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Addressing climate change data needs: the global debate and central banks' contribution

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Executive summary

Improving climate risk data has become a universally acknowledged imperative. This priority is shared by central banks, which in recent years have been actively exploring ways to enhance their policymaking frameworks to better address the impact of climate change. The focus has been on assessing the broad spectrum of data-related issues and developing adequate solutions.

While important initiatives are under way at both national and international levels to identify and address climate risk-related information needs, **significant challenges remain in terms of data availability, reliability and comparability.** Data gaps are particularly pronounced for forward-looking indicators of physical climate risks, as well as for the assessment of progress associated with net zero transition policies.

Moreover, **the climate risk landscape is constantly evolving**, indicating that environmental impacts will materialise gradually over time and may follow non-linear patterns. Climate risk outcomes will depend on the development of both physical risks (such as increased flooding and heatwaves) and transition risks (such as bank exposures to carbon-intensive sectors). These outcomes will be influenced by evolving national priorities, which will, in turn, significantly affect policies and progress.

The identified data-related challenges call for **ambitious statistical strategies to successfully bridge existing data gaps.** While information should be available at different aggregation levels to reflect the variety of stakeholder needs, specific attention has to be given to developing global climate metrics that are essential for rigorous impact and policy evaluation. Ideally, such metrics should be publicly

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available, reliable, comprehensive and comparable. Furthermore, the importance of exchanging national experiences in addressing a truly universal issue like climate change cannot be overstated. This serves as a reminder that global progress cannot be achieved without active and close cooperation between critical national and international stakeholders.

Central banks have already taken many steps to address climate data issues, leveraging their unique perspective as both producers of official statistics and users of robust and trustworthy evidence in fulfilling their public mandates. A driving factor is that climate change is expected to gradually affect their core policies, especially in the areas of monetary and financial stability, as well as their roles as asset and reserve managers and supervisors of payment systems. In particular, climate change may affect inflation by disrupting supply chains, reducing output in key sectors such as agriculture and increasing overall production costs. Additionally, both transition and physical risks could pose significant challenges to the pursuit of central banks' financial stability mandates. Climate risk is also a crucial consideration for central banks tasked with the microprudential supervision of financial institutions, potentially necessitating a revision of regulatory frameworks to ensure that vulnerabilities in the financial system are properly identified, monitored and mitigated. Lastly, a growing number of central banks are taking specific policy actions to support the development of green finance as a means of mitigating the impact of climate change.

Looking ahead, and reflecting their important roles in today's economies, **central banks can be instrumental in spurring global efforts to overcome climate data gaps.** They are well placed to take stock and make sense of the growing related data available from different sources and in various formats. They can also more actively contribute to the compilation of necessary analytical indicators, particularly in the context of their oversight role of the financial system. Additionally, central banks have been actively fostering coordinated data work on climate risk within national data ecosystems, especially in collaboration with their counterparts in national statistical offices.

In addition, **a key part of central banks' efforts to close climate risk-related data gaps will continue under the umbrella of international initiatives**, employing a multifaceted approach. A first objective is to finalise data compilation exercises organised globally, particularly in the context of the G20 Data Gaps Initiative (DGI). A second focus is to develop common methodologies and experimental indicators, including forward-looking ones, by promoting harmonised statistical frameworks and practices. Third, enhanced information-sharing (including data, frameworks and methodologies) is essential for accurately assessing the environmental footprint of economic activities in today's globalised world. Lastly, technological innovation offers promising solutions to overcome climate-related data gaps, and central banks have been playing an active role in utilising new data sources and tools in this endeavour.

1. Introduction

There is widespread recognition of the need to facilitate the exchange of experience between the various stakeholders involved and the general public on **the challenges**

and prospective solutions that can enhance climate resilience strategies, with a primary focus on bridging existing and large information gaps.

In this context, **improving climate risk data** – and data on a wider range of environmental, social and governance (ESG) topics more generally – has become a universally acknowledged imperative. This priority is shared by central banks which, in recent years, have actively considered ways to enhance their policymaking frameworks to better tackle the impact of climate change, identify a broader spectrum of data-related challenges and develop potential remedies in close coordination with all involved stakeholders (IFC (2022)).

Indeed, **important ongoing initiatives, both at the national and international levels, are contributing to identify and address climate risk-related data needs**. These initiatives focus, in particular, on better measuring the climate impact of economic activities, monitoring the contribution of climate finance and government expenditure to mitigate climate change, and developing forward-looking physical and transition risk indicators.

Yet **key data challenges remain**, not least because the climate risk landscape and national priorities are constantly evolving. First, this calls for clear and **ambitious statistical strategies for successfully bridging existing information gaps** – by developing adequate methodological concepts and technical solutions, identifying the most relevant indicators, developing international collaborations to concretely make progress on data collections and ensuring that policy actions can effectively benefit from the information revealed by these data.

Second, **the exchange of national experiences is essential for tackling a truly global issue like climate change**. For its part, the central banking community has worked to identify best practices in adopting climate risk resilience and data initiatives, integrating internationally recognised methodological concepts, extracting insights from the information collected and developing adequate, evidence-based policy actions.

Lastly, **global progress cannot be achieved without active cooperation between critical national and international stakeholders** – especially multilateral institutions, central banks, financial regulators, finance ministries, statistical offices, academia and the private sector – in their efforts to address climate risk data issues and adopt broader climate risk strategies. Such cooperation can, in particular, be very effective to better leverage innovation collectively so as to benefit from the growing availability of innovative data sources and artificial intelligence (AI) techniques.

It is in this context that the Irving Fisher Committee on Central Bank Statistics (IFC) of the Bank for International Settlements (BIS) organised a dedicated workshop on "Addressing climate change data needs: the global debate and central banks' contribution" with the Central Bank of the Republic of Türkiye, the Bank of France and Deutsche Bundesbank in May 2024.[2]

This overview aims to shed light on the various issues highlighted above, benefiting from the **unique perspective of central banks as both producers of reference official statistics and users of robust and trustworthy evidence to**

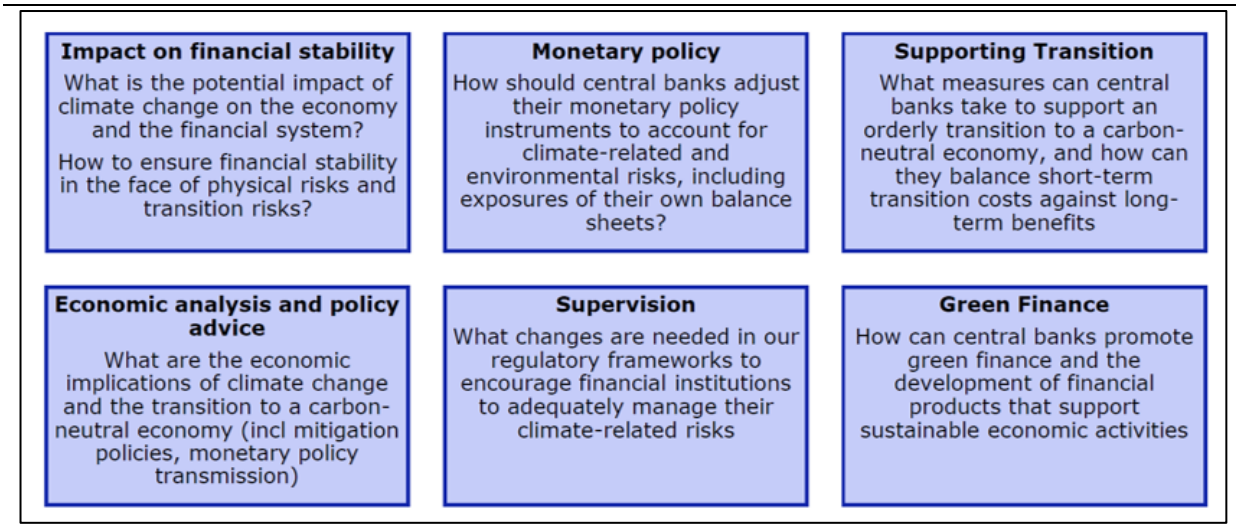
[2] The workshop built upon previous IFC work in this area (IFC (2021)).

support their policies. It starts with a discussion of why central banks need climate risk-related data (Section 2) and a review of the most pressing information gaps (Section 3). It then analyses the various possible contributions of central banks in supporting national strategies for overcoming climate risk data gaps (Section 4) and takes stock of the main international initiatives pursued in this context (Section 5). Finally, looking forward, it provides a brief overview of the possibilities offered by new data sources and innovative techniques (Section 6).

2. Why do central banks need climate risk-related data?

Central banks around the world are increasingly recognising the need for robust evidence to assess climate-related risks in pursuing their public mandates (Tamez et al (2024)). The reason is that climate change is expected to gradually affect their core policies, especially in the areas of monetary and financial stability, in addition to their activities as asset and reserve managers. Climate risk is also an important factor to consider for those central banks tasked with the microprudential supervision of financial institutions such as commercial banks or insurance companies (Dafermos (2021)). Lastly, a growing number of central banks are taking specific policy actions to support the development of green finance as a means of mitigating the impact of climate change (Graph 1).

Central banks' activities related to climate change — Graph 1



Source: Fortanier (2025).

Climate risk and monetary policy

Climate risk can have significant implications for monetary policy, particularly reflecting the expected impact of supply-side disruptions and (structural) changes in economic activity on inflation. Extreme weather events such as droughts, hurricanes, flooding and wildfires can reduce agricultural output, disrupt supply chains or

damage infrastructure, leading to **higher costs** for the production of various goods and services, **at least on a transitory basis** (Box A and NGFS (2021)).

Box A

Economic implications of climate risk

Climate change poses the risk of large economic shocks, potentially affecting nearly every sector. In particular, extreme weather events, rising sea levels and shifts in climate patterns may have adverse effects on physical infrastructure and on the production of specific goods, in turn undermining economic performance. While costly mitigation measures could provide some relief and protect economic agents from excessive losses (though their insurability conditions may worsen), businesses may face an increase in their ongoing operational costs. They would also have to deal with a higher degree of uncertainty, associated for instance with potentially disrupted supply chains in specific sectors and more volatile market conditions generally. Governments may also have to spend more on both prevention and disaster response, putting further pressures on public resources. Lastly, climate change could also amplify credit risk, as extreme weather events and long-term climate shifts would impair borrowers' ability to repay loans, especially in vulnerable industries/geographical areas, in turn giving rise to potentially large financial stability issues.

Specific segments of the economy, such as agriculture, are likely to be markedly affected by climate change. For instance, recent estimates suggest that the impact of climate change on wheat production in Türkiye could be quite large, as it will suffer from evolving rainfall patterns and extreme temperatures. For example, excessive heat and drought, especially during the spring and summer months, may significantly reduce crop yields and food security in the short, medium and long term. The extent of their impact will depend on the climate scenario and time horizon, with possible important underlying non-linearities. Timely and detailed climate data, such as temperature and precipitation trends, will therefore be essential for carefully monitoring the consequences of climate change on agriculture.

Moreover, the economic and financial systems are highly interconnected, making any assessment and mitigation of climate change a complex task. For example, a recent analysis of Poland's banking portfolios shows that the share of credit exposure to greener sectors has risen slightly over time, with a parallel fall in "dirty" exposures. At the same time, banks' exposure to environmental, social and governance (ESG) transition risks has remained substantial, and an important share of climate-sensitive loans could raise operating costs for banks, reduce asset values and worsen borrowers' creditworthiness. These findings, which are consistent with studies about other countries, matter not only at the level of the individual financial institutions involved, which have to manage their climate-related exposures and refine their business strategies accordingly, but also from a more macro-financial stability perspective.

Another important factor to consider is the impact of policy responses to climate risk. In the European Union, for instance, one critical development has been setting up the Carbon Border Adjustment Mechanism (CBAM), which will impose tariffs on carbon-intensive imports by 2026. This mechanism could raise production costs and disrupt global trade patterns, leading to new challenges in specific sectors/areas.

The above examples suggest that climate risk may extend far beyond environmental concerns into economic realities, posing deep challenges in terms of development as well as financial and monetary stability. National policy responses will also matter greatly, including through their global repercussions. In any case, access to comprehensive climate-related data will be essential for identifying the risks involved, assessing potential macroeconomic impacts and guiding policy responses.

At the same time, **the shift to a low-carbon economy could also be associated with more lasting shifts in price levels over the coming decades**, driven by factors such as a marked rise in carbon pricing, substantial public infrastructure investment, including the development of new energy sources, and the introduction of new regulations. These factors may put persistent upward pressures on production costs, particularly in carbon-intensive industries, and thus on consumer inflation. Hence,

climate change may be a relevant factor challenging central banks' ability to maintain price stability in the longer run.

Moreover, climate risk introduces uncertainty that complicates decision-making. Should inflationary pressures from climate-related disruptions become more frequent, central banks may need to adjust their policy frameworks, for instance to better take into account the impact of supply side shocks in addition to the more traditional focus on demand side factors (Ehlers et al (2025)). Furthermore, climate considerations may need to be integrated into inflation-targeting frameworks, not least to properly address potential short-term inflationary shocks due to changes in price levels caused by structural adjustments in the economy (Bolton et al (2020)). And climate risk may also influence the design of central banks' monetary policy operations, for instance as regards their asset purchase programmes and collateral frameworks, as suggested by the experience of the European Central Bank (ECB (2023)).

All in all, the evolving impact of climate change on inflationary prospects may call for a fundamental review of central banks' tools and objectives to maintain monetary stability. Inaction could raise the risk of prolonged periods of price volatility, challenging central banks' credibility and effectiveness in achieving their public mandates (NGFS (2021)).

Climate risk and financial stability

Climate risk may also pose significant challenges to the pursuit of central banks' financial stability mandates (eg Campiglio et al (2018)). Specifically, physical risk events[3] – such as extreme weather conditions – can lead to asset devaluations, insurance losses and borrower defaults, particularly in those sectors highly exposed to climate change, such as real estate, infrastructure and agriculture. For instance, rising sea levels and flooding may reduce the value of properties in vulnerable areas, increasing credit risks for banks that own related specific assets or are indirectly exposed to corresponding loans. Meanwhile, transition risks – eg those stemming from shifts in government policies, technological advancements or changing consumer preferences – could lead to a rise in stranded assets, particularly in fossil fuel-intensive industries. The reason is that companies with high carbon footprints may suffer from unanticipated or premature write-downs, lowering equity valuations as investors reallocate capital towards greener alternatives, in turn raising potential instability in financial markets (Bolton et al (2020)).

To address these risks, central banks as well as other financial authorities are **increasingly incorporating climate risk analysis into their financial stability frameworks, with both a macroprudential and microprudential perspective.** At the macro level, they are developing scenario analyses for assessing the resilience of the overall financial system in the face of possible climate-related shocks. At the micro level, they are monitoring and identifying the vulnerabilities of individual banks or insurers under different climate scenarios. The aim is to better understand potential pressure points in the financial system and take proactive supervisory measures to

[3] The consideration of physical risks by central banks has been discussed by Raga et al (2024), for example.

mitigate solvency risks when deemed appropriate (see ECB (2023) and Board of Governors of the Federal Reserve System (2024)).[4] Insights gained on the implications of climate change at the macro and micro levels may call for a careful review of the existing macroprudential and microprudential frameworks. Additionally, climate-related disclosure requirements for market participants would need to be refined further to enhance the quantity and quality of information available to authorities, financial investors and other stakeholders.

Supporting the development of sustainable finance

A growing number of central banks are taking specific actions to support the development of sustainable finance and, as an essential step, the availability of related data. The reason is that tracking financial investments in more environmentally friendly activities can be essential in assisting private and public agents to take informed decisions and make progress in achieving internationally agreed environmental commitments. In this context, attention is being placed on the promotion of green finance, with the aim of increasing the use of dedicated financial instruments (green bonds, equities and investment funds) to support sustainable development priorities.

While green finance is still not well captured in existing macroeconomic statistical frameworks, important initiatives are under way. In particular, central banks in many jurisdictions have been making use of their large-scale security-by-security (SBS) databases to identify financial instruments such as green bonds and sustainability-linked bonds in a very granular way (IFC (2024b)). These databases make use of precise information both in the issuance and stock of **debt instruments**, which can be essential for policymakers to understand the scale, sources and direction of green financing. There is also increasing recognition of the need to better identify and measure **green equity**, at least with regard to listed corporate shares, and also to facilitate assessment of the environmental impact of the global supply chain, especially through **foreign direct investment** (FDI) (Box B).

Important work is under way to develop a more standardised methodology for compiling statistics on green finance. At the European level, the ECB has set up a framework to measure green equity securities using two keys SBS databases, namely the Centralised Securities Database (CSDB) and the Securities Holdings Statistics Database (SHSDB). The approach relies on the identification of granular securities through attributes such as issue dates, security status and type of climate finance debt instrument, following the methodological guidance provided in the context of the System of National Accounts (SNA).[5] It shows that the outstanding

[4] Several other central banks, including the Bank of England, have undertaken financial stability analyses that integrate climate risk considerations.

[5] As reflected in the Handbook on Securities Statistics (HSS), with due consideration for the new methodological advancements developed in the 2025 revision of the international statistical standards. In addition, the approach has taken into account various initiatives – eg Climate Bonds Initiative (CBI) Climate Bonds Standards, International Capital Market Association (ICMA) Green Bond Principles, ICMA Social Bond Principles, ICMA Sustainability-linked Bond Principles, ICMA Sustainability Bond Guidelines or the European Green Bond Standard. The main objective is to identify the following characteristics: issuer sector, currency of denomination, maturity, interest rate type, type of climate finance security, assurance level and climate bonds standard.

amount of green securities in the euro area has nearly tripled in the past few years (Graph 2, left-hand panel).[6] The data also reveal a high degree of reliance on independent evaluations of the data reported ("external assurance"), with about 90% of these securities benefiting from second-party certification (Graph 2, right-hand panel).

Box B

Measuring FDI's carbon footprint

Climate risk-related data are usually analysed on the basis of the economic units that are located in specific jurisdictions, not least because they are used for supporting policy decisions taken by national authorities. Yet, **such a "residency-based" approach may be too restrictive to assess climate risk which, by definition, has a global dimension**. In particular, the climate data disclosed by corporate groups in their financial statements are provided on a "nationality basis" that typically spans across national borders, not least because of the foreign activities that take place outside the jurisdictions of the controlling parents (Tissot (2016)).

In this context, **increased attention is being put on assessing the impact of the global value chain and in particular on the role of foreign direct investment (FDI) on climate-related issues** (Duan and Jiang (2021)). On the one hand, FDI can help to reduce greenhouse gas (GHG) emissions by facilitating the transfer of greener technologies ("pollution halo hypothesis"). On the other hand, FDI can also lead to the use of pollution-intensive technologies in countries with lower environmental standards, increasing carbon emissions ("pollution haven hypothesis").

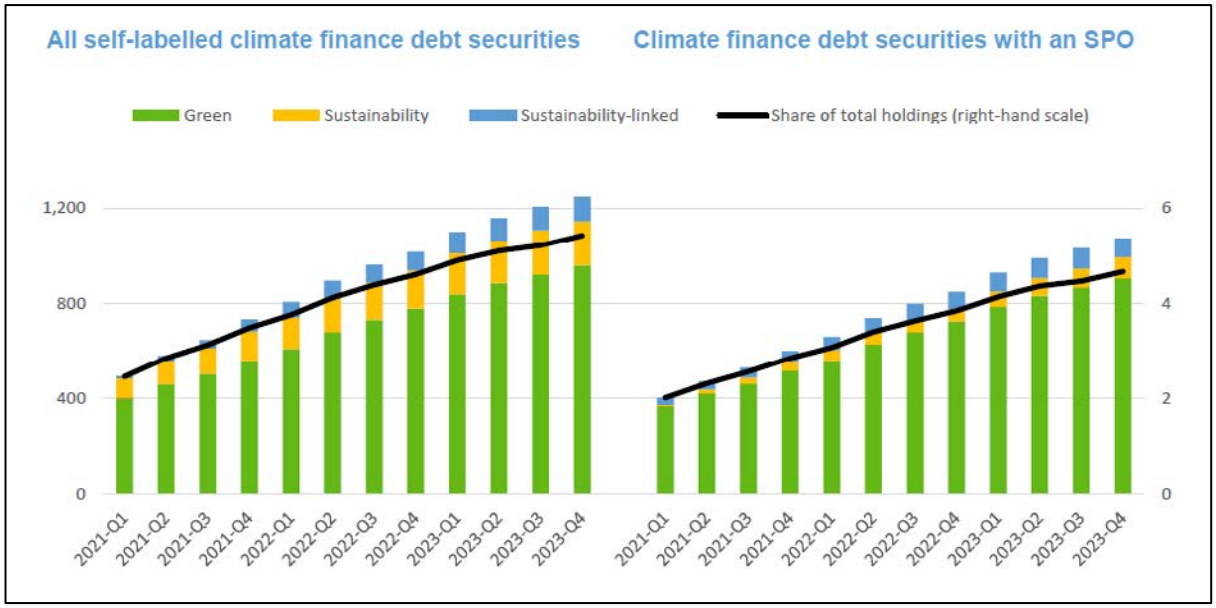
Addressing these issues **calls for adequately measuring FDI's carbon footprint**, but this is challenging and mostly done at the aggregate level in practice. For instance, work undertaken in the context of the third phase of the G20 Data Gaps Initiative (DGI-3) has underscored interest in using macro-level data (eg on gross fixed capital formation) and multi-regional input-output tables to split aggregate carbon emissions by FDI breakdowns.

But **more granular methods can be promising alternatives to aggregate approaches**. For example, a measurement of both inward and outward FDI carbon footprints has been conducted for France using granular data on listed companies' GHG emissions (collected from commercial data providers) combined with a financial data set from the Bank of France and direct investment enterprises data from the French National Institute of Statistics and Economic Studies (INSEE) and the European Central Bank. GHG data for the other, unlisted companies were inferred from their parent groups' characteristics. The study found that the carbon footprint of inward FDI is lower compared with outward FDI, likely due to France's strong reliance on low-carbon nuclear energy.

Substantial conceptual work remains to be done to tackle existing data limitations. These include inconsistencies in GHG emissions disclosed in corporate reports, the lack of carbon efficiency data for many countries, especially in developing regions, and the limited information available on the foreign affiliated entities of global groups. Addressing these issues calls, in particular, for improved international coordination in developing and validating the necessary methodologies and models.

[6] The global issuance of climate finance debt securities has surged to over USD 500 billion annually over the past decade (IMF (2024)).

Euro area holdings of climate finance debt securities Graph 2



Left-hand scale (for all bars, in both the left- and right-hand panels): EUR billions, outstanding amounts at face value; right-hand scale: share of climate finance debt securities with a second party opinion (SPO) in all debt securities held in the euro area, in per cent (black line).

Holdings refer to all (ie self-labelled) climate finance debt securities (left-hand panel) and to those with an SPO (right-hand panel).

Source: Fusero et al (2025).

3. Climate risk data gaps

Data availability, reliability and comparability issues

Dealing with climate-related risks calls for having adequate information available at different aggregation levels, reflecting the variety of use cases at stake. At the micro level, financial and non-financial companies are asked to compile and disclose specific climate-related reports to meet evolving reporting standards or regulations, including for supervisory stress tests (Mohan (2024)). Such granular insights can also be used to support the measurement of the carbon content of economic output by sectors, a key element for monitoring the implementation of national climate objectives, such as those outlined in the Paris Agreement (IFC (2024a)). And, at the global level, there is an urgent need for more common, comprehensive and publicly available reference data for aggregate country emissions (eg OECD (2024)).

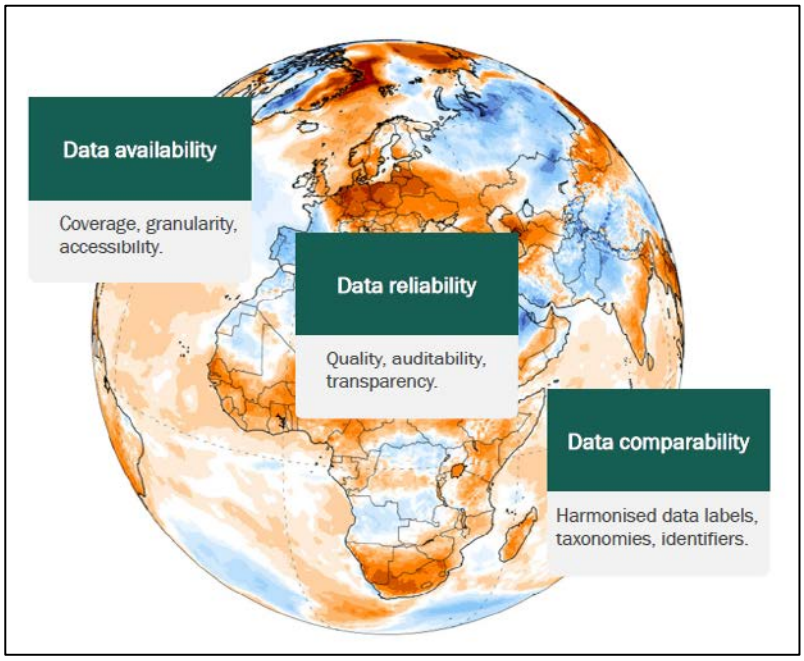
Irrespective of the granular or aggregate levels considered, **three main challenges** are faced in addressing the various stakeholders' climate-related data needs (Graph 3). These challenges relate to:

- **data availability**;
- **data reliability**; and

- **data comparability**.

These three challenges are particularly pronounced for forward-looking indicators of physical climate risks as well as for assessing the risks and opportunities associated with net zero transition policies (NGFS (2022)).

Addressing climate-related information needs – main data challenges Graph 3



Source: Izmir workshop on "Addressing climate change data needs: the global debate and central banks' contribution".

First, as regards data availability issues, there are significant gaps related to non-listed financial instruments and, more generally, for assessing risks in emerging markets and developing economies. While adequate climate-related financial analyses require detailed, entity-level or asset-level insights, actual data collections often focus on listed instruments (equities and bonds), ie information that is readily available in the public domain. At the same time, other key asset classes, such as loans and private equity, are often blind spots. Moreover, even for well covered financial instruments, such as listed corporate debt securities, climate-relevant data collection is geographically uneven, with far greater availability for Europe and North America compared with the Asia-Pacific and Latin America regions, and even more so with Africa.

Addressing these availability gaps calls for enhanced corporate disclosure requirements and capacity-building efforts. There are already (quasi-) mandatory firm-level disclosure initiatives by the International Sustainability Standards Board (ISSB) at the global level, with additional complements across jurisdictions, for instance the Corporate Sustainability Reporting Directive (CSRD) in the European Union. Additionally, simplified disclosure requirements have been developed in various places to facilitate data collections from small and medium-sized enterprises (SMEs) (ADB (2025)). Specific actions have also been taken to strengthen climate-related disclosure at the firm level, for instance in the context of the Corporate Climate Governance (CCG) Facility of the European Bank for Reconstruction and Development

(Haralampieva and Chawla (2024)). In this context, emerging data sources and technologies, such as geospatial data and AI/machine learning-assisted analytics, will likely play an increasingly important role to help bridge climate-related disclosure gaps. For example, satellite data are already being used to support the monitoring of methane emission reductions and assess physical climate risks at the asset level (see Section 6).

A second key challenge relates to the reliability of climate-related data, which is essential for supporting meaningful policy action, including by correctly identifying aggregate risks and preventing the provision of misleading information to investors (ie greenwashing). From this perspective, metadata transparency and the credibility of underlying methodologies are crucial, yet often lacking. For example, the quality of data on carbon offset markets[7] is notoriously weak, not least because the necessary methodological concepts are still being developed, implying that companies' climate offset pledges often lack transparent metrics and targets. This calls for providing clear guidance, standards and certification to ensure the reliability of related data and analyses.

Third, comparing climate-related data across jurisdictions, sectors and entities can be challenging due to different assumptions and design choices. A primary example is the reconciliation of climate ratings across various data providers, as they tend to adopt different methodological approaches when scoring the degree of sustainability of financial instruments. For example, Graph 4 displays the climate alignment ratings for eight selected corporates, illustrating that such evaluations vary widely. These differences can stem from different choices in the metrics considered themselves (eg absolute vs intensity-based emissions), the time focus (short or long term) and the emissions coverage (eg scopes 1, 2 and 3),[8] all of which can significantly influence the resulting assessments (Noels and Jachnik (2022)). Ensuring transparency regarding these factors is essential to support "apple-to-apple" comparisons. At the same time, further work should be pursued by the international community to converge towards interoperable taxonomies and sustainability disclosure standards as a key foundation for enhancing the comparability of the underlying data.

[7] Carbon credits, also known as carbon offsets, are permits that allow the owner to emit a certain amount of carbon dioxide or other greenhouse gases. See Advisory Expert Group on National Accounts (2022) for planned enhancements to the recording of emission trading schemes in the SNA.

[8] For a description of these concepts, see Box B in IFC (2024a).

Climate ratings vary widely across rating providers Graph 4

Company	Provider 1	Provider 2	Provider 3	Provider 4	Provider 5
Company A	Not aligned	Not aligned	Not available	2 Degrees	Not aligned
Company B	Not aligned	Not aligned	1.5 Degrees	Not aligned	Not aligned
Company C	Not aligned	Not aligned	Not aligned	Not aligned	2 Degrees
Company D	1.5 Degrees	2 Degrees	Not aligned	Not aligned	Not aligned
Company E	1.5 Degrees	2 Degrees	Not aligned	Not aligned	Not aligned
Company F	1.5 Degrees	2 Degrees	Not aligned	Not aligned	Not aligned
Company G	Not aligned	1.5 Degrees	Not aligned	Not aligned	Not aligned

The graph displays typical climate alignment ratings for eight listed corporates, illustrating that such evaluations can vary widely across rating providers. For example, provider 1 comes to a fairly favourably conclusion for companies D to F, suggesting alignment with a scenario of a global rise in temperatures by 1.5 degrees Celsius in 2050, but not for the other companies (assessed as "not aligned" with even a two-degree scenario). In addition, data gaps matter, as they impair the consistency or prevent the assignment of ratings (for instance here with provider 3 for company A).

Source: Noels and Jachnik (2025).

Measuring physical and transition risks: a long way to go

The measurement of physical risks is a case in point, illustrating the importance of climate risk-related data gaps. Ideally, physical risks should be measured at the asset level. However, such granular data do not exist in many places; and when they do exist, it is difficult to allocate assets to their ultimate owners. Certainly, some micro information is already collected to study specific types of climate-related risks at the local level (eg flooding risk or the impact of storms), sometimes through the use of innovative information sources or tools (Section 6). Yet a common feature across jurisdictions is the absence of precise data to support broader analyses covering different risk types across geographical areas. Because of these shortcomings, physical risk analyses tend to rely in practice on a mix of micro and aggregate data.

A second key information gap relates to transition risk analyses, reflecting both data availability and modelling challenges. Indeed, developing forward-looking climate transition risk metrics has proved to be a complex exercise, reflecting disparities in the information available on transition effects data as well as in the methodologies applied across regions and sectors (Félez de Torres et al (2025)). As a result, estimating the impact of transition risk for the financial industry is usually a key challenge for central banks and supervisors alike (Jung et al (2025)).

In addition to the above gaps, important challenges relate to the actual modelling and analysis of physical risks (Box C). These challenges are visible when one tries to assess the combined effect of physical and transition risk over extended periods of time, a key element for developing comprehensive climate risk scenario analyses – for example to simulate short- and long-term impacts for banks (Schmieder et al (2025)).

Box C

Analysing physical risks: the need to go granular

The analysis of physical risks is evolving rapidly, leading to new data requirements at the aggregate and more granular levels. For example, a recent multi-country study examined economic losses from floods and tropical cyclones under alternative scenarios, suggesting a significant increase in damage rates by 2050, particularly in small island nations and vulnerable regions such as the Caribbean, Southeast Asia and East Africa. This underscores the necessity of having robust forward-looking indicators to anticipate the physical impact of climate risk and inform policies accordingly.

In particular, sufficiently granular data are needed to avoid **relying on aggregate calibrations that can be misleading**. Indeed, a recent analysis shows that neglecting granular asset-level data in the case of Mexico can lead to a significant underestimation of portfolio losses and the mispricing of tail risks, in turn undermining investment and policy decisions.

Granular data are also helpful to **support the identification of financial transmission channels of physical risk**. For instance, a study conducted in France found that micro-level information was key to pinpointing the precise localisation of physical assets exposed to floods and differentiating consequences for their owners and those occupying them. Such precise insights can be particularly valuable for countries lacking the capacity to develop sophisticated climate simulation exercises independently.

4. The role of central banks in national strategies for overcoming climate risk data gaps

Reflecting their important roles in today's economies, central banks are well placed to take stock and make sense of the growing climate-related data already available from different sources and in various formats. However, closing existing information gaps may also call for a more active role on their part, not least in the context of their oversight of the financial system. Lastly, central banks have been actively fostering coordinated data work on climate risk within national data ecosystems.

Making sense of the available information

What should the role of central banks be in national strategies to close information gaps related to climate risk? **One option is to leverage the wide range of available data and alternative indicators**, especially those to which they are exposed in conducting their various activities, so as to be able to develop a comprehensive perspective. The underlying reasoning is that the different data inputs at hand have their own strengths and limitations and can thus provide complementary insights. For example, absolute emissions metrics are directly relevant for assessing national carbon reduction plans and the cumulative climate impact. In contrast, emissions intensity indicators are useful indicators for analysing reduction efforts. Other meaningful metrics can shed light on a range of issues, such as climate adaptation strategies, supply chain characteristics, the impact of investors' decisions or related shifts in the portfolio composition of financial assets. In particular, the gathering of even anecdotical information can provide useful inputs on forward-looking capacity and capital expenditure plans.

The above suggests that **authorities such as central banks have a key role to play to facilitate the gathering of all existing information and the identification of the core set of complementary metrics** needed to overcome climate information gaps. In addition, they can set the direction for future enhancements in the global statistical infrastructure, in particular by emphasising the need for more data standardisation, the development of forward-looking metrics that are crucially lacking and the strengthening of scenario analyses.

A more direct role for central banks?

Closing existing information gaps also calls for developing new, more suitable data collection exercises needed to manage climate-related risks and support the transition to a sustainable economy. Though this can require substantial resources and time, **central banks may play a useful role and provide the necessary impetus for developing a more solid data foundation** to support evidence-based policies for tackling climate risks.

In particular, experience shows that central bank statisticians have been able to directly contribute to closing data gaps at the national and international levels, including by leveraging new models and innovative technologies and relying on a wide range of information sources (Jahangir-Abdoelrahman and Tissot (2023)). Apart from such compilation efforts, the focus has also been on dissemination, as central banks have been developing dashboards and repositories to facilitate public access to climate data and share their findings with a broader audience. They have in addition worked on addressing existing obstacles in data access and sharing.

Besides, central banks have an important role to play in boosting conceptual advancements, including by establishing reference information (metadata) and developing adequate methodologies. For instance, the development of new imputation methods and the clarification of interpretations have paved the way for a more accurate assessment of climate-related financial indicators in certain places. Efforts have also been made to include carbon accounting in the value chain (IFC (2024a)) and to provide reporting agents with more guidance on related methodologies and tools (BCBS (2024)).

Reflecting the above, **various central bank initiatives have been under way to actively bridge climate-related data gaps**, including in many emerging market economies (Box D). For instance, Bank Indonesia is fostering the establishment of a comprehensive data repository on the volume and type of green financial instruments. Such information can be essential for monitoring progress in the development of sustainable finance in the country and also to support the introduction of green incentive supervisory tools (eg the increase in loan-to-value ratios for green mortgages and the lowering of required down payments for electric vehicle loans). Similarly, a project led at the Central Bank of Malaysia simulates flooding scenarios and urban heat island effects, both very relevant climate-related risks, while initiatives in Saudi Arabia include the development of metrics to measure the transition to a low-carbon economy, supported by satellite data. Turning to Angola, the central bank has gradually been incorporating ESG sustainability information into its policies and processes.

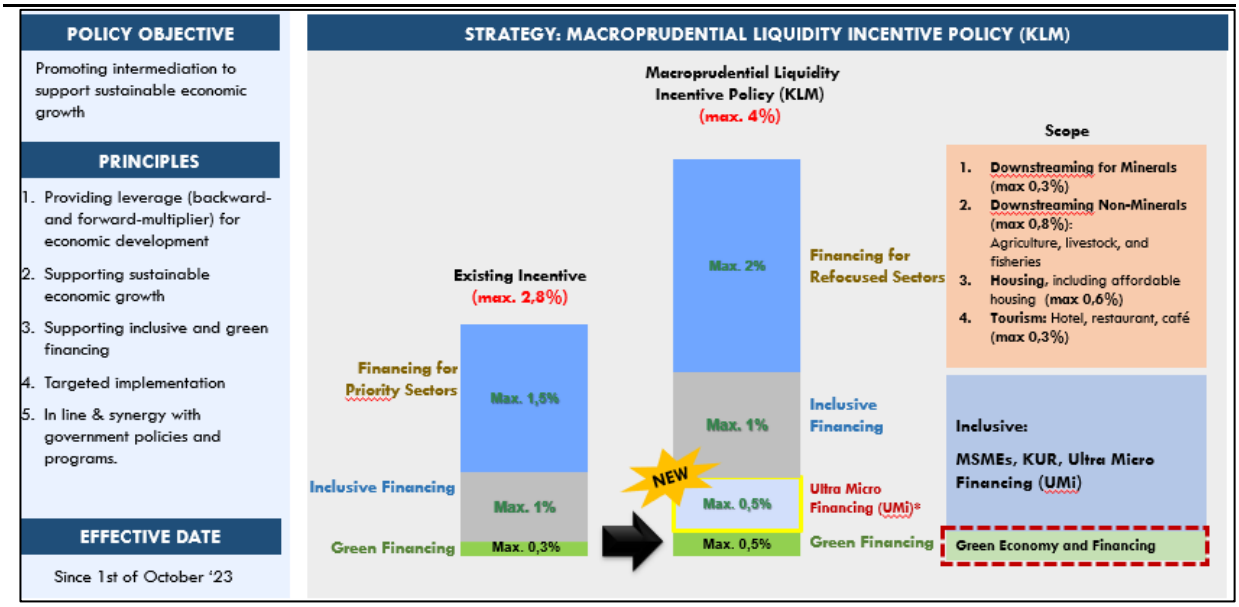
Box D

Central banks at the forefront of initiatives to close climate data gaps – an illustration

Many central banks throughout the world are leading national efforts to close climate data gaps, not least to support their policy decisions and spur sustainable finance. For instance, Bank Indonesia is collecting data on sustainable finance, including green mortgages, electric vehicle loans and sustainable bond holdings. A parallel project aims to identify green debt securities using novel methods (eg text mining, machine learning classification algorithms) and leveraging partnerships with data providers. In parallel, the Indonesian Financial Services Authority has initiated projects to report bank loans based on the Sustainable Finance Taxonomy and mandated banks to disclose scope 3 emissions. Authorities have also been focusing on the adoption of the Task Force on Climate-related Financial Disclosures (TCFD) framework and on expanding industry data partnerships to improve information transparency in sustainable finance. Lastly, better data will facilitate the monitoring of macroprudential liquidity policies that have been adjusted to accelerate sustainable financing and meet international climate agreements (Graph D1).

Climate data and national efforts to develop sustainable finance: the example of Indonesia's macroprudential liquidity policies

Graph D1



Source: Juhro et al (2025).

Malaysia, which is ranked fifth in the Asian region in terms of the economic impact of flooding, faces significant risks from rising temperatures and sea levels in the future. Projections suggest a significant increase in surface temperatures and a rise in sea levels of around 0.7 metres by 2100, impacting various sectors. In this context, the Central Bank of Malaysia launched a Joint Committee on Climate Change in 2022, co-chaired with the Securities Commission. A key project was the setting up of a platform integrating climate and environmental data within the existing financial sector information framework, allowing for the linking of flood scenarios and urban heat island effects to socio-economic risks.

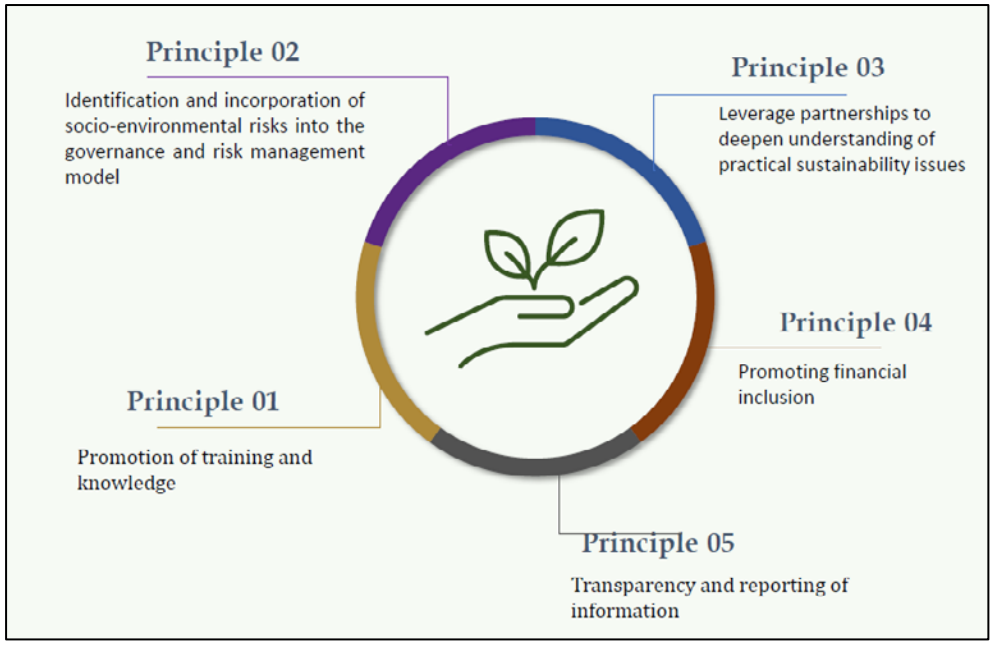
Turning to **the Arabian Peninsula**, the Gulf Cooperation Council (GCC) has developed a Circular Carbon Economy index to support its regional transition finance plan. This index helps policymakers assess and compare countries' performance and potential in achieving climate goals and is based on various indicators comparing oil and gas producers' progress in achieving the objective to *reduce, remove, recycle and reuse*. Other data initiatives include the use of satellite information for measuring greenhouse gas emissions.

A final example is related to the National Bank of **Angola**'s plan to incorporate the wide range of sustainability indicators into its policies and processes. Key challenges are related to capacity-building among internal staff, the creation of adequate databases and the conduct of climate stress tests to inform policies. The central bank also plays a key role in facilitating data cooperation between regulators, supervisors and market participants, and has established several principles in this context (Graph D2). A key driving factor was the recognition that the availability of relevant climate risk data is essential to support the following three main action points:

- The establishment of sustainability principles for the financial system in regulatory and supervisory policies, in line with international standards (eg Basel III, International Financial Reporting Standards (IFRS) and Financial Action Task Force (FATF) standards).
- The integration of climate risk into monetary and financial stability policies.
- The reduction of the central bank's carbon footprint and the incorporation of environmental, social and governance (ESG) factors in its operations.

Environmental, social and governance data for supporting the principles guiding the actions of the National Bank of Angola

Graph D2



Source: Monteiro (2025).

Supporting the data initiatives of other public stakeholders

Fortunately, central banks have been able to join forces to develop climate risk data with other relevant stakeholders in national data ecosystems. Various public administrations are important in this regard, reflecting the fact that a wide range of **government policies, including those on subsidies, research and development expenditures and technological incentives, can be mobilised to tackle the impact of climate change**. For example, authorities may support the production of relevant data underpinning national decarbonisation objectives in various ways, such as through fiscal incentives, regulatory disclosure requirements and the publication of climate-relevant information related to public spending.

In turn, the conduct of climate-related public policies can help to provide useful information for dealing with climate risk. For instance, a recent study shows that the implementation of national climate policies in various advanced and emerging economies has led to a better understanding of the complex relationships between fossil fuel subsidies, CO_2 emissions, the use of low-carbon technologies and the development of climate finance.[9] Central banks have a keen interest in supporting these initiatives that can contribute to the availability of better and more relevant data to address the consequences of climate change.

5. International initiatives to close climate risk data gaps

A key part of central banks' work to close climate risk-related data gaps has been undertaken under the umbrella of international initiatives. Those have been instrumental, in particular, for boosting the development of common methodologies and experimental indicators, including forward-looking ones.

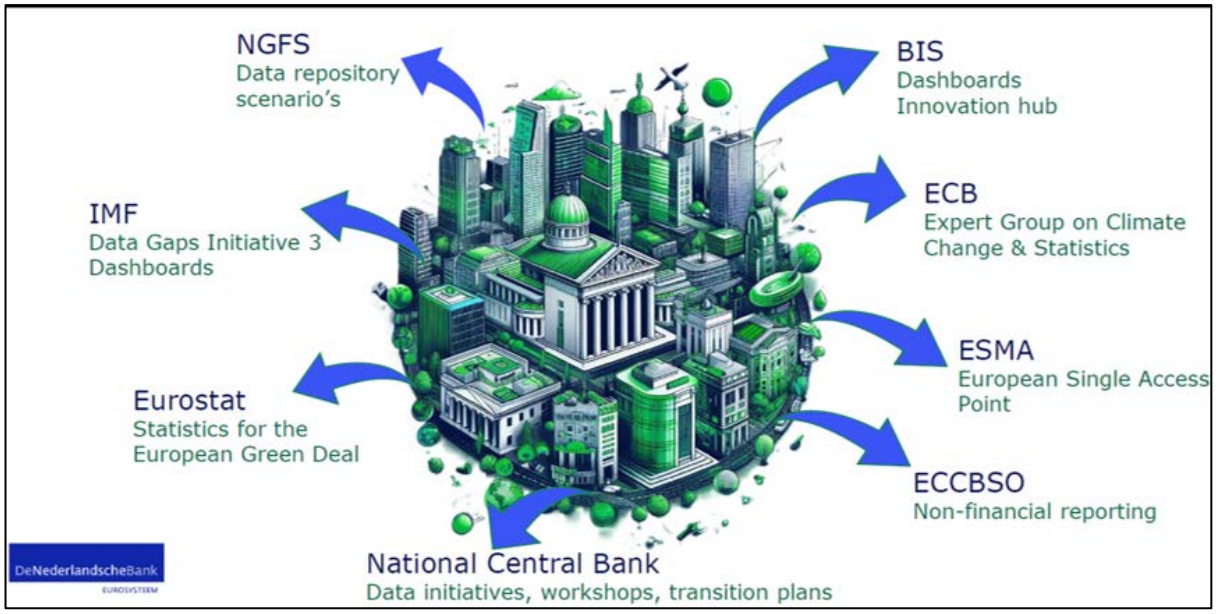
Central banks' active involvement

Central banks have been actively supporting the global exchange of experiences to enhance statistical information related to climate risk, not least through the IFC, the Network for Greening the Financial System (NGFS), the various financial standard-setting bodies hosted by the BIS and the BIS Innovation Hub. For instance, the IFC has facilitated an exchange of experiences on the need for and availability of climate data to support central bank policies, while also contributing to arrangements set up to actually close the related data gaps, especially in the context of the G20 DGI (IFC (2022)). Turning to the NGFS, key initiatives include the development of climate data repositories and the establishment of benchmark scenarios. The various financial standard-setting bodies and the Financial Stability Board (FSB) have developed a regulatory and supervisory perspective to tackle climate risk, thereby helping to uncover data gaps and work on adequate methodologies and concepts to address them. Last but not least, important projects have been pursued by the BIS Innovation Hub to set up a number of state-of-the-art dashboards and innovative tools for collecting data and conducting climate risk analysis.

Apart from supporting these knowledge-sharing initiatives, **many central banks have also contributed directly to the various exercises initiated by international organisations in the area of climate risk statistics** (Graph 5). These exercises have been directed towards the creation of internationally harmonised statistical indicators for climate-related analysis, with the aim of providing a robust data foundation for more informed decision-making.

[9] The approach combined carbon intensity data (CO_2 emissions per GDP) to measure climate change with an analysis of government policies based on: (i) total fossil fuel support (% of tax revenue); (ii) environment-related research and development budget (% of total research and development budget); and (iii) development of environment-related technologies (% of all technologies).

Central banks' involvement in various international initiatives on climate risk data Graph 5



Source: Fortanier (2025).

They include in particular:

1. **The third phase of the DGI endorsed by the G20,** which covers seven climate risk-related recommendations addressing four topics: measuring carbon output; climate finance; forward-looking physical and transition risk indicators; and mitigation and adaptation measures (Graph 6; IMF et al (2023)). Efforts are ongoing to improve conceptual frameworks for these indicators, enhance data interoperability and comparability, and foster the global dissemination of the statistics compiled.

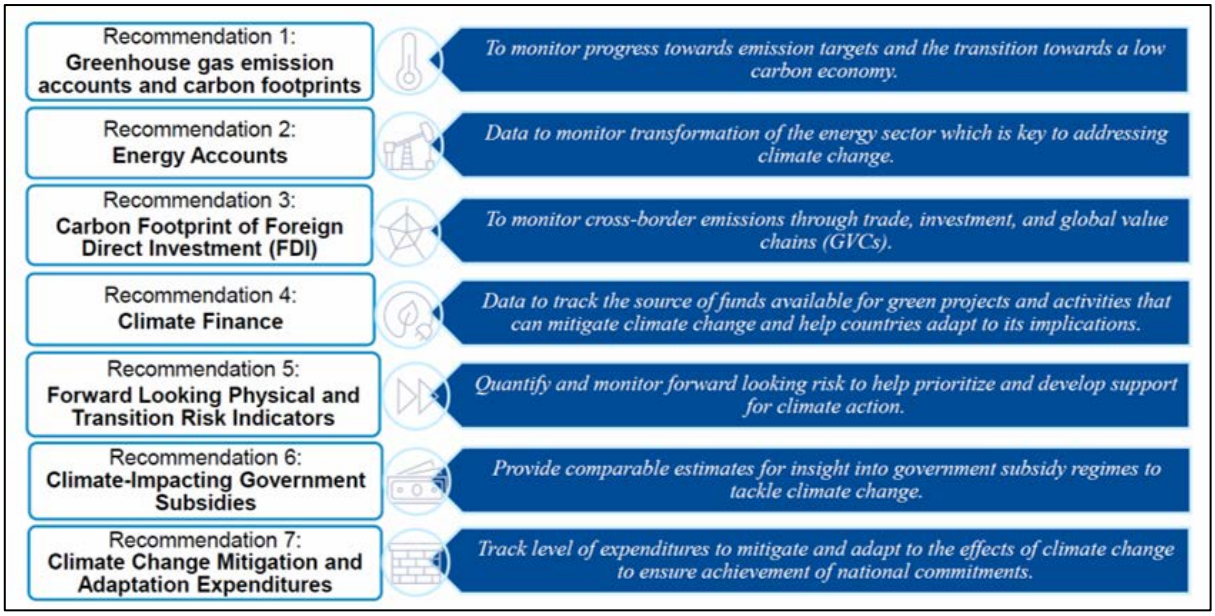
2. **Updates of international statistical standards:** the new 2025 version of the SNA includes environmental classifications for financial instruments and definitions for ESG and green financial instruments. Consistent with this, the revised Balance of Payments and International Investment Position Manual (BPM7) offers detailed breakdowns to better capture sustainable finance activities. Such efforts to harmonise compilation concepts are essential to build a global and comprehensive data ecosystem to tackle climate risk issues. For instance, the implementation of the new 2025 SNA will enhance data collections on natural capital, including non-renewable versus renewable energy stocks and their impact on economic growth.

3. **Work by the FSB to assess climate-related financial stability risks,** with a primary focus on enhancing the underlying concepts and dealing with associated data needs (FSB (2025)).

4. **The IFC review of the issues posed by carbon content measurement**, which has, in particular, highlighted the need for a comprehensive framework for establishing carbon content accounts consistent with emissions statistics (IFC (2024a)).

5. **Other international initiatives to collect and compile climate data,** including the International Monetary Fund (IMF) Climate Change Indicators Dashboard (CID)[10] and the NGFS data directory project developed together with the BIS Innovation Hub.

Overview of G20 DGI-3 recommendations related to climate risk Graph 6



Source: Harutyunyan et al (2025).

Lastly, **the central bank community has also been actively supporting specific data initiatives at regional levels.** A case in point relates to Europe, with the work led by the European System of Central Banks (ESCB) Expert Group on Climate Change and Statistics and related contributions of European national central banks in collaboration with other main stakeholders eg Eurostat, the European Securities and Markets Authority (ESMA) and the European Committee of Central Balance Sheet Data Offices (ECCBSO). The ESCB Statistics Committee has also developed harmonised indicators covering sustainable debt securities and financial sector portfolios across the euro area. Outside Europe, central banks have joined efforts in the context of training initiatives organised by the Center for Latin American Monetary Studies (CEMLA) and the South East Asian Central Banks (SEACEN) (Chadwick et al (2024)).

Fostering a comprehensive and coordinated international framework

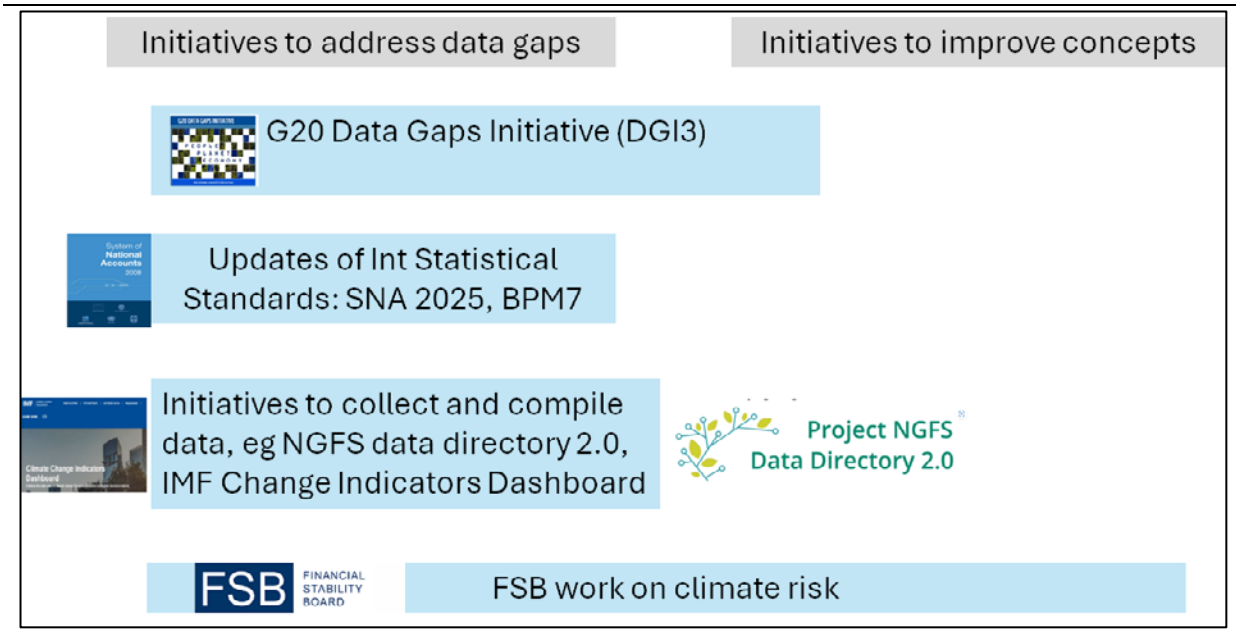
In addition to their active involvement in international statistical initiatives, **central banks have played a key role in fostering the development of a comprehensive**

[10] This dashboard tracks various climate-related indicators to provide reliable data for policymakers and stakeholders in pursuing related macroeconomic and financial stability analyses.

and coordinated framework for closing climate-related data gaps. This, according to their own experience, requires a multi-faceted approach (Graph 7):

- The starting point is to ensure close collaboration through international organisations and networks, with a view to involving a wider range of stakeholders working with climate risk data (eg official statisticians, academics, regulators, policymakers, accountants and firms).
- Another focus area is to favour the convergence of the various data frameworks and practices developed across jurisdictions, especially through global methodological initiatives, especially in the context of the DGI-3 and the updates of the SNA/BPM (Barahona (2025)).
- The third point is to support the dissemination of reference data for the general public (eg through the various dashboards set up by the IMF and the Organisation for Economic Co-operation and Development (OECD)) as well as more restricted information-sharing exercises targeted at specific groups, for instance in the context of BIS central bank cooperative activities.
- Lastly, the active promotion of innovative concepts, estimation techniques, information technologies and data sources can facilitate the closing of climate risk data gaps by the various stakeholders involved.

Key climate data-related initiatives at the global level — Graph 7



Source: Harutyunyan et al (2025).

While central banks have not been alone in supporting the above actions, they have been instrumental in ensuring that they are understood within a comprehensive and coordinated framework. This reflects, in particular, the unique role they have as both providers of reference statistics and as users of trusted information to conduct evidence-based policies. The aim is to foster, in parallel and in a coordinated way, the improvement in definitions and taxonomies used, the development of new and relevant indicators, the dissemination of more accurate

statistics and the adequate assessment of various risks associated with climate change.

An illustration: assessing the development of climate finance

One key illustration of the initiatives discussed above for enhancing climate risk information is related to sustainable finance. First, the update of international standards (SNA/BPM) has proved a key opportunity to develop comprehensive metrics for green financial instruments, covering bonds, loans, equities and investment funds. In particular, the SNA 2025 and BPM7 will incorporate principles and definitions for sustainable finance in, respectively, national accounts and balance of payments statistics (SNA (2024)). Second, improved data collection frameworks have been set up, especially in the context of the DGI-3 that is providing guidance for measuring and compiling climate finance statistics. Third, parallel efforts are being pursued to improve firm-level disclosure, especially with ISSB initiatives and the implementation of the European CSRD.

Yet a key challenge remains the lack of a single global taxonomy for sustainable finance, implying that views on what is "green" may greatly differ across jurisdictions. Moreover, the reliability of firms' disclosed information remains questionable in the **absence of comprehensive and consistent reporting practices**. For example, ESG instruments can be classified through various methods, such as self-labelling, second party opinions (SPOs) or external certification, and the results of these approaches may diverge markedly. This calls for further harmonisation work, which is likely to take time at the global level. In the meantime, a key focus should be on the transparency of the information collected, as issuers and holders of financial instruments should provide detailed metadata on the classification methods used for defining green instruments.

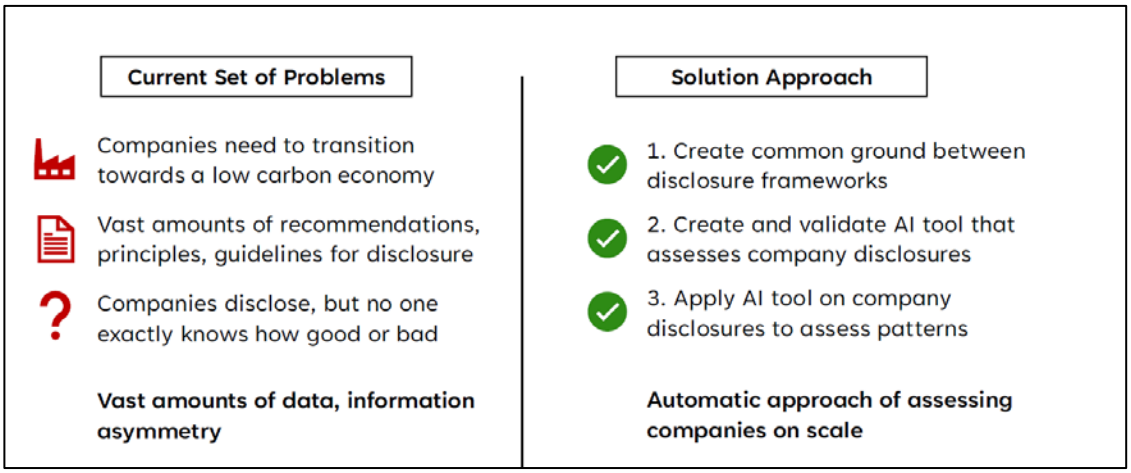
6. Leveraging innovation

Technical innovation (eg AI) offers promising solutions to overcome climate-related data gaps. **Central banks have indeed been playing an active role in making use of new data sources and tools in this area**, though their experience underscores the limitations of their traditional focus on economic and financial information and thus on the importance of ensuring collaboration with other stakeholders in the climate data ecosystem.

A first lesson is that new techniques can be effectively leveraged to better exploit existing but often non-conventional data sources. For example, text-mining techniques can extract relevant information from firms' climate disclosures to support the monitoring and analysis of sustainable finance developments.

Second, AI tools can help assess, in an automated way, the quality of the vast amount of information published by companies. For example, an AI-based solution has been developed to signal red flags in companies' published transition plans by identifying potential inconsistencies across the various indicators reported and assessing the completeness and quality of the information provided (Graph 8). This project revealed that companies' financial reports often emphasise climate target setting over concrete strategy implementation.

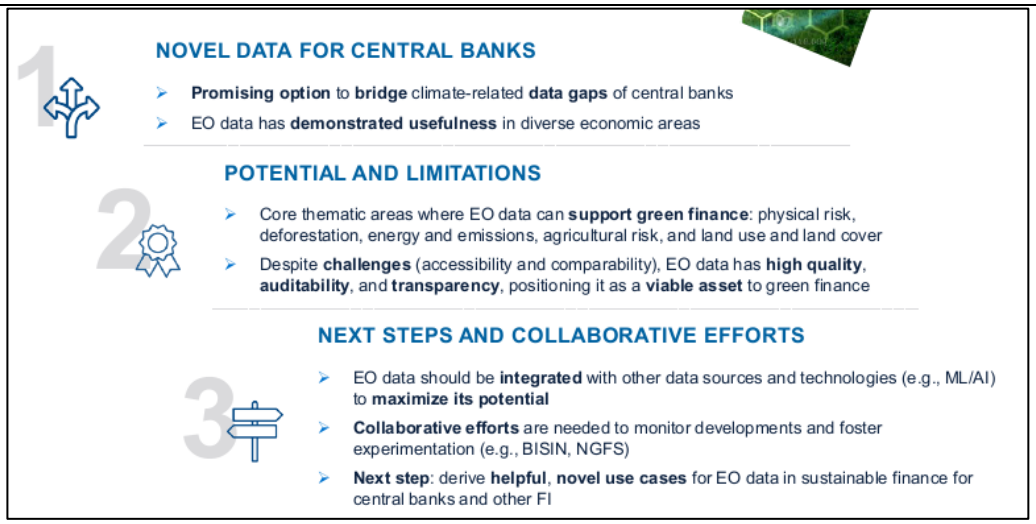
An AI-based approach to assessing the quality of firms' disclosed transition plans Graph 8



Source: Bingler et al (2025).

Third, innovation also brings the possibility of developing new, unstructured data sources. Earth observation satellite data are a case in point, as they can provide more granular insights to assess climate-relevant developments and address shortcomings and inconsistencies in existing (traditional) data. They can also reduce information asymmetries across scattered data sources, thereby limiting the potential for greenwashing practices (Graph 9).

Opportunities provided by new data sources: the case of Earth observation (EO) data Graph 9



Source: Alonso-Robisco et al (2025).

Fourth, innovation can boost both the accessibility to and analysis of climate-related data for supporting policies. For instance, the BIS Innovation Hub Singapore Centre has been able to develop three interrelated initiatives to enhance information on climate issues (Graph 10):

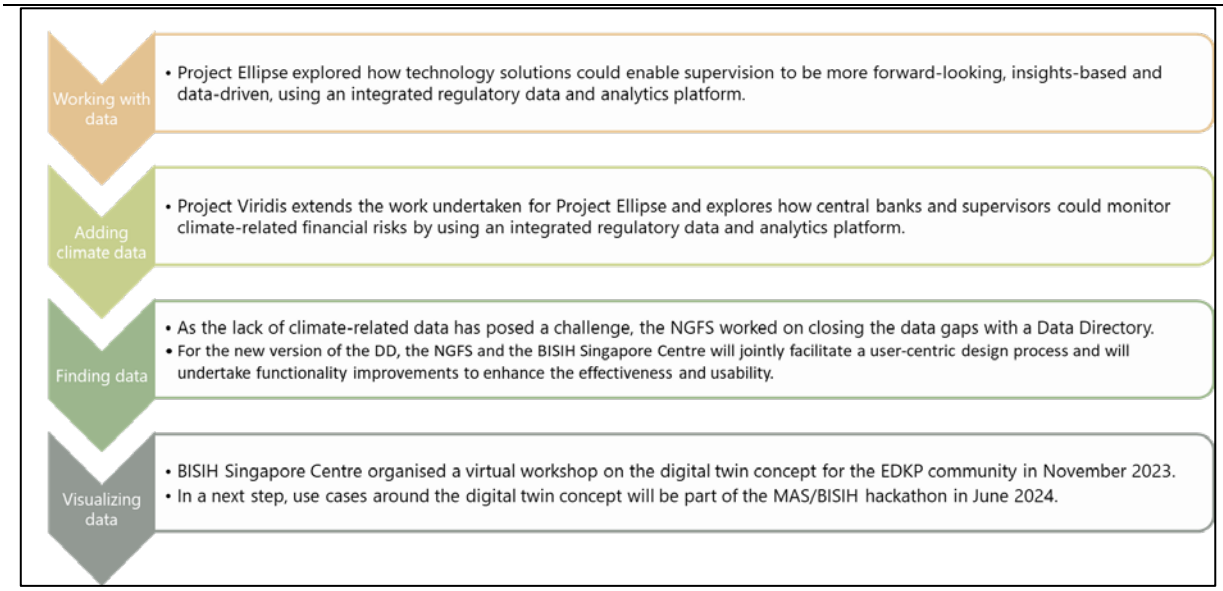
i. Building on Project Ellipse, Project Viridis provides a climate risk platform for financial authorities, allowing them to explore how integrating regulatory and climate data with advanced analytics can help identify key risk drivers potentially affecting financial stability.

ii. The NGFS Data Directory is a collaborative platform that allows crowdsourcing of climate-related information, including new data sources and adequate metrics. This directory offers, in particular, enhanced data search and analytical capabilities.

iii. The Ellipse Data Knowledge Platform (EDKP) Collaboration Community fosters dialogue on climate risk data and promotes collaboration.

Dealing with climate risk data: the BIS Innovation Hub Singapore Centre approach

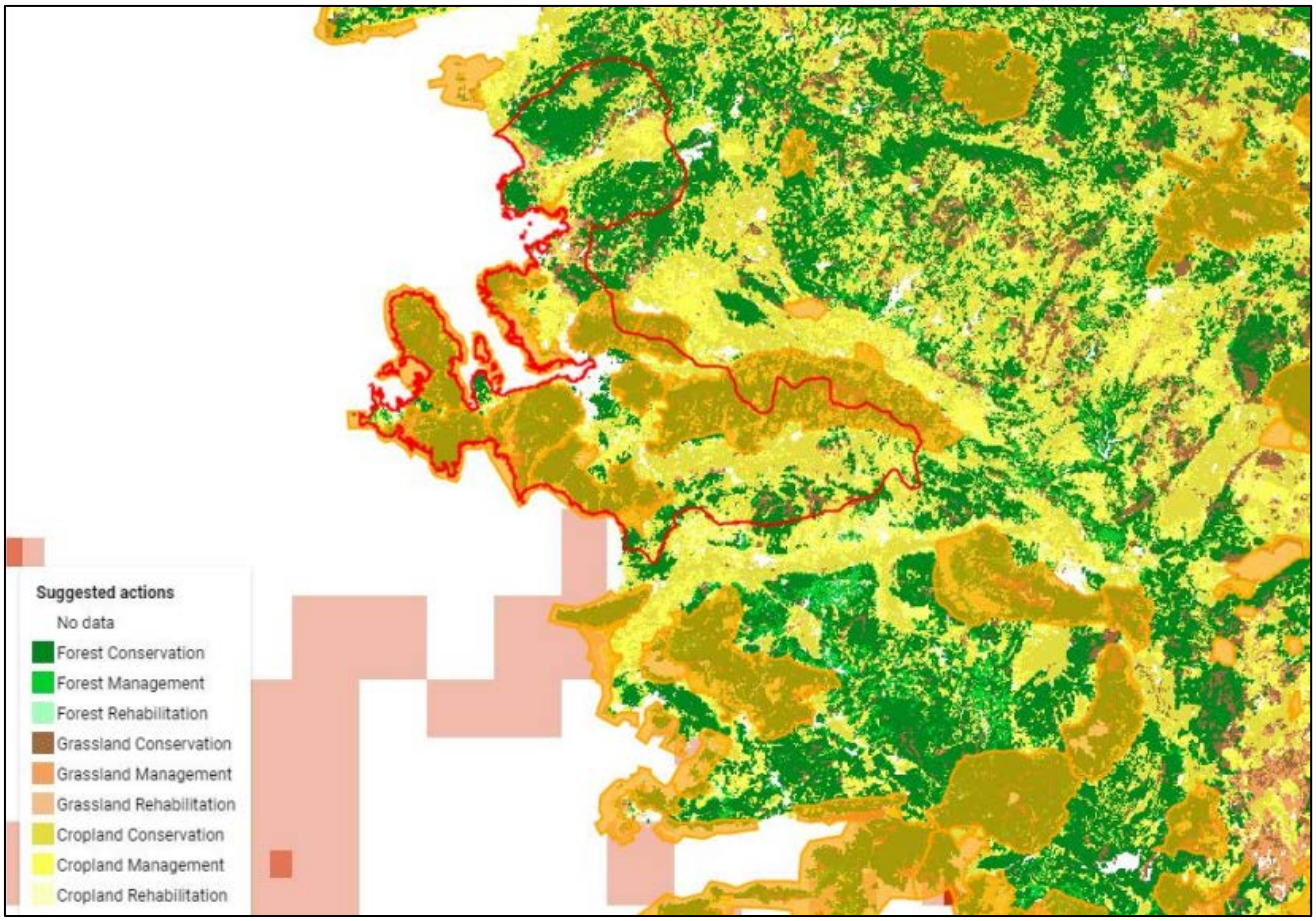
Graph 10



Source: Hoffmann et al (2025).

Fifth, new techniques allow for combining different types of a priori unrelated data sources that can be instrumental for addressing the complex interactions of climate change. For instance, data from geographic information systems, remote sensing, and environmental and socioeconomic sources in Türkiye have been usefully combined to support more informed decisions on sustainable land use, the restoration of degraded soil and overall environmental conservation (Graph 11).

Combining various data sources for simulating sustainable land use: an application to the region of İzmir (Türkiye) Graph 11



Source: Seyhun and Yıldırak (2025).

Sixth, innovation allows for analysing alternative scenarios that are essential for dealing with the complex implications of climate change and potential non-linearities. A key example is the NGFS Scenarios Portal set up to assist central banks, supervisors and financial institutions in assessing both transition and physical risks based on sound evidence. The portal features two key components: the Scenario Explorer and the Climate Impact Explorer. The Scenario Explorer allows users to explore a range of climate scenarios, providing insights into potential future climate pathways and their economic and financial impacts. It offers detailed data and visualisations on variables such as temperature changes, carbon prices and economic indicators under different circumstances. The Climate Impact Explorer, on the other hand, focuses on physical risk. It provides users with access to data and models that illustrate the potential effects of climate change on various sectors and regions under different climate scenarios.

Lastly, and despite the promising use cases being explored, **a key lesson from central banks' experience is that adequately leveraging innovation can require considerable investment in information technology infrastructure, tools and skilled staff**, posing important challenges given existing resource constraints.

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