

## Financial Risk and Stability Network Financial Stability Conference - Research Workshop

*Climate change entrenched financial risks, implications for banks and the transition to a low-carbon economy.*

### **Stress testing the climate: designing scenarios for SDGs**

19 November 2021

Stavros Pantos<sup>1</sup>

School of Law, University of Reading

#### **Abstract**

The policy contribution paper composes a critical examination of the effectiveness of climate change scenario analysis and Environmental, Social and Governance (ESG) impacts of financial services towards sustainable development goals. Specifically, it presents a literature review on the existing regulatory prescribed climate change related stresses and scenarios tests, developed for financial services in Europe from supervisory authorities. A critical analysis of the supervisory approaches towards climate change risk management is performed, commenting on disclosures and financial metrics, focusing on the gaps identified from existing climate change scenarios in relation to the United Nations Sustainable Development Goals. This analysis complements the exercise of regulators and supervisors towards the development of policies for a more sustainable and inclusive post COVID-19 transition for financial services. This research highlights the need of integrating the 17 United Nations Sustainable Development Goals (UN SDGs) and ESG factors in the design and development of scenarios to ensure the resilience of the financial sector. This research examines what the financial stability implications of climate change are, how they are managed and what is the link of the supervision of climate change related risks with the sustainable development, the UN SDGs and ESG factors. Preliminary findings include policy recommendations and advances to supervisory practices for the design of market wide and idiosyncratic enhanced scenarios, complementing the existing stress tests exercises.

**JEL classification:** E58, G38, G21, K20, Q54, Q58.

**Keywords:** climate change, climate risks, stress testing, sustainability, UN SDGs, ESG factors.

---

<sup>1</sup> Stavros Pantos is a PhD candidate from the Centre of Commercial Law and Financial Regulation (CCLFR) of the School of Law, of the University of Reading, in the UK ([s.pantos@pgr.reading.ac.uk](mailto:s.pantos@pgr.reading.ac.uk)).

## 1. Introduction

This policy contribution paper presents a critical examination of the effectiveness of climate change scenario analysis and Environmental, Social and Governance (ESG) risks for financial services in Europe towards the United Nations Sustainable Development Goals (UN SDGs) (UN, 2021). This topic composes a high priority agenda item for financial services supervisors, as discussed at the recent Green Swan 2021 Conference (BIS, 2021)<sup>2</sup> considering its importance from the recent June 2021 G7 Summit, as well as the forthcoming 26<sup>th</sup> United Nations Climate Change Conference in Glasgow (COP 26)<sup>3</sup>, as well the associated challenges from the coronavirus pandemic (COVID-19).

This paper starts with a brief introduction on how it all started with the focus on climate change risk management and its implications, from regulators and prudential supervisors for financial institutions<sup>4</sup>. Then, the existing regulatory prescribed climate change related stress and scenario tests are documented in the literature review, before commenting on what is missing, the gap from existing scenarios in relation to ESG factors and the UN SDGs. The final part of this paper includes some preliminary recommendations for designing scenarios focusing on sustainability, towards the development of policies for a more sustainable and inclusive post COVID-19 transition for financial services, effectively complementing the plan of regulators and supervisors.

After the Paris Agreement with the United Nations Framework Convention on Climate Change in 2015 (UNFCCC, 2015), regulators and supervisors across the world started thinking about climate change considerations, implications and policy implementation for their agenda and action plan. Initial reports from the World Economic Forum (WEF)'s Global Agenda Council on Climate Change and on Measuring Sustainability (O'Connell et al., 2013) were published<sup>5</sup>, providing more insight on the associated implications, risks and what's coming on the horizon, as an early warning, to understand how to address those challenges. In the UK, the Bank of England (BoE) and the Prudential Regulation Authority (PRA) published a series of papers on the response to climate change, starting with climate change implications to central bank's ability to meet its monetary and financial stability objectives, with policies to address those effects (Batten et al., 2016). This was followed by reports capturing the implications to

---

<sup>2</sup> Organised by the Bank for International Settlements (BIS), Banque de France, the International Monetary Fund (IMF) and the Network for Greening the Financial System (NGFS).

<sup>3</sup> The UK hosted the G7 Summit as part of its 2021 G7 Presidency; UN Climate Change Conference UK 2021, COP26 Goals.

<sup>4</sup> Referring to banks, re-insurers and asset management companies. Please note that the focus of this paper is primarily banks and then re-insurance companies, with the recommendations being applicable to all financial services.

<sup>5</sup> For more articles, please see WEF Agenda Climate Change and Governance for Sustainability (WEF, 2021a;b).

financial services, starting with insurers because of the direct exposure to weather events and their socioeconomic role for natural catastrophes (PRA, 2015), before commenting on banks (PRA, 2018b), documenting enhancements to approaches for the management of financial risks arising from climate change (PRA, 2018a; 2019a; 2019b). At international level, the Task Force on Climate-related Financial Disclosures (TCFD) provided recommendations for risk management, strategy, disclosures and scenario analysis in relation to climate change risks. This was followed by a coordinated action plan from central banks and supervisors in establishing the Network for Greening the Financial System (NGFS). In 2020, under the Chairmanship of the BoE, the NGFS published a first set of climate scenarios alongside a first-of-its-kind guide to climate scenario analysis for central banks and supervisors (NGFS, 2020a; 2020b; 2020c), discussed in the following sections.

## **2. Climate Change Scenarios**

This section captures the literature review on the existing regulatory prescribed climate change related stress and scenario tests, developed for financial services in Europe. There have been different publications on scenario planning and stress testing from regulators and supervisors across the globe, such as from the BoE/NGFS, as well as reports from think tanks and research initiatives on managing and quantifying future uncertainty around climate change. Scenario analysis is a process for identifying and assessing the potential implications of a range of plausible future states under conditions of uncertainty. Scenarios and stresses are hypothetical constructs and are not designed to deliver precise outcomes or forecasts (FSB, 2020b). Instead, scenarios provide a way for organizations to consider how the future might look if certain trends continue or certain conditions are met (FSB, 2020b). Climate risk scenarios and stress tests constitute comprehensive assessments of the impact of macroeconomic and financial variables delivered from climate/economic models according to the Basel Committee for Banking Supervision (BCBS, 2021a). Climate scenarios explore different possible climate change futures and pathways towards achieving long-term climate goals (NGFS, 2020a).

Hulme et al. (2002) initially documented the UKCIP02 climate change scenarios, followed by scenarios from the International Energy Agency (IEA), the WEF, the Intergovernmental Panel on Climate Change (IPCC)<sup>6</sup> and from the 2° degrees investing initiative (2ii)<sup>7</sup>. The TCFD published guidance for companies on conducting climate-related scenario analysis, which composes the fundamental TCFD recommendation that helps

---

<sup>6</sup> Referring to the IPCC comprehensive assessment reports on climate change, on causes, potential impacts and response options, such as AR4 to AR6 synthesis reports, as well as special and methodology reports.

<sup>7</sup> See Ralite and Thomä (2019) for the initial proposal for a climate stress-test scenario and Ramirez et al., (2020) for an example from Latin American Financial Institutions and the use of scenario analysis for transition risks.

companies plan for resilience (TCFD, 2017a; 2017b; 2020). This was followed by the PRA's Insurance Stress Test for life and general insurers in 2019 which included an exploratory exercise in relation to climate change (BoE, 2019). The set of climate scenarios explored the impacts to both firms' liabilities and investments stemming from physical and transition risks. Building on that insurance stress test, the BoE developed the 2021 Climate Biennial Exploratory Scenarios (CBES) to test the UK financial system's resilience to the financial risks from climate change, based on the NGFS scenarios (BoE, 2019b; 2021b). The NGFS scenarios have been developed to provide central banks and supervisors, as well as financial firms and companies, a common starting point for analysing climate risks under different future pathways (NGFS, 2020a; 2020c; 2021a; 2021b). These scenarios are used by the NGFS' members for macroprudential purposes (NGFS, 2021c).

There have been additional recommendations, guidance and tools for climate change scenarios, as well as climate stress tests<sup>8</sup>. These include the climate stress test from Battiston et al. (2017), scenarios developed by the Banque de France based on the NGFS for French banks/insurers<sup>9</sup> (Allen et al., 2020), a short-term stress test of financial institutions with focus on transition risks in the Netherlands by the De Nederlandsche Bank (Vermeulen et al., 2018) and the Danish stress test with transition risks in development by the Danmarks Nationalbank (DN, 2019). The Geneva Association has also developed methodologies and tools to perform decision-relevant climate risk assessment and scenario analysis for the insurance and reinsurance industries (TGA, 2021). Climate-related risks are a source of financial risk which might be translated to prudential risks for insurance entities, impacting the overall resilience of the insurance industry (IAIS-SIF, 2021), explaining the supervisory focus on that industry (EIOPA, 2021). Earlier this year in 2021, the ECB designed the top-down economy-wide climate stress test to assess the resilience of non-financial corporates and banks in the euro area to climate related risks, under different future climate policies (Alogoskoufis et al., 2021a), whereas in 2022, the ECB supervisory climate stress test for the EU banks under ESB supervision is expected (ECB, 2021b). A list of different climate reference scenarios is captured by the Principles for Responsible Investment (PRI, 2021), that provides the background forecasts of the supervisory climate change scenarios<sup>10</sup>.

---

<sup>8</sup> For more a detailed description on the methodological framework about climate change scenarios, please see the ECB/ESRB Project Team on climate risk monitoring (2021), where a comparison between alternative climate-risk macro-financial scenarios is presented.

<sup>9</sup> These were submitted to group of banks and insurance companies and performed on voluntary basis, as part of the first bottom-up pilot climate-related risk assessment (Allen et al., 2020).

<sup>10</sup> For more scenarios and detail please see the NGFS survey results on objectives of climate scenario analysis (NGFS, 2021c).

### 3. Analysis and Gaps

The climate change scenarios listed in the previous section, capture UN SDG 13 climate action and potentially some of the rest SDGs indirectly, based on the relationship and interconnectedness between climate action and the rest SDGs (Nerrini et al., 2019). The same applies in relation to the ESG risks/factors, where only Environmental is captured. That's the key element missing from the existing climate change scenarios. Despite the fact that existing policy measures capture climate change related risks, this does not apply to the 17 UN SDGs and the "S" and the "G" from the ESG risks/factors. There is an obvious and well documented link between UN SDGs, ESG risks/factors and sustainability disclosures and climate change, based on the TCFD recommendations (TCFD, 2017) and the plans for ESG corporate reporting system<sup>11</sup>. Therefore, what is missing from the existing climate change scenarios, is the consideration of the implications to the UN SDGs and ESG risks, beyond the climate change risks, with this being part of the integrated financial and sustainability reporting, under risk management, strategy and scenario analysis. Therefore, understanding targets and strategy of financial institutions in relation to the UN SDGs beyond climate change should be included in the reporting and disclosures. The focus from climate change related risks and environmental criteria to social and governance factors should be expanded, capturing the rest UN SDGs and their interconnectedness. To address this gap and constraining limitation from the existing climate change scenarios, the design of a qualitative exercise to capture each UN SDG and ESG risk for each financial institution, followed by exploratory market wide assessments, should be performed. These scenarios should replicate the format of climate change scenarios with (a) targets (commenting on the 17 UN SDGs being fully, partially or not met at all, regarding their targets and indicators), linked with (b) policy action<sup>12</sup> and a (c) long-run long-term horizon (until 2030 and beyond).

There are limitations to traditional stress testing methodologies in assessing the impact of climate change to inform prudential policies as NGFS highlights (NGFS, 2021c). Results of the ECB economy-wide climate stress test highlighted the benefit from adopting green policies early towards a zero-carbon economy transition, being cost effective in the long-run, while providing cover for future natural catastrophe events (ECB, 2021b). However, from those results, there is no clear direct link the rest UN SDGs beyond SDG 13. Whilst the ECB EU-wide climate stress test captures the interactions between transition and physical risks, used in

---

<sup>11</sup> In 2020, five ESG standard-setters, the Carbon Disclosure Project (CDP), the Climate Disclosure Standards Board (CDSB), the Global Reporting Initiative (GRI), the International Integrated Reporting Council (IIRC) and the Sustainability Accounting Standards Board (SASB), pledged to work together towards this IFRS (2020a;b).

<sup>12</sup> Referring to early action, late action, no action at all, similar to the 2021 CBES from the Bank of England (BoE, 2019b; 2021b).

the comparison between future costs and benefits of climate policy action (Alogoskoufis et al., 2021a), it fails to capture the cross-implications between climate action (SDG 13) and the rest SDGs. Gaps in scenario modelling in relation to (i) scope, (ii) coherence and (iii) uncertainty are documented by NGFS (2020c; 2021a). The recommendations in relation to the link and consideration of the ESG factors, SDG 13 targets and metrics as well as for the rest UN SDGs reinforce those gaps. Particularly in relation to scope and coherence, since an extension of the scope of the modelling and output of risks is recommended, capturing the interactions within the different economy sectors beyond the financial services. What is not captured by the NGFS (2020c; 2021a) regarding the scenario modelling gaps, are the links to ESG factors, consideration of the UN SDGs and the disclosures and reporting on their associated impact. Scenario barriers documented by the NGFS (2020b) linked to the lack of awareness of environmental risks and appreciation of their relevance, with inadequate environmental and loss data, are related to the gaps identified about the absence of consideration of the rest ESG factors and the UN SDGs beyond climate action. This interconnectedness and links between climate action and the rest UN SDGs under different scenarios, are highlighted by COVID-19, where under this system-wide shock, adverse implications to macroeconomic factors with uncertain long-term impact to non-financial metrics are observed (NGFS, 2020c; 2021a).

#### **4. Policy Developments/Recommendations**

Climate risks affect the economy and financial system through a range of different transmission channels in the form of acute and chronic impact (NGFS, 2020c; 2021a). They are part of the financial stability monitoring considering their macroprudential nature, being a source of systemic risk (FSB, 2020b; Alogoskoufis et al., 2021a; de Guinos, 2021). There is a plethora of published plans and statements capturing the implications and policy responses (e.g., climate change risk management, scenarios, green finance, carbon pricing etc.) available from prudential authorities and supervisory bodies. There is a need and drive to facilitate sustainable and inclusive green recovery out of the COVID-19 crisis. Therefore, the development of a coordinated action plan with combined (i) policy, (ii) regulation and (iii) supervision of financial institutions, focusing on the 17 UN SDGs and ESG risks, as well as providing guidance and tools for assessments<sup>13</sup> is recommended. As graphically depicted below, policy, regulation and supervision should be updated to incorporate UN SDGs and ESG criteria in scenario planning and stress testing and be translated into reporting and disclosures.

---

<sup>13</sup> An example in that direction is the Insurance and Risk Finance Facility is a flagship initiative of the UNDP Finance Sector Hub (UNDP, 2021; IRFF).

**Figure 1: Scenario/Stress Testing Policy Development**



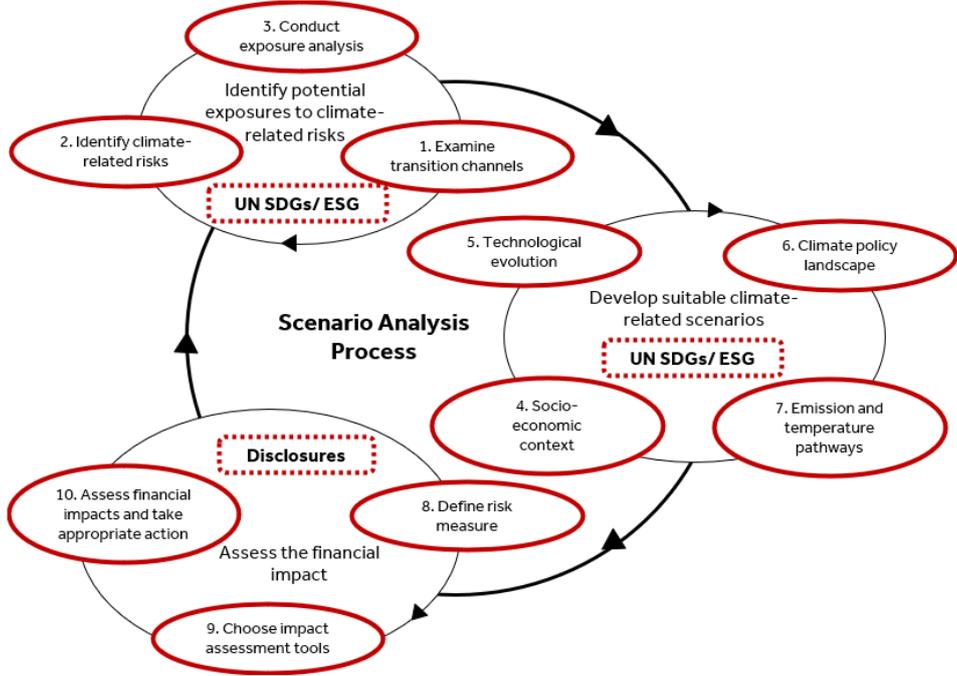
In relation to policy design, perhaps testing empirically the precautionary financial policy and regulation of Chenet et al. (2019; 2021), based on precautionary principle and macroprudential policy, could be an approach in line with the gaps identified. Andersson et al. (2020) comment on the risk that climate change may lead to widespread disruption to the economic and financial system, supporting the recommendation to consider the impact of the UN SDGs and ESG factors when examining the climate change scenarios. In the same way that transition and physical climate risks are interlinked, climate risks are related to the UN SDGs (de Guindos, 2021), thus coordinated policy action and scenario design should target a holistic view and coverage. The development of models to monitor the implication of climate change and related policies in relation to the economy and the entire financial system is currently ongoing, with enhancements expected in relation to the data for climate change risk analyses in line with the EU policies and initiatives linked to sustainability disclosures and reporting (ECB, 2021a).

Scenario analysis composes an important tool to identify and measure the potential implications of climate change and test the resilience of a firm’s overall approach to climate-related risks (FSB, 2020b; Baudino and Svoronos, 2021). Stress tests are used to evaluate the financial sector’s resilience to climate change (de Guindos, 2021), but considering the link of climate change with the rest UN SDGs and ESG factors, those tests or additional scenarios should capture the interconnectedness and comment on the overall resilience. Developing scenarios linked to UN SDGs to test sustainability plans, with exercise for all financial institutions to evaluate and incorporate in disclosures is recommended. The available options are creating new scenarios only for the UN SDGs and ESG risks and their interconnectedness with climate risks and SDG 13 climate action, or attempt enhancing existing scenarios that is going to add to the validity of this exercise. Enhancing the NGFS scenarios as part of the longer-term NGFS project to improve the scenarios further should be adopted, to ensure that they are coherent, comprehensive and relevant for the economic and financial analysis (NGFS, 2021), effectively capturing climate risks but also the ESG risks and the implications towards the UN SDGs. Financial institutions should also attempt to develop their own idiosyncratic scenarios, beyond reporting on the impact to UN SDGs and ESG risks from market wide stress tests. Therefore, a combined top-down and bottom-up approach towards stress and scenario testing should be followed, since bottom-up risk assessments complement and augment top-down and

macroeconomic approaches (Breedon, 2021), with an even split and variations in the degree of granularity proposed (NGFS, 2021c).

To realize this, the four-step process of scenario development as described in the guide of NGFS (NGFS, 2020a) should be enhanced, starting with the objective and exposure identification, to extend the focus beyond climate change and climate action, capturing the rest UN SDGs. In terms of granularity in relation to economic and geographical resolution, medium at sectoral and country/regional level respectively should be adopted (NGFS, 2020a). Effectively the recommendation in relation to the scenario planning and stress testing for the rest UN SDGs and ESG factors, involves replicating the TCFD guide for scenario analysis, where it should be used beyond climate action (TCFD, 2020). An example of an enhanced scenario in that direction based on the above recommendations, is the Sustainable Development Scenario (SDS) developed by the IEA (IEA, 2021). Further guidance<sup>14</sup> in that direction could become available via the creation of the Central Banks’ and Supervisors’ Climate Training Alliance (CTA) (SIF, 2021). The above recommendations are linked to the NGFS survey results on objectives of climate scenario analysis, in relation to the assessment of the impact of climate risks on the financial system and the economy, as well as developing capabilities within the financial services sector (NGFS, 2021c). Extending the areas for future work identified by the CFRF working group, in relation to the climate change scenario assessment and modelling (CFRF, 2020; 2021) is also proposed, as in the following figure.

**Figure 2: Climate Scenario Analysis Process**



<sup>14</sup> NGFS plans to create extensive and free to use climate scenarios (NGFS, 2021c), whereas updated guidance on climate scenario modelling and assessment is also expected by the Scenarios Analysis Working Group of the Climate Financial Risk Forum (CFRF), established by the PRA and the FCA in the UK.

In relation to disclosures and reporting of the results, the scenario output should capture the impact on the ESG risks, the UN SDGs targets and metrics, either indirectly between the cross-implications between SDG 13 or ideally directly. There is a strong case for mandatory climate-related disclosures (Weidmann, 2021). However, beyond the TCFD recommendations for disclosures, financial companies should disclose metrics against the UN SDGs. Data to monitor and assess those risks and associated implications are of high importance (FSB 2021a). Perhaps creating key performance indicators (KPIs) and key risk indicators (KRIs) for climate-related risks, ESG risks and UN SDGs, mapped to targets and metrics and testing them under stressed situations in the form of sensitivities might be the appropriate way towards the development of coherent scenarios to include ESG risks and UN SDGs implications (ECB, 2020b). Linking this with the stress testing methodology, documentation on the transmission channels of the ESG risks should be included, and replicated for the UN SDGs, to allow the design of more coherent and comprehensive scenarios (EBA, 2020b). The EU taxonomy regulation with its six environmental objectives provides both the legal framework and link between climate change and sustainability, supporting the proposal about the linking the UN SDGs and ESG with the climate scenarios (Alessi et al., 2021).

Finally, the last part after linking the scenarios and stress testing with the disclosures and reporting, covers advances in prudential supervision. Implications of climate change for financial stability with climate-related financial risks, part of the long-term financial supervision from central banks, are reflected in the existing climate change related risks guidance and scenarios. Consideration of the impact of financial institutions to the rest UN SDGs and ESG risks should become part of the supervisory approach, to ensure the resilience of the financial sector to climate-related risks (FSB, 2020a) and the associated risks from the interconnectedness with the rest UN SDGs. Supervisory practices with monitoring and review<sup>15</sup> should be adjusted to reflect the amendments towards the effective supervision of the risks and implications regarding ESG and UN SDGs. Towards long-term supervision of those associated risks, additional work is required to translate the climate change related risks and the risk associated with the rest ESG factors and the UN SDGs into scenarios and stress tests, to help inform evaluating policy and setting action (Ralite and Thomä, 2019).

Regarding recommendations for setting supervisory expectations in relation to approach to climate-related and environmental risks, these are linked to scenario analysis and stress testing as in the TCFD recommendations (TCFD, 2017), with the right balance required between climate risk disclosures and supervisory action (Restoy, 2021). There is an expectation

---

<sup>15</sup> Referring to the Supervisory Review and Evaluation Process (SREP) / Supervisory Review Process (SRP) and other inspections (EBA, 2020a; 2021a).

that forward-looking methodologies and tools should be developed in that direction to identify, monitor and manage climate related and environmental risks, capturing the magnitude of their implications (NGFS, 2020a). Scenario thinking and design about the channels of risk transmission (NGFS, 2020a) should also capture the interlinkages between the ESG factors and UN SDGs. It should be a supervisory expectation for financial institutions to disclose climate-related risks and their interconnectedness with ESG risks and UN SDGs, in extending the TCFD recommendations, as part of the risk management strategy (ECB, 2020b). ESG factors as drivers of financial risks should be captured over an extended time horizon in supervisory assessments via stress and scenario tests, detailing the transmission channels linking them to climate risks (EBA, 2020b), and thus should be linked to the climate scenarios, included in the supervisory review (Baudino and Svoronos, 2021).

Climate change risks pose a systemic threat to financial stability beyond the idiosyncratic risks faced by individual financial institutions, with their associated macroeconomic and financial implications examined under the stress and scenario tests (NGFS, 2021c). Macroprudential design could perhaps be adopted to capture climate risks, with macroprudential policy deployed to complement supervisory measures to address climate risks and capture their systemic implications (Baranović et al., 2021). Prudential framework and regulation for banks should be enhanced to capture effectively the financial impact arising from the climate change risks (Chaves et al., 2021; Restoy, 2021). Insights from the enhanced climate scenario analysis could assist the understanding of the financial and economic implications of climate change, informing future macroprudential considerations (NGFS, 2021c) after capturing the economic consequences of the climate and environmental crisis (Elderson, 2021). Therefore, the results from the comprehensive and extended climate scenarios could shape policy climate related responses for the wide economy (Budnik, 2021). This involves effectively linking the risks associated with a transition to a low-carbon and more environmentally sustainable economy, explaining the recommendations described above and summarised in the following table above the UN SDGs and ESG considerations.

**Table 1: Recommendations**

<b>Proposal</b>	<b>Example components</b>
Policy	<ul style="list-style-type: none"> <li>- developments around monetary policy implications of climate change, with macroprudential</li> <li>- macroprudential policy and approach for climate risks</li> <li>- public policy responses to the climate emergency, for transition to a sustainable economy</li> <li>- European Green Deal</li> </ul>
Regulation	<ul style="list-style-type: none"> <li>- EU taxonomy regulation</li> <li>- macroprudential approach design and deployment of macroprudential tools for climate risks</li> <li>- enhance disclosure requirements and reporting</li> </ul>
Supervision	<ul style="list-style-type: none"> <li>- development of climate scenario analysis tools, providing guidance on consideration and inclusion of the UN SDGs and ESG impacts</li> <li>- update and extension of the CFRF scenario analysis guide, creation of guidance as part of the CTA initiative, with development of material, methodologies and frameworks for banks</li> <li>- use the results of the scenarios to inform the supervisory review and evaluation process</li> </ul>

## 5. Discussion

A critical analysis of the supervisory approaches towards climate change risk management is performed, commenting on the scenario analysis and the disclosures, before listing certain policy recommendations. The aim of the analysis performed is to comment on gaps identified from existing climate change scenarios in relation to the UN SDGs. The analysis performed adds to the growing literature about the design of scenario planning for climate change related risks, with focus on sustainability<sup>16</sup>. This eventually is going to complement the exercise of regulators and supervisors towards the development of policies for a more sustainable and inclusive post COVID-19 transition for financial services (da Silva, 2021). This research highlights the need of integrating the 17 UN SDGs and ESG factors in the design and development of scenarios to ensure the resilience of the financial sector. This will be realised after gathering evidence on the existing supervisory practices in relation to regulation and reaching conclusions for policy making, after understanding how regulators, supervisors and central banks work together in practice for the management of climate change related risks (FSB, 2020). The economic analysis of law composes the underlying methodology of this empirical legal research adopted, using economic theory to analyse regulation and its effectiveness with regards to the regulation and supervision of climate change related risks (ECB, 2020b). This legal methodology provides a framework for critical analysis on how regulation should be designed, and reformed to ensure financial stability of the banking industry, highlighting the need of this proposed ‘economically informed’ legal research. This research examines what the financial stability implications of climate change are, how they are managed and what is the link of the supervision of climate change related risks with the sustainable development, the UN SDGs and ESG factors. Preliminary findings with recommendations for the design of market wide and idiosyncratic enhanced scenarios, complementing the existing stress tests exercises, and linked to risk management and disclosures regarding UN SDGs and ESG risks/factors beyond climate change are presented. Research in this direction aims to highlight the importance on extending the work on climate change scenarios to the rest UN SDGs and ESG risks, to ensure sustainable futures. The world progress for SDG 13 since 2015 is marginal (as captured in detail in Sachs et al., 2021) with urgent action required. There is a need for financial services to have a leading role to ensure this transition and lead to development and strategic changes, with financial services requiring to drive this, to prevent the next big systemic catastrophic shock and a climate change or better sustainability crisis that could be worse than the financial crisis and the COVID-19 outbreak.

---

<sup>16</sup> Stability and Sustainability in Banking Reform: Are Environmental Risks Missing in Basel III? (CISL & UNEP FI, 2014).

## 6. Bibliography

1. Alessi, L., Battiston, S. and Melo, A.S. (2021). **Travelling down the green brick road: a status quo assessment of the EU taxonomy**. ECB Macroprudential Bulletin. Available at: [https://www.ecb.europa.eu/pub/financial-stability/macprudential-bulletin/html/ecb.mpbu202110\\_2~ea64c9692d.en.html](https://www.ecb.europa.eu/pub/financial-stability/macprudential-bulletin/html/ecb.mpbu202110_2~ea64c9692d.en.html) [last accessed 20 October 2021].
2. Allen, T., Dees, S., Boissinot, J, Graciano, C.M.C., Chouard, V., Clerc, L., de Gaye, A., Devulder, A, Diot, S., Lisack, N., Pegoraro, F., Rabaté, M., Svartzman, R. and Vernet, L. (2020). **Climate-Related Scenarios for Financial Stability Assessment: an Application to France**. *Working paper No 774*, Banque de France.
3. Alogoskoufis, S., Dunz, N., Emambakhsh, T., Hennig, T., Kaijser, M., Kouratzoglou, C., Muñoz, M.A., Parisi, L. and Salleo, C. (2021a). **ECB economy-wide climate stress test: Methodology and results**. *Occasional Paper Series No 281 / September 2021*, European Central Bank.
4. Alogoskoufis, S., Carbone, S., Coussens, W., Fahr, S., Giuzio, M., Kuik, F., Parisi, L., Salakhova, D. and Spaggiari, M. (2021b). **Climate-related risks to financial stability**. Published as part of the Financial Stability Review, May 2021, European Central Bank: Available at: [https://www.ecb.europa.eu/pub/financial-stability/fsr/special/html/ecb.fsrart202105\\_02~d05518fc6b.en.html](https://www.ecb.europa.eu/pub/financial-stability/fsr/special/html/ecb.fsrart202105_02~d05518fc6b.en.html) [last accessed 20 October 2021].
5. Andersson, M., Baccianti, C. and Morgan, J. (2020). **Occasional Paper Series Climate change and the macro economy**. *No 243 / June 2020* European Central Bank.
6. Baranović, I., Busies, I., Coussens, C., Grill, M. and Hempell, H. (2021). **The challenge of capturing climate risks in the banking regulatory framework: is there a need for a macroprudential response?** ECB Macroprudential Bulletin. Available at: [https://www.ecb.europa.eu/pub/financial-stability/macprudential-bulletin/html/ecb.mpbu202110\\_1~5323a5baa8.en.html](https://www.ecb.europa.eu/pub/financial-stability/macprudential-bulletin/html/ecb.mpbu202110_1~5323a5baa8.en.html) [last accessed 20 October 2021].
7. Batten, S., Sowerbutts, R. and Tanaka, M. (2016). **Let's talk about the weather: the impact of climate change on central banks**. *Working Paper No. 603*, Bank of England.
8. Battiston, S., Mandel, A., Monasterolo, I., Schuetze, F. and Visentin, G. (2017). **A climate stress-test of the financial system**. *Nature Climate Change*, 7, pp. 283-288.
9. Baudino, P. and Svoronos, J.-P. (2021). **Stress-testing banks for climate change – comparison of practices**. *FSI Insights on policy implementation No 34*, Financial Stability Institute Bank for International Settlements.
10. BCBS (2021a). **Climate-related risk drivers and their transmission channels**. April 2021, Basel Committee on Banking Supervision, Bank for International Settlements.
11. BCBS (2021b). **Climate-related financial risks – measurement methodologies**. April 2021, Basel Committee on Banking Supervision, Bank for International Settlements.
12. BCBS (2021c). **Remarks for the panel discussion at the BIS-BdF-IMF-NGFS Green Swan 2021 Global Virtual Conference**. 4 July 2021, Bank for International Settlements.
13. BIS (2021). **The Green Swan Conference - Coordinating finance on climate**. BIS-BdF-IMF-NGFS Green Swan 2021 Global Virtual Conference. Available at: [https://www.bis.org/events/green\\_swan\\_2021/overview.htm](https://www.bis.org/events/green_swan_2021/overview.htm) [last accessed 1 October 2021].
14. Bolton, P., Despres, M., Da Silva, L.A.P., Samama, F. and Svartzman, R. (2020). **The green swan: Central banking and financial stability in the age of climate change**. January 2020, Bank for International Settlements/Banque de France.
15. BoE (2019a). **Insurance Stress Test 2019**. Bank of England. Available at: <https://www.bankofengland.co.uk/prudential-regulation/letter/2019/insurance-stress-test-2019> [last accessed 1 October 2021].
16. BoE (2019b). **The 2021 biennial exploratory scenario on the financial risks from climate change**. *Discussion paper* BoE

17. BoE (2021a). **The Bank of England's climate-related financial disclosure 2021**. BoE Available at: <https://www.bankofengland.co.uk/prudential-regulation/publication/2021/june/climate-related-financial-disclosure-2020-21> [last accessed 1 October 2021].
18. BoE (2021b). **Key elements of the 2021 Biennial Exploratory Scenario: Financial risks from climate change**. Bank of England. Available at: <https://www.bankofengland.co.uk/stress-testing/2021/key-elements-2021-biennial-exploratory-scenario-financial-risks-climate-change> [last accessed 1 October 2021].
19. Born, A., Giuzio, M., Lambert, C., Salakhova, D., Schölermann, H. and Tamburrini, F. (2021). **Towards a green capital markets union: developing sustainable, integrated and resilient European capital markets**. ECB Macroprudential Bulletin. Available at: [https://www.ecb.europa.eu/pub/financial-stability/macroprudential-bulletin/focus/2021/html/ecb.mpbu\\_focus202110\\_3.en.html](https://www.ecb.europa.eu/pub/financial-stability/macroprudential-bulletin/focus/2021/html/ecb.mpbu_focus202110_3.en.html) [last accessed 20 October 2021].
20. Breeden, S. (2021). **Driving different decisions today: putting climate scenarios into action**. Speech given at the MIT Golub Center for Finance and Policy 8th Annual Conference. Available at: <https://www.bankofengland.co.uk/speech/2021/october/sarah-breeden-keynote-presentation-at-the-mit?sf153066508=1> [last accessed 20 October 2021].
21. Budnik, K. (2021). **Towards a macroprudential stress test and growth-at-risk perspective for climate-related risk**. ECB Macroprudential Bulletin. Available at: [https://www.ecb.europa.eu/pub/financial-stability/macroprudential-bulletin/focus/2021/html/ecb.mpbu\\_focus202110\\_1.en.html](https://www.ecb.europa.eu/pub/financial-stability/macroprudential-bulletin/focus/2021/html/ecb.mpbu_focus202110_1.en.html) [last accessed 20 October 2021].
22. Campiglio, E., Dafermos, Y., Monnin, P., Ryan-Collins, J., Guido Schotten, G. and Tanaka, M. (2018). **Climate change challenges for central banks and financial regulators**. *Nature Climate Change*, 8, pp. 462-468.
23. CFRF. **Climate Financial Risk Forum**. Bank of England. Available at: <https://www.bankofengland.co.uk/climate-change/climate-financial-risk-forum> [last accessed 20 October 2021].
24. CFRF (2020). **Scenario Analysis Chapter**. June 2020, Climate Financial Risk Forum Guide 2020, Climate Financial Risk Forum, Bank of England. Available at: <https://www.fca.org.uk/publication/corporate/climate-financial-risk-forum-guide-2020-scenario-analysis-chapter.pdf> [last accessed 20 October 2021].
25. CFRF (2021). **Scenario analysis**. October 2021, Climate financial risk forum guide 2021, Climate Financial Risk Forum. Available at: <https://www.fca.org.uk/publication/corporate/climate-financial-risk-forum-guide-2021-scenario-analysis.pdf> [last accessed 20 October 2021].
26. Chaves, M., Grill, M., Parisi, L., Popescu, A. and Rancoita, E. (2021). **A theoretical case for incorporating climate risk into the prudential framework**. ECB Macroprudential Bulletin. Available at: [https://www.ecb.europa.eu/pub/financial-stability/macroprudential-bulletin/focus/2021/html/ecb.mpbu\\_focus202110\\_2.en.html](https://www.ecb.europa.eu/pub/financial-stability/macroprudential-bulletin/focus/2021/html/ecb.mpbu_focus202110_2.en.html) [last accessed 20 October 2021].
27. Chenet, H., Ryan-Collins, J. and van Lerven, F. (2019). **Climate-related financial policy in a world of radical uncertainty: Towards a precautionary approach**. *UCL Institute for Innovation and Public Purpose, Working Paper Series (IIPP WP 2019-13)*. Available at: <https://www.ucl.ac.uk/bartlett/public-purpose/wp2019-13> [last accessed 20 October 2021].
28. Chenet, H., Ryan-Collins, J. and van Lerven, F. (2021). **Finance, climate-change and radical uncertainty: Towards a precautionary approach to financial policy**. *Ecological Economics*, 183, 106957.
29. Climate scenarios. **The SENSES toolkit**. Potsdam Institut für Klimafolgenforschung (PIK). Available at: <https://climatescenarios.org/toolkit/> [last accessed 20 October 2021].

30. da Silva, L.A.P. (2021). **How are central banks helping to make the recovery from the Covid-19 pandemic more sustainable and inclusive?** People's Bank of China / International Monetary Fund: High Level Online Seminar on Green Finance and Climate Policy, 15 April 2021, Bank for International Settlements. Available at: <https://www.bis.org/speeches/sp210416.pdf> [last accessed 20 October 2021].
31. de Guindos, L. (2021). **Shining a light on climate risks: the ECB's economy-wide climate stress test.** 18 March 2021, the ECB blog. Available at: <https://www.ecb.europa.eu/press/blog/date/2021/html/ecb.blog210318~3bbc68ffc5.en.html> [last accessed 20 October 2021].
32. DN (2019). **Climate change can have a spillover on financial stability.** 2 December 2019, No.26, Danmarks Nationalbank.
33. EBA (2020a). **Discussion paper: On the future changes to the EU-wide stress test.** 22 January 2020 *EBA/DP/2020/01*, European Banking Authority.
34. EBA (2020b). **On management and supervision of ESG risks for credit institutions and investment firms.** 30 October 2020, *EBA Discussion paper, EBA/DP/2020/03*, European Banking Authority.
35. EBA (2021a). **Mapping climate risk: main findings from the EU-wide pilot exercise.** 21 May 2021, *EBA/Rep/2021/11*, European Banking Authority.
36. EBA (2021b). **EBA 2022 Work Programme.** *EBA/REP/2021/28*, European Banking Authority.
37. EC. **A European Green Deal.** European Commission. Available at: [https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal\\_en](https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en) [last accessed 20 October 2021].
38. EC. **A European Green Deal.** European Commission. Available at: [https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal\\_en](https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en) [last accessed 20 October 2021].
39. EC. **Delivering the European Green Deal.** European Commission. Available at: [https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/delivering-european-green-deal\\_en](https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/delivering-european-green-deal_en) [last accessed 20 October 2021].
40. ECB (2020a). **ECB publishes final guide on climate-related and environmental risks for banks.** 27 November 2020, European Central Bank. Available at: <https://www.bankingsupervision.europa.eu/press/pr/date/2020/html/ssm.pr201127~5642b6e68d.en.html> [last accessed 20 October 2021].
41. ECB (2020b). **Guide on climate-related and environmental risks: Supervisory expectations relating to risk management and disclosure.** November 2020, European Central Bank.
42. ECB (2020c). **ECB report on institutions' climate-related and environmental risk disclosures.** November 2020, European Central Bank.
43. ECB (2021a). **ECB presents action plan to include climate change considerations in its monetary policy strategy.** press release 8 July 2021 European Central Bank. Available at: [https://www.ecb.europa.eu/press/pr/date/2021/html/ecb.pr210708\\_1~f104919225.en.html](https://www.ecb.europa.eu/press/pr/date/2021/html/ecb.pr210708_1~f104919225.en.html) [last accessed 20 October 2021].
44. ECB (2021b). **Firms and banks to benefit from early adoption of green policies, ECB's economy-wide climate stress test shows.** press release 22 September 2021 European Central Bank. Available at: <https://www.ecb.europa.eu/press/pr/date/2021/html/ecb.pr210922~59ade4710b.en.html> [last accessed 20 October 2021].
45. EIOPA (2021). **Opinion on the supervision of the use of climate change risk scenarios in ORSA.** 19 April 2021 EIOPA-BoS-21-127, EIOPA.

46. Elderson, F. (2021). **Integrating the climate and environmental challenge into the missions of central banks and supervisors.** Speech given at the 8th Conference on the Banking Union, Goethe University, Frankfurt am Main, Frankfurt am Main, 23 September 2021. Available at: <https://www.ecb.europa.eu/press/key/date/2021/html/ecb.sp210923~0c7bd9c596.en.html> [last accessed 20 October 2021].
47. FSB (2020a). **Stocktake of Financial Authorities' Experience in Including Physical and Transition Climate Risks as Part of Their Financial Stability Monitoring.** 22 July 2020, Financial Stability Board.
48. FSB (2020b). **The Implications of Climate Change for Financial Stability.** 23 November 2020, Financial Stability Board.
49. FSB (2021a). **The Availability of Data with Which to Monitor and Assess Climate-Related Risks to Financial Stability.** 7 July 2021, Financial Stability Board.
50. FSB (2021b). **Report on Promoting Climate-Related Disclosures.** 7 July 2021, Financial Stability Board.
51. FSB (2021c). **FSB Roadmap for Addressing Climate-Related Financial Risks.** 7 July 2021, Financial Stability Board.
52. Griggs, D.J., Nilsson, M., Stevance, A. and McCollum, D. (2017). **A guide to SDG interactions: from science to implementation** (eds). International Council for Science.
53. Hauser, A. (2021). **It's not easy being green – but that shouldn't stop us: how central banks can use their monetary policy portfolio to support orderly transition to net zero.** Speech given by Andrew Hauser at Bloomberg 21 May 2021, Bank of England. Available at: <https://www.bankofengland.co.uk/-/media/boe/files/speech/2021/may/its-not-easy-being-green-but-that-shouldnt-stop-us-speech-by-andrew-hauser.pdf?la=en&hash=6859472C053CB4130189220C3141648C0AADF5C2> [last accessed 20 October 2021].
54. Hulme, M., Jenkins, G.J., Lu, X., Turnpenny, J.R., Mitchell, T.D., Jones, R.G., Lowe, J., Murphy, J.M., Hassell, D., Boorman, P., McDonald, R. and Hill, S. (2002). **Climate Change Scenarios for the United Kingdom: The UKCIP02 Scientific Report.** Tyndall Centre for Climate Change Research, School of Environmental Sciences, University of East Anglia, Norwich, UK.
55. IAIS-SIF (2021). **Application Paper on the Supervision of Climate-related Risks in the Insurance Sector.** Adopted by the IAIS Executive Committee – May 2021, International Association of Insurance Supervisors and Sustainable Insurance Forum.
56. IFRS (2020a). **Consultation Paper on Sustainability Reporting.** September 2020, International Financial Reporting Standards Foundation.
57. IFRS (2020b). **Hope for a New Paradigm—Sustainability Reporting.** 09 October 2020, International Financial Reporting Standards Foundation. Available at: <https://www.ifrs.org/news-and-events/news/2020/10/hope-for-a-new-paradigm-sustainability-reporting/> [last accessed 20 October 2021].
58. IRFF (2021). Insurance and Risk Finance Facility. initiative of the UNDP Finance Sector Hub. Available at: <https://irff.undp.org/> [last accessed 20 October 2021].
59. Nerini, F.F., Sovacool, B., Hughes, N., Cozzi, L., Cosgrave, E., Howells, M., Tavoni, M., Tomei, J., Zerriffi, H. and Milligan, B. (2019). **Connecting climate action with other Sustainable Development Goals.** *Nature Sustainability*, 2, pp. 674-680.
60. NGFS (2019). **A call for action: Climate change as a source of financial risk - First comprehensive report.** April 2019, Network for Greening the Financial System.

61. NGFS (2020a). **Guide for Supervisors: Integrating climate-related and environmental risks into prudential supervision.** May 2020, Technical document, Network for Greening the Financial System.
62. NGFS (2020b). **Overview of Environmental Risk Analysis by Financial Institutions.** September 2020, Technical document, Network for Greening the Financial System.
63. NGFS (2020c). **NGFS Climate Scenario for central banks and supervisors.** June 2020, Network for Greening the Financial System.
64. NGFS (2020d). **The Macroeconomic and Financial Stability Impacts of Climate Change: Research Priorities.** June 2020, Technical document, Network for Greening the Financial System.
65. NGFS (2021a). **NGFS Climate Scenario for central banks and supervisors.** June 2021, Network for Greening the Financial System. Available at: [https://www.ngfs.net/sites/default/files/media/2021/08/27/ngfs\\_climate\\_scenarios\\_phase2\\_june2021.pdf](https://www.ngfs.net/sites/default/files/media/2021/08/27/ngfs_climate_scenarios_phase2_june2021.pdf) [last accessed 20 October 2021].
66. NGFS (2021b). **Scenario Portal.** Network for Greening Financial Services. Available at: <https://www.ngfs.net/ngfs-scenarios-portal/> [last accessed 20 October 2021].
67. NGFS (2021c). **Scenarios in Action: A progress report on global supervisory and central bank climate scenario exercises.** October 2021, Network for Greening the Financial System.
68. O'Connell, D., Raison, J. Steve Hatfield-Dodds, S., Braid, B., Cowie, A., Littleboy, A., Wiedmann, T. and Clark, M. (2013). **Designing for Action: Principles of Effective Sustainability Measurement.** Summary Report Prepared by the Commonwealth Scientific and Industrial Research Organization for the World Economic Forum Global Agenda Council on Measuring Sustainability.
69. OECD (2017). **Investing in Climate, Investing in Growth.** OECD Publishing. Available at: <https://www.oecd.org/env/investing-in-climate-investing-in-growth-9789264273528-en.htm> [last accessed 20 October 2021].
70. PRA (2015). **The impact of climate change on the UK insurance sector.** September 2015, A climate change adaptation report by the Prudential Regulation Authority, Prudential Regulation Authority, Bank of England.
71. PRA (2018a). **Enhancing banks' and insurers' approaches to managing the financial risks from climate change.** Consultation Paper 23/18, Prudential Regulation Authority, Bank of England.
72. PRA (2018b). **Transition in thinking: The impact of climate change on the UK banking sector.** Prudential Regulation Authority, Bank of England.
73. PRA (2019a). **Enhancing banks' and insurers' approaches to managing the financial risks from climate change.** Policy Statement PS 11/19, Prudential Regulation Authority Bank of England.
74. PRA (2019b). **Enhancing banks' and insurers' approaches to managing the financial risks from climate change.** Supervisory Statement SS 3/19, Prudential Regulation Authority, Bank of England.
75. PRI (2021). **PRI Climate scenario analysis.** Principles for Responsible Investment, investor initiative in partnership with UNEP Finance Initiative and UN Global Compact. Available at: <https://www.unpri.org/climate-change/climate-scenario-analysis/3606.article> [last accessed 20 October 2021].
76. Pradhan, P., Costa, L., Rybski, D., Lucht, W. and Kropp, J.P. (2017). **A Systematic Study of Sustainable Development Goal (SDG) Interactions.** *Earth's Future*, 5, pp. 1169.
77. Ralite, S. and Thomä, J. (2019). **Storm ahead: a proposal for a climate stress-test scenario.** April 2019, discussion paper, 2° Investing Initiative.
78. Ramirez, L., Thomä, J. and Cebreros, D. (2020). **Transition Risks Assessment of Latin American Financial Institutions and the use of Scenario Analysis.** 2° Investing Initiative.

79. Restoy, F. (2021). The role of prudential policy in addressing climate change. Speech by Fernando Restoy<sup>1</sup>, Chairman, Financial Stability Institute, Bank for International Settlements, "Sustainability: green-washing or emerging issues for deposit insurers?" Organised by IADI–ERC in cooperation with EFDI, 8 October 2021. Available at: <https://www.bis.org/speeches/sp211008.htm> [last accessed 20 October 2021].
80. Sachs, J.D., Kroll, C., Lafortune, G. and Fuller, G. and Finn Woelm, F. (2021). **Sustainable Development Report 2021: The Decade of Action for the Sustainable Development Goals**. Cambridge University Press.
81. SIF (2021). **International financial organisations unite with the central bank and financial supervisory community to launch the Central Banks’ and Supervisors’ Climate Training Alliance (CTA) ahead of COP26**. Sustainable Insurance Forum. 9<sup>th</sup> July 2021, Available at: <https://www.sustainableinsuranceforum.org/international-financial-organisations-unite-with-the-central-bank-and-financial-supervisory-community-to-launch-the-central-banks-and-supervisors-climate-training-alliance-cta-ahca/> [last accessed 20 October 2021].
82. Singh, G.G., Cisneros-Montemayor, A.M., Swartz, W., Cheung, W., Guy, J.A., Kenny, T.A., McOwen, C.J., Asch, R., Geffert, J.L., Wabnitz, C.C.C., Sumaila, R., Hanich, Q. and Ota, Y. (2018). **A rapid assessment of co-benefits and trade-offs among Sustainable Development Goals**. *Marine Policy*, 93, pp. 223-231.
83. Stability and Sustainability in Banking Reform: Are Environmental Risks Missing in Basel III? (CISL & UNEP FI, 2014).
84. TCFD (2017a) **Recommendations of the Task Force on Climate-related Financial Disclosures**. Task Force on Climate-related Financial Disclosures.
85. TCFD (2017b). **The Use of Scenario Analysis in Disclosure of Climate-Related Risks and Opportunities**. June 2017, Technical Supplement, Task Force on Climate-related Financial Disclosures.
86. TCFD (2020). **Guidance on Scenario Analysis for Non-Financial Companies**. October 2020, Task Force on Climate-related Financial Disclosures.
87. TGA (2021). **Climate Change Risk Assessment for the Insurance Industry: A holistic decision-making framework and key considerations for both sides of the balance sheet**. February 2021, The Geneva Association Task Force on Climate Change Risk Assessment for the Insurance Industry, The Geneva Association.
88. UN (2015). The Paris Agreement. United Nations Treaty Collection, United Nations. Available at: <https://www.un.org/en/climatechange/paris-agreement> [last accessed 20 October 2021].
89. UN (2021). **Sustainable development goals**. Department of Economic and Social Affairs Sustainable Development. Available at: <https://sdgs.un.org/goals> [last accessed 1 October 2021].
90. UNDP (2021). **UNDP launches new Insurance and Risk Finance Facility**. 27 September 2021. United Nations Development Programme. Available at: <https://www.undp.org/press-releases/undp-launches-new-insurance-and-risk-finance-facility> [last accessed 20 October 2021].
91. UNFCCC (2015). **The Paris Agreement**. United Nations Framework Convention on Climate Change. Available at: <https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement> [last accessed 20 October 2021].
92. Vermeulen, R., Edo Schets, E., Melanie Lohuis, M., Barbara Kölbl, B., David-Jan Jansen, D.-J., and Willem Heeringa, W., (2018). **An energy transition risk stress test for the financial system of the Netherlands**. *Occasional Studies Volume 16 – 7*, De Nederlandsche Bank.
93. WEF (2021a). **WEF Agenda Climate Change**. World Economic Forum. Available at: <https://www.weforum.org/agenda/archive/climate-change> [last accessed 20 October 2021].

94. WEF (2021b). **WEF Agenda Governance for Sustainability**. Available at: <https://www.weforum.org/agenda/archive/governance-for-sustainability> [last accessed 20 October 2021].
95. Weidmann, J. (2021). **Climate risks, financial markets and central banks' risk management**. 02.06.2021 Speech at the Green Swan 2021 Global Virtual Conference, Deutsche Bundesbank Eurosystem. Available at: <https://www.bundesbank.de/en/press/speeches/climate-risks-financial-markets-and-central-banks-risk-management-867360> [last accessed 20 October 2021].