

MARKETS, FINANCIAL INSTITUTIONS
AND CENTRAL BANKS IN THE FACE
OF CLIMATE CHANGE: CHALLENGES
AND OPPORTUNITIES

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Clara I. González and Soledad Núñez

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MARKETS, FINANCIAL INSTITUTIONS AND CENTRAL BANKS IN THE FACE OF CLIMATE CHANGE: CHALLENGES AND OPPORTUNITIES ^(*)

Clara I. González (**)

BANCO DE ESPAÑA

Soledad Núñez (***)

BANCO DE ESPAÑA

(*) The views expressed in this article are those of the authors and do not necessarily reflect those of the Banco de España or the Eurosystem.

(**) E-mail: clara.gonzalez@bde.es (Banco de España, calle de Alcalá, 48, 28014 Madrid).

(***) E-mail: soledadnunez@bde.es (Banco de España, calle de Alcalá, 48, 28014 Madrid).

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Abstract

Climate change and the transition to a low-carbon economy involve the financial system in two ways. First, because it channels the funds needed to make the large investments to comply with the Paris Agreement. Recent years have seen headway, albeit insufficient, in the development of new products, of which green bonds are the most advanced green financing instrument. Second, because of the financial risks associated with climate change and the transition to a low-carbon economy, which affect financial institutions' balance sheets and are, moreover, systemic. This means that financial institutions have to assess these risks and their exposure to both of them, although it is not an easy task. There are still obstacles and challenges to overcome, such as the lack of a complete taxonomy that comprises what is "green" and what is not green, the lack of information on and knowledge of appropriate methodologies, and the long and uncertain time horizon of these risks, which calls for rolling out new skills and integrating these risks in the whole of the organisation, as well as taking a forward-looking approach. Lastly, central banks' responsibilities regarding bank supervision, financial stability, asset management and monetary policy also make it necessary for them to analyse the potential systemic implications they may have for the economy and the financial system as a whole in order to incorporate climate-change issues into their supervisory and macro-prudential practices, into the portfolio management of their own portfolios, and, within their mandates, in their monetary policy framework. The progress made in recent years by financial markets, financial institutions and central banks has been significant although there is still a way to go.

Keywords: climate change, financial risks, financial stability, green bonds, central banks, sustainable finance.

JEL classification: G10, G20, E58, Q50.

Resumen

El cambio climático y la transición a una economía baja en carbono implican al sistema financiero mediante dos vías. Primero, por su papel de canalizador de la financiación necesaria para realizar las cuantiosas inversiones que requiere el cumplimiento del Acuerdo de París. En los últimos años se han producido avances —aún insuficientes— en el desarrollo de nuevos productos, siendo los bonos verdes el instrumento de financiación verde más avanzado. Segundo, por los riesgos financieros que el cambio climático y la transición hacia una economía de bajo carbono implican, los cuales afectan al balance de las entidades financieras y tienen, además, una naturaleza sistémica. Esto significa que las instituciones financieras han de evaluar estos riesgos y su exposición a ambos, aunque no es una tarea fácil. Todavía hay obstáculos y retos que superar, como la falta de una taxonomía completa que comprenda lo que es «verde» y lo que no lo es, la falta de información y de conocimiento de las metodologías apropiadas, y el largo e incierto horizonte temporal de estos riesgos, que exige el desarrollo de nuevas competencias y la integración de estos riesgos en el conjunto de la organización, así como la adopción de un enfoque prospectivo. Por último, las responsabilidades de los bancos centrales en materia de supervisión bancaria, estabilidad financiera, gestión de activos y política monetaria también hacen necesario analizar las posibles implicaciones sistémicas que pueden tener para la economía y el sistema financiero en su conjunto, con el fin de incorporar las cuestiones relativas al cambio climático en sus prácticas de supervisión y macroprudenciales, en la gestión de sus propias carteras y, dentro de sus mandatos, en su marco de política monetaria. Los avances realizados en los últimos años por los mercados financieros, las instituciones financieras y los bancos centrales han sido significativos, aunque todavía queda camino por recorrer.

Palabras clave: cambio climático, riesgos financieros, estabilidad financiera, bonos verdes, bancos centrales, finanzas sostenibles.

Códigos JEL: G10, G20, E58, Q50.

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1 Introduction

Currently, there is a broad consensus that global warming of more than 2°C above pre-industrial levels will have economic and social consequences of considerable importance. Since the end of the Second World War, notable changes have been occurring, characterised by a rise in the temperature of the atmosphere and oceans, a decrease in the icecap and a higher sea level, as pointed out by the Intergovernmental Panel on Climate Change (IPCC)¹ in its fifth assessment report (IPCC, 2014). According to the IPCC, we have already reached 1°C warming above pre-industrial levels (with a range between 0.8°C and 1.2°C) and all the paths considered entail an increase in temperature during the 21st century. At the current rate, warming of 1.5°C will be reached between 2030 and 2052 (IPCC, 2018) and the human influence has led to warm the atmosphere, ocean and land (IPCC, 2021). The Earth's average global surface temperatures in 2020 matched those of 2016, making the two years tied as the warmest on record (NASA, 2021).² According to ESPON Climate (2011), the countries of the south of Europe would present a higher potential impact of climate change and lesser capacity to adapt to it (see Chart 1).

To limit the temperature, it will be necessary to reduce greenhouse gas emissions through resolute and effective climate policies. The implications of climate change are broad and encompass many areas at the economic and social levels. The signature in 2015 of the Paris Agreement and the United Nations 2030 Agenda for Sustainable Development marked the starting point for countries to join forces and launch a programme of activities designed to prevent temperatures from rising more than 2°C above pre-industrial levels and move towards a fully decarbonised economy. This objective, along with that of mobilising the necessary resources, is what is driving the various institutional measures and initiatives being taken.

The transition to a low-carbon economy entails structural economic changes which affect practically all economic sectors and activities and require large-scale mobilisation of financial resources and hence the involvement of the financial sector in the flow of funds from savers to the necessary investment projects. At present there are various estimates, based on different scenarios and sector coverages, of the volume of financing needed to achieve the goal of net zero emissions by 2050. Nevertheless, most estimates show that the average global annual investment would have to exceed \$4 trillion per year over the coming decades to achieve the net-zero CO₂ emissions by 2050. Against this background, recent years have seen the development of new green financing instruments, of which green bonds are the most advanced. Since the first issue by the European Investment Bank in 2007, the market has been increasingly active since 2014, when the Green Bond Principles were published,

1 The IPCC or Intergovernmental Panel on Climate Change is a scientific body created in 1988 by the World Meteorological Organization and the United Nations Environment Programme. Its objective is to provide governments at all levels with scientific information which can be used in the development of climate policies. The analyses are conducted by hundreds of scientists who make voluntary contributions on the impact of climate change and on future risks and how they can be reduced by adaptation and mitigation initiatives.

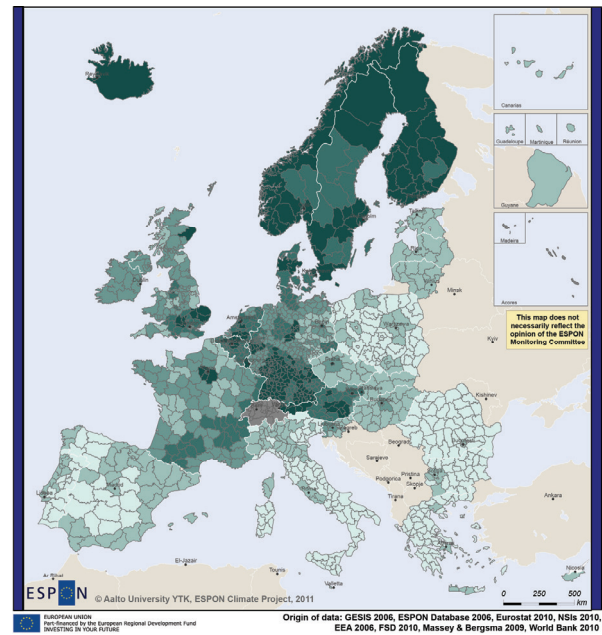
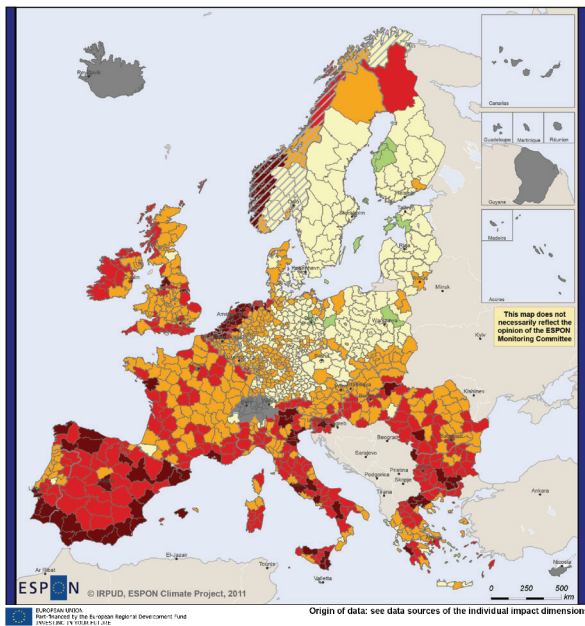
2 In the case of Spain, an analysis by the Spanish Weather Agency (AEMET, 2019) shows that the frequency and intensity of anomalous heating events have increased in the last few decades and 2020 was the warmest year in Spain where the temperature has risen 1.7 °C since pre-industrial times, and 1.3 °C in the last 60 years (AEMET, 2020).

Chart 1

POTENTIAL IMPACT OF AND CAPACITY TO ADAPT TO CLIMATE CHANGE IN EUROPE

1 AGGREGATE POTENTIAL IMPACT OF CLIMATE CHANGE (a)

2 CAPACITY TO ADAPT TO CLIMATE CHANGE (b)



SOURCE: ESPON Climate (2011).

- a Weighted combination of physical (weight 0.19), environmental (0.31), social (0.16), economic (0.24) and cultural (0.1) potential impacts of climate change. Weights are based on a Delphi survey of the ESPON Monitoring Committee. Impact calculated as combination of regional exposure to climatic changes and recent data on regional sensitivity. Climatic changes derived from comparison of 1961-1990 and 2017-2100 climate projections from the CCLM model for the IPCC SRES A1B scenario.
- b Overall adaptive capacity towards climate change classified by quintiles. The overall adaptive capacity was calculated as weighted combination of economic capacity (weight 0.21), infrastructural capacity (0.16), technological capacity (0.23), knowledge and awareness (0.23) and institutional capacity (0.17). Weights are based on a Delphi survey of the ESPON Monitoring Committee.

with a cumulative issuance over \$1.4 trillion by September 2021 and an outstanding nominal over \$1.1 trillion. Most frequent issuers are corporates, financial institutions, supranational entities and, more recently, sovereign treasuries.

Regarding climate change, financial institutions face both opportunities and risks. On the opportunity side, the channelling of funds needed for the transition represents a business opportunity. Thus banks are becoming active in the issuance of green bonds, syndicated loans and project finance, and are beginning to offer various services relating to green finance, such as the placement of issues, the opening of special facilities, assessment, valuation, etc. However, by contrast, the effects of climate change and the actions to mitigate it also pose risks for financial institutions. In the case of banks, both physical risks (those arising

from an increase in the frequency and severity of climate events) and transition risks (those linked to the transition to a low-carbon economy as a response to climate change) may take the form of credit, market and operational risks, as pointed out by the Bank of England (2018). This means that banks have to consider the risks associated with climate change and the transition to a low-carbon economy in their integrated risk management.

At the same time, central banks and supervisors are incorporating the analysis of climate change and the assessment of its risks into their work programmes. The motivation is multiple, due to the need to integrate these tasks into their micro-prudential supervisory practices and to monitor their potentially systemic nature insofar as they may affect the whole of the economy and the financial system. In addition, central banks are starting to consider ESG factors and Sustainable and Responsible Investment principles in the management of their own portfolios and planning to disclose climate related risks of their portfolios. As regards playing a more active role in promoting green finance, i.e. in the utilisation of monetary policy or macro-prudential policy instruments, central banks, particularly Western ones, are more cautious although some significant steps are starting to be taken by Bank of England and the Eurosystem. Institutional initiatives such as the creation of the *Network for Greening the Financial System* (NGFS) by central banks and supervisors, are contributing to an improved analysis allowing to incorporate environmental and climate-related issues in all these areas.

Although the last few years have seen headway in green finance, in banks' consideration of the opportunities and risks posed by climate change and the transition to a low-carbon economy and in the inclusion of these matters by central banks, the road ahead is still long. The obstacles and challenges to progress for investors, financial institutions and central banks are not insignificant. Notable among them are the lack of market information on exposures to climate change risks, the lack of common criteria for defining "green" and "carbon intensive or brown" assets,³ the lack of adequate methodologies for assessing the impact of climate change on the financial system, the fact that the time horizon of these risks is longer than the decision horizon of economic agents, etc. These obstacles, along with the lack of resolute and predictable policies, may explain the widespread observation that at present the value of assets is not being properly incorporated into climate and transition risks, and that financial resources are thus not being properly allocated. Against this background, international initiatives such as the recommendations of the *Task Force on Climate Related Financial Disclosure* (TCFD) on climate-related financial disclosures, and the work of the European Commission to develop a taxonomy and standards, are being of great help.

The purpose of this article is to briefly review the current state of Green Finance and in particular the role being played by financial institutions and central banks. To do this, in order to place the institutional arena in its financial setting, we first look at institutional commitments relating to climate change and the transition to a low-carbon economy.

³ So far, the term "brown" assets are usually used for those assets that harm the environment or don't contribute to fight against climate change, for example assets related to those activities linked to coal or fossil fuels. Lately, there is some controversy over the use of the word "brown" but a common term has not yet been reached so in this article we will use "brown" with the meaning of "carbon-intensive".

Then, in section 3, we analyse the evolution of financial instruments designed to finance this transition, basically green bonds, and, in section 4, the risks posed by climate change to the financial system and particularly to banks. Section 5 looks at how central banks are considering climate matters in the performance of their functions and the tools they have at hand to address the risks posed by climate change to the financial system. The paper ends with some conclusions.

2 Climate change and institutional commitment

The Paris Agreement, signed in 2015 by 195 countries within the United Nations Framework Convention on Climate Change, has a clear aim set out in the form of specific goals: keep the global temperature rise this century well below 2°C above pre-industrial levels, pursue efforts to limit the temperature increase to 1.5°C, increase the ability of countries to deal with the adverse effects of climate change, promote the development of low greenhouse gas emissions and foster the financing of investment to support sustainable growth. Every five years the countries have to communicate and maintain their national emission-reduction targets and, in addition, they have to set in train national policies and measures to achieve those targets. Furthermore, the implementation of the Paris agreement is essential to achieve the Sustainable Development Goals also agreed in 2015 in the United Nations 2030 Agenda for Sustainable Development.⁴

Since then, various institutional initiatives relating to the involvement of the financial system at the global and European levels have been launched.⁵ In the G20 ambit, the “G20 Green Finance Study Group” created in 2016 provided a starting point for sharing experiences at international level and for the main countries to become involved in developing measures to heighten the financial system’s sensitivity to climate change risk and interiorise it in its decision-making. This work continued in the “G20 Sustainable Finance Study Group” in 2018, where measures were proposed to increase the involvement of institutional investors in the financing of sustainable projects, sustainable initiatives in the venture capital area, and analysis of the new technologies applied in sustainable finance. In 2021, the Italian Presidency of G-20 set the digital and green economic recovery as priorities of the work and the Sustainable Finance Study Group was reactivated with the objective to develop a multi-year roadmap.

At the European level, the European Commission presented the European Green Deal at the end of 2019 with the aim of making Europe the first climate-neutral continent by 2050. It comprises several regulatory initiatives in order to achieve this goal. It comprises, among others, the development of a European Climate Law,⁶ the adoption of a European Industrial Strategy, an Action Plan for the Circular Economy, an European Union Biodiversity Strategy for 2030, and, all of this, jointly to achieve a fair transition and the need to mobilize resources to finance it.⁷ In this process, the financial sector has a key role. In September 2020, Ursula von den Leyen, in her State of the Union speech, proposed the reduction target to be set at 55%, alongside a revision of the EU’s climate and energy legislation by June 2021, a target of spending 37% of the €750 billion NextGenerationEU recovery fund on Green Deal objectives, and the intention to raise 30% of the NextGenerationEU

⁴ The 2030 Agenda defines 17 Sustainable Development Goals with 169 associated targets encompassing the economic, social and environmental areas in a 15-year strategy. Among the goals there is one devoted to “Climate Action”.

⁵ See González (2021a) for more detailed overview of the current institutional initiatives in sustainable finance.

⁶ The European Parliament approved the European Climate Law in June 2021.

⁷ See Communication (COM(2019)640) and more information in: https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_es.

budget through green bonds. In July 2021, the European Commission adopted a package of proposals to make the EU's climate, energy, land use, transport and taxation policies fit for reducing net greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels, raising the goal established in the European Green Deal of 40% emissions reduction target.

One important element of the European Green Deal designed by the European Commission (EC) is the Renewed Strategy in Sustainable Finance, launched on 6 July that will be based on the so-called “*Action Plan on Financing Sustainable Growth*” on which the EC has been working since 2018. It will contribute to the link between finance and the European Union's sustainable development agenda. Specifically, the Action Plan on Financing Sustainable Growth presented by EC in 2018 seeks to develop the European Union's strategy on sustainable finance and to integrate environmental, social and governance (ESG) matters into the European financial system.⁸ Through this Action Plan (European Commission, 2018), the EC strengthens its commitment to EU sustainability goals, linked to the Agenda 2030 Sustainable Development Goals, and the Paris Agreement climate change goals.

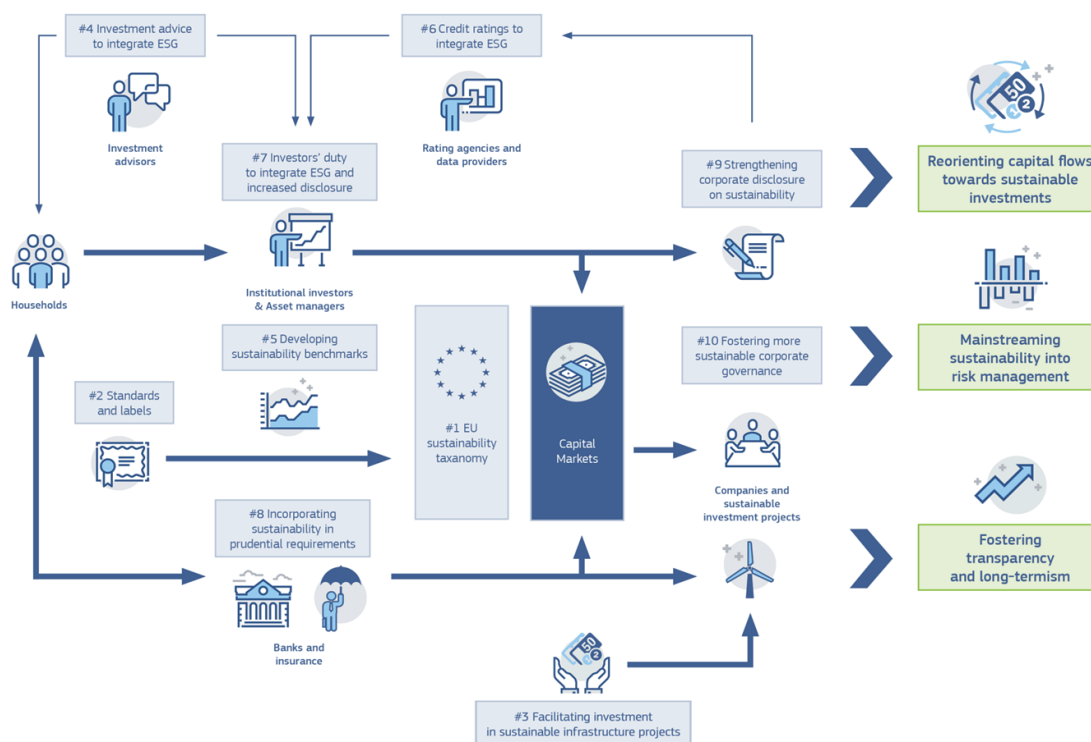
The main goals of the EC's Action Plan are: i) reorient capital flows towards sustainable investment, ii) manage financial risks stemming from climate change, environmental degradation and social issues, and iii) foster transparency and long-termism in financial and economic activity. To achieve these goals, the EC has worked on ten specific actions, as are shown in Figure 1.

In 2018 the European Commission created a Technical Expert Group on Sustainable Finance (TEG) to provide support in four actions of the Action Plan: i) a classification to determine whether an economic activity is environmentally sustainable (known as taxonomy), ii) methodologies for developing EU climate benchmarks and iii) guidance to improve corporate disclosure of climate-related information, iv) an EU Green Bond Standard. The TEG published its work on these four topics between 2018 and 2020 and they have been the input for the work of the EC. Specifically, the EC has drawn up several regulations and texts about the first three issues. The taxonomy regulation is the first action of the Action Plan and constitutes a classification system of environmentally sustainable economic activities. It was approved in June 2020, entering into force in July 2020. The Taxonomy Regulation establishes the criteria for determining whether an economic activity qualifies as environmentally sustainable, that is mainly when it contributes substantially to one or more of the environmental objectives set by the regulation, it does not significantly harm any of the environmental objectives, it is carried out in compliance with the minimum safeguards and it complies with technical screening criteria that have been established by the Commission. Specifically, the six environmental objectives set are: i) climate change mitigation, ii) climate change adaptation, iii) the sustainable use and protection of water and marine resources, iv) the transition to a circular economy, v) pollution prevention and control, vi) the protection

⁸ The Action Plan defines “sustainable finance” as the process of taking due account of environmental and social considerations in investment decision-making, leading to increased investments in longer-term and sustainable activities. More specifically, environmental considerations refer to climate change mitigation and adaptation, as well as the environment in a broader sense and related risks (e.g. natural disasters).

Figure 1

GOALS AND ACTIONS OF THE EC'S ACTION PLAN ON FINANCING SUSTAINABLE GROWTH



SOURCE: European Commission (2018).

and restoration of biodiversity and ecosystems.⁹ The European Commission is working on the development of the technical criteria for each of the six environmental objectives.

With the aim to increase the transparency and disclosure, the EC developed, based on the work of the TEG, a specific regulation with the minimum standards for the elaboration of EU climate transition benchmarks and EU Paris-aligned benchmarks¹⁰ and new guidelines for companies on how to report climate-related information. The latter consist of a supplement to the existing guidelines on non-financial reporting and integrate the recommendations of the Financial Stability Board's taskforce on climate-related financial disclosures (TCFD).¹¹ In addition, the regulation on sustainability related disclosures in the financial sector services became effective in March 2021 and imposes sustainability-related disclosure requirements of financial market participants and financial advisers.¹² And in April 2021, the EC adopted

⁹ See European Commission (2020).

¹⁰ See Commission Delegated Regulation (EU) 2020/1818 of 17 July 2020 supplementing Regulation (EU) 2016/1011 of the European Parliament and of the Council as regards minimum standards for EU Climate Transition Benchmarks and EU Paris-aligned Benchmarks.

¹¹ See Communication from the Commission Guidelines on non-financial reporting: Supplement on reporting climate-related information (2019/C 209/01).

¹² Regulation (EU) 2019/2088 of the European Parliament and of the Council of 27 November 2019 on sustainability-related disclosures in the financial services sector.

a proposal for a Corporate Sustainability Reporting Directive (CSRD), which would amend the existing reporting requirements of the Non-Financial Reporting Directive (NFRD). The proposal extends the scope to all large companies and all companies listed on regulated markets (except listed micro-enterprises), requires the audit of reported information, introduces more detailed reporting requirements, and a requirement to report according to mandatory EU sustainability reporting standards.¹³ Moreover, the EC adopted a delegated act under the Taxonomy Regulation in July 2021 specifying the information to be disclosed by financial and non-financial undertakings concerning their environmental performance based on the EU Taxonomy and will apply from January 2022.

Regarding the development of a European green bond standard, the EC published a legislative proposal in July 2021. This standard will be voluntary and the main key requirements of this proposed framework are: taxonomy alignment, transparency, external review and supervision by the European Securities Market Authority (ESMA) reviewer.¹⁴

The role of the TEG continues through the Platform on Sustainable Finance created by EC in December 2020 composed of experts from the private and public sector that will advise the EC on the technical screening criteria of the six environmental objectives of the taxonomy, as well as, the possible development of the taxonomy to other activities that significantly harm the environment or the development of a social taxonomy.¹⁵ In addition, the Platform will monitor and report on capital flows towards sustainable investments and will advise the Commission on sustainable finance policy more broadly.

Building on the work done in the last years under the Action Plan on Sustainable Finance, and in the framework of the European Green Deal, the EC is developing a Renewed Sustainable Finance Strategy with the aim of creating an enabling framework for private investors and the public sector to facilitate sustainable investments. In July 2021 the EC presented the *“Strategy for Financing the Transition to a Sustainable Economy”*¹⁶ that identifies four main areas where the actions are needed to focus and six specific actions as can be seen in Table 1. This strategy also complements other European Green Deal initiatives and the Fit for 55 Package presented in 2021 to make the EU’s climate, energy, land use, transport and taxation policies fit for reducing net greenhouse gas emissions by at least 55% by 2030, compared to 1990 levels.

In terms of financing, the Commission presented in January 2020 the European green deal investment plan as part of the Green Deal, which will mobilise at least 1 trillion euros

13 Expected to apply from 2023. See Proposal for a Directive of the European Parliament and of the Council amending Directive 2013/34/EU, Directive 2004/109/EC, Directive 2006/43/EC and Regulation (EU) No 537/2014, as regards corporate sustainability reporting.

14 See Press release “Commission puts forward new strategy to make the EU’s financial system more sustainable and proposes new European Green Bond Standard” https://ec.europa.eu/commission/presscorner/detail/en/ip_21_3405.

15 The Platform published two draft reports on social taxonomy and on an extended taxonomy to support economic transition in July 2021. The Platform will collect the stakeholder feedback on both drafts in order to submit final reports with their advice to the Commission in autumn 2021.

16 See Communication from the Commission to the European Parliament, The Council, The European Economic and Social Committee and The Committee of the Regions Empty Strategy for Financing the Transition to a Sustainable Economy.

Table 1

OBJECTIVES AND ACTIONS OF THE RENEWED SUSTAINABLE FINANCE STRATEGY

I Financing the transition of the real economy towards sustainability	
Action 1: To develop a more comprehensive framework and help the financing of intermediary steps towards sustainability	<p>The Commission will:</p> <ul style="list-style-type: none"> a Consider proposing legislation to support the financing of certain economic activities, mainly in the energy sector, that help to reduce greenhouse gas emissions b Consider options for extending the EU Taxonomy framework to possibly recognise economic activities performing at an intermediate level c Adopt a Complementary EU Taxonomy Climate Delegated Act covering new sectors including agriculture and certain energy activities d Adopt a delegated act under the EU Taxonomy covering the remaining four environmental goals, i.e. water, biodiversity, pollution prevention and circular economy by Q2-2022 e Consider a general framework for labels for financial instruments, work on other bond labels such as transition or sustainability-link bonds, an ESG Benchmark label, minimum sustainability criteria for financial products that promote environmental or social characteristics and introduce targeted prospectus disclosures
II Towards a more inclusive sustainable finance framework	
Action 2: To improve the inclusiveness of sustainable finance	<p>The Commission will:</p> <ul style="list-style-type: none"> a Ask the EBA for an opinion on the definition of and support for green loans and mortgages, explore options to facilitate their uptake by 2022, and increase access of citizens and SMEs to sustainable finance advisory services b Integrate sustainable finance related data in the data spaces under the European Data Strategy and reflect, together with the Digital Finance Platform, on possible further actions to enable and encourage innovative solutions using digital technologies to support SMEs and retail investors c Identify insurance protection gaps through EIOPA's natural disaster dashboard and initiate a Climate Resilience Dialogue with all relevant stakeholders (2022) d Publish a report on a social taxonomy by the end of 2021 e Strengthen tracking methodologies for climate and biodiversity spending, support Member States who want to redirect their national budget to green priorities and organise an inaugural annual Sustainable Investment Summit ahead of COP 26
III Improving the financial sector's resilience and contribution to sustainability: the double materiality perspective	
Action 3: To enhance economic and financial resilience to sustainability risks	<p>The Commission will:</p> <ul style="list-style-type: none"> a Work with EFRAG, ESMA and the IASB on how financial reporting standards can best capture relevant sustainability risks b Take action to ensure that relevant ESG risks are systematically captured in credit ratings and rating outlooks in a transparent manner, taking into account further assessment by ESMA (2023) c Propose amendments in the Capital Requirements Regulation and Capital Requirements Directive to ensure the consistent integration of sustainability risks in risk management systems of banks, including climate change stress tests by banks (2021) d Propose amendments in the Solvency II Directive to consistently integrate sustainability risks in risk management of insurers, including climate change scenario analysis by insurers (2021) e Strengthen long-term financial stability through closer cooperation on financial stability risk assessment, regular stress tests, an assessment of macro-prudential tools and a study dedicated to risks stemming from environmental degradation and biodiversity loss

SOURCE: European Commission (2021).

Table 1

OBJECTIVES AND ACTIONS OF THE RENEWED SUSTAINABLE FINANCE STRATEGY (cont'd)**III Improving the financial sector's resilience and contribution to sustainability: the double materiality perspective**

Action 4: To increase the contribution of the financial sector to sustainability

The Commission will:

- a Improve financial institutions' disclosures of sustainability targets and transition planning, examine to what extent more guidance could ensure that voluntary pledges are credible and monitor progress
- b Ask EIOPA to assess the need to review the fiduciary duties of pension funds and investors to reflect sustainability impacts as part of investment decision making processes, including stewardship and engagement activities by 2022
- c Take action to improve the reliability and comparability of ESG ratings and further assess certain aspects of ESG research, to decide on whether an intervention is necessary

Action 5: To monitor an orderly transition and ensure the integrity of the EU financial system

The Commission will:

- a Monitor greenwashing risks, and assess and review the current supervisory and enforcement toolkit available to Competent Authorities, to ensure that supervisory powers, capabilities and obligations are fit for purpose, with the support of the European Supervisory Authorities
- b Develop a robust monitoring framework to measure capital flows and assist Member States in assessing the investment gap and measuring the progress made by their financial sectors by 2023
- c Strengthen cooperation among all relevant public authorities, including Member States, the ECB, the ESRB, the European Supervisory Authorities and the European Environment Agency, to work towards a common approach to monitor an orderly transition and ensure the double materiality perspective is consistently integrated across the EU financial system (by 2022)
- d Establish a Sustainable Finance Research Forum to foster knowledge exchange between researchers and the financial community

IV Fostering global ambition

Action 6: To set a high level of ambition in developing international sustainable finance initiatives and standards and to support EU partner countries.

The Commission will:

- a Seek an ambitious consensus in international forums, mainstream the concept of double materiality, stress the importance of disclosure frameworks, and agree on objectives and principles for taxonomies
- b Propose to expand the work of the IPSF to new topics and strengthen its governance
- c Support low- and middle-income countries in scaling up their access to sustainable finance by developing a comprehensive strategy and by promoting sustainability-related financial instruments.

SOURCE: European Commission (2021).

of sustainable investments over the next decade. Reaching the 2030 climate and energy targets would require additional investments of approximately €260 billion a year by 2030.¹⁷ Moreover, in a context of recovery from the COVID-19 crisis, the EU adapted its long-term budget to prioritise actions for the recovery and resilience that includes to support a green and digital transition. Next Generation EU (NGEU) is the temporary programme with which

¹⁷ The figure of investment is referred to the objective of a 40% cuts in greenhouse gas emissions from 1990 levels in set in the European Green Deal (presented in December 2019), however this goal has been updated in the "Fit for 55" increasing the reduction up to a 55% reduction in net greenhouse gas emissions by 2030.

the EC will borrow €750 billion on the financial markets, of which the 30% will be through the issuance of green bonds. The funds of the NGEU will be channelled through EU programmes and the 37% of the NGEU will be spent directly on the EU Green Deal objectives.¹⁸

In Spain, the Ministry for Ecological Transition and the Demographic Challenge presented in 2019 the Strategic Energy and Climate Framework to facilitate the transformation of the economy based on three pillars: the *Plan Nacional Integrado de Energía y Clima* (Integrated National Energy and Climate Plan – PNIEC by its Spanish abbreviation) 2021-2030, the Climate Change and Energy Transition Act¹⁹, and the *Estrategia de Transición Justa*²⁰ (Fair Transition Strategy) with the ultimate long-term goal to transform Spain into a carbon-neutral country by 2050 (see Miteco (2020)). The Ministry estimates that in the coming decade this framework will mobilise around €241,000 million of private and public investment in Spain between 2021 and 2030.

As regards the financial sector, the Climate Change and Energy Transition Act, passed in May 2021, its article 32 is devoted to the financial sector stipulating that companies issuing securities, credit institutions, insurance companies and firms above a certain size will have to provide a higher level of detail about the financial impact of their risks associated with climate change through an annual report. In the case of credit institutions, they will have to publish specific decarbonization targets for their lending and investment portfolio aligned with the Paris Agreement as of 2023. The law includes the main areas that will have to be disclosed, about governance, strategy, real and potential impact of the risks and opportunities linked to climate change, risk management and assessment but the specific details will be legally developed in the next two years. Furthermore, in article 33 it is specified that the Banco de España, the *Comisión Nacional del Mercado de Valores* (Spanish National Securities Market Commission) and the *Dirección General de Seguros y Fondos de Pensiones* (Directorate General of Insurance and Pension Funds) have to prepare a joint report with the assessment of the climate change risks to the financial system and the proposal of policies for combating them.

As can be seen, there is currently a resolute institutional commitment to contribute to reducing the impact of climate change and to move towards a low-carbon economy. Achieving it will call for the mobilization of resources and the financial sector is indispensable for doing this.

¹⁸ See Ursula von der Leyen, Speech State of the Union Address, 16 September 2020, https://ec.europa.eu/commission/presscorner/detail/en/ip_20_1657.

¹⁹ The Climate Change and Energy Transition Act was approved in May 2021 and constitutes the legislative framework for consolidating the strategy in diverse sectors and thus fostering the energy transition.

²⁰ The Fair Transition Strategy aims to facilitate the transition in those sectors and geographical areas which may be most strongly affected by the transition to a more sustainable economic model.

3 Financing the transition to a low-carbon economy

Achieving the goals of the Paris Agreement and, in general, completing the measures designed to mitigate the effects of climate change will require far-reaching structural economic changes affecting practically all economic sectors and activities, particularly energy, extractive industries, transport, water treatment, waste treatment, infrastructure and residential construction. These economic changes will naturally entail considerable mobilisation of financial resources from some sectors to others and substantial additional investment. Hence the involvement of the financial system in achieving a decarbonised economy is absolutely necessary.

There are various estimates on the funds needed to achieve the goal of keeping temperatures less than 2°C above pre-industrial levels. Thus, the International Energy Agency estimates that the current average of \$2 trillion per year of global energy investment will have to raise to almost \$5 trillion (4.5% of GDP) by 2030 and to \$4.5 trillion (2.5% of GDP) by 2050, in order to achieve net-zero CO₂ emissions in 2050.²¹ IRENA (International Renewable Energy Agency) calculates that, on average, an investment of \$4.4 trillion would be needed annually over the period 2021-2050 (more than double the level of investment in 2019 of \$2.1 trillion), to limit global warming to 1.5°C²² and Bloomberg New Energy Finance (BNEF) estimates average investment requirements to be between \$3.1 trillion and \$5.8 trillion per year until 2050.²³ These estimates are made under different scenarios, methodologies and sector coverages, but, the available estimates make it clear that an average amount of above \$4 trillion must be invested every year in the coming decades to achieve a low-carbon economy. For the European Union, the European Commission estimates that to achieve greenhouse gas emission reduction of 55%²⁴ by 2030 would require €350 billion of additional investment per year with respect the average annual investment of the last decade.²⁵

The transition to a low-carbon economy requires resolute action by the public sector in policies, investments and resources, but the financing of these investments also unquestionably requires the action of the private sector and the involvement of financial institutions in channelling funds from savers to fund-seekers through multiple financing instruments. To date the progress, as will be seen below, is substantial but still insufficient, with green bonds being the most commonly used financing instrument.

3.1 Green bonds

A green bond is a bond in which the funds are used to finance projects directly relating to sustainability, the preservation of natural environments and the transition to a low-carbon

21 By sector, much of this investment will go to transport, electricity generation and infrastructure. Figures are using 2019 prices. See IEA (2021) and Lenaerts *et al.* (2021).

22 See IRENA (2021) and Lenaerts *et al.* (2021).

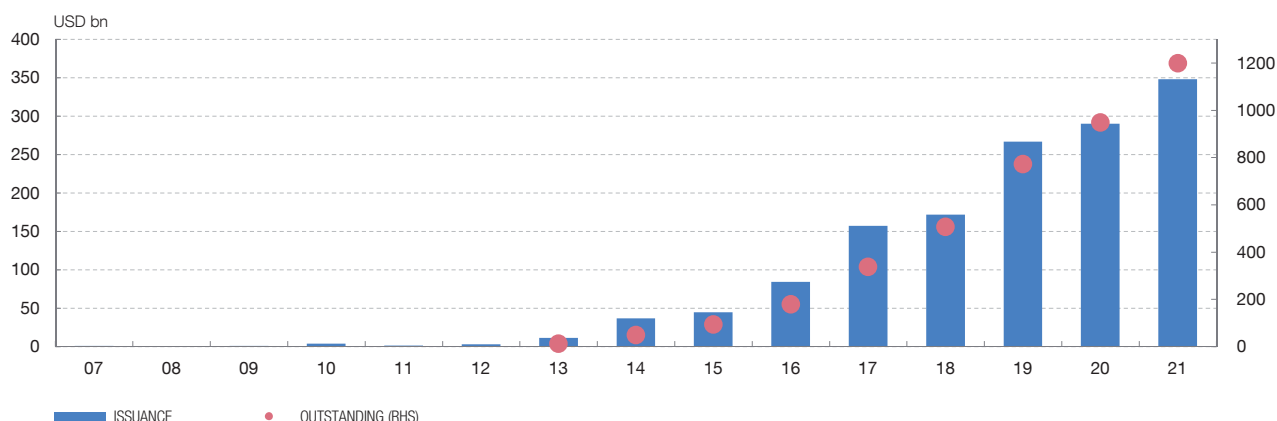
23 See Lenaerts *et al.* (2021).

24 The target of 40% greenhouse gas reduction by 2030 has been updated under the new package "Fit 55" presented by the European Commission in July 2021. The new objective is to reduce net greenhouse gas emissions by at least 55% by 2030.

25 See European Commission (2021) and Lenaerts *et al.* (2021).

Chart 2

GREEN BOND ISSUANCE AND OUTSTANDING VOLUMES (2007-2021) (a)



SOURCE: CBI (since 2014) & Dealogic.

a Up to September 2021 (provisional figures).

economy. To receive certification as a green bond, a bond has to meet certain principles (e.g. the *Green Bond Principles* or GBP),²⁶ under which the issuer has to identify in detail the activity to be financed and allocate it to an eligible category,²⁷ quantify the impact, inform about the management of the proceeds, the process for project evaluation and selection and regularly report about the status of the project. Generally, in order to avoid “greenwashing” i.e. fraudulent declaration as green, an external assessor²⁸ certifies that the principles declared by the issuer are being faithfully observed. Additionally, the bond can be certified by a certifier such Climate Bonds Initiative (CBI).

Chart 2, which describes the development of green bond issuance, shows that the issuance of these instruments has grown considerably from 2014, when the GBP were published, with a cumulative issuance up to September 2021 over \$1.4 trillion and an outstanding nominal over \$1.2 trillion.²⁹ The COVID-19 outbreak had a substantial impact in most financial markets, and the green bond segment was not an exception. Thus, in the first half of 2020 green bond issuance dropped by 22% with respect to H1 2019, being the fall

²⁶ The Green Bond Principles were drawn up by ICMA in 2014 and are generally updated once a year to include the latest market developments (see ICMA (2018)). Other principles or standards are those established by the Climate Bond Initiative or CBI (see CBI (2019)). Some jurisdictions, such as China, have set their own standards. The rating agencies have also prepared criteria to assess the “greenness” of issues targeted at potentially green projects (and to take account of matters relating to climate change in their ratings of financial institutions and non-financial corporations). As it has been mentioned in section 2, the EC is working on a proposal of a European green bond standard (EUGBS).

²⁷ For example: renewable energy, energy efficiency, reduction of polluting emissions, sustainable mobility, conservation of biodiversity, recycling technology and construction of sustainable buildings.

²⁸ For example, Cicero, Sustainalytics, Vigeo Eiris and others. Currently more than 80% of green bonds have an external assessor. See Alonso and Marqués (2019) for a panorama of new sustainable financial service providers.

²⁹ Figures for green bonds in this section are obtained from CBI database and may not exactly match other sources. CBI includes bonds in its database only if they meet certain criteria, such as that at least 95% of the proceeds go to finance green projects that meet CBI taxonomy. Figures for September 2021 are provisional.

general across types of issuers and regions, with the exception of LatAm driven by the Chilean Treasury issuance. In contrast, issuance of sustainability and social bonds more than doubled in H12020 with respect H12019, and total issuance in 2020 increased from \$64 billion in 2019 to \$235 billion,³⁰ with a large portion of the proceeds used to finance COVID-19 response measures.³¹ Green bond primary market activity recovered during the second half of 2020, and issuance for the whole year reached \$290 billion, an 8% higher than 2019 issuance. In this recovery of the green market, the statements made by governments and regulators on giving a green and sustainable orientation to measures supporting stabilisation and recovery of the economy played, certainly, a role. Against this background, sustainable bonds issuance has been even more dynamic during the first half of 2021, with an issuance of \$245 billion in green bonds, \$139 billion in social bonds, \$89 billion in sustainability bonds and \$43 billion of Sustainable linked bonds (SLB).³²

The first green bond issue was issued by the European Investment Bank in 2007 for an amount of €600 million. In subsequent years, green bond issuance was dominated by international financial institutions (the EIB itself, the World Bank, the International Finance Corporation, the IMF and development banks). From 2014, coinciding with the publication of the ICMA Green Bond principles (GBP), an increasingly active role has been played by banks, large firms, municipal corporations, government agencies and treasuries. As Chart 3 describes, non-financial corporates are the largest issuers, with a cumulative issuance since 2013 to H1 2021 of \$323 billion, being the main issuers energy, transport and real state corporations. Non-financial corporates are followed first by financial institutions with a cumulative issuance of \$266, mainly banks, second by government-back entities, with \$199 billion, and third by development banks (including supranational entities) with \$172.

The first treasury to issue green bonds was that of Poland in December 2016 with an issue of €750 million, closely followed by the French treasury, which issued €2 billion in January 2017. Since then, and up to 2020, other fifteen treasuries such as those of Germany, Sweden, Netherlands, Belgium, Lithuania, Ireland, Indonesia and the Netherlands have made green issuances totalling approximately \$86 billion up to December 2020 (see Chart 4). Sovereign issuance is increasing significantly in 2021, with an issuance up to September of \$57 billion and , Italy, Spain, Serbia and United Kingdom entering the green bond market.³³ The EU have announced that it will start a €250 billion green bond program over the next five years in October 2021.

³⁰ See IFF (2021). These figures include Sustainability bonds, Social bonds and Sustainability-linked bonds. A Sustainability Bond is defined as a bond which proceeds are applied to environmentally sustainable outcome, a combination of both green and social projects. For Social bonds the proceeds are applied towards social projects, like promoting social welfare (health, education, support of SMEs, etc.) and creating a positive impact within communities. A Sustainability-Linked Bonds ("SLBs") is any type of bond for which the financial and/or structural characteristics can vary depending on whether the issuer achieves predefined Sustainability/ ESG objective.

³¹ See CBI (2020).

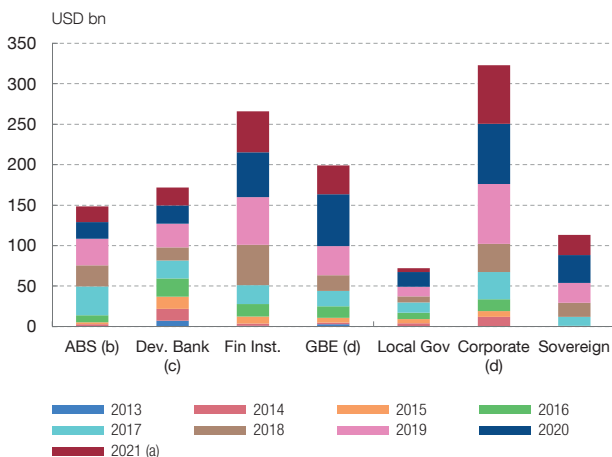
³² Issuance of green bonds in Q3 2021 continuous to be very dynamic, particularly in September. From July to mid-September, green bond issuance has exceeded \$107 billion.

³³ Italy issued a €8.5 billion inaugural green bond in March 3, 2021 with a maturity of 24 years and an order book of €80 billion. Spain launched its inaugural green bond in September 7, 2021, with a volume of €5 billion a maturity of 20 years and an oversubscription multiplied by 12. Serbia issued its first sovereign green bond in September 17, 2021 raising €1 billion. UK has issued its first green bond in September 21, 2021 with a volume of £10 billion and an order book of over £90 billion.

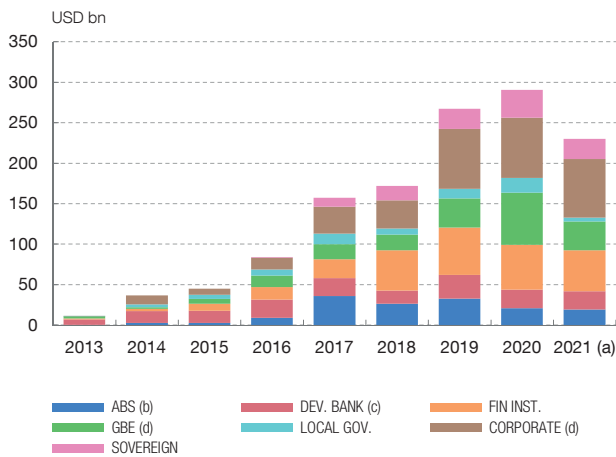
Chart 3

ISSUANCE BY TYPE OF ISSUER AND YEAR

1 BY TYPE OF ISSUER AND YEAR



2 BY YEAR AND TYPE OF ISSUER

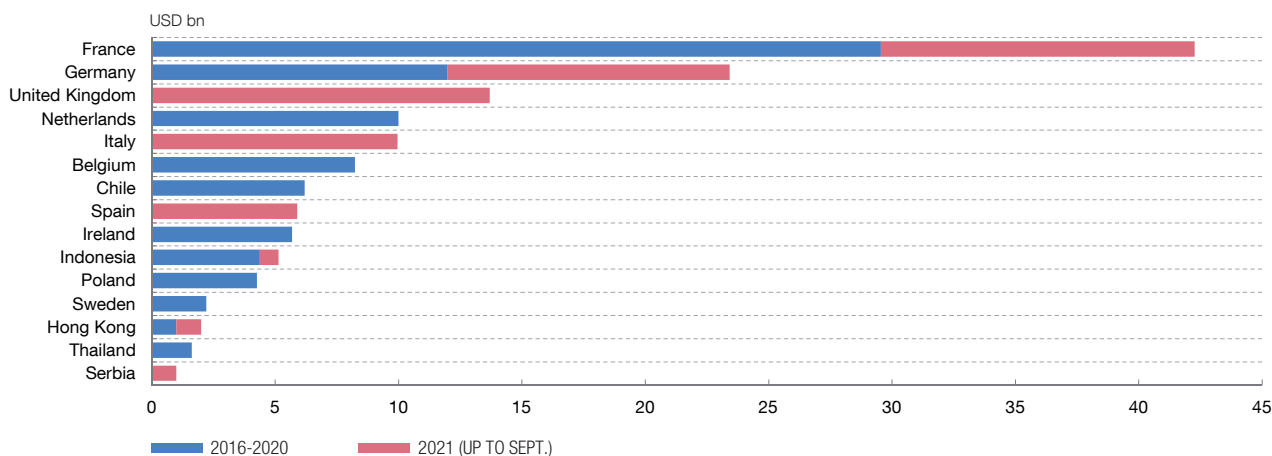


SOURCES: CBI & DEALOGIC.

- a Up to H1 2021.
- b Includes Supranationals.
- c Asset backed securities.
- d GBE: Government-backed Entitie (agencies & state owned enterprises).

Chart 4

GREEN BOND SOVEREIGN ISSUANCE (a)



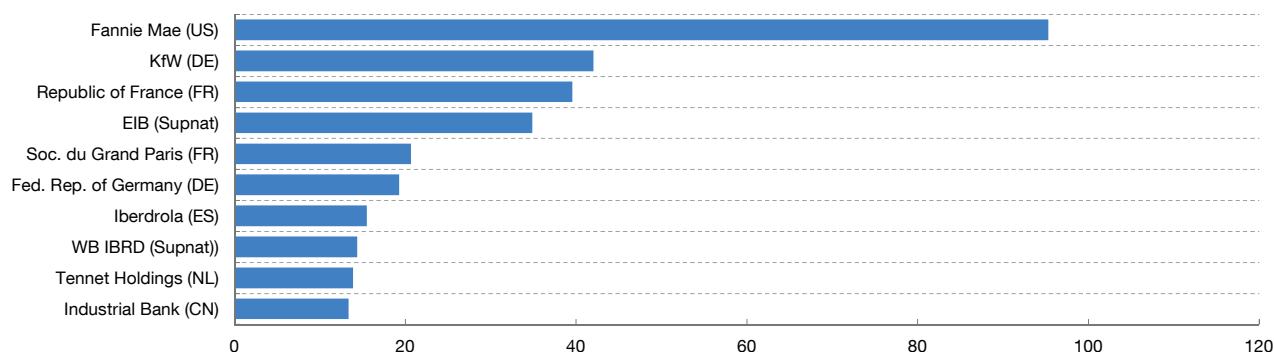
SOURCE: CBI.

- a Egypt, Hungary, Lithuania, Nigeria, Fiji, Ghana and Seychelles, all of them with an issuance below \$1bn, are omitted in the graph.

The issuances shown in Charts 2, 3, and 4 include a wide range of bond types such as straight bonds, subordinated bonds, covered bonds, Islamic bonds, asset-backed securities. Among these instruments, straight bonds are the most common, accounting for more than 40% of green bond issuance, followed by asset-backed securities (11.4% of cumulative issuance) and, with some distance, covered bonds. Notable regarding the issuance

Chart 5

TOP TEN ISSUERS (2013-H1 2021)



SOURCE: CBI.

of green asset-backed securities (ABS) is the role played by the US government-sponsored agency Fannie Mae, issuing securitises backed by mortgages meeting certain energy efficiency conditions for the purpose of refinancing them. Since 2013, and up to June 2021, this agency has issued \$96 billion of green asset-backed securities, 7.4% of total cumulative issuance, leading the ranking of individual issuers (see Chart 5), although in 2020 its issuance dropped substantially, a 43%, mostly during the first half of the year as a consequence of Covid 19 pandemic effect. The second largest issuer is the German development bank KfW, followed very closely by French Treasury and EIB. All together, these ten top issuers represent 26% of total accumulative issuance, among them there are two French issuers, two German, two Supranational, one from Spain, one from Netherlands and one Chinese. Only two of them are private corporations, coming from the energy sector: Iberdrola (Spanish) and Tennet Holdings (Dutch).

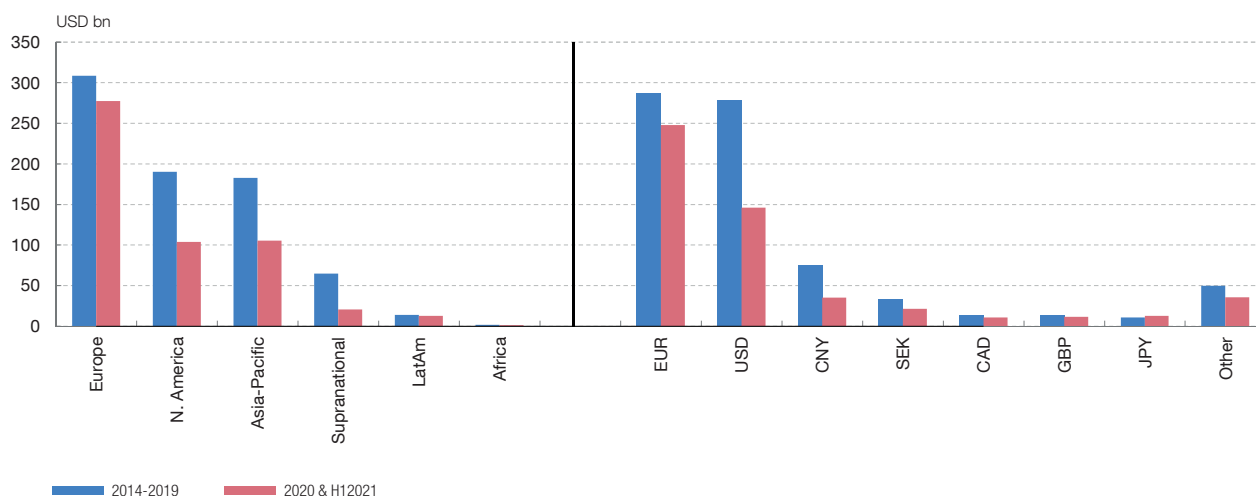
Issuance by currency shows the predominant and increasing role played by Euro (see Chart 6), with a 38% share for the period 2014-2019 and of 48% for period 2020-H1 2021. Euro is followed by USD, with a share of 37% for 2014-2019 that have decreased to 28% for 2020-H1 2021. USD is followed, at a long distance, by CNY, with an 10% of share in 2014-2019 and of 7% in 2020-H1 2021. The fall in USD share was partly due to lower Fannie Mae issuance in 2020, whereas the decline in CNY is explained by the general weaker activity of Chinese issuers during 2020.

Regional analysis shows that most issuances are in Europe (see Chart 6), with 46% of them in the period 2014-H1 2021 and an increasing trend in the share (53% in 2020-H1 2021). Next comes North America, with 23% (and a decreasing trend), followed closely by the Asia-Pacific region with 22.5%. Issuances by Supranational institutions for the aforementioned period amount to \$85 billion, representing 7% of total issues.

By country, the main issuer is the USA (with \$261 billion since 2014 and up to H1 2021), with ABS (promoted by Fannie Mae) and Local Governments being the main type of

Chart 6

ISSUANCE BY REGION AND CURRENCY (2014-H1 2021)



SOURCE: CBI.

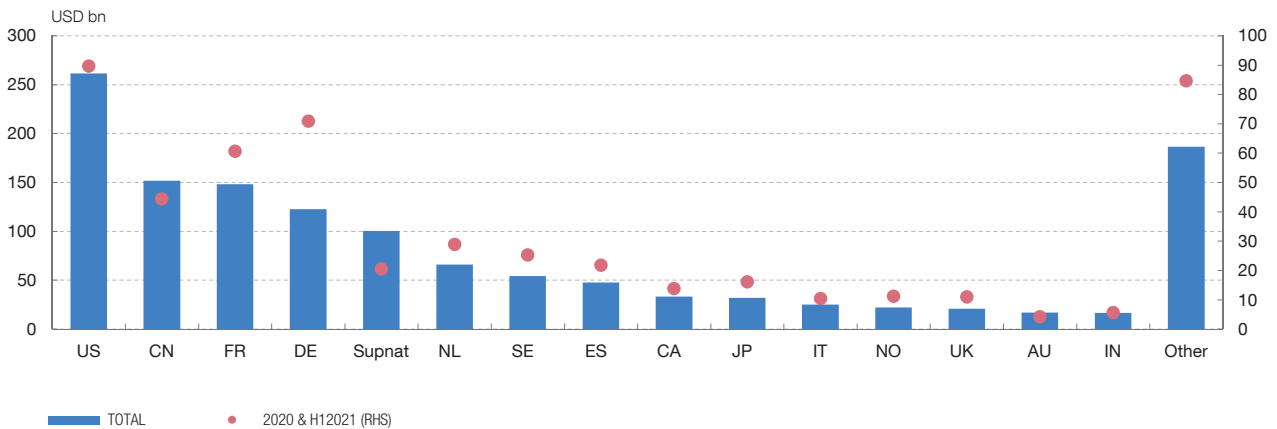
issuers, having a combined share of around 70%. The USA is followed by China (\$152 billion), France with \$148 billion and Germany with \$122 billion. Spain ranks eighth with issuance of \$47 billion (see Chart 7) and fifth country in Europe. 2020-H1 2021 ranking shows some changes, with Germany, that increased its issuance significantly, ranking second, France third, China falling to the fourth position and Supranational entities to eight. Spain ranks seventh in this period and fifth in 2021.

The first Spanish green bond issuer was Iberdrola in 2014 with a €750 million green bond. From 2014 to September 2021, a total of \$50 billion was issued, the main issuer being Iberdrola, with \$15 billion (see Chart 8). To date, Spanish issuers have been mainly non-financial corporations, with a share of 52%, followed, by financial institutions (27%), Spanish Treasury (11.8%) and Government-backed entities (Adif and ICO) with a share of 9%. From January to September 2021, Spanish issuers have issued a total of \$16.8 billion, including the first Spanish sovereign bond issued in September 2021 with a nominal value of €5 billion (\$5.9 billion).

Stock Exchanges have played, and will continue to play, an important role in scaling up the green bond market by facilitating liquidity, transparency and market integrity. The first stock exchange to create a dedicated green bond segment was the Oslo Stock Exchange. Today, there are 22 exchanges with green bond sections, being the most popular the Luxembourg Stock Exchange, followed by Euronext Paris, Luxembourg Green Exchange and Frankfurt. Also, since 2014, several green bond Indices have been launched such as Solactive Bond Green Index (the first one launched), MSCI Barclays Green Bond Index, BAML Green Bond Index, S&P Green Bond Index and China Bond China Green Bond Index. Green bond indices make it easier for investors to track the performance of

Chart 7

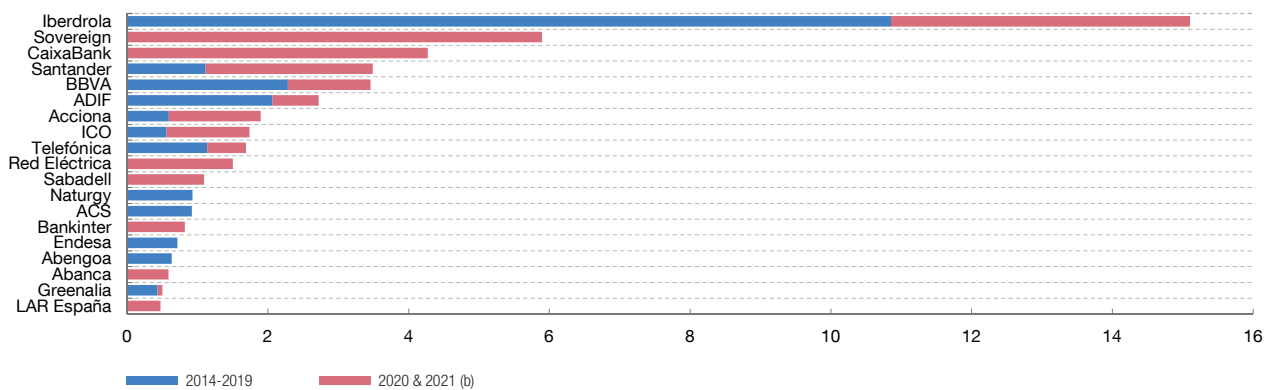
ISSUANCE BY COUNTRY (2114-H1 2021)



SOURCE: CBI.

Chart 8

ISSUANCE BY SPANISH ENTITIES (a)



SOURCE: CBI.

a Issuance by Audax, AEDAS homes, Ence, Ecoener Fotowatio, Arclight, Solaria and Grenergy, all of them below \$500 million.
 b Up to September 2021.

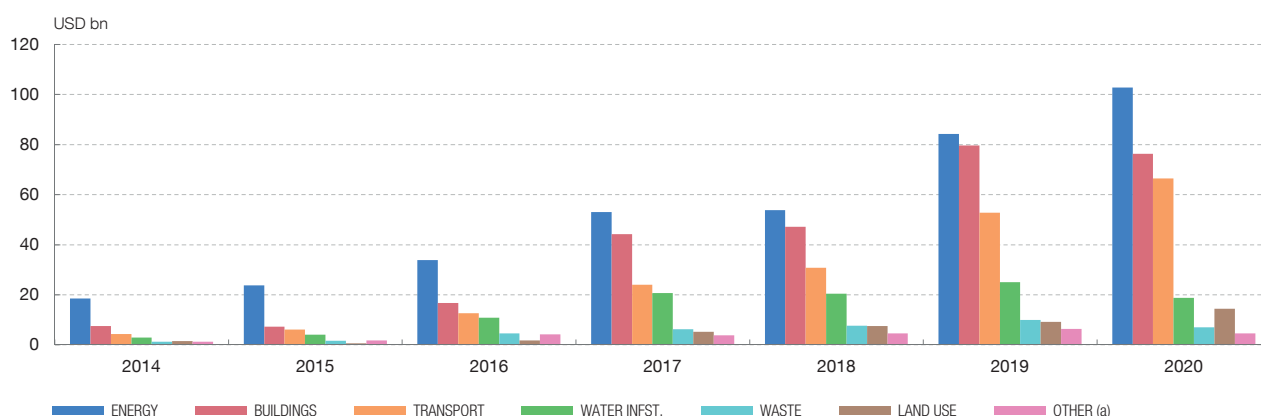
green bonds, and compare returns and volatility with other investments although currently there are multiple indices with different approaches.

Other interesting topic is the purpose of the project behind the green bond issuance. Chart 9 exhibits the use of proceeds from green bond issuance for the period 2014-2020, classified in nine broad sectors used in CBI Taxonomy.³⁴ Energy sector projects get the highest green funding, although throughout the observed period it has been losing share

³⁴ See CBI (2021).

Chart 9

USE OF PROCEEDS (2014-2020)



SOURCES: ICB.

a Include ICT, Industry and Unspecified uses.

in favour of low carbon buildings and low carbon transport (which includes infrastructure). In 2020, Energy and Transport green funding through green bonds have been resilient while low carbon buildings have experienced a slight drop.

3.2 Green bond premium?

As the green bond market has matured, academics and analysts have studied whether *green bonds* trade at a higher price than comparable conventional bonds (see Table 2), that is whether investors are willing to receive a somewhat lower yield, a green bond premium (or *greenium*) to invest in a green bond, suggesting a high demand for these bonds by investors with environmental and sustainability preferences.

Regarding issuance, Ehlers and Packer (2017) compare the issue price of 21 straight green bonds issued from 2014-2017 with that of conventional bonds from the same issuers, in order to monitor the credit risk. They conclude that, on average, green bonds are issued with yield around 18 basis points lower than that of comparable conventional bonds, although five of the 21 green bonds examined showed no advantage. The study also reports that this green bond premium (GBP) on green bonds is higher for lower-rated issuers. Fatica *et al.* (2019) also find evidence for a green bond premium when the issuer is an international financial institution (IFI) or non-financial corporation and the green bond is certified. However, if the issuer is a financial institution and not certified, the green bond premium disappears. These results indicate that the issuer’s environmental reputation and the certainty that the financing is actually for a green project are important when it comes to explaining the existence of a green bond premium. Gianfrate and Peri (2019) obtains statistically significant average greenium of around 18 basis points at issuance, being larger

Table 2

SELECTED GREEN BOND PREMIUM LITERATURE

Paper	Green Bond Premium (GBP)?
Bachelet <i>et al.</i> (2019)	GBP only if they are issued by institutional issuers (such as the World Bank) or have certification. (Data 2013-2017)
Baker <i>et al.</i> (2018)	GBP of around 6 bps on average and notably higher for certified green bonds. (US municipal green bonds - period 2016-2017)
Barclays (2015)	A greenium of 17 bps for the Global Green Bond Index with respect to the Global Credit Index
Ben Slimane <i>et al.</i> (2020)	Statistically significant overall negative premium that is greater for certain types of green bonds. When controlling for liquidity, the greenium is even higher. (Green bonds included in an the MSCI Barclays Green Bond Index)
Ehlers and Parker (2017)	Green bonds are issued with yield around 18 bps lower than comparable conventional bonds. GBP on green bonds is higher for lower-rated issuers. In the case of bond indexes, no significant difference in returns compared with conventional bonds (Data 2014-2017)
Fatica <i>et al.</i> (2019)	GBP when the issuer is an international financial institution (IFI) or non-financial corporation and the green bond is certified. If the issuer is a financial institution and not certified, the green bond premium disappears
Gianfrate and Peri (2019)	Statistically significant average GBP of around 18 bps at issuance. The premium is larger for corporate issuers (21 bps). The premium persists in the secondary market (Data 2013-2017)
Gimeno and Sols (2020)	In the case of the European Investment Bank (EIB) and Kreditanstalt für Wiederaufbau (KfW), There is no greenium at the start of the period analysed (2015-2016). Throughout 2017 (for KfW) and 2018 (for the EIB) the premiums began to be negative (in favour of green bonds versus conventional bonds) reaching 8 bps in 2019 H1. However, they diminished in 2019 H2
Hachenberg and Siereck (2018)	No appreciable GBP
Hyun <i>et al.</i> (2020)	On average, there is no robust and significant GBP, however for green bonds certified by an external reviewer they find a significant greenium of about 6 bps and for those bonds with a CBI certificate the greenium is of around 15 bps
Kaiser <i>et al.</i> (2021)	Signicant GBP of 8 bps, on average the GBP is driven by green bonds denominated in Euro, whereas USD denominated bonds yield a positive premium (9 bps). The Second Party Opinion (SPO) has no impact on the GBP when the issuer's environmental performance is high; whereas SPO has a significant impact when the issuers environmental performance is low
Kapraun and Scheins (2019)	Greenium at issuance of about 18 bps This GBP is high and significant for bonds issued by official entities such as governments or supranational, or for bonds denominated in major currencies USD or EUR. For corporate green bonds, however, additional certification of green credentials is required. For the secondary markets, the greenium increases significantly with the green credibility of the bond
Larker and Watts (2019)	No appreciable GBP
Marqués and Romo (2018)	Slight positive return for green bonds. (Green bond indices - Data 2017-2018)
Nanayakkara and Colombage (2019)	Green bonds are traded at a GBP of 63 bps, compared with a comparable corporate bond issue (Data 2016-2017)
Zerbib (2016)	GBP of around 2 bps using a sample of 110 green bonds issued between 2013 and 2017. GBP higher for lower-rated issuers

SOURCE: Own elaboration.

for corporate issuers. It persists in the secondary market. Baker *et al.* (2018) analyse the green bond premium in the issuance of US municipal green bonds for the period 2016-2017, and find a GBP of around six basis points on average and notably higher for certified green bonds. They also find that the holders of these green bonds are highly concentrated, particularly when the green bonds are certified, suggesting that the demand comes from very specific investors that hold the bonds to maturity.

In the secondary market, Zerbib (2016) estimates a green bond premium of around two basis points using a sample of 110 green bonds issued between 2013 and 2017, the GBP being higher for lower-rated issuers. Barclays (2015) estimates a *greenium* of around 17 basis points for the *Global Green Bond Index* with respect to the *Global Credit Index*. However, Hachenberg and Shiereck (2018) and Larcker and Watts (2019) did not find an appreciable green bond premium. Bachelet *et al.* (2019), using data on bonds between 2013 and 2017, conclude that green bonds are traded at a lower than those of conventional bonds only if they are issued by institutional issuers (such as the World Bank) or have certification. Gimeno and Sols (2020) find that in the case of the European Investment Bank (EIB) and KfW (German development bank), there is no greenium at the start of the period analysed (2015-2016). Throughout 2017 (for KfW) and 2018 (for the EIB) a GBP up to 8 bps is observed. Hyun *et al.* (2020) use secondary market data to compare green bonds with synthetic conventional bonds and after adjusting for liquidity they find that, on average, there is no robust and significant GBP. However, for green bonds certified by an external reviewer they find a significant greenium of about 6 bps and for those bonds with a CBI certificate, the greenium is of around 15 basis points. Kapraun and Scheins (2019) use a large data set of green and conventional bonds and find a greenium at issuance of about 18 basis points. This premium is high and significant for bonds issued by official entities such as governments or supranational, or for bonds denominated in major currencies USD or EUR. For corporate green bonds, however, additional certification of green credentials is required. For the secondary markets, they find that the greenium increases significantly with the green credibility of the bond, indicated e.g., by a listing on a green exchange, the overall environmental sentiment in the country of issue, as well as the sustainable reputation of the bond issuer.

Ben *et al.* (2020) consider green bonds included in the MSCI Barclays Green Bond Index and use two methodologies, finding in both of them a statistically significant overall negative premium that is greater for certain types of green bonds. When controlling for liquidity, the greenium is even higher. Nanayakkara and Colombage (2019) obtains that green bonds are traded at a GBP of 63 basis points compared with a comparable corporate bond issue. Kaiser *et al.* (2021), following the methodology in Zerbib (2019), obtain that there is, on average, a significant GBP of 8 bps and that Second Party Opinion (SPO) has no impact on the GBP when the issuer's environmental performance is high, while it has a significant impact on the greenium when the issuers environmental performance is low.

In the case of indices, Ehlers and Packer (2017) and Marqués and Romo (2018) use green bond indices and general bond indices to analyse the return on green bonds in comparison with ordinary bonds. Ehlers and Packer (2017) conclude that, for the period 2014-2017, green bonds do not generally yield a higher hedged return than conventional bonds,³⁵ while Marqués and Romo (2018) find for the period 2017-2018 a slight positive return for green bonds. However, the authors of both studies report that the results have to be interpreted with caution given the differing composition of green bond indices compared

³⁵ Both studies analyse the hedged returns, i.e. the proceeds in dollars that can be obtained by hedging the portfolio of the exchange rate risk index.

with those of conventional bonds as regards maturities, outstanding volume, liquidity and other non-green characteristics which may affect yield.

In short, although the results are mixed, the most recent evidence seems to favour the existence of a moderate *green bond premium*, in particular if the green bond has a certification or the issuer has credibility and ESG reputation. However, the fact that investors are willing to receive a lower return than for an ordinary bond does not mean they are attributing lower risk to green assets, since the feature of green bonds used for the studies cited in the preceding paragraphs is the issuer (i.e. the bank or IFI, or the Treasury, etc. which issued the bond) and not the green project itself. The green bond premium seems to indicate an excess demand coming from investors willing to forego some income given their investment mandates that seek green level or explicitly account for climate risks (see Zerbib (2016)). Gimeno and Sols (2020) argue and explore the possibility that, in addition to risk and return factors, certain investors incorporate a sustainability factor in their investment decisions. This is consistent with the general mispricing of climate related risks explained in next sub-section.³⁶

3.3 The broader world of sustainable finance

Not all green finance comes from green bonds, but that from other instruments such as project finance, self-finance, wholesale/syndicated loans and retail loans (of which little is known) is of a smaller amount. Chart 10 displays the **green loan market** development since 2013. The market experienced a significant growth since 2018, following the publication of the Green Loan Principles (GBPs) by the Loan Market Association, providing rules of play and guidance to the loan market. In spite of this significant growth, green bond market is still three times larger than green loan market.

As in the case of green bonds, green loans are raised most actively in mature market, mainly European market, making up more than half of the total market, followed by Asia-Pacific market. The green loan activity is very insignificant in Africa and LatAm regions. Almost 85% of the funds raised by green loans goes to investments in just five sectors: renewable energy (47%), power generation (23%), utilities (8%) and buildings (6%).³⁷

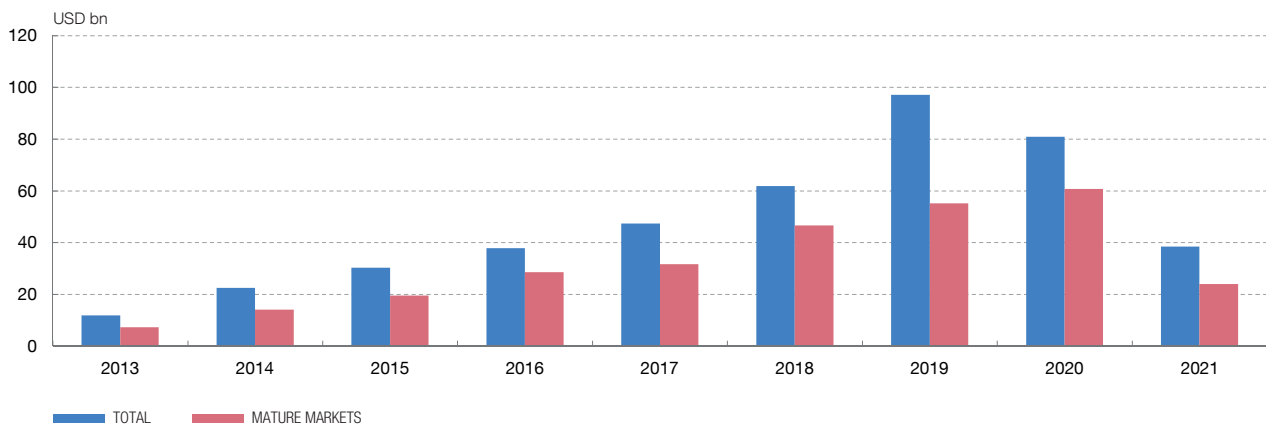
In addition to green bonds and green loans, other sustainable debt instruments such sustainability bonds, social bonds, sustainability linked bonds and sustainability linked loans are receiving an increasing attention by issuers and investors.³⁸ Chart 11 shows the development of these markets since 2013. The issuance of these instruments have risen very significantly since 2017, and particularly in 2020, with an overall increase of 152% with respect to 2019, and a share of total sustainable debt over 40%, while in 2017 this share

³⁶ See ESRB (2020).

³⁷ See Nordea (2020).

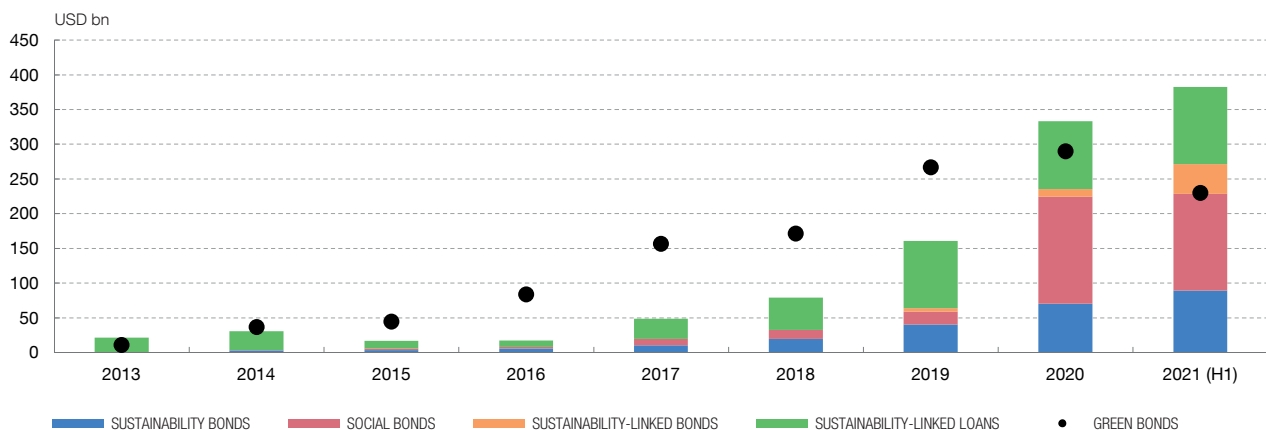
³⁸ For a definition of Social bond, Sustainability bond and Sustainability-linked bond, see footnote 30. A sustainability-linked loan (SLL) is defined as any type of loan instrument and/or contingent facility (eg bonding line, guarantee line, letter of credit) that incentivizes the borrower's achievement of ambitious, predetermined sustainability performance objectives.

Chart 10
GREEN LOANS (2013-H1 2021)



SOURCES: IIF. Sustainable Debt Monitor.

Chart 11
SUSTAINABLE DEBT (2013-H1 2021)



SOURCE: IFF. Sustainable Debt Monitor & CBI (Green bonds).

was just close to 8%. A stronger political and social awareness towards the need of a more sustainable economic growth and the need to fight inequality are forces behind this growth. First half of 2021 shows that the activity of this market is expanding even more.

In 2020, the segment of sustainable debt with more impressive growth was **social bonds**. Issuance in these bonds went from \$18 bn in 2019 to \$148 bn in 2020, with the Covid-19 crisis being a clear catalyst for this growth and, in particular, the European Union’s temporary aid program to mitigate unemployment risks in an emergency, “SURE”, which

saw €39.5 billion issued in the social bond format. In 2021, a further €50 billion have been issued under the program, totaling then €89.5 bn, very close to the total SURE fundraising planned (€94 bn). Overall market activity in the social bonds market segment has remained very active during the first half of 2021, with a total issuance of \$139 billion, close to the 2020 whole year figure. The majority of the issuers in this segment of the market come from supranational, sovereign, local or regional governments, and agencies sectors.

The market for **sustainability-linked finance** also experienced a rapid growth. In 2020, **sustainability-linked bond** issuance (SLB) almost doubled to \$11bn, and up to June 2021 the issuance is over \$40 billion. The publication of the Sustainability-linked Bond Principles in June 2020 and the announcement in September of SLB bond's eligibility for central bank collateral by the ECB starting in January 2021, have been two important drivers of this growth. An even more dynamic segment is the one of **sustainability-linked loans** (SLL), particularly since 2019, following the publication of the Sustainability-linked Loan Principles, with an activity in the first half of 2021 of \$111 billion. The format of sustainability-linked loans allows for a broader application than green loans, not requiring a definition of green assets and projects to be financed but instead allows an entity to commit to sustainability targets that are linked to the terms of the debt.

Finally, another bond segment that have emerged in the sustainable debt club are **transition bonds**. Transition bond are bonds that do not meet the criteria and market adopted standards for green bonds but which are associated with issuers who are transitioning to decarbonized business models and are particularly targeted at the high carbon-emitting sectors or industries such as mining, steel, chemicals, cement, aviation. The concept of a transition bond was developed by AXA Investment Managers in 2019. The market is still very incipient, \$2.2 billion in H1 2021, but it has some potential of growing, in particular following the publication by ICMA in December 2020 of the Climate Transition Finance Handbook. With the aim of supporting the growth of climate transition finance, the handbook seeks to provide clear guidance and common expectations to capital markets participants on the practices, actions and disclosures to be made available when raising funds in debt markets for climate transition-related purposes.

3.4 The road ahead and the challenges to overcome: informational market failures and carbon pricing

Although the issuance of green instruments has progressed notably in recent years, it has still not reached the goal of \$1 trillion per year and represents only a small part of total bond issuance (around 5%). The issuance of green instruments, and of green bonds in particular, has significant potential for growth, but to do so it has to overcome significant obstacles (see Box 2).

One of the factors hindering a further expansion of green financial markets, and therefore of green funding, is the observed mispricing of climate related risk. That is, climate risk does not seem to be fully reflected in current asset prices. In this vein, Monnin (2018a) consider that, if investors correctly reflected climate change risks in asset values, carbon-intensive assets should

have higher discount rates because they are exposed to higher risks, but this does not seem to be the case. Thus, as cited by Monnin (2018a), the Blackrock Investment Institute (2015) analyses how climate risks are reflected in the value of the shares of a wide range of sectors in the global market, and do not find any significant evidence that the securities of firms more exposed to climate change incorporate a higher risk premium. Also, if markets correctly reflected climate risks, it could also be expected that asset prices should react to news on climate risk, which also does not seem to be the case. For example, Batten *et al.* (2016) do not find any statistically significant evidence that the value of oil and gas company shares reacts to news relating to the transition to a low-carbon economy. Other studies finding evidence of incorrect valuations of climate change risks are Hong, Li and Xu (2017) and Kumar, Xing and Zhang (2018).

Taking a somewhat more optimistic view is Pereira da Silva (2019), who cites a Bank for International Settlements (BIS) research paper written by T. Ehlers, K. de Greiff and F. Packer in 2018, which examines whether climate change risks, particularly those relating to climate policy risks, are properly valued in the syndicated bank loan market and concludes that climate change risk premia have risen considerably since the Paris agreements, due to greater investor awareness of climate change. Along the same lines, some recent studies provide further evidence that investors may have started to incorporate climate change information when assessing risk profiles.³⁹

Despite this progress, there is a broad perception that climate risks remain to be mispriced in financial markets. Krueger, Sautner and Starks (2019) report, on the basis of a survey of 439 institutional investors, that investors generally consider that assets are incorrectly valued in respect of climate change, although the valuation error is considered to be slight, particularly in the securities of oil companies and traditional and electric automobile manufacturers. Also, according to a survey of investors by BNY Mellon, ninety-three percent of institutional investors view climate change as an investment risk that has yet to be priced in by all the key financial markets globally.⁴⁰

Empirical evidence suggests that there are two main factors behind this mispricing of climate risks by financial markets. First, informational market failures, and second, a failure by market participants to correctly price externalities and tail events that are beyond the historical distribution of outcomes.

Without appropriate information on the financial risks associated with climate change, it is not possible to properly factor climate change into asset valuations and avoid inefficient allocation of resources. In this line, Batten *et al.* (2016) consider that adequate public information should allow market participants to assess risks more accurately, avoid investing in firms which they consider are causing large negative externalities, and evaluate the risks associated with policies limiting the use of CO₂ emissions. This not only would

³⁹ See, for example, Ilhan *et al.* (2018) and Bolton and Kacperczyk (2020).

⁴⁰ See BNY Mellon (2020).

contribute to a better pricing of climate risks but also would facilitate an orderly transition to a low-carbon economy and would be of help for formulating efficient climate policies and for a knowledge of their impact on the stability of the financial system. The absence of common, clear and transparent definitions as well as standardized disclosures requirements are the main factors behind the informational market failures. In this context, the European regulation on “green” taxonomy⁴¹ and that on benchmark indices (see section 2), will be of a great help for investors and issuers to distinguish what is “green”.

Regarding climate-related financial disclosures, in June 2017 the TCFD (*Task Force on Climate Financial Disclosure*), a group launched by the FSB and formed by representatives of the private sector, published its recommendations on voluntary, consistent, comparable, reliable and clear information on climate-related financial risks for companies to provide information to lenders, insurers, investors and other interested parties. These recommendations are structured around four thematic areas: governance, strategy, risk management, and metrics and targets (see Box 1). As of end of September 2021, TCFD recommendations are supported by over 2,300 companies and organizations.

TCFD recommendations are serving as a global base of climate-related financial disclosure. Thus, governments and financial regulators are including the recommendations in policy and guidance and are moving toward requiring TCFD based disclosures through legislation and regulation.⁴² Additionally, investor demand for companies to report information in line with the TCFD recommendations is also growing significantly⁴³ and many large asset managers are requesting investee companies to report in line with the TCFD recommendations and reflected this in their investment practices or policies. At a more international level, the International Financial Reporting Standards Foundation (IFRS) is working, with the support of FSB and IOSCO, on establishing internationally agreed consistent, high-quality and auditable standards for disclosures for climate-related financial risks based on the TCFD recommendations.

In its last Status Report (TCFD, 2020), the TCFD recognizes the progress made both in terms of the number of companies reporting and the quality of such reporting, with an increase of 6% between 2017 and 2019 of disclosure aligned with TCFD recommendations (see Box 1). However, a significant and faster progress is still needed since here are still significant gaps between the focus of current climate reporting by many companies and the

41 Entered into force on 12 July 2020. Now the Commission will adopt delegated acts containing specific technical screening criteria to supplement the principles set out in the Regulation and determine which economic activities can qualify for each environmental objective.

42 For example, The European Commission incorporated the TCFD recommendations into its [Guidelines on Reporting Climate-Related Information](#) to support companies in disclosing climate-related information under the European Union’s reporting requirements (Directive 2014/95/EU), and the Financial Conduct Authority (UK) released a [proposal](#) for certain listed companies to state in their annual financial reports whether they made disclosures consistent with the TCFD recommendations.

43 For example, as part of Climate Action 100+ (an investor-led initiative to ensure the world’s largest corporate greenhouse gas emitters take necessary action on climate change), more than 500 investors with over \$47 trillion in assets under management are engaging the world’s largest corporate greenhouse gas emitters to strengthen their climate-related disclosures by implementing the TCFD recommendations.

information that must be synthesized to meet the TCFD recommendations. In particular, the TCFD considers that companies' disclosure of the potential financial impact of climate change on their businesses and strategies remains low. In the same line ESRB (2020) considers that disclosures remain incomplete, inconsistent and insufficient.⁴⁴

One of the reasons for the slow progress in disclosures aligned with TCFD recommendations is that they are rather challenging. Aspects that are particularly challenging for companies are identifying and quantifying the potential financial impact of climate-related issues and stress testing the resiliency of their strategies under different climate scenarios. Against this background, organizations like the World Business Council for Sustainable Development, the Climate Disclosure Standards Board, the Institute for International Finance, the United Nations Environment Programme Finance Initiative (UNEP Fi) and the TCFD itself, are giving support and guidance on implementing the TCFD recommendations. Also regulatory bodies such as European Banking Authority, European Commission and European Central Bank among others, are publishing or working on guidelines.

However, even if climate related disclosures improve and informational market failures are lessened, mispricing of climate related risks and allocative inefficiencies may persist. Given the absence of a, ideally global, consistent carbon pricing scheme that adequately captures climate change externalities, such as an increase in carbon taxes, financial markets will continue to be unable to fully reflect climate related risks, and allocate capital sub-optimally.

Lastly, it should be mentioned that a good part of the transition to a low-carbon economy will have to come from micro, small and medium-sized firms, particularly in the emerging and less developed countries. However, the lack of access to green finance by these firms is currently one of the main barriers to progress in financing a sustainable economy, since the usual difficulty of credit assessment of these micro- and small firms is compounded by the additional task of assessing the profitability of new projects. To mitigate these obstacles, many development banks and international financial institutions are developing and launching green lending programmes for small and medium-sized enterprises financed by green bond issuance, but the road ahead is still long.

⁴⁴ ESRB (2020) explains that "Incompleteness relates to the voluntary nature of current disclosures, meaning that firm disclosures of climate metrics remain partial and incomplete amid likely selection bias, and therefore not representative of the broader industrial sample of polluting firms. Inconsistency relates to the potential for so-called "greenwashing", with an inadequate accreditation for green labelled products absent a widely accepted benchmark taxonomy. Insufficiency relates mainly to the downstream emission intensity of the products of portfolios, which are rarely reported in a consistent manner."

4 Financial institutions and climate change: opportunities and risks

The transition to a low-carbon economy offers financial institutions clear business opportunities and, as a result, the green finance activities of banks are growing notably. As seen in the preceding section, financial institutions are actively issuing green bonds and syndicated loans⁴⁵ and other wholesale loans. In addition, financial institutions are offering all kinds of green finance services, such as issuance underwriting, arrangement of special facilities, advisory services, valuation, etc. According to the Risk Assessment Questionnaire conducted by the EBA in Autumn 2020,⁴⁶ more than 90% of the 60 respondent banks have developed or plan to develop green products and/or services based on environmental considerations, of which the most notable are energy-efficient mortgage loans (82% of respondent banks), followed by green commercial real estate loans (65%), green corporate non-retail loans (65%) and green car loans (48%). In addition, EBA survey reports that 58% of respondent banks have already issued some type of green or ESG financial instrument (54% of them have issued green bonds, 22% covered green bonds, 10% sustainability linked bonds, 8% green ABS and 24% other type of sustainable instrument).

4.1 Financial risks associated with climate change

The effects of climate change, and the action undertaken to mitigate them represent not only opportunities, but also risks for financial institutions, particularly insurance companies⁴⁷ and banks. The risks associated with climate change are classified in two broad categories: *physical risk* and *transition risk*.

Physical risks arise from climatic and geological events and from changes in ecosystem equilibria (G20 GFSG, 2016), and may manifest themselves suddenly (i.e. linked to a specific event such as torrential rain, hurricanes, flooding and other natural catastrophes) or manifest themselves gradually (longer-term changes in climate patterns such as, for example, a sustained increase in temperatures which may cause a rise in the sea level, chronic heatwaves or desertification). In any event, they entail physical damage to the assets of households and firms, disruptions to the supply chain or greater expenditure needed to deal with them (TCFD, 2017).

Transition risks arise from efforts to move towards a low-carbon economy as a response to climate change. Thus, changes in policies, regulations (such as CO₂ emission limits or carbon taxes), technologies and consumer preferences may prompt

⁴⁵ However, as noted by Marqués and Romo (2018), these green syndicated loans are still rare compared with syndicated loans to companies in CO₂-intensive sectors. Moreover, in the period 2009-2017, syndicated loans to oil and gas companies increased notably, although those to coal-related companies decreased. The authors conclude that this activity may be indicating that the increase in green financing by banks is still be excessively linked to a consideration of climate risk from the standpoint of corporate liability, rather than a genuine concern for this type of risk.

⁴⁶ See EBA (2021a).

⁴⁷ This paper focuses on the effects of climate change on banks, although insurance is one of the sectors most affected by it. A recent report by PwC and CSFI observes that US insurance companies consider the risks posed by climate change to be the third most important threat and that reinsurance companies consider them to be the second most important (see PwC and CSFI (2017)). In general, analysts consider the insurance sector to be ahead of the banking industry in incorporating climate-related factors into its management.

the reassessment of a wide range of assets, including those of banks and other lenders, as climate-related costs and opportunities become apparent.⁴⁸

Transition risks will be smaller if the transition is made gradually and in good time, such that the policies and regulations implemented allow an orderly shift to investment in low-carbon technologies. By contrast, if policies are introduced late and suddenly, the transition will be accompanied by a fall in the value of assets, particularly those of companies dealing with or highly dependent on the use of fossil fuels (Carney, 2015). In this respect, the Prudential Regulatory Authority of the Bank of England (BoE) warns that the window of opportunity for an orderly transition is finite and closing (Bank of England, 2018).

With the current global warming of 1°C above pre-industrial levels, some of these risks are already beginning to crystallise, so financial institutions cannot afford to ignore them. According to the IPCC (2014), the risks associated with extreme events, such as heatwaves, torrential rain and coastal flooding, are already “moderate”. Furthermore, although the transition to a low-carbon economy is a long-term process, some energy transition risks may crystallise in the short term if governments decide to implement carbon taxes or other restrictions on CO₂ emissions.

Physical and transition risks are not independent from each other: the higher the transition risk, the lower the future physical risk, and vice versa. Depending on the intensity of the policies and actions undertaken to mitigate the effects of climate change, various scenarios are possible (see figure 2). Those in which the remedial action is strong and early have a higher transition risk but lower physical risk; by contrast, in those envisaging weak remedial action, the physical risk is substantial and likely, while the transition risk is lower. Also possible are scenarios in which both risks are high, for example those envisaging remedial action that is sudden and late, when some of the physical risks are already difficult to prevent. Conversely, a timely and orderly transition could mitigate both physical and transition risks.⁴⁹

These physical and transition risks manifest themselves in the typical types of risk facing banks, i.e. credit, market, operational, etc. risks.

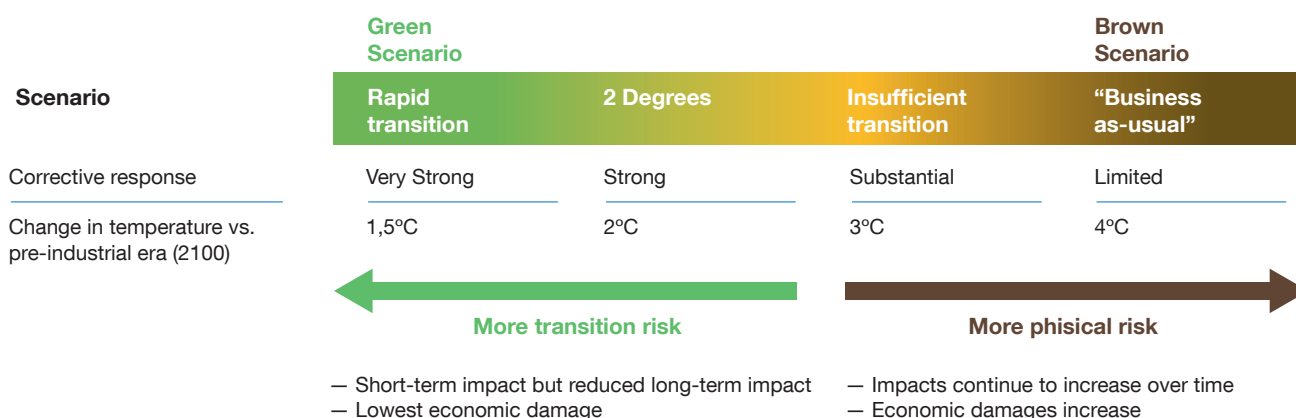
Credit risk. First, extreme climatic phenomena may cause significant losses for households and firms, reducing their ability to repay loans and impairing the value of their assets. For banks, this raises their credit risk insofar as it increases the likelihood of default, apart from impairing the value of collateral. This loss of ability to pay and of collateral value may also occur in gradual climatic phenomena, for example when the desertification of a geographical area weakens its economy. Second, credit risk may increase when a bank

⁴⁸ See NGFS (2019a) for a detailed analysis of the relationship between transition and physical risks, the economy and the financial system.

⁴⁹ See NGFS (2020a).

Figure 2

CLIMATE SCENARIOS AND GENERAL IMPLICATIONS



SOURCE: Oliver Wyman (2019).

has credit exposures to firms whose business models are not aligned with the transition to a low-carbon economy and which are thus more prone to undergo loss of profit and interruption of business and therefore more likely to default on loans and to fail to meet other financial obligations, in addition to loss of value of their business.

Market risk. As noted above, the transition to a low-carbon economy, the policies aimed at achieving this objective, the changes in the preferences of economic agents and technological progress may lead to substantial and sudden repricing of assets (bonds, shares, etc.), particularly if this transition is late, sudden and disorderly. Thus, McGlade and Ekins (2015) estimate that limiting global warming to 2°C would mean that 80% of coal reserves, 33% of oil reserves and 50% of gas reserves cannot be used and that the assets associated with them would lose value. Technological changes may also affect the value of certain assets whenever they bring about sharp shifts in old processes and systems through creative destruction (TCFD, 2017). Also, changes in the expectations of consumers, firms and investors as to future regulations or technological changes may give rise to sharp changes in the value of assets. Additionally, the growing frequency of severe weather phenomena may adversely affect actual and potential economic growth in countries vulnerable to climate change, thus affecting the value of their sovereign debt by increasing their cost of financing and reducing their access to markets.

Operational risk. Severe weather phenomena may affect business continuity, including branch networks, offices, infrastructure, processes and staff. The prices of inputs such as energy, water and insurance may increase and thus raise operating costs.

Reputational risk. Transition risk may also crystallise in the form of reputational risk if customers and investors perceive banks as not being appropriately aligned with the objectives of the transition to a low-carbon economy.

Liability/legal risk. These risks can arise if parties who have suffered losses from the crystallisation of physical and transition risk factors seek to recover those losses through litigation against those they view as responsible.⁵⁰ This risk may affect banks directly or indirectly, i.e. through the impact it may have on firms to which the banks are exposed.

Although physical and transition risks are classified within the ordinary risks facing a bank, they have differences from other risks⁵¹ which complicate their valuation. Thus, first, climate change-related risks are **far-reaching** since they affect multiple lines of business, sectors and geographical areas, so the total impact on the bank, and on the financial system, may be greater than for other types of risk. Second, they have a **long, undefined time horizon**. Indeed, the time horizon over which they may crystallise is longer (and less well-known) than the time horizons used in business planning and risk assessment. This is one of the manifestations which the former Governor of the Bank of England, Mark Carney, calls the “tragedy of the horizon”.⁵² Climate change-related risks are, moreover, foreseeable, since there is a high degree of certainty that some combination of physical and transition risk will crystallise. Lastly, they are risks which **depend on actions to be taken in the short term**, since the size of the future impact will be largely determined by the actions taken now by governments, firms, investors, consumers, banks and other actors, i.e. they are of an endogenous nature (see Battiston (2019)).

In addition to the opportunities and risks which climate change entails for banks, there is growing pressure from customers, investors and regulators for banks to provide public information on their exposures and actions relating to climate change. As noted above, this information is necessary to effectively assess climate-related financial risks and to efficiently allocate resources. In this respect it is worth mentioning that 190 banks have signed the document expressing support for the recommendations of the TCFD, thereby committing themselves to publish information on climate change-related risks in accordance with the standards set by the TCFD.

4.2 How are banks acting?

The business opportunities for banks offered by the transition to a low-carbon economy, the physical and transition risks posed by climate change and the pressures for significant publication regarding the financial effects of climate change are factors which, although they will manifest themselves most strongly in the future, are already taking place, as noted above. For example, there is evidence of the increasing frequency of adverse weather

⁵⁰ For example, in January 2019, the Californian company PG&E (Pacific Gas and Electricity) filed for bankruptcy protection in view of the legal proceedings for more \$30 billion claiming liability in the 2017 and 2018 forest fires which devastated its geographical area of operations. According to experts, these fires, preceded by severe drought, were a consequence of climate change and PG&E was accused of not having implemented technological innovations and preventive measures which would have mitigated the damage. According to analysts, cases such as this will become increasingly frequent.

⁵¹ See Bank of England (2018) and NGFS (2019b).

⁵² The tragedy of the horizon manifests itself as a result of the fact that the catastrophic impacts of climate change will basically materialise beyond the traditional decision horizons of economic agents, i.e. firms, investors, banks, governments, central banks, etc. The materialisation of climate change risks is, in short, a cost for future generations which the current generation does not have a strong incentive to alleviate. See Carney (2015).

events. The share of weather-related catastrophe losses has increased steadily to account for over 80% of insured catastrophe losses in 2018 (see ESRB (2020)). And some policies aimed at compliance with the objectives of the Paris agreement are already in place in some countries, while technological innovations are being rolled out which will have more or less success in the future.

As a result of the foregoing, banks, which had until recently relegated climate change matters exclusively to the sphere of corporate social responsibility, are increasingly taking into consideration the opportunities and risks associated with climate change, making them part of their central business management.

A survey by the Bank of England in 2018 of 90% of the UK banking sector concluded⁵³ that 30% of the sector could be classified as simply “responsible”, i.e. they view climate-related risk from the standpoint of corporate social responsibility, focusing on reputational risks; 60% of the sector can be classified as “responsive”, an approach where climate change is viewed as a financial risk, albeit from a relatively narrow, short-term perspective; and 10% can be classified as “strategic”, i.e. a more comprehensive approach taking a long-term view of the financial risks and opportunities, which includes engaging at board level and so supporting an orderly transition. The Autorité de Contrôle Prudentiel et de Résolution (ACPR), also conducted a survey in 2018 to banks and insurance companies. On this basis it concludes that there has been significant progress in last years regarding the governance of climate change risks and that they are gradually being incorporated into the management of financial risk. However, it also notes that progress is uneven and that there is still a considerable lack of operational adaptation of business strategies.⁵⁴

Sabine Lautenschläger (2019), former Executive Board member of the ECB, referred to a pilot project conducted by the ECB to obtain information on how banks are approaching the challenges posed by climate change issues. The project concluded that, although banks are mindful of climate change risks, most of them address these issues from the standpoint of corporate social responsibility rather than from the standpoint of risk management. Coleton *et al.* (2020) reach similar conclusions based on a survey conducted among 39 European banks in Spring 2019. The results of the survey show a clear trend towards banks embedding sustainability into their business strategies, through a variety of channels and as a result of a mix of underlying motivations, ranking first ethical business considerations, followed by business opportunities and with risk considerations ranking only in a fifth position. Many banks stated that there are still challenges with regard to implementing sustainability more systematically within their business, with the most cited reasons being time horizon, awaiting regulatory proposals and lack of understanding of the potential impacts of climate change. The survey also demonstrates that governance arrangements and risk management processes applicable to climate-related risks are developing, at varying degrees across institutions.

53 See Bank of England (2018).

54 For more details on the banking sector, see ACPR (2019a), and for the insurance sector, see ACPR (2019b).

Overall, despite the growing acknowledgment that climate-related risks deserve attention from a prudential risk management perspective, the actual incorporation in the risk management framework, the development of proper risk management functions to handle these risks and the elaboration of robust risk identification and assessment tools are still at preliminary stages. More recent surveys show clear progress, at least among the biggest institutions, although this progress is still insufficient. Thus, in a survey conducted by GARP in 2020 among 43 banks and 28 other financial institutions across all geographies, 55% of respondent firms describe their approach to climate risks as strategic and more than 90% of the firms aim to have a strategic approach in the next five years (see GARP Risk Institute (2020)). Also, over 90% of firms report some degree of involvement at the board level. However, GARP concludes that climate risk measurement approaches are immature being mostly qualitative with more than 25% of firms not using either metrics, targets or limits in their climate related risk management and only other 25% use all three.⁵⁵ Over 40% of respondents do not use scenario analysis, 43% used it on an ad-hoc basis and only 10% of them use it as a regular part of risk assessment. Overall, respondents find several barriers and challenges to addressing climate risks, being most concerned about the availability of reliable models, regulatory uncertainty and getting internal alignment on climate risk strategy, although these challenges are expected to diminish over time.

Regarding disclosure, the ECB carried out an assessment exercise of climate related and environmental risk disclosures of 107 significant institutions and 18 less significant institutions in the reference year 2019. In its assessment, the ECB recognizes a clear positive trend in the level of climate-related disclosures over the past two years, with good practices spreading rapidly across institutions. However, the ECB concludes that, in general, institutions do not yet comprehensively disclose their risk profile and that significant efforts are needed to improve transparency. Thus, although most of the assessed institutions refer to climate-related risks in their public disclosures in some form, most of them do so in their annual report, with only a limited number of institutions disclosing information on the outcome of their materiality assessment. On business strategy, less than one third of the institutions assessed disclose the potential impact of transition risk on their business model in the short and long term. This proportion is even smaller for physical risk. In both cases, they make no clear distinction available between short-term and longer-term assessments. On governance, only half of the institutions provide disclosures on the board's oversight of either climate-related risks or climate-related opportunities. On risk management, one in two institutions described their processes for identifying, assessing and managing climate-related risks, of which only a minority have done so comprehensively. Less than one quarter of institutions refer to the use of climate-related scenario analysis in their disclosures and even fewer refer to stress testing, although many institutions disclose that work in these areas is under way. Institutions that have integrated climate-related risks in their credit risk management policies typically refer to the use of a combination of sectoral approaches, ranging from the exclusion of certain sectors to heightened engagement with

⁵⁵ A metric is a measure used to assess climate risk. A target is the outcome the organization aims to achieve. Limits represent the worst outcome the organization is prepared to accept without taking corrective action.

clients in identified sectors. On metrics and targets, just over one third of the institutions assessed disclose both targets and metrics, and only a minority discloses quantitative information about the carbon intensity of their portfolios (see ECB (2020a)).

In sum, clear advances have been made, but there is still much ground to be covered. This is partly because the challenges and obstacles to the proper management of climate change-related opportunities and risks are substantial (see Box 2), as pointed out by many of the respondents to the surveys mentioned above. Indeed, right now it is no easy task to assess the business opportunities associated with the transition.⁵⁶ Assessing the risks is also complicated, since it calls for designing possible scenarios, knowing the economic impact on each of those scenarios, valuing the financial risks which that economic impact may involve, having a projection and action horizon longer than the standard one, etc. In short, as concluded by Monnin (2018a), the assessment of climate-related risks requires methodologies which are based on forward-looking scenarios and complex links between cause and effect, and that use data and information not observed in the past. All this also requires having a generally accepted taxonomy of what is green and what is not, as well as new, harmonised methodologies to ensure that the analyses conducted by different banks are comparable.

In contrast, banks have continued lending to the fossil fuel sectors. Hence, the world's largest investment banks have provided more than \$1.9tn of financing for the fossil fuel companies most aggressively expanding in new coal, oil and gas projects during the period 2015-2019 (see Chenet *et al.* (2021)) and ECB finds that in the Eurozone loans extended to carbon-intensity have mostly increased during 2015-2019 (see ECB (2020b)).

Nevertheless, some significant steps are taking place, as pointed out before. Thus the banking sector has started to make public commitments to be aligned with the objectives of the Paris agreement and the role it implies for the financial sector through the sign of comprises, such as the Principles of Responsible Banking under the UNEP Fi initiative with more than 200 banks (more than a third of the global banking industry) that joined in 2019 under six principles regarding alignment of the business strategy, impact and target setting, work responsibly with their clients, engage stakeholders, implementation through an effective governance and culture and implementation of transparency and accountability. Some of these banks signed the Collective Commitment to Climate Action in 2019 to achieve a more ambitious framework to contribute to limit global warming to well-below 2°C through their services and lending. In Spain, a similar compromise was signed in December 2019 in the 25 COP held in Madrid. More than the 95% of the sector presented a joint commitment to proceed within a certain period of time to reduce the carbon footprint in their credit portfolios.

More recently, in April 2021, 43 banks from 23 countries (with assets of \$28.5 trillion) formed the UN-convened Net-Zero Banking Alliance (NZBA) with its members committing

⁵⁶ For instance, in the EBA risk Assessment Questionnaire of June 2019, 65% of the respondent banks report corporate and social responsibility among the main motivation for developing green products and services, while business opportunities are marked as a main motivation only for 45% of respondent banks (see EBA (2019a)).

to align their lending and investment portfolios with net-zero emissions by 2050. The commitment includes the setting of an intermediate target for 2030 and accountability by publishing annually absolute emissions and emissions intensity in line with best practice and within a year of setting targets, disclose progress against a board-level reviewed transition strategy. NBZA is the banking element of the Glasgow Financial Alliance for Net-Zero (GFANZ).⁵⁷ Santander, Caixabank and BBVA are among the signatories' banks.

⁵⁷ GFANZ is a strategic forum bringing together the leading net-zero initiatives across the financial sector, and is chaired by Mark Carney, UN Special Envoy on Climate Action and Finance. GFANZ is the place where the financial sector meets to accelerate the transition of finance and the global economy to net-zero emissions by 2050 at the latest.

5 The central banks also talk about climate

Central banks' responsibilities regarding bank supervision, financial stability, asset management and monetary policy also make it necessary for them to analyse the potential systemic implications they may have for the economy and the financial system as a whole in order to incorporate climate-change issues into their supervisory and macro-prudential practices and into the portfolio management of their own portfolios.

The results of the survey conducted by NGFS (2020b), asking to 26 central banks representing 51 countries, confirms an increasing awareness of climate-related risks among central banks. There is a general understanding that climate change poses a challenge for central banks however, in practice central banks are still at an early stage when it comes to considering adjustments to their operational frameworks to incorporate climate change-related factors. The recognition by central banks that climate related risks should be taking into account in their areas of work and their awareness that the tasks involved are complex and require international coordination.

The creation of the *Network of Central Banks and Supervisors for Greening the Financial System* (NGFS) in December 2017, has driven the work of Central banks in this area with a view to exchanging experience and knowledge of climate change-related matters, identifying best practices and promoting green finance. The Network groups together 95 central banks and supervisory authorities and 15 observers in June 2021⁵⁸ identifying best practices and promoting green finance. The NGFS's report released in April 2019 made a series of recommendations for central banks and policymakers (see Box 3). Since then, the NGFS, has published several reports and guides on implementation of these recommendations and has become a catalyst in raising awareness towards climate related issues and need for action by central banks and international standard setting bodies.

Specifically, as described in this section, central banks are incorporating climate change issues into their supervisory practices and gathering information from supervised institutions on their exposure to climate-related risks. In the last years they have increasingly recognised the need to incorporate the implications of climate change into their financial stability analyses and to develop specific climate stress tests on the financial systems. At the same time, central banks have started to incorporate sustainable and responsible principles to the management of their own portfolios. Regarding the recognition by central banks that climate related issues affect their areas of work include price stability and the transmission of monetary policy, although the way to address the challenge that poses climate change in this area, is still under study.

5.1 Micro- and macro-prudential supervision and financial stability

Where physical and transition risks affect financial institutions, as we have seen in section 4.1, the central banks or supervisors (if this task is not entrusted to the central bank) should,

⁵⁸ See the list of members: <https://www.ngfs.net/en/about-us/membership>.

as part of their function of overseeing the security and solvency of supervised institutions, take into consideration the risks posed by climate change. In this respect, central banks have to incorporate climate change issues into their supervisory practices and gather information from supervised institutions on their exposure to climate-related risks, on their management thereof and on their policies and governance in relation to climate change and to the transition to a low-carbon economy. As for financial institutions, this is no easy task for central banks. Yet they also need to comprehend climate risk and build skills.

Climate change-related risks are systemic in nature, since they affect all economies and may have a large impact. Regarding physical risk, natural disasters may give rise to the total or nearly total disruption of economic activity, to scarcity of resources, to prolonged interruption of supplies of vital resources and to the need to devote considerable funds to reconstruction. For their part, physical risks of a gradual nature may give rise to depopulation and a significant loss of economic potential. Large-scale migratory phenomena and political instability are also systemic risks to be taken into account.

In the absence of resolute action by governments and other economic agents, the physical impact of climate change in the second half of the century will be substantial. As mentioned by the NGFS (2019b), some studies estimate that average global income may decrease by 25% towards the end of the century and that the value of privately owned assets will also fall substantially, with an expected loss of as much as \$7-13 trillion, depending on the degree of warming reached in 2100 (see Economist Intelligence Unit (2015)). Dietz *et al.* (2016) find that under a scenario that lacks a policy for transitioning to a low-carbon economy (scenario with warming of 2.5°C), the expected value at risk (VaR) of the global private non-bank assets in existence in 2013 would be 1.8%, equivalent to approximately \$2.5 trillion. Most of the risk is in the tail, with a VaR in the 99th percentile of 16.7%, or \$24.2 trillion.

Furthermore, the transition to a low-carbon economy, which entails far-reaching economic structural change, also has costs and risks which affect financial stability.⁵⁹ The transition may involve substantial losses in the value of some assets (stranded assets), sharp appreciation of others, mis-matched prices and excessive volatility, with the consequent harm for owners and issuers and for the financial system in general. Dafermos *et al.* (2018) analyse the effects of climate change, using and simulating a model called DEFINE (Dynamic-Ecosystem-FINance-Economy), which depicts interactions between the ecosystem, the financial system and the macroeconomy. They conclude that financial stability is affected in three ways. First, the economic catastrophes resulting from climate change would destroy the capital of firms, reducing their profitability and prompting a rise in corporate bad debts that would affect financial and non-financial firms. Second, climate damage may lead to a reallocation of assets which would cause a gradual deterioration in the price of corporate bonds. And third, the adverse macroeconomic effects would lead to a decrease in credit, thus exacerbating the macroeconomic deterioration. The study of the ESRB (2016)

⁵⁹ See FSB (2020) for a stocktake of financial authorities' experience in including physical and transition climate risks as part of their financial stability monitoring.

argues that while the systemic risks of a gradual transition to a low-carbon economy are limited, those of a late and sudden transition would be considerable, acting through the macroeconomic impact of sudden changes in the use of energy, with a possible scarcity of supply of alternative energies due to sharp appreciation of carbon-intensive assets, and also through an increase in the incidence of natural catastrophes.

The extent of the potential systemic risk to the financial system associated with climate damage and the transition to a low-carbon economy has aroused concern among central banks as the institutions responsible for ensuring financial stability. Since the address entitled “*Breaking the Tragedy of the Horizon: Climate Change and Financial Stability*” in 2015 by the former Governor of the Bank of England (BoE), Mark Carney, central banks have increasingly recognised the need to incorporate the implications of climate change into their financial stability analyses and into their stress tests on the financial systems overseen by them (see Carney (2015)).

This mission would require central banks carry out economic impact analyses under different scenarios and the consequent financial impact in each of them, which is an exercise entailing similar or greater difficulties than those facing banks (see Box 2). Indeed, the assessment of financial risks requires two ingredients: data which are hard to obtain and innovative modelling of dynamic interactions between the real economy, the financial system, climate change and transition policies. The first element, data availability was identified as the most cited challenge in the survey realized by BCBS (2020). And the latter ingredient is exacting because, first, the existing models of the interactions between the economy (Integrated Assessment Models, IAM)⁶⁰ and the climate do not include the financial channel; and, second, the models generally used by central banks in their macroeconomic analyses do not include factors relating to climate change and the energy transition and do not take into account the interaction of heterogeneous agents in an environment of fundamental uncertainty (see Campiglio *et al.* (2018)).⁶¹

There is a broad and growing consensus among central banks that the effects of climate change and of the transition to a sustainable economy should be incorporated into their micro- and macro-prudential supervisory work, basically through the use of Pillar 2 and Pillar 3 instruments, i.e. requiring banks to assess their exposure to climate change, to conduct stress-testing exercises which address climate change-related risks⁶² and to publish the attendant information. They also agree on the need to develop methodologies that take into account those effects when assessing the effect of climate change and the

60 These models are based on the pioneering work of the winner of the 2018 Nobel Prize in economics, W. D. Nordhaus, *Managing the Global Commons: The Economics of Climate Change*, MIT Press, 1994.

61 However, notable progress is being made in macroeconomic-climate-financial modelling. See for example: Balint *et al.* (2017), Fontana and Sawyer (2016), Monasterolo and Raberto (2018), Dafermos *et al.* (2017), Dafermos *et al.* (2018), Stolbova *et al.* (2018), Bovari *et al.* (2018), Lamperti *et al.* (2018), Roncoroni *et al.* (2019) and others.

62 The Scientific Committee of the European Systemic Risk Board proposed in 2016 the incorporation of climate-related risks in stress tests and the inclusion of a hard landing in the adverse macroeconomic scenario. In the medium term, it also proposed the development of specific “carbon stress tests”, albeit acknowledging that their methodology is under development and depends on the emission paths considered (ESRB, 2016).

transition on the financial system as a whole. They further concur on the need to conduct stress tests to assess the resilience of the financial system to the effects of climate change and of the transition.⁶³

5.2 Integration of sustainability factors, “green” use of monetary policy and prudential instruments

Following NGFS recommendation number two regarding the integration of sustainability factors into own portfolio management,⁶⁴ numerous central banks have made the commitment of integrating sustainability factors into own-portfolio management.⁶⁵ For example, the Eurosystem central banks — the 19 national central banks of the euro area countries and the European Central Bank (ECB)— announced in February 2021, that they have defined a common stance for applying sustainable and responsible investment principles in the euro-denominated non-monetary policy portfolios that they each manage under their own responsibility.⁶⁶ Regarding the disclosure of climate-related financial risk of their portfolios and operations,⁶⁷ the number of central banks that have committed to disclose is only a few by now, but it is increasing. In this vein, in 2020, the Bank of England published its first climate related financial disclosure, setting out its approach to managing the risks from climate change across its entire operations, and the steps taken to improve the central bank’s understanding of these risks.⁶⁸ The Sveriges Riksbank has taken a first step towards disclosure of its own climate-related risks on the Riksbank’s balance sheet by calculating and reporting the carbon footprint of the holdings of corporate bonds. National central banks of the Eurosystem also aims to start to disclose about climate-related issues for their non-monetary policy portfolios within the next two years, using the recommendations of the TCFD as the initial framework and reporting, as a minimum, in the category of metrics and targets, as announced in February 2021.^{69,70} Concerning Eurosystem monetary policy portfolio, the ECB has committed, in the context of its new monetary policy strategy, to start disclosing climate-related information of the corporate sector purchase programme (CSPP) by the first quarter of 2023.⁷¹

The recognition by central banks that climate related issues affect their areas of work include price stability and the transmission of monetary policy. Thus, in an address

63 See NGFS (2020c) for a higher detail on how supervisors can integrate climate-related and environmental risks into prudential supervision and BCBS (2021) for measurement methodologies of climate-related financial risks.

64 See NGFS recommendations in Box 3.

65 See NGFS (2019c) y (2020d).

66 See Press Release “Eurosystem agrees on common stance for climate change-related sustainable investments in non-monetary policy portfolios” 4 February 2021. https://www.ecb.europa.eu/press/pr/date/2021/html/ecb.pr210204_1~a720bc4f03.en.html.

67 In the NGFS (2021) Technical Document “Adapting central bank operations to a hotter world. Reviewing some options” is stated that “Central banks may wish to disclose information on their own exposures to climate-related risks and on their climate strategy and performance. This would help set a positive example to assist market participants in developing their own disclosure frameworks and incorporating climate related considerations into their investment and lending decisions.”

68 In June 2021, Bank of England published the second annual climate disclosure report.

69 See section 5.4.

70 Several Eurosystem central banks already make climate-related disclosures for some of their non-monetary policy portfolios (see section 5.4).

71 See Press Release “ECB presents action plan to include climate change considerations in its monetary policy strategy” 8 July 2021. https://www.ecb.europa.eu/press/pr/date/2021/html/ecb.pr210708_1~f104919225.en.html.

in November 2018, Benoît Coeuré,⁷² former ECB Executive Board member, remarked that monetary policy is affected by climate change whether there is or not action to mitigate climate change effects, in his opinion, if action is not taken to counter climate change, identification of the major shocks for medium-term inflation projections will be more complex. Also, the most likely natural catastrophes may erode the conventional monetary policy space with greater frequency, raising the number of occasions on which central banks have to face a trade-off between stable prices and growth. On the other hand, if action is taken to counter climate change, the impact on monetary policy may be equally significant, particularly if the change associated with the energy mix alters relative prices so as to destabilise medium-term inflation expectations.

The Governor of the Banque de France, François Villeroy (2019), considers that the effects of climate change may give rise to inflationary tension in the medium term through their impact on agricultural and energy prices. Moreover, extreme weather conditions may have a broader impact on the economy, affecting GDP and price structures. In this situation, monetary policy will face sustained shocks whose impact extends throughout the economy, and will have to play its role to achieve gradual price structure rebalancing, in line with its ultimate objective of price stability.

Several other central bankers have made statements in the same line. Governor of Banco de España, Pablo Hernández de Cos (2021), pointed out that the effects that climate change and policies aimed at promoting the transition towards a carbon neutral economy may have on headline inflation and natural interest rate could lead central banks to rethink how to formulate their policies in pursuit of price stability over the medium time horizon. Andrew Bailey (2021a), Governor of the Bank of England, remarked that the effects of climate change matter for monetary policy because structural shifts in the supply side of the economy can affect not only future point-in-time macroeconomic variables, but also the expected natural rate of interest and the natural rate of unemployment.⁷³

Once again, this is no easy task in view of the difficulty of predicting the nature, frequency and intensity of climate change effects and the path of transition policies. Against this backdrop, Villeroy (2019) considers it necessary for central banks to improve their understanding of how to conduct monetary policy in a setting of climate change and of measures to reduce greenhouse gas emissions, and, to this end, the forecasting models normally used by central banks, developed to analyse medium-term trends, will have to be reviewed. Hernández de Cos (2021) also deems necessary to step out efforts to develop the tools and models needed to have better answers for the implications of climate change on the economy and on monetary policy. NGFS (2020e) concludes that central banks need to reinforce their analytical toolkit by considering adding climate risks to their macroeconomic models and forecasting tools. In particular, issues that require model upgrades include the estimation of the impact of climate change on the natural interest rate, the identification

⁷² See Coeuré (2018).

⁷³ See also Christine Lagarde (2021).

and propagation of climate-related shocks, and the impact of transition policies. To this end, NGFS recommends that central banks embrace an interdisciplinary approach to research the impacts of climate change, and how to best reflect these impacts in macroeconomic models.

Against this background, the ECB announced in July 2021, in the context of its monetary policy strategy review, its climate change action plan that includes a commitment to further incorporating climate change considerations into its monetary policy framework and to expanding its analytical capacity in macroeconomic modelling, statistics and monetary policy with regard to climate change (see Box 4).

However, the active role which central banks could play in fostering green finance, i.e. in ensuring ready availability of the funds needed to achieve a low-carbon economy, through the use of monetary policy and prudential instruments (green asset purchases, differing reserve requirements, differing regulatory capital requirements, liquidity ratios which favour green finance, sectoral leverage ratios, constraints on “brown” credit, etc.) is more controversial.⁷⁴

The proponents of the “green” use of these tools argue that, although the transition to a low-carbon economy is primarily the responsibility of governments through investment programmes, regulatory measures (e.g. energy efficiency measures) and taxes (e.g. a carbon tax), financial market failures prevent asset prices from accurately reflecting costs and positive and negative externalities. This means there are insufficient incentives to mobilise the necessary financing for the transition to a low-carbon economy, which may also adversely affect financial stability. It is also argued that the prudential regulation entailed by Basel III contains elements which discourage green financing by banks. Thus D’Oracio, Monnin and Popoyan (2019) maintain that regulatory capital and liquidity ratios do not take into account climate change risks in exposures. That is tantamount to omitting a source of risk in some assets (those that are carbon-intensive) and, thereby, to promoting its financing along with an inappropriate allocation of credit to the detriment of green assets.

Against this background, in the European arena, including the European Parliament, there have been various proposals for the corporate bond programmes of the ECB (CSPP) and the BoE to include green finance criteria (what has come to be known as “green QE”), or even to launch a special “green assets” purchase programme. The ECB observes the “market neutrality” principle, i.e. in the purchased portfolio it maintains the maturity structure and the sectoral mix of the total outstanding bonds.⁷⁵ Various studies conclude that the application of this neutrality principle results in carbon-intensive sectors bias, given the higher volume, rating and liquidity of bonds issued by carbon-intensive entities. It thus contributes to an inadequate assessment of climate-related risks –with possible adverse effects on financial stability– and to the failure to meet its commitments to support the mobilisation of funds to finance the transition (see, for example, Monnin (2018b), Matikainen *et al.* (2017), Battiston and Monasterolo (2019) and Shoenmaker (2019)).

⁷⁴ For a detailed set of possible actions to be taken by central banks to actively contribute to a net-zero economy see Dikau *et al.* (2021a) and Dikau *et al.* (2021b).

⁷⁵ See ECB (2018).

Thus, Matikainen *et al.* (2017) find that the portfolios acquired by both the ECB and the BoE are biased towards firms with carbon-intensive activities. They estimate that in 62% of the ECB's corporate bond purchases, the issuers are firms from the sectors, such as energy and industry, responsible for 59% of greenhouse gas emissions, while accounting for 18% of gross value added. In the case of the BoE, 49% of its purchases are from issuers which altogether are responsible for 52% of greenhouse gas emissions and contribute only 12% of gross value added. Battiston and Monasterolo (2019), using more granular information at the NACE4 level, which allows a more accurate calculation of the degree of carbon usage, reach the same conclusion: the bonds issued by carbon-intensive companies, particularly those from sectors such as carbon-intensive transport, fossil fuels, carbon-intensive energy and other "utilities", are those accounting for the highest share of the corporate bond asset purchase programme (APP) portfolio. Papoutsi *et al.* (2021) compare the sectoral distribution of the "market portfolio"⁷⁶ to the ECB's current holdings under its corporate sector purchase programme (CSPP), finding that ECB's corporate bond portfolio is tilted towards high emission sectors. More specifically, they find that relative to the market portfolio, the ECB holds a large share of carbon-intensive sectors, suggesting that there is a strong positive correlation between emissions and ECB holdings by sector. This bias is explained by the fact that carbon-intensive companies, such as oil and gas companies and car manufacturers, are typically also capital intensive and thus issue more corporate bonds

In view of this carbon-intensive bias in asset purchases, Matikainen *et al.* (2017) consider that the ECB and the BoE should analyse the impact of their asset purchase policies on the price of carbon-intensive assets and, if they conclude they are contributing to a price misaligned with risk, should act accordingly. Monnin (2018b) considers that central banks should include an assessment of climate-related risks in their asset purchase criteria and collateral policy. Shoenmaker (2019) proposes that asset purchase criteria and collateral assessment should gradually introduce a penalty factor proportional to the intensity of CO₂ usage of the issuers of the assets purchased. They argue that in this way the maturity structure of the current portfolio would not be altered. A similar proposal is made by Battiston and Monasterolo (2019). Dafermos *et al.* (2018) calibrate a model in which they introduce *green QE* and conclude that it would have beneficial effects for the financing of the transition; however, for those effects to be significant, *green QE* would have to be supplemented by other government measures. Monasterolo and Raberto (2018) also calibrate the effect of a green bond purchase programme and find beneficial effects on green investment and other macroeconomic variables, though these purchases would have a negative effect on income inequality.

Central banks, and specifically Eurosystem central banks, did not show, at first, much enthusiasm for *green QE*. Thus, the governor of the Bundesbank, J. Weidmann (2017), regarding the possibility of using bond purchases or collateral policy to promote

76 Ideally, market portfolio should be constructed with the market value of equity plus debt. Since the market value of equity is not available for non-listed firms, the authors use alternative measures such as capital income (value added minus wages) by sector.

green finance, considers that the Eurosystem mandate is to maintain price stability and that, to achieve this objective, monetary policy should not be overloaded with other objectives. Also, neutrality is a basic principle of the Eurosystem operational framework. Hence, to avoid opening Pandora's Box, green bonds should not be afforded preferential treatment either in the APP or in collateral policy. A somewhat more ambiguous stance is taken by the ECB Executive Board Member B. Coeuré (2018), who considers that the ECB, acting in accordance with its mandate, can and should actively support the transition to a low-carbon economy in two main ways: first, by helping define the rules of play; and second, by acting in consequence, without harming price stability. Draghi (2018) considers that the corporate bond APP's ultimate objective is to contribute to achieving price stability. Therefore, to avoid market distortions and safeguard competition, asset purchases should proceed in accordance with the principle of neutrality and risk management, avoiding any discrimination regarding the activity of the issuer.⁷⁷ The governor of the Banque de France, François Villeroy (2019), considers that green QE could introduce distortions into the market, given the scant volume of the green bond market, and that the consideration of climate-related factors in collateral policy requires a deeper knowledge of climate risks and a taxonomy which clearly distinguishes *green* from *carbon-intensive activities*.

More recently, however, European central banks have shown a more open mind towards a more active role. Thus, Andrew Bailey (2021b), governor of Bank of England, claims that for them, the need to act in greening monetary policy is clear and unambiguous. First, given the financial markets mispricing of climate risks, "*continuing to replicate the structure of the sterling corporate bond market, without taking explicit account of the climate impact of bond issuers, is no longer in fact a truly 'market neutral' approach*". Second, given the remit for MPC of March 2021 that states that, subject to achieving price stability, the MPC should support the transition to net-zero as part of the government's economic strategy. Consequently, Bank of England is planning to modify its approach to the composition of assets in the CBPS in order to take account of climate considerations, although the CBPS will remain a monetary policy tool for achieving its primary inflation objective. The principles of the greening the CBPS would be: i) incentivise companies to take decisive action to achieve net zero, ii) lead by example, learn from others, iii) increase the requirements over time.⁷⁸

Isabelle Schnabel and Frank Elderson, ECB board members, have also questioned the market neutrality principle of the corporate assets programs run by the ECB. In a podcast by Elderson and Schnabel (2021), Elderson, in reference to the ECB corporate bond purchases, says that if the conclusion is that the market is not pricing in everything that needs to be priced in, then just blindly following the market might make ECB markets neutral, but it might not be in line with the principle of an open market economy with free competition, favouring an efficient allocation of resources, that in the end, is what needs to be ECB guiding principle. Schnabel says that sticking to the market neutrality principle may

⁷⁷ However, under this policy the ECB has purchased a small amount of green bonds (proportional to the scant volume of green bonds which now exists), and, in view of this, Draghi (2018) asserts that the ECB can thus be considered to contribute to green finance.

⁷⁸ See the Discussion Paper published by Bank of England (2021a).

reinforce existing biased of corporate bonds purchases towards carbon-intensive issuers and, in turn, delay the transition towards a carbon-free economy. In her opinion, this suggest to tilt the ECB asset purchases towards less emission-intensive firms, recognizing that to do it in a proper way, is challenging. In any case, she points out, these actions must not impede the smooth functioning of monetary policy the precedence of price stability over other objectives should remain.⁷⁹ Similar opinion is held by Klaas Knot, President of the Netherlands Bank, that in a Bruegel event in February 2021 stated that “*Central banks could explore how, within the boundaries of their mandates, they can redesign their monetary policy instruments to prevent such biases from occurring, and instead contribute to unlocking more green investments*”.⁸⁰

*François Villeroy de Galhau, governor of Banque de France, has shown a strong opinion in favor of greening ECB’s actions.*⁸¹ In his opinion, “*the Eurosystem’s consideration for climate change is neither an abuse of its mission, nor a mere militant conviction or a fad; it is an imperative that we must pursue in the very name of our current mandate and to ensure the smooth implementation of monetary policy*”. Accordingly, he proposes to “*start decarbonising the ECB’s balance sheet in a pragmatic, gradual and targeted manner for all corporate assets, whether they are held on the central bank’s balance sheet (purchases) or taken as collateral, without including government securities*”. In contrast, Bundesbank President Jens Weidmann, claims that central bank should prioritize disclosures but not asset allocation. Nonetheless, in January 2021 he argued that central banks should also integrate climate-related financial risks into their risk management framework, including the financial risks arising from monetary policy operations, remarking that ECB should consider only purchasing bonds or accepting them as collateral for monetary policy purposes if their issuers meet certain climate-related reporting requirements.⁸²

C. Lagarde (2021) in an speech given in January 2021 stated that the effects that climate related risks may have on price stability, on key macroeconomic variables for the conduct of monetary policy, on the natural interest rate, on the transmission of monetary policy and on the ECB’s balance sheet explains the inclusion of climate related issues in its monetary policy strategy review, evaluating the feasibility, efficiency and effectiveness of available options for action, ensuring that they are consistent with ECB’s mandate. Consistent with this statement, the ECB action plan to include climate change considerations in its monetary policy strategy, announced in July 2021, embraces a commitment to including climate change considerations in monetary policy operations in the areas of disclosure, risk assessment, collateral framework and corporate sector asset purchases (see Box 4).

Regarding Pillar 1 prudential tools, a proposal which has received special interest is that of introducing differentiated regulatory capital requirements such as a “*green supporting factor*”

⁷⁹ See also Schnabel (2021).

⁸⁰ See Knot (2021).

⁸¹ See Villeroy (2021).

⁸² See Weidmann (2021).

(GSF), based on a lower risk weight in green exposures when calculating bank regulatory capital or, alternatively, a penalty weighting for carbon-intensive exposures (a “brown penalising factor”, BPF), suggested, inter alia, by the European Parliament, the Commissioner V. Dombroskis and the Euro Banking Association. The proponents of these measures argue that a GSF, or a BPF, would align regulatory capital requirements more appropriately with the risks actually taken, in addition to encouraging green finance.

In general, analysts and academics do not consider the introduction of a GSF to be appropriate for the time being. They argue that the available evidence that green assets have a lower risk is not conclusive and that its introduction would tighten the capital position of banks which currently face rather uncomfortable capital levels. This could have adverse consequences for financial stability (see, for example, Dankert *et al.* (2018), Boot and Schoemaker (2018), D’Orazio and Popoyan (2019), European Financial Services Roundtable (2017)). By contrast, the BPF has merited greater support. It is considered to be more in line with prudential regulation, being based on risk, since the increase in capital it would entail would provide a higher buffer for banks with which to address the possible asset impairment caused by a faster transition to a low-carbon economy. That would in turn discourage investments contributing to climate change, which may reduce systemic risk (see, for example, Monnin (2018b), D’Orazio and Popoyan (2019), Boot and Schoemaker (2018), and Campiglio *et al.* (2018)). However, the introduction of BPF would have to be preceded by a clear “brown” asset taxonomy⁸³ and new methodologies to assess credit risk, since the models based on historical data are not applicable because the energy transition is a new phenomenon.

Central banks are not, at least for now, very sympathetic to the introduction of differentiated capital requirements, particularly of a GSF. Thus, M. Carney (2018), former governor of the Bank of England, is not much in favour of the introduction of a GSF, arguing that central banks cannot replace governments in their responsibilities for meeting the *objectives* set in the Paris Agreement. He is, however, less contrary to the introduction of a BPF for those exposures which are demonstrated to be ecologically harmful and, therefore, to constitute a high risk. The same position has been expressed by the governor of the Banque de France, F. Villeroy de Galhau (2018). Sabine Lautenschläger, former ECB Executive Board member (2019), considered that any change in the prudential framework must be based solely on prudential criteria. In general, central banks consider that economic policy criteria have no place in their prudential policy and, therefore, only if it is proven that green assets entail lower risk than others, or that carbon-intensive assets entail a differentially high risk compared with other exposures, can the introduction of a GSF or BSF be considered. However, such a check requires empirical analytical evidence which is currently not available and, furthermore, an accurate taxonomy of what is green and what is brown. This same position is held by the NGFS (2018) and, therefore, by a good number of central banks. Against this background, the European Banking Authority (EBA) has the mandate to assess

⁸³ The Platform on Sustainable Finance has the mandate of the European Commission to advise on the design of a taxonomy of activities that significantly harm the environment.

if a dedicated prudential treatment of exposures related to assets or activities associated substantially with environmental and/or social objectives would be justified and the findings should be summarised in a report due in 2025 (see Article 501c of CRR2 and EBA's Action Plan in EBA (2019b)). However, the Renewed Strategy for Sustainable Finance launched by the European Commission in July 2021 proposes to bring forward to 2023 this assessment (European Commission, 2021).

5.3 A matter of mandate

Clearly, the extent of involvement of central banks in climate change depends basically on their mandate and on the interpretation of that mandate. Most banks, particularly Western ones, set their main objective as price stability. This main objective is based on the theoretical and empirical understanding that low, stable inflation is a necessary condition for growth or development. Apart from low, stable inflation, safeguarding financial stability is another of the functions generally entrusted to central banks.⁸⁴ Also, a large number of central banks are responsible for the prudential supervision of financial institutions. These mandates are what 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. That said, they are not a remit to actively foster sustainability and green finance (see Dikau and Volz (2018)).

Yet if central banks are to adopt an active role through the establishment of incentives for green finance or of penalties for carbon-intensive finance, they require an express legal mandate on environmental and sustainability objectives (see Dikau and Volz (2018)). This is necessary in view of the potential distortions which direct intervention to promote green finance may cause in the markets and the possible clash with their objectives. Dikau and Volz (2019a) analyse the mandates of 133 central banks and conclude that only 16 of them are expressly entrusted with promoting sustainable growth. The mandate of another 38 central banks includes as a secondary objective the achievement of the government's economic policy objectives, though it is subordinate to that of price stability. As noted by Dikau and Volz (2019b), this almost invariably includes sustainable growth under the Paris Agreement.⁸⁵ According to NGFS (2020b), that realized a review of 107 central banks with the aim of analyzing their institutional frameworks and balance sheet features, few central banks have a mandate that explicitly refers to "sustainability" as a central bank objective, while references to "economic development" are more common. Almost half of central banks have price stability as their sole explicit primary objective, almost one-quarter of

⁸⁴ This responsibility for financial stability is often shared with the government and other supervisors or with an independent authority.

⁸⁵ The ECB is an example of a central bank where sustainable growth is a secondary objective, subordinate to price stability. Thus, Article 127(1) of the Treaty on the Functioning of the European Union establishes that: "*The primary objective of the European System of Central Banks (hereinafter referred to as 'the ESCB') shall be to maintain price stability. Without prejudice to the objective of price stability, the ESCB shall support the general economic policies in the Union with a view to contributing to the achievement of the objectives of the Union as laid down in Article 3 of the Treaty on European Union. For its part, Article 3(3) of the Treaty on European Union stipulates that "The Union... shall work for the sustainable development of Europe based on balanced economic growth and price stability, a highly competitive social market economy, aiming at full employment and social progress, and a high level of protection and improvement of the quality of the environment..."*". (our emphasis).

all central bank mandates reviewed explicitly list sustainability-related aspects as central bank objectives and about half of the central banks have mandates that explicitly refer to supporting government economic policy or economic development either as a primary or as a secondary objective.

In most advanced economies, central banks have a relatively narrow mandate in relation to sustainable growth, either because it is secondary and subordinate to the main objective, or because it is not expressly stated. That explains why they are somewhat cautious in the use of prudential or monetary policy tools to support green finance for reasons other than prudential or financial stability considerations. By contrast, a good number of developing and emerging economies, central bank mandates are broader and include sustainability, and social and economic objectives. This is reflected in the fact that the central banks of many developing and emerging economies have been comparatively more active in promoting green finance and sustainable development, as analysed below.

5.4 What central banks are doing

In the last years, central banks have launched several initiatives to incorporate climate change matters into their actions. This means that central banks are working on different areas, such as the analysis of exposures of the financial system to those sectors that will be more affected by climate-change risks, the development of climate stress tests and supervisory expectations, and the incorporation of sustainable and responsible principles in the management of their own portfolios, as are collected in this section and in Table 3.

Between the first steps that various institutions have taken is to carry on the **analysis of the exposure of the financial system** of their countries to climate change risks and, in particular, to the sectors most affected by the transition to a low-carbon economy. In this respect, the *European Central Bank* (ECB), in ECB (2019), analyses the channels through which climate change may affect financial stability and exposure of euro area financial institutions to certain sectors. It concludes that the exposure to transition risks, although fairly contained in relative terms, could be significant for some banks in absolute terms. It also points out limitations regarding the lack of exhaustive and comparable data, evidencing the need for more information on carbon emissions and exposures of banks and other financial institutions and for the performance of scenario analysis and/or stress test exercises to address transition risk in a forward-looking manner (ECB, 2019).

The *Bank of England* (BoE), *Autorité de Contrôle Prudentiel et de Résolution* (ACPR) in France, *De Nederlandsche Bank* (DNB) in the Netherlands, the *Swedish supervisory authority Finansinspektionen*, *Banco de España* and the *Central Bank of Belgium* have also undertaken work to ascertain the level of exposure to climate change risks of the corresponding financial system. Thus the BoE and, specifically, the *Prudential Regulation Authority* (PRA) have

Table 3

EXAMPLES OF TOOLS USED BY CENTRAL BANKS

Category	Institution
Assessment of exposure to climate change related risks	Finansinspektionen (2016)
	De Nederlandsche Bank (2017)
	Bank of England and PRA (2018)
	European Central Bank (2019)
	Banque de France and ACPR (2017 y 2019)
	Banco de España (2019)
Climate tress tests	National Bank of Belgium (2020)
	De Nederlandsche Bank (2018)
	Danmarks National Bank (2020)
	ECB and ESRB (2020, 2021)
	EBA (2021 - pilot exercise)
	Banque de France and ACPR (2021)
	Banco de España (2021)
	ECB Banking Supervision (2022)
	Bank of England (2022)
	Bank of Canada
Supervisory expectations	UK Prudential Regulation Authority (2019)
	BaFin (2020)
	De Nederlandsche Bank (2020)
	ECB (2020)
	Banco de España (2020)
	Banoco de Portugal (2021)
ESG, SRI or exclusion in own portfolio management	Banco de España
	Banca d'Italia
	Banque de France
	Bank of Ireland
	Bank of Finland
	Banco de México
	De Nederlandsche Bank (DNB)
	Central Bank of Hungary
	Norges Bank
	Swiss National Bank
Monetary Policy	Bank of England
	Bank of Japan
	Central Bank of Hungary
	Riksbank
	ECB (2021-2024)
Credit policies	Bangladesh Bank
	Reserve Bank of India
Macro-prudential measures	Banco Central do Brasil (Pillar 2)
Reserve ratio	Banque du Liban
	PBOC (China)
Collateral policy	PBOC (China)

SOURCE: Own elaboration.

conducted various analyses of the banking and insurance sectors and have carried on consultations to these sectors⁸⁶ to obtain information on how they are being affected and how they are dealing with the issues; the main results were described in section 4. In France, the work by the *ACPR* found that physical risks continue to be considered as moderate by most of the institutions surveyed, since their exposures are concentrated in less exposed areas. There was some slight progress in banks' management of transition risks. Thus, the 20 most carbon-intensive sectors accounted for 12.2% of credit risk exposures in December 2017, although there were differences among banks.⁸⁷ On its part, *DNB* performed various studies to analyse exposure to physical risks and transition risks. The largest losses from physical risks may arise from flooding. Exposures to carbon-intensive sectors were found to account for 11% of the balance sheet of banks, 12.4% of that of pension funds and 4.5% of that of insurance companies (see Regelink *et al.* (2017)). In the case of the Swedish financial sector is less exposed to climate-related risks than other parts of the world, according to *Finansinspektionen* (2016). For the Spanish banking sector, Delgado (2019), Deputy Governor *Banco de España*, finds that exposures to the potentially most affected sectors by an energy-transition represent around 25% of the portfolio of loans for productive activities. Banco de España is also working to incorporate climate-related matters into its assessment of risks for the banking system as a whole and, in general, to incorporate all the recommendations issued by the NGFS for central banks.⁸⁸ The National Bank of Belgium has analysed the climate-change-related transition risk associated with real estate exposures in the Belgian financial sector (see Van Tendeloo (2020)). Finally, *Bank of Canada* has announced plans for a pilot project on climate change scenarios applied to a small group of voluntaries with the aim of achieve a better understanding of the risks for the financial system.⁸⁹

Some central banks have also begun to implement **climate stress tests** of their financial systems.⁹⁰ For example, the *DNB* conducted in 2018 a stress test exercise for transition risks with a five-year horizon. It considers four possible scenarios regarding the implementation of policies designed to mitigate the adverse impact of climate change and technological advances to reduce CO₂ emissions.⁹¹ The *Bank of England* will integrate climate scenarios with macroeconomic and financial models and will incorporate physical and transition risks into its stress tests and it will be part of the 2021 Climate Biennial Exploratory Scenario (Bank of England, 2019, 2021b). *Banque de France* has developed a framework for a climate pilot exercise focused on transition risks that takes into account the scenarios developed by the NGFS (Allen *et al.*, 2020). Relying on this approach, the ACPR, the French Prudential Supervision and Resolution Authority, selected a number of quantitative scenarios

86 For the insurance sector, see Bank of England (2015). For the banking sector, see Bank of England (2018) and the consultation in 2018 by the Prudential Regulation Authority in "Consultation Paper on 'Enhancing banks' and insurers' approaches to managing the financial risks from climate change".

87 For more details, see ACPR (2019a) and an earlier analysis by DG Trésor, Banque de France and ACPR (2017), which assessed physical and transition risks.

88 See González (2021b) for more details.

89 See Bank of Canada (2021).

90 See Chart 16 in ESRB and ECB (2021) for a list of European Union institutions that are putting in place climate stress tests and sensitivity analysis.

91 See Vermeulen *et al.* (2018) for more details of the impact.

to be submitted to a group of voluntary banks and insurance companies to conduct the first bottom-up pilot climate-related risk assessment (ACPR, 2020). According to ACPR (2021), the pilot exercise revealed an overall moderate exposure of French banks and insurers to climate risks, although there are several uncertainties concerning both the speed and the impact of climate change. *Danmarks National Bank* (2020) has recently performed a first exercise of climate stress test focused on transition risks and performing several sensitivity analyses instead of a full-developed climate stress test, and *Banco de España* is developing the methodology for transition risks following the scenarios published by Aguilar *et al.* (2021).

At European level, the *European Systemic Risk Board* (ESRB) and ECB run a pilot stress test in 2020 (ESRB, 2020) and the ECB has developed the framework for an economy-wide climate stress test obtaining impact of climate change on more than four million firms worldwide and 1,600 euro area banks under three different climate policy scenarios (see De Guindos (2021) and Alogoskoufis *et al.* (2021)). ECB Banking Supervision will carry out separate supervisory climate stress-test of individual banks in 2022. In addition, the *European Banking Authority* (EBA) has developed a sensitivity analysis for transition risks as a pilot exercise on climate risk with a sample of voluntary European banks. The results show that it is needed a more harmonized approach and common metrics to address and mitigate the consequences of environmental risks. This analysis also obtains a first calculation of a EU aggregated “green asset ratio” to know the alignment of credit institutions’ balance sheets with the Taxonomy, and through a top-down tool this figure stands at 7.9% (see EBA (2021b)).

From the **supervisory area**, the *European Single Supervisory Mechanism* (SSM) identified climate change risk as one of the risks to be monitored from a supervisory perspective in its risk assessment and priorities for 2019 and 2020⁹² (SSM, 2018, 2019) and in 2021 supervisory activity will also focus on action taken by banks in response to the ECB Guide on climate-related and environmental risk (SSM, 2021). The EBA is working on its own action plan on sustainable finance to give a response to the mandate that received to cover ESG related factors and ESG risks, although the first phase of work will focus on environmental factors and especially climate change. Some of the last works has been: a EU-wide pilot exercise on climate risk, the publication of a report on management and supervision of ESG risks for credit institutions and investment firms, a public consultation on draft technical standards on Pillar 3 disclosures of ESG risks, the advice to the EC on Key Performance Indicators for transparency on institutions’ environmentally sustainable activities, including a green asset ratio, recommendations on the application of the Regulation on sustainability-related disclosures.

In 2020, the *ECB* published its supervisory expectations that describes through eleven expectations how the institution expects banks to consider climate-related and environmental risks relating to: i) business models and strategy, ii) governance and risk appetite, iii) risk management and iv) disclosures (see ECB (2020d)). This guide is not binding

⁹² In 2020 it is mentioned that climate change-related risks are more relevant over the longer-term horizon (i.e. a horizon of more than three years).

but the expectations set out are to be used in the ECB's supervisory dialogue with significant institutions directly supervised by the ECB. They have been developed jointly with the national competent authorities (NCAs). Banco de España published in October 2020 supervisory expectations for the less significant institutions around the same areas pointed out by ECB's document. These expectations are not binding and are not subject to the "comply or explain" principle. The Banco de España expects the content of expectations to be considered in a proportionate manner (*Banco de España, 2020*). Other central banks that has elaborated supervisory expectations are, for example, the *German Federal Financial Supervisory Authority (BaFin)*, *DNB*, *Banco de Portugal* and *UK Prudential Regulation Authority (PRA)*.

Furthermore, more and more central banks are incorporating **ESG factors and Sustainable and Investment principles in the management of their own portfolios**, as pointed out before. The NGFS conducted in 2019 a first overview of the strategies applied among its members, indicating that 25 out of 27 respondents have already adopted sustainable and responsible investment (SRI) principles or are planning to do so in their investment approaches (see NGFS (2019c)). One year later, SRI practices have been adopted in 67% of the central banks surveyed, and for another 21%, this step is being considered (see NGFS (2020d)). Some of the central banks that are incorporating these SRI principles are:

- The *Eurosystem* agreed in February 2021 a common stance for applying sustainable and responsible investment principles in the euro-denominated non-monetary policy portfolios that they each manage under their own responsibility (see ECB (2021b)).
- *Banco de España* applies, since 2019, sustainable and investment principles as part of its investment policy in respect of its own portfolios, the Banco de España has direct green bond investments in different currencies and participates in the open-ended investment funds for US dollar-denominated and euro-denominated green bonds launched by the Bank for International Settlements (BIS) (see Banco de España (2021a)).
- *Banca d'Italia* adapted the investment policy for its own funds by integrating ESG criteria for its internally managed equity portfolios (see Bernardini *et al.* (2021) and Banca d'Italia (2021)).
- *Bank of Ireland* takes into account ESG criteria in the management of shares and is preparing to do so for bonds (see Lane (2019)).
- *Banque de France* published its first annual Responsible Investment Report in 2019 where explains that its responsible investment strategy is organized around three pillars: i) align investments with France's climate commitment, ii) ESG criteria in asset management, iii) exercise its right to vote and influence issuers (Banque de France, 2019). In the annual reports published in 2020 and 2021 more details and comparisons are included (see Banque de France (2020, 2021)).

- *Bank of Finland* considers, since 2019, climate risk management as key focus area in its responsibility programme, and has signed the UN-backed Principles for Responsible Investment (PRI).
- The *DNB* published in 2019 its Responsible Investment Charter with the policy applied based on five commitments: i) screen, ii) integrate, iii) promote, iv) report and v) develop (see *DNB (2019)*). In 2019, *DNB* signed the Principles of Responsible Investment (PRI) for its own portfolios and foreign exchange reserves.
- The *Norges Bank* applies exclusion criteria⁹³ in investments of the government pension fund managed by it and *Swiss National Bank* also applies exclusion criteria in share purchases and the exercise of voting rights at annual and extraordinary meetings.⁹⁴
- Finally, *Magyar Nemzeti Bank* (*MNB*) from Hungary created a green bond portfolio as part of its Green Programme.
- Banco de *México* incorporated SRI considerations within the fixed-income holdings in its own portfolios, including debt issued by supranational organisations, government-sponsored entities, and corporations. The central bank considers in its investment decisions environmental elements, as well as ESG and negative screening.

Regarding **monetary policy**, some central banks have started to develop specific programmes in monetary policy frameworks. For example, *MNB* has implemented environmental considerations in its monetary policy toolkit considering that sustainability considerations can be derived from the primary goal of the *MNB* and are also consistent with the additional mandates set out in the Central Bank Act, such as achieving and maintaining price stability.⁹⁵ *Bank of England* is revisiting its monetary policy framework to include climate change considerations.⁹⁶ *Riksbank* only purchases bonds issued by companies deemed to comply with international standards and norms for sustainability, so-called norm-based negative screening, since January 2021.⁹⁷ In July 2021, *Bank of Japan* (*BoJ*) launched a new funding provisioning program by the end of this year under which the central bank of Japan will provide funds to financial institutions against investment or loans they make to address climate change based on their own decisions. Eligible counterparties will be financial institutions that disclose a certain level of information on their efforts to address climate change of the investment/loans made by counterparties as part of their

⁹³ The fund does not invest in companies making certain types of weapons, belonging to the coal sector or producing tobacco or in those engaging in activities which contravene basic human rights. See *Norges Bank (2018)*.

⁹⁴ “The *SNB* also avoids shares in companies which produce internationally banned weapons, seriously violate fundamental human rights or systematically cause severe environmental damage” (*SNB, 2015*).

⁹⁵ See *MNB (2021)*.

⁹⁶ See section 5.2 and *BoE (2021a)*.

⁹⁷ See *Riksbank (2021)*.

efforts, those that contribute to Japan's actions to address climate change. The Bank will purchase foreign currency-denominated green bonds issued by governments and other foreign institutions based on the existing management principles.⁹⁸

In the case of **emerging and developing countries**, a broader range of tools is being used. For example, credit allocation policies are used by the *Bangladesh Bank*, which has set up various green finance facilities for investments in specific sectors such as, for example, water, energy use and textiles. Under this regulation, commercial banks and non-bank financial institutions have to assign 5% of their total loan portfolio to green sectors.⁹⁹ Moreover, *Bangladesh Bank* published Policy Guidelines for Green Banking in 2011 and the Environmental Risk Management (ERM) Guidelines in 2012 that were upgraded and replaced in February 2017 to include social risk.¹⁰⁰ The central bank of *Mongolia* is developing and implementing the sustainable finance framework and issued in 2015 an official directive requiring all banks to report on the implementation of the Principles in their annual reports. The *Reserve Bank of India* extended its "*RBI's Priority Sector Lending*" in 2015 to include social infrastructure and renewable energy projects in the list of priority sectors to which commercial banks must grant 40% of net commercial bank credit.¹⁰¹ The *Banco Central do Brasil* also imposes restrictions on credit in environmentally sensitive areas of the Amazon. Furthermore, it requires commercial banks to incorporate environmental and social criteria into stress tests and to include such risks in capital requirements.¹⁰² In 2020 elaborated a sustainability agenda with the objective to incorporate climate risk and other elements of sustainable finance in the reserves management, the study of the potential creation of a "Green Liquidity Facility", in supervision, regulation.¹⁰³ In April 2021, launched two public consultations on two regulations, one related to risk management and social, environmental and climate responsibility and other on the disclosure of social, environmental, and climate-related risks by financial institutions.¹⁰⁴

The *People's Bank of China* (PBOC) has implemented various "green" tools in recent years, likewise in cooperation with other agencies. These include a *Green Credit Policy*, a database containing detailed information, voluntary *Green Credit Guidelines* for banks, collateral policies and reserve requirements. It is also considering green finance facilities for commercial banks¹⁰⁵ and in 2015 issued a green bond catalogue usually referred as taxonomy.¹⁰⁶ An updated Green Bonds Endorsed Projects Catalogue was released in 2021. The *PBOC* has a policy of promoting green finance through monetary policy (NGFS, 2018). In 2016, the *PBOC*, together with other ministries, published the Guidelines for Establishing

⁹⁸ See Bank of Japan (2021).

⁹⁹ For more details, see Dikau and Volz (2018) and Dikau and Ryan-Collins (2017).

¹⁰⁰ See IFC (2020).

¹⁰¹ It is also being considered including environmental risks when assessing agricultural prices in the analysis of financial and monetary stability. For more details, see Dikau and Ryan-Collins (2017) and Dikau and Volz (2018).

¹⁰² In line with Internal Capital Adequacy Assessment Process (ICAAP)/Basel Accords Pillar 2. See Dikau and Ryan-Collins (2017).

¹⁰³ For more details, see Banco Central do Brasil (2020).

¹⁰⁴ See Banco Central do Brasil (2021a and 2021b).

¹⁰⁵ For more details, see Dikau and Volz (2018).

¹⁰⁶ For a greater detail about this taxonomy, see OECD (2020).

a Green Financial System. It has put in place policies on green bonds, green credit and environmental information disclosure. PBOC is considering the possibility to establish mandatory disclosure requirements for financial institutions (Gang, 2020).

6 Conclusions

The commitments acquired under the Paris agreement will involve the launch of numerous policies aimed at preventing global temperatures from increasing and consequently staving off climate change. The financial system will play a significant role in this process for two reasons. The first is the role it plays in the flow of funds from savers to borrowers, thereby facilitating the investment needed for the transition to a low-carbon economy. And the second is that the effects of climate change and of the transition entail financial risks.

Regarding the need for funds, green finance instruments have emerged and, in particular, the issuance of green bonds has increased considerably in the last three years, their outstanding volume amounting to around \$1.1 trillion in September 2021. However, the issuance of green instruments represents only a small part of total bond issuance (around 5%). Moreover, the valuation of carbon intensive assets is generally misaligned, giving rise to an inappropriate allocation of resources to the detriment of green finance.

Climate change-related financial risks, physical risks and transition risks, are not independent of one another. The fewer the mitigating policies and actions implemented, the greater the physical risks, and vice versa. That said, the worst scenario is that of a late and disorderly transition, when it is already late to avoid the materialisation of physical risks. What is more, their characteristics make them more difficult to assess: broad scope, long and undefined time horizon, foreseeable occurrence and dependence on actions taken now by agents, i.e. they are endogenous. Physical and transition risks are, furthermore, of a systemic nature. However, the systemic scope of these risks will be lower if there is an early and orderly transition to a low-carbon economy which allows economic agents to adapt adequately. By contrast, a late and sudden transition has notable systemic consequences, since not only will there be the economic consequences of the materialisation of physical risks, but systemic shocks involving sudden unexpected changes in the value of numerous assets will also ensue. The political complexity of the economic policy decision-making needed for an orderly transition means that the probability of a scenario of late and disorderly transition is significant.

The business opportunities offered by the transition to a low-carbon economy and the physical and transition financial risks associated with climate change particularly involve and affect financial institutions. As key financial intermediaries, banks are essential actors in the financing of a low-carbon economy. Physical and transition risks give rise, inter alia, to credit and market risks, affecting bank balance sheets. Therefore, banks have to manage climate change-related factors outside the framework of corporate social responsibility, integrating them into the strategy of their main business and furnishing public information on their exposure.

The mandates and responsibilities of central banks regarding financial stability and, where applicable, banking supervision make it necessary for central banks to take into consideration climate change-related factors in their micro- and macro-prudential

supervisory work and in their economic forecasts. Moreover, climate related risks would also affect price stability, the transmission of monetary policy and the balance sheet of central banks. Central banks are analysing how to incorporate climate change aspects in the monetary policy framework and how to apply sustainable and responsible investment practices in the management of their own portfolios. The implications of climate change also prompt central banks to support the financing of the green economy insofar as the achievement of a low-carbon economy through an orderly transition, lessens, as noted above, the risks to financial stability. In this respect, central banks must not be economic policymakers, which is the sole responsibility of governments; rather, they 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.

In recent years, investors, financial institutions and central banks have made headway in the incorporation of climate-related matters into their decisions and actions. First, in the public arena, the European Commission has been working on developing several specific regulations about disclosure, climate indices or environmental classification of activities and continues under the European Green Deal and the Renewed Sustainable Finance Strategy. The International Platform on Sustainable Finance is a multilateral forum of dialogue between policymakers to promote best practices, compare their different initiatives and identify barriers and opportunities of sustainable finance. From the private sector, banks have increased their commitment through several initiatives such as those under UNEP Fi, such as Principles for Sustainable Finance, Collective Commitment to Climate Action and more recently the Net Zero Banking-Alliance. In the vein, the number of asset owners and investment managers that have signed the Principles for Responsible Investment have increased in the last years and the incorporation of SRI investment criteria has increased significantly. In the case of central banks, the progress has been also remarkable. The launch of the Network of Central Banks and Supervisors for Greening the Financial System at the end of 2017, pushed the work of them in relation to contribute to combating climate change and promoting sustainable finance. Currently, central banks are working on the potential impact of climate change in monetary policy, the application of SRI principles in the management of their own portfolios, the assessment of the risks for the financial systems, climate stress tests and supervisory expectations. Against this background, the ECB announced in July 2021 a comprehensive action plan to further incorporate, within its mandate, climate change considerations into its monetary policy framework.

The progress made in the last few years have been remarkable but even greater progress is necessary. It is no easy task and there are numerous challenges to overcome. These include the lack of public information from firms and financial institutions on exposures, the lack of common definitions, for example a broad taxonomy that defines from green to brown, the lack of comparable data, and the underdeveloped state of methodologies incorporating climate-related, macroeconomic and financial factors, and the interactions between them. This task also requires adopting a long-term approach in decision-making

and in the assessment of risks and impacts. In this respect, the publication of different regulations put in place by the European Commission, such as the EU regulation on taxonomy or the EU Sustainable Finance Disclosure Regulation, the commitment to adopt the TCFD recommendations by numerous financial institutions, the NGFS's efforts to increase awareness developing the framework in which central banks incorporate climate-related issues in their agendas, as well as the work of individual central banks, and the progress in academic circles, are all welcome news. The road is long and we have no time to lose.

TASK FORCE ON CLIMATE RELATED FINANCIAL DISCLOSURES (TCFD)

2015 saw the creation of the Task Force on Climate Related Financial Disclosures (TCFD) led by the industry to foster the effectiveness and consistency of voluntary disclosures on risks and opportunities associated with climate change.

In 2017 the TCFD published its recommendations on disclosures on climate-related financial risks for companies and entities to provide information to lenders, insurers, investors and other interested parties (see TCFD (2017)). These recommendations are voluntary and aimed at the provision of consistent, comparable, reliable and clear information structured in eleven disclosure elements of four thematic areas: governance, strategy, risk management, and metrics and targets.

The support for the TCFD has grown remarkably since the launch of the recommendations, with 1924 companies and other organizations committing their support to March 2021. Among them, 957 are from the financial sector (of which, 139 are banks and 518 asset managers), 7 central banks (Belgium, Hong Kong, Japan, Morocco, Netherlands, Singapore and United Kingdom), 26 supervisors and regulators and 15 governments. Spain has 34 signatories, among them 7 banks.

The last Status Report of the TCFD (TCFD, 2020) reviewed 1700 public companies to determine whether their reports

include information aligned with TCFD recommendations. The report recognizes that climate-related disclosure has improved significantly since 2017, but its alignment with recommendations remains low (see last column of above table). Areas for which the percentage of reviewed companies with TCFD aligned disclosure is 25% or below are the ones related with board oversight, risk management and resilience of strategy. For this last area, the report found that the percentage of companies disclosing the resilience of their strategies (a 7%), taking into consideration different climate-related scenarios, including a 2°C or lower scenario, was significantly lower than that of any other recommended disclosure. The report also found that disclosures are primarily made in sustainability reports.

TCFD has developed pilot exercises joined with UNEP FI for banks, insurers and investors. In the case of banks there have been two phases. The first one (2017-2018) was focused on the development of transition and physical assessment models and metrics to enable scenario-based, forward-looking assessment and disclosure of climate-related risks and opportunities. Phase II (2019-2021) focused on the four pillars of TCFD disclosures and how to establish good practices across the financial sector. Finally, in January 2021 has started phase III to explore more climate stress testing, the integration of physical and transition risk assessments, and sector-specific risks and opportunities.

Table 1
TCFD-ALIGNED DISCLOSURES

TCFD recommendation by thematic area	Disclosure elements	Companies with TCFD aligned disclosure 2019
Governance		
Disclose the organization's governance around climate-related risks and opportunities	a) Board Oversight	24%
	b) Management's Role	28%
Strategy		
Disclose the actual and potential impacts of climate-related risks and opportunities on the organization's businesses, strategy, and financial planning where such information is material	a) Risks and Opportunities	41%
	b) Impact on Organization	35%
	c) Resilience of Strategy	7%
Risk management		
Disclose how the organization identifies, assesses, and manages climate-related risks	a) Risk ID and Assessment Processes	25%
	b) Risk Management	25%
	c) Integration into Overall Risk Management	17%
Metrics and targets		
Disclose the metrics and targets used to assess and manage relevant climate-related risks and opportunities where such information is material	a) Climate-Related Metrics	35%
	b) Scope 1, 2, 3 GHG Emissions	26%
	c) Climate-Related Targets	33%

SOURCE: TCFD. 2020 Status Report.

OBSTACLES AND CHALLENGES TO PROGRESS

The advance of green finance, the factoring-in by banks of climate-related opportunities and risks and the inclusion of climate change matters in micro- and macro-prudential supervision by central banks has been notable, although much remains to be done. To press ahead, it will be necessary to overcome a series of obstacles and challenges, some of which are behind the widespread perception that asset prices do not adequately reflect climate risks, particularly transition risk. And that, in turn, gives rise to an inefficient allocation of financial resources and has adverse effects on financial stability.

These obstacles include most notably:

- **Insufficient public information.** Without public information on exposures to climate-related financial risks, it is not possible to accurately value the impact of climate change on financial assets and prevent inefficient allocation of resources. This public information is crucial for firms, investors and consumers to take appropriate decisions, for banks to value their exposures, for governments to draft policies and for supervisors to assess impacts on the financial system. In addition, this information has to be disseminated in a harmonised fashion at international level. In this respect, the recommendations formulated by the TCFD and their implementation guide mark an advance.
- **Common taxonomy.** Many of the actions to be carried out by investors, banks and supervisors need a taxonomy with standard criteria at global level to distinguish what is “green” and what is “brown”. The EU regulation on taxonomy is a step forward, but unfortunately it only encompasses “green” activities.
- **Time lag between action and impact (the tragedy of the horizon).** The impact of climate change-related risks will occur beyond the decision horizon of investors, banks, supervisors and other agents. Nevertheless, the future impact depends on the actions taken today. This time lag induces a lack of perception and consciousness of the risks associated with climate change. A long-term perspective by all agents is needed so that the decisions made today take into consideration their future impact.
- **Lack of adequate methodologies.** The assessment of climate-related risks requires methodologies based on forward-looking scenarios, with complex cause-effect interactions between climate-economy-financial sector, and on data which have not been observed in the past. As noted by the Network for *Greening the Financial System* (NGFS), the tools and methodologies for assessing climate-related financial risks are still incipient, albeit developing briskly.
- **Lack of data.** The limited availability of data reduces the ability of supervisors and financial institutions to properly assess risks. Access to data at individual asset level with granular information on the issuer’s sector of activity is particularly limited.

RECOMMENDATIONS OF THE NETWORK FOR GREENING THE FINANCIAL SYSTEM (NGFS)

In April 2019 the NGFS issued six recommendations which will hopefully inspire central banks and supervisors, whether NGFS members or not, and other financial system participants to take the necessary measures to promote a greener financial system (see NGFS (2019b)). They are not compulsory and reflect the best practices identified by NGFS members to facilitate the role of the financial sector in achieving the objectives of the Paris Agreement. Specifically, the six recommendations are as follows:

- 1 **Integrating climate-related risks into financial stability monitoring and micro-supervision.** The purpose of this recommendation is to assess risks by identifying transmission channels, adopting risk indicators and conducting quantitative analyses.
- 2 **Integrating sustainability factors into own-portfolio management.** Central banks are encouraged to lead by example in their own operations. Notwithstanding institutional differences, this entails integrating sustainability factors into the management of some of their portfolios, such as own funds, pension funds and reserves.
- 3 **Bridging the data gaps.** Authorities are recommended to share data and, wherever possible, make them publicly available.
- 4 **Building awareness and intellectual capacity and encouraging technical assistance and knowledge-sharing.** The NGFS encourages central banks, supervisors and financial institutions to build in-house capacity and to collaborate within their institutions, with each other and with wider stakeholders to improve their understanding of how climate-related factors translate into financial risks and opportunities.

- 5 **Achieving robust and internationally consistent climate and environment-related disclosure.** The NGFS emphasises the importance of a disclosure framework and supports the recommendations of the TCFD.
- 6 **Supporting the development of a taxonomy of economic activities.** This recommendation aims to enhance the transparency in respect of economic activities which i) contribute to the transition to a green and low-carbon economy and ii) are more exposed to climate-related risks (both physical and transition).

The first four recommendations apply to the work of central banks and supervisors, while the last two are aimed more at policymakers to facilitate the work of central banks and supervisors. The NGFS published in 2019, 2020 and 2021 reports on: i) a sustainable and responsible investment guide for central banks' portfolio management, ii) a guide for supervisors: integrating climate-related and environmental risks into prudential supervision, iii) a status report on financial institutions' practices with respect to risk differential between green, non-green and brown financial assets and a potential risk differential, iv) NGFS climate scenarios for central banks and supervisors, v) a guide to climate scenario analysis for central banks and supervisors, vi) initial takeaways on climate change and monetary policy and how it is incorporated in their frameworks, vii) an examination of the implications of climate change for central banks' operational frameworks and for the implementation of monetary policy in practical terms, viii) research priorities on the macroeconomic and financial stability impacts of climate change, ix) an overview of the environmental risk analysis done by financial institutions, x) a report on sustainable finance market dynamics and a dashboard with indicators, and xi) a progress report on bridging data gaps.

EUROPEAN CENTRAL BANK'S ROADMAP FOR INCORPORATING CLIMATE CONSIDERATIONS INTO ITS MONETARY POLICY STRATEGY

The Governing Council of the European Central Bank announced on July 8, 2021 its roadmap for incorporating climate considerations into its monetary policy framework (see ECB (2021a)). Climate and environmental sustainability issues have featured prominently in the review of the strategy conducted in 2020 and 2021. Recognizing that governments and parliaments have the primary responsibility to act on climate change, the ECB establishes, within its mandate and in line with its obligations under the European Union Treaties, a set of actions to incorporate climate considerations into its monetary policy framework. The design of the necessary measures will be consistent with the objective of price stability and should take into account the implications of climate change for an efficient allocation of resources. Specifically, the areas of work between 2021 and 2024 are going to be:

- **Macroeconomic modeling and assessment of the implications for monetary policy transmission.** The work will be carried out in two phases, first, between 2021 and 2022 technical assumptions on carbon pricing will be introduced to forecast and regularly assess the impact of related fiscal policies. Then, between 2022 and 2024, climate risks will be integrated into the models by assessing their impact on potential growth, scenario analyses will be carried out in terms of transition policies and analysis of implications for monetary policy transmission.
- **Statistical data for risk analysis.** New indicators will be developed on green financial instruments, financial institutions' exposures to physical risks through their portfolios, as well as on the carbon footprint of their portfolios.
- **Introduction of disclosure requirements for private sector assets** as a new eligibility criterion or as a basis for differentiated treatment for the purposes of their presentation as collateral and asset purchases. Ongoing EU initiatives on disclosure, as well as proportionality, will

be taken into account. A detailed plan will be announced in 2022.

- **Improved risk assessment capabilities.** From 2022, the ECB will conduct climate stress tests on the whole Eurosystem balance sheet based on the pilot exercise conducted in 2021 to the economy. Disclosures by CRAs eligible for the Eurosystem credit assessment system will also be assessed and the ECB will consider developing minimum criteria for the incorporation of climate risks in its internal ratings.
- **Collateral framework.** The ECB will consider relevant climate change risks when reviewing the valuation and risk control frameworks for assets mobilised as collateral by counterparties for Eurosystem credit operations. The ECB will also continue to monitor structural changes in the markets for sustainability products to support innovation in sustainable finance within the scope of its mandate. One example is the decision to accept Sustainability Linked Bonds with objectives subject to environmental sustainability criteria as collateral (see ECB (2020c)).
- **Corporate sector asset purchases.** The ECB has already started to take climate risks into account in due diligence procedures for corporate sector asset purchases for its monetary policy portfolios. Looking ahead, the ECB will adjust the framework guiding the allocation of corporate bond purchases to incorporate climate change criteria, in line with its mandate. In the first quarter of 2023, the ECB will start disclosing climate-related information of the corporate sector purchase programme (CSPP).

All these actions will be done taking into account the progress made in the European Union in terms of information disclosure, such as the proposed Corporate Sustainability Reporting Directive, as well as the Taxonomy Regulation and the Regulation on the disclosure of information related to sustainability in the financial services sector.

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Acronyms and abbreviations in sustainable finance

AEB	Spanish Banking Association
BCBS	Basel Committee on Banking Supervision
CECA	Spanish Confederation of Savings Banks
COP	Conference of the Parties to the United Nations Framework Convention on Climate Change
CSRD	Corporate Sustainability Reporting Directive
EBA	European Banking Authority
ECB	European Central Bank
EIOPA	European Insurance and Occupational Pensions Authority
ESG	Environmental, Social, Governance
ESMA	European Securities and Markets Authority
EUGBS	European green bond standard
FC4S	Financial Centres for Sustainability network
FINRESP	Spanish Centre for Responsible and Sustainable Finance
HLEG	High-Level Expert Group
INVERCO	Spanish Association of Collective Investment Schemes and Pension Funds
IPSF	International Platform on Sustainable Finance
NFRD	Non-Financial Reporting Directive
NGEU	Next Generation EU
NGFS	Network of Central Banks and Supervisors for Greening the Financial System
PRI	Principles for Responsible Investment
RSFS	Renewed Sustainable Finance Strategy
SDGs	Sustainable Development Goals
SRI	Sustainable and Responsible Investment
TCFD	Task Force on Climate-related Financial Disclosures
TEG	Technical Expert Group
TNFD	Task Force on Nature-related Financial Disclosures
UNACC	Spanish Association of Credit Cooperatives
UNEP	United Nations Environment Programme
UNEP FI	United Nations Environment Programme Finance Initiative
UNESPA	Spanish Association of Insurers and Reinsurers
UNFCCC	United Nations Framework Convention on Climate Change

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