

Louvain School of Management

Finance : what is the likely impact of climate change on the Banking sector?

Will those stress tests on climate rechannel the Investments to a more sustainable future?

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Summary

This thesis aims to bring answer to the following questions: *“What is the likely impact of climate change on the Banking sector? Will climate stress tests rechannel the Investments to a more sustainable future?”*. It is divided in two sections. The first one is a state-of-the art. It sums up the history regarding human awareness of their impacts on climate, the measures taken by countries and banking sector to be proactive actors in this regard and climate risks consideration (type of risks, defined scenarios, climate impacts, climate risks stress test, metrics). The second part focuses on a more personal analysis of the banking sector capacity to act to rechannelled investments towards greener ones and the needs to have a more sustainable development.

The first convincing results about climate-related impacts on financial sector are only popping up. Although results are starting to be disclosed, banks' statements remain cautious. ECB's climate stress test conclusions speaking about a learning exercise to assess sector's preparedness for managing climate risk remain vague. With both these careful approaches and great concerns regarding climate change, banking sector is only at the beginning of its introspection. Currently, is therefore premature, to forge a clear opinion regarding these thesis questions. However, in analysing financial stability, climate-related risk stress test methodologies, policies, *etc.* to made up my own opinion I would say that I doubt that climate stress tests in the banking sector will rechannel investments towards more sustainability in a near future. Indeed, methodology better definition, standardised approaches, controls have to be put in place by banking supervisory institutions. Also, efforts in the worlds of finance have to be combine with government incentives such as support through fiscal policy. Although the Financial World is slowly moving, the efforts put in place towards a greener future cannot be denied and some bright light can be seen at the horizon.

Foreword

With globalization, world has become a complex place to run with even more difficult decisions to take. Natural events are difficult to predict and the impacts they could have on earth and on anthropic life let us disillusioned. While data gathering, model predictions, metrics standardization are developing, a heavy weight seems to prevent use to move forward and take actions. Financial institutions, government and all authorities in general do not look up and do not seem to take into consideration the tremendous negative environmental impacts and the macroeconomic destabilisation to which it could lead. To what extend banking system has a role to play in rechannelling our way to set up projects, our way to live? And if their role turn out to be essential, to what extend do they have the possibility to act for it?

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1. Introduction

In 2015, Paris agreement to contain temperature rise below 2°C compared to preindustrial level were ratified by more than 183 parties. Different institutions among which banking sector engaged to act for limiting their impacts in respect with this agreement. However, Kahn suggests that a persistent increase in average global temperature by 0.04°C per year, current rate, reduces world real Gross Domestic Product (GDP) per capita by more than 7% by 2100 [1]. The rise of awareness regarding climate-related risk impacts on macroeconomy and finance leads central banks, institutions and governments to take actions: Network for Greening the Financial System (NGFS) defined different risk scenarios to follow for analysing climate-related risks, European Central Bank (ECB) achieved its first climate risk stress test, banks started to disclose climate-related risk metrics, etc. However, Kahn shows that without more rapid transition, banks' combined credit and market risk losses related to flood, drought and heat risks could reach \$70 billion [2]. Following this statement, it is essential that for the health of our World, to go further in the actions we take to fight against climate change. Methodology assessment, disclosures, climate-related risks integration into bank capital requirements need to be standardised, mandatory and controlled by supervision entities. However, financial sectors by its own cannot deliver sufficient mitigation and complex policy mix equilibrium has to be found in order to allow a smooth integration of greener projects into our economy and finance.

This master thesis aims to investigate the following questions: *“What is the likely impact of climate change on the Banking sector? Will climate stress tests rechannel the Investments to a more sustainable future?”*. It is divided in two sections. The first one is a state-of-the art. It sums up the history regarding human awareness of their impacts on climate, the measures taken by countries and banking sector to be proactive actors in this regard and climate risks consideration (type of risks, defined scenarios, climate impacts, climate risks stress test, metrics). The second part focuses on a more personal analysis of the banking sector capacity to act to rechannelled investments towards greener ones and the needs to have a more sustainable development.

Part 1 – Literature review

2. History

2.1. Links recognition between human activities and climate change and reactions

Kellogg retraces the first link made between gases in the atmosphere and surface warming in the course of 19th century, by Jean Baptise-Joseph Fourier. In 1863, John Tundall measured the absorption of infrared radiation by carbon dioxide and water vapor and showed that these atmospheric constituents could significantly raise the earth's surface temperature. Just before the turn of the century, Svante Arrhenius, who received one of the first Nobel prizes in chemistry, attempted to calculate the effect on the average surface temperature of a doubling of carbon dioxide. Kellogg underlines the fact that many important pieces explaining the relation between carbon dioxide and climate were in place by 1900. Only a few people interest themselves to the question of the impact of mankind on the earth's temperature. The importance of the carbon dioxide-impact was beginning to be recognized and addressed by a larger community by the 1950s: 1950 "climate control" by John von Neumann, "Human beings are now carrying out a large-scale geophysical experiment" by Hans Suess and Roger Revelle in 1958. In 1958, Charles David Keeling started his continuous monitoring of carbon dioxide at the Mauna Loa Observatory on Hawaii. The President's Science Advisory Committee Report on atmospheric carbon dioxide of 1965 brought the idea that the earth could become warmer as a result of human activities. In 1972, several scientists from the Massachusetts Institute of Technology wrote "The limits to growth". This report is now a reference in debates and critics linked to the ecological consequences related to economic growth, resources limitation and demographic evolution. In 2022, Dennis Meadows and Jorgen Randers, two authors that wrote "The limits to growth" joined other contributors to update it and write "Limits and beyond" [3].

These few quotes show that the climate changes understanding and its impacts on the world are not new.

2.2. Evolution regarding climate considerations

2.2.1. Countries commitments

Worldwide instances started to gathered people to limit climate change impacts in December 1986. During this year, an international conference sponsored by the U.N. Environment Programme (UNEP), the US Environmental Protection Agency (EPA) and the Alliance for Responsible CFC Policy were organised to discuss the proposal for “a reasonable global limit of the future rate of growth”. Numerous other meetings were organised and convention signed such as the following ones:

- 1992: United Nations Framework Convention on Climate Change;
- Since 1995: Yearly COP organised to talk of climate and fight against climate warming;
- 1997: The Kyoto protocol – First Worldwide Climate agreement. The Kyoto Protocol operationalizes the United Nations Framework Convention on Climate Change by committing industrialized countries and economies in transition to limit and reduce greenhouse gases (GHG) emissions in accordance with agreed individual targets. The Convention itself only asks those countries to adopt policies and measures on mitigation and to report periodically;
- 2015: The Paris Agreement which is a legally binding international treaty on climate change adopted by 196 Parties at COP21 in Paris. Its goal is to limit global warming to well below 2, preferably to 1.5 degrees Celsius, compared to pre-industrial levels. The United Nations Climate Change webpage specifies the following: “*Climate finance is needed for mitigation, because large-scale investments are required to significantly reduce emissions. Climate finance is equally important for adaptation, as significant financial resources are needed to adapt to the adverse effects and reduce the impacts of a changing climate*”;

And many other climate pacts and meetings continued to come into existence after The Paris Agreement (Glasgow Climate Pact, The Katowice climate package, ...).

2.2.2. Banking sector's climate actions

As Vaitilingam underlines it, banks remain the backbone of the European financial system. Their primacy among lenders in assessing the credit risk of individual loans makes them

particularly important for financing the origination of sustainable assets and for lending in support of the transition to a more sustainable economy [4]. Despite their role of Europe's leader for a more sustainable economy, transitions to climate changes also represent a huge opportunity for the banking sector. Wenxi precises that financial institutions cannot afford to be outside of the transition path to low-carbon economies as energy subsidies, emission standards and carbon prices will all have a direct impact on the financial positions making climate risk an important element of any credit decisions [5]. According to the International Finance 2016 Report, the vast majority of climate change adaptation is financed by the public sector. Of a total of \$361 billion in climate financing in 2014, less than 6% was by the private sector. This disequilibrium represents an opportunity for private enterprises, including financial institutions. Despite this opportunity represented by climate change transitions, Carlin explains that climate change has become a widely acknowledged financial risk [6].

The following not exhaustive steps have taken place in the recent years:

- 2015:
 - The G20 Finance Ministers and Central Bank Governors ask the Financial Stability Board (FSB)¹ to review how the financial sector can take account of climate-related issues. One of the outcome of the review was the need for better information to support informed investment, lending, and insurance underwriting decisions as well as the improve of climate related risks understanding;
 - Task Force on Climate-related financial disclosures (TCFD) creation – the TCFD has the role to help identify the information needed by stakeholders to assess and price climate-related risks and opportunities. TCFD is constituted by 29 representatives from private sectors;

¹ According to their website (7. *About*. Available from: <https://www.fsb-tcf.org/about/>), the Financial Stability Board (FSB) is an international body that monitors and makes recommendations about the global financial system. It promotes international financial stability by coordinating national financial authorities and international standard-setting bodies as they work toward developing strong regulatory, supervisory and other financial sector policies.

- UN 2030 agenda and sustainable development goals adoption. The Paris climate agreement includes the commitment to align financial flows with pathway towards low-carbon and climate-resilient development [8];
- 2016:
 - the European Commission launched the High-Level Expert Group (HLEG) on Sustainable Finance to examine how to integrate sustainability considerations into the EU's financial policy framework [9];
 - "G20 Green Finance Study Group" creation to provide a starting point for sharing experiences at international level to develop the financial system's sensitivity to climate change risk and interiorise it in its decision-making [10];
- December 2017: at the COP21 in Paris, Network of Central Banks and Supervisors for Greening the Financial System (NGFS)² creation by eight central banks and supervisors.
- 2018: Commission set up a technical expert group on sustainable finance (TEG) to assist them in the development of a unified classification system for sustainable economic activities (EU Green Bond Standard, methodologies for low-carbon indices and metrics for climate-related disclosure). TEG is constituted by 35 members from civil society, academia, business and the finance sector as well as observers from EU and international public bodies;
- 2019:
 - The European Union launched the International platform on sustainable finance (IPSF) at the International Monetary Fund/World Bank annual meetings;
 - Responsible Banking Principles launching by founding banks and the United Nations Environment Programme – Finance Initiative (UNEP – FI). These principles aim to help banks to learn from their peers and produce cutting-edge guidance on key areas of sustainable finance [12].

² According to their website, (11. *Origin and Purpose*. Available from: <https://www.ngfs.net/en/about-us/governance/origin-and-purpose>.), NGFS's purpose is to help strengthening the global response required to meet the goals of the Paris agreement and to enhance the role of the financial system to manage risks and to mobilize capital for green and low carbon investments.

- 2020:

- **European green deal investment plan:** environment creation to facilitate and stimulate the public and private investments for transition to a climate-neutral, green economy;
- **European Taxonomy Regulation** establishing conditions that an economic activity has to meet in order to qualify as environmentally sustainable;
- Guide to climate scenario analysis for central banks and supervisors report written by NGFS;
- **ECB's final guide on climate-related and environmental risks for banks.**
- **The European parliament council** adopts reforms to define new benchmarks and transparency obligations for sustainable finance [9].

- 2021:

- G7 and G20 pledge to promote implementation of disclosure requirements ;
- The European Commission publishes its “**strategy for financing the transition to a sustainable economy**” which especially includes extending the EU taxonomy framework and sustainable finance standards and labels to recognise transition efforts;
- The International Financial Reporting Standards Foundation (IFRS) announces the creation of the International Sustainability Standards Board (ISSB)³ which is a new standard-setting board to help meet the demand of international investors for high quality, transparent and reliable reporting by companies on climate and Environmental, Social and Governance (ESG);
- **European banking authority (EBA)'s report on management and supervision of ESG risks for credit institutions and investment firms.**

³ The IFRS is a not-for-profit, , public interest organisation established to develop a single set of high-quality, understandable, enforceable and globally accepted accounting and sustainability disclosure standards—IFRS Standards—and to promote and facilitate adoption of the standards (13. *Who we are.* Available from: <https://www.ifrs.org/about-us/who-we-are/>).

These few key facts highlight both the opportunity and the threats that climate-risks represent for the financial sector, the banking sector included.

In order to mitigate these risks, European Central Bank (ECB) started an economy-wide climate stress test (cf. 3.3.2). In addition to this economy-wide climate stress test, ECB Banking Supervision is also currently carrying out a supervisory climate stress-test of individual banks. This test relies on banks' self-assessment of their exposure to climate change risk and their readiness to address it. [14]. Although institutions acknowledge the impacts of physical and transition risks and the necessity to assess and incorporate it into their risk management processes, most of them don't have the tools to assess their impact on their balance sheet. Only a few institutions have incorporated climate-related risk into their risk management framework by defining their risk appetite, performing stress tests and scenario analyses and assessing the impact on their capital adequacy [15].

3. Climate risks

Transitional and physical risks are two exposures for the banking sector. According to Guindos, physical risk is the economic impact stemming from the expected increase in the frequency and magnitude of natural hazards. Whereas transition risk depends on the potential delayed and abrupt introduction of climate policies to reduce CO2 emissions. However, it is worth noting that these two risks are interconnected [14].

Physical and transition risks give rise to credit and market risks therefore affecting bank balance sheets⁴. In this regard, banks have to manage climate change-related factors and integrate them into the strategy of their main business [10].

⁴ The balance sheet reflects the volume of a bank's business gathering information related to both assets (lending) and liabilities (customer deposits or other financial instruments).

3.1. Type of risks

3.1.1. Physical risks

Physical risk is the economic impact created from an expected increase in the frequency and magnitude of natural disasters ([14] and [16]). Physical risk is considered to be instantaneous in different models [17].

ECB explains that climate risks are unevenly distributed both in sectors and geographic areas. Regions and sectors more exposed to physical risk could face very severe and frequent natural disasters which would affect their creditworthiness [16]. According to Rancoroni, physical risks will directly lead to physical asset damages, human live threats and natural capital reductions [18].

In the northern regions, physical risks will be mainly floods and in the southern regions heat stress and wildfires [16].

For examples, physical risks come out of:

- Drought and heat risk: Long periods of drought and heatwaves can lead to several output losses across several economic sectors such as labour productivity decrease, crop losses, supply chain problems,... ; and
- Flood risk: river flooding is a major source of physical risk in Europe. As the European Central Bank underlined it, the summer of 2021 show the consequences of heavy rainfall on both human lives lost and physical capital being destroyed or severely impaired. Flood risks can have real impact on residential and commercial real estate values [17].

3.1.2. Transition risks

ECB defines transition risk as *“the risk that some sectors of the economy might face in the transition to a low carbon economy”*. The transition could translate into important financial losses for the economic activities that are carbon intensive [17].

There are three important sources of shocks that could limit the ability of market participants to fully anticipate price adjustments of carbon-intensive assets. These sources include:

- (i) Technological developments (e.g. renewable energy production costs);

- (ii) Scientific discovery (e.g. new evidence on the likelihood to miss the 2 °C target);
- (iii) Introduction/implementation of climate-relevant policies (e.g., the achievement of COP21 agreement in 2015, or the US withdrawal from the Paris Agreement in 2016) [18].

In addition to the list above, one could add the shifts in consumer preference as a potential source for carbon-intensive assets adjustment [17, 19].

Implementing a carbon tax cut the margin of carbon intensive industries proportionally to their emissions. Implementing policies that favours low carbon emissions path would likely result in about half as much global warming and less climate uncertainty. This transition requires new energy sources and business models. Impacting carbon intensive sectors directly or indirectly through production chains and second-round effects will also affect banks through their credit and market risk exposures.

It is worth to note that while in a first time, transitional risks assessment is focusing on the expected impact due to carbon-intensive exposure, ECB also encourages to evaluate whether exposures to “green industries” carry an increased credit risk. This concern is called the “Green bubble” which would result on potential uncertainty in terms of future technology paths, increased competition or over-funding and hence too many players in the respective industry sector [20].

3.1.3. Banks’ existing risk categories and climate-related risks

In its Supervisory Climate Stress Test, the ECB lists the eleven risk types included in banks’ risk management framework which are listed below. Climate-related and environmental risks are drivers of existing risk categories and therefore should be subject to banks’ comprehensive analysis [15].

- **Credit and counterparty risks:** according to the Capital Requirement Directive (CRD), competent authorities must ensure that institutions grant credit on the basis of sound and well-defined criteria. Therefore, institutions must take into account risks associated with climate-related and environmental factors in their credit risk policies and procedures.

Climate and environmental risks could impact the following parameters are :

- Probability of default (PD); and
- Loss given default (LGD).

Both could be impacted by lower collateral valuations in real estate portfolios (physical risk), energy efficiency standards changes (transition risk) triggering adaptation costs and lower corporate profitability, *etc.* As a mitigation measure, when PD is high, banks should reflect it in their loan pricing by setting the credit cost charges at a higher level.

- **Operational risk:** Banks' operations could be disrupted in case of physical damage to its property. Regarding transition risks, changing in consumer's sentiment regarding climate issues can lead to reputational and liability risks for the bank as a result of scandals caused by the financing of environmentally controversial activities. Banks should assess operational risk across all business lines and operation and act to safeguard business continuity.
- **Market risk:** changes in market expectations could lead to sudden impact on asset values, securities and derivatives such as :
 - Price: price could be lower leading to losses;
 - Volatility: volatility could rise leading to more unpredictable market.
- **Liquidity risk:** if clients withdraw their money from their account in order to finance damage repairs.
- **Strategic/business model risk:** transition risk drivers may affect the viability of some business lines and lead to strategic risk.
- **Reputational risk:** Changing market sentiment in relation to environmental and climate-related risks, could lead to negative financial impacts due to social or environmental controversies. Therefore, banks should regularly screen counterparties for controversial activities.
- **Concentration risk:** concentration risk is the probability of loss due to a large dependence on a single vendor, geographic area, or investment portfolio. As climate-related risks hit the planet heterogeneously, investing in one geographic area could have disastrous effects on asset values *etc...* Therefore, banks have to diversify investments, loan granting *etc* to reduce risks.

Left categories usually less developed in papers are: interest rate risk from non-trading activities, foreign exchange risk, securitisation and conduct-related risk and associated litigation costs

The Basel Committee on Banking Supervision (BCBS) recognised that these existing categories can be used to capture the impact of banks' climate-related exposures. [21]

3.2. Transition scenarios and their impacts on climate-related risks

Running different scenarios provide insight into market stability and resilience. Figure 1 summarizes the different scenarios and their impacts on transition and physical risks.

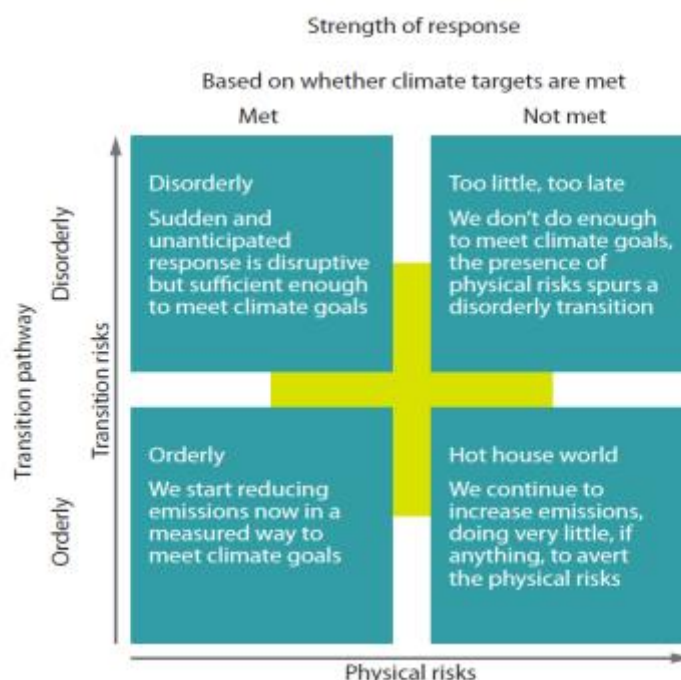


Figure 1: Expected impacts for orderly transition, disorderly transition and hot house world scenarios (source: [22])

3.2.1. Scenario 1 - Orderly transition

This scenario considers that the implementation of climate policies is effective and timely which allows to limit global warming. This scenario is based on the NGFS "Net Zero 2050" scenario limiting the global warming to 1.5 °C. and reaching net zero CO₂ emissions around 2050 [17]. This scenario considers that thanks to this orderly transition, costs from transition and physical risks are relatively contained [14].

3.2.2. *Scenario 2 - Disorderly transition*

This scenario considers the impact of a delayed and abrupt implementation of climate policies [14]. This scenario is based on the NGFS “Delayed Transition” scenario. It considers that no new climate policies are introduced before 2030 and that the policymakers do not provide the right incentives for a green transition [17].

3.2.3. *Scenario 3 - Hot house world*

This scenario considers that no new climate policies are implemented. Therefore, the costs for transition are limited as nothing is done. However, the costs related to physical risk accelerate and are extremely high by the end of the scenario [14]. This scenario is based on the NGFS “Current Policies” scenario which captures the long-term physical risk to the economy and financial system if the world continues on the current path to a hot house world. It considers a global emissions rise until 2080 leading to a global warming of $\sim 3^{\circ}\text{C}$ [17].

3.2.4. *Default probability depending on scenarios*

Preliminary results of the ECB’s climate stress test shows that in the absence of further climate policies, the impact of extreme physical events on companies’ probabilities of default (PD)⁵ will rise substantially over the 30-year time horizon. The PD for a median firm initially rises in the scenario 1 compared with scenarios 2 and 3 which reflects the short-term costs of introducing climate policies in an orderly fashion. In the scenario 3, PDs rise rapidly and beyond the levels of scenario 1 in the second half of the time horizon. Climate change may thus represent a source of systemic risk, particularly for banks with portfolios concentrated in certain economic sectors and geographical areas [2, 23].

Bank of France’s exercise also shows the materiality of the negative economic impacts of disorderly transitions toward a low-carbon economy. Although the effects at macroeconomic and financial market levels remain somewhat limited, the impacts on the sectors exposed to the transition policies simulated are substantial [22].

⁵ The combined impact of transition and physical risk on corporate profits, operating costs and debt allows the probabilities of default to be estimated for firms under different climate scenarios.

3.3. Climate impacts

3.3.1. General

Climate change will have a broad impact in terms of the business activities and geographic areas.

Considering physical or transitional risks, the impacted sectors will be different:

- Sectors that are more likely to be physically impacted are for example agriculture, forestry, fisheries, human health, energy, mining, transport and infrastructure, and tourism.
- Sectors that are likely to be impacted by the transition to a low-carbon economy include energy (oil, coal, natural gas), transport (automotive, aviation), manufacturing (cement), construction and agriculture.

In particular, assets that are directly or indirectly associated with the extraction, processing, combustion or use of fossil fuels, or which are not sufficiently energy efficient, may suddenly and significantly decrease in value or even become “stranded assets”.

Geographically, the impact of climate change is expected to vary across the world. For example, the European Environment Agency concludes:

- In southern Europe, the costliest affects is expected to be an increase in energy demand, heat waves, water stress;
- In western Europe, the costliest affects is expected to be coastal flooding and heat waves;
- In northern Europe, the costliest affects is expected to be coastal and river flooding;
- In eastern Europe, the costliest affects is expected to be river flooding. [15]

3.3.2. Climate impacts on the banking sector

As part of the Financial Stability Review prepared by the ECB in 2021, the institution analysed the financial system exposure to climate change risk. Concerning the banking system, the ECB states: “*The banking sector of the euro zone could be badly touched by a scenario in which climate change is not taking into account*”. Their studies show that the expected loans

portfolio losses would rise considerably through time and could become critical in the 30 following years. The institution also said that climate change represents a major source of systematic risk [24]. Regarding transition risks, firms with high carbon emissions represent the higher risk⁶. Banks' loan portfolios are exposed to the four levels with the highest emissions associated with high scope 3 emissions. According to the ECB, firms in the mining and energy sectors account for about 5% of banks' loan exposure. However, manufacturing represents ~20% of banks' loan portfolios. As the manufacturing sector's emissions are mainly linked to scope 3, a change in consumers' behaviour represents a significant transition risk for banks.

Transition risk exposure due to securities holdings follows a similar pattern, as around 30% of banks' equity and corporate bond portfolios consist of high-emitting NFCs. Figure 2 highlights the exposure of banks' loan by NACE⁷ sector and the share of corporate emissions in each sector [23].

⁶ Regarding carbon emissions, 3 levels of assessment are defined: "scope 1" – direct emissions linked to the non-financial corporations (NFC), "scope 2" – energy-related emissions and "scope 3" – indirect emissions associated with all other steps in the value chain. Scope 1 assessment is mainly done by large corporates and scope 3 emissions has the lowest coverage of all disclosures (23. Spyros Alogoskoufis, S.C., Wouter Coussens, Stephan Fahr, Margherita Giuzio, Friderike Kuik, Laura Parisi, Dilyara Salakhova and Martina Spaggiari. *Climate-related risks to financial stability*. Financial Stability Review, May 2022 2021; Available from: https://www.ecb.europa.eu/pub/financial-stability/fsr/special/html/ecb.fsrart202105_02~d05518fc6b.en.html).

⁷ NACE is a statistical classification of economic activities in the European Community. So far, some of the initiatives run by competent authorities to measure transition risk have relied on a method that maps the standard EU classification of economic activities (NACE) into categories that are relevant for climate transition risks known as the Climate Policy Relevant Sectors (CPRS) methodology. This methodology covers both low- and high carbon sectors (thus complementing the EU Taxonomy). In its more aggregate level, the CPRS consists of eight categories: 1. Fossil fuel, 2. Utility, 3. Energy-intensive, 4. Building, 5. Transportation, 6. Agriculture, 7. Finance and 8. Others (25. *Mapping climate risk: Main findings from the EU-wide pilot exercise*. 2021, European Banking Authority.).

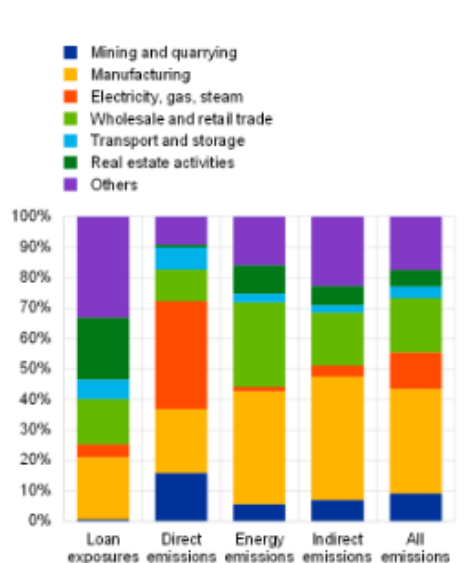


Figure 2 : Banks' loan exposures by NACE sector, and share of corporate emissions in each sector (source: [23])

Regarding physical risks, the Financial Stability Review presents the following: “around 30% of euro area banking system credit exposures to NFCs are to firms subject to high or increasing risk due to at least one physical risk driver”. Looking at individual hazards, around 10% of loan exposures involve firms at high or increasing risk of floods, heat stress or water stress. Taken together, around 80% of loan exposures are to firms with at least some exposure to physical risks”. Figure 3 shows the share of euro area banks’ credit exposures to firms by corporate physical risk level [23].

The ECB explains that two-thirds of exposures to firms highly or increasingly subject to physical risks are secured by collateral. Although it is playing a role in mitigating losses for banks, it is also subject to damage or loss of value. Banks are most exposed to firms in the manufacturing and real estate sectors, with more than two-thirds of exposures to sectors like real estate activities, construction, and accommodation and food being covered by collateral (mainly physical assets).

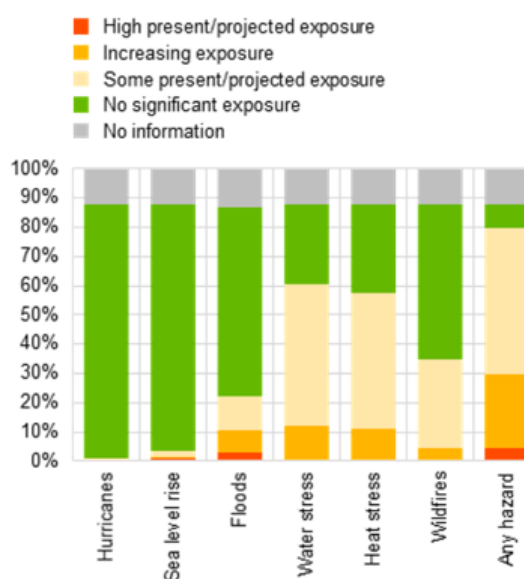


Figure 3: Share of euro area banks' credit exposures to firms by corporate physical risk level (source: [23])

4. Climate risk assessment

Climate stress tests test the resilience of banks and non-financial corporations in a range of climate scenarios. The UNEP – FI defines climate stress test as a forward-looking exercise designed to measure a financial institution's exposure to climate risks, using scenario analysis to assess the potential impact of climate change on the institution's business model. According to ECB, the government is responsible for combating climate changes but central banks play an important contributory role ensuring that the financial system is resilient to the transition to a low-carbon economy. Central banks have to ensure that the market participants have accessible good information on the risks from climate change and therefore a tool they use is the stress tests [26].

4.1. Stress test

Since the financial crisis (2007-2008), international financial and federal authorities have established stress tests as a toolkit to assess the resilience of financial institutions to adverse conditions. A stress test of the banking system investigates how bank liquidity and capital is affected under a number of severe scenarios of potential future events [14].

Climate stress test takes place in the scope of the Supervisory Review and Evaluation Process (SREP). In the framework of the SREP, the European Banking Authority (EBA) has put in place guidelines in accordance with Capital requirements directive (CRD IV). These guidelines are

addressed to competent authorities and aim to promote common procedures and methodologies [27]. The SREP allows to assess the capital needed to cover the risks to which the institution is or might be exposed (Pillar 1 - own funds requirements). The SREP also allows to determine the Pillar 2 requirement (P2R) which is the bank-specific capital requirement which applies in addition to, and covers risks which are underestimated or not covered by, the minimum capital requirement (Pillar 1). That requirement is legally binding and failing institutions can be subject to supervisory measures. Institutions also have to follow the Pillar 2 guidance (P2G) put in place by the ECB. A bank's P2G indicates the level of capital that it should maintain in order to be able to withstand financial stress. P2G is not legally binding and only reflects supervisory expectations [28]. The formal process through which a bank identifies, measures, aggregates and monitors material risk to build a risk profile for capital allocation is the Internal Capital Adequacy Assessment Process (ICAAP). ICAAP is a self-evaluation made by banks. Regarding climate risk stress test results, they could indirectly impact Pillar 2 requirements through the SREP scores⁸ but it will not directly impact capital through Pillar 2 guidance [29].

4.1.1. Banks' type and roles in climate problems and solutions

The World Resources Institute (WRI) explains that banks have differing business lines and play many different roles in financial intermediation in the economy. The three main categories of intermediation are:

⁸ In the SREP framework, competent authorities assign a risk and viability scores which summarise the outcomes of the assessment of various risk categories. The score ranges from 1 (low risk) to 4 (high risk). This score represents the likelihood that a risk will have a significant impact on institution after the risk controls mitigation of the banks but before consideration of the institution's ability to mitigate the risk through available capital or liquidity resources. The risks to capital are: credit and counterparty risk, market risk, operational risk and interest rate risk from non-trading activities. Risks to liquidity and funding have to be align with minimum EU regulatory requirements (liquidity coverage ratio and net stable funding ratio) 27. *Guidelines on common procedures and methodologies for the supervisory review and evaluation process (SREP) and supervisory stress testing under Directive 2013/36/EU*. 2022, European Banking Authority .

- Retail banking: banking services targeted to individual consumers. Relevant services include consumer lending (credit and debit cards, automotive loans and white goods⁹) and mortgage finance;
- Corporate banking: services targeted to corporate clients. Relevant services include corporate loans and other credit products (e.g., lines of credit, letters of credit), financing for projects, equipment leasing, and commercial real estate activities.
- Investment banking: services performed by banks relating to investment markets and traded securities. Relevant services are: underwriting debt and equity securities for corporate and government clients, securitization of pooled mortgage-backed securities (MBS) and other asset-backed securities and advisory and merger and acquisition services;
- Investment and asset management service [30].

The WFI identifies which banking roles is the most important for funding climate problems and solutions (Figure 4). Retail and corporate banking activities can have an indirect impact on GHG emissions through the way their lending to households and companies. Investment products and investment banking activities in the other way can help shift the larger pools of investor assets toward climate solutions/problems. As illustrated, the largest shares of global emissions outside AFOLU¹⁰ are industry building and road transportation. Therefore, WFI highlights the fact that the categories of banking transactions and assets that are the most important ones for banks to account and report on are: corporate credit, mortgages and auto loans to consumers as well as underwriting of securities associated with these entities. These categories of transaction are the most related to climate progress/impacts. While stakeholder engagement and reputational risk are the main drivers for commercial banks' disclosure and action regarding climate changes, stakeholder attention in the retail banks pay little attention

⁹ White goods can be defined as large electrical goods for the house (cookers, washing machines *etc.*).

¹⁰ AFOLU states for agriculture, Forestry and Land Used changes.

to the financing of mortgages and auto loans despite being responsible for relatively large portions of global emissions [30].

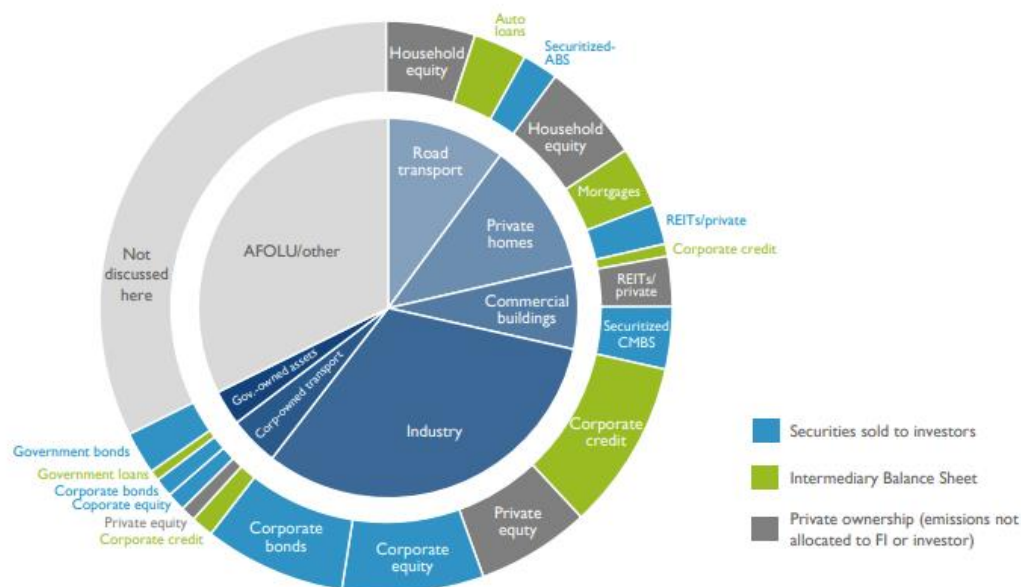


Figure 4: Schematic of global GHG emissions and financial intermediary roles in their financial structure (external financing only) [30]

Considering these differences in banking activities and among different banks, performance metrics tracked at bank group level would show some weakness.

4.1.2. Climate risk stress test – Banking sector

In 2020, ECB started its first economy-wide climate stress test that covers a period of 30 years into the future with 2 000 banks and approximatively four million companies worldwide. This top-down¹¹ exercise aims to assess the exposure of euro area banks to future climate risks by analysing the resilience of their counterparties under various climate scenarios. It is based on the NGFS outputs and assess both transitional and physical risks. Climate risks differ from the more familiar risks as climate change occurs slowly over a long period of time with potentially

¹¹ Top-down approach reflects the fact that the exercise is managed almost entirely by a single authority proving the scenario, the hypothesis and manage everything. While bottom-up approach results from firms own modelling. This could better reflect individual circumstances (21. Svoronos, P.B.a.J.-P., *Stress-testing banks for climate change – a comparison of practices*, in *FSI Insights on policy implementation* B.f.i. settlements, Editor. 2021, Financial Stability Institute.)).

irreversible consequences. Therefore, modelling frameworks need to incorporate both aspects related to economy and climate as well as how policies involve to prevent and/or mitigate climate change. In addition to the economy-wide climate stress test the ECB Banking Supervision are carrying out a supervisory climate stress-test of individual banks. The economy-wide stress test is a top-down exercise, and it has been conducted centrally by ECB staff. At the opposite, the supervisory climate stress test is a bottom-up exercise and rely on banks' self-assessment of their exposure to climate change risk and their readiness to address it [14]. BCE is not the only institution leading a climate stress test. As raised at point 2.2.2, climate risks awareness in the banking sector is rising and many other central banks are trying the exercise. For example, the National Bank of Belgium which has been studying climate-related risks to financial stability since 2018 also wants to lead a smaller scale climate risks stress test and the aim is that the banks would make their own analysis to include in their stress risks management system. Svoronos analyses climate stress-test achieved by Bank of France, Netherlands Bank and Bank of England [21].

4.2. Climate risk stress test

4.2.1. Difficulties

Assessing climate-related impacts represents a challenge regarding the following elements:

- Time horizons is longer (~generally 30 up to 50 years) that the one usually used in traditional banking sector risks (~3 years). This longer period leads to an increase of exposure sizes and potential losses quantification uncertainty;
- Regarding physical risks, data covering climate patterns is difficult to collect and may not be completely applicable in the future due to important changes in climate patterns. Data related to transition risks may not exist as they may be unprecedented;
- Data granularity must be important in order to be able to differentiate and assess risks along sector and region. While a relatively low-level of data granularity could be sufficient for a top-down macroprudential assessment of a financial system main vulnerabilities, it is not the case if the aim is to assess the resilience of individual banks. This evaluation requires firm-specific and individual properties data to assess bank's corporate and household exposure;

- Modelling has to integrate multiple elements regarding climate and macroeconomic variables [21]. Though financial data are already needed as they are used for currently stress tests and evaluate portfolio and client risk, climate data are typically less well-integrated into institutional processes. Part of climate data comes directly from scenarios and offer high-level detail on physical risks and transition pathways. However, for both risks, banks and firms require to work closely with clients and know the portfolio they invest in to granularly assess the diverse physical hazard confronting specific assets over different timeframes [6]. What's more models have to estimate linkages between climate events, climate and environmental policies, the economy, the financial system and individual institutions.

4.2.2. Data & Model

The four steps needed to translate climate change into financial impacts according to the Financial Stability Institute (FSI) are explained in Figure 5. The steps described below allow to translate the first-round effects. However, one could expect a second-round effects in order to consider feedback loops as climate risk shock affect the whole economy. However, this second-round effects are currently not integrated.

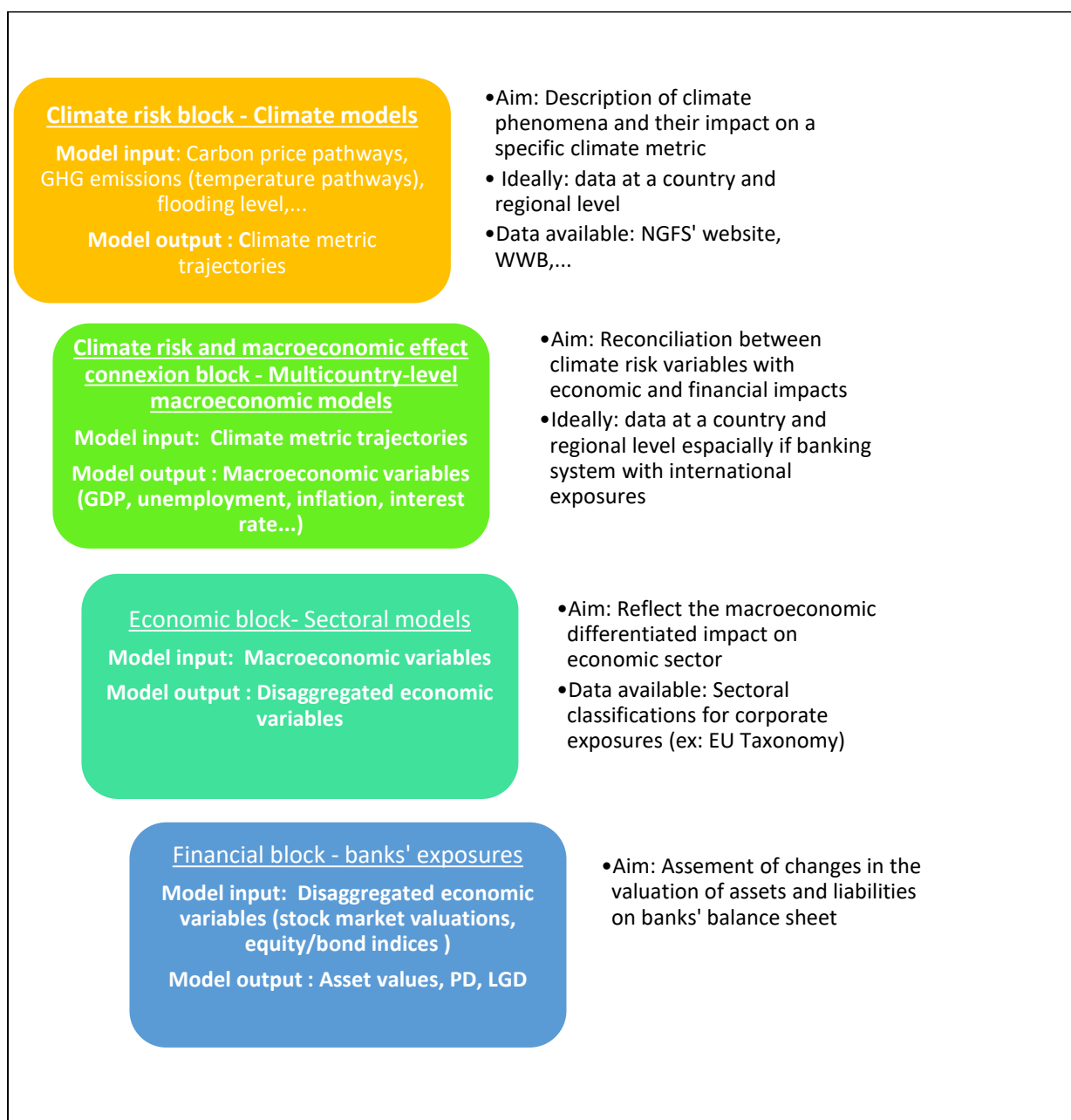


Figure 5 : Modelling blocks and interlinkages [21]

Banks use Integrated Assessment Model (IAM) to quantify the impact of climate change on macroeconomic variables. IAMs usually integrate economics and climate science. The most comprehensive IAMs also integrate energy systems, changes in land use, agriculture, technology, infrastructure and health. They also use the NiGEM model to assess the impacts of scenarios on key macroeconomic and financial variables [22].

4.2.3. Results

Regarding ECB's climate risk stress results, the institution is really cautious while presenting them as climate risk stress tests are at their beginning and consistent data and reasonable step-back have not yet been reached. However, they did write: *"The share of interest income related to the 22 most GHG-emitting industries amounts to more than 60% of total non-financial corporate interest income on average for the banks in the sample (median of 65.2%)"* (2022 climate risk stress test, 2022). Which translates the need for banks the importance to gain insights into their clients' transition plans.

ECB as well as Bank of England, Dutch Bank and Bank of France's results have the following conclusion in common : given the high-level of uncertainty, authorities haven't made firm-level disclosures and delivered aggregate information and exposures in order to catch bank's attention on their climate risk.

4.3. Metrics

4.3.1. Banks are trying to define and use climate risks metrics in their communication to clients

In a first time, standard financial risk metrics¹² were backward-looking. They were calculated from historical data which didn't allow to assess them correctly as they are not good predictors [32]. Climate risks were mainly based on portfolio carbon exposure which only reflects a portion of transition risk. However, climate change is a result of multiple sub-processes that interact with one another and are evolving through time. What's more today's business are highly interconnected which imply a network models of investment chains to assess risk metrics.

In addition to the necessity of using forward-looking data, standard financial risk require a high exposure granularity to be able to distinguish both physical and transition risk [31]. The

¹² Standard financial risk metrics or Value-at-risk (VaR) allow to assess the impacts of climate change on the value of financial assets over a given horizon at a given probability under particular climate scenarios (31. Settlements, B.f.l., *Climate-related financial risks – measurement methodologies*, B.f.i. settlements, Editor. 2021, Basel Committee on Banking Supervision.)

accuracy of the climate change risk metrics depends for physical risk to the climate scenarios used and can therefore vary from one to another simulation [33]. Regarding transitional risk, it is categorised by the Task Force on Climate-Related Financial Disclosures (which considers policy and legal, technology, market and reputational risks). Assessing the financial risk linked to climate policies requires estimations of the likelihood of the introduction of a specific policy. However, the likelihood that a climate policy is introduced depends on the expectations of the agents on that very likelihood [34]. Depending on granularity, climate risk metrics can be generated for several climate risk factors independently which allows banks to apprehend the different sources of risk. However it remains interesting to globally look at the climate risk metrics as it reflects the interrelated processes of the sub-factors forming the different categories of climate risk [33].

As an ultimate difficulty, as shown in point 3, the integration of climate risks considerations on the financial sector is growing. However, data are scarce and data gathering are slowly going on.

While the difficulties quoted above are focusing on data gathering and accuracy, one could question the data selected themselves. While metrics related to emissions or currency facilitate public and stakeholder understanding, communication values could be biased as it could be difficult to understand how to combine loans, transactions and assets under management in a meaningful manner and because such metrics are strongly correlated to the overall size of the banks. Therefore, it could be interesting to develop a suite of metrics most applicable to each type of activity or business with the drawback that these metrics are more difficult to communicate in aggregate and lead to more difficult comparison between institutions in aggregate [30].

The difficulties listed above are probably part of the following conclusion stated by Battison: there is no consensus on the methodology to use to assess the impact of climate risks and climate policies on the financial system [34]. The EBA has been mandated to develop appropriate qualitative and quantitative criteria, including stress testing processes and scenario analyses to be applied by financial institutions to assess the impact of ESG risks under scenarios with different severities. In addition, the EBA regulation has been aligned with these

new tasks and it mandates the EBA to develop common methodologies for assessing the effect of risks stemming from adverse environmental developments on an institution's financial position [25].

4.3.2. *Some metrics examples*

Principal types of metrics that are currently used by major banks and investors are [30] :

- GHG accounting: To measure exposure to carbon-intensive industries, each bank is expected to provide the necessary data to calculate a weighted average GHG intensity metric. This will provide an indication of the climate-related risk in the bank's non-financial corporations portfolio. The metric will rely on Scope 1, 2 and 3 GHG emissions of the counterparties within the scope of this metric. The final calculation of the metric then provides an overview of the emissions financed by the bank via its corporate portfolio [15].

Metrics can be:

- Corporate-level tracking of annual GHG emission related to a company's operations;
- Estimating net GHG emissions or emission reductions from projects relative to a baseline scenario;
- Green/brown metrics: metrics that measure climate progress of a project, activity, or asset class in terms of exposure in financial terms:
 - Corporate finance
 - Share of high cost capital expenditure (brown);
 - Share of revenues in carbon capture and storage (green);
 - Financing for projects:
 - Share of projects by Equator Principles category;
 - Number of renewables projects, loans;
 - Retail banking:
 - % car loan to hybrids or electrics;
 - % of mortgage financing to energy efficient homes;
 - Asset management and investment products:

- Number of ESG rated issuers;
- Number of socially responsible investment (SRI) funds;

These metrics have their “pro and cons” and a common critic is that banks and counterparties are lacking benchmarks¹³ and science-based targets to compare “green” or “brown” portfolio for example; and

- ESG scores: A metric aggregating a combination of the above metrics to provide insight on the extent to which a firm manages environmental, social and governance issues [35]; and
- Sector-specific energy and carbon metrics: Metrics that are specific to a sector:
 - kWh generated;
 - kWh/m².

Metrics are multiple and no official benchmark exist yet to standardize banks’ communication regarding climate-related risks. What’s more it is easy to orientate communication with metrics. Commercial banks for example disclosed a significantly greater number of “green financing” metrics than “brown” (cf Figure 6).

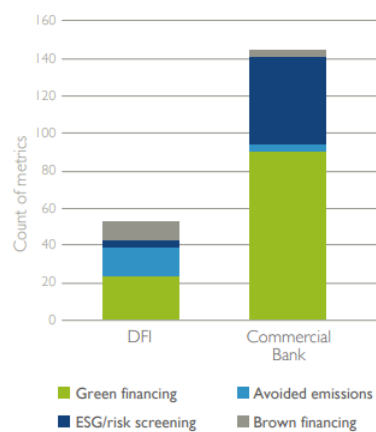


Figure 6 : Count of identified metrics in WRI and UNEP-FI Landscape review [30]

¹³ Different green/brown and sector classification schemes are used to classify green and brown activities such as ESG-Specification classification (Climate bonds initiative, MSCI), Standard industrial classification schemes (NACE, BICS from Bloomberg) and Investor classification (ICB, GICS),... but their overall practicality can vary a lot.

Part 2 – Insights

The first convincing results about climate-related impacts on financial sector are only popping up. Although results are starting to be disclosed¹⁴, banks' statements remain cautious. ECB's climate stress test conclusions speaking about a learning exercise to assess sector's preparedness for managing climate risk remain vague. Interrogated sustainability manager from Argenta (Appendix B) goes along the same way. With both these careful approaches and great concerns regarding climate change, banking sector is only at the beginning of its introspection. This situation does not allow to forge a clear opinion regarding the question *"What is the likely impact of climate change on the Banking sector? Will climate stress tests rechannel the investments to a more sustainable future?"* Therefore, despite collecting results regarding climate change quantified effects on the banking sector, I ended up reading a lot on financial stability, climate-related risk stress test methodologies, policies, etc. to make up my own opinion on this question.

Regarding the question previously quoted my answer would be: ***I doubt that climate stress tests in the banking sector will rechannel investments towards more sustainability in a near future.***

This "Insights" is divided into three sections. The first one is a reflexion around the research question. The second gathers the identified difficulties related to climate-risk assessment and the capacity of banking sector to take action in this regard. Final part explains required improvements.

5. Thoughts on the research question

5.1. Study scale: Banking sector vs financial sector

There is a misleading study scale in the question. In my opinion climate-related risks not only need to take into consideration banking sector but should include the financial sector as a

¹⁴ As examples 2022 climate risk stress test achieved by ECB and Supervisory stress tests can be quoted (2. 2022 climate risk stress test, E.c.b.-B. supervision, Editor. 2022, European central bank - Banking supervision. including climate-related impacts made by Bank of France, Netherlands Bank and Bank of England).

whole: credits institutions, pension funds and most of all, insurers. Since the 1980's, registered number of weather-related loss events has tripled. In 2017, global insurance industry had to face a \$135 billion in cost from natural disasters against \$49 billion in 2007 [9]. The interactions between banks and insurances have to be taken into consideration as banks are more or less affected by materialising risks depending on the insurance coverage of the exposures or the collateral [36]. Spyros has also pointed out that evidence from past disasters shows how economic recovery benefits from higher level of insurance coverage, as insurers play a role in managing and distributing the risks. However, with climate impacts raising, there is a growing insurance protection gap due to insurance premiums increase or because risks are simply becoming uninsurable [23]. That said, I would anyway remain more focused on the banking sector as it was the main subject of the question.

5.2. *Climate-related risks vs ES(G) risks*

Besides the question of the study scale, I wish to add a small comment regarding the question of the relevance of focusing only on “climate risks stress test”. Both climate and environment factors have in fact a materialised risk over a long-term horizon in the banking sector. ECB's guide on climate-related and environmental risks underlines it: *“although the majority of studies have focus on climate-related risks in particular, other environmental factors [...] have also shown to drive financial risk”*. The report further adds: *“Therefore, an integrated analysis would be needed to correctly assess the external impacts linked to natural aspects on finance. There is also evidence of an interconnection between climate-related change and environmental risks, resulting in combined effects capable of potentially generating even greater impacts”* [15]. Therefore, I would tend to think that the banking sector and the financial one as a whole should include both aspects in their risk management. However, I can face up that taking into account these multiple aspects in finance decision complexifies a lot the exercise.

6. Difficulties

6.1. *Disclosure obligations regarding climate risks*

Several articles I read were starting by the following idea: financial sector has a key role to play in climate risk mitigation challenges for both business and societal objectives. While the

first objective focuses on the risk and/or opportunity management, the second can be seen as climate progress carried out by financial sector by supporting the transition to low carbon economy. The aim of both approaches for the banking sector comes from the same objective: reducing its carbon footprint balance sheet.

However, whereas literature suggests that ESG and climate-related factors are compatible with fiduciary duties¹⁵, there is no binding obligation to report them. The OECD report *“Investment Governance and the Integration of Environmental, Social and Governance Factors”* notes that *“Traditional investors believe that ESG factors do not improve the fiduciaries capacity to meet their obligations, which are **purely financial**, and that ESG risks are already priced in the market”*. However, this statement is not shared by everyone and the report concludes that ESG and climate factors integration into banks’ investment governance depend on the extent to which they believe that these factors have a material impact on their ability to meet liabilities now and in the future [9].

That statement leads me to interrogate myself on two aspects: firstly *“To what extend banking sector integrate ESG and climate-related risks in their risks management, if it is not yet mandatory?”* and secondly *“What is the actual financial interest to invest in greener securities?”*.

6.1.1. Banks’ integration of ESG and climate-related risk

6.1.1.1. Stress test disclosure market affect

Although I didn’t find papers neither reports tackling climate risk stress test results and market affect, ECB analysed bank stress results and their impact on bank stock prices. ECB’s results show: *“Banks performing poorly in stress tests experience, on average, a reduction in returns and an increase in volatility. [...] These results support the hypothesis that stress tests and their publication improve market discipline”* [37]. On this basis, I could imagine that bank

¹⁵ Fiduciary duties refer to the legally-binding obligations of institutional investors to their beneficiaries. However there is no precise common definition as standards and their application vary across contexts 9. Geraldine Ang , H.C., *Integrating Climate Change-related Factors in Institutional Investment*, in *Round table on sustainable Development*. 2018, OECD..

performing well in sustainable investments would reduce its balance sheet carbon footprint, its risks and therefore, would have market favour. However, the following sections will detail elements that could balance this observation.

6.1.1.2. *Banks' disclosures*

ECB's studies show that banks are mindful of climate change risks and Banking Supervision results indicates that 70% of the assessed banks oversee those risks. However, 75% of the banks do not disclose whether climate and environmental risks have a material impact on their risk profile and 60% of the banks in the sample do not describe how transition or physical risks could affect their strategy. Even worse, almost 30% of the banks that have committed to aligning their exposures with the Paris Agreement do not provide any information to back this statement up [38].

I identified the following main issues:

- Climate-related disclosure is not mandatory.

Task Force on Climate-Related Financial Disclosures's (TCFD) recommendations go in a way to encourage climate disclosure by both financial and non-financial institutions and urge them to assess the type of information that should be released by organisations to shift financial flows towards a low carbon economy [9]. Also, banks' Internal Capital Adequacy Assessment Process (ICAAP) is a self-evaluation with internal control review. Climate-risks are not part of Pillar 1 analysis. In addition, although European Banking Authority (EAB) may raise the possibility of including climate risk stress test results in Pillar 2 requirements, it says that it will not impact capital (cf 3.1.1). I found it curious that while materiality of climate-related impacts are recognised by 75% of ECB assessed banks in 2021, this is not traduced in capital increase to cover the risks to which the institution is or might be exposed. My statement was backed by the 2022 ECB climate risk stress test report and Nuñez who also conclude that in general, institutions do not yet comprehensively disclose their risk profile and that significant efforts are needed to improve their transparency [2, 10].

- Actual climate-related risk considerations are **too preliminary**

The difficulties I faced to find results in climate risk stress tests and possible investment reallocations mentioned in my introduction of Part 2 are linked to the fact that the data and modelling underlying the banks' projections are still at a preliminary stage, with climate factors only captured to a rudimentary degree [6].

❖ Data

ECB's 2022 stress test report indicates data gaps and inconsistencies across institutions. Data are still scarce concerning corporate loans and banks are often missing carbon footprint data, especially for scope 3 analysis (cf 3.3.2). Regarding mortgage or real estate investments, banks are missing energy performance certificates (EPC, *etc.*). Moreover there is a lack of harmonised legislation regarding EPC or disclosure of greenhouse gas emissions which hampered banks' ability to collect hard data [2].

❖ Metrics

Metrics are multiple (cf 4.3) and clear guidance to support banks in their climate-related risks is not yet defined. Following raising concerns regarding climate-related and environmental risks, new suppliers and services are seeing the day light. These "new" stakeholders are offering services such as external verifications of sustainability commitment. These multiple companies are attributing different ESG rating for same institutions (Figure 7) [39]. This multiplicity of actors and standards are leading to readability and comparison difficulties for the different counterparties. This can also lead to distrust in ESG investments.

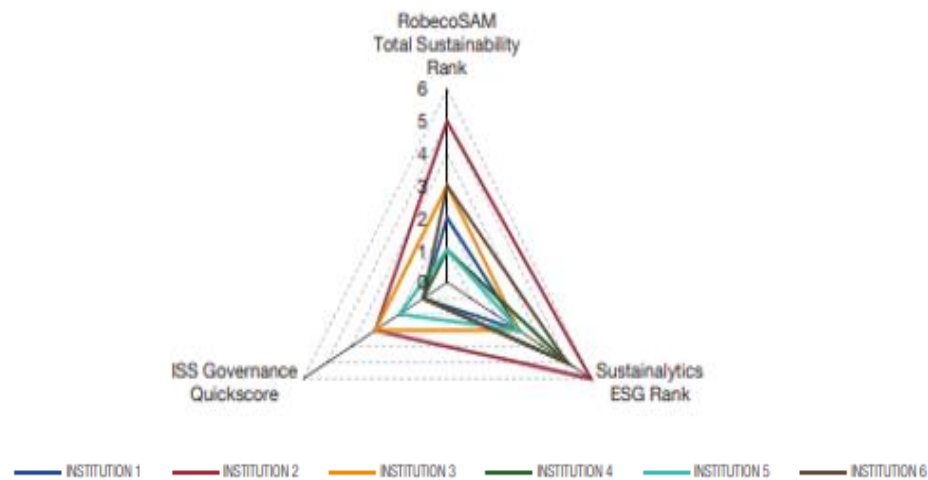


Figure 7 : Dispersion of ESG ratings [39]

❖ Modelling

As explained at point 3.3.2, modelling encountered multiple issues such as the need for forward looking analysis, clear scenario considerations, clear model input integrations, clear key macroeconomic and financial model outputs communications, *etc* [9]. Currently, input considerations in modelling are not clearly defined as there are multiple, complex to integrate notably since a lot of data is still missing. Therefore, models are not all considering the same things and we end up with several models focused on transition risks while letting aside physical risks or models that only consider part of the physical risks and do not involve heat and drought's effect on productivity, migration flows, increased food price, *etc*. Besides models do not include second-round effect (cf point 4.2) [6, 40].

Another main modelling difficulty is what bring us to the following point.

➤ Time consideration mishandle

Time is an important compound. As seen in point 1, human effects on climate go back from a long time and deeper considerations to mitigate them should have been taken sooner. However, given the current situation, strong actions are difficult to set and take time. As seen at point 3.2.4, probability of default linked to transition and physical risks is one of the major risks weighing on banking sectors. Therefore, authorities and institutions must find a way to

balance urgency of taking action to respect Paris Agreement with the adaptability capacity of firms in order to honour their loan reimbursements.

❖ Financial word

Climate and other ESG-related factors have long term effects that turned out to be a great challenge for risk stress test integration which has a smaller time horizon [9, 40]. The path of investing in climate-related opportunity and mitigating climate risks trades off the cost of mitigation (e.g., reduced growth up front due to paying more for renewable energy and costly investments in new productive capital and infrastructure) with the expected benefits (e.g., higher growth for future generations). The International Monetary Fund's (IMF) report tells us about a **"tragedy of the horizon"** as the catastrophic impacts of climate change will be felt beyond the traditional horizons of market participants [41]

❖ Politic and governance world

In my opinion, duration of mandates, whether there are corporate related or political are too short to fully take into consideration climate-related risks in their decision process. In my point of view, our endless race for growth and short profit limit real involvement in putting true measures in place. I think this could be one of the explanations for: the reopening of coal power station in Germany, the built of new gas power station in Belgium, the low carbon taxes¹⁶. These actions allow us to maintain society purchasing power and economic growth. Despite all scientific proves that an orderly transition would have the lowest impacts on both the nature and the financial sector, short-termism of direct impacts observed by society such

¹⁶ "The average effective carbon tax, or the emission tax plus energy taxes, is currently below EUR 30 per tonne of carbon emissions in most countries. [...] However, the effective carbon tax needs to be substantially higher. [...] The carbon price also varies widely among the sectors in EU Member States. For example, manufacturing and agriculture have relatively low effective carbon taxes, while private households (non-business emissions) and the service sector pay a relatively high price for their emissions. This is mainly because a number of sectors have exemptions and degressive tax rates for competition reasons. It is also notable that within the transport sector the most carbon-intensive sectors, such as aviation and shipping, barely pay any energy tax" 42. Justin Dijk, J.W.v.d.E., Rianne Luijendijk, Guido Schotten and Sophie Steins Bisschop, *Financing the transition : seizing opportunities for a green recovery*, in *Occasional Studies*. 2021, DeNederlandscheBank..

as COVID-19 or Ukrainian war leads to take non-integrated actions. However, I admit that the world becoming such a complex place do not allow for a simplified answer.

6.1.1.3. Banks' investments

As shown in point 3.3.2, banks investments in high GHG emission sectors remain high (e.g., manufacturing, transport and real estate). Many actions such as Carbon Tracking Initiative, ShareAction or 350.org claimed for fossil-fuel divestment campaign. One year after the adoption of the Paris Agreement, total divestments from fossil fuels reached \$5 trillion worldwide [9]. However despite a slow investment reduction in fossil fuel, they remain far below sustainable investments [42] and quite dependant on short term event. For example, in 2021 investments in coal supply raised by 10% notably due to new coal capacity coming onto Chinese domestic market. Oil and gas investment raised up 10% as well following Russia's invasion [43]. The proportion of carbon-intensive sectors in the equity and debt markets is greater than their economic contribution (cf. 53Appendix C) [42].

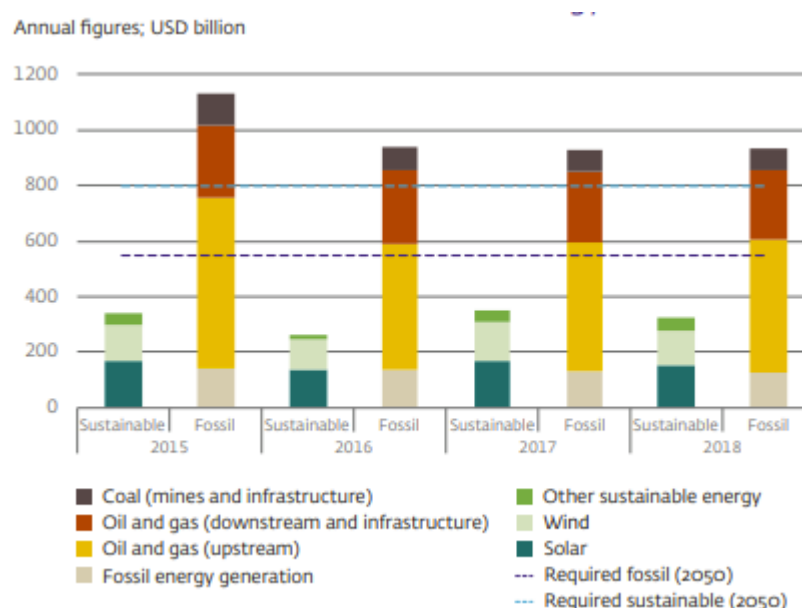


Figure 8 : Annual private investment in fossil energy exceeds investment in sustainable energy [42]

Despite this pessimistic view of investments redirected towards more sustainable ones, BIS Quaterly Review shows that labelled bonds to finance projects with environmental or social benefits has risen more than tenfold over the past five years and now stands at more than \$2 trillion (Figure 9).

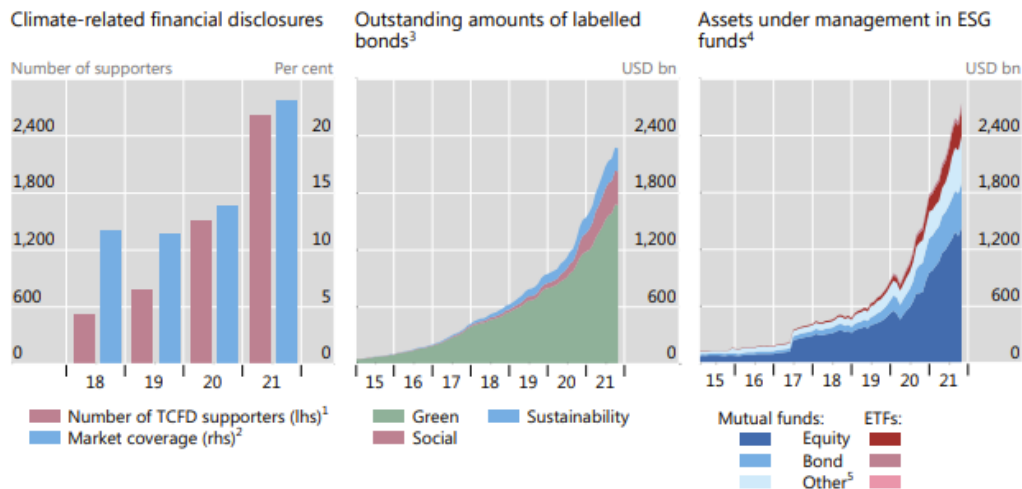


Figure 9 : ESG markets are booming [44]

6.1.2. Sustainable investments

Multiple labelled bonds, portfolio, etc emerged in the past few years. One of them is the green bond¹⁷ whose Principles are coordinated by the Executive Committee of the International Capital Market Association. Although a rise of green investments is observed they are far behind the amount needed to fulfil Paris Agreement. The following elements could partially explain this mitigated evolution.

6.1.2.1. Climate investment higher risks

“Sustainable” investments represent a higher financing risk as such investments are often innovative, long-term and have uncertain payback period [42]. The investment profitability also highly depends on future government policy such as incentives for greener investments or penalties for high GHG emitters. Therefore, investors should expect higher yield. However, most of studies confirm that a negative yield spread for green bond compared to conventional counterpart exists. Lau makes the hypothesis that, maybe, the benefit to investors of green bonds is the satisfaction derived from a goal, one of supporting climate change solutions, being fulfilled. However, it is important to note that such demand cannot sustain if it is not underscored

¹⁷ The Green Bond Principles are published under the governance of the Principles where are a collection of voluntary frameworks with the stated mission and vision of promoting the role that global debt capital markets can play in financing progress towards environmental and social sustainability 45. Voluntary Process Guidelines for Issuing Green Bonds, in *The Green Bond Principles*. 2021, ICMA.

by a growing desire among world citizens to protect the environment [46]. Regarding banking sector, the World Resources Institute suggests that banks may seek to contribute to GHG emissions reductions and the transition to a low-carbon economy in response to internal or external pressures that go beyond risk management. These could include the bank's mission, its external mandate, corporate social responsibility considerations, and reputational concerns [30].

6.1.2.2. Externalities & co-benefits poor integration

Contrast between green asset valuation and carbon intensive sectors is not present enough as there is an under-pricing of carbon emission and a lack of tail events consideration [41]. Under-pricing is set at international and European level and coordinated in order to protect competitiveness and limit carbon leakage effects [42].

In addition, co-benefits of valuing greened assets are not taken into consideration (e.g. lower temperatures, increased in well-being and productivity).

6.1.2.3. Label transparency

As for green bond, some authors are doubting that some green labelled securities lead to more sustainable business. They are denouncing insufficient visibility and oversight of the ultimate impact of sustainable investment strategies. In fact, the bank of Netherlands says that the least sustainable businesses (based on the above Bloomberg classification) in Europe account for around two-thirds of green corporate bond issues (excluding issuances by financial institutions) [42]. Lau explains that part of the unwillingness to invest in green securities/portfolio may be attributable to the risk that some green bonds may be greenwashed [46].

7. Climate-related risks channelling investments to greener ones?

As other authors, I fear that because we are in a relatively preserved part of the world, national and local levels of governments may lack incentives for climate mitigation action, since the benefits of these mostly accrue to citizens of other jurisdictions or countries [47]. Indeed, in its cross-country, the International Monetary Fund exposed that a conclusion one may obtain from literature is that the economic effects of climate change are highly uneven (cf point 3.3),

with severe negative effects in hot/poor countries and limited impact on cold/rich economies (and in some studies even large gains in Canada, Russia and most of Western Europe). This results in less developed countries being more likely to suffer from climate-related risks than developed countries [1].

This observation shows that both global and local institutions and authorities have to be involved in taking measures to favour greener investments. The past few points also exposed the room for improvement, which can take several forms.

8. Improvements

8.1. Financial sector

8.1.1. Climate risks stress tests

The financial sector needs standards and available data in order to achieve a climate risks stress tests and quantify the real impact of climate change on its capital. To allow this evaluation, externalities have to be taken into consideration in order to asset a fair price for both GHG bigger and lower emitters.

8.1.1.1. Global disclosure standards

As mentionned in points 4.2 & 6.1.1.2, climate risk stress test has to pass through some difficulties. As part of its efforts to address data gaps, the NGFS has made data and resources available for scenario design in a dedicated section of its website[35]. NGFS's Progress report on bridging data gaps says: *"Convergence towards a global disclosure framework, alongside progress towards a globally consistent set of minimal climate disclosure standards and requirements is likely to improve the availability and comparability of climate-related data. Mechanisms for verifying and auditing climate-related financial disclosures are essential to make data reliable and comparable"* [35].

Banks should have the obligation to quantify climate-risks analysis and results should be part of the financial report. This should allow them to adapt their capital requirement as well as their strategy of investments and their politics regarding corporate credit rates, mortgage, etc (EBA guidelines on loan origination and monitoring).

8.1.1.2. Global taxonomy

There is a need to intensify and coordinate the development of taxonomies across the globe, and to examine the possibility of harmonizing them over time. Efforts towards developing a globally agreed upon taxonomy could help ensure worldwide comparability of raw data. The convergence of different taxonomies over time will be important in ensuring consistency in climate-related disclosures [42].

8.1.1.3. Long-term investment funds and securitisation

The European Commission is investigating how the use of long-term investment funds and securitisation can be promoted safely. The Taskforce for Climate-related Financial Disclosures (TCFD) therefore advises investors to adopt an active investment approach, for example by taking carbon intensity levels¹⁸ into account in the composition of their investment portfolio. A disadvantage of an active strategy based on carbon intensity is that it is retrospective. However this strategy does not consider the capital that polluting businesses invest in future carbon emission reduction. Therefore, investors are advised to consider not only historical carbon intensity levels, but also forward-looking data concerning carbon reduction paths[42].

8.2. Political sector

Central Banks shall not be economic policymakers, which is actually the role of governments. Central banks must evaluate whether their asset purchases, collateral policy and prudential regulation are causing climate-related risks not to be reflected adequately in asset prices, with the consequent adverse effects for financial stability. Should this be so, they should have to act accordingly, albeit always within their mandate [10].

8.2.1. Harmonisation

According to ECB, misalignments of financial regulations and other policies (e.g reporting requirements or corporate governance standards) with climate goals can hinder the allocation

¹⁸ The carbon intensity indicator measures the amount of emissions businesses need in order to generate USD 1 million of revenues and applies a correction for the size of the business 42. Justin Dijk, J.W.v.d.E., Rianne Luijendijk, Guido Schotten and Sophie Steins Bisschop, *Financing the transition : seizing opportunities for a green recovery*, in *Occasional Studies*. 2021, DeNederlandscheBank..

of long-term finance to low-carbon infrastructure investment. Well-aligned policy packages are needed to mobilise financing and investment in low-carbon, climate resilient infrastructure, while enhancing growth [9]. For example, the Commission decision to include specific nuclear and gas energy activities in the list of environmentally sustainable economic activities covered by EU Taxonomy seems to me completely controversial regarding Paris Agreement and the need to act towards more sustainability. It leads to mispricing CO₂ emissions (cf point 6.1.2.2) and biased investments from both country members of EU and the financial sectors. This need for harmonisation is yet also raised in the regulation of the European Parliament and of the Council (2018/0180), which says that in the absence of a harmonised framework to ensure the accuracy and integrity of the main categories of low-carbon benchmarks used in individual or collective investment portfolios, it is likely that differences in Member States' approaches will create obstacles to the smooth functioning of the internal market [48].

The Sustainability Standards Board (SSB) intends to translate the various existing initiatives in the field of sustainability reporting into a harmonised global reporting standard. Climate reporting must also contain forward-looking indicators, enabling investors to assess whether a business is making the transition [42].

8.2.2. Negative externalities correct pricing

As the Netherland bank indicates it, I think that government has to be more severe with GHG emitters in order to correctly price assets. The Netherland bank indicates that at European level, the emissions trading system covering the electricity sector, the refining and the chemical industries should be expanded to include other sectors such as transport, shipping and buildings. The Emissions Trading System (ETS) also needs to be improved with a lower emission ceiling and fewer free ETS allowances for manufacturing. In order to prevent European businesses losing market share to polluting competitors outside the EU as a result of the stricter climate policy, a carbon-based levy on imports at the EU's external border is desirable.

Since the emission ceiling has been set at European level, additional emission reduction for ETS sectors at national level creates more scope to emit in other countries. Therefore, if

countries introduce a supplementary climate policy, the emission allowances thereby released must be cancelled [42]. Adequate carbon pricing is one example among many others negative externalities (e.g. water pollution, waste management in general, land use modification, *etc.*).

8.2.3. Regional and global authorities

Governments at European and national level can also reduce uncertainty through co-financing and guarantees, as provided for in the European Green Deal [42].

8.2.4. Politic implications

As mentioned above, governments have an important force in rechannelling investments towards greener ones and can use different tools:

8.2.4.1. Fiscal policy

Fiscal tools are instruments that directly affect the government budget and are implemented by fiscal authorities. Therefore, government can play with taxes, subsidies, investment and public guarantees in order to internalized climate change externalities, therefore reaping the co-benefits of climate change mitigation (cf point 8.2.2) and securing low-carbon public infrastructure. However public finance deterioration due to COVID-19 crisis and Ukrainian war leave less fiscal room available for climate policy as higher public debt often leads to lower public investment [41].

The only preoccupation I may raise is that when government supports innovative project, companies could lean on those subsidies and invest less in research and development. For example, Shell and Total respectively cleared a net profit of \$11.47 billion and \$9.796 billion. While a negligible part is allocated to renewable energy, the majority (\$6 billion and \$5 billion) will be used to buy new shares. TotalEnergies (\$35 billion), Shell (\$24 billion) and BP (\$12 billion) have really small shares in low carbon emissions compared to their valuations (respectively for 2021 in “zonebourse”: \$175 577, \$220,405 and \$126,435 billion) [49].

8.2.4.2. Financial policy

Financial policy tools include financial regulation, financial governance and policies to enhance financial infrastructure and markets. These policies can approach subjects such as better accounting for climate risks for financial institutions (demand change for green and carbon-

intensive investments) or better internalizing externalities and co-benefits at the level of society [41].

8.2.4.3. *Monetary policy*

Monetary policy make use of the central bank balance sheet. This is completely linked with central bank mandates and the eventual requirements of making them reflect climate risks in largescale asset purchase programs or collateral frameworks. The Bank of Spain explains that the extent of involvement of central banks in climate change depends on their mandate and their interpretation of it. The main objective of Western banks is to maintain price stability through notably low and stable inflation. Another function generally entrusted to bank is safeguarding financial stability which justify the consideration of climate change and energy transition issues in micro- and macro-prudential supervision, and in oversight of the monitoring of the effects on price stability [10].

9. Conclusion

Climate change cannot be denied anymore. Through drought, flooding, heat waves, *etc* it represents an important source of risks for the World including the banking sector. In addition, transition risks linked to politics, technology development and changes in consumer tastes are also taking part in climate-related risks. It is now recognised that climate change can lead to economic or financial shocks and have macroeconomic impacts due to default rate, lenders' earnings destabilisation, asset prices volatility, *etc*. Risk modelling should allow the banking sector to anticipate these negative impacts and rechannelled their investments to limit these impacts. However, currently, only a few banks are disclosing climate-related information and even lesser are quantifying them. This statement is the results of many elements that do not help to reallocate investments towards greener ones.

Banks' disclosure isn't mandatory as it is not yet part of its fiduciary duties. Until recently, banks were seen as independent organisms whose mandate was focus only on financial aspects. However, as the world is complexifying, financial aspects are now interlinked with other aspects such as climate-related factors. What's more taking into account the preliminary stage of the climate risk stress test, no convincing results related to climate impact on banking sector and its way to rechannel investments are yet available. Climate risk stress test is really

complicated exercise has time horizon is really different from the one usually used in finance. What's more, some data have little accessibility and are not well comparable. Regarding modelling, many models exist and depending on their scenario, physical and transition risk considerations, results can vary a lot. Therefore, the conclusions of ECB's climate stress test report are relatively vague. However, the investigation led will serve as information sources to push banks in better monitoring and disclosing their climate risks. Therefore, to be able to be used as a tool to rechannel investments towards greener ones, climate-risks stress tests still have to be adapted. Institutions have to better communicate on data availability and benchmarks, standardise procedure and deliver certificates which are transparent and don't afraid counterparties' trust who could be preoccupied by greenwashing as it is currently the case.

While it is becoming clear that banking sector is trying to green part of their investments, politics have also a major backup role to play through fiscal, financial and monetary policy tools. Among other solutions, governments need to create better incentives to allocate the real costs of polluters through better integration of externalities (such as CO₂ taxes). Regarding monetary policy, mandate definition of central bank should likely be reviewed as they are adopting an active role in fostering sustainability and green finance. On July 2022, ECB announced indeed that it would integrate climate change considerations into Eurosystem monetary policy through changes to its corporate bond asset purchase program and its credit operations, to be implemented from October 2022. Therefore, ECB will redeploy funds received from maturing Corporate Sector Purchase Programme (CSPP) securities towards securities issued by "issuers with better climate performance" (lower GHG emissions). This represent a big shift from the principle of "market neutrality" where securities were purely selected by credit quality (relative market capitalization of each economic sector of the CSPP eligible bond universe) [50]. This announcement shows that world is involving and although it is probably to slow for the Earth, political and financial systems are turning to more sustainable actions. Therefore, even if it doesn't seem to be the case yet, climate stress test would probably be a major tool used by central banks to rechannel investments to greener ones.

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Appendices

Appendix A. ECB's questionnaire to assess banks vulnerability to climate risk

Block 1. General climate risk stress test: General questions regarding the existence and use of climate risk stress testing within the institution.

Block 2. Climate risk stress test governance and risk appetite: Governance structure of the bank's climate risk stress test and the integration of the climate risk stress test results into the risk appetite framework of the bank.

Block 3. Integration of the climate risk stress test into the institution's long-term business model strategy: Use of the results from the climate risk stress test in the strategy, loan granting process and product pricing or capital requirements of the institution.

Block 4. Stress test methodology: Assumptions, transmission channels and portfolios used in the climate risk stress test.

Block 5. Stress test scenarios: Scenarios used by the bank in the climate risk stress test, for example for physical and/or transition risk.

Block 6. Data: The role of data (availability/sources) in the climate risk stress test framework of the institution.

Block 7. ICAAP: Integration of the climate risk stress test in the Internal Capital Adequacy Assessment Process (ICAAP) of the institution.

Block 8. Future plans regarding climate risk stress testing and interaction with other priorities: Plans to further improve climate risk stress test capabilities and the respective priorities.

Block 9. Involvement of the internal audit function in the climate risk stress test: Involvement of the third line of defence in the internal climate risk stress test.

Block 10. Application of parent company climate risk stress test framework: Applies to EU subsidiaries of non-EU institutions and explores their climate risk stress test framework.

Block 11. Bottom-up stress test: Assumptions applied by the institution when making the bottom-up climate risk stress test projections and some additional aspects of the projections under Module 3.

Appendix B. Argenta's email exchange

1) First email from Elodie to Argenta with general questions – 25 of July 2022

From: elodie jacquemin <elodie.jacquemin@outlook.fr>
Sent: lundi 25 juillet 2022 15:15
To: Cherdon Finance SPRL 3701 <gembloux@argenta.be>
Subject: Climate change risk assessment
 Bonjour,

Je vous sollicite car je réalise actuellement un master complémentaire en sciences de gestion. Dans le cadre de mon mémoire je cherche à répondre à la question suivante : « Finance : what is the likely impact of climate change on the Banking sector ? Will those stress tests on climate rechannel the Investments to a more sustainable future ? »

J'aurais souhaité recevoir une réponse sur les questions suivantes :

- Les résultats du climate change risks analysis conditionnent-ils les investissements/les prêts réalisés par Argenta ?
- Y a-t-il une transition vers des investissements/prêts pour des entreprises plus vertes ? Qu'est-ce qui influence le plus ceux-ci (résultats du climate change risks analysis, ESG assessment...) ?
- Est-ce que le COVID a eu un impact sur la façon dont Argenta met en place le climate change risk assessment et sur sa stratégie d'investissement à court/moyen et long termes ?

Afin de pouvoir intégrer votre réponse aux résultats de mon mémoire, je souhaiterais votre réponse pour fin de cette semaine. J'espère que malgré ce délai très court, je pourrai recevoir un retour de votre part.

Bien à vous,

Elodie Jacquemin

2) Stéphanie Dangreau - Manager Sustainability's answer – 2 of August 2022

De : Dangreau Stéphanie <Stephanie.Dangreau@argenta.be>
Envoyé : mardi 2 août 2022 10:38
À : elodie.jacquemin@outlook.fr <elodie.jacquemin@outlook.fr>
Cc : Van Horen Joeri <JOERI.VANHOREN@argenta.be>; Cherdon Finance SPRL 3701 <gembloux@argenta.be>
Objet : RE: Climate change risk assessment

Dear Elodie,

Thank you for your interest in Argenta and specifically our sustainability and climate change approach.

We have been working for almost 2 years intensively on the topic of climate change. It is a very complex topic, where the financial sector is still at the beginning of exploring the impact of climate change on our business. The most difficult issue is the lack of data:

- For our investments in companies: only a very few (mostly large) companies disclose their CO2-impact (scope 1, 2 & 3) and other related climate information, so it makes it very difficult to calculate accurate risks. We believe that this will change in the coming years, as the regulator is forcing companies to disclose their climate impacts (through Taxonomy Regulation, through SFDR, through CSRD...). To perform stress-tests and scenario-analysis, we use proxies to estimate the impact of the companies. It's a first step...
- For our exposure in mortgages: also here we need data such as the EPC-information of the houses, but we also need to map our geographical exposures with flooding maps, heat maps, drought maps... Again a very complex exercise where there is lack of information.

To answer your questions:

- Yes: we perform risk assessments on our investment (funds under management and own investment portfolios) and mortgage portfolios (both Belgium and the Netherlands), but also on our insurance portfolio.
- Yes, Argenta has the ambition to evolve fully to a 100% sustainable exposure, both in our investment portfolios and in our mortgage portfolios. But this is a transformation that will take many years. Specifically for our mortgages, we need to support our customers to build or renovate in a sustainable manner, and there it will be key to make it affordable and accessible for everyone. Working on it!
- The effect of covid or similar viruses is not (yet) in scope of the ECB-stresstesting on climate risk, today the focus is mostly on the physical and transition risks of climate change. But there have been risk exercises on covid in other stresstests, separately from climate risk.

I hope this information can help you a bit further.

In our [sustainability report 2021](#), we have included a [climate report](#), where you can read more on our climate risk approach.

Kind regards,



Stéphanie Dangreau
Manager Sustainability

Argenta Bank en Verzekeringen
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T +32 3 287 44 17
M +32 496 98 13 92
stephanie.dangreau@argenta.be

3) Subsidiary questions from Elodie – 2 of August 2022

From: elodie jacquemin <elodie.jacquemin@outlook.fr>
Sent: dinsdag 2 augustus 2022 12:30
To: Dangreau Stéphanie <Stephanie.Dangreau@argenta.be>
Cc: Van Horen Joeri <JOERI.VANHOREN@argenta.be>; Cherdon Finance SPRL 3701 <gembloux@argenta.be>
Subject: RE: Climate change risk assessment
 Dear Stéphanie,

Thank you for your email.

Could you maybe be more specific concerning your opinion on methodology used for climate-related risks stress test? Do you think its consistant and allow to compare results between banks/investisment found *etc*?

Could you elaborate a bit the difficulty you face ? (I have noted that CO2 data gathering is a major one).

Would you have some criticisms the way ECB/BNB/others are working to implement climate-related stress tests ?

Would you say that climate-related stress test results would have more influence on your investment strategy that all the standards that are actually put in place by regulators (Taxonomy Regulation *etc*)?

Thank you again for your answers, they help a lot.

Regards,

Elodie Jacquemin

4) Final answer from Stéphanie – 2 of August 2022

De : Dangreau Stéphanie <Stephanie.Dangreau@argenta.be>
Envoyé : mardi 2 août 2022 15 :19
À : elodie.jacquemin@outlook.fr <elodie.jacquemin@outlook.fr>
Cc : Van Horen Joeri <JOERI.VANHOREN@argenta.be>; Cherdon Finance SPRL 3701 <gembloux@argenta.be>
Objet : RE: Climate change risk assessment

Hi Elodie,

Again a lot of complex questions, and I'm afraid I cannot fully disclose because we need to be discrete on the process and the results, since the stresstesting process is still ongoing with the ECB.

The methodology of the stresstests was defined by the ECB, but I don't know if this is published publicly. Nevertheless, the ECB wants to perform benchmarking-exercises between peers, so everyone has to follow the same methodology.

The climate stress test is very useful to gain more insights in climate risk, but is indeed not the only driver. Again, it is a mix of our own investment aspirations and regulatory frameworks.

You can find more information on our investment policy here.

Kind regards,



Stéphanie Dangreau

Manager Sustainability

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Appendix C. Sectoral share in Dutch banking finance, 43 European market finance and broader economy

Percentages

NACE	Sectors	Bank loans	Equity market	Debt market	Employment	GDP	CO ₂ emissions
A-U	All economic activities	100%	100%	100%	100%	100%	100%
A	Agriculture, forestry and fisheries	3%	0%	0%	5%	2%	4%
B	Mining and quarrying	1%	3%	0%	0%	0%	1%
C	Manufacturing	10%	62%	43%	15%	17%	31%
D	Energy services	2%	6%	17%	1%	2%	34%
E	Water companies and waste management	1%	0%	3%	1%	1%	2%
F	Construction	2%	2%	2%	7%	6%	2%
G-I	Trade, transport and the catering industry	12%	8%	9%	25%	20%	21%
J	Information and communication	2%	11%	17%	3%	6%	0%
L	Real estate rental and trade	28%	2%	7%	1%	12%	0%
M-N	Business services	12%	4%	2%	13%	11%	2%
O-Q	Government and healthcare	27%	1%	1%	24%	20%	3%
R-U	Culture, recreation and other services	1%	1%	0%	6%	3%	1%

Source: AnaCredit: bank loans to entities in EU Member States (2020 Q3), Bloomberg: equity and debt markets (2020 Q3), Eurostat: employment, GDP (2020 Q3) and CO₂ emissions based on scope 1 & 2 (2019)

Abstract :

This thesis aims to bring answer to the following questions: “What is the likely impact of climate change on the Banking sector? Will climate stress tests rechannel the Investments to a more sustainable future?”.

It thesis is divided in two sections. The first one is a state-of-the art. It sums up the history regarding human awareness of their impacts on climate, the measures taken by countries and banking sector to be proactive actors in this regard and climate risks consideration (type of risks, defined scenarios, climate impacts, climate risks stress test, metrics, *etc*). The second part focuses on a more personal analysis of the banking sector capacity to act to rechannelled investments towards greener ones and the needs to have a more sustainable development.

Résumé :

Cette thèse vise à apporter des réponses aux questions suivantes : « Quel est l'impact probable du changement climatique sur le secteur bancaire ? Les tests de résistance climatique réorienteront-ils les investissements vers un avenir plus durable ? »

Cette thèse est divisée en deux sections. La première partie est un état de l'art. Elle résume l'historique de la prise de conscience humaine de leurs impacts sur le climat, les mesures prises par les pays et le secteur bancaire pour être des acteurs proactifs à cet égard et la prise en compte des risques climatiques (type de risques, scénarios définis, impacts climatiques, stress test des risques climatiques, métriques, *etc*). La deuxième partie porte sur une analyse plus personnelle de la capacité du secteur bancaire à agir pour réorienter les investissements vers des investissements plus verts et les besoins d'un développement plus durable.

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