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CENTRAL BANK OF THE U.A.E.

CLIMATE TRILOGY – PEOPLE, POLICIES AND PROCESSES

CBUAE Climate Forum

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Under the Patronage of H.H. Sheikh Mansour Bin Zayed Al Nahyan
Vice President, Deputy Prime Minister and Chairman of the
Presidential Court, Chairman of the Board of Directors of
the Central Bank of the United Arab Emirates

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1 Corresponding author (editor): Andreas (Andy) Jobst (Chief – Monetary Policy), andreas.jobst@cbuae.gov.ae.
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MESSAGE FROM

H.E. KHALED MOHAMED BALAMA
GOVERNOR

It gives me great pleasure to present this report on the inaugural Central Bank of the UAE (CBUAE) Climate Forum, held under the patronage of His Highness Sheikh Mansour bin Zayed Al Nahyan, Vice President, Deputy Prime Minister, Chairman of the Presidential Court, and Chairman of the Central Bank of the UAE.

The 2025 Climate Forum marked a strategic milestone in our journey to embed sustainability within the UAE's financial and regulatory architecture. As the first event of its kind in the region, convened alongside a technical meeting of the Network for Greening the Financial System (NGFS), it reaffirmed the country's evolving regional leadership in sustainable finance and climate-related risk management.

The Forum's objective was to strengthen the understanding of how the implications of climate change intersect with financial stability and monetary policy - core elements of the CBUAE's mandate. It also aimed to explore the pivotal role of central banks as catalysts for supporting government initiatives aimed at ensuring a smooth and orderly transition to a low-carbon economy. The event brought together policymakers, regulators, and industry leaders to share insights, exchange best practices, and advance collective efforts to build institutional readiness against climate-related risks.

The discussions highlighted that climate-related factors are increasingly relevant to investment decisions, asset valuations, and credit risk assessment. Physical risks from extreme weather events, such as droughts and flooding, carry tangible economic costs, while transition risks stemming from shifts in technology, policy, and market expectations are transforming entire economic sectors and trade. For the GCC region, these realities are especially relevant as we navigate both the opportunities and challenges of transitioning from hydrocarbon dependency toward diversified, low-carbon economies.

The Forum reflect the CBUAE's ambition to move from awareness to action—building a bridge between dialogue and implementation. This commitment is anchored in our "Climate Change Trilogy," which focuses on people, policies, and processes.

- People are at the heart of our efforts. We are investing in capacity building, enhancing staff expertise in climate risk assessment and sustainable finance, and deepening our engagement in global platforms such as the NGFS and international innovation initiatives.
- Policies reflect our resolve to embed sustainability into our regulatory and monetary frameworks. Recent efforts including integrating climate risk into supervision and incorporating sustainability criteria in reserve management.
- Processes ensure we operationalise these commitments into our daily work by embedding environmental considerations across institutional practices. We have implemented climate stress testing and scenario analysis and have made considerable progress towards launching Sustainable Islamic Monetary Bills - a pioneering step in aligning Shari'ah compliance with environmental goals.

The Forum's interactive panels provided valuable insights into how financial systems can strengthen resilience to climate risks and mobilise capital for sustainable investment. A recurring theme across all discussions was collaboration—within the UAE, across the GCC, and with the international community. Climate risks transcend borders; managing them requires shared responsibility and coordinated action.

The outcomes of this landmark event provide a strong foundation for future progress, building on the momentum of COP28. The 2025 Climate Forum reinforces our national commitment to achieving climate neutrality by 2050. The CBUAE will continue to support this vision by ensuring that our financial system remains robust, adaptive, and forward-looking. We have a critical role in facilitating an orderly climate transition - not by expanding their mandates, but by fulfilling them with foresight, prudence, and innovation.

I extend my deep appreciation to our partners from the Network for Greening the Financial System (NGFS), regional and international central banks, regulatory authorities, financial institutions, and experts whose contributions shaped this dialogue. Their insights have set the stage for continued collaboration and collective progress toward a sustainable and climate-resilient financial ecosystem.

Together, we can ensure that our financial systems remain stable, our economies remain competitive, and our shared future remains sustainable.

CONFERENCE SUMMARY

The inaugural Central Bank of the UAE (CBUAE) Climate Forum, held in Abu Dhabi on 26 June 2025, marked a significant milestone in advancing dialogue on the intersection of climate change and central banking. Convening policymakers, regulators, and financial leaders from across the GCC and around the world, the Climate Forum examined how climate-related shocks and transition policies are reshaping the macro-financial landscape and redefining the responsibilities of central banks. The event was held in conjunction with a technical meeting of the Network for Greening the Financial System (NGFS),[2] marking it the first of its kind in the MENA region.

The Climate Forum comprised several opening remarks followed by five interactive panel discussions, which highlighted the pressing challenges facing central banks, supervisors, and the broader financial system in addressing the impacts of climate change. Discussions centred on the CBUAE's "Climate Change Trilogy" focusing on people, policies, and processes, which encapsulates the approach to integrating sustainability into institutional frameworks and market operations. The event also explored emerging areas such as sustainable monetary instruments, climate-smart investment strategies, and the enhancement of climate stress testing and scenario analysis. In doing so, it underscored the growing need to embed environmental risk considerations within regulatory, supervisory, and monetary policy frameworks to strengthen economic resilience and foster sustainable growth.

This report captures the key proceedings and insights from the Climate Forum, highlighting regional vulnerabilities, evolving policy responses, and the expanding opportunities for sustainable finance and low-carbon transition in the UAE, across the GCC and beyond.

2 The Network for Greening the Financial System (NGFS) is a group of 144 central banks and supervisors, and 21 observers (as of March 2025) committed to sharing best practices, contributing to the development of climate and environment-related risk management in the financial sector and mobilising mainstream finance to support the transition towards a sustainable economy.

KEY TAKEAWAYS

Speaker contributions and panel discussions reinforced a common message - the need to move from dialogue to action in addressing climate risks within the financial system:

- *From discussion to implementation.* Participants stressed the importance of translating climate commitments into tangible actions, supported by clear policies and measurable results.
- *Strengthening institutional capacity.* Participants called for enhanced training, resources, and governance structures to equip financial institutions and regulators to manage climate-related risks effectively.
- *Policy and operational updates.* Participants highlighted the need to update and refine policy frameworks and operational tools to improve the financial system's resilience and support a sustainable transition.

Central banks were identified as key actors in (1) integrating climate considerations into monetary policy and financial supervision, (2) promoting data transparency and climate-related disclosures, (3) creating enabling environments for green investment, including the development of data disclosure standards, climate metrics and sustainability taxonomies, and (4) building partnerships that channel capital towards climate mitigation and adaptation efforts (Jobst, 2025a).

Other important aspects covered during the discussions include:

- *GCC context and regional collaboration.* The GCC region faces unique challenges and opportunities, particularly for economies reliant on hydrocarbons but seeking diversification. Examples included joint regional initiatives in carbon monitoring, water security projects, and eco-city developments. Regulatory innovation and cross-border cooperation were highlighted as essential to achieving sustainable growth.
- *Advancing sustainable Islamic finance and monetary policy innovation.* The Climate Forum examined the potential for Islamic finance instruments to mobilise green capital, aligning Shari'ah principles with sustainability objectives. More generally, participants considered adjustments to monetary operations to better support climate-aligned investment and economic stability.
- *Data and disclosure priorities.* High-quality, standardized climate data and consistent reporting frameworks were identified as vital for informed decision-making and stronger market discipline.
- *Improving risk management frameworks.* Experts discussed ways to embed climate stress testing and scenario analysis into supervisory and institutional risk management practices.
- *UAE leadership and next steps.* The Forum confirmed the UAE's regional leadership in sustainable finance through institutional and regulatory reforms, development of regional frameworks for climate resilience and ongoing collaboration with international partners to advance responsible, inclusive, and sustainable growth.

1. INTRODUCTION

Central banks need to account the financial risks from climate change and play a critical role – within their mandate – in facilitating effective policies to mitigate their impacts.[3] The impact of climate change and mitigation efforts does not only affect societies and economies in the longer term but is also becoming increasingly material within time horizons relevant to prudential and monetary policies. Climate hazards damage assets, disrupt supply chains, and slow down production, while climate policies reshape demand, drive innovation and affect firm profitability – effects that ripple through the economy and ultimately can drive capital reallocations and financial market adjustments. While their impact will vary, these shocks may look similar to those that central banks have faced in recent years – large, unpredictable and potentially persistent, supply shocks, which may present increasingly difficult inflation-output trade-offs; they also introduce rising property losses, higher uncertainty in asset prices and diminishing debt service capacity, which can affect the safety and soundness of financial institutions.

Central banks in the GCC region are particularly impacted by climate change in carrying out their mandate. The region's combined exposure to rising physical risk and transition risk due to dependence on fossil fuels highlights the crucial role of central banks in contributing to socio-economic resilience and promote sustainable growth. Severe weather events, such as storm surges and pluvial (rainfall) flooding pose significant risks to coastal cities but chronic risks, such as rising temperatures (and related droughts and water scarcity), can degrade the quality of infrastructure and severely reduce labour productivity, often with non-linear adverse effects. Rapid urbanisation and population growth further strain natural resources in the region. In addition, the green transition may reshape economic structures, influencing trade patterns, balance of payments, and exchange rates – factors that are particularly relevant for the hydrocarbon-exporting economies of the GCC region. And while each GCC country has pursued economic diversification and individual environmental policies—such as the UAE's Green Agenda 2030, Saudi Arabia's Vision 2030, and Qatar's National Climate Change Action Plan, there is growing recognition that these issues cannot be tackled in isolation.

As part of its strategic objective to promote greater climate awareness in the financial industry and encourage regional collaboration, the CBUAE successfully hosted its inaugural Climate Forum on 26 June 2025.[4] The event facilitated constructive discussions between policymakers and financial sector representatives to help guide capital flows towards a more sustainable future, building on the success of COP28 held in the UAE. It also allowed for the exchange of best practices and experiences among central bank officials, regulatory bodies, climate experts, and the exploration of effective strategies to promote a climate-resilient and forward-thinking financial environment.

The Climate Forum emphasised the importance of central banks and financial regulators in driving the transition to a low-carbon economy. It specifically highlighted the CBUAE's ongoing sustainability initiatives and participation in the NGFS's work, such as integrating "greening practices" into monetary policy through the issuance of sustainable (Islamic) monetary bills as well as augmenting financial stability assessments with climate scenario analysis and stress testing. Discussions underscored the significance of incorporating climate risk into strategic planning and risk management, as well as seeking sustainable finance opportunities through public-private sector collaboration.

3 Climate change affects central bank mandates through both physical risks, such as climate-related natural disasters, and transition risks, such as policy shifts, changed in demand, and the adoption of new technologies.

4 The YouTube video of the event can be found at https://www.youtube.com/live/VLRhns5Eo1I.

In his opening speech, His Excellency Khaled Mohamed Balama, Governor of the CBUAE, introduced the CBUAE's comprehensive climate strategy, emphasising the importance of the three Ps - people, policies, and process, which he referred to as the "Climate Change Trilogy." He highlighted the essential role of human capital in addressing climate change and mentioned that the CBUAE is enhancing staff capacity through specialised training in climate risk assessment and sustainable finance. In addition, CBUAE staff are actively involved in NGFS working groups and innovation initiatives like TechSprint.[5] The CBUAE has also increased its focus on sustainability in financial regulation and collaborates with other UAE supervisory authorities in the UAE Sustainable Finance Working Group.[6] Furthermore, the CBUAE is integrating climate considerations into its supervisory and regulatory activities, conducting comprehensive climate stress tests, and incorporating sustainability criteria into reserve management to enhance sustainability in operational processes.

The panel discussions focused on ways to enhance the integration of climate policies in risk and investment management, and the need to find effective solutions to strengthen the financial sector's resilience by adopting global best practices in environmental risk analysis and enhancing sustainability-related disclosures. Discussions also covered frameworks for activating regional and international cooperation in legislation, financial policies, and sustainable Islamic finance, reflecting UAE's emerging regional leadership in sustainable finance. The high-level panel provided an insightful view on the changing global climate policy agenda following UAE COP28, incorporating diverse viewpoints from the private and public sectors. Of particular interest was the discussion on trading national mitigation outcomes instead of project-based carbon credits. During the technical panels that followed, speakers delved into the ways in which physical and transition risks are evident in the GCC region and their impact on central banks and the financial sector. The conversation also covered the recent work of the NGFS on climate change adaptation and how experts view its crucial role in transition planning, highlighting the potential for increased investment in this often-overlooked area. The last two technical panels focused on the current work of the NGFS Subgroup on Monetary Policy Operations (which is co-chaired by the CBUAE), highlighting the CBUAE's innovative development of sustainable Islamic monetary bills. In addition, staff presented the CBUAE climate stress testing framework in the context of current regulatory and industry trends building on open-access NGFS scenarios to explore the short-term and long-term economic and financial implications of different climate transition pathways.

At the conclusion of the Forum, His Excellency Ebrahim Al Zaabi, Assistant Governor of the CBUAE for Monetary Policy and Financial Stability Sector, stressed the Forum's role as a high-level platform for effective dialogue and strengthening frameworks for close cooperation between regulatory and financial authorities to address climate challenges. He also affirmed the Central Bank's continued commitment to supporting the UAE's sustainable development agenda and continuing to work closely with the NGFS and all local and international partners to formulate effective climate policies that contribute to solidifying financial and monetary stability at both local and international levels.

5 See https://www.centralbank.ae/media/hanfdsa4/the-central-bank-of-the-uae-cbuae-teams-up-with-the-bank-for-international-settlements-bis-and-the-cop28-presidency-to-launch-the-cop28-en.pdf.

6 See https://www.centralbank.ae/en/our-operations/sustainable-finance/.

2. SPEECHES AND ADDRESSES

2.1. OPENING SPEECH – H.E. KHALED MOHAMED BALAMA (GOVERNOR, CBUAE)

Your Excellencies, Ladies and Gentlemen, Distinguished Guests

السلام عليكم ورحمة الله وبركاته،

Welcome to our Climate Forum.

Today, we come together at a pivotal moment – one that underscores the essential role central banks, supervisors and the financial sector play in mitigating climate risks while advancing sustainable finance and climate action. Around the world, and particularly in our region, climate change presents a significant macro-financial challenge.

The transition risks associated with a shift to a more sustainable society and the pressing physical risks arising from changes in weather and the environment have direct effects on our economies, and especially on our financial institutions. As an example close to home – the widespread flooding we witnessed in the UAE only last year was the heaviest in 75 years.

That's why it is vital that the UAE continues its economic diversification while enhancing its resilience to climate change. This ambition is firmly anchored in our vision for sustainable development, which is guided by the leadership of His Highness Sheikh Mohamed bin Zayed Al Nahyan, President of the UAE.

As a result of embedding this vision across all aspects of our society, it is safe to say that the UAE is a regional climate leader. This status was further reinforced last month when the *Federal Decree on the Reduction of Climate Change Effects* came into force.[7] I wish to thank Her Excellency Amna Al Shamsi, Minister of Climate Change and Environment, who is here today, for her efforts in this regard. The Law marks a transformative step in the country's climate policy framework. Specifically, it introduces mandatory emissions monitoring… and sector-specific adaptation plans.

At the Central Bank of the UAE, we continue to make an impactful contribution to the UAE's strong commitment on climate change. Building on the positive momentum from COP28 hosted in the UAE, we are climate-proofing our operations and supporting effective climate action in the financial sector.

But, we cannot tackle these challenges alone. The active participation of our staff members in the Network for Greening the Financial System is crucial as we collectively address the impacts of climate change on monetary policy and financial supervision.

The focus of today's Climate Forum is to enable active dialogue on the different roles of central banks, international organisations and financial institutions in further embedding sustainability in the financial system.

However, financial institutions can only contribute meaningfully to climate action if they remain resilient. Therefore, our primary goal should be to ensure a robust financial ecosystem. With this objective in mind, throughout the day we will share best practices, case studies, and promote regional cooperation on maintaining financial stability and fostering a forward-looking financial ecosystem in the UAE and beyond.

I would like to take this opportunity to express my gratitude to Mr. James Talbot, Chair of the NGFS Workstream on Monetary Policy, and Mr. Yann Marin, Head of the NGFS Secretariat, for their participation and collaboration.

7 See https://uaelegislation.gov.ae/en/legislations/2558/download.

Looking ahead, tomorrow the Central Bank of the UAE will proudly host a NGFS meeting of the Monetary Policy workstream, the first in the Gulf region, where discussions will aim to further exchange knowledge and perspectives among its members.

Ladies and Gentlemen,

I would like to highlight the specific contribution of the Central Bank of the UAE to the sustainable finance landscape. Our work can be conveniently grouped under three important "Ps" – people, policies and processes.

Firstly, our people are the foundation of our work.

In recognition of this, we are enhancing the capacity of our staff by providing specialised training in climate risk assessment and sustainable finance. This includes utilising technology and focusing on innovation in their work activities. We are also promoting a culture of accountability within the Central Bank through our Sustainability Committee, which coordinates all sustainability-related initiatives and ensures appropriate senior management oversight in this area.

Secondly, we are guided by our policies. The Central Bank has increased the emphasis on sustainability in financial regulation and works alongside other UAE supervisory authorities in the UAE Sustainable Finance Working Group. Collectively, we have published important climate risk-related guidance in recent years. These publications focused on the management of climate-related financial risks and sustainability-related disclosures. The Central Bank also facilitated an agreement on the global "Roadmap for Islamic Sustainable Finance," to which the Islamic Financial Services Board (IFSB) was a co-signatory. We are pleased to have the IFSB represented here today.

Finally, we have refined our processes. We are integrating sustainability principles into our risk-based supervisory practices and thematic reviews of financial institutions. As part of this, we continue to climate stress-test our banks, which most recently analysed the exposure of real estate lending to flooding and storm surge. With regard to central bank operations, we are integrating sustainability considerations into our reserves management and monetary instruments. In particular, we are developing an Islamic Shari'ah compliant and sustainable equivalent to our existing Monetary Bills. This instrument will be the first of its kind globally and will promote the creation of sustainable assets.

Overall, our hard work across our people, policies and processes has already yielded positive results. Financial institutions have become climate-smarter…and sustainable finance has significantly expanded. As an example, the UAE now accounts for around half of total green bond and sukuk issuance in the MENA region.

Your Excellencies, Distinguished Guests,

In closing, I am optimistic that today's Climate Forum will generate innovative ideas on how to tackle some of the most urgent climate-related challenges facing the financial sector. I urge all of you to come together under the framework of the three Ps I have outlined earlier. By investing in our people, advancing our policies, and strengthening our processes, we can ensure a resilient, sustainable, and positive future for the UAE and the world.

Before I conclude, I want to express my gratitude to His Highness Sheikh Mansour Bin Zayed Al Nahyan, Vice President, Deputy Prime Minister, Chairman of the Presidential Court and Chairman of the Board of Directors of the Central Bank of the UAE for his guidance and support on hosting this important event.

Finally, I wish to thank you all for your attendance today, particularly to those who have made the trip to Abu Dhabi. Your presence today will make our dialogue even more meaningful.

Thank you for your attention.

السلام عليكم ورحمة الله وبركاته،

2.2. Keynote Speech – James Talbot (Executive Director, Bank of England; Chair of Monetary Policy Workstream, NGFS)

Thank you to His Excellency the Governor for his warm welcome.

I wanted to begin by saying thank you also to the Central Bank of the UAE for hosting this Climate Forum. I would like to extend particular thanks to Andy Jobst and his team, who have been the driving force behind this event. I am very sorry not to be there with you in person today, but I am pleased to be able to contribute virtually.

I am here today to speak in my capacity as Chair of the Network for Greening the Financial System's Workstream on Monetary Policy. For those who are not familiar, the NGFS is a network of around 150 central banks and supervisors from across the world who have come together to undertake analytical work and share best practice on how climate change can impact on central bank's objectives.

Initially, the work of the NGFS focussed on the implications of climate change for the supervision of insurance companies and banks. This included the development of detailed scenarios to understand how climate change and climate policy affect the risks faced by the financial system.

But as the effects of climate change and climate policies on the real economy become more apparent across countries, they will also become relevant for monetary policy makers too. In light of this, the NGFS workstream on monetary policy was established in 2022 to further central banks' collective understanding of these issues.

Before I talk about that work, I wanted to clarify two important points.

The first is that, as central banks, we take the science around climate change as given. The IPCC estimates that average global temperatures are now more than one degree higher than pre-industrial levels and are set to rise at 0.2°C per decade, due to past and ongoing greenhouse gas emissions. 2024 was the warmest year on record, with average global temperatures exceeding 1.5°C above pre-industrial levels. As climate change has accelerated, the frequency and intensity of extreme weather events has already increased; and even small increases in global temperatures are expected to have significant impacts in future.

The second is that governments, not central banks, are responsible for climate mitigation policies. But central banks are interested in the impact of those government policies, and the physical effects of climate change, on the economy and financial system, because this in turn matters for our objectives of achieving price and financial stability.

So how is climate change affecting the economy?

Annual global damages from weather-related hazards have more than doubled in real terms in the past twenty years. Last year alone, natural catastrophes resulted in global economic losses of over $300 billion. Even countries like the UK, which may be less susceptible to large climate shocks, can be affected by the impact of events abroad, for example through the impact on international food commodity prices.

As severe weather events intensify, become more frequent and more geographically widespread, so too will their macroeconomic effects.

The physical effects of climate change will affect both the demand and supply side of the economy, and their effect can be amplified through financial channels, too. These impacts can alter the path of output and inflation in the short-run as well as altering investment and savings behaviour in the longer-run.

At the same time, governments across the world are implementing policies to transition to a less carbon-intensive economy in order to prevent the large and longer-term damages from a changing climate, including through carbon taxes and green subsidies. The shift towards a lower-carbon economy will affect how firms produce; how households consume; how governments spend and raise taxes; how banks and investors allocate finance; and can have international spillover effects.

Just under a quarter of global greenhouse gas emissions are currently covered by some form of carbon pricing mechanism. Increasing the price of carbon is way of internalising the negative externalities created by these emissions. In the short term, this can act as a negative supply shock leading to an increase in inflation and a fall in output. Over the medium and longer term, the overall macroeconomic impacts will depend on policy design and how tax revenues are spent as well as how economic behaviour adjusts in response.

In contrast, directly subsidising private investments in green sectors, can act as a positive demand shock increasing both output and inflation in the short term. Whereas subsidising the price of green inputs can look more like a positive supply shock, increasing output but reducing inflation. Transition policies can of course have important impacts on hydrocarbon exporters like the UAE, who may see a considerable reshaping of economic activity.

There is increasing evidence that the impact of climate change and the climate transition is becoming macroeconomically relevant over the monetary policy horizon, as well as affecting our societies and economies in the longer term. Understanding the nature of these shocks has therefore become vital for central banks.

In light of that, last year, the NGFS published a set of reports highlighting the macro-economic impacts of climate change and the climate transition. Those reports reflect the culmination of two years of work by NGFS members to develop a framework and analytical foundation to model and understand the impact of climate change on the economy.

As well as allowing us to better understand the potential macroeconomic impacts of climate change, the reports also support central banks as they develop their modelling toolkits. They set out the types of models that can be used and provide guidance on how central banks can embed these models into processes which support monetary policy decision making.

A further report considers how central banks can green their monetary operations, building on work conducted previously by Mrs Sabine Mauderer, the current Chair of the NGFS. Different central banks have different remits in this space, but the NGFS aims to draw on the diverse experiences of members to share knowledge and best practice if central banks wish to act in this area.

Indeed, this is an area where the UAE central bank has been particularly active, and we have benefited hugely from their experience, including on how to green the liability side of the central bank balance sheet.

So where will the NGFS work go next?

Having established the case that climate change is a macroeconomically relevant shock, we are now turning to the question of how monetary policy makers may need to respond. Both the physical effects of climate change and many of the policies implemented to tackle it are likely to push inflation and output in different directions. Indeed, these shocks may look similar to those that monetary policy makers have faced in recent years – large, unpredictable and potentially persistent, supply shocks. In other words, they may increasingly present difficult inflation-output trade-offs for policymakers to manage. This is relevant for all central banks whether they have an inflation target like the Bank of England or an exchange rate peg like the Central bank of the UAE.

We are now focusing on developing and using a core set of economic models to better assess how climate change affects the economy. This is no easy task in that it combines the integration of two disciplines – economics and climate science – but we are making good progress by sharing knowledge and learning from each other. The aim of this work is to allow central banks to adjust their economic forecasts and scenario analysis to factor in climate-related shocks and to decide how monetary policy should respond to them.

Indeed, we are very fortunate to have such an enthusiastic coalition of central bankers dedicated to analysing these issues, some of whom will be speaking to you later today.

For now, let me conclude with two points:

First, while the climate transition may create challenges for monetary policy to deal with, the "no transition" scenario looks much worse. The latest vintage of the NGFS scenarios, show that the economic costs of climate inaction would be a far worse shock to deal with further ahead. Losses from the chronic impacts of climate change without further policy action are expected to be close to 15% of global GDP by 2050 relative to the theoretical baseline without climate change. And under that scenario, central banks would be managing more extreme economic volatility.

Second, talking about how climate change affects monetary policy making can be a controversial topic. However, I see this in much more simple terms. If climate change – or the policies enacted to mitigate it – affect economic outcomes, it becomes a relevant consideration for monetary policy makers just like any other economic shock.

I hope today will be a fruitful exchange of views on climate-related issues, and I look forward to the discussions.

2.3. CLOSING REMARKS – H.E. EBRAHIM AL ZAABI (ASSISTANT GOVERNOR, CBUAE)

Your Excellencies, Ladies and Gentlemen, Distinguished Guests,

السلام عليكم ورحمة الله وبركاته،

It is with great pleasure that I offer these concluding remarks at the close of what has been a truly enlightening and dynamic day. We have had interactive discussions and gained invaluable insights into the pressing challenges facing central banks, supervisors, and the broader financial ecosystem in addressing the impacts of climate change.

I think it is fair to say that we have successfully achieved the primary goal outlined by H.E. the Governor of the CBUAE in his opening address – to forge a robust platform for meaningful dialogue among key stakeholders as we collectively embark on the climate transition.

Our aim was to facilitate the exchange of best practices and experiences to not only evaluate our current efforts, but also to identify opportunities for strengthening the capacity and resilience of the financial ecosystem.

What resonated most profoundly with me throughout the day was the strong sense of shared purpose and commitment evident across this room. It is clear that we are united in our resolve to address climate-related financial risks, promote sustainable finance, and decisively drive impactful climate action.

Please allow me to briefly recap some of today's important discussions:

Our inaugural high-level panel offered a compelling perspective on the evolving global climate policy agenda in the wake of UAE COP28, combining interesting perspectives from both the private and public sectors.

In the subsequent technical panels, we explored how physical and transitions risks manifest across the GCC region and their implications for central banks and the financial sector.

We also touched on the latest work of the Network for Greening the Financial System (NGFS) on climate change adaptation and how leading experts in adaptation finance assess the current challenges within this largely under-funded area.

In addition, we looked into the current findings from an NGFS Subgroup dedicated to greening monetary policy operations, notably featuring the CBUAE's pioneering development of Sustainable Islamic M-Bills, and finally, we touched on climate stress testing at the CBUAE, alongside current regulatory and industry trends in defining credible climate scenarios and overcoming– often formidable – data challenges.

These critical topics require an effective combination of the three Ps – people, policies, and process, which H.E. the Governor introduced as "climate change trilogy" in his opening remarks when he illustrated the CBUAE's multi-faceted climate strategy.

In closing, I wish to underscore the CBUAE's dedication to fully supporting the country's ambitious sustainable development agenda.

Yet, we are equally aware that developing truly effective policies requires continuous collaboration with fellow central bankers, the financial industry, government bodies and civic society in collectively enhancing our shared abilities. In this spirit, we stand fully committed to the NGFS's mission.

My team and I look forward to tomorrow's technical meeting of the NGFS Workstream on Monetary Policy. We are involved, because we believe it can effectively contribute to creating impactful climate policies – and essential for safeguarding financial and monetary stability.

I would like to extend my sincere gratitude to all our speakers, moderators, and every participant for their invaluable engagement today. A special thanks is also due to the dedicated CBUAE team, whose efforts were instrumental in making this a truly exceptional event.

Once again, thank you all for joining us today.

3. CLIMATE CHANGE AND CURRENT POLICY/INDUSTRY ACTIONS: AFTER COP28 – WHAT NOW?

A high-level panel followed by a technical discussion reflected on the plans agreed at *28th Conference of the Parties* (COP28) of the *United Nations Framework Convention on Climate Change* (UNFCCC) under UAE Presidency from a central banking perspective. Some of the most relevant questions raised during the discussion focused on concrete physical and transitions risks affecting the GCC region and the evolving global climate policy agenda for central banks and financial sector supervisors.

High-Level Panel

- What are the most significant outcomes of COP28, and how do they shape expectations for central banks and financial sector supervisors in supporting the climate transition within their mandates?
- What mechanisms should central banks and supervisors adopt to monitor and report progress on the implementation of current agreements, and how can they foster greater international cooperation to close the remaining gaps?
- How does the current geopolitical fragmentation influence the climate agenda and the cooperation of central banks/supervisors and consistent behaviour of financial institutions with global operations?
- How can the financial sector accelerate the tripling of renewable energy capacity and the doubling of energy efficiency improvements by 2030, as agreed at COP28, and what regulatory changes might be required?
- In light of the new commitments on climate finance and the operationalisation of the loss and damage fund, what are the immediate priorities for financial institutions to ensure capital flows effectively to vulnerable countries and sectors?
- With COP28's emphasis on integrating climate and nature agendas, including links to the Kunming-*Montreal Global Biodiversity Framework*, how should financial supervisors address biodiversity and nature-related risks alongside climate risks?

Technical Panel

- What are the most pressing physical climate risks currently facing the GCC region, and how are these risks affecting critical sectors such as infrastructure (energy/transport/water), agriculture, real estate and public health?
- How are central banks and financial regulators in the GCC adapting their policies to address both physical and transition risks associated with climate change, particularly given the region's reliance on hydrocarbons? Are there particular areas where more can be done, and if so, why/how?
- What are the key challenges and opportunities for the financial sector as the GCC economies pursue economic diversification and decarbonisation strategies?
- How do we assess some of recent regional initiatives (*Gulf Blue Carbon Network* [December 2024], *Joint Air Quality Monitoring Grid* [January 2025], *Waste-to-Energy Cooperation Protocol* [February 2025], *Regional Water Security Task Force* [March 2025], *Eco-Cities Collaboration Hub* [Q1 2025])? How do they demonstrate effective industry or government action on climate adaptation and mitigation? What is still missing?
- What steps should the financial sector take to enhance resilience to climate-related risks, and how can cross-border cooperation among GCC countries accelerate progress on climate policy and sustainable finance?
- What are the current findings from the NGFS Monetary Policy Workstream on how central banks in the region can prepare themselves in terms of monetary policy framework and strategy?

3.1. THE WORK OF NGFS IN THE WAKE OF COP28 – JAMES TALBOT (EXECUTIVE DIRECTOR, BANK OF ENGLAND)

It is clear that tackling climate change is a crucial international endeavour. Progress has been made in recent years through collaboration among central banks and supervisors in international forums such as the Financial Stability Board (FSB), the Basel Committee on Banking Supervisions (BCBS), and the International Association of Insurance Supervisors (IAIS) as well as specialised groups with a thematic focus on climate risk like the Network for Greening the Financial System (NGFS). As we continue to advance, it is important to enhance our understanding and monitoring of climate risks through evidenced-based analysis. Given the Bank of England's responsibility for both monetary and financial stability, including its oversight of a major financial centre, it is well positioned to engage on these issues with other stakeholders in both bilateral and multilateral fora, including the NGFS.

Looking forward, as we navigate a more complex landscape, we anticipate the NGFS playing a crucial role by:

- Continuing to produce work that offers insights into the economic impact and financial risks of climate change.
- Helping central banks and financial supervisors implement NGFS guidance and recommendations to address and incorporate the risks from climate change and nature degradation, in line with their mandates.
- Advancing on technical issues related to central bank and supervisory mandates and, when appropriate, acting as an incubator of thought to further develop analysis and prudential tools.
- Serving as a centre of expertise on climate scenario development for central banks and the financial sector.

The key strength of the NGFS is both the diversity of its membership and the fact that it is a coalition of the willing. This means that members can learn from each other to better tackle the economic and financial sector impact from the risks that we face from climate change.

The NGFS (2023) Dubai Stocktake, which was published on the Finance Day of the 28th *Conference of the Parties* (COP28) of the *United Nations Framework Convention on Climate Change* (UNFCCC) under UAE Presidency, offered a landmark assessment of the progress made globally towards the Paris Agreement goals. The Stocktake highlighted that while progress has been made, Parties are not collectively on track to achieve the goals of the Paris Agreement. This has implications for central banks and supervisors in two main areas.

Firstly, considering physical risks. As climate change has accelerated, the frequency and intensity of extreme weather events has already increased, and even small further increases in global temperature rises are expected to have significant impacts in the future. Central banks therefore need to consider the adverse effects of natural disasters on both the economy and financial system. In particular, central banks may find it harder to "look through" repeated shocks, resulting in a challenging trade-off between inflation and output for monetary policymakers in the short term. The NGFS's scenarios can help assess the potential impact of climate risk-related financial risks.

Secondly, the Stocktake emphasised the need for further policy action by governments, as outlined in its call for action. This includes tripling renewable energy and doubling energy efficiency by 2030, as well as accelerating efforts towards net zero emission by mid-century. These actions will also have economic implications, making them a relevant consideration for central banks and supervisors to consider in pursuit of their mandates. More stringent policies to address climate change may give rise to large, prolonged, relative price changes in the economy, creating trade-offs for central banks in maintaining price/currency stability in the near term. However, the scenarios outlined by the NGFS demonstrate that the economic consequences of not acting on climate change would be even more severe in the future.

The current focus of the NGFS work is to help central banks improve their understanding of these impacts and the implications for their monetary and financial stability policies and contribute to the development of climate risk management in the financial sector. For regulators, like the Bank of England's Prudential Regulation Authority, climate change matters both from a risk perspective and in terms of the financial sector's ability to support the wider economy. By implementing effective risk management practices, financial institutions can contribute to building a more resilient financial system capable of withstanding the growing frequency and intensity of climate-related events and potential shifts in the transition process. To manage those risks effectively, the Bank of England establishes supervisory expectations for firms.

We are currently considering feedback on revising these expectations, with a focus on:

- Ensuring that firms have a well-defined risk appetite statement that is communicated to all business units;
- Encouraging the use of climate scenario analysis to inform business decisions; and
- Establishing strong risk management frameworks with clear assumptions and senior management oversight to help firms manage risks effectively when developing their business strategies.

Once more, it is important to have international cooperation in developing frameworks and standards as well as exchanging knowledge for evaluating and handling climate risk. Over the recent years, the Bank of England has actively participated in various forums to establish and advocate for international best practices in these fields. Our proposed updated expectations will align our approach with the applicable international standards for insurers and banks in a manner that supports our prudential objectives (Bailey, 2025).

3.2. ACCELERATING CLIMATE FINANCE IN THE GCC: CAPITALISING ON STRATEGIC OPPORTUNITIES – LARRY ABELE (CEO, IMPACTCUBE)

The Gulf Cooperation Council (GCC) is currently at a crucial point, having made significant progress in climate finance with key renewable energy projects, improved regional cooperation, and international commitments like the *Global Methane Pledge*. While each GCC country has pursued individual environmental policies—such as Saudi Arabia's *Vision 2030*, the UAE's *Green Agenda 2030*, and Qatar's *National Climate Change Action Plan*— there has been a growing recognition that these issues cannot be tackled in isolation. The need for action is evident: economies still heavily reliant on fossil fuels in a region with high temperatures are increasingly vulnerable to climate change impacts such as more frequent heatwaves and water shortages, compounded by volatile energy markets due to transition policies. Rapid urbanisation and population growth further strain natural resources in the region.

To address these challenges effectively, strategic investments are essential to capitalise on successful approaches, identify overlooked efficiencies, and seize emerging opportunities, positioning the region for long-term economic resilience and competitive edge. Amid this evolving landscape, there is a growing global momentum for sustainable finance. UAE's hosting of COP28 highlighted the region's ability not only to facilitate international discussions but also to take the lead in developing climate finance structures for developing markets. This is a significant change for the GCC to not just align with global trends but to shape the international sustainability agenda.

Building on Proven Pathways

Renewable energy, particularly solar power, is already a key pillar for the GCC's transition strategy. Projects like the Mohammed bin Rashid Solar Park in the UAE and Saudi Arabia's NEOM initiative showcase the region's leadership in this area. The Al Shuaiba project in Saudi Arabia recently achieved a record-low tariff of $0.0104 per kWh (IEA, 2023), highlighting the GCC's competitive advantage in solar energy deployment. This competitive pricing not only boosts energy security and economic diversification but also attracts significant interest from international investors. Realising the full potential of solar energy would require an estimated additional investment of up to $120 billion by 2030 (IRENA, 2023).

Green hydrogen is an emerging frontier that complements traditional energy sources. The NEOM Green Hydrogen Project in Saudi Arabia is targeting a daily production of 650 tonnes, positioning the region as a potential leader in the future energy landscape. Projections suggest that green hydrogen could make up 10–20% of global energy consumption by 2050, the GCC's favourable geography and existing renewable infrastructure provide a solid foundation for international competitiveness (IEA, 2023). Financial tools such as blended finance and sovereign guarantees can be used to help de-risk such projects. Transparent ESG metrics will be crucial for attracting institutional investors through credible performance evaluations.

While carbon-focused strategies often receive more attention, reducing methane emissions presents a highly impactful and financially attractive opportunity. Addressing methane emissions in the upstream sector can yield an average internal rate of return (IRR) of more than 50%, positioning it as a cost-effective climate mitigation measure (Szarek and others, 2024). Despite some regional commitments, actual reductions remain limited. However, proactive management could greatly enhance the environmental credentials of GCC hydrocarbons, ensuring continued market access amid tightening global standards.

Unlocking Untapped Efficiencies

Energy efficiency is still not being fully utilised as a tool for reducing energy consumption. Although buildings account for almost half of the region's electricity use, mainly for cooling, efforts to retrofit them are limited. Upgrading efficiency can cut energy use by 25–66% and bring significant economic benefits. The IFC (2023) projects that green buildings could create investment opportunities worth more than $180 billion in the MENA region by 2030. Monitoring ESG metrics related to emissions reductions and return on investment will be key to attracting this capital.

The move towards sustainable transport also presents significant potential. Despite positive developments like Dubai's metro expansion and electric vehicle infrastructure, progress has been slow due to the widespread use of cars and long-standing fuel subsidies. However, transitioning just a quarter of urban vehicle fleets to electric power could reduce carbon emissions by over 20 million tonnes annually (IEA, 2023; UNEP, 2023). These shifts not only bring environmental advantages but also economic benefits, including substantial savings in healthcare costs and productivity losses, further supporting the need for investment.

Water infrastructure reform is another strategic area for climate finance. Renewable-powered desalination and wastewater reuse could reduce energy consumption by up to 50% compared to conventional methods. Moreover, enhanced water efficiency could lead to savings of up to $70 billion and reduced investment needs by 2040 (Alawad and others, 2023; World Bank, 2012). By deploying ESG data to monitor performance and resilience over time, the GCC can position these initiatives as attractive, low-risk investment options.

Embracing Emerging Opportunities

As urban temperatures continue to increase, investments in adaptation measures like urban greening, reflective surfaces, and green infrastructure are no longer just desirable but essential. According to the UN Environment Programme (2023), these approaches can lower city temperatures by up to 5°C, leading to improving health and productivity. For instance, a modest 10% expansion of green spaces in Doha could reduce in a 4-5%-reduction in cooling-related energy consumption in certain areas, resulting in tangible cost savings and investment benefits, especially when supported by ESG impact data.

Nature-based solutions also offer lucrative investment opportunities. The UAE's commitment to planting 100 million mangroves demonstrates a growing recognition of their value, both in terms of biodiversity and economics. Mangroves can store up to four times more carbon per hectare than terrestrial forests and restoring them can generate between $3 to $10 in ecosystem services for every $1 invested (Sunkur and others, 2023; World Bank 2022). Financing these initiatives through green bonds and sustainability-linked instruments could broaden the investment appeal to a wide range of investors.

It is also increasingly important to enhance food security through sustainable agriculture. The region's $1.2 billion agritech sector could more than double by 2030 (GRC, 2024), with innovations like vertical farming playing a key role. Vertical farms can reduce water usage by up to 95% compared to traditional agriculture (Weal, 2025); this not only provides environmental benefits but also enhances climate resilience, food security, and financial stability. Quantifying these via ESG frameworks enhances investor confidence and supports scaling.

Strategic Use of ESG Data

Accessing these climate finance opportunities hinges on the efficient use of objective ESG data. High-quality metrics allow organisations to transparently assess their environmental and financial performance, transforming ESG compliance into a strategic tool for attracting capital. Accurate data enables investors to conduct comprehensive pipeline evaluations, analyse risk-adjusted returns, and adhere to global stability standards, bolstering the GCC's standing as a progressive region for climate finance.

Strategic Leadership for Sustainable Prosperity

The GCC's climate transition is more than just a defensive measure; it is a foundation for long-term economic leadership. By strategically investing in both established business and emerging technologies, supported by robust ESG data, the region can mitigate risk, boost economic diversity, and influence global sustainability standards. Institutional investors, sovereign wealth funds, and central banks will be instrumental not only in funding this transition but also shaping its direction. With decisive leadership, climate finance can become a major driver of the GCC's global impact and sustainable prosperity.

4. ADAPTATION FINANCE

The panel included a short impulse presentation on the main findings from the recent NGFS work on adaptation as part of the Input Paper to the *G20 Sustainable Finance Working Group* (NGFS, 2025a), followed by a discussion with adaptation finance experts. The paper supports the G20's 2025 priority on scaling up adaptation finance for a just climate transition. It builds on the Concept Note on Adaptation (2024a) and the Transition Plan Package and Adaptation Framework (NGFS, 2024d), and was developed in close collaboration with key partners: International Transition Plan Network (ITPN), Carbon Disclosure Project (CDP), and the Sustainable Insurance Forum (SIF), the Resilient Planet Finance Lab (University of Oxford), and the Grantham Research Institute on Climate Change (London School of Economics).

Some of the most relevant questions raised during discussion were:

- What are the key findings and recommendations from the recent NGFS work on adaptation, and how do they inform the role of central banks and financial supervisors in scaling adaptation finance? Do you agree with the NGFS's findings?
- Given the persistent global adaptation finance gap, what innovative financing mechanisms or partnerships show the most promise for mobilising resources at the scale required, especially in developing countries?
- How can companies be encouraged to invest more in adaptation?
- How can adaptation finance better reach and empower local communities most vulnerable to climate impacts, and what changes are needed in investment design and delivery to ensure their meaningful participation?
- In what ways can financial institutions integrate physical and systemic climate risks into their investment and risk assessment processes to support long-term adaptation and resilience?
- What are the main barriers to mainstreaming nature-based and ecosystem-based adaptation solutions in adaptation finance, and how can these be overcome to deliver both climate and biodiversity benefits?
- What can the insurance sector to encourage adaptation in terms of signalling effects/pricing of restorative measures?

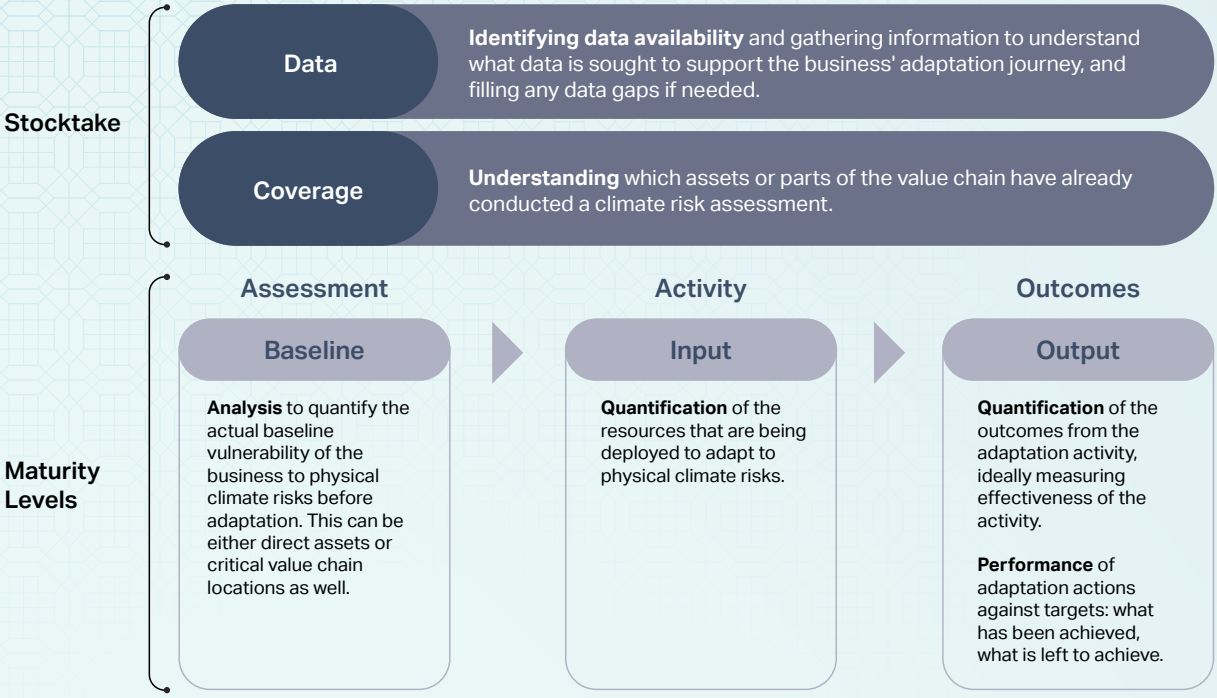
4.1. INTEGRATING ADAPTATION AND RESILIENCE INTO TRANSITION PLANS – SEAN CARMODY (EXECUTIVE DIRECTOR, APRA)[8]

Despite global efforts to achieve net zero emissions by 2050, physical risks from climate change remain substantial. Even under a "net zero scenario," chronic physical risks could reduce global GDP by 7.3%, and under a "current policies scenario," the loss could be as high as 15%. These risks are transmitted throughout the economy through various micro- and macroeconomic channels, resulting in adverse impacts for financial institutions.

Adaptation measures provide substantial advantages, with studies estimating economic benefit-to-cost ratios ranging from 2:1 to 15:1 across different sectors and geographies. Nevertheless, adaptation finance remains insufficient, particularly in emerging market and developing economies (EMDEs), where the funding falls short of requirements by at least 70%. Against this background, transition plans can act as strategic instruments to evaluate and address physical risks, direct capital toward resilience-building investments, and improve transparency and alignment with climate objectives.

8 This chapter summarises the key findings from the paper, which was co-led by Sean Carmody (Australian Prudential Regulation Authority) and Donald Chen (Hong Kong Monetary Authority) together with the co-lead drafters Graham Sinden and Francois Leffage.

Figure 1. A Maturity Model for Adaptation Metrics and Targets



Source: NGFS (2025a)

Operationalising Adaptation

To enhance the integration of adaptation and resilience into climate transition plans, the NGFS suggests a practical framework based on five pillars: governance, foundations, implementation strategy, engagement strategy, and metrics and targets. The foundations pillar focuses on setting objectives to manage exposure to physical risks and seize adaptation-related opportunities. Implementation strategies translate risk assessments into concrete actions, such as risk avoidance, acceptance, reduction, transfer, and investment in new opportunities. Engagement strategies emphasise the need for collaboration with governments, value chains, industry peers, and academia. Governance mechanisms should oversee both mitigation and adaptation efforts, building upon existing mechanisms for addressing corporate mitigation challenges rather than replacing them. The final pillar, which is considered the most difficult of the five, introduces a maturity model for adaptation metrics and targets (Figure 1). This model presents a progression from basic data collection to more advanced outcome-based metrics. It suggests metrics should begin by evaluating exposure and vulnerability, progress to input metrics measuring resources allocated to adaptation efforts, and finally to output metrics for assessing the impact of adaptation measures. The model allows for gradual improvement and can be adapted to suit institutions with different capabilities and environments.

The Path Forward

Financial and non-financial institutions, policymakers, and academia must intensify their efforts to incorporate adaptation into transition plans, building a conducive enabling environment, including national adaptation plans, regulatory frameworks, and public-private partnerships. By integrating adaptation into transition planning, institutions can better manage climate-related risks and contribute to a resilient and sustainable future.

5. GREENING MONETARY OPERATIONS AND ISLAMIC SUSTAINABLE FINANCE

The panel included a short presentation of current work by the *NGFS Subgroup on Monetary Policy Operations* on "greening" central bank liabilities, followed by a discussion of the CBUAE's planned Sustainable Islamic M-Bill Programme. Some of the most relevant questions raised during discussion were:

- What are the key issues and challenges in green monetary policy operations? How do you see the potential for a greater focus on liability-side measures?
- How did the idea of creating a Sustainable Islamic M-Bill Programme arise, and why is it so important for the CBUAE (in terms of monetary policy effectiveness) and the UAE (in terms of capital market development)?
- What are the main objectives, key benefits and operational challenges in integrating Shari'ah compliance and climate considerations into central bank liabilities and monetary operations?
- How does the planned Sustainable Islamic M-Bill Programme by the CBUAE align with international best practices, and what unique features does it introduce to the Islamic finance landscape?
- How can we ensure that the Sustainable Islamic M-Bill Programme effectively mobilises capital towards climate-resilient projects while maintaining market integrity and investor confidence?

5.1. A NEW FRONTIER IN GREENING MONETARY POLICY OPERATIONS: MONETARY BILLS – ANDREAS (ANDY) JOBST (CHIEF – MONETARY POLICY, CBUAE)[9]

While governments and legislators are responsible for creating the conditions conducive to enhancing climate resilience and creating an orderly transition to a low-carbon economy, central banks can play a supportive role within their respective mandates. The economic implications of climate change do not only influence how central banks assess their monetary stance but also inform how they conduct monetary policy operations. By strategically adjusting their monetary policy operations, central banks can not only shield themselves from climate-related financial risks ("climate risk protection") but they could also contribute to a more effective allocation of capital to funding toward low-carbon investment opportunities, in line with their government's transition pathways ("climate change mitigation") and enhance socio-economic resilience ("climate change adaptation").

The influence of climate-related financial shocks on the monetary stance require central banks to review (and amend as necessary) existing frameworks guiding monetary policy operations. Central banks can also adapt monetary policy operations in support of government-led climate mitigation and adaptation strategies, provided these actions are within their legal mandate. However, this approach requires balancing environmental objectives with market neutrality principles and their medium-term objective of monetary stability. Each central bank's specific mandate would ultimately determine the scope of implementation — especially as such actions can threaten the principle of market neutrality.

9 With contributions from Wassim Slama (Senior Director – Monetary Policy, Monetary Policy Department) and Amadou Dieye (Senior Manager – Liquidity Forecasting, Monetary Policy Department).

Current NGFS guidance on greening operations is largely focused on measures affecting central bank assets, and, thus, remains incomplete (NGFS, 2021 and 2024b). Considering financial risk protection of central bank's balance sheet and the implications of asset purchases and credit operations on climate policy (i.e., mitigation and adaptation) is particularly relevant when tight liquidity conditions make access to central bank money more valuable. However, changes in central bank assets are inherently cyclical and their effectiveness can vary over time. Many central banks are now dealing with the issue of managing excess reserves (as a result of recent balance sheet expansion), which diminishes the effectiveness of asset side-driven measures in determining financing conditions (including the impact of climate-related conditionality). In addition, climate-sensitive monetary operations affecting only central bank assets are less relevant in monetary policy where liabilities-driven measures, such as material reserve requirements and/or the issuance of short-term debt securities and certificates of deposit, are essential to effective liquidity management and monetary policy transmission amid system-wide excess reserves.

Current NGFS work aims to widen the existing guidance by recognising that central banks can also change the composition and treatment of their liabilities in a way that reflects environmental objectives. A comprehensive approach that considers both sides of central bank balance sheets, with stronger structural features, can engender a more persistent, inclusive and reliable effect of greening monetary policy within the acceptable scope of central banks' actions in supporting the efforts for an orderly climate transition across the NGFS membership. Greening monetary policy operations has so far focused mainly on central bank assets, such as credit operations (i.e., standing liquidity facilities and open market operations in the form of repo activities) and asset holdings related to monetary policy operations (such as government bonds and other debt securities). But also the liability side of the balance sheet matters when central banks need to proactively manage reserve demand; in this case, liquidity absorbing measures can help strengthen incentives aimed at encouraging climate-smart behaviours (in terms of risk management and investment of financial and non-financial institutions alike). For instance, central banks could link reserve requirements to climate-related factors or issue "green monetary bills" to manage system-wide liquidity.

Table 1. Extending the scope for greening monetary operations

Area	Examples
Assets *Persistence of climate considerations: structurally integrate climate factors*	• Greening (long-term) **credit operations** by adjusting pricing or counterparty eligibility • Greening **collateral frameworks** through valuation haircut adjustments or screening of collateral • Greening **asset purchases** (including reserves management) through screening or tilting • Dedicated **liquidity facilities** for non-bank financial institutions (NBFIs) involved in sustainable/climate projects • **Monetary-fiscal coordination** (e.g., providing (emergency) funding for climate-focused public sector investment initiatives)
Liabilities *Effectiveness of climate considerations: manage liquidity surplus with climate considerations*	• Green **reserve requirements** (through differential reimbursement or tiering of the reserve account) depending on climate-related investment/lending • Issuing **green short-term debt securities** (monetary bills) and/or certificates of deposit • Offer **central bank accounts** to non-bank financial institutions (NBFIs) involved in sustainable/climate projects

Sources: author and NGFS *(2026)*

The issuance of central bank's short-term securities is an effective and market-friendly liquidity management tool, offering central banks greater autonomy compared to other instruments. Other OMO tools, such as repurchase or swap agreements, depend on the availability of eligible collateral, which might be difficult to implement in jurisdictions with a weakly developed local capital market (and create dependence on foreign currency-denominated collateral that could impinge on the effectiveness of the prevailing monetary policy framework); in contrast, local currency-denominated central bank securities provide autonomy in this regard (and do not impact the monetary base). Central bank securities also boost banks' counterbalancing capacity to secure funding from the interbank market (rather than the central bank) during times of stress, which strengthens the central bank's role as lender of last resort (rather than first resort).[10]

Central banks could consider incorporating climate considerations into the design of their short-term debt instruments. Some central banks issue securities, such as monetary bills, to manage system-wide liquidity in the banking sector, ensuring excess reserves align with pre-defined target levels. The issuance (and amortisation) of these securities through open market operations (OMO) directly affects the central bank balance sheet and banking sector reserves.[11] Unlike direct instruments like minimum reserve requirements, which act as a general tax on financial intermediation unless fully remunerated, central banks securities are demand-driven and priced at prevailing money market rates, supporting effective monetary policy transmission. Central banks could use the issuance proceeds to directly finance or refinance eligible sustainable assets, creating a new category of green financial instruments. This approach of creating a green asset-backed monetary bill would require all (or a portion of) underlying assets to meet specific sustainability criteria, complemented by robust impact tracking mechanisms to monitor and report the environmental impact of funded projects.

Green monetary bills would provide incentives for banks to issue and hold sustainable finance instruments. The inclusion of sustainability features may lower the yield compared to traditional monetary bills, creating a "greenium" or improving other terms.[12] This can result in more favourable financing terms for sustainable investments, as the high prices of eligible assets purchased by the central bank encourage banks to issue new eligible assets. By issuing short-term debt to fund longer-term assets on a rolling basis (and setting the interest rate floor), central banks can benefit from term structure transformation. This allows central banks to support climate goals by signalling the value of sustainable investments in the market.

10 The absorption of excess reserves through the issuance of central bank debt securities does not increase the counterbalancing capacity in the banking sector but improves the availability of a highly-liquid and safe collateral asset for secured funding in the interbank market. Additionally, in some cases, central bank securities can support bond market development, addressing gaps where fiscal authorities do not issue sufficient securities to meet market demand for risk-free domestic currency assets, thereby helping establish a benchmark yield curve (Boonstra and van Geffen, 2022).

11 According to the IMF's *Information System for Instruments of Monetary Policy* (ISIMP) database, more than 35 central banks currently issue monetary bills/short-term debt securities (Gray and Pongsaparn, 2015). These central banks include Bahrain, Chile, Sweden, Thailand, and the UAE, which could consider integrating sustainability considerations into their issuance programmes. While having a pre-existing debt issuance programme is beneficial for promptly implementing this recommendation, it is not a requirement. Furthermore, some central banks issue certificates of deposits, which can also be utilized for promoting sustainability, although they may have a lesser signalling impact as they are not traded.

12 The term "greenium" generally refers to the yield difference between a green bond and its conventional equivalent. A positive "greenium" implies premium investors are willing to pay for funding green assets, which reduces the funding cost (Nederkoom and Scholten, 2024; Jobst and others, 2024).

Several limitations can, however, constrain the potential greening of monetary bills. In countries without a legislated sustainable finance framework (and/or taxonomy), the central bank would need to provide a de facto benchmark for what constitutes (eligible) sustainable activities to inform the screening criteria for the selection of eligible assets; creating such a benchmark takes significant time and resources to implement consistently (and may involve legal challenges).[13] The issuing central bank would also need to carefully manage any credit risk from holding sustainable assets over longer periods of time beyond the average maturity of issued monetary bills; ideally, the sourcing of sustainable assets would supplement available commercial bank funding rather than crowding out private capital. If the risk and maturity profile of monetary bills and eligible assets differ significantly, it may be difficult to measure the overall benefit (and the degree of funding benefit, and, thus, effectiveness of issuing monetary bills to simulate the creation of sustainable assets).[14] Finally, the creation of green monetary bills could compromise the effectiveness of liquidity management as the primary objective of issuing short-dated central bank debt securities. The acquisition of sustainable assets initially injects liquidity into the banking sector, either directly (in the case of financial assets held by banks) or indirectly (in case of real assets, such as infrastructure projects, resulting in higher bank deposits by corporates or government entities). So green monetary bills only absorb surplus liquidity if the volume of underlying sustainable assets is smaller than the nominal issuance amount.

The introduction of a green monetary bills programme could start with small-scale pilot projects and then expand based on market feedback and effectiveness in encouraging sustainable investments. The success of this gradual approach would rely on creating clear classifications, implementing strong verification processes, and maintaining transparent reporting systems to ensure credibility and effectiveness. This strategy would enable central banks to use these monetary bills as part of their structural open market operations to support environmental objectives while still meeting the responsibilities under their core mandate. However, the feasibility of greening central bank securities hinges on the availability of suitable assets and the expertise needed to develop a reliable financial instrument based on these assets.

The Central Bank of the United Arab Emirates (CBUAE) is currently the only central bank considering the issuance of green debt securities. Starting in 2023, the CBUAE initiated the development of Shari'ah-compliant and sustainable-equivalent versions of its monetary bills (M-Bills), which can serve as collateral to access the CBUAE's standing and liquidity insurance facilities. These "Sustainable Islamic M-Bills" do not only provide a new safe asset to the local capital market, but also facilitates greater collateralisation among market participants while promoting equality between conventional licensed financial institutions and those operating in accordance with Shari'ah law (CBUAE, 2025b). The first stage of the project concentrated on assessing the feasibility and potential scope of the programme, as well as setting up the legal framework (Box 1).

13 While most advanced economies have an official sustainable finance taxonomy or framework, this coverage drops to less than one-third in EMDEs (NGFS, 2025c).

14 For instance, most sustainable assets are likely to be infrastructure projects, which tend to generate very stable and predictable cash flows during their operational phase (and outperform corporate debt of similar credit quality over time) but entail significant default risk during construction (Jobst, 2025b).

BOX 1. CASE STUDY: SUSTAINABLE ISLAMIC M-BILLS PROGRAMME

The CBUAE is currently developing a "Sustainable Islamic Monetary Bills" programme as additional element of the Dirham Monetary Framework (DMF) to support the national sustainability agenda and enhance the prevalence of Islamic finance more generally. The programme aims to create a tradable Shari'ah-compliant[15] alternative to existing (conventional) monetary bills (M-Bills) that also meets globally accepted sustainability criteria consistent with the UAE's sustainability agenda as defined in the *UAE Green Agenda 2015-2030*, the *National Climate Change Plan 2017-2050* and the *UAE Net Zero 2050 Strategy* (MOCCAE, 2015, 2017 and 2023). It will incentivise climate-smart investments that could be included as eligible assets for the programme. The asset-based nature of the Sustainable Islamic M-Bills programme offers the opportunity to introduce sustainability considerations in the eligibility of the underlying collateral pool of reference assets.

The Sustainable Islamic M-Bills programme also supports the development of the UAE's money and capital markets. These M-Bills are expected to be issued regularly as tradable short-term, Shari'ah-compliant securities that can be used as collateral to either access the CBUAE's standing and liquidity insurance facilities or secure inter-bank lending. It will also offer domestic capital markets with sustainable and Shari'ah-compliant securities that can be traded locally, thereby creating a market for such securities.

The programme could also help (partially) offset the cost of liquidity absorption. Issuing short-term debt securities by the CBUAE to refinance longer-dated assets can take advantage of term structure transformation in typical market conditions, such as an upward-sloping yield curve. This strategy, when factoring in transaction and administrative expenses, can result in an operational net profit from any interest rate differential, thereby supporting cost-effective open market operations.

Current Status

T**he preparatory work for programme approval has been completed.** Building on a comprehensive feasibility analysis as well as finalisation of the design and assessment of an effective legal structure, work will proceed after the in-principle validation from the CBUAE's *Higher Shari'ah Authority* (HSA), pending approval from the CBUAE Board. Once operational, the programme will be the first of its kind worldwide and will be instrumental in supporting the continuous growth of Islamic capital markets and sustainable finance in the UAE.

15 Non-permissible activities under Shari'ah principles (which includes alcohol production and sales, gambling and betting, pork-related products, adult entertainment, interest-based financial services, tobacco production and sales, weapons and defence manufacturing) do not conflict with sustainability requirements for the intended programme.

5.2. FROM LIQUIDITY TO SUSTAINABILITY: THE IILM'S ROLE IN CLIMATE-RESPONSIVE ISLAMIC FINANCE – MOHAMAD SAFRI SHAHUL HAMID (CHIEF EXECUTIVE OFFICER, IILM)

Climate change has become a systemic threat to global financial stability. Central banks, regulators, and financial institutions are incorporating climate risk into monetary policy, regulatory frameworks, and capital market instruments. Islamic finance, which is based on ethical principles, presents a natural synergy with sustainability goals. One of the key players to help identify this synergy is the *International Islamic Liquidity Management Corporation* (IILM), which helps in the creation of Shari'ah-compliant liquidity instruments.[16] The IILM is a distinctive global Islamic institution whose mandate is to address liquidity management challenges faced by the Islamic banks worldwide. It achieves this by creating and releasing liquid, Shari'ah-compliant financial instruments designed for institutions offering Islamic financial services.

The core principles of Islamic finance — including the prohibition of harmful *(haram)* activities, the emphasis on stewardship *(amanah)*, and the pursuit of justice — naturally align with environmental and social responsibility. These shared values position Islamic financial institutions as leaders in ethical investment and sustainable development, making the integration of ESG principles not only strategic but genuine. This chapter explores how climate risk is reshaping financial governance and how institutions such as the IILM can contribute to a low-carbon transition, particularly through the lens of Islamic finance.

Islamic Liquidity Instruments and Regulatory Requirements

The IILM contributes to regulatory objectives by increasing the supply of Shari'ah-compliant high-quality liquid assets (HQLA). This is particularly important in jurisdictions where Islamic banks are systemically important but do not have access to conventional liquidity tools. These instruments could be tailored to support green initiatives, such as linking issuance to sustainable projects or aligning with ESG standards. At the same time, financial regulators and central banks are embedding climate risk into both micro- and macroprudential frameworks, including (1) climate stress testing to assess institutional resilience, (2) disclosure requirements aligned with the Task Force on Climate-related Financial Disclosures (TCFD),[17] and capital requirements that reflect the financial risks of climate-related exposures. By broadening the variety of available liquidity instruments and potentially integrating climate considerations into Sukuk issuance, the IILM can assist Islamic financial institutions in meeting evolving regulatory requirements.

Capital Markets and the Green Transition

Capital markets are crucial in funding the transition to a low-carbon economy by supporting mitigation efforts aimed at reducing greenhouse gas emissions. The increasing popularity of green and sustainable bonds underscores increasing investor demand for climate-friendly assets. However, there are still challenges such as greenwashing, inconsistent standards, and a limited supply of high-quality financial products. Islamic finance, which focuses on ethical and socially responsible investing, is well-suited to support sustainability objectives. The IILM can take advantage of this alignment by: (1) considering green (short-term) Sukuk issuance, backed by environmentally friendly assets, (2) working with standard-setting organisations to create frameworks for sustainable Islamic finance, and (3) fostering local market growth in jurisdictions with untapped opportunities for sustainable finance.

16 Based in Kuala Lumpur, Malaysia, the IILM was founded on 25 October 2010. Its diverse membership comprises central banks and monetary authorities from Indonesia, Kuwait, Malaysia, Mauritius, Nigeria, Qatar, Türkiye, the United Arab Emirates and the Islamic Corporation for the Development of the Private Sector (ICD), a part of the Islamic Development Bank (IsDB) Group. The IILM is also responsible for promoting cooperation at national, regional, and international levels to enhance liquidity management infrastructure.

17 The TCFD offers a guiding framework for companies to disclose information to investors regarding their efforts to address climate change risks and their governance practices. Following COP26, the TCFD merged with the International Sustainability Standards Board (ISSB) under the International Accounting Standards Board (IASB).

The Global Islamic Liquidity Management Report 2023 (IILM, 2024) highlights the IILM's leadership in addressing liquidity challenges within Islamic finance, having issued over USD 100 billion of high-quality short-term Sukuk rated 'A-' by S&P Global Ratings and 'F1' by Fitch Ratings. As of end-September 2025, this amount has grown to USD 130 billion through 325 short-term issuances. The introduction of green or sustainability-linked Sukuk within this programme could substantially strengthen the contribution of Islamic finance to global climate mitigation efforts.

The Network for Greening the Financial System (NGFS)

While the IILM is not a member of the NGFS, its work complements the NGFS's objectives. The NGFS is a coalition of central banks and financial regulators committed to exchanging best practices, advancing climate and environment-related risk management in the financial sector, and encouraging mainstream finance to aid in the shift towards a sustainable economy. Its key initiatives include: (1) climate scenario analysis (i.e., tools to assess the impact of different climate pathways), (2) stress testing frameworks, and (3) guidance on sustainable finance (including best practices for integrating climate risk reporting and management in financial sector regulation and supervision). By offering liquidity instruments that adhere to green finance principles, the IILM can assist central banks in Islamic finance jurisdictions that are members or observers of the NGFS.

Looking Ahead - IILM's Strategic Role in the Transition to a Low-Carbon Economy

Climate change presents a significant challenge for the global financial system. Central banks and regulators are increasingly integrating climate risk into their mandates, and capital markets are evolving to support the shift towards a low-carbon economy. The IILM plays a vital role in ensuring that Islamic finance keeps pace with these developments. In particular, the IILM is uniquely positioned to bridge the gap between Islamic finance and global sustainability efforts. Its potential contributions can be categorised into three strategic areas: product innovation, market development, and policy alignment.

- **Product Innovation:** The IILM could offer short-term, environmentally friendly Sukuk to help Islamic banks manage liquidity and fund climate-friendly projects. They could also introduce short-term sustainability-linked Sukuk with environmental performance targets to encourage better ESG practices. Additionally, the IILM could support short-term Sukuk issuances by backing them with long-term Sukuk assets from eligible obligors with low carbon goals, benefiting both parties.
- **Market Development:** The IILM can collaborate with regulators and financial institutions to enhance understanding and technical expertise in green finance among key players in Islamic finance. Strengthening partnerships with the *Accounting and Auditing Organisation for Islamic Financial Institutions* (AAOIFI) and *Islamic Financial Services Board* (IFSB) can help establish robust and uniform capital market standards and frameworks for sustainable Islamic finance.
- **Policy Alignment:** By providing Shari'ah-compliant HQLA, the IILM assists central banks in enhancing the effectiveness of monetary policy in dual financial systems. Additionally, it can adjust its issuance strategy to take climate risk into account, thereby contributing to broader financial stability objectives.

The IILM is well positioned to be a key partner to the NGFS and its members in advancing an inclusive and effective low-carbon transition across Shari'ah-compliant jurisdictions. By expanding its product offerings to include green and sustainability-linked Sukuk, promoting regulatory harmonisation and supporting market development, the IILM can enhance climate resilience and sustainable growth in Islamic capital markets and ensure that Islamic financial institutions remain robust and are at the forefront of the global climate transition.

6. SCENARIOS, STRESS TESTING AND DATA FOR CLIMATE POLICY

The panel included a short presentation of climate stress testing at the CBUAE, followed by a discussion on the current status of climate scenarios, stress testing and data analysis. Some of the most relevant questions raised during the discussion were:

- What are the main lessons we can learn from climate stress testing, and how can findings influence supervisory practices and risk management practices among financial institutions? How can we distinguish between direct and indirect effects? Are there differences between banks, insurers and other financial institutions?
- How do current climate scenario analysis and stress testing frameworks in the region compare with international approaches, particularly regarding the integration of transition and physical climate risks?
- What are the key data challenges faced by central banks/supervisors as well as financial institutions in conducting robust climate scenario analysis, and how can access to high-quality emissions and physical risk data be improved?
- In what ways can scenario analysis and stress testing be further embedded into the supervisory and regulatory processes to enhance the resilience of the financial sector to climate-related risks?

6.1. CLIMATE STRESS TESTING AT THE CENTRAL BANK OF THE UAE – Jouni Timonen (Chief – Financial Stability, CBUAE)[18]

Climate change poses complex challenges as policy shifts toward a low-carbon economy and extreme weather events threaten financial stability. Many central banks, including the CBUAE, are adjusting their stress testing frameworks to address these risks, acknowledging the need for innovative approaches. The UAE, historically reliant on oil and gas, is diversifying its economy through initiatives like the UAE *Vision 2031*,[19] promoting sectors such as renewable energy, tourism, and technology. With hydrocarbons contributing around 25% of GDP, the economy is susceptible to transition risks from lower global demand for fossil fuels. In addition, UAE's hot and arid environment, coupled with its extensive, low-lying coastline where most of its population and infrastructure are located, exposes the country to physical risks from rising temperatures and sea levels. This dual vulnerability underscores the critical importance of financial institutions conducting comprehensive climate risk scenario analysis to bolster resilience and support sustainable economic growth.

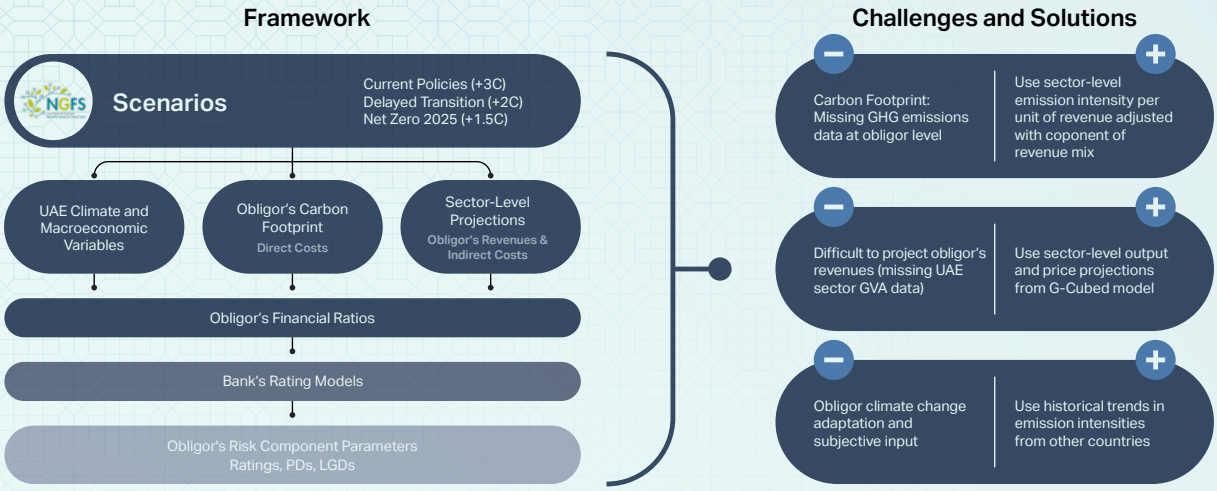
Climate Risk Stress Testing Programme

The CBUAE has created an innovative climate risk stress testing programme, leveraging and enhancing NGFS scenarios. By integrating UAE-specific economic dependencies and localised environmental hazard data, the CBUAE has tailored these scenarios to address the distinct transition and physical risks in the region. The objective of the programme is to safeguard financial stability by identifying vulnerabilities in crucial economic sectors and real estate lending, ensuring that financial institutions are adequately prepared to manage climate-related disruptions and losses.

18 With contributions from Bing Zhao (Director, Macroprudential Modelling and Stress Testing) and Beka Lamazoshvili (Assistant Director, Macroprudential Modelling and Stress Testing).

19 See https://u.ae/en/about-the-uae/strategies-initiatives-and-awards/strategies-plans-and-visions/innovation-and-future-shaping/we-the-uae-2031-vision.

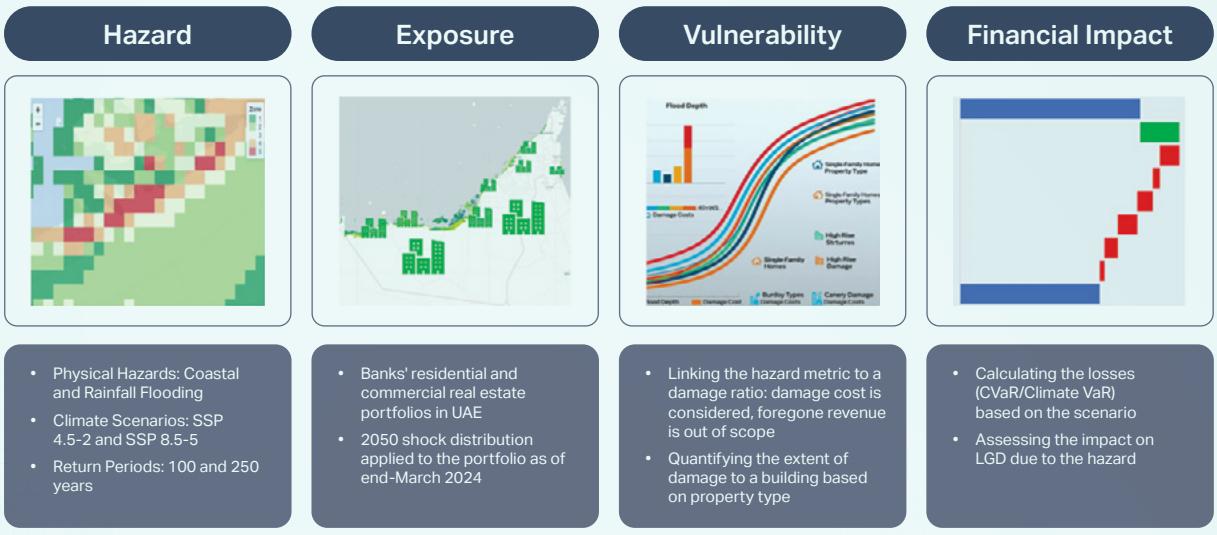
Figure 2. Climate Stress Testing Framework: Transition Risk Assessment



Sources: UNEP (2020 and author.

The CBUAE's methodology for assessing transition risk focuses on evaluating the financial impact of global decarbonisation policies on the UAE's economy, particularly targeting the largest 20 borrowers in economic sectors like oil and gas, petrochemicals, and transportation (Figure 2). This approach incorporates NGFS macroeconomic scenarios and transition pathways, including carbon and oil price trajectories, adjusted to reflect the UAE's economic diversification efforts, such as investments in renewable energy and green hydrogen. [20] Sector-level output and revenue projections from the G-Cubed model (NGFS, 2022; McKibbin and Wilcoxen, 2013) align with the 'We the UAE' Vision 2031 goals to reduce reliance on hydrocarbons.[21] The methodology also considers estimates of obligor-specific carbon footprints, based on actual emission data (where available) or sector-level emission intensities, to stress financial ratios, such as profitability and debt-to-equity, translating these changes into credit risk parameters like the probability of default (PD). This provides a detailed assessment of borrower resilience under different NGFS transition scenarios (e.g., Net Zero 2050, Delayed Transition and Current Policies).

Figure 3. Hazard-Exposure-Vulnerability Framework for Stress Testing Physical Climate Risk



Source: author

20 The CBUAE's refinements to NGFS scenarios include region-specific transition pathways, such as the UAE's commitment to net-zero emissions by 2050, ensuring that stress tests align with national policy objectives.

21 See also https://www.sensiblepolicy.com/Manuals2021/GGGv6GManual/model.htm.

The stress testing framework covers both physical and transition risks, with a focus on the financial impact of acute climate hazards. Acute threats from storm surges (coastal flooding) and pluvial (rainfall) flooding pose significant risks to the UAE's coastal cities and infrastructure and take precedence over chronic risks, such as rising temperatures, which are integrated into macro scenarios via damage functions. The main focus is on the real estate sector, which is a cornerstone of the UAE's economy, which is exposed to flood risks; in addition, property is one of the most widely used types of collateral in the financial system. The CBUAE employs a hazard-exposure-vulnerability framework, incorporating high-resolution hazard maps sourced from a leading climate-tech company and enriched with UAE-specific geographic data, such as coastal elevation, to assess risks. Flood damage curves, adapted from international research, are customised to the UAE's modern infrastructure and building standards (Figure 3). Granular property-level data from banks are used to evaluate damage under different climate scenarios and return periods (e.g., 1-in-100-year floods of RCP 8.5). These assessments help estimate collateral value losses and their impact on risk parameters, ensuring a thorough evaluation of financial stability risks.

Data Sources and Methodological Enhancements

The stress testing programme relies on a blend of global and localised data sources to ensure accuracy and relevance. NGFS scenario narratives provide standardised frameworks for transition and physical risk assessments, including variables like carbon prices, energy demand and climate impact projections. The CBUAE further refines these scenarios by incorporating UAE-specific data, such as national energy transition plans, regional climate models, and property-level risk exposures. For transition risks, the G-Cubed model's projections are adjusted to reflect the UAE's economic diversification, including growth in non-hydrocarbon sectors like finance, tourism and renewable energy. For physical risks, hazard maps are refined with UAE-specific data on coastal topography, urban planning and infrastructure resilience, addressing the limitations of more generalised global models that may overlook local nuances (Figure 3). The inclusion of detailed property-level data, such as building types, elevation and flood protection measures, improves the accuracy of damage estimates, establishing the CBUAE's methodology as a standard for regional climate risk assessments.

Lessons Learned

The CBUAE's climate risk stress testing exercise provides valuable insights for central banks and financial institutions globally. The integration of country-specific economic and environmental data ensures that stress tests are both globally aligned and locally relevant, supporting the UAE's economic diversification and climate resilience goals. Several lessons underscore the importance of tailoring global frameworks to regional contexts, a practice the CBUAE has implemented through its enhancements to NGFS scenarios:

- **Realistic Assumptions:** Overly optimistic assumptions about mitigating factors, such as corporate transition plans or government subsidies, can significantly underestimate risks. The CBUAE emphasises conservative assumptions to ensure robust risk management, particularly for borrowers in high-emission sectors.
- **Standardised Methodologies:** Adopting a common methodology across banks enhances consistency, transparency and comparability of results. The CBUAE's standardised approach to PD and credit rating assessments has improved the reliability of stress test outcomes.
- **Data Granularity:** Firm-level emission and transition plan data as well as high-resolution, property-level data are essential for credible transition and physical risk assessments. The CBUAE's use of detailed collateral data has revealed significant variations in flood risk exposure, even within relatively small geographic areas.

- **Coastal Flooding Severity:** The increased severity of coastal flooding tail events under climate change scenarios (compared to pluvial flooding) highlights the need for targeted mitigation measures for coastal urban areas.

Challenges and Future Directions

Implementing climate risk stress testing presents several challenges. The lack of detailed, high-quality, localised climate data remains a constraint, especially when it comes to firm-level emissions. Moreover, modelling transition risks in a hydrocarbon-dependent economy is complex and requires ongoing adjustments to economic models to reflect global energy market dynamics, leading to considerable uncertainty in outcomes. The CBUAE has addressed these obstacles by investing in cutting-edge climate technology partnerships and data-sharing agreements with international research organisations. Future plans involve broadening the scope of stress testing to include more borrowers and sectors, such as manufacturing and construction, and integrating both chronic and acute risks in short-term scenarios for a more comprehensive assessment.

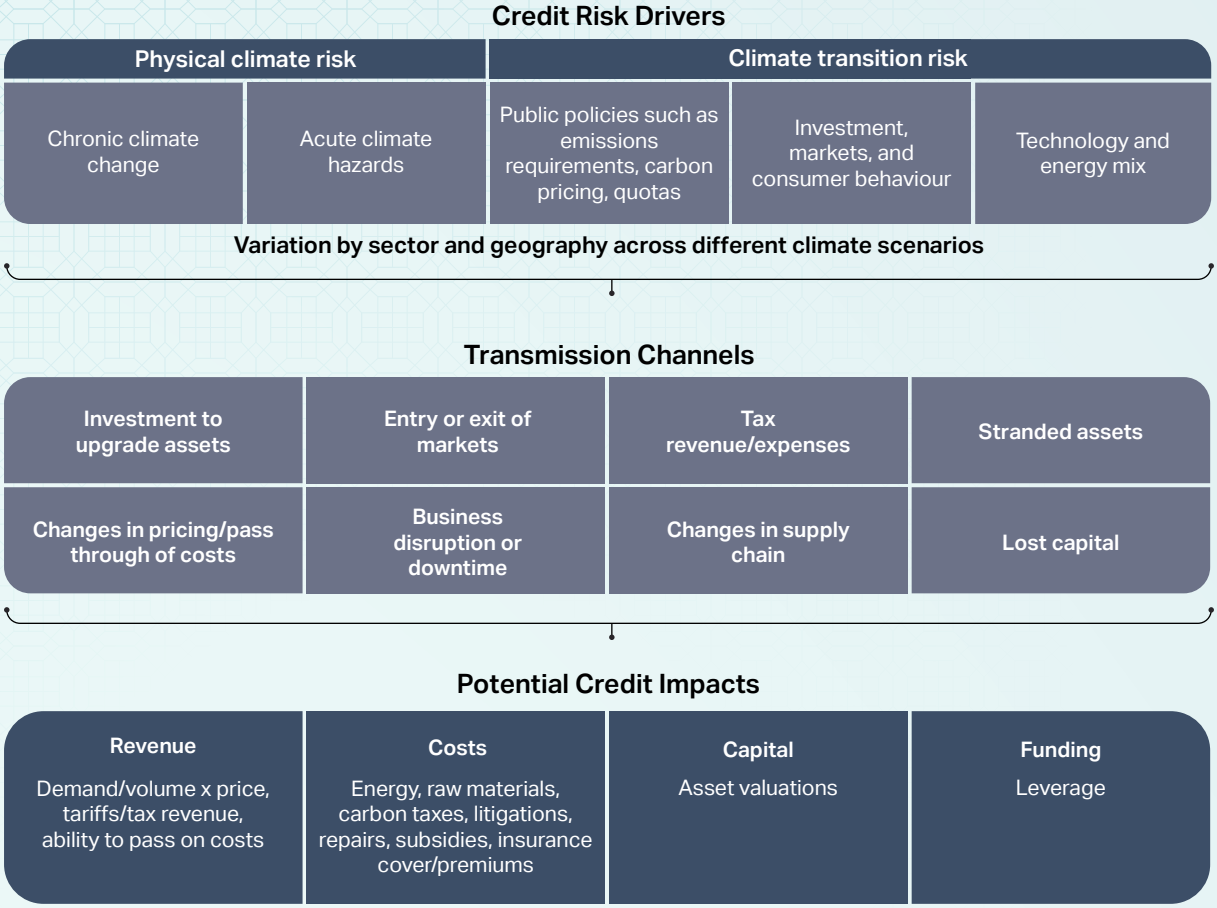
The CBUAE's climate risk stress testing programme helps safeguard financial stability in the face of escalating climate-related risks. By adopting and enhancing NGFS scenarios with UAE-specific economic dependencies, the CBUAE has developed a robust framework for assessing transition and physical risks. The focus on critical sectors like oil and gas and real estate, along with advanced methodologies and detailed data, ensures accurate and actionable risk assessments. The key takeaways from this initiative, including the importance of realistic assumptions, standardised methodologies, and high-quality data, offer valuable insights for other central banks navigating similar challenges. As the UAE advances its economic diversification and pursues the transition to a net zero emission economy, the CBUAE's climate risk stress testing programme will be instrumental in building a resilient financial system, contributing to both national and global efforts to address climate change. Ongoing improvements to the CBUAE's stress testing exercise will further solidify the UAE's position as a leader in climate risk management in the region, supporting a sustainable and diversified economic future.

6.2. CLIMATE SCENARIO ANALYSIS FOR DETERMINING RISK EXPOSURE AND TRANSMISSION CHANNELS IN THE CONTEXT OF CREDIT RATINGS – MARION AMIOT (HEAD OF CLIMATE ECONOMICS, S&P GLOBAL RATINGS)[22]

Scenario analysis helps improve our understanding of how transition and physical climate risks in different sectors or regions may evolve over time and affect ratings. It can highlight the most vulnerable locations and sectors, potential inflection points where climate-related credit risk drivers could affect our ratings, beyond what is already implied, and the potential magnitude of impacts (Figure 4; S&P Global Ratings, 2024). However, scenarios are not forecasts, and their results should be considered in conjunction with their underlying assumptions, aligned with current trends, and evaluated in the context of specific strengths and vulnerabilities.

22 For legal disclaimers applicable to this article, please refer to www.spglobal.com/ratings/en/regulatory/content/legal-disclaimer#ratings. Climate change can have material impacts on the creditworthiness of issuers and debt instruments and is one of the risks we monitor in our credit conditions publications (www.spglobal.com/creditconditions). However, the clarity on how and when climate transition and physical climate risks are transmitted to creditworthiness is generally low, since the transmission channels tend to be indirect and vary across sectors.

Figure 4. How Climate-Related Credit Risk Drivers Can Transmit to Potential Credit Impacts



Source: Birry and others (2024)

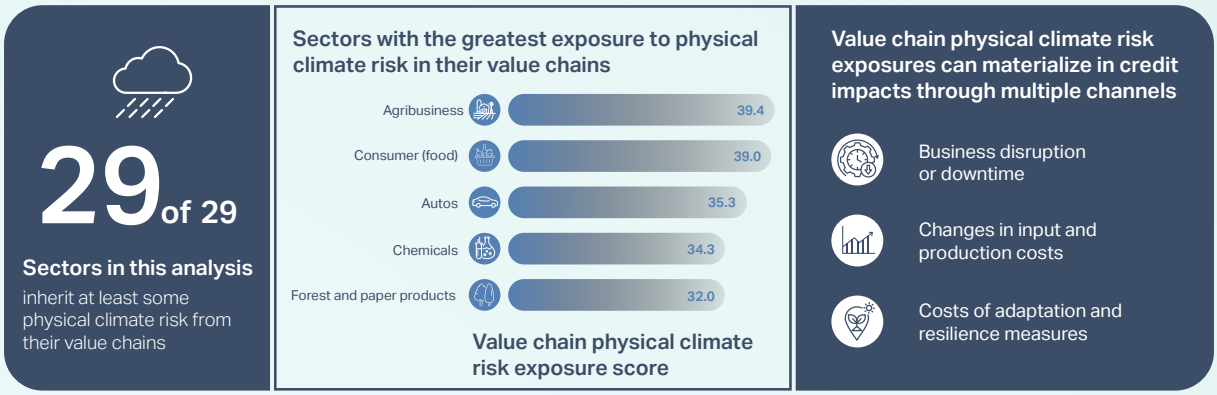
Vulnerabilities may differ across sectors and geographies

Transition risks from climate change are driven by a proactive reduction of carbon emissions due to changes in policy, technology, and consumer demand. Economies and sectors can be relatively more affected by transition or physical risks, or by both in tandem, depending on their specialisation and location. For instance, companies with higher emissions are more vulnerable to (climate) policy changes and preferences favouring decarbonisation, leading to supply-side reallocation of resources within industries. Environmental taxes can increase costs for polluting firms, which may be passed on to consumers through higher prices (and inflation) if alternative technologies are not available. Investing in new technologies may not be immediately profitable until they become competitive and there is sufficient demand, resulting in a reluctance to abandon older technologies without policy incentives. Different jurisdictions offer varying levels of support for the development and adoption of new technologies through subsidies and other industrial policy measures, affecting the pace of transition within and across countries. For example, China's policies to promote clean technology have reduced the cost of clean energy but also created global tensions (Amiot, 2025). Changes in relative prices can influence the adoption of new technologies or market shifts and indicate the ability of established companies to remain competitive (i.e., supply can adjust to changes in demand).

Material climate transition risks may result in rating actions. For example, in January 2021, S&P Global Ratings revised its industry risk for oil and gas companies from intermediate to moderately high, leading to some rating downgrades. The revision reflected the economic outlook for oil and gas supply and demand, as well as the effects of the growing shift towards renewable energy options to address climate change (S&P Global Ratings, 2021).

In the case of physical risks, rating actions can reflect the implications of capital destruction, business interruptions, supply-chain vulnerabilities and/or investment requirements on debt service capacity. Capital may be lost when natural hazards such as storms and flooding suddenly occur, while productivity may suffer from ongoing risk events like heatwaves or droughts. Without adaptation, a slow transition could lead to an estimated annual loss of up to 4.4% of global GDP by 2050 due to worsening climate hazards (Munday and others, 2023). Impacts can be direct or indirect, particularly affecting highly integrated sectors and those dependent on outdoor production, such as food and timber highly integrated sectors and those relying on outdoor production (e.g. food and timber) more exposed (Figure 5; Munday and Thomson, 2025).

Figure 5. Value Chain-Based Physical Climate Risk Exposure



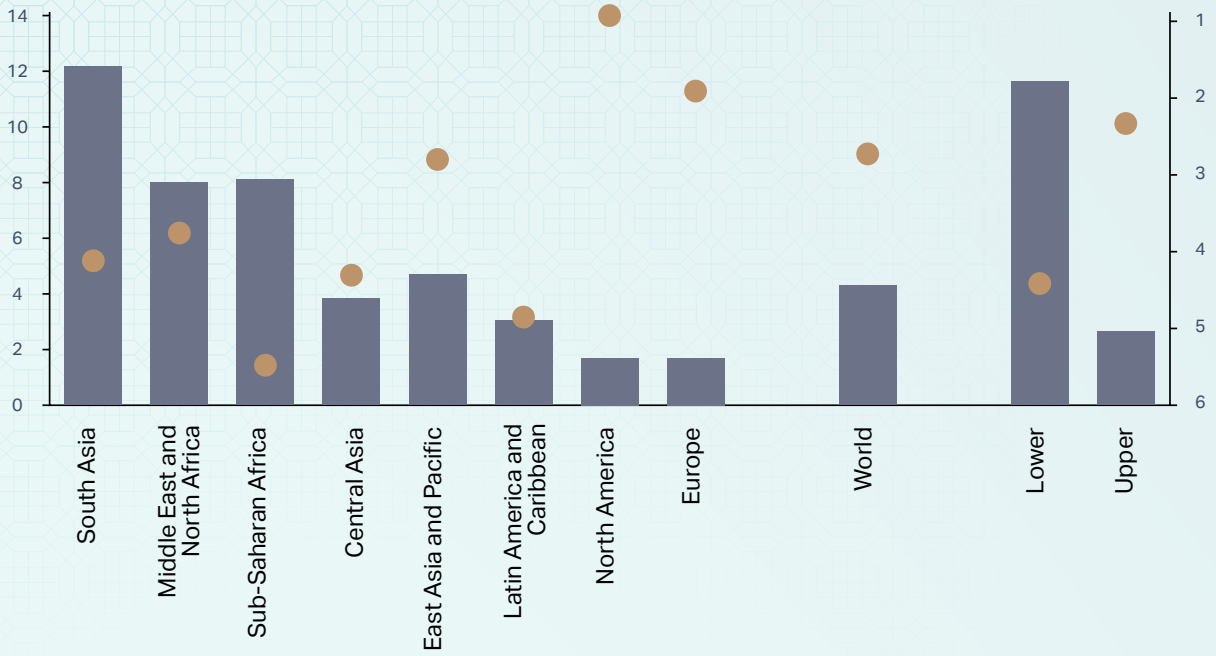
Source: Munday and Thomson (2025)

Investments in adaptation and resilience can help mitigate the increasing risk posed by climate-related natural disasters, but the progress in adaptation measures varies across firms. Munday, Georges and Baddeley (2024) show that only about one-fifth of surveyed companies have an adaptation plan and less than half of them intend to put their plans into action within the next ten years. This leaves some corporates vulnerable to the impacts of physical risk from climate change. Larger companies in jurisdictions with stricter environmental regulations, facing higher physical risks today, and with stronger governance structure are generally better prepared than smaller firms. Failure to address exposure to climate-related physical risks could lead to long-term declines in market share and income levels.

Scenarios are not forecasts and tend to focus on a specific risk

Scenarios can offer an effective way to depict potential future conditions that can help assess the financial impacts of key risks without assigning a specific likelihood to their occurrence and, thus, cannot be considered as a baseline projection. For instance, factors unrelated to climate can also influence drivers of climate-related risks. Shifts in geopolitics may result in sudden policy changes that impact companies' supply chains, expenses, or revenues. Technological advancement, such as AI, can influence companies' investment choices, valuations, and energy usage. Changes in consumer behaviour can prompt swift alterations in business models (for example, many companies moved to online sales platforms during the COVID-19 pandemic). Competing priorities can affect how policymakers address climate change (Amiot and others, 2024).

Figure 6. Estimated Regional Economic Losses and Readiness in Adverse Transition Risk Scenario (Slow Transition Scenario (SSP3-7.0) in 2050 – without adaptation; percent)



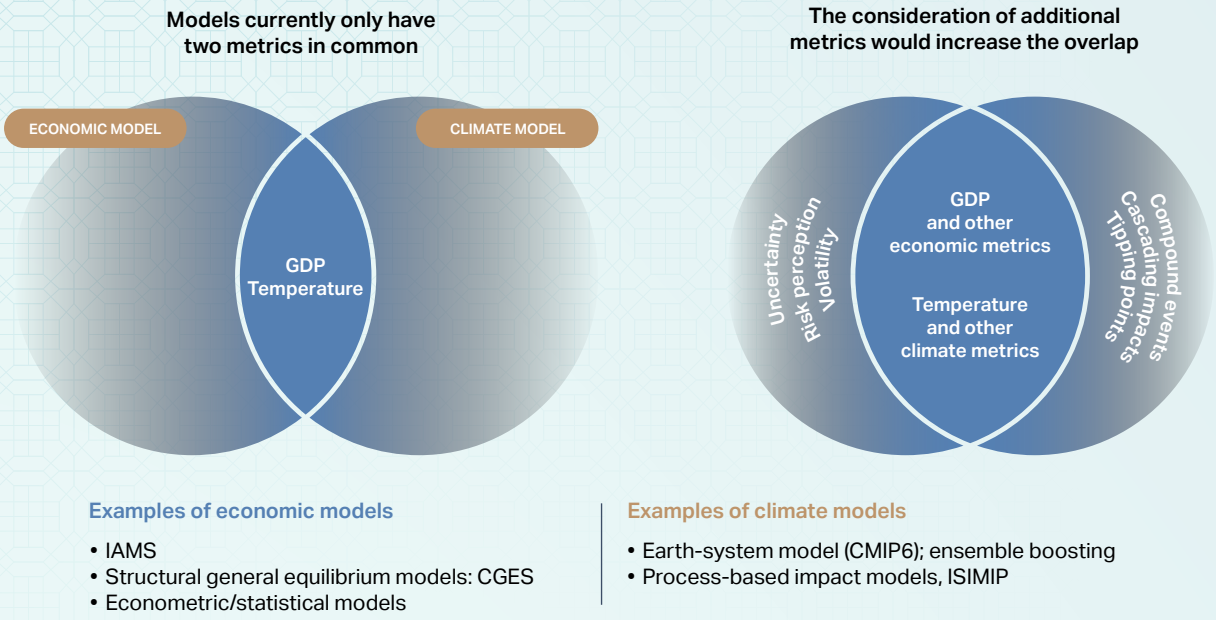
Source: Munday and others (2024)

The context in which climate-related risk materialises matters. These risks intersect with other vulnerabilities that impact the ability of countries and businesses to withstand and adapt to shocks. Munday and others (2023) find that the countries most exposed to physical climate risks are also the least prepared to handle and adjust to such challenges, often due to lower incomes and weaker institutional capacity (Figure 6).

Climate risks may not materialise as outlined in the scenario narrative and do not necessarily lead to rating changes. Since early 2022, S&P Global Ratings has made very few rating adjustments for non-financial corporates linked to climate-related risks. The relative climate-related stability of credit ratings reflects the lack of significant environmental regulations in highly polluting sectors, the stability of consumer behaviour, and the strong operational performance in industries like oil and gas and metals and mining due to the rises in commodity prices (Georges and others, 2023). At the same time, companies also have measures in place to mitigate potential challenges (Uboytseva and others, 2025).

Finally, models used for scenario analysis also influence how we perceive climate-related risks. Some dynamics and linkages are not captured by current macro-climate models. For instance, the potential for non-linear changes in weather patterns, such as tipping points or compounding events, is not accounted for. Also, the way in which macro-economic impacts are not well understood, with most impacts directly connected to GDP (Figure 7; Amiot and Gruenwald, 2025). Historical data used to calibrate these models may not accurately reflect the future, especially when considering variations in adaptation capabilities and opportunities.

Figure 7. Overlap Between Economic and Climate Models



Source: Amiot and Gruenwald (2025). Note: CGE= computable general equilibrium, CMIP6=coupled model comparison project phase 6, IAM=integrated assessment mode, ISIMIP=inter-sectoral impact model intercomparison project.

6.3. UNDERSTANDING IMMEDIATE CLIMATE-RELATED RISKS: NGFS SHORT-TERM SCENARIOS FOR CENTRAL BANKS AND SUPERVISORS – AGNIESZKA TRZCINSKA (TEAM LEAD, EUROPEAN CENTRAL BANK)

Acknowledging the importance of measuring the effects of climate risk in the short term, the NGFS released a novel set of short-term scenarios in May 2025 (NGFS, 2025b). The scenarios are designed to support central banks and financial supervisors in managing the immediate macroeconomic and financial risks of climate change. They provide an analysis of how climate policies and physical climate risks could impact economic and financial systems up to 2030. These scenarios are a crucial addition to the NGFS's long-term climate scenarios, helping to connect future climate projections with current policy considerations.

A New Framework for Immediate Climate Risk Analysis

The NGFS short-term scenarios represent a major step forward in climate risk assessment. They are specifically designed to inform risk assessments over the next five years. They integrate four core elements: climate policy (transition risk), extreme weather events (physical risk), sectoral dynamics, and connections between the macroeconomy and financial systems. The scenarios also bring in important several methodological innovations: (1) compound climate events (i.e., modelling of extreme weather hazards, such as floods, storms, droughts, heatwaves and wildfires, happening simultaneously), (2) global spillovers (i.e., regional shocks spreading through trade and supply chains), and (3) integrated modelling (i.e., macro-financial feedback loops incorporating policy responses, changes in cost of capital, and impacts on the financial system).

The scenarios are supported by a suite of three connected models: GEM-E3 (a computable general equilibrium model for macroeconomic climate impacts), EIRIN (a stock-flow consistent model for monetary impacts), and CLIMACRED (a climate credit risk model for financial system impacts). These models generate detailed scenario-contingent outputs related to climate variables (e.g., emissions, carbon prices), macroeconomic indicators (e.g., real growth, inflation, unemployment), and credit risk (e.g., probabilities of default, cost of capital, bond spreads). These are essential for financial risk analysis of both transition and physical climate risk, delivering granular insights at both sector and country levels.

Scenario Narratives: Transition and Physical Risks

The short-term scenarios are based on four core narratives, with two focused on transition risks and two focused on physical risks.

Transition Risk

- **Highway to Paris:** A seamless, forward-looking, technology-driven, and internationally coordinated transition to net-zero. Carbon tax revenues are channelled back into green reach and development, facilitating a gradual reduction in emissions with limited macroeconomic impact.
- **Sudden Wake-Up Call:** A delayed and sudden change in policy in 2027 to meet the 2050 net-zero 2050 leads to a disorderly adjustment with inefficient utilisation of carbon tax revenues. The abrupt rise in carbon prices results in inflationary pressures and increased financial strain, particularly in carbon-intensive industries unprepared for the shift.

Physical Risk

- **Disasters and Policy Stagnation:** A series of severe but realistic weather events (physical risks) affects a particular region, leading to global repercussions due to trade and financial interlinkages.
- **Diverging Realities:** A hybrid scenario blending physical and transition risks, where advanced economies fully embrace green initiatives while other regions face extreme weather events. These events cause disruptions in global supply chains and increase the economic challenges of transitioning to green practices in advanced economies.

Key Economic Insights and Trade-Offs

These short-term scenarios provide a rich comparative analysis of the economic consequences of various climate policies and climate change impacts:

- **An orderly transition minimises costs.** The *Highway to Paris* scenario limits output loss to 0.5% of GDP by 2030, with a slight increase in unemployment (+0.7 percentage points (pp)). Early and coordinated policies reduce uncertainty, facilitate more efficient capital reallocation, and lower financial risks.
- **A disorderly transition increases risks.** The *Sudden Wake-Up Call* scenario decreases GDP by 1.3% while increasing unemployment by 1.3pp until 2030. The abrupt shift exacerbates financial risks for high-emission sectors.
- **Severe regional shocks can have significant global implications.** The *Disasters and Policy Stagnation* results in significant regional GDP losses, with Africa experiencing a peak loss of 12.5% and South America over 7%. Even regions not directly impacted face reduced trade, investment, and financial contagion, particularly affecting capital-intensive sectors, such as power and agricultural.

- **Diverging transition paths create asymmetrical outcomes.** The *Diverging Realities* scenario depicts a world divided between advanced economies (North America, Europe, Oceania and part of Asia) transitioning effectively and less developed regions with insufficient ambition. Advanced economies face higher transition costs due to mineral supply shortages and recurring disasters in other regions, leading to a global GDP loss exceeding 2.8% and unemployment rising by up to 1.7pp.

Sectoral Winners and Losers

A defining feature of the NGFS short-term analysis is its sectoral granularity, covering 50 industries across 46 countries. Key findings from sector-level analysis underscore significant dispersion of the impact of physical and transition risks.

Transition scenarios lead to sector-specific re-pricing of risk, influenced by investor sentiment and the reallocation of capital between low and high-emission sectors. Low-emission sectors experience positive outcomes, with energy production from green technology doubling and default probabilities for low-carbon industries. Trade in green equipment, such as batteries and PV panels, sees a significant increase of over 100%. In contrast, high-emission sectors suffer face challenges, including declining production and higher capital costs (up to +8pp), leading to elevated default risks. The coal sector is at risk, with its probability of default projected to exceed over 30% by 2030 in both transition scenarios.

Physical risk scenarios lead to system-wide credit shocks, resulting in short-term increase default probabilities across various sectors. The impacts are more widespread and less selective compared to the transition risk scenario, with agriculture and capital-intensive industries such as power generation being the most severely affected. Disasters result in the destruction of physical assets, loss of productivity loss, and decreased output.

Conclusion

The NGFS short-term climate scenarios are a significant advancement in the global effort to incorporate climate risk into economic and financial decision-making. These scenarios provide crucial insights into the immediate impacts of transition and physical climate risks, enabling empower central banks, regulators, and financial institutions to better anticipate challenges, adjust responses, and mitigate risks.

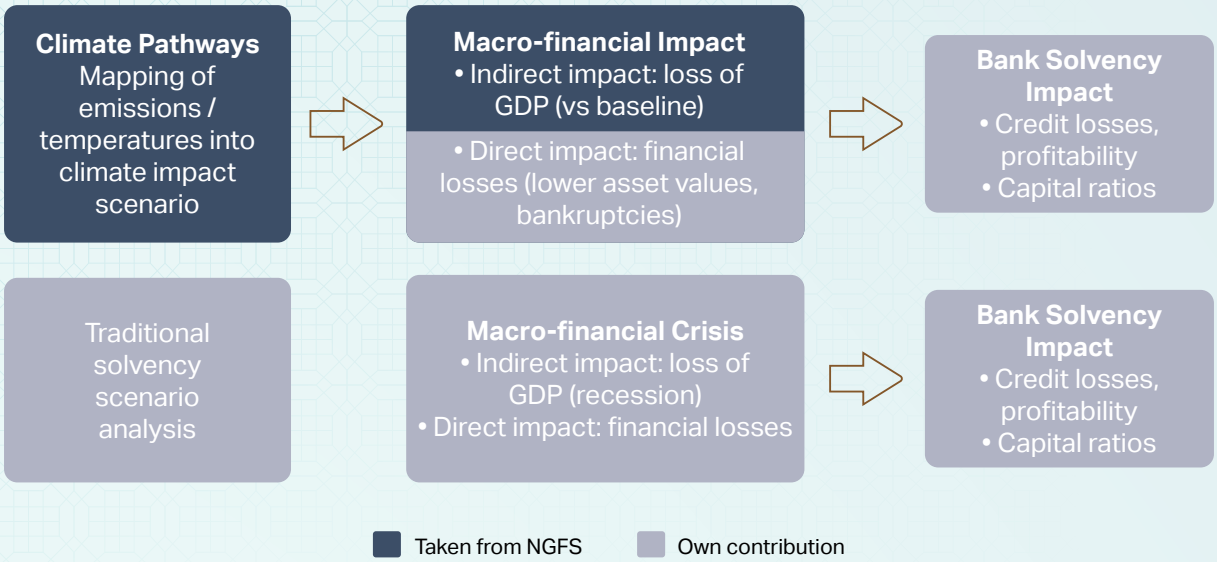
6.4. SCENARIOS, STRESS TESTING, AND DATA FOR CLIMATE POLICY – CHRISTIAN SCHMIEDER (HEAD OF OPERATIONS - MONETARY AND ECONOMIC DEPARTMENT, BIS)

The growing exposure of the financial sector to climate-related risks has underscored the need for advanced analytical tools, comprehensive frameworks, and robust data infrastructure. This chapter explores three key aspects of climate risk assessment: (1) lessons learned from climate stress testing; (2) ongoing difficulties related to data availability and quality that hinder accurate risk assessment, and (3) institutional frameworks needed to incorporate scenario analysis into current supervisory and regulatory systems.

Lessons Learned from Climate Stress Testing

Climate stress testing poses distinct challenges. Unlike traditional financial risks, such as credit, market, and operational risks, climate risks are inherently more complex and harder to quantify. Assessing the ultimate implications of climate risk stress scenarios on bank solvency and liquidity involves an additional step: mapping climate pathways to macro-financial impacts (Figure 8). Moreover, both physical risks (e.g., extreme weather events) and transition risks (e.g., low-carbon economy transition) are inherently uncertain and influenced by factors such as policy decisions, technological progress, and societal trends.

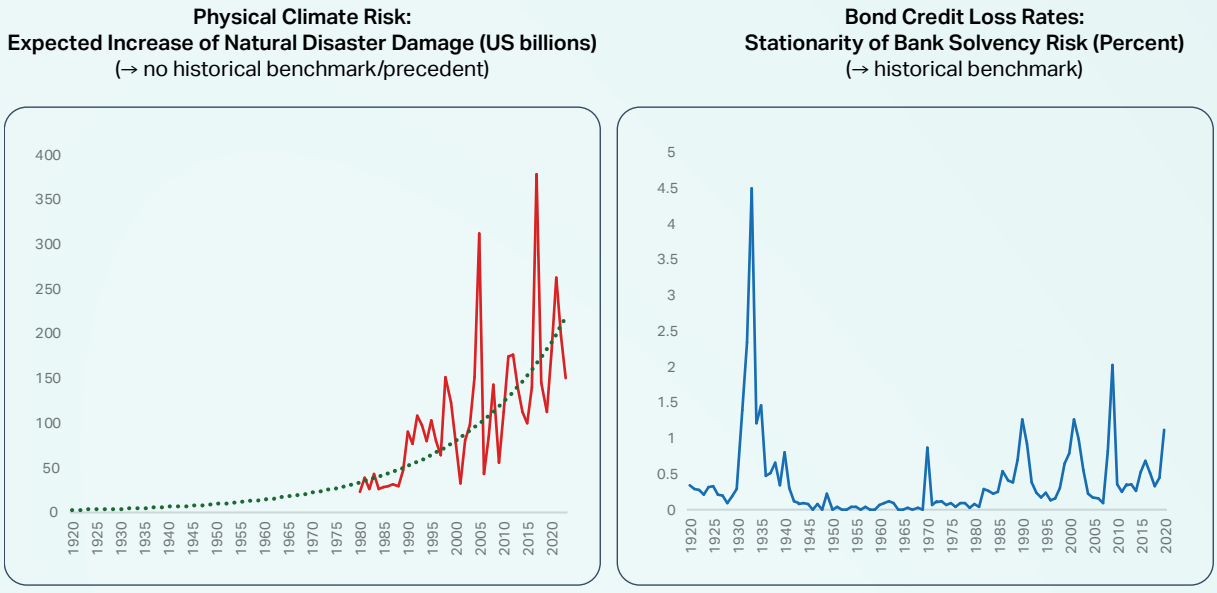
Figure 8. Scenario Analysis Concept



Source: Schmieder and others (2025). Note: own contribution largely based on Hardy and Schmieder (2013).

Climate risks have no historical precedents, as they lack meaningful historical benchmarks and are expected to intensify over time (Figure 9). Therefore, scenario design requires extrapolating plausible future scenarios rather than relying on past data. In contrast, traditional financial risks are more stable, allowing for the calibration of scenarios similar to 1-in-50 or 1-in-100 years.

Figure 9. Evolution of Climate and Bank Solvency Risks



Source: EM-DAT (https://www.emdat.be/) and Moody's Investors Service.

The integration of advanced climate change frameworks with traditional stress testing methodologies may impede scalability and agility. A simplified top-down framework for country-level climate risk scenario analysis (Schmieder and others, 2025) strikes a balance between simplicity and scalability, allowing for the identification of key drivers and sensitivities while maintaining the flexibility to adapt to evolving circumstances.

Two critical considerations in this context are:

- The growing prominence of climate risks, with physical risks (e.g., extreme weather events) gradually outweighing transition risks (e.g., shift to a low-carbon economy).
- The sensitivity of outcomes to assumptions and scenarios. Given the long-term and non-linear nature of climate risks, even minor changes in assumptions can result in significantly different outcomes, underscoring the need for robust scenario design.

Climate stress testing provides valuable insights for both banks and financial regulators. To effectively integrate climate risks into banks' risk-return frameworks and financial stability assessments, enhanced tools and high-quality data are essential. Furthermore, top-down stress tests can help identify broader risks, including indirect and systemic impacts, thereby supporting financial supervisors in their oversight responsibilities.[23]

Data Challenges

The lack of detailed and consistent data poses major challenges for scenario development and accurate risk assessments. Effective scenarios need to consider both short-term and long-term physical risks, as well as transition risks. However, the intricate and uncertain nature of these risks makes scenario development particularly difficult, especially when faced with data limitations. High-quality data that is readily accessible, reliable, and comparable is essential to conduct meaningful stress tests. Unfortunately, detailed data at the asset level is scarce, making it challenging to conduct thorough bottom-up risk analysis to generate assessments of aggregate systemic risks.

Despite these challenges, several promising international initiatives are working to address data gaps (Figure 10):

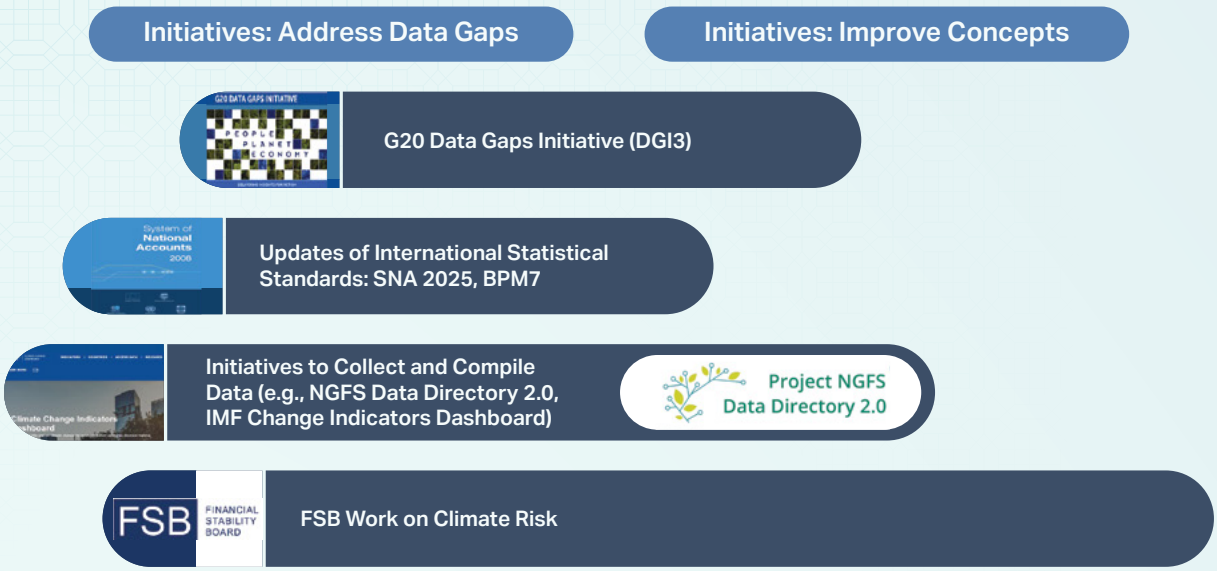
- The third phase of the *G20 Data Gaps Initiative* (DGI-3) is focusing on forward-looking indicators for physical and transition risks;[24]
- Updates to the *System of National Accounts* (SNA) and *Balance of Payments Manual* (BPM) serve to enhance data consistency and comparability;
- The *International Sustain*ability *Standards Board* (ISSB) is promoting greater transparency on climate-related risks and opportunities at the firm level; and
- Emerging technologies, such as satellite data, are providing new insights into physical risks.

23 Enhanced credit risk assessment has also implications for users of financial services. For instance, households and businesses may experience higher insurance premiums/credit prices and reduced insurability due to climate vulnerabilities.

24 The DGI-3 covers 14 recommendations addressing priority policy needs in the areas of: (i) climate change; (ii) distribution of household income and wealth; (iii) fintech and financial inclusion; and (iv) access to private sources of data and administrative data, and data sharing to improve the timeliness and granularity of official statistics. For detailed recommendations, see https://www.imf.org/en/News/Seminars/Conferences/DGI/g20-dgi-recommendations#dgi3.

In addition, the BIS has been actively supporting various data initiatives and is fostering international collaboration to address existing data gaps, with an emphasis on standard-setting and financial stability risks. For example, the Irving Fisher Committee on Central Bank Statistics (IFC) is collaborating with central banks to analyse climate risks and tackle existing data challenges. Furthermore, the BIS Innovation Hub is exploring new tools for monitoring and managing financial stability risks. While these initiatives hold significant promise, their implementation will require time. In the meantime, financial institutions and policymakers must work with available data while advocating for enhancements in data collection and quality.

Figure 10. Key Climate Data-related Initiatives at the Global Level



Source: Fareed and others (2025)

Embedding Scenario Analysis in Supervisory and Regulatory Processes

Climate risk assessments need to be fully integrated in all aspects of traditional stress testing and relevant risk drivers. Climate risks should be incorporated into top-down, bottom-up, and bank-level stress tests. This allows for a comprehensive evaluation of risks by portfolio and asset class, and their marginal contributions to overall risks. The scope of regulatory risk metrics (i.e., credit, market, and operational risks) must reflect climate risks to influence business decisions and encourage sustainable practices based on granular risk measurement. Furthermore, enhanced data quality supports evidence-based policy-making.

6.5. THE CARBON BUDGET CONCEPT – AMIT TYAGI (GROUP HEAD FOR ENTERPRISE RISK, CREDIT RISK AND CLIMATE RISK, EMIRATES NBD)[25]

Stress testing the carbon budget constraint is essential to understanding climate transition risks. The carbon budget framework serves as a quantitative anchor for stress testing climate risks, establishing the maximum allowable cumulative CO_2 emissions to limit global warming to 1.5°C or 2°C. Stress testing approaches, such as those developed by the NGFS and applied by central banks and financial supervisors, translate these carbon budget limitations into transition pathways at the macroeconomic and sector levels.

25 All data in this chapter have been obtained from the IPCC (2021 and 2023) unless otherwise referenced.

The pathways consider factors like carbon pricing, energy mix shifts, and stranded asset risks. For banks and financial institutions, adherence to the remaining carbon budget is critical for assessing the potential impact of transition risks, adjusting IFRS-9 expected credit losses, and evaluating capital adequacy under Pillar 2 regulations. By integrating the carbon budget into scenario design, both regulators and firms can ensure alignment with climate science while accurately quantifying the possible effects impacts on credit, market, and operational risk profiles.

The carbon budget represents the net total amount of allowable carbon dioxide emissions that limit global warming to a specific level, such as 1.5°C or 2°C above pre-industrial levels. This includes both past emissions and future allowable emissions. The remaining carbon budget quantifies the maximum CO_2 emissions that can still be released to stay within the desired temperature limit. The size of the remaining carbon budget is determined by factors like the target temperature, the likelihood of achieving it, and efforts to reduce other greenhouse gas emissions. Once these factors are considered, the remaining carbon budget can be estimated by examining current global warming levels, the impact of CO_2 emissions on temperature, and the expected warming after reaching net zero CO_2 emissions globally.[26]

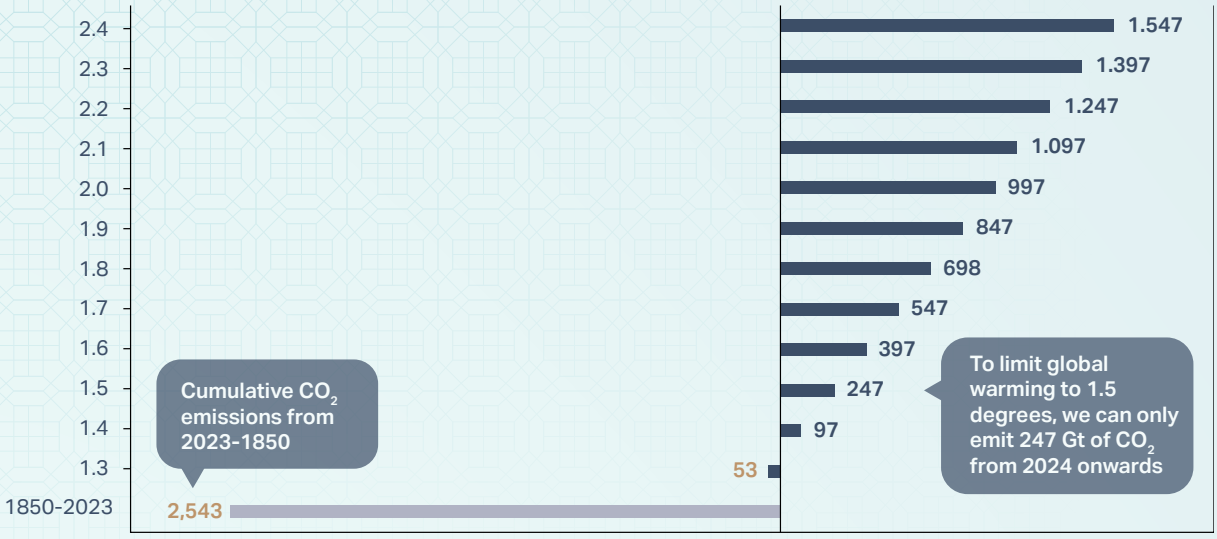
To determine the carbon budget, we first assess the total amount of CO_2 that has already been released. Globally, CO_2 emissions are measured in Gigatons ($GtCO_2$), which is equivalent to one billion metric tons (with one metric ton equalling 1,000 kilograms). To put this into perspective, consider that the combined weight of all humans is 0.39 $GtCO_2$, making one $GtCO_2$ about 2.5 times the of the entire humanpopulation.[27]

Figure 11 illustrates the remaining carbon budget to limit global warming (relative to the 1850-1900 average) to various temperature thresholds. The carbon budgets presented are based on the 67th percentile, indicating a roughly 2 in 3 chance of success. The figure is slightly complicated, so let us walk through it step by step. The bottom bar represents total emissions of 2,543 $GtCO_2$ from 1850 to 2023. To restrict global warming to 1.5°C, only 247 $GtCO_2$ can be emitted from 2024 onwards. Exceeding this limit would prevent us from achieving the 1.5°C target. Can we keep the temperature increase to 1.3°C? The second bar from the bottom indicates that we have already exceeded the budget for 1.3°C warming by 53 $GtCO_2$. Therefore, unless we remove 53 $GtCO_2$ from the atmosphere, we are not likely to limit the temperature increase to 1.3°C. To provide context on the carbon budget, in the last four years, we have emitted 38 $GtCO_2$ annually. If this trend continues, the carbon budget for 1.5°C will be exhausted in the next 6.5 years (247 divided by 38), around the middle of 2030. It is important to acknowledge that the remaining carbon budget is an estimate, which is influenced by uncertain historical temperatures, the impact of non- emissions, and political commitments to zero emissions. If the chance of success is lowered to the median (50th percentile), the remaining carbon budget will increase accordingly. Despite these limitations, the remaining carbon budget serves as a valuable tool to understand the significance of reducing emissions for different levels of global warming.

26 Relatedly, another important concept to understand is the transient climate response to cumulative CO_2 emissions (TCRE), which measures the amount of global warming per unit of CO_2 emissions. The relationship between cumulative CO_2 emissions and global temperature increase is nearly linear, with an estimated 0.45°C temperature increase for every 1,000 Gt of CO_2 emissions.

27 Calculated based on data from IPCC (2021), Crippa and others (2023), as well as Friedlingstein and others (2023) for the time periods 1850-2019, 2020-22, and 2023, respectively. See also https://sustainability.stanford.edu/news/global-carbon-emissions-fossil-fuels-reached-record-high-2023#:~:text=The%20researchers%20estimate%20that%20the,continuing%20a%2010%2Dyear%20plateau.

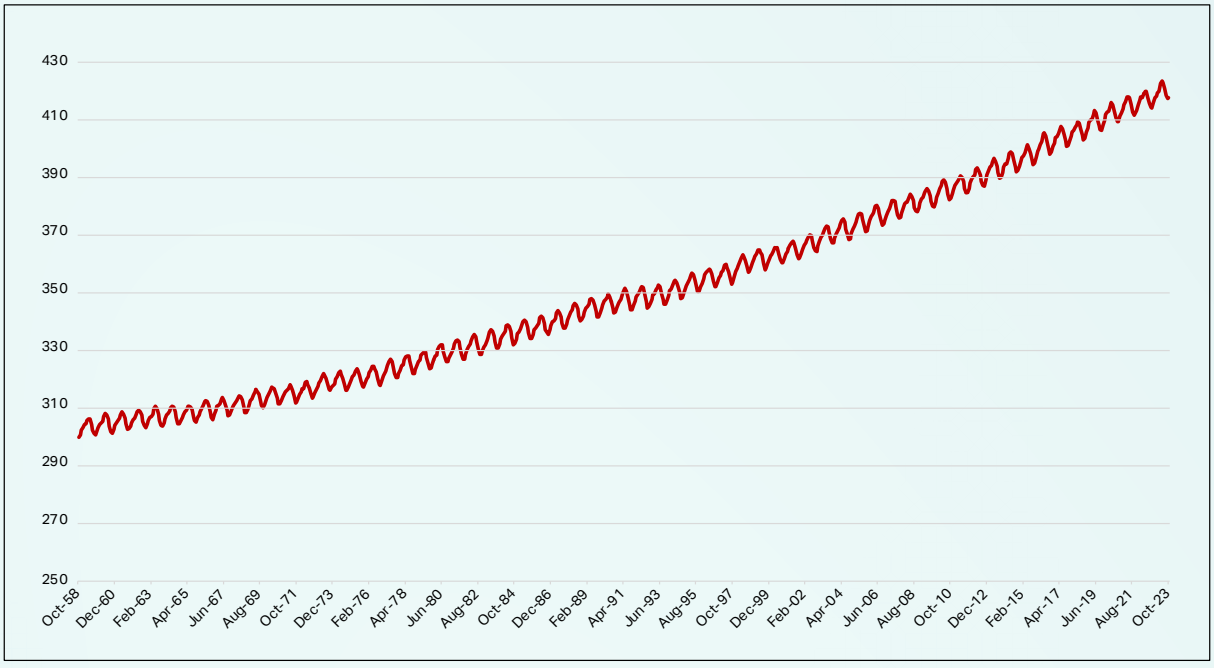
Figure 11. Estimated Carbon Budget for Different Temperature Increases (In $GtCO_2$; 67th percentile)



Source: author

Another perspective on CO_2 in the atmosphere is its concentration. The concentration is measured in parts per million (ppm), indicating the number of CO_2 molecules per million air molecules. Figure 12 shows the monthly average from 1958 onwards. Currently, the CO_2 concentration is 419ppm, the highest in the last 2 million years.

Figure 12. Average Monthly CO_2 Emissions (In ppm)



Source: author

Emissions from sources other than CO_2, such as nitrous oxide (N_2O) and methane (CH_4), have a notable impact on global warming. In addition to CO_2, methane (1,912 parts per billion) and nitrous oxide (337 parts per billion) concentrations in the atmosphere are currently higher than they have been in the past 800,000 years. Methane is the second most significant greenhouse gas after CO_2 and has contributed to about 30 percent of the increase in global temperatures since the Industrial Revolution (IEA, 2024). These emissions affect global warming either gradually over time or based on their annual release rates, influencing calculations of the additional warming that CO_2 emissions alone can cause. The effects of non-CO_2 emissions on global warming and the remaining carbon budgets have been evaluated by considering different assumptions about these emissions and their associated warming effects. By analysing future trends of CO_2 and non-CO_2 emissions consistently, it is possible to estimate the warming contributions from non-CO_2 sources. Such assessments are in line with scenarios in which global CO_2 emissions reach net-zero, effectively limiting future CO_2 emissions. Scenarios following this path often suggest a stabilisation or reduction in non-CO_2 radiative forcing and warming levels once global CO_2 emissions reach net-zero.[28]

There is a close to linear relationship between cumulative CO_2 emissions and the rise in global surface temperature.[29] The current consensus suggests that every 1,000 Gt of cumulative CO_2 emissions increase the global surface temperature by 0.45°C (IPCC, 2021). Over the past 175 years, from 1850 to 2023, the cumulative emissions were 2,543 $GtCO_2$. If every 1,000 $GtCO_2$ of emissions increases the average global temperature by 0.45°C, then 2,543 $GtCO_2$ should increase it by 1.14°C.[30] Since carbon dioxide stays in the atmosphere for a long time (300-1,000 years), Earth's temperature will continue to rise if the existing stock of anthropogenic CO_2 in the atmosphere keeps increasing.[31] So there is a finite amount of CO_2 that can still be emitted without breaching a specific temperature target. For instance, to restrict global warming to 1.5°C, only 247 $GtCO_2$ can be emitted from 2024 onwards. Exceeding this limit would prevent the containment of global warming within 1.5°C. Therefore, the key to slowing global warming is to stop the cumulative build-up of CO_2 and other greenhouse gases, either by reducing emissions, enhancing carbon sinks, or a combination of both.

28 It is projected that when global CO_2 emissions achieve net-zero, the additional warming contribution from non-CO_2 sources will be approximately 0.1°C to 0.2°C compared to temperatures recorded between 2010 and 2019.

29 While changes in climate are typically assessed using multidecadal averages, the data from 2014 to 2023 shows a nearly linear relationship between cumulative CO_2 emissions and global surface temperature rise.

30 Note that there is some oversimplification here as we do not account for non-CO_2 emissions. Moreover, there could be some time lag between increase in atmospheric CO_2 and corresponding temperature increase.

31 This is fairly close to observational data. Between 2014 and 2023, the global surface temperature was 1.20 – 0.12°C above the 1850-1900 average, making it the warmest decade on record (WMO, 2023).

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7. ANNEX

7.1 ANNEX 1 – PRESS RELEASE FOR THE CLIMATE FORUM (CBUAE, 2025a)

The Central Bank of the UAE concluded the Climate Forum held today in Abu Dhabi, under the patronage of His Highness Sheikh Mansour bin Zayed Al Nahyan, Vice President, Deputy Prime Minister, Chairman of the Presidential Court, and Chairman of the Central Bank of the UAE (CBUAE). The Forum emphasised the importance of effective dialogue and close cooperation among key stakeholders in addressing climate-related financial risks, promoting sustainable finance, and exchanging best practices and expertise to enhance the resilience of the financial system to support the climate transition.

The Forum is part of the CBUAE's efforts to advance the transition towards a more sustainable financial system and enhance its vital role in leading sustainable finance initiatives, in line with the UAE's goals to achieve climate neutrality by 2050.

His Excellency Khaled Mohamed Balama, Governor of the CBUAE, opened the forum in the presence of H.E. Dr. Amna bint Abdullah Al Dahak Al Shamsi, Minister of Climate Change and Environment; His Excellency Abdulaziz Al Ghurair, Chairman of the UAE Banks Federation; James Talbot, Chair of the Monetary Policy Working Group at the Network for Greening the Financial System (NGFS); and an select group of financial leaders, policymakers, international experts in sustainable finance and climate risks, and senior officials from regulatory bodies, central banks, and local and international financial institutions.

In his opening speech, His Excellency Khaled Mohamed Balama, CBUAE, affirmed that the Climate Forum represents a significant strategic milestone in the UAE's sustainability agenda in the face of major economic transformations and accelerating climate challenges.

He added: "The Climate Forum marked a pivotal turning point in transitioning from dialogue and exchanging insights to practical implementation, through systematic investment in building institutional capabilities, updating policies, and developing operational processes in financial institutions. This contributes to enhancing the resilience and stability of the financial system and increasing its readiness to face future risks, thereby establishing the desired balance between sustainable economic growth and environmental protection." His Excellency stressed that the Climate Forum reflects the UAE's ambitious vision and its commitment to solidifying its position as a leading global centre for institutional dialogue on sustainable finance and responsible climate action.

Panel discussions at the Forum focused on ways to enhance the integration of climate policies in risk and investment management, and the need to find effective solutions to strengthen the financial sector's resilience by adopting global best practices in environmental risk analysis and enhancing sustainability-related disclosures. Discussions also covered frameworks for activating regional and international cooperation in legislation, financial policies, and sustainable Islamic finance, reflecting UAE's emerging regional leadership in sustainable finance.

At the conclusion of the Forum, His Excellency Ebrahim Al Zaabi, Assistant Governor of the CBUAE (Monetary Policy and Financial Stability), affirmed the Forum's success in achieving its strategic objectives by providing a high-level platform for effective dialogue and strengthening frameworks for close cooperation between regulatory and financial authorities to address climate challenges.

He added: "The fruitful discussions at the forum contributed to enhancing understanding of current climate challenges and exploring promising prospects for building and developing a more resilient and integrated financial system through expanding partnerships and strengthening international cooperation." His Excellency affirmed the Central Bank's steadfast commitment to supporting the UAE's sustainable development agenda and continuing to work closely with the NGFS and all local and international partners to formulate effective climate policies that contribute to solidifying financial and monetary stability at both local and international levels.

7.2 ANNEX 2-AGENDA

9:45	**Registration**	
10:25 – 10:30	**Welcome and Overview**	
10:30 – 10:45	Opening Speech	H.E. Khaled Mohamed Balama *(Governor, Central Bank of the UAE)*
10:45 – 10:55	Opening Remarks	H.E. Abdulaziz Al Ghurair *(CEO, Mashreqbank; Chairman of the UAE Banks Federation)*
10:55 – 11:05	Opening Remarks	H.E. Amna Al Shamsi *(Minister of Climate Change and the Environment, UAE)*
11:05 – 11:20	Keynote Speech	Mr. James Talbot *(Executive Director, Bank of England; Chair NGFS WS Monetary Policy)*
11:20 – 12:00	**High-Level Panel: After COP28 – What Now?** *The panel will reflect on the plans agreed at UAE COP28 and the evolving global climate policy agenda for central banks and financial sector supervisors* Moderator: Mr. Manus Cranny (Geo Economics Editor, The National News)	• Dr. Ghiath Shabsigh *(Secretary General, Islamic Financial Services Board)* • Mr. James Talbot *(Executive Director, Bank of England; Chair NGFS WS Monetary Policy)* • Mr. Richard Paton *(Partner, EY-Parthenon S&E MENA)* • Mr. Yann Marin *(Deputy Director for Financial Stability, Banque de France; Head of the NGFS Secretariat)*
12:00 – 12:30	**Family Picture (speakers/high-level panel) + Coffee/Tea Break**	
12:30 – 1:15	**Technical Panel 1: Climate Change and Current Policy/Industry Actions** The panel will discuss concrete physical and transition risks affecting the GCC region and implications for central banks and the financial sector Moderator: Dr. Lúðvík Elíasson (Deputy Director - Economics and Monetary Policy, Central Bank of Iceland)	• Mr. Larry Abele *(CEO, Impact Cubed – Euroclear SA)* • Mr. Karim Mourad *(Global Head – Infrastructure, ADIA)* • Mrs. Maia Mesanger *(Senior Associate, BloombergNEF)* • Ms. Solveig Erlandsen *(Senior Adviser, Norges Bank; Co-Chair, NGFS Monetary Policy Strategy Subgroup)* • Mrs. Anita Wieja-Caruba *(Associate Director – Policy, Dubai Financial Services Authority)*
1:15 – 2:30	**Prayer & Lunch Break**	

2:30 – 3:15	**Virtual Panel: Adaptation Finance** Short presentation of recent NGFS work on adaptation and discussion with adaptation finance experts Moderator: Mrs. Maia Mesanger (Senior Associate, BloombergNEF) - virtual	Impulse Presentation: Dr. Sean Carmody *(Executive Director, APRA; Co-Chair NGFS Adaptation Task Force)* • Prof. Dr. Nicola Ranger *(Executive Director, Earth Capital Nexus & Professor in Practice, London School of Economics)* • Mr. Nicholas Pfaff *(Deputy CEO and Head of Sustainable Finance, ICMA)* • Dr. Raffaele Della Croce *(Co-Director of the Singapore Green Finance Centre and Advanced Research Fellow, Imperial College Business School)* • Mrs. Ekhosuehi Iyahen *(Secretary General, Insurance Development Forum)*
3:15 – 4:00	**Technical Panel 2: Greening Monetary Operations and Islamic Sustainable Finance** *Short presentation of current work by the NGFS Subgroup on Monetary Policy Operations on "greening" central bank liabilities, followed by panel discussion of the CBUAE's planned Sustainable Islamic M-Bill Programme* Moderator: Mrs. Pearl Mahaga (Senior Associate, Clifford Chance LLP)	Impulse Presentation: Dr. Andreas (Andy) Jobst *(Chief – Monetary Policy, Central Bank of the UAE; Co-Chair, NGFS Monetary Policy Operations Subgroup)* • Mr. Mohamad Safri Shahul Hamid *(CEO, International Islamic Liquidity Management)* • Mr. Samy Ben-Jaafar *(Senior Director - Treasury & Sustainability, Alpha Dhabi Holding PJSC)* • Dr. Wassim Slama *(Senior Director, Central Bank of the UAE)* • Mr. Amadou Dieye *(Senior Manager, Central Bank of the UAE)* • Mr. Daniel Gribbin *(Director, Deloitte)*
4:00 – 4:30	**Coffee/Tea Break**	
4:30 – 5:15	**Technical Panel 3: Scenarios, Stress Testing and Data for Climate Policy** Short presentation of climate stress testing at the CBUAE followed by a discussion on the current status of climate scenarios, stress testing and data analysis Moderator: Mrs. Dana Khraiche (UAE Bureau Chief – Dubai, Bloomberg LP)	Impulse Presentation: Mr. Jouni Timonen *(Chief – Financial Stability, CBUAE; NGFS Plenary Member)* • Mr. Amit Tyagi *(Group Head for Enterprise Risk, Credit Risk and Climate Risk, Emirates NBD)* • Mrs. Marion Amiot *(Head of Climate Economics and European Economist, S&P Global Ratings)* • Dr. Agnieszka Trzcinska *(Team Lead - Directorate General Macroprudential Policy and Financial Stability, European Central Bank; Member of the NGFS Workstream Scenarios)* • Dr. Christian Schmieder *(Head of Operations - Monetary and Economic Department, Bank for International Settlements; Secretariat Member of the Irving Fisher Committee on Central Bank Statistics)*
5:15 – 5:20	**Closing Remarks**	**H.E. Ebrahim Al Zaabi (Assistant Governor – Monetary Policy and Financial Stability, Central Bank of the UAE)**
6:30 – 8:00	**Casual Dinner (by invitation)**	

7.3 ANNEX 3-EVENT PHOTOS

H.E. Khaled Mohamed Balama
Governor
Central Bank of the UAE (CBUAE)

H.E. Ebrahim Al Zaabi
Assistant Governor (Monetary Policy and Financial Stability)
Central Bank of the UAE (CBUAE)

High-Level Panel and CBUAE Senior Leadership

H.E. Amna Al Shamsi
Minister of Climate Change and the Environment
H.E. Khaled Mohamed Balama
Governor, Central Bank of the UAE

Standing for the National Anthem

H.E. Ebrahim Al Zaabi
Assistant Governor (Monetary Policy and Financial Stability) with Climate Forum project team and attending CBUAE staff

High Level Panel: Panorama 1

High Level Panel: Panorama 2

High Level Panel: Panorama 3

High Level Panel: Manus Cranny (Moderator), James Talbot, Yann Marin

High Level Panel: Ghiath Shabsigh

High Level Panel: Richard Paton

Technical Panel 1: Lúðvík Elíasson (Moderator), Larry Abele, Solveig Erlandsen, Maia Mesanger, Karim Mourad, Anita Wieja-Caruba

Technical Panel 2: Lúðvík Elíasson (Moderator), Larry Abele, Solveig Erlandsen, Maia Mesanger, Karim Mourad, Anita Wieja-Caruba

Technical Panel 2: Amadou Dieye, Daniel Gribbin, Mohamad Safri Shahul Hamid, Samy Ben-Jaafar, Pearl Mahaga (Moderator), Wassim Slama

Technical Panel 2: Andreas (Andy) Jobst, Impulse Presentation

Technical Panel 2: Amadou Dieye

Technical Panel 2: Wassim Slama

Technical Panel 3: Jouni Timonen, Impulse Presentation

Technical Panel 3: Marion Amiot, Dana Khraiche (Moderator), Christian Schmieder, Agnieszka Trzcinska, Amit Tyagi

Technical Panel 3: Marion Amiot, Dana Khraiche (Moderator), Christian Schmieder, Agnieszka Trzcinska, Amit Tyagi

Virtual Panel: Sean Carmody, Impulse Presentation

Virtual Panel: Sean Carmody, Impulse Presentation

Virtual Panel: Sean Carmody, Raffaele Della Croce, Ekhosuehi Iyahen, Maia Mesanger (Moderator), Nicholas Pfaff, Nicola Ranger

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This document is a collaborative effort of staff from the Central Bank of the UAE (CBUAE). The drafting of the document was coordinated and led by Andreas (Andy) Jobst *(Chief – Monetary Policy, CBUAE)*.

The opening and concluding remarks were provided by H.E. Khaled Mohamed Balama *(Governor, CBUAE)* and H.E. Ebrahim Al Zaabi *(Assistant Governor, CBUAE)*.

This document relies on contributions from the following selected speakers and participants at the event *(in alphabetical order, without titles)*:

- Larry Abele *(CEO, Impact Cubed - Euroclear SA)*
- Marion Amiot *(Head of Climate Economics and European Economist, S&P Global Ratings)*
- Sean Carmody *(Executive Director, APRA; Co-Chair of NGFS Adaptation Task Force)*
- Amadou Dieye *(Senior Manager, CBUAE; Member of NGFS Monetary Operations Subgroup)*
- Andreas *(Andy)* Jobst *(Chief – Monetary Policy, CBUAE; Co-Chair NGFS Subgroup on Monetary Policy Operations)*
- Beka Lamazoshvili *(Assistant Director, CBUAE)*
- Mohamad Safri Shahul Hamid *(CEO, International Islamic Liquidity Management Corporation)*
- Christian Schmieder *(Head of Operations - Monetary and Economic Department, Bank for International Settlements; Secretariat Member of the Irving Fisher Committee on Central Bank Statistics)*
- Wassim Slama *(Senior Director, CBUAE)*
- James Talbot *(Executive Director, Bank of England; Chair of the NGFS Workstream Monetary Policy)*
- Jouni Timonen *(Chief – Financial Stability, CBUAE)*
- Agnieszka Trzcinska *(Team Lead - Directorate General Macroprudential Policy and Financial Stability, European Central Bank; Member of the NGFS Workstream Scenarios)*
- Amit Tyagi *(Group Head for Enterprise Risk, Credit Risk and Climate Risk, Emirates NBD)*
- Bing Zhao *(Director, CBUAE)*

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