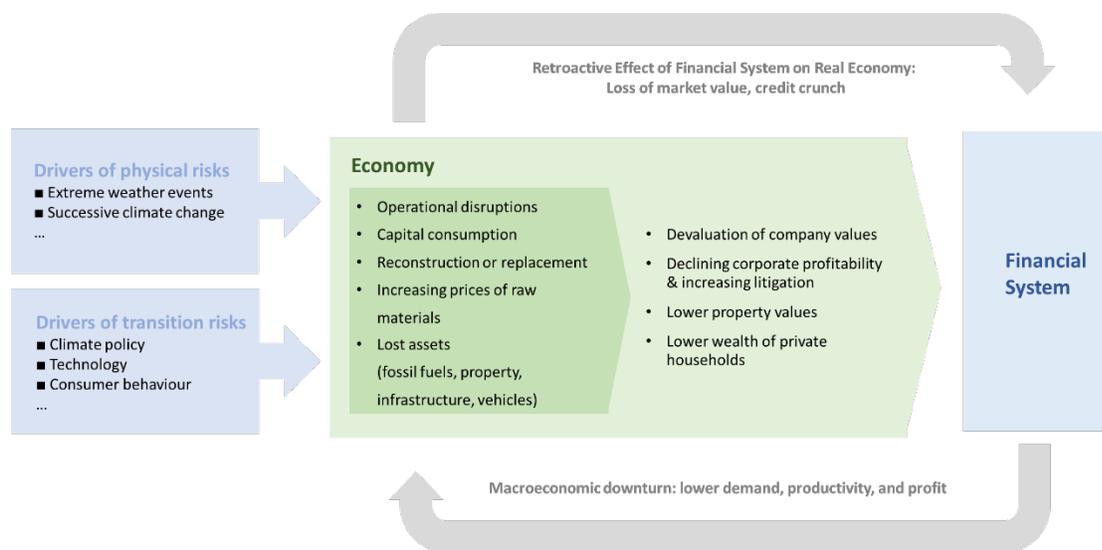


Figure 1: Physical and transitory risk drivers and their impact on the interaction between the real economy and the financial system. (Own illustration based on BaFin and NGFS.)

Nevertheless, a policy scenario of “Climate Neutrality 2035” seems suitable as a starting point to begin a process in which companies can form targeted expectations about structural change and - for example, through reporting - send signals to the market about how they are positioning themselves for change. The figure also illustrates that producers and users (regulators and companies in the real and financial economy) of the scenarios are equally called upon to design them. It is important to weigh up which key points are particularly significant drivers.

Scenario Analyses as a Communication Tool between Investors and Companies

For a companies’ transition risks to be evaluated by third parties, it is necessary that companies report on the changes a given policy scenario such as “Climate Neutrality 2035” involves for them. Corresponding with various companies has shown that analysts are able to evaluate the plausibility of a specific business strategy. They can also compare companies within an industry and validate their scenarios with external data and models (IEA, IPCC, etc.) if necessary. For this

purpose, it should also be reported, if applicable, whether and which additional regulatory developments were assumed in the policy scenario.

For the final translation, e.g. into a key figure, quantitative indicators would also be necessary, as they are already reported for the core scenario as the basis for the earnings forecast:

- Expected development of market volume (revenue) in the policy scenario “Climate Neutrality 2035” - if applicable for different product categories.
- Expected development of profit margins in the policy scenario, e.g. in new market segments/customer groups, or to what extent the additional costs can be passed on to consumers.
- Additional capital expenditure in the policy scenario and, if applicable, also expected unscheduled depreciations.
- As part of the plausibility check of the corporate strategy in the stress test scenario: standardized reporting of the expected CO₂ emissions for Scope 1, 2 and 3

Scenario Analysis in Investor Risk Assessment and Financial Market Regulation

Central banks and financial regulators are working on scenario analyses for climate-related risks to ensure resilience to such risks at the level of financial institutions and at the level of the financial system. Both physical climate risks and transition risks play a role here. This is widely accepted as a necessary step to ensure that these risks can be considered in the risk management of financial institutions despite the lack of comparable historical precedent. To this end, the consideration of climate risks in the risk management of financial institutions should be ensured.⁶

Central banks use stress tests to assess the impact of economic shocks on the financial system. However, transition risks have not yet been considered in these tests.⁷ To do so a factor for transition risk⁸, for example, would be necessary. To enable a joint consideration of activities in institution-wide risk management, a policy scenario used by companies in all sectors is needed. In the absence of suitable company data for this purpose, and since climate economic models

⁶ “ECB expects institutions to incorporate climate change, in particular the energy transition, into the assessment from an economic value perspective. Institutions are expected to take into consideration the impact of climate-related and environmental risks when determining their capital adequacy”

https://www.bankingsupervision.europa.eu/legalframework/publiccons/pdf/climate-related_risks/ssm.202005_draft_guide_on_climate-related_and_environmental_risks.en.pdf

⁷ “Climate-related risks are considered to be a key risk driver for the euro area banking sector. Banks’ practices for considering these in their risk management processes are barely established and heterogeneous.” [ECB report on banks’ ICAAP practices](#), August 2020.

⁸ The CARIMA Project at Augsburg University has developed a capital market-based procedure to quantify carbon risks and their effect on a company <https://carima-project.de>

are usually designed at the sector level, existing approaches primarily consider companies as part of their industry - as illustrated, for example, by a publication of the Network of Greening the Financial System (NGFS) and the Partnership of Carbon Accounting Financials (PCAF) or similar approaches. These approaches work with sector-specific metrics and, in some cases, estimated values. Thus, from the scenarios based on climate-economic models, several sectors emerge that are considered to have a high transition risk due to their high energy intensity. In a climate stress test, these sectors would thus receive an increased risk factor.

From the perspective of risk management in the financial sector, this generalization is not desirable, as the general risk assessment of entire sectors either under- or overestimates the specific risks of individual companies. Against the backdrop of this uncertainty, overall investments would have to be reduced if a specified stability target is to be achieved. This generalization is also undesirable from the perspective of companies in the real economy, as it hinders the capital market access for companies in the affected sectors or leads to higher financing costs. This would make larger investments in the affected sectors more difficult, even though this is precisely where these investments are necessary for the transformation to climate neutrality and thus would help to reduce their transition risk.

Generalization at the sector level also leads to risk management systems not giving credit to individual companies that invest in strengthening their resilience to transition risks. Sectoral valuation discourages shareholders and managers from making such investments in resilience. Thus, the intended guiding function of the capital market is not fulfilled. At the same time, investment opportunities for "green" capital are limited to green sectors, increasing the risk of bubble formation. For these reasons, forward-looking planning (and reporting) that includes a comparable policy scenario should no longer be established only at sector level, but also at company level.

In general, a distinction is made between risk management (previously at the level of the entire portfolio with aggregated figures) and portfolio management (based on company data). Company-level data that includes ESG ratings should be increasingly used in risk management.⁹ This could be based on a company-specific transition metric and added to existing multifactor risk management models. So far, these models have been used to examine how each individual asset reacts to changes in interest rates, exchange rates or economic growth on the basis of historical time series in order to estimate the impact of future shocks. If a company-specific transition metric could be integrated into the models, it would be possible to also determine how

⁹ This also corresponds to a more general demand by ECB. In the [ECB's report on Banks' ICAAP practices](#) from August 2020, improvements to the data quality are one of the three core demands.

the value of a company would change if, for example, a transition shock occurred at the same time as an economic downturn.¹⁰ A plausible stress test scenario could be, for example, a supra-regional climate event (such as a summer heat wave) that leads to widespread societal request to tighten climate targets and policies, while, at the same time, disrupting transportation routes and production processes, causing an economic downturn. In the risk assessment for large financial institutions, the expected loss in value due to a possible shock is determined in stress test scenarios. To be prepared for the event of a crisis, financial institutions must hold sufficient equity capital.

Such an analysis of transition risks not only helps to price them appropriately, but could also provide a foundation for regulatory intervention, if necessary. This is particularly the case if it reveals that the risks are not adequately reflected in market prices. Such an approach, moreover, is fundamentally different from "green supporting" or "brown penalizing" factors, since potential capital requirements would arise solely from the risk perspective. Portfolios would thus no longer be assessed solely according to their sectoral composition, but also according to their resilience to existing transition risks. The extent to which such an approach would also be useful for smaller institutions or could also include insurance companies and asset managers in the medium term would certainly have to be discussed.

Which scenarios could be used?

Future-oriented, scenario-based reporting could be guided by existing resources.

Scenario analyses are well established in climate science

Statements about the impacts of climate change depend heavily on a number of assumptions about the future. How much will the world's population and economy grow? Will growth in energy consumption decouple from economic growth? What technologies will be used to produce energy twenty years from now? All these parameters are subject to very high uncertainty, especially over the long periods for which climate change is relevant.¹¹

Nakicenovic et. al.¹² therefore define scenarios as "[...] images of the future, or alternative futures. They are neither predictions nor forecasts. Rather, each scenario is one alternative image of how the future might unfold."

¹⁰ Here it is crucial to use scenario-based techniques as a complement to capital market-oriented techniques, such as CARIMA-Projekt und Görger, M., Jacob, A., Nerlinger, M., Riordan, R., Rohleder, M., & Wilkens, M. (2019). Carbon risk. Available at SSRN2930897

¹¹ See also Gramelsberger, G. & Feichter, J. (Eds.). (2011). Climate change and policy: The calculability of climate change and the challenge of uncertainty. Springer Science & Business Media.

¹² Nakicenovic, N., Alcamo, J., Davis, G., Vries, B.D., Fenhann, J., Gaffin, S., Gregory, K., Grubler, A., Jung, T.Y., Kram, T. and La Rovere, E.L., 2000. Special Report on emission scenarios.

To discuss these assumptions transparently and as consistently as possible, climate science began standardizing such scenarios as early as the 1990s. The framework commonly used today is based on several components that can be combined in a modular fashion:

- Representative Concentration Pathways (RCPs) describe possible future greenhouse gas concentrations in the atmosphere.
- Shared Socioeconomic Pathways (SSPs) are narratives of global growth trends. Is the world becoming more sustainable and inclusive (SSP1) or is it more likely to follow a fossil fuel-driven growth model (SSP5)? These narratives are based on underlying assumptions about growth rates of the world population and the global economy.¹³

So far, these scenarios have been consulted as a basis for decision-making in international climate negotiations and agreements, as well as for national and regional climate protection plans and climate adaptation plans. Based on global climate scenarios, the Kyoto Protocol was adopted in 1997 and the Paris Climate Agreement (UNFCCC) in 2015. Article 4 of the Paris Agreement stipulates that all countries enter their climate change plans into a public registry (Nationally Determined Contributions, NDCs). These plans must be updated and resubmitted every five years.¹⁴

Application of climate scenarios in the private sector

An effective use in the financial sector requires that climate scenarios and models are made available to various audiences, such as those in the real economy. To this end, the SENSES project has developed a platform with which various climate scenarios and their impacts can be explored.¹⁵ The Network of Central Banks (NGFS) is already using these results to create its own climate scenarios. The NGFS scenarios are based on three integrated assessment models.¹⁶ There are three representative scenarios ("orderly transition," "disorderly transition," "hot house world") and a total of five variations of these three scenarios. These differ primarily with respect to the assumption of how much CO₂ can be removed from the atmosphere. The scenarios contain two 1.5°C scenarios, one of which is based on less carbon capture and storage and thus a faster reduction in global greenhouse gas emissions.

Two challenges and a fundamental dilemma complicate the use of climate scenarios for businesses and financial market actors: the global scenarios used so far have low geographic

¹³ A recent overview can be found at the Helmholtz Society's Climate Service Center, <https://klimanavigator.eu/dossier/artikel/085116/index.php>

¹⁴ <https://www4.unfccc.int/sites/ndcstaging/Pages/Home.aspx>

¹⁵ <https://www.pik-potsdam.de/en/news/latest-news/making-sense-of-climate-scenarios-toolkit-for-decision-makers-launched>

¹⁶ The integrated assessment models GCAM, MESSAGEix-GLOBIOM and REMIND-MAgPIE are complex models that link highly simplified economic and energy systems with carbon cycles and other systems.

(depending on the climate model used, Europe, for example, is divided into two to five regions) and sectoral granularity. However, a higher level of detail would be necessary for a reliable risk assessment of individual companies or investment projects. At the same time, however, a scenario that is too detailed runs the risk of inadequately reflecting the given uncertainties regarding technologies, policy measures and other parameters and thus could - if mandatory by regulation - lead to misjudgements and misallocations.

Definition of a Stress Test Scenario Possible with Few Key Data

Despite these challenges, scenario analyses can help to focus on the structural change that is to be tackled. Even a few key data could be sufficient for specific application in a stress test to accelerate the implementation of policy measures to achieve climate neutrality.

To achieve the 1.5°C target of the Paris Climate Agreement, rapid emission reductions and global climate neutrality by 2050 are necessary. Emerging and developing countries do not only require notable catching up in terms of economic development, but also face greater challenges in implementing a transformation to climate neutrality. Therefore, industrialized countries would have to reduce their emissions much faster and achieve climate neutrality already in the 2030s if the 1.5°C target is to be reached.

Against this backdrop, a scenario in which industrialized countries commit to achieving climate neutrality as early as 2035 and implement the necessary measures to achieve this seems entirely plausible. As a stress test scenario, this policy scenario “Climate Neutrality 2035” has a major advantage over policy scenarios that assume the achievement of climate neutrality at a later point in time, for example in 2050. With long implementation timeframes, measures can be delayed and so-called interim or transitional technologies can be used. The shorter time span until 2035 minimizes ambiguities regarding the emission pathway. This should mean that the emissions path does not have to be specified and that the 2035 climate neutrality benchmark date is already sufficient.

In workshops with stakeholders from the real economy and the financial sector, it was also discussed which further aspects would have to be included in the definition of a policy scenario “Climate Neutrality 2035” in order to ensure sufficient comparability of the results. It is important to clarify how climate neutrality will be achieved in a country. Therefore, it is suggested that climate neutrality in this scenario is not achieved at the expense of emissions in other regions, i.e., through increased import of CO₂-intensive products, such as the relocation of industrial and agricultural production.

Furthermore, it seems necessary to assume that other industrialized countries outside Europe also achieve climate neutrality in 2035. Otherwise, transition risks and opportunities faced by companies in other industrialized countries would not be considered. If a stress test ignores this, yet ends up impacting portfolio allocation, it could lead to a preference for GHG-intensive activities in other industrialized countries and climate-friendly activities in Europe.

Since all emissions are relevant at the macroeconomic level and climate neutrality should be aimed for in all areas of the value chain, it is important that Scope 1, 2 and increasingly also Scope 3 of the relevant emissions are considered. Thus, the carbon footprint of the supply chain, for example, would not only be an indicator for the environmental performance of a company, but also for the resilience of the business model in the stress test scenario. It is crucial to know, for example, whether an automobile manufacturer has access to basic materials produced in a climate-neutral way or whether there is still demand for emission-intensive products.

To simplify the evaluation of the respective company strategies and to ensure the comparability of the strategies for achieving climate neutrality of different companies, emission reductions should be achieved through direct measures and not through an extensive use of international emission offsets. Compensations for early shutdown of CO₂-intensive plants should also be viewed critically and should not be assumed for the definition of a scenario.

In discussions with stakeholders from the real economy and the financial sector, little emphasis was placed on assumptions about the specific level of a CO₂ price. This may reflect the fact that the formulation of the goal of climate neutrality represents a clearer target in terms of the market potential of technologies and products than a CO₂ price. This is particularly the case because the consequences of a specific CO₂ price must always be assessed in combination with assumptions about technology costs, fossil fuel prices, and other regulatory instruments. All these factors are also volatile themselves.

Furthermore, it is being discussed that government measures to avoid or hedge regulatory risks should be reflected in the characterization of a stress test scenario. Other policy measures, such as efficiency standards for existing buildings or automobiles, targets for the share of green products and product standards, and measures to promote recycling, can play a central role for the investment and business models of individual companies and sectors. However, describing policy scenarios in too much detail could be controversial and, in case of doubt, lead to the scenario not being used for internal decision-making processes. Alternatively, companies could instead be asked to explicitly communicate additional assumptions they make about regulatory developments. Financial market players and stakeholders can then check whether inconsistent or implausible assumptions have been made. This would initiate a learning process in which

companies and governments can respond appropriately to the challenges associated with achieving the 1.5°C target based on a growing supply of data and the subsequently gained knowledge.

Conclusions

Scenario analyses can be a key tool for achieving the goal of climate neutrality. They provide involved actors in the financial and real economy with important information to successfully manage necessary transformation processes. This applies not only to strategic decision-making in companies in the real economy and risk management in financial institutions, but also to financial market regulation.

In order to establish forward-looking reporting based on scenario analyses on a broader scale, companies in the financial and the real economy should report both on the basis of a core scenario, in which companies report on currently expected political targets, and on the basis of a policy scenario, which assumes that climate policy measures will be tightened in the near future.

In particular companies that have been disadvantaged in previous valuation models due to their sectoral affiliation could benefit from forward-looking reporting. This may be particularly relevant for emission-intensive sectors of the economy. A company-specific assessment would appropriately reward progressively oriented companies for their commitment, for example through better access to financing. At the same time, incentives would be created for other companies to follow this example. This simplifies the investments needed to achieve climate neutrality, also and especially in emissions-intensive sectors.

Compared to the usual scenarios with longer time horizons, a “Climate Neutrality 2035” policy scenario has the technical advantage that there is little time flexibility or scope for interim solutions. Only few key points would suffice to define a reference scenario that allows comparable reporting in the financial and the real economy. In addition to the target year, this includes the assumption that climate neutrality is achieved by transforming production processes and products and not by relocating production to other regions. Furthermore, it would have to be assumed that policy measures such as CO₂ pricing do not preclude viable options, but are designed in such a way that economically viable emission reduction options can be realized.

The Sustainable Finance Research Platform is supported by:

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