

### Managing Climate Change Like a Central Banker The Political Economy of Greening the Monetary Technocracy

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MANAGING CLIMATE CHANGE LIKE A CENTRAL BANKER

Stine Quorning

Department of Organization

CBS M COPENHAGEN BUSINESS SCHOOL

# MANAGING CLIMATE CHANGE LIKE A CENTRAL BANKER

## THE POLITICAL ECONOMY OF GREENING THE MONETARY TECHNOCRACY

PhD Series 11.2023

## Managing Climate Change Like a Central Banker

The Political Economy of Greening the Monetary Technocracy

**Stine Quorning** 

CBS PhD School Copenhagen Business School, 2023

Supervisors: Cornel Ban & Eleni Tsingou Stine Quorning Managing Climate Change Like a Central Banker The Political Economy of Greening the Monetary Technocracy

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## Abstract

It is becoming increasingly clear that if we want to live up to the Paris Agreement and meet the 1.5°C commitment, our societies and economies need to undergo systemic changes at an unprecedented scale. All sectors in the economy will be affected and climate change will therefore likely impact financial and price stability. This realization has led central banks to engage with climate-related issues, leaving central bankers in an unprecedented situation: working with a policy domain outside their immediate knowledge remits. Climate change has become a mainstream issue in central banks, and it is against this background that I seek to understand how central bankers have approached the work with climate change and the extent to which central banks have been repurposed as they have set out to deal with the greatest challenge of our time: the climate crisis.

The dissertation draws on insights from International Political Economy, where the dominant approach has been to view central banking from institutional, structural, or ideational perspectives. Here I utilize a micro-level analytical approach constructed around three factors: practices, expertise, and legibility. To understand how central bankers have worked with climate change, I examine the practices they have incorporated, with a focus on climate stress testing and modeling of climate-related risks. I also discuss the types of expertise deployed as I seek to understand how central bankers, trained mainly as economists, work in an entirely new policy domain such as climate change. Finally, I set out to analyze how central bankers have made climate change legible by turning climate change into a risk issue; for central bankers, climate change becomes a risk-based issue, similar to other routine economic problems.

I argue central bankers have approached climate change like any other task. In treating climate change as a risk issue, central bankers have been able to work with climate change using their existing expertise and adapting their modeling frameworks to deal with climate-related risks, like any other financial risk. Thus, even though climate change represents a new policy domain, central bankers have maintained the status quo, and subsumed climate change under their current modus operandi. The necessary fundamental changes to the conduct of central banking in the age of anthropogenic climate change remain absent. Despite the urgency of the climate crisis, it is business as usual for the central banks.

## Resumé

Det bliver i stigende grad tydeligt, at hvis vi vil leve op til Paris Aftalen og 1,5°C målsætningen, skal vores samfund og økonomier undergå en vidtrækkende omstilling. Alle sektorer i økonomien vil blive påvirket, og omstillingen til et grønnere samfund vil derfor også påvirke finansiel stabilitet og prisstabilitet. Centralbanker er derfor begyndt at beskæftige sig med klimaforandringer, hvilket medfører at medarbejderne i centralbankerne står i en situation uden fortilfælde hvor de nu skal arbejde med et felt der er uden for deres ekspertområde. Klimaforandringer er nu blevet et udbredt emne i centralbankerne, og jeg vil derfor i denne afhandling undersøge, hvordan ansatte i centralbankerne har arbejdet med dette nye emnefelt, og hvorvidt det har ført til, at centralbanker har åbnet for en fortolkning af deres formål, idet de har påbegyndt arbejdet med vor tids største udfordring: klimakrisen.

Denne afhandling tager afsæt i teorier indenfor international politisk økonomi. De dominerende teoretiske tilgange undersøger centralbanker fra et institutionelt, strukturelt eller idémæssigt perspektiv. Jeg inddrager derimod et analytisk greb, der starter fra et mikroniveau ved at inddrage tre faktorer: praksis, ekspertise og læselighed. For at forstå hvordan medarbejdere i centralbankerne har arbejdet med klimaforandringer, undersøger jeg de forskellige former for fremgangsmåder og metoder (praksis) de har udarbejdet og inkorporeret med et fokus på klimastresstests og udarbejdelse af modeller til at kalkulere klimarisici. Jeg undersøger også hvilke former for ekspertise, der inddrages i disse processer og hvordan ansatte i centralbankerne, der primært har en uddannelse indenfor økonomi, arbejder med dette nye emnefelt. Slutteligt analyserer jeg, hvordan centralbanker har gjort klimaforandringer læselig ved at gøre klimaforandringer til et spørgsmål om risiko.

På baggrund af dette argumenterer jeg, at centralbanker har behandlet spørgsmål omkring klimaforandringer på samme måde som alle andre typer af opgaver medarbejdere sidder med i centralbankerne. Idet de behandler klimaforandringer som en risiko, har ansatte i centralbankerne muliggjort, at de kan arbejde med klimaforandringer ud fra deres eksisterende ekspertise og modeller. Til trods for at klimaforandringer repræsenterer et nyt emnefelt har centralbankerne bevaret status-quo, idet de har integreret arbejdet med klimaforandringer i deres eksisterende aktiviteter. Mere fundamentale ændringer i måden at udføre deres aktiviteter på udebliver, selv i en tid mærket af den menneskeskabte klimakrise.

## Acknowledgements

Had people told me five years ago, that in January 2023 I would hand in dissertation that examined climate change, I would have brushed this aside. Throughout my undergraduate and graduate studies, I tried to avoid working on issues related to climate change. I have always found it daunting because the minute you start reading this literature you realize that unless society manages to radically change our way of life we are heading toward doomsday at full speed. Instead, I chose to study the financial system and central banks. It fascinated me because of the complexity, the impact on the lives of ordinary people, and I found it to be less dauting. Even though it has a great impact on the lives of all of us, money is gained and lost exacerbating inequalities, and people may be forced onto the street if they are unable to pay their mortgages because some banker has taken on too much risk as we saw during the financial crisis, it does not threaten human existence as the climate crisis does. Then this opportunity came up, to study central banks and climate change. I could study some of the most powerful and fascinating organizations in the world, central banks, and the greatest challenge of my generation, the climate crisis, in the very same research project. It even provided me with a brief sense of hope, because if central banks wanted to, they could be a force of good in speeding up the pace of the green transition. It has been a great privilege to work on this research project, because I have been able to follow my professional passion, but mostly because of the amazing people I have met and worked with along the way and to whom I owe a huge thank you.

First of all, I would like to thank my two supervisors Cornel Ban and Eleni Tsingou. Thank you, Cornel, for generously sharing your knowledge, wit, passion, and time in guiding me through these three years. Thank you for setting the bar high, challenging my work, and asking annoyingly good questions, but at the same time encouraging me to follow my own passion and ideas throughout this project. Though it has been challenging at times, I know it has improved my work, and I have learned so much from you in this process. Thank you, Eleni, for your kindness, wisdom, and enthusiasm along the way and your advice on big and small matters, which I have really appreciated. I am grateful to both of you for always being there. Even when we suddenly found ourselves amid a pandemic with homeschooling, childcare, online teaching, and endless Zoom meetings, I knew I could count on you. Finally, thank you for entrusting me to work on this research project, even though I did not know much about green finance and climate change when I started. I hope I have lived up to your expectations.

Thank you to everyone at IOA for welcoming me to the department and creating a safe and inspiring research environment from the minute I stepped into Kilen. From casual talks over lunch, department meetings, and winter games, I have felt a spirit of collegiality every day. A warm thank you to everyone in the administration particularly Marianne Aarø-Hansen, Marianne Kellmann, Mette Busk Ellekrog, and Joan Knudsen, PhD coordinator at IOA Ursula Plesner, Katja Høeg Tingleff at CBS' PhD support, as well as kind and supportive Heads of Department Signe Vikkelsø and Carsten Greve. I also owe a special thank you to the Political Economy Group at IOA for thoughtful and inspiring discussions and feedback, and for taking care of my 'academic upbringing' in discussions around the process of publishing, how to give feedback, facilitate passionate and fruitful discussions, and so much more. While everyone in this group has contributed to this, I particularly want to thank Oddný Helgadóttir, Stine Haakonsson, Jacob Hasselbalch, Leonard Seabrooke, Duncan Wigan, Lasse Folke Henriksen, Rasmus Corlin Christensen, Tessa Kunkel, Xuan Li, Morten Ougaard and Rune Møller Stahl.

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papers at different stages of this research project at Ph.D. courses and conferences and who provided me with comments and suggestions including Leonard Seabrooke, Susan Park, Wim Carton, and Mark Blyth.

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Last, but certainly not least, I want to thank my friends and family. Thank you for keeping asking me questions and showing interest in a project you could only distantly relate to, but you knew was important to me. Thank you to my parents for your endless support and encouragement, which made me believe I could do this. Above all, thank you to Peter, my anchor in life. This would not have been possible without your unconditional love and support, every single day, also when we were several time zones apart. And thank you Wilma for keeping me companied at the home office in the basement, providing me with a calming paw or a set of loving eyes when I needed it.

Stine Quorning January 2023

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PART I: FRAME

Mary regarded them thinking it through. Because money ruled the world, these people ruled the world. They were the world's rulers, in some very real sense. Bankers. Non-democratic, answerable to no one. The technocratic elite at its most elite: financiers. Mary thought of her group back in Zurich. It was composed of experts in the various fields involved in the matter, people with all kinds of expertise, many of them scientists, all with extensive field experience of one sort or another. Here, she was looking at a banker, a banker, a banker, a banker, and a banker. Even if they understood an idea, even if they liked an idea, they wouldn't necessarily act on it. One principle for bankers in perilous times was to avoid doing anything too radical and untried. And so they were all going to go down.

Kim Stanley Robertson (2020, p. 189), The Ministry for the Future

## 1. Introduction

In Kim Stanley Robertson's science fiction novel, *The Ministry for the Future*, the main character Mary, head of the very same UN-established Ministry for the Future, has taken on a mission to convince central bankers to create a 'carbon coin'. The idea is that every time someone sequesters CO<sup>2</sup> emissions from the atmosphere, the central banks will issue a carbon coin, backed by hundred-year bonds with a guaranteed rate of return by the central banks. As Mary's economic adviser in the Ministry for the Future explains to her, it is basically asking central banks to conduct 'carbon quantitative easing'. All fiction aside, it turns out that the discussions of the role of central banks in addressing climate change resembles the current discussions amongst central bankers and observers of the financial system. As I will show in this decade, becoming more intense in recent years, to the extent that it is now a mainstream topic in central banks. To take the example of the European Central Bank (ECB), in the bank's 2021 strategy review, climate change was made one of the key priorities for the coming years, and climate change was mentioned at least once in 45 per cent of ECB speeches in 2021 (Deyris, 2023).

The pace and extent to which climate change has become a mainstream topic in central banks is a remarkable development. To cite yet another example: the Network for Greening the Financial System (NGFS) was established by eight central banks and financial supervisors in December 2017. Since then, the NGFS has grown to 121 members and 19 observers, including the world's largest central banks and the major international financial organizations such as the IMF, OECD, and the World Bank. The rapid expansion of the NGFS is remarkable, not only because of the broad geographical support, but also because only a few of the world's central banks have sustainability as part of their mandate. Yet, as Dikau and Volz (2021) note, in joining the NGFS, central banks explicitly acknowledge climate change as a source of financial risk. In this case, ensuring the financial system against this kind of risk is within their mandate. It is against this background that I ask the following research question: *how can we understand central banks' approach to climate change and to what extent has central banks' role been repurposed in the face of a looming climate crisis?* 

#### 1.1. Climate change, the financial gap and the role of central banking

The extent of change due to the climate crisis and the possible impact of climate change on the economy, the financial sector and thereby central banks should not be underestimated. The consequences of an increase in global warming of 2°C is increasingly difficult to foresee, as tipping points might be closer than hitherto anticipated (McKay et al., 2022; Rockström, 2022). The future is simply uncertain, and the financial sector does not like uncertainty. Moreover, it is becoming increasingly clear that to meet the 1.5°C commitment codified in the Paris Agreement, the goal must be net zero emissions by 2050. To reach net zero in 2050, however, our economies and societies need to undergo systemic changes, the scope and pace of which would be historically unprecedented (IPCC, 2018). These changes include decarbonizing electricity, electrifying ground transport, radical improvements in energy efficiency, radical changes or even elimination of ruminants, radical breakthroughs in the production of steel and cement and so the list continues (Paterson, 2020). As noted by the IPCC (2018) the system transitions required are unprecedented in terms of scale and require massive emission reductions in all sectors. This task would demand an increase in adaptation and mitigation investments, policy instruments, acceleration of technological innovation, and behavioral changes (IPCC, 2018).

Meeting the 1.5°C degree commitment from the Paris Agreement or even the 2°C degree threshold requires significant investments that have hitherto not been made. While the estimates of the amounts of investments vary, the level of investments is undoubtedly substantial. In the latest World Energy Outlook for 2022, IEA estimates that in order to reach net zero by 2050 investments in clean energy need to rise from USD 1.3 trillion today to USD 4 trillion by 2030.

IPCC (2018) has estimated that average annual investments in the energy system of USD 2.4 trillion between 2016 and 2030 are needed to meet the 1.5°C target. In a report from 2017, the OECD estimates a total level of investments covering not just clean energy but also transportation and other infrastructures USD 6.9 trillion between 2016 and 2030. These amounts are a testament to the enormous effort required to mitigate climate change, and all three organizations also agree that the state cannot carry out the task alone. The role of governments is not only to provide financing, but also to take a leading role and redirect private financial resources toward low-carbon infrastructures (IEA, 2022; IPCC, 2018; OECD, 2017).

While the financial gap between funds needed and funds committed poses a serious impediment to decarbonization, it is also evident that it is not impossible to close the financing gap. The IPCC (2018) found that the investments needed constitute around 2.5% of world GDP, and the private resources needed to enable the energy sector transition are between 3.3% and 5.3% of annual capital income to remain below the 2°C degrees global warming limit. The main challenge, therefore, is not necessarily the amount of investments needed, but a redirection of the current investments (IPCC, 2018). This speaks to the importance of obtaining a better understanding of the directionality of investments; it widely recognized that investments need to be redirected toward green investments, but green investments also need to be targeted toward different types of green technologies, including new and riskier ones (Mazzucato & Semieniuk, 2018). Even article 2(c) of the Paris Agreement sets out an explicit goal of making 'finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development.'. However, there is considerable evidence that the channeling of financial flows toward decarbonization is occurring all too slowly, and in some instances, regressing. Thus, we need to understand the environmental implications of decisions around the highly influential private financial flows (Clapp & Helleiner, 2012, p. 491).

An example of this regressive tendency is that of fossil fuel financing: support for the fossil fuel industry from the world's 60 largest banks has reached USD 4.6 trillion since the Paris Agreement in 2015, with USD 742 billion in 2021 alone (Rainforest Action Network, 2022). The *Financial Times*<sup>1</sup> reported that members of the Glasgow Finance Alliance for Net Zero (GFANZ), formed prior to the COP26 held in 2021, have nevertheless continued to fund fossil fuel activities, including coal companies where bonds running well into 2030 have been issued

<sup>&</sup>lt;sup>1</sup> See 'Cop27: Mark Carney clings to his dream of a greener finance industry' https://www.ft.com/content/8d0c1064-881e-42b4-9075-18e646f3e1ad

after COP26. This is despite the fact that it was at COP26 that world leaders committed to phasing out coal. At the same time, banks continue to lag behind in their disclosure of climate-related risks. The ECB, in the latest survey on climate disclosures, found that 45% of banks' disclosures are insufficient, and only 15% of the banks disclose their financed emissions (ECB, 2022a).

Added to this is the fact that the fossil fuel sector itself is falling behind in investments in renewable energy. Research has shown how these companies follow a two-pronged strategy: a political strategy proclaiming investment in renewables and a business strategy where only a fraction of overall investments is channeled into decarbonization projects (Green et al., 2022). Part of the problem is that even though renewable energy sources such as solar power are now amongst the cheapest energy sources, profit in this part of the energy sector is too low compared to fossil fuel investments, which lowers the incentive to invest (Christophers, 2022). Thus, we cannot expect the private financial system to channel investments into decarbonization projects. The incentives for such 'investor environmentalism' is simply too weak as even institutional investors face strong incentives to maximize short-term profits (Harmes, 2011; Helleiner, 2011).

This continued preference towards fossil fuel investment highlights the need to evaluate the role of central banks in addressing climate change. Recalling the opening quotation of this introduction, Mary acknowledged that it was the central bankers who rule the world, because money rule the world. We therefore need to discuss the role of central banks amid the climate crisis, because as Tooze (2019) notes, 'If the world is to cope with climate change, policymakers will need to pull every lever at their disposal.'. This, however, begs the question of what policymakers in central banks can do given the immense power of the financial sector to shape the course of global financial governance (Braun, 2018; Braun et al., 2021).

Today there is a widespread agreement that climate change need to be an issue of utmost concern for central banks. Mark Carney, then governor of the Bank of England (BoE), made the case in 2015 that central banks need to consider the impact of climate change on financial stability, arguing that 'once climate change becomes a defining issue for financial stability, it may already be too late.'. However, there is disagreement about the extent to which central banks can or ought to intervene. Scholars argue that central banks have a role to play as 'climate governors of last resort' (Langley & Morris, 2020) and that they have to 'tilt' the quantitative easing (QE) programs towards greener investments in order to avoid 'carbon bias' (Dafermos et

al., 2018; Schoenmaker, 2021), or that central banks need to engage in coordination between fiscal and monetary policies to ensure the allocation of capital (Braun, 2021; Kedward, Gabor, et al., 2022; Svartzman et al., 2021). However, central bankers are less convinced about the extent to which they can and should intervene.

Unfortunately for such attempts at broadening the agenda, while there has been an important discursive shift in the way central banks address climate-related issues (Schnabel, 2020; Thiemann et al., 2022) and they fully recognize that climate change imposes a new type of risk on the financial sector (Bolton et al., 2020; Network for Greening the Financial System, 2019), central banks have remained hesitant to undertake more activist measures. Central banks have hitherto mostly followed a market-correcting approach, pressing for improved disclosure of climate-related risks and conducting climate stress tests to better understand the exposure to climate-related risks (Baer et al., 2021; Boneva et al., 2022; Dafermos, 2022; Kedward, Gabor, et al., 2022). The main thrust of central banks' policy on climate seems to be, then, information gathering, not carrots, let alone sticks.

Still, to understand where this policy leads, we need to get a better look at how central bankers think when they engage with climate. Here, we know from speeches and reports that central bankers read the climate science literature and the IPCC reports. They do not hesitate to address the urgency of climate change and the importance of decarbonization, as illustrated in this speech by Frank Elderson, a member of the ECB's Executive Board:

'The most recent IPCC report confirms the dramatic consequences of not taking immediate action: additional global warming of up to 1.5°C degrees in the near term would increase climate hazards, and present numerous risks to ecosystems and human society... It is time we face the facts... It is essential that banks share with their stakeholders detailed information on their exposures to C&E risks [climate and environmental, red.]. Only then can we all effectively work together to address the consequences of climate change.' (Elderson, 2022)

As indicated by Elderson's statement, central bankers are fully aware of the hazards that come with climate change, and they keep abreast of the latest developments in climate science. But his statement also suggests that the actions taken by central banks until now, which pertain to information sharing (Baer et al., 2021; Dafermos, 2022), do not meet the 'all hands on deck' that is needed to achieve net zero by 2050.

The main argument of the dissertation is that central banks have engaged in climate-related issues because it has been framed in a way that allowed central bankers to subsume this new

policy field under their current modus operandi. Climate change has been turned into a risk issue, and as a risk issue it has become familiar to central bankers who have then been able to use their existing expertise, tools, and modeling frameworks. Thus, I find that even though central banks have started to deal with climate change, being a field that is outside their knowledge practice and traditional remit, central banks have not been repurposed, in the sense that the aim of any type of instrument in the name of climate change is to ensure financial and price stability. In short, central banks aim to green finance, and not financing green, and necessary fundamental changes remain absent, nor are they on the horizon.

To make this argument, I switch the focus away from the prevailing focus on mandate (Alexander & Fisher, 2020; Baer et al., 2021; Boneva et al., 2022; Dikau & Volz, 2021a) and possible policy tools, including ways of greening monetary policies (Bingler & Colesanti Senni, 2022; Dafermos et al., 2018; Matikainen et al., 2017; Schoenmaker, 2021) that is currently dominating the literature on green central banking. While this emphasis is important, it does not open the black box of central bank thinking about the policy implications of the climate crisis and, most importantly, where this thinking takes place: the spaces where climate experts and central bankers meet or where advocates of green central banking enter the central bank policy process. In doing so, I take a micro-level perspective and uncover three concepts that help open up this black box: practices, expertise, and legibility (see table 1).

I examine the *practices* of central banks in their work with climate change by looking at measures and tools such as climate stress testing. A departure from the dominant view in the literature that highlights what central banks *can* do (Chenet et al., 2021; Dafermos et al., 2018; Kedward, Gabor, et al., 2022). When I look at the new, climate-related practices of central banks my goal is to analyze how central banks apply these practices, how they rationalize their decision-making process, and the underlying normative assumptions. Ultimately, I want to assess whether the tools applied represent a fundamentally new approach or whether the central banks' practices are but a continuation of status-quo embellished with some new climate change rhetoric. This focus on practices is not new to IPE, where there have been important contributions to understanding macroeconomic and risk valuation models (Clift, 2019; Helgadóttir, 2021a; Henriksen, 2013; Lockwood, 2015) and the new assessment tools and calculation methods for macroprudential policies (Kranke & Yarrow, 2019; Thiemann et al., 2020).

The concept of *expertise* is important because we need more insight into precisely how central bankers, as economists, can deal with esoteric issues related to climate change. To return to the quote from Robinson's novel that I introduced at the outset, recall Mary's remark about how she was in a room full of bankers who knew nothing about climate change, an observation that is not too far from reality. In elaborating on the concept of expertise, my goal is to understand how the particular economic expertise that characterizes central bankers (Adolph, 2013; Ban & Patenaude, 2019) influences their way of thinking about climate change. The concept of expertise is often associated with the literature on linked ecologies, and even though this literature has made important contributions to understanding professional interaction and how professionals operate within and between institutional systems (Baker, 2013; Ban et al., 2016; Seabrooke & Henriksen, 2017; Seabrooke & Tsingou, 2015), I invoke the concept of expertise to understand how central bankers think about their work with climate change and how their background influences their worldview (Adolph, 2013; Riles, 2019). In that sense, I focus on the micro perspective of expertise rather than the networks of professionals.

Finally, I draw on the concept of *legibility* introduced by James C. Scott (1998). Just like the forester in the late eighteenth century Germany invented scientific forestry by introducing the 'Normalbaum' and a new vocabulary for measurement, calculation, and value (Scott, 1998), I analyze how central banks have made climate change legible. Their existing tools, assumptions, and worldview has made climate change into an issue of risk management. In doing so, I draw on the existing literature in IPE and economic sociology, which includes the body of literature that seeks to understand how economists, including central bankers, make sense of the world through formal modeling (Braun, 2014; Helgadóttir, 2021b), or a particular framing stemming from their training and worldview (Fligstein et al., 2017; Golub et al., 2015). Such a perspective gives a better understanding of the 'cognitive environment' that guides people in organizations (Broome & Seabrooke, 2012).

While neither of these concepts are new to the field of IPE, this dissertation examines how they come into play at a time where economic practices and expertise meet climate science, and how central bankers way of thinking affect the way they make climate change legible.

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Target journal	Review of International Political Economy (accepted)	New Political Economy (ready for submission)	Review of International Political Economy (ready for submission)
Concept(s)	Expertise, legibility	Legibility, practices	Practices, expertise
Theoretical space	Linked ecologies, epistemic arbitrage, field arbitrage	(Hard) Epistemic boundaries, economic ideas	Central banks as a transnational 'wormhole' community, incremental change
Argument	Field arbitrageurs working in think tanks at the intersection of finance and climate, strategically advanced the frame of a carbon bubble to convince central bankers that climate change posed a risk to financial stability.	Central banks have had little interaction with climate scientists, despite lacking this expertise, and have instead approached the work on climate-related issues following a risk-based economic science ethos. Central banks ensured that they could address climate-related issues with traditional economic training and tools to uphold their institutional expertise.	Central bankers have, through the NGFS, decided to use IAMs as they found a group of like-minded peers in the IAM community who shared a similar approach to modeling using neoclassical economic models. Further, the IAM community provided important legitimacy to the exercise through their close connections to the IPCC.
Methods	A longitudinal study (2010-2018). Expert interviews, document analysis, and participant observation at webinars	Expert interviews, quantitative content analysis of speeches by central bankers	Expert interviews, document analysis, participant observation at webinars, speeches by central bankers
Research questions	Why and how did the idea of climate change as a form of systemic risk go mainstream in central banks?	How do central banks claim to have institutional expertise in climate change being a field that works from an entirely different scientific standpoint, and why have central banks reduced the agenda to one that is solely about risks?	How do central banks motivate the use of IAMs as they seek to understand the broader macroeconomic implications of climate change?
Title	The Climate Shift in Central Banking: How Field Arbitrageurs Paved the Way for Climate Stress Testing	Seeing Climate Change Like a Central Banker	Managing Climate Risks: How Climate Scenarios Entered Central Bank Policymaking

#### **1.2 Main contributions**

This dissertation makes several contributions to the field of central banking and international political economy more broadly. Theoretically, I provide a micro-level analytical framework that can help us understand how central banks work to incorporate a new policy domain outside their traditional remit and knowledge practices. The IPE literature, while providing detailed descriptions of organizational change in central banks and economic institutions (Baker, 2013; Clift, 2018; Helleiner, 2014; Moschella, 2015b, 2015a), still lacks an analytical framework for understanding how institutions adapt to topics outside their immediate remits. Climate change is one topic that central banks will have to address, but central bankers will also have to consider other issues lying outside their immediate purview, such as cyber security or biodiversity. As the consequences of anthropogenic climate change unfold, we can only expect the engagement with this field to deepen. I therefore, suggest this theoretical layering, with a focus on the dynamics at the micro-level, the goal being to understand what happens within the organizations, that is how climate change is presented in a way that is relatable for central bankers (legibility), how the training and worldview of central bankers affect the way they approach the work with climate change (expertise) and how they adapt their models and instruments to address this new field (tools). While this re-instates the micro-foundations and disregards the macro-effects (Blyth & Matthijs, 2017), I argue that such a micro-oriented approach is a necessary first step in attempting to understand the emerging field of green central banking.

Empirically, this dissertation contributes to the emerging literature on green central banking, a field that is in its infancy, with many research questions remaining to be addressed. In this effort, I want to highlight three contributions of my research. First, in contrast to the green central banking literature and the narrative advanced by central bankers themselves, important as Mark Carney's speech was in 2015, it was not the event that kickstarted this debate. I agree his address represents a critical juncture, but I will show here that it was more of a culmination of some of the early work that had been ongoing since 2010/2011 both inside and outside central banks. Second, I show how central banks have approached the climate change issue, their scope of reasoning, and how climate change has been adapted to the existing modeling framework of central banks. Finally, I seek to elucidate the key institution in green central banking the NGFS, which has hitherto received little attention in the literature. My goal here is to elucidate the working practices and underlying normative assumptions of this newcomer organization in international financial governance.

Methodologically, this dissertation is an attempt to show the usefulness of studying the field of central banking and climate change virtually. Although I did not intend to rely on online resources at the outset of this research project, I was forced to do so because of the pandemic, the lockdown and the travel bans that followed. The methods that I utilized in this dissertation, interviews, and online participant observation, are by no means new to the field of IPE, but online interviewing and participant observation at webinars has only been used to a limited extent. Even though this kind of virtual ethnography (Hine, 2020) was not my first choice, I have discovered that it can indeed be a useful tool for scholars seeking to study central banks. As I conducted my interviews, I gained the impression that the central bankers actually felt more comfortable with the online format. They did not have to worry about the practicalities of informing the reception about a visitor, booking a meeting room, or preparing coffee. My impression was that the interviewees felt that speaking to me online was less of a commitment or less pressure, as the transaction costs were lower in terms of me traveling a long way just to talk to them when I could instead just sit at home. Concerning the online participant observation, it gave me the opportunity to attend more seminars than would have otherwise been the case. As I will discuss in the methodology chapter, my virtual attendance also has obvious disadvantages compared to the traditional face-to-face interaction, but it is still worth considering for future research on central banking.

#### 1.3 Green central bank: introducing key concepts and practices

Before proceeding with the next chapters, I will describe the main tools and concepts in the field of green central banking that I deploy throughout this dissertation. I start by briefly explaining the concept of 'climate risk' and more specifically 'transition risk' and 'physical risk'. I then discuss the different tools used and initiatives taken by central banks. Since the first discussions emerged around central banks and their role in addressing climate change and climate-related risks a broad range of initiatives have been publicized and various tools discussed, and the discussion here is not an exhaustive list (see for instance Oman et al., 2022 for a more elaborate discussion). After the discussion of climate risk, I will briefly introduce the NGFS as an initiative to facilitate international collaboration, and then go on to discuss climate stress tests, disclosure frameworks, and greening asset purchase programs.

#### 1.3.1 Climate-related risks

Climate-related risks can take the form of transition risk or physical risk. This is an important distinction because it impacts the financial sector and the real economy in different ways. Physical risks arise due to climate-related weather events such as storms, floods, and heat waves, as well as the long-term changes in climate patterns such as rising sea levels, increasing temperatures, and changes in the nature and amounts of precipitation. These types of events pose a risk, as they may lead to the destruction of capital through damage to property and production facilities, interfering with manufacturing facilities or supply chains, and disrupting the production of crucial goods such as agricultural produce. Transition risk arises from the adjustment to a low-carbon economy. Transition risks can derive from climate policy (e.g. carbon pricing), technology (e.g. technological breakthroughs in transportation or energy production), and changes in market preferences and social norms (e.g. households switching to a greener consumption pattern). Carbon-intensive industries such as the fossil fuel industry and the automobile industry are particularly vulnerable to these transition risks and may pose a risk to financial stability if large parts of those industries lose value rapidly or end up as 'stranded assets' – an asset that once was highly valued but has now become low valued or worthless due to changes in the environment, technology, etc. (Bolton et al., 2020; Despres & Hiebert, 2020). In discussions around climate-related risks in central banks, this distinction between physical risk and transition risk is important because it represents two different transmission channels, each of which will affect the macroeconomy in different ways.

#### 1.3.2 The Network for Greening the Financial System (NGFS)

One of the first initiatives to come from the central banks was the establishment of the NGFS. The NGFS was established in 2017 by eight central banks and financial supervisors with the goal of sharing best practices and contributing to the development of climate-related risk management in the financial sector (NGFS, 2017). Since its establishment, the NGFS has seen rapid growth and by October 2022 contained 121 members (i.e., central banks and supervisory authorities) and 19 observers such as the BIS, the World Bank, and the IMF. As an organization, the NGFS is loosely organized. It has a rotating chairmanship and is currently chaired by Ravi Menon, Managing Director of the Monetary Authority of Singapore. The NGFS secretariat is managed by Banque de France (BdF). From the very outset, it has been emphasized that engagement should take place on a voluntary basis (NGFS, 2017). The most recent annual report emphasizes the NGFS is a 'coalition of the willing' and a 'voluntary, consensus-based

forum whose purpose is to share best practices' (NGFS, 2022). With the aim of sharing best practices, the NGFS is organized into workstreams, each of which relates to the conduct of monetary policy and financial supervision. The workstreams have published several reports, including a guide for supervisors on how to integrate climate-related risks into supervisory practices, sustainable investment practices for central banks' portfolio management, and three vintages of the NGFS scenarios, for conducting climate stress testing.

#### 1.3.3 Climate stress testing

Climate stress testing (CST) is the most widely applied tool that has been taken into use by central banks to better understand climate-related risks, and the tool in which NGFS has also invested a lot of time and resources. The latest report by NGFS and the Financial Stability Report (FSB) from November 2022 finds that a total of 67 CST exercises had been completed, in progress, or in the planning stage (FSB & NGFS, 2022). Climate stress testing follows the same principle as the existing stress testing framework implemented in the aftermath of the financial crisis. CST is anticipatory in nature, and it provides a set of future 'tail risk' scenarios to test the resilience of the banks, which is then modeled according to projected losses (Coombs, 2020; Langley, 2013; Langley & Morris, 2020). In this sense, CST fits well into the continuous expansion of risk imagination that has taken place since the financial crisis (Morris, 2018). However, CST is distinct in several areas. First, its time horizon is decades longer than the traditional stress test, which typically operates with a time horizon of two to three years. CSTs, in contrast, are conducted with a time horizon of 30-50 years. Secondly, CST relies on forwardlooking data, as the impact of climate change will be unprecedented, and it is therefore not feasible to construct the exercise around historical data. Finally, CST requires an approach that can account for the complex interactions between climate and finance, differentiating it yet again from the conventional stress test (Battiston et al., 2017; Bolton et al., 2020).

#### 1.3.4 Climate-related financial disclosures

Another measure aimed at improving the understanding of climate-related risks is to improve the disclosure frameworks for these new types of risks. There are many disclosure guidelines and standards for how best to report on climate-related risks, and by some measures, there are close to 400 different standards promoted or used by industry groups, NGOs, stock exchanges, international organizations, and regulators (TCFD, 2016). In December 2015, the FSB announced that they would develop a set of recommendations for future disclosure frameworks that would allow for 'consistent, comparable, reliable, clear and efficient' disclosures (FSB, 2015). With a firm belief in the principle of improved information as a driver of market discipline, FSB established the Task Force on Climate-related Financial Disclosures (TCFD), the purpose of which was to develop a set of recommendations for the disclosure of climate-related risks (Christophers, 2017). Even though the TCFD was initiated by the FSB, it was created as a private sector-led initiative, chaired by Michael Bloomberg, former mayor of New York and founder of Bloomberg L.P. The task force included members who were 'preparers and users of financial disclosures' which means they came from financial as well as non-financial companies. The final recommendations, published in 2017, suggested that disclosures be organized around four thematic areas: governance, strategy, risk management, and metrics and targets. While the TCFD is a privately-led initiative, an annual progress report is prepared for the chairman of the FSB each year.

#### 1.3.5 Greening asset purchases or 'green QE'

The final tool discussed amongst academics, observers and central bankers is greening asset purchases, popularly known as 'green QE'. There is no clear definition of 'green QE' and there are many ways in which such a scheme can be designed, ranging from purchasing green bonds, adapting the collateral framework to account for climate-related risks, to aiming for a tilt away from 'dirty' assets (Schoenmaker, 2021; van Lerven et al., 2020). Discussion around green QE grew out of the observation that the QE programs implemented in response to the financial crisis had a 'carbon bias' built into them due to a structural bias towards carbon-intensive industries, operating on the principle of 'market-neutrality' (Matikainen et al., 2017). The debate over market neutrality has been instrumental for advancing the green QE agenda. The ECB executive board member Isabel Schnabel was the first high-ranking central banker to acknowledge the problems stemming from the carbon bias. In a speech in September 2020, she argued that 'In the presence of market failures, market neutrality may not be appropriate benchmark...' (Schnabel, 2020). The BoE and ECB have now announced that they will seek to 'tilt' their corporate asset purchase programs. In July 2022, the ECB announced in July 2022 that they would begin to tilt their corporate bond holdings towards companies with better climate performance (ECB, 2022b). The BoE has also announced a tilt of its corporate bond purchase scheme, but it has seen little effect up until this point (Dafermos et al., 2022).

These are all concepts and tools that are instrumental to understand the discussions in the field of green central banking. The distinction between physical and transition risk is the cornerstone to discussions of climate-related risks, and the introduction of NGFS, climate stress testing, disclosure frameworks and 'green QE' give an overview of the different tools and initiatives. These concepts and tools have been dominating the debates in green central banking, and are therefore also widely discussed throughout this dissertation.

#### 1.4 Structure of the dissertation

This dissertation is structured as a paper-based work. It is organized into two parts. Part I, with three additional chapters besides this one, serves as the overall introduction and frame of the research project, and Part II contains the three papers and a concluding chapter. In this introductory chapter, I have outlined the overall topic and relevance of studying climate change and central banks, presented the overall argument, and introduced the reader to the basic concepts and developments in the field of green central banking.

The remainder of Part I is organized as follows. In Chapter Two, I provide a comprehensive introduction to the issue of central bank mandates. I place the current discussion around central banks and climate change into a broader historical discussion around the mandate. I argue that the remits that are dictated in the mandate pose no barrier to central banks also engaging with climate-related issues, whether or not the central banks wanted to go beyond the risk-based approach. In Chapter Three, I outline my theoretical approach to understanding central banks' approach to climate change. The mission here is to open the black box of the conduct of central banking in order to understand how central bankers have approached the task of incorporating climate change as a field that ostensible lies outside their immediate remits. In Chapter Four, I develop the methodological approach and demonstrate how I have applied a qualitative, abductive approach using the interviews, (virtual) participant observation, and document analysis to answer how we can understand central banks' approach to working with climate change.

Part II contains the three individual papers that provide three distinct perspectives on how central banks take on climate change. Paper I 'The Climate Shift in Central Banking: How Field Arbitrageurs Paved the Way for Climate Stress Testing' analyzes how and why central banks started to work with climate-related issues and why the idea of climate change as a systemic risk issue went mainstream in central banks over the course of just a few years. In this paper, I argue the 'climate shift' in central banks can be ascribed to a particular group of professionals whom I dub 'field arbitrageurs'. These professionals came to this issue from a mixed career trajectory in finance, while also working with questions related to climate change. Their combined profile

enabled them to frame climate change in a way that made the issue attractive to central bankers. They did so through the 'carbon bubble' frame, making climate change into a risk issue that fell into the financial stability mandate of central banks. As a risk issue of this kind the central bankers could simply not ignore climate change.

In paper II 'Seeing Climate Change Like a Central Banker' I examine the puzzle of how central bankers could claim to have institutional expertise in climate change, a field that is embedded in an entirely different scientific approach than the central bankers' economic tradition. Based on interviews with central bankers who work with climate change, the paper seeks to understand how they view their work. I found that although central bankers have had limited interaction with climate scientists, and while they admit that they lack expertise on this issue, they nevertheless approached climate change from an economic perspective. Hence, they followed a risk-based economic science ethos of calculating risk levels and incorporating climate change into their existing modeling framework. I conclude that there are hard epistemic boundaries in central banks, such that an idea that enters from the outside must be 'translated' into an economic issue so that it can become mainstream in central banks.

In the third and final paper 'Managing Climate Risks: How Climate Scenarios Entered Central Bank Policymaking' I analyze the creation of the NGFS scenarios. I show how central banks, through the NGFS, have decided to use 'integrated assessment models' (IAMs) to create a set of scenarios for conducting climate stress tests, despite the fact that these IAMs are ill-equipped to account for uncertainties and extreme risks. I argue the NGFS chose this set of models because they found a group of like-minded modelers in the IAM community who shared similar worldviews and modeling approaches based on neoclassical economic models driven by a costefficiency rationale. Thus, central banks subsume the management of climate risks into the current modus operandi, and the result is a suboptimal policy outcome. With the tendency to rely on the pre-existing modeling framework the NGFS has ended up developing a set of scenarios that confirms the pre-existing quantifying approach and dominant worldview of central banks. This increases the risk of overlooking climate-related risks, which are not captured within the current set of models, and thereby underestimate not just climate-related risks but also the urgency of economy-wide decarbonization initiatives.

In the final chapter of Part II, I summarize the overall findings of this dissertation, bringing together the insights from the three papers. I conclude that central banks have not been

repurposed to deal seriously with the climate crisis. Although central banks have incorporated climate change in parts of their policies and operations, they still operate with their conventional narrow interpretation of the scope of the central bank mandate, which is very far from the 'all hands on deck' approach required in times of anthropogenic climate change.

## 2. Climate change and the mandate of central banks

Today's central banks have a very particular institutional setup which sets them apart from other state institutions and agencies. Central banks are independent, meaning they are insulated from the influence of elected officials and it is hard for any branch of government to reverse decisions made by the central bank (Blinder, 1998). This is an institutional arrangement that has gained traction since the 1970s, stemming from the theoretical rationale that delegation of authority was needed as there was a widespread belief that elected government officials were using monetary policy to produce short-term outcomes to win the next election, at the cost of the long-term effectiveness of monetary policy (Epstein, 2006; McNamara, 2002). Because central banks were granted independence from the government and thereby faced little democratic oversight it was argued that central banks in return should have a clear and limited mandate to pursue and to which they could be held directly accountable (Tucker, 2018). To the majority of central banks, this mandate is to pursue price stability, which means secure low and stable inflation, and in theory, central banks should not move beyond their mandate. Thus, to understand the actions, and inactions, of modern central banks we need to understand what these discussions about mandates entail.

If we take a closer look, very few central banks have a mandate that explicitly dictates the involvement with climate-related issues. A recent survey of the mandates of 135 central banks shows that only 12 percent of the central banks have a mandate that explicitly mentions sustainability (Dikau & Volz, 2021a). Nevertheless, to many central banks, climate-related issues have become part of their everyday tasks, and climate-related risks are treated on par with other types of risk, where one example is the NGFS membership which now counts well on the other side of 100 central banks and financial supervisors. This shows central banks have willingly engaged with climate-related issues, even though it is not mentioned explicitly within their mandate. While it is important to understand the mandate and the scope for action that the mandate provides (Alexander & Fisher, 2020; Blinder, 1998; Dikau & Volz, 2021a; van 't Klooster & de Boer, 2022), I show in this dissertation that in discussions about central banks and climate change the mandate is not necessarily a constraining factor to central banks.

While the majority of central banks share the mandate of price stability, there are differences in the way the mandate is outlined. If we take a closer look at the central banks I discuss in this dissertation, we find that there are differences in the formulation of the mandate. The ECB is known for being the most independent central bank in the world, with the narrowest mandate. Designed in the mirror of the Bundesbank, the ECB has a primary mandate of securing price stability and a more vaguely formulated secondary mandate to support the general policies of the EU without prejudice to the objective to secure price stability. While climate change arguably falls under 'general policies', as there is widespread agreement within EU institutions and amongst member states to mitigate climate change, the ECB has been reluctant to invoke the secondary mandate as the motivation for engaging in this agenda (van 't Klooster & de Boer, 2022). Within the EU, it is not just the ECB that has pushed forward this agenda, it has also been pushed strongly by the DNB and the BdF as members of the euro. While these central banks are often overlooked, as decisions around monetary policy are taken within the governing council of the ECB (McPhilemy, 2016), DNB and BdF have advanced this agenda as founders and active members of the NGFS and through policy entrepreneurs, most notably Frank Elderson, former board member of DNB and board member of the ECB since 2021 (Siderius, 2022; Thiemann et al., 2022).

The BoE works differently from the ECB and the other central banks in the Eurozone. It also has the mandate to ensure price stability and financial stability, but there is closer coordination between the BoE and the government, where the BoE receives a so-called remittance letter from the Chancellor of the Exchequer every year. In the letter, the Chancellor specifies how price stability is defined and outlines the economic policies of the government. The remittance letter is important in this case because the BoE was granted a green mandate in the letter in 2021. However, this happened six years after they formally started the exploration of climate-related issues (see Prudential Regulation Authority, 2015). Thus, when the BoE first started to engage with climate-related issues it was to ensure financial stability. As Carney explained in his now-famous speech in 2015, climate change is a new type of risk to the financial system because '…once climate change becomes a defining issue for financial stability, it may already be too late' (Carney, 2015). Even though the BoE now has the mandate to support the transition to a net zero economy and has made a commitment to green the corporate asset purchase program, this effort is found to lack ambition (Dafermos et al., 2022).

With the mandate being an important institutional constraint, at least in theory, it is important to understand how climate change falls under the mandate of central banks. Yet, as I will show in this section, discussions around the mandate of central banks follow a long trajectory. While there is a tendency to think of the mandate as something that can only involve price stability and financial stability, a look at the history of central banks shows otherwise. Though the last four decades have involved a narrow mandate of central banks, this has not always been the case. As the next section will show central banks were actively taking part in allocating credit after WWII, and during the financial crisis of 2007-2008 they took a new role upon themselves with the implementation of unconventional monetary policies. Taken together, this suggests that central banks have more leeway in terms of interpreting their mandate and that the mandate is not a constraining factor for central banks' involvement in climate change.

#### 2.1 The mandate of central banks from a historical perspective

The discussion of the role of central banks in addressing climate change taps into a long-existing debate about central banks and the remits of the mandate. From a historical perspective, central banks have traditionally had three objectives: to ensure price stability, to maintain financial stability, and to support the state's finances in times of crisis. The balance of the three objectives has changed over time, and in the absence of war, there has been a shifting balance between price stability and financial stability (Braun & Downey, 2020; C. Goodhart, 2011). In the 19<sup>th</sup> century up until the outbreak of World War I, and after countless financial and banking crises, the conduct of central banking was characterized by a focus on financial stability (Braun & Downey, 2020; Jacobs & King, 2016). During WWI the Fed had an important role as it ensured a floor price on Treasury bonds to ensure the Treasury could borrow cheaply to finance the war (Mehrling, 2010). In the aftermath of World War II, there was a 'government take-over of monetary policy' (Goodhart, 2011, p. 138), and credit policies became the new standard to ensure the strategic allocation of credit as Europe and the US recovered after WWII (Bezemer et al., 2021; Monnet, 2018).

To envision the scope of maneuverability for a central bank fit for the 21<sup>st</sup> century marked by climate change, we need, ironically enough, to revisit the 20<sup>th</sup> century and the credit policies that were conducted in the aftermath of WWII. This period is interesting because credit policies were the norm in the period from WWII up until the 1980s (Bezemer et al., 2021). There is no clear definition of credit policies, but in his ground-breaking work on French credit policies in post-

war France, Monnet (2018) defines credit policy as a policy that 'seeks to act on the way credit is allocated across the economy by favoring particular sectors and institutions' (pp. 2-3). Important to understand in this regard is how the idea of affecting the allocation of credit may also encompass credit controls, and that credit policies served multiple purposes. As Monnet (2018) explains credit policy could be conducted for the purpose of monetary policy (controlling credit to fight inflation), industrial policy (to help key economic sectors), budgetary policy (prioritize government financing), trade policy (favoring exporting companies), capital controls (stimulating domestic loans) or financial stability (preventing excess credit to be disconnected from the real economy).

Credit policy was the norm in the post-war period and central banks had a key role in managing the debt level, rebuilding the domestic economies, and supporting industrial policy (Bezemer et al., 2021; Epstein, 2006). Central banks in advanced economies used direct means to support particular economic sectors, including the BoE and the Fed who are often disregarded in this discussion but who promoted their domestic financial sectors (Epstein, 2006). While these two central banks relied on credit policies that included subsidized interest rates, moral suasion, and directed credit, other countries favored sectors that included exports, agriculture, and manufacturing in a broader range of countries such as West Germany, Canada, Belgium, Italy, and France (Bezemer et al., 2021; Epstein, 2006; Monnet, 2018). Thus, central banks had an active role in shaping the national financial systems and financial markets, and they influenced the allocation of capital in line with the strategic national objectives (Bezemer et al., 2021; Monnet, 2018).

However, the conduct of credit policies in line with national strategic priorities happened in a very different institutional context where central banks were considered as a part of the government, and the central banks that were independent prior to the war had been subsumed by the government during the war (Epstein, 2006; Monnet, 2018). As Monnet (2018) shows in the case of credit policies in France, the BdF operated in a very different institutional context compared to contemporary central banks. The institutionalization of credit depended on three components: the legal framework that distributed the power to the relevant actors; a widespread social norm that entrusted state intervention in the allocation of credit; and an approach to monetary policy that ensured inflation through the control of credit. However, the institutional context changed throughout the 1980s and 1990s and was replaced by a focus on price stability through the pursuit of inflation targeting and central bank independence (Goodhart, 2011; Kaya,

2022; McNamara, 2002; McPhilemy & Moschella, 2019). Thus, the role of the central bank has changed over time, and as Goodhart (2011) shows each epoch of central banking has been followed by a time of interregnum and a search for a new institutional blueprint for the conduct of central banking.

For the past four decades, the main objective of central banks has been to ensure price stability through the use of one instrument: the adjustment of the interest rate. Braun and Downey (2020) call this the holy trinity of inflation targeting: price stability as the primary goal; central bank independence as the institutional arrangement; and the short-term interest rate as the operational target. The Fed, for example, has a dual mandate of ensuring price stability and full employment, but it proves to emphasize inflation over unemployment in the pursuance of monetary policy (Braun & Downey, 2020; Kaya et al., 2019). Indeed, the 'holy trinity' had proved efficient to the extent, that in the years leading up to the financial crisis, central bankers were considered to have perfected the act of central banking. The period became known as the 'Great Moderation' as a period of continuous low and stable inflation (Braun & Downey, 2020; van 't Klooster, 2020). However, this changed with the financial crisis that led to a renewed discussion of the mandate and objectives of central banks.

The financial crisis put central banks at the center stage and started new discussions around the mandate. During the immediate outbreak of the financial crisis, central banks stepped in and assumed a new and unprecedented role not only as lenders of last resort but also as market makers of last resort (Gabor & Ban, 2016; Tooze, 2018). Once the financial system was saved from the brink of collapse, central banks resorted to unconventional monetary policy tools with the implementation of quantitative easing (QE), arguably to maintain price stability and prevent a situation of deflation (Lombardi & Moschella, 2016; Ronkainen & Sorsa, 2018; van 't Klooster & Fontan, 2019). The use of these experimental instruments made it clear to many, what political economists had argued for a long time: that central banks had more leeway in terms of their mandates (van 't Klooster, 2020; van 't Klooster & de Boer, 2022). An example is the QE programs which is largely considered as monetary financing, which in the case of the ECB is prohibited according to the TFEU, but the ECB chose to justify this intervention with the argument that it was needed to preserve price stability (van 't Klooster, 2020; van 't Klooster & Fontan, 2019).

The financial crisis can in many ways be considered as a window of opportunity for a looser interpretation in terms of the discussion of mandate. The financial crisis did not just lead to a reinforced focus on financial stability (Johnson et al., 2019; McPhilemy & Moschella, 2019; Thiemann, 2019), a development that has also been crucial for the engagement with climaterelated issues, as the first engagements happened with reference to financial stability (see for instance Carney, 2015). The crisis also led to a general discussion of the mandate of central banks, as the crisis management tools rolled out by central banks in an attempt to stabilize the financial system made it clear that the conduct of central banking was not just an act of financial engineering, it actually had an impact on real people (Riles, 2019). While fundamental reforms of the financial system remained absent (Helleiner, 2014; Moschella & Tsingou, 2013), the QE programs resulted in an ever-larger presence of central banks in the financial markets (Gabor, 2016a, 2016b). After years of QE programs, it became clear that central banks are deeply embedded in the functioning of the financial system (Braun, 2018; Thiemann et al., 2022; van 't Klooster & Fontan, 2019). After the financial crisis, central banks rolled out the crisis toolkit anew to avert the shock from the Covid-19 pandemic, underlining the relevance of questioning the remits of central banks, and whether they are in fact capable of mitigating climate change within their mandate (Ban, 2021; Langley & Morris, 2020).

In sum, there is not necessarily anything in the mandate that prevents central banks from dealing with climate-related issues, and historical precedence shows how central banks have been active in supporting the state in times of crisis. Even though central banks have had a more active role historically and there is room for discretion in the interpretation of the mandate, there is currently a consensus that climate change falls under the remits of central banks within the existing and narrow interpretation of central bank mandates.

#### 2.2 A green central bank for the 21st century?

In the slipway of the financial crisis, the discussion about the mandate and the extent of the mandate has come to the fore again. Concerns about the mandate and whether climate change would fall under the mandate of central banks have been an important point of discussion, not just in the literature but also amongst central bankers themselves. It has been emphasized in countless number speeches by central bank governors and board members that central banks will only contribute to mitigating climate change '*within its mandate*' often restating that it is the government that bears the main responsibility (see for instance Elderson, 2021; Lagarde, 2021;

Villeroy de Galhau, 2021). Even so, there have been accusations of central banks overstepping their mandate by engaging in a policy area that falls under the remit of democratically elected governments (see for instance Gros, 2020; Issing, 2019) or falling into the trap of 'mission creep'. As explained by Jens Weidmann, then President of the Bundesbank, in a speech in 2020 mission creep can result in central banks being expected '...to correct market outcomes in other areas as well.', with the consequence that 'an active role in climate policy – or in other fields of politics – could undermine our independence and, ultimately, jeopardize our ability to maintain price stability.' (Weidmann, 2020). Because only a few central banks have a mandate that explicitly mentions sustainability (Dikau & Volz, 2021a), it appears to central bankers as a difficult balance to strike.

While most central banks do not have a mandate that dictates them to deal with climate-related issues, a consensus has emerged that climate change can pose a risk to the financial system and as a result, climate-related risks fall under the financial stability mandate. This was recognized in the first report coming from the NGFS. The report concluded it is under the mandate of central banks to ensure the financial system is resilient to climate-related risks (Network for Greening the Financial System, 2018). The argument is that climate-related risks can materialize in a way that can impact the financial sector more broadly through stranded assets such as oil rigs that are forced to close down (transition risk), or major physical events such as severe floodings or extreme hurricanes that can lead to financial market dislocations (physical risks) (Alexander & Fisher, 2020). Thus, climate-related risks fall under the micro-prudential supervision as well as the macro-prudential supervisory tasks, as it is important to ensure the collective financial system is not brought down by the systemic nature of climate-related risks (Alexander & Fisher, 2020; Bolton et al., 2020; Dikau & Volz, 2021a; Smoleńska & van 't Klooster, 2022).

A similar argument can be made for the case of price stability where climate change can impact the price level of food and energy. In a world with an increase in the frequency and severity of extreme weather events, food prices can increase as agricultural production may be affected. This can happen through the more permanent change to the climate such as an increase in precipitation or areas that are used for agricultural production today may become deserts in the future. Agricultural production can also be impacted by more acute weather events such as droughts or floods. In either case, such events will have a severe impact on agricultural
productivity which might lead to food shortages and thereby an increase in food prices which are an important part of consumer price inflation (Cœuré, 2018; Dikau & Volz, 2021a). Another channel of influence is how energy prices might be affected, particularly in the case of the implementation of a carbon price, which could cause aggregate output to decline and inflation to spike. Such a development may also lead to what Schnabel has called 'greenflation', which means companies will face supply restraints for metals and minerals used for green technologies as they rush to reduce carbon emissions, leading to another spike in prices (Schnabel, 2022). These shocks will have the characteristics of supply shocks which 'are less easy to accommodate for central banks as they pull output and inflation in opposite directions' which leaves central banks in the unpleasant dilemma where they 'have to choose between stabilizing inflation or economic activity' (Cœuré, 2018).

These interpretations of the mandate in relation to financial stability and price stability, however, fall under the narrower interpretation of the scope of the mandate. There is a broad range of alternative tools that central banks have at their disposal. Arguably these tools fall under the remit of central banks as well, but they go beyond the market-correcting approach that is hitherto seen by central banks (Baer et al., 2021; Dafermos, 2022; Kedward, Gabor, et al., 2022). As argued by Dafermos (2022) and Svartzman et al. (2021) if central banks take financial stability seriously, they need to take more extensive measures than seen until now. Dafermos (2022) argues that central banks do not need a new environmental mandate, but a re-interpretation of the financial stability mandate that interprets the mandate over a long-term time horizon. In doing so central banks can better cater to the uncertainties in risk management that institutions need to account for and it recognizes that climate risks are not exogenous to the actions of central banks. Such an approach would follow a precautionary principle that encourages more preventative policies in the face of uncertainty (Chenet et al., 2021).

With a similar long-term perspective on the financial stability mandate, but going one step further, Svartzman et al. (2021) argue that central banks need to engage in policy coordination, involving fiscal, monetary, and prudential policies to mitigate climate change. Indeed, policies that include feed-in tariffs, tax credits, loan guarantees, and national development, all policies that require more activist levels of intervention from monetary and fiscal authorities, are more effective in mobilizing climate finance, than more indirect policies such as disclosures and green bonds (Bhandary et al., 2021; Mikheeva & Ryan-Collins, 2022). Closer coordination between monetary and fiscal authorities is important because investments in green technologies require

patient and long-term capital. Historically, these forms of capital have been provided in coordination between fiscal, industrial, and monetary policy to steer private finance towards priority sectors or penalize lending to non-priority sectors (Kedward & Ryan-Collins, 2022; Svartzman et al., 2021), but research on the more recent developments have also shown how public investments increase the share of total investment and investments in riskier portfolios (Mazzucato & Semieniuk, 2018).

Thus, according to this argument, if central banks are serious about maintaining financial stability in accordance with their mandate, they can only do so if they play a proactive role in mitigating climate change through coordination with other government agencies. Even though these arguments fall under the financial stability argument that has been advocated by central bankers themselves (see for instance Carney, 2015; Network for Greening the Financial System, 2019), the level of engagement in mitigation reaches much further in this interpretation of the financial stability mandate.

To conclude, this chapter has shown, how the remits outlined in the mandate should not prevent central banks from engaging in climate-related issues. In fact, looking at the historical precedence, central banks have had different societal goals and have used a broad range of instruments in different institutional settings. If we take the historical precedence of the capacity of central banks to be an active part in domestic strategic objectives, central banks should be considered as a Swiss army knife and not just a hammer whose only purpose it is to ensure low inflation (Braun & Downey, 2020). Central banks hold the potential to have an active role in addressing climate change and use the many different tools they have available ranging from engagement in credit policies, following precautionary principles in managing financial stability to targeting unconventional monetary policies in a greener direction, even though the latter is of less importance in the current inflationary environment.

In this context, it is also important to emphasize, that even in a narrow reading of the remit of central bank mandate, there is consensus that the widespread impact of climate change implies that climate change will impact financial stability as well as price stability and that central banks must act for these reasons. Thus, this review of the literature on central bank mandate shows that mandate should not be considered as the constraining factor for central bank action. As I will show in this dissertation it is important to examine other factors to understand how central banks work with climate change.

# 3. Analytical framework: studying central bankers at the micro-level

I have set out in this dissertation to understand how central banks have approached the work with climate and whether this has led to central banks being repurposed to deal with such issues. To do so, I conduct a micro-level analysis to understand central bankers' scope of reasoning as they work with climate-related issues. The dominant approach in IPE is to focus on institutional, structural, or ideational explanations to understand how central banks adapt or resist adapting to new circumstances, whereas concrete practices of central banking conducted by central *bankers* have received less attention in the literature with important exceptions (see for instance Adolph, 2013; Ban & Patenaude, 2019; Braun, 2015; Fligstein et al., 2017; Golub et al., 2015; Riles, 2019). Thus, taking such an inside perspective to talk to central bankers to understand their practices and how their training and career influence their way of thinking is not new to IPE; my contribution in this regard is I apply this inside perspective to a new policy domain.

I argue that to understand how central bankers deal with climate change, a policy domain that is new to central banks and outside their immediate area of expertise, I need to explore a different set of factors than the ones that are often emphasized in the literature. Thus, I look at how this work unfolds at the micro-level and to do so I look at the three factors of *practices, expertise,* and *legibility*.

#### 3.1 State of the art

Even though there is limited literature that explicitly discusses green central banking and how central banks have approached the work with this agenda, there is a rich literature in IPE that discusses change and inertia in central banks to help us understand which factors can lead to or impede central banks from being repurposed. I will focus here on the financial crisis literature, which contains rich discussions on change, inertia, and whether central banks were repurposed after the financial crisis. This literature can broadly be grouped into three: the institutional design of central banks, structural explanations that emphasize the interdependency between central banks and private financial markets, and ideas within central banks.

One strand of literature in IPE looks at how the institutional setup of central banks influences how and whether central banks are repurposed. It is argued in this literature that these institutional characteristics of central banks, which is central bank independence and the price stability mandate, create boundaries to the degree of change that can be induced within central banks. Indeed, the independence of central banks can lead to loneliness and ultimately a policy gridlock (Mabbett & Schelkle, 2019). This also implies that this literature questions the degree of change that can happen within central banks, and largely considers the institutional characteristics of central banks as limitations to real reform (Johnson et al., 2019; Lombardi & Moschella, 2016; van 't Klooster & Fontan, 2019). This argument has been made for unconventional monetary policies such as quantitative easing (Cour-Thimann & Winkler, 2012; Lombardi & Moschella, 2016; Ronkainen & Sorsa, 2018; van 't Klooster & Fontan, 2019), or the post-crisis macroprudential reforms (Hungin & James, 2019; Johnson et al., 2019; Thiemann, 2019; Thiemann et al., 2020) that had been implemented with reference to maintaining the principle of price stability or independence, or in some cases both.

In the pursuance of the implementation of unconventional monetary policies, central bankers justified these interventions by arguing that they did not compromise either the principle of independence or the mandate of price stability. It is shown how unconventional monetary policy instruments were implemented with reference to these principles. Lombardi and Moschella (2016) find that the ECB's government purchase program was relatively modest in its implementation as a result of legal, doctrinal, and institutional fundamentals guiding ECB governance, which also included an emphasis on the principle of independence. Similarly, the implementation of QE by the ECB and the Swiss central bank (SNB) was implemented with reference to the principle of 'market-neutrality', which van 't Klooster and Fontan (2019) argue is a strategy to uphold the principle of independence by the two central banks. To the Fed, it was important to institutionally legitimize the use of QE to ensure it could continue to use this policy instrument (Ronkainen & Sorsa, 2018). Cour-Thimann and Winkler (2012) also find the early non-standard monetary policy measures initiated by the ECB were influenced by the institutional environment the ECB operated within, which included the multi-country context and the focus to ensure price stability.

Similar observations can be made in the case of post-crisis macroprudential policy reforms. Macroprudential policies are different from the pre-crisis approach to regulation and supervision (Baker, 2013) and while it has been argued that it can put the independence and autonomy of central banks at risk (L. M. Goodhart, 2015), it has been important for central banks to show that macroprudential reforms did not compromise independence or the price stability mandate.

Johnson et al. (2019) find the implementation of macroprudential policies has been layered on top of the existing institutional framework of price stability and independence, what they call the 'core monetary policy pre-crisis paradigm'. They, therefore, conclude that central bankers have neither been willing nor able to rethink their beliefs about how monetary policy works after the outbreak of the financial crisis.

A key concern for central banks in the implementation of these new policy instruments after the financial crisis was to uphold the legitimacy and credibility of central banks. Breaking with the institutional principles could harm the legitimacy of central banks, which central banks depend on. Hungin and James (2019) argue that reputational damage was the main concern for BoE in the formation of new prudential measures to ensure financial stability and that this concern of reputational damage led to a suboptimal institutional design. As a strategy to legitimize the macroprudential measures, central bankers engaged in collaboration with the academic community to create a new measure for systemic risk (Thiemann et al., 2020). Similarly, Thiemann (2019) finds that while measures to improve the financial sector's resilience have been implemented, the most ambitious part of the macroprudential policy agenda namely the goal to smoothen the business cycle was sidelined, arguably because of reputational concerns. This part of the macroprudential reform agenda has been left out of central bank work because of the uncertain scientific status of the concept of the 'business cycle' as well as a lack of metrics, which could prove harmful to the reputation and thereby the legitimacy of central banks (Baker, 2018; Thiemann, 2019).

Thus, this part of the literature finds that concerns to uphold institutional principles of monetary policy guide the direction and extent of change that can be implemented within and across central banks. It is important for central banks to uphold the institutional principles of price stability and central bank independence and avoid compromising their institutional legitimacy and credibility by putting themselves in a position where the adherence to those principles could be put into question.

The second strand of literature that looks at how central banks have changed and the extent to which this change has been radically different from the approach to regulation prior to the crisis considers the role of financial market structures and the entanglement between central banks and private financial markets (Braun, 2018; Gabor, 2016b; Gabor & Ban, 2016; Walter & Wansleben, 2019). It is argued that to the extent central banks have changed it is to

accommodate and adjust their conduct of monetary policy to the demands of market-based finance. Like the literature that discusses the influence of institutional principles, this literature highlights how change has happened in the approach to regulation by central banks, but that the directionality of change has largely been decided by entanglement between central banks and the financial markets.

It is argued in this literature that there is a close entanglement between central banks and financial markets resulting from the shift to market-based finance well before the financial crisis (Hardie & Howarth, 2013). The first signs of this entanglement can be traced back to the 1970s with the global integration of the Eurodollar market, where central bankers played a key role (Braun et al., 2021). The entanglement became even clearer in the post-crisis response and the implementation of regulation by central banks that followed. As Birk and Thiemann (2020) note, post-crisis reforms did lead to change, but, in qualitative terms, the overall approach to regulation remained the same. It followed pre-crisis neoliberal principles and represent a refinement of the commitment to markets with an aim to provide a more efficient market structure for cultivating market liquidity (Birk & Thiemann, 2020). Walter and Wansleben (2019) identify a similar pattern and argue that the close alignment between central banks and financial markets explains how central banks have endorsed fragile liquidity structures and an increasing reliance on debt in financial markets.

A large part of the work in this part of the literature has been to investigate the so-called repo markets, and the hesitance amongst central banks to regulate this part of the financial sector, especially in the eurozone (Braun, 2018; Gabor, 2016a; Gabor & Ban, 2016). It is argued in this literature that there is an interdependence between central banks and the repo market, where repos, or repurchase agreements, involve the sale at an agreed repurchase of an asset used as collateral (Gabor, 2016b; Gabor & Ban, 2016). As Gabor (2016b) argues, central banks found they were dependent on liquid repo markets for the conduct of monetary policy. With the outbreak of the financial crisis central banks and the FSB recognized the financial instability inherent in deregulated repo markets, and while this recognition triggered changes in the crisis management by central banks, it did not lead to any regulatory interventions into the repo markets (Gabor, 2016a, 2016b). Braun (2018) theorizes this relationship as 'infrastructural power' meaning that the interdependence and entanglement between private financial markets and central banks lead to a situation where the latter needs a liquid and well-functioning financial market to conduct its monetary policy. This makes central banks and financial

regulators hesitant to implement new regulations and thereby the degree of change, which in the words of Braun (2018) leads to a situation where 'finance wins'.

The third and final branch of literature on change in central banking looks at the importance of ideas. The financial crisis paved the way for a debate in central banking around financial stability, which led to the implementation of macroprudential policies after the financial crisis (Baker, 2013; Baker & Widmaier, 2014; Bell & Hindmoor, 2017). In the immediate aftermath of the financial crisis, it was possible to observe this macroprudential shift, which was significant because it represented a break with the approach to financial regulation prior to the financial crisis as it took a system-wide approach to financial regulation. Concerns around financial stability and macroprudential tools led to an unexpected intervention in the foreign exchange market by the SNB because of this post-crisis ideational change (Moschella, 2015a). In the UK, Bell and Hindmoor (2017) find that expert state elites developed and deployed ideas about capital buffers that contested the traditional arguments of the banks, thereby mediating the structural power mechanism. Thus, this literature finds that new ideas can lead to institutional change within central banks.

While there is a branch of literature that highlights how new ideas about macroprudential regulation led to change in the approach to regulation, there is another branch of the literature that shows how economic ideas have led to stability and persistence, even in times of crisis. In the case of the implementation of QE, Gabor (2014) shows how the ECB, dominated by New Keynesian ideas, maintained a particular interpretation of the Japanese experiments with QE years earlier, which led to a focus on experiences on risk spreads. In doing so, the ECB completely disregarded that the success of such monetary policy innovations depends on banks' funding models which otherwise weakens the effectiveness of the policy tool (Gabor, 2014). Levingston (2021) has also identified a particular reading of Keynesian ideas as being dominant within the Fed after the financial crisis. He finds that Keynesian ideas were made compatible with pre-crisis policymaking which resulted in 'depoliticized Keynesianism', which led to a selective interpretation of Keynesian and Minsky scholarship (Levingston, 2021). Thus, ideas can enable institutional change, but they can also be an important force in preserving the status quo.

#### **3.2** Limitations from state of the art in understanding climate change

While these three bodies of literature make important contributions to our understanding of how and whether central banks were repurposed, they focus on external factors and the larger macroeconomic structures of which central banks are part. A neoliberal macroeconomic regime that follows the principle of an independent central bank, a strong and powerful financial sector, and a set of economic ideas that largely stem from neoclassical economics. Yet the literature does not take into consideration practices within central banks, and the fact that monetary policy is conducted not by central *banks* but by central *bankers*. As Peter Conti Brown puts it in his work on the history of the Fed 'The Federal Reserve is a 'They', not an 'It'' (Conti Brown cited in Riles, 2019). The contribution of the work in this dissertation is to look into and seek to understand the practices and the culture that central bankers are a part of as professionals, in order to understand how central banks have approached the work with climate change.

It is important for me to underline here, that in conducting this work I do not wish to question the expertise and effort put into this by the individual central banker. I believe central bankers are highly intelligent people, and many of them are amongst the best economists in their national jurisdictions, if not in the world, and they genuinely believe that something must be done to mitigate climate change. Yet at the same time, the initiatives put into place at the time of writing will most likely have a limited impact (Dafermos, 2022; Kedward, Gabor, et al., 2022). In observing this schism, I argue that to understand how central bankers approach their work with climate change, we need to understand 'the culture of central banking, how it came to be, and what actions and thoughts are possible for someone who is part of this culture' (Riles, 2019, p. 23).

To sum up, this section shows how previous discussions in the literature on change in central banks have centered around three factors: institutional setup, material structures, and economic ideas. These three factors have in different ways acted as an impediment or incentive to change. The goal here is not to argue that these factors do not matter. They obviously do. Instead, in the next section I argue that in order to understand central banks' involvement with climate-related issues – a terrain that is quite unique in the sense that this is the first time central banks engage with an issue outside their immediate field of knowledge – we need to explore a different set of factors than the ones emphasized in the literature.

## **3.3** Practices, expertise, and legibility: The micro-level turn in the study of central banks

While much of the work on green central banking focuses on the ways of greening monetary policy (Dafermos et al., 2018; Matikainen et al., 2017; Schoenmaker, 2021), the institutional constraints in the form of mandate and how this relates to climate change (Baer et al., 2021; Boneva et al., 2022; Dikau & Volz, 2021a; van 't Klooster & de Boer, 2022), or discursive shifts (Thiemann et al., 2022), I seek to open the black box of central banks and look at the practices within central banks by focusing on the individual central bankers that mattered to the process. To do so I build on Riles' (2019) work on 'financial citizenship', which calls for a broader perspective on the activities of central banking and looks at what central banks do (practices), how they do it (expertise) and why they do it (legibility).

This is not to say that previous work on central banks has disregarded the work of individual central bankers. There have been important contributions here, but this literature is underrepresented in the field of IPE (Braun, 2015) and is more or less uncovered in the literature on green central banking that mostly considers institutional issues (Baer et al., 2021; Dafermos, 2022; Oman et al., 2022), with the important exception of Siderius' (2022) work on the DNB and Deyris' (2023) work on the ECB. Such contributions include the work by Fligstein et al. (2017) and Golub et al. (2015) who in their seminal work on the Fed seek to understand how central banks think, in asking how the Fed could fail to foresee the financial crisis in 2007-2008. They uncover a particular culture and set of practices that led to this ignorance, like an inherent belief in the idea of 'post hoc interventionism' (Golub et al., 2015), or the dominance of a macroeconomic frame which made it difficult to connect the events in the financial sector to the housing bubble (Fligstein et al., 2017). We also know from the literature on professionals that training and career background matters in the production of new policies (Ban & Patenaude, 2019), that expert networks are highly influential in central banks and associated international organizations such as BIS and FSB (Ban et al., 2016; Seabrooke & Tsingou, 2014; Tsingou, 2015) and that we should not think of professionals as attached to their organizations, but as individuals who seek to take issue control on a given issue (Seabrooke & Henriksen, 2017).

Yet to understand the approach to climate change taken by central banks, we need to not only look at training and career trajectories, but also unpack the practices of central banking as well, and talk to the individual central bankers central to the engagement with climate change in an attempt to understand their worldview and underlying normative assumptions as well as how these influence their daily professional work on the challenges that the climate crisis poses to central banking.

My focus on the micro-level of analysis entailing the study of individual central bankers and their work in specific networks comes from Riles (2019), who argued that central banks should be understood as organizations with real people, who are part of and affected by the cultural context. Seeing central bankers as individual technocrats who manage the economy with the greatest precision, somewhat like financial engineers, is an obsolete perspective, she argues. Instead, central banking should be considered a value-laden and relational activity where actions by central bankers and the type of tools and instruments they use have an impact on the lives of ordinary people, not just people working in the financial sector. Furthermore, as Thiemann and colleagues (2020) as well as Ban and Patenaude (2019) argued, central bankers do not work alone, but are embedded in broader networks reaching out into academia and the financial system. This perspective is not common in IPE. While there are important contributions in IPE that uncover the broader societal impact of central bank policies (Fontan et al., 2016; van 't Klooster & Fontan, 2019), they focus on the broader macroeconomic implications of central bank policies rather than on the details of how individual central bankers work 'with all of the tensions, biases, disagreements, uncertainties, common aspirations, career trajectories, and ideological orientations' (Riles, 2019, p. 25). Indeed, even the work on individual central bankers working in networks (Ban & Patenaude, 2019; Thiemann et al., 2020) does not systematically engage with these micro-level dynamics that Riles emphasizes. Drawing on Riles, in this dissertation I focus on three such micro-level factors that aggregate into organizational ones: practices, expertise, and legibility (see figure 1).

First, consider *practices*. They tell us a lot about underlying normative assumptions and principles of political economy and can act as a transmissions device between economic paradigms and a policy program (Clift, 2019; Heimberger et al., 2020). As Riles (2019) notes, the practices of central banks are important to understand because they encourage certain types of behavior and shape market actors' way of thinking. She shows how the design of the payment system has consequences for routines and practices by private banks (p. 32-33). As Clapp and Helleiner (2012, p. 492) argue, we need to devote more attention to 'the environmental implications of the actual everyday functioning of the markets'. We can for instance observe how this feed into the practices of governing climate change, where, as Carney stated in his

2015 speech 'what is measured can be managed', meaning that if central banks implement a measure that seeks to improve disclosure of 'climate-related risks', market actors will adapt and find ways to disclose and measure such 'climate-related risk'. Thus, to evaluate whether or the extent to which central banks have been repurposed to address new issues, we need to look at the types of practices central banks make use of and whether this use is extensive, sparse, or nonexistent.



Figure 1: the micro-level analytical framework

There is often a tendency to consider the work conducted by central bankers as highly technical work, indeed as 'boring', mundane activities of financial engineering. However, these technical details are highly value-laden activities, they impact the lives of ordinary citizens, and they have power (Riles, 2019). In any design of a policy tool, choices are made regarding what goes into the tools, which also implies that something is left out. The work of including or excluding content from tools is important because it tells us something meaningful about what constitutes legitimate knowledge production (Helgadóttir, 2021a, pp. 21–22). One example is the NGFS climate scenarios which I analyze in the third paper. The scenarios are designed in a way that makes them ill-equipped to address uncertainties in terms of how climate change will develop in the future, but you only realize this once you unpack the models using the analysis I propose in this dissertation. There would have been alternative modeling frameworks that would be better suited to account for the uncertainties, but which received less support given the politics and sociology that the central bankers are embedded into. Thus, prioritizing the type of scenarios that tells a clearer story for policymakers, but are ill-equipped to account for uncertainties will

ultimately impact the results of climate stress tests and thereby the perceived robustness to climate-related risks.

Second, consider *expertise*. Central bankers are often considered as these technical experts who work unbiasedly and detached from any social or political considerations, and who put their personal beliefs and motivations aside as they enter the door of the central bank (see for instance Blinder, 1998). This is not the case, however, and as Adolph (2013, p. 10) notes, this 'myth of bureaucratic impartiality' often stems from an eagerness to continue monetary policy as a purely technical problem. Given the mythical nature of the 'neutral' conduct of central banking above, this dissertation looks at what shapes the biases of the expertise of central bankers. The entry point here is a focus on the career background of central bankers in the production of new tools and policies (Adolph, 2013; Ban & Patenaude, 2019). Central bankers can in many ways be said to constitute a rather closed expert community, composed of individuals with similar training, worldviews, and work practices who interact regularly in formal and informal ways, and a central banker often feel more comfortable in talking to international central bank colleagues than with ordinary citizens (Johnson, 2016; Riles, 2019). Thus, it is important to open the 'black box of bureaucracy' and look at how central bankers are recruited, how they are trained, how they are promoted, and where they go when they leave (Adolph, 2013; Riles, 2019).

The micro-level turn advocated by this dissertation contributes to this scholarship by emphasizing the limits to and effects of expert culture, a decisive environmental feature of central banking that 'allows people to communicate quickly and fluidly about highly complex and technical matters' (Riles, 2019, p. 34). As experts in the field of monetary policy, central bankers carry with them a set of unspoken preferences, and this influences who is included and excluded in the conversation. I have for instance analyzed the types of expertise and backgrounds that central banks have prioritized in their work with climate-related issues. This has shown how economists have been prioritized over climate scientists and ecological economists, with the consequence that the questions raised, and the models applied have followed a decisively economic rationale that clashes with the urgency of decarbonization.

Finally, consider *legibility*. This concept builds on the work by Scott (1998), which theorizes how states have made nature and social life governable by enacting technical tools and measurements. Consider the introduction of German scientific forestry, where the forest went from being a space for different types of trees, plants, wildlife, and ancient rituals to being

considered as an abstract tree representing a given value according to the volume of lumber and firewood (Scott, 1998, p. 12). I hereby invoke the concept of legibility because the lens through which central banks 'see' climate change affects what is 'thinkable' inside central banks, which ultimately impacts the content of the policies they invoke (Broome & Seabrooke, 2012; Riles, 2019). Central bankers' scope of reasoning and the way they conceive climate change can either act as a constraint or enabler in terms of the scope of policy imagination in envisioning alternatives to their everyday activities (Broome & Seabrooke, 2012, p. 2). In other words, how central banks make climate change legible limits the scope and content of the suggested policies and the extent to which central banks can become repurposed.

As I include this concept of legibility, I adopt an inside-out perspective (Broome & Seabrooke, 2012; Helgadóttir, 2021b) which provides insights in terms of the dialogues and scope of reasoning that takes place within central banks as they seek to make climate change legible. This is a process that Scott (1998, p. 23) describes as administrative manipulation, which involves abstractions and simplification guided by state agents' objectives to implement measures to increase the collection of taxes, revenue income from timber, or a framework for quantifying climate-related risks. However, no administrative system can represent any social community or natural phenomenon in full, and the administrative manipulation will therefore narrow the scope of reasoning and what is 'thinkable' which will create blind spots in the way of understanding the given issue. Thus, the apparent efficiency benefits from the standardization process will only lead to new problems (Broome & Seabrooke, 2012). In the second paper, I take this inside-out perspective as I seek to uncover central bankers' scope of reasoning in their work with climate change. Central bankers look at climate change as an economic issue following a particular economic logic of reasoning based on neoclassical economics, where the types of questions asked pertain to issues around risk, taxation, growth, and efficiency. Or, from the perspective of the very climate science central banks subscribe to, these foci ultimately narrow down the scope of reasoning and envisioning of alternative central banking approaches to the challenges posed by the climate crisis as presented by climate scientists.

One caveat here is that it can be difficult to separate practice, expertise, and legibility, especially because the former two often feed into the latter. As Broome and Seabrooke (2012) note, the attempt to make something 'legible', in this case, climate change, often happens by implementing systems of measurement and standards, or in other words practices. One could therefore argue that the three factors should not be seen as equals, but that practices and

expertise feed into legibility. My aim is not to contest this argument, but to highlight that each of these serves its own analytical purpose.

I have presented the micro-level analytical framework that I use in this dissertation to understand central bankers and their way of thinking about climate change. I have argued that the dominant approach in IPE explores institutional, structural, or ideational perspectives, but that we need to explore a different set of factors to understand not the central *banks* but the central *bankers* and how their underlying worldview and way of thinking influence their work with climate change. To do so, this dissertation calls for a micro-level turn in studying central bankers and sets out to examine three factors: practices, expertise, and legibility. The next chapter will show how, as it outlines the methodological starting point of this dissertation and the methods used.

## 4. Methodology and methods

The aim of this dissertation is to enhance the understanding of why central banks started to work with climate-related issues, and how they have done so. This chapter sets out the research design of this study. I begin by outlining the methodological point of departure followed by a presentation of the methods used to answer the research question. These methods include interviews, analysis of relevant documents and participant observation at webinars where key actors are present. Finally, I discuss the scope and limitations of this study.

#### 4.1 Methodological considerations

I follow a qualitative and context-dependent methodological approach based on the logic of abductive reasoning. Hence, the overall aim is not to identify a verifiable truth, but to instead produce sufficient input so as to construct an ongoing social dialogue (Flyvbjerg, 2001). Implicit in this approach is that the aim of this research project is one of *erklären*, which is to explain action through exogenous causal factors. Rather the purpose is one of *verstehen*, i.e., to understand the subjective experience of the actors involved in this study, which in this case is central bankers, and how they have incorporated climate change into their everyday work (Flyvbjerg, 2001; Welch et al., 2011). My emphasis on *verstehen* implies the research has largely been driven by what I viewed as puzzling empirical observations, i.e., observations that simply differed from what I had expected (Flyvbjerg, 2001; Reichertz, 2014). As noted by Reichertz (2017), research does not begin with theories that we wish to test, but with an observation of a phenomenon that is significantly different from what we had expected. In that sense, the data gathered has become a 'critical dialogue partner' (Alvesson & Kärreman, 2007, p. 1266) that I deploy to question the dominant understanding of the given issue and encourage problematization.

Following Flyvbjerg (2001), I employ a *phronetic* approach to research, the aim of which is to conduct a reflexive analysis of values and interests, and elucidate significant political, economic, and cultural developments. In this sense, science is not a purely logical process that seeks to construct explanatory and predictive theories. Rather, science is a social practice with which we explore a particular part of the world systematically (Flyvbjerg, 2001; Packer, 2011). A phronetic line of inquiry instructs the researcher to start by asking 'little questions' and focus on micro-practices, since we often find the big answers within the small questions (Flyvbjerg,

2001, p. 133). This approach means that the analysis often begins with an interest in a particular phenomenon, rather than some abstract, explicit theoretical assumptions. An example from this research is the observation of the initial dominance of the idea of climate stress testing, where I was driven by an interest in understanding the prevalence of this particular policy tool. In other words, a phronetic research approach seeks to clarify and outline how things may be done differently. We social science researchers know there are no ultimate answers to the questions we raise. In taking this phronetic research approach three issues arise: (1) the importance of context, (2) the abductive logic of reasoning, and (3) the process of theorizing.

The first important element of the phronetic perspective is to consider context. We need to acknowledge that context matters. Context matters in the social sciences precisely because we study human behavior, and human behavior cannot be isolated from the context in which it occurs. This also means that in social science, we cannot have an overarching, explanatory, and predictive theory, as context will always have an impact on the phenomenon we seek to study (Flyvbjerg, 2001). However, rather than considering context as a problem, we should think of context as a necessity with which we construct richer, more nuanced explanations of the phenomena we want to understand (Welch et al., 2011). It has therefore been important to create a research design that incorporates the possibility to make contextual descriptions, recognizing that context is essential to understand a given issue. With a contextual emphasis, it is not surprising that case studies are often the preferred method (Flyvbjerg, 2001; Welch et al., 2011). However, I have tried to account for context in different ways. The third paper in this dissertation 'Managing Climate Risks: How Climate Scenarios Entered Central Bank Policymaking' is the only paper that resembles a case study. The paper focuses on the creation of the NGFS scenarios. It thus represents a case of the general approach to modeling climaterelated issues in climate change. Another example of how I seek rich descriptions of the context is my analysis of the field arbitrageurs in the first paper 'The Climate Shift in Central Banking: How Field Arbitrageurs Paved the Way for Climate Stress Testing'. Here I seek to contextualize the early developments of central banks' engagement with climate-related issues in 2014-2015 in a post-financial crisis context.

The second issue of the phronetic approach has been to pursue a strategy of abductive reasoning. The logic of abductive reasoning lays out the interplay between theory and method, oscillating between what we observe at the empirical level and how this can be explained theoretically. Similar to the inductive approach, abduction takes its starting point from empirical observations, but it then seeks to construct a probable explanation against the background of extant knowledge (Giese & Schnapp, 2021). Thus, from an abductive perspective, good research requires observation *and* reasoning (Reichertz, 2014). The logic of abduction starts with an unexpected observation or a problem. The researcher then works backwards to come up with a plausible explanation for the observation, then constructing a theory. Abduction is thereby a continuous process that takes place throughout the research project, and theorizing is the result of thought trails and approximations. The abduction approach is summarized by van Maanen et al. (2007, p. 1148):

Moving back and forth from data-based theorizing to intuition resting on experience, habits of mind, and research context plays an important role in generating interesting theory, as does absorbing what one can of the scholarly literature in the field and working through conjectures without being tethered to data.

Throughout the work on this research project, this interplay between empirical observations and existing scholarly work on the conduct of central banking provides a driver to advance our understanding of how central banks have approached the field of climate change. Combining empirical observations with scholarly studies has enabled a problem-driven research agenda that can identify overlooked issues and fill gaps in the literature (van Maanen et al., 2007).

The third element in my methodological approach is the process of theorizing. I do not seek to develop a predictive and explanatory theory. This is because human activity cannot be reduced to a set of rules, and without rules, there is no theory (Flyvbjerg, 2001, p. 46). Instead, I suggest a set of *probable* explanations that can help us to understand how and why central banks have chosen to follow a market-based approach to climate change instead of other possible alternatives. My aim here is to 'suggest plausible connections and relationships that have not yet been glimpsed' (van Maanen et al., 2007, p. 1148). Theorizing is thus an ongoing process (Weick, 1995) that does not seek to validate knowledge or present theory in an acclaimed final form. I instead invoke a 'logic of discovery', that unfolds over time traveling back and forth between theorizing and data (Swedberg, 2016; van Maanen et al., 2007).

Following these methodological reflections, I have sought to present a research design that enables a qualitative and context-dependent research approach. The two main research question (How can we understand central banks' approach to climate change and to what extent has central banks' role been repurposed in the face of a looming climate crisis?) reflect the emphasis on understanding the underlying context and processes behind the central banks' approach. As I set out to answer these research questions, I have made use of a set of qualitative methods that include interviews, analysis of documents and other written sources, and participant observation at webinars. When I first started this research project, I had a certain degree of knowledge about central banks, having studied this organization at during my undergraduate and graduate studies, but I had little knowledge about issues green finance, climate change, and climate modeling as they applied to central banking operations. An important first step, therefore, was to read up on this field and use these empirical observations as an 'anchor' (Alvesson & Kärreman, 2007) for further exploration in terms of problematization, theorizing, and collection of further empirical material.

While the three papers in Part II of this dissertation are independent presentations of data and analysis, each with their own purpose, the papers, taken together contribute to a fuller understanding of central bankers' approach to climate change. The first paper, 'The Climate Shift in Central Banking: How Field Arbitrageurs Paved the Way for Climate Stress Testing' is a diachronic analysis that seeks to map out how and why central banks came to incorporate climate change into their work, with a focus on the relevant actors and contexts. The second paper 'Seeing Climate Change Like a Central Banker' takes a more endemic approach; here the emphasis is on how central bankers understand climate change, and how they see themselves incorporating climate change into their institutional context. Finally, the third paper 'Managing Climate Risks: How Climate Scenarios Entered Central Bank Policymaking' presents a more case-oriented approach, where I focus on the creation of the NGFS scenarios to understand how climate change has been incorporated into one specific feature of central banking, namely the modeling framework.

#### 4.2 Methods

Central banks are notoriously secretive in their operations. This makes them difficult objects to study. As has been noted by other scholars studying central banks, the ideal scenario would be to access deliberations of Governing Council meetings. However, these are confidential, and are released with decades of delay. Deliberations from the ECB Governing Council meetings, for example, are released after 30 years (Braun et al., 2022). Even when we as researchers interview central bankers, we cannot count on receiving forthcoming and open-minded points of view. As Adolph (2013, p. 18) notes, agents working in independent institutions such as central banks 'are especially likely to attribute their decisions to impartial wisdom and expertise, as these

claims are often essential to protecting that independence', which means a researcher cannot rely only on interviews. In an attempt to overcome these obstacles, I employ three different qualitative methods: interviews, collection of documents and written sources, and participant observation. This set of methods has been widely used in previous scholarly work on central banking (see for instance Birk & Thiemann, 2020; Braun, 2018; Harmon, 2019; Johnson, 2016; Lombardi & Moschella, 2016), including the few studies of green central banking and sustainable finance (Deyris, 2023; Siderius, 2022; Taylor, 2022). Hence, I follow a long tradition of applying a set of qualitative methods to study the phenomenon of central banking.

#### 4.2.1 Interviews

Qualitative semi-structured interviews constitute the bulk of the primary data that I have collected for the papers in this dissertation. I am far from the first one to use interviews to study central bankers and financial policymaking (see for instance Braun, 2018; Johnson, 2016; Thiemann, 2018; Tsingou, 2015). An example is the work of Johnson (2016) and her seminal work on central bankers in the postcommunist countries, to show how central bankers were crucial in transforming these countries from command economies to market economies. She based her work on an extensive set of interviews with central bankers, policymakers and finance professionals to examine how Western central bankers integrated postcommunist central bankers into their network to shape their way of thinking about the role of central banks in a market economy and how to use monetary policy tools. Thus, interviews as a method is particularly useful to understand how central bankers work and think.

Interviewing has been important in this study as well because it provides the best window to the central bankers' way of thinking about climate change. I ended up conducting a total of 28 interviews, 15 of which were with central bankers, and an additional 13 interviews with external actors working in the financial or climate sector: academics and professionals working in think tanks, a group of 'field arbitrageurs' (see paper 1), and a group of climate modelers (see paper 3). It was important to me to not just limit my interviewees to central bankers, but to also gain insights from external experts in the field in case I had overlooked significant issues. Three aspects that have been important to consider in the conduct of the interviews have been: (1) the role of the researcher in conducting interviews, (2) the selection of interviewees, and (3) the specific issues of conducting interviews with elites and experts.

The first factor of importance in conducting the qualitative interview is the role of the researcher. The positivist approach to interviews sees the interview situation as a way to extract knowledge, and to obtain further insight about the topic at hand by hearing the views of key informants, just as the conventional survey interview seeks to uncover voting patterns or consumer trends. In the qualitative research interview, the researcher is an active co-producer of knowledge, in the sense that the interview takes the form of a conversation with a particular purpose and structure (Kvale & Brinkmann, 2008; Marta, 2021; Packer, 2011). The conversational nature of the qualitative research interview allows the researcher a high degree of flexibility. Even though there is an overall structure, the researcher can phrase the questions the way she sees fit for the individual interviewee, ask the interviewee to elaborate responses where necessary, and follow the flow of the conversation if she suddenly obtains new knowledge or insights during the course of the interview (Packer, 2011). The conversational flow of the qualitative research analysis is well-suited for expert interviews (see below) because expert interviewees often like to provide nuance to their responses and explain in detail their way of reasoning (Aberbach & Rockman, 2002) to the point where they will instruct the researcher how to conduct their research.

A second issue regarding interviewing is that of selecting whom to interview. I sought out those interviewees whom I considered the most central actors. Three years ago, when I began this project, there were only a handful of people within the individual central banks who worked with climate change (today there are many more). Hence, I needed to 'catch' members of this small group of people, reflecting a strategy of critical case sampling. This strategic sampling was then combined with snowball sampling, where I made sure to reach out to new interviewees suggested by other participants (Flick, 2023). Interviewees were thus selected if they had given presentations or speeches on the topic of banking/climate change, and/or figured as (co)authors of relevant reports. This strategy of purposive sampling through critical cases may, however, have led to a bias, as it implies that I have tended to talked to those people who have been the most vocal about this issue (Goldstein, 2002). Nevertheless, interviewing these engaged with the problem of how central banks can work with climate-related issues.

The third factor relevant to my interviewing data is the problem of interviewing elites or experts. Interviews with experts have served the purpose of obtaining 'interpretive knowledge', i.e., understanding the experts' subjective orientation (Bogner & Menz, 2009) about how they as

central bankers, or how they observed central bankers', work with climate-related issues. Expert and elite interviews exhibit a unique type of power dynamics and barriers in terms of access and deference to authority. In terms of power dynamics, the expert interviewee is in a more powerful position than the interviewer (Odendahl & Shaw, 2014). As a female Ph.D. student in my late 20s, I talked to people who were highly educated, more experienced than me in working in this field, often a lot older than me, and the majority of the interviewees were men. Despite my age, gender, and social status, I felt that I was taken seriously, but I also made sure to wear business clothes (shirt and jacket), learn the technical jargon (which I could acquire through participant observation, see below), and I sought to be extremely well prepared in terms of questions and background, all of which helped me to establish a clearer degree of control over the interview situation (Odendahl & Shaw, 2014).

The first problem when interviewing experts is, of course, to get the interview. Experts are people with a busy schedule, they say 'No' to interviews or other requests all the time. Hence, I had to convince them, or their personal assistant for that matter, that they would derive some kind of benefit by discussing the issue of banks and climate change with a Danish Ph.D. student. (Aberbach & Rockman, 2002; Beyers et al., 2014; Goldstein, 2002; Littig, 2009). In a majority of my requests for interviews, I was successful. Nevertheless, the task required persistence, a sense of creativity, and overcoming several rejections. In a few instances, I also had to accept that it was difficult to obtain the ideal format of the interview, where some interviews lasted only 20 minutes. The most challenging interview, however, was with an interviewee who was sitting in a taxi in between meetings, giving directions to the taxi driver and paying during the interview, while running off to the next meeting. However, I also encountered many positive experiences where the interviewee got caught up in our conversation and the interview lasting longer than the planned 45-60 minutes.

#### 4.2.2 Documents, reports, and other written sources

Aside from interviews and participant observation, my research utilized a range of documents, reports, and other written sources. Without access to minutes of policy meetings it is a difficult task for us as researchers to assert how policy choices have been derived in meetings. However, we can use a range of different documents such as official documents, articles from the financial press and speeches to get an understanding of the turn of events and to triangulate information across different sets of sources (Lombardi & Moschella, 2016).

The documents are a vehicle for understanding codified social and organizational practices (Coffey, 2014). They are not just 'text containers', as Jacobsson (2022) notes. Documents are closely related to organizational life and interaction, as they contain instructions, recommendations, and explanations for people to follow (whether these documents are followed or ignored, of course, is another question). For many organizations, there has been an increasing trend of creating and publishing documents. This tendency has led social scientists to be more active in their use of documents in their research (Jacobsson, 2022). Central banks are no exception. The 'scientization' trend across central banks has led to an increasing number of reports and working papers emanating from the central banks' research departments (Marcussen, 2009). This is important for social science researchers because it is these types of documents that function as 'artifacts of modern knowledge practices' (Riles, 2006).

Together with participant observation (see below), documents have been an important gateway to understanding how climate change issues affect central banks. When I first started on this research project, I had little prior knowledge about the field as such, and perusing various documents became an important way for me to gain an overview of the field and form an initial line of inquiry in line with the abductive reasoning. Thus, I spent the first couple of months of my project just reading through various reports, working papers, and speeches so as to better understand how central banks approached climate change work. Because of their more permanent character (Jacobsson, 2022), it was valuable to follow developments in the field through the documents, both across central banks more generally, from the very first documents coming from BoE and BdF in 2015-2016, to the more recent publications published by other actors. In addition, it has also been possible to observe trends within an organization such as the NGFS, where the documents functioned as a channel for understanding changes within the lifespan of the organization.

#### 4.2.3 Participant observation

Participant observation enabled me to follow and observe the debates between central bankers and academic experts firsthand. Participant observation allows for real-time observations, such that one can observe 'discourses, practices, interactions, and context together rather than separately' (Olsson, 2021, p. 189). From participant observation, the researcher immerses herself in the social context, enhancing understanding of the field 'from within'. In this sense, you 'dive headlong into the field' (Flick, 2023, p. 303). You observe the meaning and

interaction from the perspective of the people who are insiders to the particular setting or situation. Participant observation enables the researcher to escape from the carefully crafted documents that we are reading and instead, observe the underlying dynamics, disagreements, and compromises that are so often hidden in the finished document (Olsson, 2021).

In this research project, I have used exploratory participant observation. As Taylor (2022) notes, participation at conferences and roundtables at sustainable finance seminars, proved to be a useful way to inform the research. Hence, I sought to get an overview of the field, understand the debate between the different actors in the field (central bankers, financial supervisors, academic experts, finance NGOs), and identify relevant questions (Olsson, 2021). My exploration consisted of participating in events where green finance, climate change, and central banks were the main topic. This provided me not only with an overview of the field but also gave me a chance to immerse myself in the language and technical jargon, to identify the key actors in the field with whom I might approach for an interview, and provided me with the kind of inside knowledge that was crucial for constructing my interview questions. I found the relevant events by signing up for newsletters from relevant institutions (e.g. BIS, FSB, NGFS) and following key actors and institutions on Twitter (e.g. the head of the NGFS secretariat or the ECB climate change center, ECB, BdF, and BoE).

Due to the pandemic, the events I attended were primarily webinars. Thus, the participant observation conducted for this research project is closer to 'virtual ethnography' (Hine, 2020) than participant observation at conferences in the more traditional sense. I attended public events and, in this sense, I was like any other member of the audience. My participation is thus a more covert type of observation (Flick, 2023). This speaks to one of the issues related to virtual ethnography, which is the ethical issue of how to make participants aware of the presence of the researcher (Hine, 2020). While I have not explicitly informed about the purpose of my attendance at the webinars, I have registered my institutional affiliation as a researcher, and I form conclusions about overall trends in the field from my participation in these events, I have not included quotes that can be ascribed to the presenters or members of the audience at the webinars. Another issue related to virtual ethnography is the extent of active participation (Hine, 2020). In the online format, you cannot rely on the informal interactions in the hallways, and directly reach out to actors whom I might have found relevant to interview. However, I made sure to make myself visible by asking a question during the Q&A session, in the hope that when

I reached out after the webinar, the person would remember my name and/or institutional affiliation.

#### **4.3 Scope of the research and limitations**

One of the most important limitations of this dissertation is that the central banks that I have examined in this dissertation are mostly European central banks, namely the European Central Bank (ECB), the Bank of England (BoE), the Banque de France (BdF), and De Nederlandsche Bank (DNB). In this sense, the dissertation is Euro-oriented, though not necessarily Eurocentric. The choice of these major European central banks, however, was grounded in the fact that they have all been frontrunners in terms of the climate change agenda. BoE was the first central bank to publicly address climate change as an issue relevant to the financial sector. While BdF and DNB were not as vocal about their work on climate-related issues at the outset, they were starting to engage with these issues around the same time as the BoE (see for instance French Treasury et al., 2016; Prudential Regulation Authority, 2015; Siderius, 2022; Thiemann et al., 2022).

It may strike the observant reader that the Federal Reserve is absent from the group of central banks studied here. The Fed, being the central bank of the most important international currency, has been a frequent object of study in the central banking literature. In the case of studying green central banking, however, the Fed has lagged behind, a notable exemption from the Fed's historical dominance in so many other areas of central banking. The Fed has completely disregarded climate change, however. Vice-chair Lael Brainard has given several speeches on the topic, stressing the relevance of climate-related risks to central banks (see for instance Brainard, 2019). The Fed joined the NGFS in December 2020, and discussions about a climate stress test of the US banking system came to the fore in 2021 and 2022 (see for instance Jung et al., 2021). At the same time, discussions around climate change and the possible role of the Fed in investigating climate-related risks have been much more politicized in the US (yet another example that context matters), which is well illustrated by the nomination of Sarah Bloom Raskin as vice-chair for bank supervision, and the subsequent blocking of her nomination by Republicans in the Senate because Bloom Raskin had argued for the relevance of investigating climate-related risks (Wessel, 2022). For these reasons, I have chosen not to include the Fed in my main observations, but as I argue later future research should examine the Fed as a different type of case from the European ones.

It is also important to underscore that the focus on these mainly 'climate-engaged' European central banks does not mean that other central banks are resistant or lagging behind. On the contrary, other central banks, especially in Asia, have also been active in working with climate-related issues and taken prominent roles in a range of initiatives, including the NGFS. Central banks and supervisory authorities from China, Singapore, and Hong Kong, for instance, were amongst the founding members of the NGFS (along with BoE, BdF, and DNB). Also, the People's Bank of Chine (PBoC) has been active in promoting a range of different tools, starting with green window guidance as early as 2007, with the goal of actively discouraging lending to carbon-intensive and polluting industries. Since 2018 the PBoC has actively supported the spread of green bonds by accepting them as eligible collateral (Dikau & Volz, 2021b; Macaire & Naef, 2022). In many ways, the PBoC can be considered a policy pioneer in the field of sustainable finance (Larsen, 2022).

Despite these relevant initiatives, I have chosen not to include this group of central banks in my study. There are two reasons: first, these Asian central banks operate within a quite different political economy, especially as regards their independence. The PBoC is a branch of the Chinese government, its policies are determined by the State Council, which entails that the PBoC is actively used to promote the political objectives of the Chinese government. Second, there are important differences in the approach to climate change taken the 'Western' central banks (ECB, BoE, etc.) and the central banks in emerging economies (incl. PBoC). To this latter group of countries, climate change is considered an opportunity to attract new types of finance, for instance through tools such as green bonds. This means that they utilize an entirely different toolbox compared to the 'Western' central banks. I fully acknowledge that the comparative approach to green central banking by central banks in advanced economies versus the emerging economies is an area that needs more research. Important research has already been conducted to better understand the different tools and policy implications of green financing (Dikau & Volz, 2021b; Macaire & Naef, 2022), and to compare these different approaches (Larsen, 2022). However, as I seek to understand how central banks have approached the work and the scope of their reasoning, looking at central banks from different political economies and drawing on a range of different tools is beyond the scope of this paper.

A final, but nevertheless important delimitation of this dissertation, is the scope of the green monetary policy tools I discuss. A reader with some prior knowledge in the field of central banking and climate change may already have observed that I do not include discussions around so-called 'green QE'. There is no fixed definition of green QE, but by green QE I refer to different ways of favoring green assets which can happen by favoring green bonds, changing the collateral framework of QE programs, or 'tilting' the QE programs away from 'dirty' bonds such as bonds from fossil fuel companies (Dafermos et al., 2020; Matikainen et al., 2017; Schoenmaker, 2021). Although discussions around green QE have faded over the course of the last year, because central banks are raising interest rates and slowly phasing out QE in this new inflationary environment, green QE has been at the center of attention in many discussions about the role of central banks in addressing climate change (see for instance Dafermos et al., 2020; Jourdan, 2020; Matikainen et al., 2017; van Lerven et al., 2020).

Even though there have been important discussions around green QE and the 'carbon bias' built into the QE programs, and although important discussions took place amongst central bankers about the concept of 'market neutrality' (Schnabel, 2020), I have chosen not to include the green QE discussion in this study. Instead, I have chosen to focus on those areas where central banks have made the most advances. To understand how central bankers work with climate change, I wanted to study the tools the central banks were using, and the major tool at the time (2020) was that of climate stress testing. Only later on did BoE and ECB engage in what we can call 'green QE', but these developments took place after I was well into my work on this research project. Hence, green QE is not included. Leaving out discussions around green QE and the tilting of asset purchase programs, therefore, was not done because I find these discussions irrelevant. On the contrary, it was because I have prioritized a focus on concrete developments and implementation of tools that were most relevant to my principal research question.

In sum, these methods and the overarching methodology have enabled my qualitative and context-dependent research approach aimed at understanding central bankers and their work with climate-related issues. I have explained here how I make use of a set of qualitative methods (interviews, document analysis, and participant observation) to understand the underlying context and worldview of central bankers in terms of how they think about climate change. Next, Part II of the dissertation presents the individual papers that apply this methodology. The three papers, each with their own purpose, will contribute to a fuller understanding of central bankers' approach to climate change.

## PART II: PAPERS

The Bank of England leaders were coolly unappreciative of her plan. Likely to cause inflation; could expose the central banks to currency-trading pirates; would create exposure to market pressure. Not sure how that could be avoided. When Mary reminded them that they had quantitatively eased trillions of pounds into existence when needed to save the banks, they nodded; their job was to save the banks. To quantitatively ease trillions of pounds into existence to save the world: not their job. That would take legislation. Kim Stanley Robinson (2020, p. 212), The Ministry for the Future *Paper I*. The Climate Shift in Central Banking: How Field Arbitrageurs Paved the Way for Climate Stress Testing

## The Climate Shift in Central Banking: How Field Arbitrageurs Paved the Way for Climate Stress Testing

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#### Abstract:

Concerns over climate-related issues have in a few years gone from the fringes of the financial sector to mainstream discussions in the boardrooms of central banks. How did we get here? Building on expert interviews, document analysis, and participant observation, this paper argues that think-tank-based 'field arbitrageurs' boasting financial sector careers and climate science expertise strategically advanced a risk-based frame dubbed the 'carbon bubble' through which they engaged central banks on climate-related issues. The frame went from the field arbitrageurs via civil servants with access to the corridors of decision-making power and then into the central banks. Thus, climate-related issues came to be understood as a financial risk issue which led to the idea of the conduct of climate stress testing. The article contributes to the study of the political economy of central banks, showing that the 'climate shift' was driven by actors outside the immediate remits of the central banking community in ways that highlighted an underexplored form of 'infrastructural entanglement' between finance, the state bureaucracy, and central banks.

Keywords: central banks; climate change; field arbitrageurs; financial governance; central bank mandate; linked ecologies 'Central banks' commitment to the climate cause may seem obvious today. But few issues have seen such rapid and massive change. My generation changed its mind, I changed my mind.' (Governor of Banque de France, Francois Villeroy de Galhau, 2021).

#### 1. Introduction

Few areas have seen such swift change as the entry of climate-related issues into the central banking community. In less than a decade, climate-related issues went from the fringes of ESG investor circles to being considered a risk to the financial system on par with other types of financial risks. A new consensus has emerged amongst central banks: climate-related risks can destabilize the financial sector. A testament to this is central bankers' increased focus on the conduct of climate stress testing (CST). The Dutch central bank, De Nederlandsche Bank (DNB), published the first CST conducted by a central bank in 2018 (Vermeulen et al., 2018). Banque de France (BdF) published the first assessment in May 2021 (Banque de France & ACPR, 2021), the European Central Bank (ECB) published results in September 2021 (Alogoskoufis et al., 2021), and the Bank of England (BoE) followed suit in May 2022 and concluded that climate change and the transition '*create risks for households and businesses globally, and so for the financial system*' (Bank of England, 2022). In short, a 'climate shift' has occurred amongst central banks, and this paper will seek to address how and why it became possible.

The climate shift is the latest development in a process of central bank transformation that has been unfurling since the financial crisis, a critical juncture that led central banks to play an increasingly active role in today's political economy (Tooze, 2018). Indeed, with the many tools central banks have in their arsenal today they could be important actors in supporting the green transition (Chenet et al., 2021). Discussions in and around central banks have revolved around the applicability of tools ranging from the greening of asset purchase programs and collateral frameworks to the conduct of CST as suggested by the latest strategy review from the ECB and the BoE's mandate to support the transition to net zero. Nevertheless, these reflections frame the climate crisis as a risk issue. It is argued this is a highly problematic frame because it narrows down the options of central bank interventions to market-based approaches: enhanced disclosure and greater transparency (Christophers, 2017; Langley & Morris, 2020). This leaves the question of why and how the idea of climate change as a form of systemic risk went mainstream

in central bank boardrooms.

The main argument is that the climate shift in central banks has been driven by 'field arbitrageurs', a group of private finance professionals with a green bent based in think tanks, in alliance with sympathetic civil servants based in the ministries of environment and finance of three European countries: the UK, France, and the Netherlands. To get the attention of central banks, these field arbitrageurs strategically framed climate change as a threat to financial stability through the frame of a 'carbon bubble'. The carbon bubble refers to fossil fuel companies, unable to extract fossil fuels because of limits to the level of emissions, even though these are already factored into the company valuation, which can lead to an overvaluation and indebtedness of fossil fuel companies (Carbon Tracker, 2011). This diagnosis leads to a focus on narrow financial stability issues rather than a frame of 'financing green' that advocates ways to more directly finance and subsidize green investments (Langley & Morris, 2020). The choice of the carbon bubble frame is important. In the post-crisis context, this framing aligned with the focus on financial stability and thereby 'locked in' the 'business as usual' mode, thus reinforcing the policy trajectory left behind by the financial crisis. However, this framing of the dilemmas intrinsic to the process of decarbonizing finance came at a high cost: it had de-limiting and depoliticizing consequences and it narrowed down the spectrum of possible central bank policy responses to CST (Langley & Morris, 2020).

This article makes two main contributions. First, a theoretical contribution as it advances the novel concept of 'field arbitrageurs'. Its distinctiveness consists in highlighting the agency in driving forward a particular framing *across* very different rather than linked professional fields, which, in turn, affects the way policymakers perceive the given problem, and thereby the solutions put forward (Hasselbalch, 2019; Özgöde, 2021). While previous IPE work on professionals looks at related professions (academic macroeconomists and macroeconomic practitioners for example), the 'field arbitrageur' concept explains how professionals work to enact knowledge that spans across extremely different, indeed previously unlinked fields of knowledge, such as financial economics and climate science, with the strategic goal to influence policymakers. In the case at hand, working at the intersection of finance and climate enabled field arbitrageurs to generate the 'carbon bubble' frame to bridge climate-related threats to concerns related to financial stability. Thus, the core concept of the paper speaks to the recently identified blind spot in IPE as it highlights the importance of looking at the agency of those who

work and conduct the activity of these organizations rather than at the agency of the organization itself (Broome & Seabrooke, 2021). The concept also contributes to debates in IPE on how to understand professionals' way of influencing policymakers in an age of anthropogenic climate change (Paterson, 2020).

The second contribution is empirical. In the broader literature on central banks and climate change, there is a tendency to consider Mark Carney's now famous speech from 2015 *Breaking the tragedy of the horizon* as the event that kickstarted this debate (Baer et al., 2021; Bolton et al., 2020; Chenet et al., 2021). However, '*ideas do not come with an instruction sheet*' (Blyth, 2002), and this paper attempts to uncover what happened in the early years of central bank involvement, well before Carney's now famous pitch. Indeed, this is an attempt to contribute to the emerging literature that seeks to uncover the intellectual 'prehistory' of the governance regime around green finance in central banks (Langley & Morris, 2020; Siderius, 2022; van 't Klooster, 2022). While this literature emphasizes the demand side of a group of central bankers seeking ways to define their roles in an age of anthropogenic climate change, this paper shows how the field arbitrageurs strategically advocated a risk-based framing that aligned with the strategic objectives of central banks.

The argument being advanced herein matters for how we think about how new issues enter central banks. Whereas Baker (2013) has shown that the macroprudential shift was driven by an inner circle of macroprudential 'cognoscenti' at the BIS, the climate shift has been driven by an advocacy coalition of actors outside the immediate remits of the central banking community, namely 'field arbitrageurs' in think tanks specialized in green finance and domestic elite civil servants in the ministries of environment and finance. As such, this is an underexplored form of 'infrastructural entanglement' (Braun et al., 2021) where field arbitrageurs strategically advanced the risk-based carbon bubble frame to engage central banks in climate-related issues. Specifically, they calculated central banks could not overlook a potential new source of systemic risk.

The remainder of this article is organized as follows. The next section presents the concept of 'field arbitrageur'. The ensuing section introduces methods and data. Section four outlines how the post-financial crisis context enabled a discussion about central bank mandates. Fifth, international climate agreements enabled the emergence of the carbon bubble frame. The sixth section shows how field arbitrageurs strategically advanced this frame. Section seven analyzes

the role of civil servants in the Ministries of Environment and Finance. Section eight demonstrates how the carbon bubble has led to a focus on climate change as a risk issue. The final section concludes.

#### 2. Field arbitrageurs as finance professionals with a green bent

In seeking to understand how central banks started to work with climate-related issues and why their approach was narrowed down to one of climate stress testing this paper introduces the concept of 'field arbitrageurs' as professionals working at the intersection of different fields such as climate science and finance. In this case, working across two very different fields of knowledge enables the field arbitrageur to address climate-related issues by invoking a particular frame that made sense to finance professionals, including central bankers. In turn, the acceptance of this frame proved decisive for how policymakers came to understand the linkages between finance and the climate crisis and what policy solutions could be deployed to address those linkages (Hasselbalch, 2019). An example of a field arbitrageur is a former NGO policy advisor on energy and finance, turned sustainability consultant within one of the 'big four' accounting companies, who thereby possesses knowledge of climate-related issues, and is also able to speak to finance professionals. Indeed, in an age of anthropogenic climate change which calls for an economy-wide green transition (Paterson, 2020), it becomes increasingly important to understand how professionals, with characteristics that enable them to straddle various relevant silos, may capture the attention of policymakers through strategic framing.

The concept of field arbitrage is inspired by the linked ecologies literature and more specifically the concept of epistemic arbitrage introduced by Seabrooke (2014). Epistemic arbitrage explains how transnational professionals can enact their professional knowledge and mediate between knowledge pools to their strategic advantage. There is an emphasis on 'knowledge' for the epistemic arbitra as they make use of knowledge gained throughout their career (Seabrooke, 2014). An example is Thistlethwaite's (2017) work on professionals behind private governance initiatives for green accounting frameworks who sought to establish issue control over non-financial disclosure. They acted as epistemic arbiters by creating an alternative professional logic to invoke a new form of expertise within ESG reporting. However, since ESG existed as a field of its own, this tells us little about what happens in the case where professionals need to navigate across completely different fields such as climate science and finance.

While the linked ecologies literature investigates how professionals from different yet related disciplines work within the same issue area, such as academic microfinance economists and microfinance practitioners, its proponents do not tackle the case of professionals who work across different and *un*related fields. Seabrooke and Tsingou's (2016) research on demographic change and low fertility found overlapping work between economists and demographers whereas interactions between economists and medical experts were limited. Similarly, Stone (2013) looks at work within related fields and shows how collaborations with external knowledge networks at the World Bank were more likely to happen in cases '*of comparable status, academic standing, and... similar experience of international development*' (Stone, 2013, p. 258). Likewise, Thistlethwaite's (2017) work on green accounting starts from the assumption of an existing ESG governance framework. Epistemic arbiters could thereby use the existing ESG frame, to create consensus around a green accounting framework (Thistlethwaite, 2017). Field arbiters, in contrast, face a situation where no framing has happened yet. Indeed, framing matters since the content of the frame and the problematizations it presents influence the suggested solutions (Hasselbalch, 2019; Özgöde, 2021).

The introduction of the concept of 'field arbitrage' thereby stresses that it is not any type of knowledge that is readily received. Field arbitrageurs are professionals with a mixed career trajectory who have worked across fields in ways that enable them to translate knowledge that spans across fields by invoking a framing that enacts a new common language within the emerging field (Seabrooke & Tsingou, 2015), in this case, climate macrofinance. The process of invoking a common language is an important first step, as it enables policymakers to understand what is at stake, which then enables them to address the given issue (Best, 2008; Özgöde, 2021). In this case, it is the 'carbon bubble' frame that is used to invoke knowledge from finance and climate professionals. The field arbitrageurs strategically frame this as a financial stability issue, thereby speaking to the ongoing trend of widening the risk imagination in central banks (Morris, 2018).

#### 3. Context, methods, and data

This paper focuses on CST as this is amongst the first policy tools central banks have started to experiment with, where such stress tests have been conducted by DNB, BoE, ECB, and BdF amongst others (for more information on CST see for instance Chenet et al., 2021; Langley &

Morris, 2020). The years 2010-2018 are the focus of this paper. 2010 is when discussions of a carbon budget started to emerge which led to the framing of the carbon bubble, and 2018 is the year when the results of the first CST were published. There have been discussions around alternative tools such as looking at the design of asset purchase programs or collateral frameworks, an example is the ECB's 2021 strategy review, but these have been introduced more recently. Recognizing that some of these initiatives are at an experimental stage and will most likely be carried out in the nearest future, the period 2010-2018 is the most relevant context for understanding how climate change came to be perceived as a potential source of systemic risk. Finally, one caveat is in order. While the carbon bubble frame advocates the urgency of transition risk, it leaves out physical risks, which have also been incorporated into the CST framework. It requires an analysis of its own to see whether the analytical framework holds for physical risks as well.

This paper draws on three strands of data: interview transcripts from semi-structured interviews, documents, and reports on CST as well as participant observation (see appendix 1 for overview). The sample of documents was created with two documents as a starting point: the first published CST by the DNB in 2018 and the first report on climate-related issues from BoE published by PRA in 2015. These were used for snowball sampling to collect other reports and documents on CST and climate-related risks (see appendix 2). An important word of caution here is that citation and/or discussion of the key concepts related to the carbon bubble are considered as a proxy for the influence of these ideas.

The second strand of data builds on interview data with relevant stakeholders. The interviews follow a semi-structured interview technique to set up an overall structure for the interview while allowing for an open discussion with the interviewee (Marta, 2021). The first of round interviews, consisting of four interviews, was conducted in an explorative manner with external stakeholders. 12 interviews (approximately 30-60 minutes each) were then conducted with key stakeholders mainly in central banks and financial think tanks (see appendix 3) from a combination of strategic and snowball sampling. In the process of collecting interviews, two of the field arbitrageurs shared unpublished manuscripts, and these have been used as well. For the strategic sampling, interviewees were contacted because they appeared as (co-)authors to a relevant report, they were speakers at relevant webinars, and/or they were identified as field arbitrageurs. To anonymize the interviews, all interviewees have randomly been assigned a

number between 1 and 12. The type of questions discussed during the interviews concerned how and why they started to conduct or advocate for CST, how they approached this early work on CST, who they considered to be the key actors from the outset and why they were successful in mainstreaming this agenda. Finally, it should be noted that while five of the interviewees are field arbitrageurs who have a strategic interest in highlighting their influence, the claims made in these interviews were tested in the other interviews and by following the principle of triangulation.

### 4. The financial crisis and the expansion of central bank mandates

To understand the effectiveness of the carbon bubble frame, it is important to recall the context which was the beginning of the 2010s just after the financial crisis, when central banks received more financial regulatory powers and there was a reiterated focus on financial stability (Baker, 2013; Thiemann et al., 2020).<sup>2</sup> They went from technocratic institutions with a strict focus on price stability, to institutions that actively intervened in the markets through quantitative easing (QE) and acted as a strategic actor intervening in fiscal policy, most particularly in the Eurozone (Diessner & Lisi, 2019; Gabor & Ban, 2016; Tooze, 2018). In other words, the financial crisis sowed the seeds for a broader discussion of central bank mandates and drastically altered the understanding of the remits of central banks' mandate as going beyond the mandate of price stability, which bred the ground for today's discussion on central banks and their role in addressing climate change (Ban, 2020; Langley & Morris, 2020).

The expansion of central bank mandates to include financial stability (Gabor & Ban, 2016) is important because the financial stability mandate and the ensuing macroprudential regulation represented fundamental shifts in the conduct of central banking. Firstly, it represents a normative shift in central bank governance. The macroprudential approach to financial regulation acknowledges that markets may not be efficient, and thereby challenged efficient market theories from the recognition that what is best for the individual financial institution, may not be so for the collective (Baker, 2013). Secondly, it has repoliticized central banking more generally. Macroprudential policies challenge the independence of central banks because macroprudential policies are more politicized, and this in turn opens the policy space for lobby

<sup>&</sup>lt;sup>2</sup> For the sake of simplicity, I do not make a distinction between the granting of a new mandate of financial stability, or a reiterated focus on financial stability post-crisis.
activities from the financial industry or financial regulatory bodies (Goodhart, 2015; Thiemann et al., 2020). Finally, since the macroprudential mandate was new to central banks, there was no common conception of systemic risk in the central banking community nor a common way to measure it. Indeed, for legitimacy reasons, macroprudential interventions needed to be based on a scientific framework for measuring systemic risk (Goodhart, 2015; Thiemann et al., 2020).

The post-crisis context and the ensuing discussions of the scope of the mandate of central banks matter for understanding the context of the carbon bubble frame. It suggests central banks have been more open to alternative perspectives post-crisis and more susceptible to widening their risk imagination (Morris, 2018). Since central banks acquired a strong mandate for ensuring financial stability, they have also become more open to alternative sources of systemic risk. With the main analogy of the financial crisis as mispricing of financial risk, policymakers have focused on 'getting the risks right' (Interview 4, see also Langley, 2013), as well as 'creating space for a more profound re-evaluation of financial and economic systems, with topics related to systemic risk and the role of finance in society gaining traction' (Unpublished manuscript 2). This allowed for a discussion around possible transmission channels between climate change and the stability of the financial sector.

One might wonder if the exact timing of the climate shift in central banks can just as well be ascribed to the increasing attention around climate change amongst the public and in global governance more broadly. However, policymakers have been aware of climate change for decades, but this awareness has not led to action amongst central banks. Historically, there has been a range of important climate agreements committed to mitigating climate change, such as the Montreal Protocol from 1987 or the Kyoto Protocol signed in 1997. Also, climate scientists have warned of the grave consequences of climate change in IPCC reports and climate scientists warned already in the early 2000s about the 2°C threshold for the rise in temperature (Paterson, 2020).

But how did it happen that post-crisis discussions of systemic risk developed into a discussion of possible climate-related risks to financial stability? To understand this, the next section will take a short detour from financial governance to explore the role of intergovernmental climate agreements as an enabling factor of the transformations in the central banking community.

# 5. International climate agreements paved the way for the carbon bubble frame

International climate agreements, the so-called COP meetings, take place on an annual basis and they have rightly been criticized for their lack of ambition. However, the outcome of the COP16 meeting in 2010, the Cancun Agreement, was crucial for paving the way for the emergence of the 'carbon bubble'. Even though the Paris Agreement played a key role in aligning finance with the climate agenda, the 2°C commitment in the Cancun Agreement enabled discussions around carbon budgets, which in turn led to the notion of the carbon bubble. The carbon bubble frame was introduced by British Carbon Tracker in 2011, where think tanks on the continent, the French 2 Degrees Investment Initiative (2DII), and the Dutch Sustainable Finance Lab jumped on to the idea in 2012 and 2013. Carbon Tracker published its first report on the carbon bubble in 2011, but at this point, there were only vague and distant ideas about CST.

The carbon bubble frame had roots in the technicalities of carbon budgeting forged by the commitments made at the COPs. The Cancun Agreement led the Potsdam Institute for Climate Impact Research (PIK) to work out a global carbon budget for the world to stay below 2°C and found only one-fifth of the world's fossil fuel reserves could be burnt unabated. This showed there was a material link between climate change and the financial sector and alluded to the urgency of investigating this matter further (interview 12). PIK's carbon budget was picked up by Carbon Tracker, which published a report in 2011 under the title "Unburnable Carbon – Are the world's financial markets carrying a carbon bubble?". This report found that if four-fifths of the world's fossil fuels had to remain in the ground, all listed fossil fuel companies would be seriously overvalued leading to the risk of the build-up of a carbon bubble (Carbon Tracker, 2011).

As stated in the report from Carbon Tracker, the 2°C commitment is important because it '...provides a reference point against which global emission scenarios can be compared, to assess whether the world is on track to achieve the two degrees target.' (Carbon Tracker, 2011, p. 6). Carbon Tracker used the 2°C commitment in its work to explicate the link between climate change and finance. The 'carbon bubble' was introduced as a reference to the 2008 'housing bubble' in order to avoid a 'carbon crash': 'In the same way that universal owners held Lehmann Brothers and HBOS to their collapse, asset owners cannot accept that a problem *exists until the carbon asset bubble bursts.* ' (Carbon Tracker, 2011, p. 18). Thus, the frame of the build-up of a carbon bubble was born, along with related concepts such as 'unburnable carbon' and 'stranded assets'. Convinced by the urgency of remaining below the 2°C degrees threshold, the field arbitrageurs in these think tanks set themselves upon the task of pitching the issues to the keepers of keys of the financial system: central banks.

### 6. Field arbitrageurs and the framing of climate change as a risk issue

Following the latest developments in international climate policy, the 'carbon bubble' frame emerged from and was spread by field arbitrageurs in three think tanks: Carbon Tracker, Sustainable Finance Lab, and 2DII. These field arbitrageurs were private financers with a green bent and an interest in turning the financial sector into a force of good in mitigating climate change. The think tanks worked at the intersection of finance and climate-related issues and acted as field arbitrageurs as they exploited their knowledge from across these two fields to advance the agenda of climate change as financial risk.

From 2011 onwards the work took up the pace, and 2DII published its first report in 2012 which suggested supervisory authorities included the effects of climate change into the existing stress testing framework (Dupré & Chenet, 2012). Carbon Tracker published its second report in 2013, which had a policy recommendation to conduct stress tests: '*Regulators responsible for financial stability should stress test reserves levels and production plans against a 2°C emissions scenario.*' (Carbon Tracker, 2013, p. 24). This report gained widespread attention, exemplified by The Guardian writing upon the publishing of the report: '*The world could be heading for a major economic crisis as stock markets inflate an investment bubble in fossil fuels to the tune of trillions of dollars*...' (Carrington 2013). The first attempt to do an actual CST was conducted by Sustainable Finance Lab which tried to give a first careful estimate of the exposure to the carbon bubble in a report published in February 2014 (Weyzig et al., 2014).

As they pushed forward this frame of the carbon bubble the field arbitrageurs actively made use of their professional backgrounds where they had worked at the intersection of climate and finance in various positions as advisors and analysts with an interest in climate-related issues. As one of the interviewed field arbitrageurs explained: I was working on climate change, strategic planning, and sustainability, so I had a pretty good idea of how to decarbonize each sector of the economy... Then I had experience with the financial sector working for banks and trying to analyze the carbon footprint of bank balance sheets, so I understood how it works, and I got this kind of bird's eye view that not a lot of people have... I didn't have any training in financial regulation, I just figured. So, I had kind of an edge which was not big, but enough for me to be able to have a conversation with a top regulator and defend my case since it was a topic they did not spend a lot of time thinking about. (Interview 8)

Thus, the field arbitrageurs utilized their skills and knowledge in climate and finance to start the conversation.

To credibly craft resonating frames one needs to have credibility with the receiver of the message. Experts in organizations such as Carbon Tracker had it. Founded by ESG advisors and analysts with the explicit aim of embedding climate change risks into the mainstream understanding of financial risk, Carbon Tracker had the markers of financial sector prestige, which they used to introduce the 'carbon bubble' frame. The same is true of the 'stranded assets' concept advocated by climate finance analyst Ben Caldecott, another field arbitrageur who worked independently from Carbon Tracker (see table 1). What these people have in common is that they worked at the intersection of climate and finance, as analysts or advisors in different kinds of ESG investment initiatives or through more direct involvement with climate-related issues as consultants or advisors to green organizations. As noted by an interviewee:

In Carbon Tracker you had prominent guys like Mark Campanale, who is the leader, and Mark Fulton was the inside research analyst working on the details. You also have Nick Robins who was behind the scenes, and more the kind of academic guy, like the wise guy. I mean seeing them working back then was like looking at the Marvel Avengers of this topic. (Interview 8)

In addition, Carbon Tracker enjoyed close links to HSBC. Nick Robins, who was the head of the global research team of green finance at HSBC, was involved in some of the early work at Carbon Tracker and coined together the 'carbon bubble' frame with Mark Campanale. At HSBC Robins co-authored two reports along with Paul Spedding, who joined Carbon Tracker in 2013 as research adviser. Already in 2008, they published a report that examined the long-term effects of the implementation of the cost of carbon on the oil industry and followed up with new publications in 2011, 2012, and 2013. The two latter reports analyzed the effects of stranded assets in the coal industry and unburnable carbon – concepts directly related to the carbon bubble frame. These two reports are of particular interest since they have been widely cited in some of the early work on climate-related risks and CST such as the first report on this matter

from ESRB in 2016, and the PRA report from 2015.

Name	Position*	Career skills
		Had previously worked with sustainable
		finance-related work in private finance,
		and co-founded responsible investment
Mark Campanale	Founder of Carbon Tracker	funds.
	Co-founder of Carbon	Former oil- and gas consultant, turned
Jeremy Leggett	Tracker	environmental activist.
		Former WWF senior policy advisor with a
		focus on energy and finance, and
	Co-founder of Carbon	sustainability and climate change
James Leaton	Tracker	consultant at PwC.
		Market strategist at Citigroup, Salomon
		Bros amongst others, previous head of
		research at Deutsche Bank Climate
Mark Fulton	Advisor at Carbon Tracker	Change Advisors.
		Collaborated with Campanale on Carbon
		Tracker's early work. Held various
	Head of climate change	positions on which he worked with
	centre of excellence at	socially responsible investments prior to
Nick Robins	HSBC	HSBC.
		Holds a PhD in economic geography.
		Analyst and advisor in think tanks and
	VP at Climate Change	government bodies focused on policies
Ben Caldecott	Capital	related to energy and the environment.
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\*Position held in the given period of time 2010-2013.

Table 1: Overview of career trajectory of UK field arbitrageurs until 2014

The work that emerged from the collaboration of Carbon Tracker and HSBC was pioneering and important in diffusing the carbon bubble frame. The frame is by no means accidental. The interviewed field arbitrageurs noted the carbon bubble frame was coined together with a focus on risk to strategically sow doubt and fear about the fossil fuel industry as a so-called 'safe asset' to engage financial regulators and institutional investors. The framing was meant to be evocative and create strong visualizations, as well as demonstrate how anything of value could be lost, physical as well as non-physical assets. The frame was successful and got the attention of policymakers, as noted by one of the interviewed central bankers:

I think the work on unburnable carbon and Ben Caldecott's work on stranded assets, some of the work Nick Robins had been doing at HSBC around carbon intensity and the risk of coal financing was basically revealing to us that there was a second channel of risk which relates to the pricing of assets and therefore the need for an orderly transition. (Interview 10)

Another significant aspect is how the two reports from Carbon Tracker gained widespread traction in some of the later work on CST, including the first report on CST by Weyzig et al (2014), the UNEP-FI Inquiry reports, as well as the report that looked solely on CST (Chenet et al., 2015), and again the first work to be published on the matter from the PRA in 2015.

However, the story of Carbon Tracker's introduction of the 'carbon bubble' was not an isolated British one. On the continent, Dutch and French think tanks, boasting a similar profile mobilized in the same fashion at about the same time and using the same frame. There was no explicit coordination of the advocacy work between the three, but as explained by the French and the Dutch field arbitrageurs, they found the carbon bubble frame to be useful. While the British story is one of the linkages between a think tank and private finance, on the continent the story is one of linkages between think tanks, private finance, *and* the state.

In the Netherlands, the carbon bubble frame was advocated by Sustainable Finance Lab, a think tank founded in 2010 to facilitate discussions of post-crisis regulation. Sustainable Finance Lab wanted to move forward with the discussion on financial governance and therefore started to work with sustainability issues in 2013. They immediately saw the relevance of the carbon bubble as they saw it as a way to '*link it to things that were playing in the boardrooms* [of the financial institutions, red.]' (Interview 6). Like the founders of Carbon Tracker, the founders and analysts of Sustainable Finance Lab had worked at the intersection of finance and climate (see table 2). Sustainable Finance Lab arranged workshops and seminars on green finance in close collaboration with the Ministry of Infrastructure and Environment and some of the big Dutch banks. This became an open forum for discussion and knowledge-sharing of the risks stemming from the green transition between finance professionals in the Netherlands, including the DNB, where Sustainable Finance Lab '*brought a certain authority, but on the other hand, provided new thinking as well.*' (Interview 6). In short, the field arbitrage between finance and ecological science was on full display here as well.

Sustainable Finance Lab was also important because it introduced the idea of the carbon bubble at the EU level. First, in a report commissioned by the Greens in the European Parliament in 2013, Sustainable Finance Lab did a first attempt to do a 'carbon stress test' and tried to measure the exposures of the financial system to so-called 'high-carbon assets'. The report was published in February 2014 and linked the carbon bubble frame and the Carbon Tracker report from 2011, with calculations of the stress level it could cause within the financial sector. This

was the first attempt to estimate the exposure to the carbon bubble based on a CST of three different scenarios: 'low-carbon breakthrough', 'uncertain transition', and 'carbon renaissance' (Weyzig et al., 2014).

Name	Position*	Career skills
	Co-founder of Sustainable	Former chairman of the executive board of
	Finance Lab and Professor	Rabobank, former chairman of the Social
	of sustainability and social	and Economic Council and former Dutch
Herman Wijffels	change	Administrator at the World Bank.
		Strong expetise in sustainable banking
		from Triodos Bank is a so-called ethical
		bank with a focus on lending to
	Co-founder of Sustainable	environmental and social projects, as well
	Finance Lab and CEO of	as founder and chair of the Global
Peter Blom	Triodos Bank	Allaince for Banking on Values.
		Advisory positions for the Dutch
		government and UN programmes on
		environmental issues. Member of the
	Co-founder of Sustainable	Social and Economic Council, and chair of
	Finance Lab and Professor in	the Dutch meteorology institute and
Klaas van Egmond	geosciences	advisor to Triodos Bank.
		Economic advisor for the Green Party in
		the Dutch and the European Parliament.
		Worked at the Dutch Advisory Council
		for Science and Technology Policy with
	Director of Sustainable	the financial sector and the possibility of
Rens van Tilburg	Finance Lab	making long-term investments.
		Former deputy Director at the Ministry of
	Analyst at Sustainable	Finance, and former senior analyst at the
	Finance Lab Professor of	Bank of England. Member of Sustainble
	finance, banking and	Finance Lab. Member of the Advisory
Dirk Schoenmaker	insurance	Scientific Committee of the ESRB.
*D	a size manifed aftime 2010 2	012

\*Position held in the given period of time 2010-2013.

Table 2: Overview of career trajectory of Dutch field arbitrageurs until 2014

Second, Sustainable Finance Lab had a connection to one of the important post-crisis oversight boards within the ECB, namely the ESRB. One of the economists connected to Sustainable Finance Lab, Dirk Schoenmaker, was a member of the Advisory Board of the ESRB, and he was one of the co-authors of the first report published by the ESRB in 2016. The report examined the systemic risks related to unburnable carbon and stranded assets in the fossil fuel industry and suggested stress testing the exposures of financial firms '...*under the adverse scenario of a late and sudden transition*.' (ESRB, 2016, p. 2). Like Carbon Tracker, Sustainable Finance Lab had

people involved who had professional backgrounds in finance and climate, and who had worked in the corridors of power in the private financial sector, the Dutch state, or in European institutions. However, the marriage between the carbon bubble idea and the stress testing instrument to address it did not happen until the carbon bubble frame went to France.

In France, the story of the climate shift in central banking begins with a think tank with a field arbitrageur profile: the 2 Degree Investment Initiative (2DII) founded in 2012 (2DII, 2013). The two founders, Stanislas Dupré and Hugues Chenet were experts with complementary skills whom both had worked at the intersection of finance and climate science (see table 3). A similar career trajectory can thus be observed for 2DII as for the other think tanks, though the direct involvement with financial institutions is less pronounced. Where Carbon Tracker and Sustainable Finance Lab had connections to the private financial sector, 2DII had important points of contact with the French state. In particular, the co-authoring of reports for ADEME, Agence de la Transition Écologique,<sup>3</sup> highlights the administrative expertise that characterizes the French system (Fourcade, 2009).

Name	Position*	Career skills		
		Executive director at CSR consultancy;		
		worked on a 'financed emissions'		
		assessment for banks with WWF, ADEME		
		and Friends of the Earth; non-exectuvie		
Stanislas Dupré	Founder of 2DII	director of a green private equity fund.		
		Geo-physicist by training; worked as		
		sustainability expert for finance and		
		management consultancies and co-		
		authored a study for ADEME on the		
		valuation of climate change in financial		
Hugues Chenet	Co-founder 2DII	analysis in 2011.		
*Position held in the given period of time 2010-2013.				

Table 3: Overview of career trajectory of French field arbitrageurs until 2014

To move the debate beyond simple discussions about 'carbon footprint' 2DII sought to advance the debate to more specific topics of climate alignment and the risks involved (interview 12). It was key to understanding the materiality associated with climate change. In a report from 2012, the carbon bubble frame was used as an argument for integrating climate goals into capital requirement frameworks, along with the possibility of coupling short-term effects from climate

<sup>&</sup>lt;sup>3</sup> 2DII had close relations with state agencies in the French bureaucracy including the Ministry of Environment, ADEME, AFD (the French Agency for Development), and Caisse des Dépôts, the investment arm of the French state.

change with existing stress testing frameworks (Dupré & Chenet, 2012).

Indeed, it is here, in this niche of the French field of debate that the carbon bubble became associated with the idea of stress testing and was carved out in a detail. 2DII continued to work on this idea of CST and published a working paper in collaboration with UNEP-FI Inquiry solely on CST in 2015. Here they emphasize challenges to time horizon and scenario building for the conduct of CST (Chenet et al., 2015), challenges that have been repeated by central banks in the first experimental conducts of CST (cf. participant observation).

There was, however, a discussion around alternative policies. But why were these not more widely discussed? The case of green QE may explain why. The idea of green QE was introduced in 2010, when the BoE launched its first QE program, by actors on the political left in the UK such as Colin Hines, convener of the Green New Deal Group, and Caroline Lucas, MP for the Green Party. While the field arbitrageurs were aware that central banks' involvement should not be seen as an additional financing instrument for the green transition (interviews 2 and 3), these green activists considered green QE as a funding mechanism facilitating the move towards a green economy.<sup>4</sup>

When the green QE agenda was picked up and re-launched in 2015 by Positive Money and the New Economics Foundation, this new group of experts tried to reframe the agenda to a matter of financial stability (see for instance Jourdan, 2020; van Lerven & Ryan-Collins, 2017), but without much success. They used green QE as a slogan to start a debate on greening the collateral framework while trying to present it more technically as a matter of climate risk. Yet, back then, green QE did not receive the same kind of positive attention. As noted by an interviewee involved in this work:

I think green QE was terribly misunderstood in the sense that I still wonder whether some central banks purposefully did not understand the point or caricatured it in a way that reduced it to a discussion about only buying green bonds. It was never meant to say just green bonds, it was about to stop buying the dirty stuff and considering shifting the portfolio. (Interview 7)

Even though the advocacy networks tried to establish a discussion on greening collateral frameworks as a climate-related risk issue, it has taken more time for this idea to mature within

<sup>&</sup>lt;sup>4</sup> See news story on the Green's website from October 2011 'Caroline calls for green quantitative easing as Bank of England announces £75BN injection and report by Richard Murphy and Colin Hines for Finance for the Future: 'Green quantitative easing: Paying for the economy we need'.

central banks. While a lot has happened with the QE programs from 2020 onwards, where BoE and ECB now pursue a tilting strategy, a reallocation of capital away from fossilized investment to greener investments remains limited (Dafermos et al., 2022; Kedward et al., 2022).

With field arbitrageurs being successful in phrasing climate change into financial language through the risk-based frame of the carbon bubble, the question is how the carbon bubble made it to the boardrooms of the central banks? It is to this sub-question that the next section turns.

### 7. The carbon bubble in the corridors of state power

The previous sections showed that between 2011 and 2013 the 'carbon bubble' frame became firmly cemented in the bespoke environments of niche think tanks. But making it actionable as a constraining framework the carbon bubble needed to become part of central bank analytical and policy frameworks. The first stop was sympathetic civil servants based at the Ministries of Environment and the Ministries of Finance and the substantive entry point was to invite the technical specification of the use of CST to investigate the exposure to climate-related risks in the financial system. Since stress testing was central bank territory, civil servants started to involve central banks in this work.

In the UK, the Department for Environment, Food, and Rural Affairs (DEFRA) had a key role in involving the BoE with the invitation DEFRA extended to PRA to examine the impact of climate change on the insurance sector. DEFRA had under the 2008 Climate Change Act the mandate to ask organizations to produce reports on the effects of climate change and suggested ways to adapt. PRA (then FSA) declined the invitation to produce a report in the first round of adaptation reports published in 2012. Yet, it was around this time that the field arbitrageurs explicitly started to target BoE. A group of activists, scholars, and private financiers led by Ben Caldecott, including Jeremy Legett at Carbon Tracker, sent an open letter to then-Governor Mervyn King in January 2012. Here they urged King, as head of the Financial Policy Committee to *'investigate how the UK's exposure to high carbon investments might pose a systemic risk to our financial system*'.<sup>5</sup> Two weeks later, King responded and invited the authors to meet Andy Haldane, then Executive Director for Financial Stability. King asked the authors of the open letter to think of three tests to examine if climate-related risks could be systemic:

<sup>&</sup>lt;sup>5</sup> Open letter published in the news outlet Citywire 20 January 2012

First, 'that the exposures of financial institutions to carbon-intensive sectors are large relative to overall assets.' Second, 'that the impact of policy and technology working to reduce returns in high carbon areas is not already being priced into the market, either through lower expected returns or higher risk premia discounting these returns.' Third, 'that any subsequent correction would take place over an insufficiently long period of time for the relevant financial institutions to adjust their portfolios in an orderly manner.' (Unpublished manuscript 2)<sup>6</sup>

Representatives from eight of the institutions behind the open letter participated in the meeting with Haldane, confident they could argue that climate-related risks could pass the first two tests. The answer to the third test hinged on future scenario analysis and stress testing. Despite interest from Haldane, discussions waned off during the Fall of 2012.<sup>7</sup> Even though the efforts from the field arbitrageurs did not lead to any concrete action in 2012, they had made the case that climate-related issues were a potential source of risk, systemic or not, and had started a train of thought within the BoE that climate-related risks were not just a matter of physical risk. As explained by one of the interviewed central bankers, the work on unburnable carbon and stranded assets laid the groundwork for the later definition of transition risk, which in turn increased the relevance of climate-related risks within the BoE:

...into more of a financial stability argument as opposed to a physical risk thing that was more appropriate to insurers... broadening the relevance of this issue to the whole of the central banks mandate and financial stability colleagues as well as just to the needs of insurance supervision. (Interview 10)

By the time the second invitation was received by PRA in April 2013 things had started to change inside the BoE, and PRA chose to accept the invitation. A few people in the FSA (later PRA) had started to study how climate change could affect the business models of the supervised entities. However, the invitation was key as it legitimized the experimental work that had already happened and provided the PRA with a formal mandate to begin more explorative conversations, beyond the existing and very narrow focus on business models (interview 10). The invitation from DEFRA arrived at the same time as Carney started his position as governor within the BoE in July 2013. Interviews suggest that the expectation within the BoE at the time was that Carney had a personal interest since his wife was known for her involvement in environmental issues. He was therefore expected to be more susceptible to explore this issue further than his predecessor.<sup>8</sup> In parallel, during the summer of 2014 discussions emerged

<sup>&</sup>lt;sup>6</sup> The same story was outlined in interview 11 as well

<sup>&</sup>lt;sup>7</sup> Interview 11 and unpublished manuscript 2

<sup>&</sup>lt;sup>8</sup> Cf. Interviews 1, 2, 3, 12

between the Parliament and the BoE on assessing and mitigating possible risks from climate change.<sup>9</sup> As one of the interviewed central bankers explained:

You know it's almost like these programs when the sorts of conditions you need for life to start on planet Earth. You need water, you need oxygen, you need all these different things. I think we were just fortunate in the UK at the time that we had a climate change act that was asking us to do things [the DEFRA invitation, red.], we had people internally in the Bank who were excited and making the case for bringing this forward, and then we had a set of research articles and external stakeholders that were able to provide the evidence that could then be translated into a language that led to prudential risk and the kind of forward-looking judgement based supervision approach. (Interview 10)

The coming together of all these different factors appears to result in a change in attitude to climate change as a potential source of risk over the fall of 2014. Carney recognized at an event at the World Bank in October 2014 that a '*vast majority of reserves are unburnable*' (the term 'unburnable' stemmed from Carbon Tracker) and called for investors to consider the long-term impacts of their investments (Shankleman, 2014). PRA accepted DEFRA's second invitation and invited Ben Caldecott along with a few other academics, mostly from 'Oxbridge', to contribute with their expertise (Unpublished manuscript 2). In the report published in September 2015, they suggested exploring stress testing as a tool to convey climate-related risks within PRA but also at the individual company level. The report concluded that climate risks hold the potential to have a substantial impact, which cemented the importance of future work in this field (Prudential Regulation Authority, 2015).

The turn of events in the Netherlands involved the Ministry of Finance and the Ministry for Infrastructure and the Environment in addition to the Sustainable Finance Lab. In May 2014 the Minister of Finance asked for an investigation from the DNB into the carbon bubble, and the DNB concluded in August 2014 that there was '*no excessive credit risk to the Dutch financial sectors from the oil, gas or coal sectors*' (Siderius, 2022, p. 9). In Spring 2015 the Ministry for Infrastructure and the Environment set to further this discussion,<sup>10</sup> and in the same year, the Green Party asked the Minister of Finance to have the DNB investigate the financial risks from climate change with a focus on the transition (see Siderius, 2022 for a more elaborate account).

This contributed to a change of sentiment within the DNB, and DNB became an active part in outlining the response from the Netherlands to UNEP-FI's Inquiry report, with participation at

<sup>&</sup>lt;sup>9</sup> Interview 1, see also letter sent from Mark Carney to MP Joan Walley, Chair of the Environmental Audit Committee 30 October 2014.

<sup>&</sup>lt;sup>10</sup> Interview 6, this is confirmed in the "Input from the Netherlands to the UNEP Inquiry Report", June 2015

the highest level with President Klaas Knot and executive board member Frank Elderson. Knot and Elderson called for further research into the carbon bubble, and as Elderson stated in a speech at the UNEP-FI event in November 2015: 'Sustainability becomes a distinct factor in how we fulfill our mandate and our dual role as central bank and financial regulator.' (Elderson, 2015). The carbon bubble frame had now carved its way into the DNB. Thus, as DNB published a study in March 2016 'Time for transition' on the transition to a carbon-neutral economy it dedicated a chapter to discussing the financial risks from the carbon bubble (Schotten et al., 2016), and Knot went to the Dutch Parliament to give an account of the carbon bubble (Siderius, 2022) which underlined DNB's attentiveness to this agenda.

France followed a similar path, but again with a twist: the collaboration on climate-related issues started to take place in 2011-2012, between the Ministry of Environment and the Ministry of Finance. Their work was published in a report in the summer of 2014, and it inspired a thorough discussion of climate change as a risk to the financial sector in the Ministry of Finance. As explained by one of the interviewees involved in this work, they concluded that there were risks related to climate change and found the work of Carbon Tracker to be a source of inspiration:

We had a lot of contact with people in the NGO community. Contact doesn't mean that it's always good contacts, but we actually found some reports to be quite good. For example, the work of Carbon Tracker was clearly an inspiration. (Interview 1)

The Ministry of Finance explored the matter further and pursued the risk agenda internationally and domestically in the spring of 2015; partly because they appeared convinced of the severity of the risks stemming from climate change, and partly because of COP21, where the French Minister of Finance, Michel Sapin, wanted to start a discussion regarding the financial sector and climate-related issues. To this end, Sapin asked the Ministry to explore how the work on climate risks could be turned into domestic law. In March 2015 the Ministry of Finance started to work on an amendment to the Climate and Transition Law under negotiation in the French National Assembly. This process enjoyed support from financial institutions who 'were often inspired and supported by French think-tanks such as 2DII and the Institute for Climate Economics' (Unpublished manuscript 1).

The Climate and Transition Law were adopted by the National Assembly in late July 2015 and Article 173 implemented mandatory climate disclosure and mandated BdF and ACPR (the French supervisory body) to analyze possible avenues for conducting CST (Chenet et al., 2015;

Directorate General of the Treasury et al., 2016). After COP21 and with the adaption of Article 173 the civil servants in the Ministry of Finance decided to involve BdF:

So we started to work on it in January 2016, and at that time we decided that it was the right place and occasion to get BdF and the ACPR completely involved in that discussion. Before it was mostly an ongoing discussion where we [the Ministry, red.] kept them informed, but we didn't actually work together. (Interview 1)

And so they did, and the work commenced soon thereafter (Banque de France & ACPR, 2021).

Parallel to the work conducted domestically, the French Ministry of Finance, enabled by their strategic position as host of the COP21, reached out directly to Carney in his capacity as chairman of the FSB, an institution tasked by member states' Ministries of Finance and central banks to monitor the global financial system. The French Ministry of Finance deemed the FSB the right place to facilitate a discussion of climate-related risks and asked whether the FSB would investigate climate-related risks. Concerned whether the issue would fly elsewhere, Carney accepted to explore the matter, if the French Ministry of Finance could get a collective mandate from the G20. The French Ministry of Finance tried to advance the agenda of risk assessment strategically to get the attention of the other central banks and finance ministers and to frame it in a way that would allow the FSB to work on the agenda without raising too many questions.<sup>11</sup> A month later, in April 2015, the G20 agreed to convene a dialogue between public and private sector actors on the implications of climate-related issues (Financial Stability Board, 2015; Pritchard, 2015). In September 2015, five days before Carney's widely celebrated speech, the FSB hosted a high-level public-private sector meeting (Financial Stability Board, 2015). Here it was agreed to proceed with the development of a disclosure framework, while the potential assessment of climate-related risks was put on hold, even though the French Ministry of Finance pushed for advancements of the latter.<sup>12</sup>

With the climate agenda safely ensconced in the FSB, the BdF and BoE worked actively in the G20 to advance this agenda. In December 2015 the G20 agreed at a meeting between Finance and Central Bank Deputies under China's G20 2016 Presidency, to set up a Sustainable Finance Study Group led by PBoC and the BoE.<sup>13</sup> Thus, the civil servants in the French Ministry of Finance, who had advanced this agenda domestically, were successful not only at the national

<sup>&</sup>lt;sup>11</sup> Turn of events as described in interview 1 and unpublished manuscript 1. An article from The Telegraph, 19 April 2015, confirms that the investigation was pushed by France (see Pritchard 2015)

<sup>&</sup>lt;sup>12</sup> Interview 1, see also FSB 2015

<sup>&</sup>lt;sup>13</sup> <u>https://unepinquiry.org/g20greenfinancerepositoryeng/</u>

level but also internationally, where they found this agenda to be advanced amongst the world's biggest central banks in the G20 within a couple of years after they had first introduced this agenda to BdF.

#### 8. The carbon bubble enters central banks

The field arbitrageurs and civil servants in national ministries were aware that the central banks would not see the relevance of addressing broader climate change mitigation and adaptation issues by channeling funds to green investments. Central banks in developing countries had worked with this approach, but there were concerns that this would jeopardize the mandate of central banks in developed economies (interview 2).

Specifically, steeped in finance and financial governance, field arbitrageurs knew central banks are conservative in nature and cater to their legitimacy, and are concerned about their mandate (interview 5). The framing of the carbon bubble spoke to the financial stability mandate of the central banks. Once the carbon bubble reached the central banks it was concluded that this work needed to be more succinct in addressing climate change as a risk, with a clear methodology based on climate science incorporated into economic modeling (see table 4). The central banks lacked a common language, which posed a challenge, as a language of consensus is crucial for central banks to uphold their status as *'technocratic professionals rather than government bureaucrats'* (Johnson, 2016, p. 237). Indeed, the idea behind the conduct of any type of stress test is to provide *'a gloss of objectivity'* to substantiate the fully rationalized technoscientific knowledge behind any central bank decision (Coombs, 2020, p. 531). Making climate change a matter of risk and financial stability and the ensuing focus on creating a CST framework enabled this process.

The risk frame aligned with the agenda of the advocates that emerged within the central banks in the years around 2014-2015. As Siderius (2022) has shown in the case of DNB, there was a small group of policy-seeking staff who sought a way to address concerns about climate change. This group of policy-seeking staff looked for ways to address concerns about climate change within the legal and political structures of the central banks to define their roles in addressing climate-related issues (Siderius, 2022). The risk frame was useful as it provided an opportunity for the advocates within central banks to subsume climate-related issues into the existing policy

paradigm. Since climate change was turned into a potential threat of climate-related risks and not a matter of emissions as such, it was possible to justify a certain level of involvement legally as well as politically (van 't Klooster, 2022). This can also be observed in the interview quotes in table 4, which show the central bankers who were involved at the outset were aware of the strategic use of the risk frame and pushed this to ensure involvement with climate-related issues. It is, however, an approach that has its limitations.

The CST exercise is an important building block in the approach that central banks have taken to address climate change, an approach that Dafermos (2022, p. 176) defines as the 'risk exposure' approach, where central banks main task is to contribute 'to the quantification of climate-related risks...'. CST plays a significant role in this regard where central banks consider it as their key role to act as neutral guardians of private exposures to climate-related risks by carefully evaluating the vulnerability of the financial system to climate-related risks (Dafermos, 2022; Kedward et al., 2022). Yet, the effect it has on decarbonization is at best questionable. Baer et al. (2021) have identified what they call a 'promotional gap' where the risk exposure approach has restricted the usage of promotional policy instruments. Instead, the priority has been to use informational and incentive-based policies to improve transparency and disclosure, which have so far yielded little results in shifting financial flows away from unsustainable assets and investments (Chenet et al., 2021; Kedward et al., 2022). As noted by Kedward et al. (2022), this is not to say that the current risk-based approach is irrelevant. It can provide the groundwork for more ambitious policy measures such as a green credit policies as suggested by Kedward et al. (2022) or a 'precautionary approach' as advocated by Chenet et al. (2021), but it cannot be a force of change in decarbonizing the economy in its current form.

Interviewee*	Quote
Interview 1	I was at the time discussing with the people from you know, yes, Carbon Tracker, people from the broader decarbonization coalition like Mats Anderson from AP4, the Swedish pension fund, and Frédéric Samama who was at Amundi, and Nick Robins as well. From this discussion, the narratives on risk took shape. It was clearly a move away from the other narrative by NGOs on climate change, which was a lot more moralistic. I think that the implicit collective idea was that risk was the only ground on which we can engage on a global basis, because I mean if the risk is material nobody can debate it.
Interview 5	I mean the the first thing that we did, and that was a key factor of success, is framing the question in a way that is understandable for central bankers. Because central bankers are by definition conservative and prudent. Their first asset is credibility and this is what they really care about and so they're not going to go starting a new adventurous thing for the sake of having fun. So you need to make the case and this is always a bit difficult because you need to collect evidence, facts and literature etc. But I mean for all on the financial stability side I think everybody is convinced now [that climate is a risk, red.].
Interview 10	For me that's the biggest thing that I learned through my journey in trying to get engagement on this. If you try to engage with this as being really important, significant, near-term risk today you need that argument that it is a risk today in order to begin the conversation, which is what the stranded asset type of argument was able to do. But at the same time, once you got people interested you then need to present the bigger picture. You know, it's not really just about the risks today, it's about the fact that if we don't manage the transition today we are going to have bigger risks in the future. And that brings in the importance of climate stress testing.
Interview 3	I spend a lot of my time trying to convince people not to think about it as an ethical issue so for example, if you're a supervisor, your job is to make sure that the financial system is safe and sound by supervising individual institutions. If those institutions are exposed to climate risks in a way which could threaten financial stability, you have to do something about that and make sure those risks are managed properly. Nobody needs to write you a new rule or change the Basel framework or anything else. You've got it squarely on your plate and so it's definitely all about risk.
Interview 4	The financial crisis showed that it is important for the private part of the financial sector to price risk correctly, because this enables them to better absorb losses. And in the same way as it was important during the financial crisis to price risk correctly, it will be important to price risks correctly when it comes to climate change, that climate-related risks, in particular transition risks are priced correctly. And that is why disclosure and climate stress testing is important as this will lead to a more correct pricing of risks.

Table 4: interviewees describing work on climate-related risks

### 9. Conclusion

How did climate change go from the fringes of the financial sector amongst ESG investors and into the center of power of financial governance: the boards of important central banks? The

evidence suggests the process owes to a well-executed framing of the 'carbon bubble' crafted by a group of field arbitrageurs who targeted civil servants in the ministries of environment and finance who then extended the advocacy chain to central banks. The frame of the carbon bubble was key in this respect since it explained the link between climate change and financial stability in a way that fell squarely within the mandate of financial stability reinforced in Western central banks after the financial crisis.

As such, the paper's contribution is twofold. Firstly, going beyond a mere restatement of the importance of framing, it highlights the importance of agency by and structural characteristics of field arbitrageurs in driving forward this framing, which underlines the strategic application of frames (Broome & Seabrooke, 2021; Hasselbalch, 2019; Özgöde, 2021). Climate change was strategically framed as a risk issue through the carbon bubble by field arbitrageurs, to capture the attention of central bankers. Just like 'systemic risk' was institutionalized after it was crafted as a discursive frame in the 1960s (Özgöde, 2021), the capacity of field arbitrageurs to translate climate-related issues into the language of central bankers has been instrumental. The carbon bubble frame did so as it combined finance and climate knowledge and made it a matter of risk.

The success of the framing is also embedded in the structural characteristics of the field arbitrageurs: only arbitrageurs structurally proximate to financial sector actors of systemic importance can credibly commit to such a framing exercise. This is what happened with Carbon Tracker and Sustainable Finance Lab's unique access to systemically important banks in the UK and the Netherlands, which in turn gave them important leverage over central banks as part of the central bank-private financiers' infrastructural entanglement that has been documented in the literature.

The second key contribution of this paper is the unique composition of the carbon bubble advocacy coalition of field arbitrageurs in think tanks and their civil servant allies. Where the literature on linked ecologies claims the unique role played by transnational professionals in advancing policy ideas (Ban, 2016; Seabrooke & Tsingou, 2016) this paper has highlighted how domestic elite civil servants have been an important ally to the think tanks. The paper thereby underscores the agency of domestic civil servants in promoting certain economic ideas over others. In her work on France, Fourcade (2009) labels this as *administrative expertise*. The findings of this paper confirm this, as it demonstrates a strong link between field arbitrageurs and civil servants, especially in France. Even though the link is weaker in the UK and the

Netherlands, it is still present and a contributing factor to the diffusion of the carbon bubble frame to BoE and DNB.

The main empirical contribution of this paper is the emphasis on BdF and DNB as international trailblazers of this framing exercise. This matters because BdF and DNB are not the usual suspects in studies of policy change in the global central banking community. This paper has shown how central banks, who are not part of 'C5', can have a decisive impact in shaping emerging global governance regimes. Central banks like the BdF and DNB are, as national central banks of the Eurosystem, oftentimes overlooked because decisions are left to the governing council at the ECB. However, this paper has shown they hold a substantial level of expert capacity that can be utilized to their advantage in terms of shaping the outcome of an emerging global climate governance regime (see Siderius, 2022 for a recent example).

Several issues uncovered by the scope of this paper demand further research. This paper shows that the Paris Agreement was influential in terms of domestic French policies, but whether COP21 also had a broader sway on the greening of central banking beyond France could hold important contributions. Also, the emphasis on BoE, BdF, and DNB leads us to an additional question: why did the field arbitrageurs gain traction with some central banks, but not with other central banks of global importance, most notably the Fed, but also the Bank of Japan, the Swiss National Bank or, most strikingly, the Scandinavian central banks? In addition, the paper has only looked at central banks in Western Europe, but central banks in emerging and developing countries have used or intend to use more active climate policies, but why have they ventured to use alternative policy tools? Finally, further research into physical risk is needed, to understand in full how central banks decided to run CST that cover both types of risks. Answering these questions could tell us something more structured about the transmission of new economic thinking about how to deal with the climate crisis and how to translate that thinking into public policies across different institutional and political environments.

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Appendix 1	1: overview	of data and	its use in	the analysis
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Data sources	Detailed description	Time span covered by the data	Use in analysis
Interviews	Total of 16 interviews with central bankers and field arbitrageurs as well as two unpublished manuscripts. 12 of the 16 interviews were transcribed and used in the analysis (the remaining four were used as explorative interviews).	Interviews conducted between 2020- 2022. Period covered in interviews is 2010- 2018	Provided rich data about the turn of events in the given time period, who the key actors were, the strategies behind the framing of the carbon bubble and stranded assets, how they approached the work on climate-related issues and what made them look to CST.
Documents	Documents published by central banks as well as field arbitrageur institutions (Carbon Tracker, Sustainable Finance Lab and 2DII) and other relevant organizations (see appendix 1 for overview).	2010-2018	Provided information on how the concepts of carbon bubble and stranded assets scattered, how discussions evolved around climate- related issues and CST, and how the first CSTs were conducted and the results reported.
Participant observation	Observations at 14 webinars with the participation of central bankers discussing climate- related issues as well as the work on the conduct of CST more specifically.	2020-2021	Provided information on the latest development in CST, how central banks worked with incorporating CST which showed a focus on transition risk, gave an overview of key stakeholders and was used in preparation for the interviews to better understand the technicalities and the jargon amongst the elite/expert interviewees (see appendix 2 for list of webinars)
Supplementary data	Newspaper articles, LinkedIn and personal/company websites	2010-2018	These additional sources were used for the purpose of triangulation and to confirm dates and events described in interviews. Information on career and background on field arbitrageurs were retrieved from LinkedIn and personal/company websites.

## Appendix 2: overview of documents

Name of report	Year and month of publication	Author(s)	Organization/institut ion	Discussion of carbon bubble concepts
Unburnable carbon - are the world's financial markets carrying a carbon				carbon bubble, unburnable carbon, stranded
bubble?	Nov. 2011	James Leaton	Carbon Tracker	assets
Oil and carbon revisited - Value at risk	Jan 2013	Paul Spedding, Kirtan Mehta, Nick Robins	HSBC	unhurnable carbon
nom unbumable reserves	Jan. 2015	Iames Leaton	libbe	
		Nicola Ranger, Bob Ward, Luke	Carbon Tracker and	carbon bubble, unburnable
Unburnable carbon 2013: Wasted capital		Sussams, and Meg	Grantham Research	carbon, stranded
and stranded assets	Apr. 2013	Brown	Institute, LSE	assets
The Price of Doing Too Little Too Late: the impact of the carbon bubble on the EU financial system	Feb. 2014	Weyzig, Francis; Kuepper, Barbara; van Gelder, Jan Willem; van Tilburg, Rens	Green European Foundation, Sustainable Finance Lab, Profundo	carbon bubble, unburnable, stranded assets
Financial risk and the transition to a low- carbon economy: towards a carbon stress testing framework	July 2015	Chenet, Hugues; Thomä, Jakob; Janci, Didier;	2DII (in cooperation with UNEP-FI, Caisse de Dépôts, French Ministry of Ecology)	carbon bubble, stranded assets
			BoE	unburnable
The impact of climate change on the			(commissioned by	carbon, stranded
	G	DD (	<b>D</b> ( )	
UK insurance sector The Financial System We Need - Aligning	Sep. 2015	PRA	Defra)	assets
UK insurance sector The Financial System We Need - Aligning the Financial System with Sustainable Development	Sep. 2015 Oct. 2015	PRA UNEP Inquiry	Defra) UNEP Inquiry	assets unburnable carbon, stranded assets
UK insurance sector The Financial System We Need - Aligning the Financial System with Sustainable Development Too late, too sudden: Transition to a low- carbon economy and systemic risk	Sep. 2015 Oct. 2015 Feb. 2016	PRA UNEP Inquiry Gros, Daniel; Schoenmaker, Dirk	Defra) UNEP Inquiry ESRB	assets unburnable carbon, stranded assets stranded assets
UK insurance sector The Financial System We Need - Aligning the Financial System with Sustainable Development Too late, too sudden: Transition to a low- carbon economy and systemic risk Time for transition: an exploratory study of the transition to a low carbon economy	Sep. 2015 Oct. 2015 Feb. 2016 March 2016	PRA UNEP Inquiry Gros, Daniel; Schoenmaker, Dirk Schotten, Guido; van Ewijk, Saskia; Regelink, Martijn; Dicou, Diederik; Kakes, Jan	Defra) UNEP Inquiry ESRB DNB	assets unburnable carbon, stranded assets stranded assets carbon bubble, stranded assets
UK insurance sector The Financial System We Need - Aligning the Financial System with Sustainable Development Too late, too sudden: Transition to a low- carbon economy and systemic risk Time for transition: an exploratory study of the transition to a low carbon economy Evaluating Climate Change Risks in the Banking Sector	Sep. 2015 Oct. 2015 Feb. 2016 March 2016 Fall 2016	PRA UNEP Inquiry Gros, Daniel; Schoenmaker, Dirk Schotten, Guido; van Ewijk, Saskia; Regelink, Martijn; Dicou, Diederik; Kakes, Jan	Defra) UNEP Inquiry ESRB DNB French Treasury, BdF and ACPR	assets unburnable carbon, stranded assets stranded assets carbon bubble, stranded assets stranded assets
UK insurance sector The Financial System We Need - Aligning the Financial System with Sustainable Development Too late, too sudden: Transition to a low- carbon economy and systemic risk Time for transition: an exploratory study of the transition to a low carbon economy Evaluating Climate Change Risks in the Banking Sector Recommendations of the Task Force on	Sep. 2015 Oct. 2015 Feb. 2016 March 2016 Fall 2016	PRA UNEP Inquiry Gros, Daniel; Schoenmaker, Dirk Schotten, Guido; van Ewijk, Saskia; Regelink, Martijn; Dicou, Diederik; Kakes, Jan	Defra) UNEP Inquiry ESRB DNB French Treasury, BdF and ACPR	assets unburnable carbon, stranded assets stranded assets carbon bubble, stranded assets stranded assets
UK insurance sector The Financial System We Need - Aligning the Financial System with Sustainable Development Too late, too sudden: Transition to a low- carbon economy and systemic risk Time for transition: an exploratory study of the transition to a low carbon economy Evaluating Climate Change Risks in the Banking Sector Recommendations of the Task Force on Climate-related Financial Disclosures	Sep. 2015 Oct. 2015 Feb. 2016 March 2016 Fall 2016 June 2017	PRA UNEP Inquiry Gros, Daniel; Schoenmaker, Dirk Schotten, Guido; van Ewijk, Saskia; Regelink, Martijn; Dicou, Diederik; Kakes, Jan TCFD	Defra) UNEP Inquiry ESRB DNB French Treasury, BdF and ACPR FSB	assets unburnable carbon, stranded assets stranded assets carbon bubble, stranded assets stranded assets
UK insurance sector The Financial System We Need - Aligning the Financial System with Sustainable Development Too late, too sudden: Transition to a low- carbon economy and systemic risk Time for transition: an exploratory study of the transition to a low carbon economy Evaluating Climate Change Risks in the Banking Sector Recommendations of the Task Force on Climate-related Financial Disclosures Waterproof? An exploration of climate- related risks for the Dutch Financial Sector	Sep. 2015 Oct. 2015 Feb. 2016 March 2016 Fall 2016 June 2017 October 2017	PRA UNEP Inquiry Gros, Daniel; Schoenmaker, Dirk Schotten, Guido; van Ewijk, Saskia; Regelink, Martijn; Dicou, Diederik; Kakes, Jan TCFD Regelink, Martijn; Reinders, Henk Jan; Vleeschhouwer, Maarten; van de Wiel Iris	Defra) UNEP Inquiry ESRB DNB French Treasury, BdF and ACPR FSB	assets unburnable carbon, stranded assets stranded assets carbon bubble, stranded assets stranded assets No
UK insurance sector The Financial System We Need - Aligning the Financial System with Sustainable Development Too late, too sudden: Transition to a low- carbon economy and systemic risk Time for transition: an exploratory study of the transition to a low carbon economy Evaluating Climate Change Risks in the Banking Sector Recommendations of the Task Force on Climate-related Financial Disclosures Waterproof? An exploration of climate- related risks for the Dutch Financial Sector An energy transition risk stress test for the financial system of the Nature of	Sep. 2015 Oct. 2015 Feb. 2016 March 2016 Fall 2016 June 2017 October 2017	PRA UNEP Inquiry Gros, Daniel; Schoenmaker, Dirk Schotten, Guido; van Ewijk, Saskia; Regelink, Martijn; Dicou, Diederik; Kakes, Jan TCFD Regelink, Martijn; Reinders, Henk Jan; Vleeschhouwer, Maarten; van de Wiel, Iris Vermeulen, Robert; Schets, Edo; Lohuis, Melanie; Kölbl, Barbara; Jansen, David-Jan;	Defra) UNEP Inquiry ESRB DNB French Treasury, BdF and ACPR FSB DNB	assets unburnable carbon, stranded assets stranded assets carbon bubble, stranded assets stranded assets No carbon bubble

### Appendix 3: overview of interview data

Overview of interviewees:

			No. of	Field arbitrageur
Interviewee	Organization	Time frame	interviews	yes/no
Senior central banker	Danish central bank	2020-2021	2	No
Senior central banker	Banque de France	2020	1	No
Director	Finance think tank	2021	1	Yes
Senior central banker	Banque de France	2021	2	No
Professor	UK university	2021	1	No
Senior central banker				
(former)	Bank of England	2021	1	No
Founder	Finance think tank	2021-2022	2	Yes
Co-founder	Finance think tank	2021	1	Yes
Executive director	Finance NGO	2021	1	No
Founder	Finance think tank	2022	1	Yes
Head of policy and	Asset management			
research	company	2022	1	Yes
Senior central banker				
(former)	Bank of England	2022	1	No

Overview of unpublished manuscripts/memoirs

		Interviewed	Field arbitrageur
Interviewee	Organizatoin	yes/no	yes/no
Former senior finance			
professional	UK bank	No	Yes
	Asset		
Head of policy and	management		
research	company	Yes	Yes

### Appendix 4: list of webinars attended for participant observation

- E-axes webinar: Sizing the risks and raising the awareness: the contribution of the 2020 ACPR Climate Risk Pilot Exercise, 16 November 2020, speaker Laurent Clerc, Director of Research and Risk Analysis, Banque de France, moderator Pierre Monnin (CEP)
- ECB forum Sintra webinar: Macro-financial implications of climate change and the carbon transition, 19 November 2020, speakers Rick van der Ploeg (Oxford University) and Signe Krogstrup (Nationalbanken), chair Luis de Guindos (ECB)
- INSPIRE webinar: INSPIRE's toolbox of sustainable crisis response measures, 2 December 2020, presenters Simon Dikau (LSE), Nick Robins (LSE), and Ulrich Volz (SOAS), discussants Irene Heemskerk (DNB/NGFS), Danae Kyriakopoulou OMFIF, Pierre Monnin (CEP)
- FSB Virtual Workshop on the implication of climate change for the financial sector: 15 December 2020, speakers include Klaas Knot (DNB), Alessio De Vincenzo (Banca d'Italia), Virginie Traclet (Bank of Canada), Paul Hiebert (ECB), Crystal Wan (BlackRock), Hugh Francis (insurance sector), James Leaton (Moody's), Robert Patalano (OECD)
- PIIE webinar: The role of International Finance and Central Banks, 16 December 2020, speakers Mark Carney, Patrick Honohan (economist, former governor of the Central Bank of Ireland), Caroline Atkinson (economist, RockCreek, PIIE executive committee), Olivier Jeanne (economist, Johns Hopkins University)
- Bank of England Flagship Seminar with Lord Stern, 18 January 2021, speaker Lord Nicholas Stern, moderator Andrew Bailey
- E-axes webinar: Climate-related Risks and Central Bank's Collateral Policy: a Methodological Experiment, 25 January 2021, speaker Pierre Francois Weber, deputy director Monetary Policy Implementation BdF, moderator Pierre Monnin (CEP)
- Webinar: Next Generation Central Banking, 3-5 February 2021, speakers include amongst other Claudia Buch (Deutsche Bundesbank), Adam Tooze (Columbia University), Sabine Lautenschläger (former ECB), Sylvie Goulard (BdF), Rens van Tilburg (Sustainable Finance Lab), Daniela Gabor (UWE Bristol)

Webinar The Economist: Editor's conversation with Christine Lagarde, 10 February 2021

- PIIE webinar: Should we worry about central banks becoming activist capital allocators, Stephen Cecchetti (economist Brandeis International Business School), Signe Krogstrup (Nationalbanken), moderator Nicholas Véron (PIIE resident fellow)
- Webinar: Net Zero Central Banking, 19 March 2021, Nick Robins (LSE), Ulrich Volz (SOAS), Luiz Awazu Pereira da Silva (BIS), Sarah Breeden (BoE), moderated by Minouche Shafik (LSE)
- PIIE webinar: How to revisit central banking and financial stability, 13 April 2021, speaker Francois Villeroy de Galhau (BdF), moderator Adam S. Posen (PIIE)
- PIIE Webinar: ECB Listens: Review of its monetary policy strategy, 25 May 2021, speakers Philip R. Lane (ECB), Stephen Cecchetti (Brandeis International Business School), Kristin J. Forbes (MIT's Sloan School of Management), Frederic Mishkin (Columbia University), moderator Adam S. Posen (PIIE)
- NGFS climate scenarios phase II online launch event, 7 June 2021, Frank Elderson (ECB), Sarah Breeden (BoE), Thessa Beck (Climate Analytics), Elmar Kriegler (PIK), Dawn Holland (National Institue of Economic and Social Research)

Paper II. Seeing Climate Change Like a Central Banker

### Seeing Climate Change Like a Central Banker

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#### Abstract:

A well-established literature in political economy has demonstrated how central banks have been susceptible to new ideas in times of crisis or periods of uncertainty, yet, the type of ideas that this literature has looked at has been economic in nature. It is therefore relevant to look into what happens when central banks are dealing with non-economic issues, in this particular case central banks' recent engagement with climate-related issues. The paper asks how central banks can claim to have institutional expertise in climate change as a field that works from a different scientific standpoint. Building on interviews with central bankers, participant observation at webinars, and quantitative content analysis of central bank speeches, this paper argues how central banks, despite lacking climate science expertise, had only limited interactions with climate science and the community of climate scientists, preferring to approach the work with climate-related issues following an economic science ethos with an emphasis on economic training and tools. The paper introduces the concept of epistemic boundaries to explain this relegation of climate-related issues to economically calculable risks stemming from climate change. As such, the argument advances the state of the art by specifying the scope conditions under which central banks are willing to engage with issues that are traditionally subject to the epistemic authority of hard sciences rather than economics.

Keywords: central banks; climate change; financial governance; economic governance; epistemic boundaries

### 1. Introduction

What will happen to the financial system in 2050 in a situation of unmitigated climate change? What would happen when the world faces natural catastrophes induced by the climate crisis, and businesses face a rapid transition away from fossil fuels towards greener alternatives? How will climate change shocks transmit to finance and the broader macroeconomy? These are the types of questions that central banks are asking themselves these days. Central bankers now work with different climate scenarios depending on the different types of mitigation, mapping out technology change and transition to a greener economy, and seeking to understand cascade effects and tipping points in climate science to get an idea of the tail risks ahead of us. In other words, central banks are currently seeking to make climate change legible and translate climate science into macroeconomic language and concepts. And they do this largely in isolation from the community of climate scientists and without any prerequisite or prior experience in working with climate science.

We know from the literature that in times of crisis or in periods of uncertainty, central banks have momentarily been susceptible to forms of expertise and ideas from outside of the traditional realms of central bank expertise with shadow banking regulation (Ban et al., 2016) and macroprudential regulation as the typical examples (Baker, 2013a; Thiemann et al., 2020). Thus, this literature tells us central banks are not as closed as they seem.

Climate change, though building on a logic of modeling and forecasting like economics, is a scientific field that is far from economics, but central banks now acknowledge that it is critical to their mandate. The question then is, what happens in the case where central banks deal with non-economic issues such as climate change, and thereby have neither the training, the credentials nor the credibility to bring judgment? Do central banks open up to the influence of a different scientific discipline, or do they block them and instead impose an economic logic by creating an economic *cognitive infrastructure* (Hirschman & Popp Berman, 2014) in the form of new models and measurements?

Given their roles as regulators and supervisors of the financial system, central banks have faced calls for an active and ambitious role in decarbonizing finance with the aim of mitigating climate change. Ranging from calls for a 'green QE' program to 'green haircuts' and closer coordination between monetary and fiscal policies to support the green transition there have been high hopes for central banks' ability and capacity to address the climate crisis (Campiglio, 2016; Schoenmaker, 2021; Svartzman et al., 2021). The IPE literature would suggest that this is the most-likely case for including non-economic scientific expertise such as climate science in central banks because this expertise rests on a different epistemic culture (Knorr Cetina, 1999). However, this paper shows that instead of doing this, the central banks have taken a very narrow focus on their work with climate-related issues, focusing on mapping out the possible transmission channels between climate change, the financial sector, and the real economy. Indeed, the approach central banks are taking is not following the calls for urgent action coming from climate scientists (Paterson, 2020) but instead deploys a neoliberal economic logic focusing on financial stability and market-based risk management, both of which operate with more heroic assumptions about the available window for climate action (Langley and Morris 2020) and possibly leading to '*capitalism*'s creative self-destruction' (Tarim, 2022, p. 491). In essence, central banks see their main task as one turning climate change into a calculable risk framework through tools of climate stress testing and scenario analysis. This paper seeks to answer how central banks claim to have institutional expertise in climate change being a field that works from an entirely different scientific standpoint, and why central banks have reduced the climate agenda to one that is solely about risks.

Building on interviews with central bankers, participant observation in relevant webinars and quantitative content analysis of central bank speeches, I show how there is a hierarchy of sciences within central banks with economics not just being the dominant scientific ethos, but the only scientific ethos within central banks. Instead of taking climate scientists on board in the development of a new framework for climate-related issues, central banks have relied on short-term collaboration at the very outset and readings of IPCC reports as the strategy for 'skilling up' on climate change. Taken together this suggests there are hard epistemic boundaries within central banks. I therefore make two interconnected claims. First, contributing to the literature on economic expertise, I suggest that within central banks, economics is superior not just to other social sciences (Fourcade et al. 2015), but to natural sciences as well with no exception being made for climate science. Secondly, I add a scope condition to the existing literature on central banks and economic ideas, in the sense that for central banks to be open to external ideas, such ideas must be presented by economists, and represent an economic logic. Thus, where central banks seek to 'scientize' their work (Mudge & Vauchez, 2012; Thiemann et al., 2020), there

appears to be a narrow acceptance of scientific value which is limited to an economic science ethos.

The paper is organized as follows: the subsequent sections offers an overview of the literature and introduces the concept of epistemic boundaries as the analytical framework of the paper. The following section presents the method and the data used in this paper. The fourth section looks into the approach taken by central banks to deal with climate-related issues. The fifth section traces how central banks have approached the work internally in order to ensure the right skills and institutional set up, arguing that there have been a priority of economic skills. Next, I show how central banks have approached the updating of the modelling apparatus. The final section seeks to conclude.

#### 2. Literature review and analytical framework

This paper contributes to an established literature in political economy that explores how ideas travel within central banks (Baker, 2013a, 2018; Gabor, 2014; Thiemann et al., 2020) and international economic institutions more broadly (Ban & Patenaude, 2019; Clift, 2018; Helgadóttir, 2016; Kaya & Reay, 2019). An emerging literature shows that central banks are not as closed as they seem, with the implementation of macroprudential policies post-crisis as the latest example to how, central banks have collaborated with external actors in setting up new measurement systems for systemic risk. Thiemann et al. (2020, p. 18) have shown how 'a new post-crisis alliance, whereby certain topics, driven by practical and academic interests generate collaborations between academics and central bankers.', which they then conclude 'points to an increasing openness of central bankers' where such a form of collaboration with non-monetary economists was unthinkable prior to the financial crisis. Another example is the debates on shadow banking regulation, which was not just dominated by IO experts from the sphere of central banks (BIS, FSB, IMF), but reinforced their expertise by drawing on research from the Fed and economists at elite US universities, whilst excluding legal scholars and private sector economists (Ban et al., 2016). This suggests that central banks are open to ideas as long as they come from economists. Indeed, even though the implementation of macroprudential regulation after the financial crisis represented an important ideational shift in terms of how regulators think of financial regulation (Baker, 2013a), it was ultimately an economic idea.

The paper furthers this literature by honing in on a new puzzle: how likely are central banks to collaborate with external actors on non-economic issues such as climate change? This matter because the political economy literature on ideas in economic governance tends to consider ideas primarily of economic origin (Baker, 2013b; Blyth, 2002; Clift, 2018; Helgadóttir, 2016). The basic assumption is that it takes an economic idea to spread within economic institutions such as central banks. Again, taking the example of the text by Thiemann et al. (2020, p. 3), the outset for their work assumes to look only at economists in asking '...*which group of economists proposed what kind of measurement*...'. This is not to say that it would have been relevant to look at non-economists in their particular example, but merely to illustrate that it is an assumption to mainly consider economic ideas presented by economists. Looking at central banks' involvement in climate-related issues and their likelihood of collaborating with climate scientists becomes an important test for whether this assumption in the literature holds in all fields of knowledge.

A useful concept to investigate the interaction of different fields of expertise is the concept of epistemic boundaries from the linked ecologies literature introduced by Seabrooke and Tsingou (2016) looking at the interaction of doctors, demographers and economists involved in the work on issues of infertility. They introduce the concept of epistemic boundaries to analyze the interaction amongst professionals coming from different educational backgrounds. Epistemic boundaries arise within a professional ecology 'through common educational training and knowledge practices steeped in a common episteme.' (Seabrooke & Tsingou, 2016, p. 76). Consequently, it becomes difficult to create ties between different ecologies because professionals have a strong incentive to stay within their epistemic boundary to maintain networks and future career prospects, stemming from the rationale that they can risk having their expertise devalued if they go beyond their episteme. However, Seabrooke and Tsingou only explore how interaction occur between professionals willing to link. But it remains an open question what happens in situations where epistemic boundaries are hard, in the sense that professionals are not necessarily *willing* to link issues, or only to a certain extent? This paper suggests taking a step back and look at the conditions of which epistemic boundaries occur, which becomes particularly pertinent in this case where central bankers are faced with an idea on non-economic origin.

It is again useful to look to the literature on the implementation of macroprudential regulation after the financial crisis, where policymakers across central banks and supervisory authorities in the face of a new, untested idea (Baker, 2013a), had to come up with a new *cognitive infrastructure* that could provide central banks with a measurement framework in order to avoid accountability issues (Goodhart, 2015; Thiemann et al., 2020). In creating this cognitive infrastructure in constructing measurements for the level of systemic risk at the national as well global level, many of the more ambitious and reformative parts of the macroprudential agenda waned out (Baker, 2018; Kranke & Yarrow, 2019; Thiemann, 2019). Even though macroprudential policies represented an important ideational shift, the implementation has been incremental at best (Baker, 2013a; Johnson et al., 2019), whilst completely disregarding the social purpose aspect as favored by Minsky (Baker, 2018). Thus, there is a scope condition to be added for epistemic boundaries to be malleable in central banks, and that is that the ideas advocated must be economic in nature.

Tackling these gaps in the literatures on ideas in economic governance and linked ecologies, this paper argues that an important scope condition for ideas to enter central banks and for the epistemic boundaries to be malleable, the idea must be economic in nature (see figure 1). Part of this explanation is found in the particular institutional set up of central banks as independent, technocratic institutions, provided with a mandate restricted to price stability and financial stability (Lombardi & Moschella, 2016; Mabbett & Schelkle, 2019). Central banks have, in their communications at least, adhered to those institutional principles (see for instance survey by Network for Greening the Financial System, 2020).



Figure 1: illustration of hard vis-à-vis malleable epistemic boundaries in central banks

However, the response by central banks to the financial crisis, and again to the outbreak of the Covid-19 pandemic, suggests that central banks have more leeway in the interpretation of their mandate (Ban, 2021; Goodhart, 2015; Langley & Morris, 2020), implying that this can only be part of an explanation. Adding to this explanation is a strong economic rationale amongst
policymakers (Hirschman & Popp Berman, 2014), what Skovgaard (2021) describes as 'economization', a process whereby economic institutions transport climate change into the field of economics to be able to address the issue within their own routines and measures. Furthermore, it is well established in the literature that there is a firm belief in the superiority of economics attributing 'their intellectual standing and autonomy to the reliance on precisely specified and parsimonious models and measures' (Fourcade et al., 2015, p. 92). A trend that is even stronger within central banks as technocratic institutions, relying on hierarchical orthodox economic knowledge seeking to steer the economy in an almost hydraulic fashion (Braun, 2018) and they would therefore be likely to have this assumption.

Therefore, the paper hypothesizes that even in a critical case such as that of climate science, where central banks would most likely engage with non-economics expertise, they continue engage in translating that science only through filters of economic expertise familiar to and controlled by central bankers.

# 3. Methods and data

In order to uncover how central bankers see climate change I draw on transcripts of interviews with central bankers who work with climate-related issues and a sample of 160 speeches retrieved from BIS. The focus of this paper is on so-called Western central banks<sup>14</sup> because there are widely different approaches once we go beyond this group of central banks, which would add too many variables to the analysis. I have found interviews to be suitable for understanding how central banks think of the work of dealing with climate-related issues as this has allowed me to enter a conversation with central bankers about how they have addressed this task. A method that have been used for similar purposes in other central bank studies (see for instance Johnson, 2016). I used the semi-structured interview approach in order to set up an overall structure for the interview, whilst allowing for an open and flexible discussion with the interviewee (Kvale & Brinkmann, 2008; Marta, 2021). The speeches have been used as a supplement to the interviews, and I include the speeches here to investigate the overall trend in the communication coming from central banks, and not just the ones where interviews were conducted. Speeches are particularly useful to answer the stated research question, as these are occasions for the governor or board member to reflect more broadly on the issue of climate change (Harmon, 2019).

<sup>&</sup>lt;sup>14</sup> Incl. the Reserve Bank of Australia, the Reserve Bank of New Zealand as well as Bank of Japan.

I have conducted a total number of 18 interviews, primarily with central bankers, but also with external stakeholders such as people working in think tanks and NGOs on this agenda. Five of the interviews were conducted with external stakeholders, and these have been explorative interviews with the purpose of getting a new and different perspective on central banks' work with climate-related issues in preparation for the interviews with central bankers. These five interviews have not been coded. The remaining 13 interviews have been conducted with central bankers working with climate-related issues. The sampling method has been a combination of strategic sampling and snowball sampling. The interviewees selected based on strategic sampling were selected from one or more of the following criteria: they figured as contributing author to a report on climate-related issues, they worked as climate coordinator or in the team for climate-related issues, or they held public presentations on this subject. The interviewees were from central banks in Western Europe: Banque de France, ECB, BoE as well as the Danish and Norwegian central banks (see table 1). The interviews were transcribed and then coded into five overall categories following an inductive approach: *economic skills, work with models, mandate, risk, climate science* (see appendix 1 for further details).

			No. of
Interviewee	Organization	Time frame	interviews
Junior central banker	BdF	2022	1
Principal Adviser	ECB	2021	1
Senior central banker	BdF	2021	2
Senior central banker	BdF	2021	1
Senior central banker	Nationalbanken	2020-2021	2
Former senior central banker	BoE	2021	1
Senior central banker	ECB	2021	1
Senior central banker	ECB	2022	1
Junior central banker	BdF	2021	1
Senior central banker	Norges Bank	2021	1
Senior central banker	BoE	2022	1

#### Table 1: overview of interviewees

The speeches used in the paper are drawn from the database of speeches from BIS, also known as the central bank of central banks (Seabrooke, 2006). Speeches are increasingly used in research on central banks and have been used for both qualitative and quantitative purposes (Bholat et al., 2015; Harmon, 2019; Johnson et al., 2019). I have searched the BIS database for speeches on climate change in the period starting 29 September 2015, the day Mark Carney gave his speech "Breaking the Tragedy of the Horizon" that is widely considered as the first

time a high-ranking central bank member publicly discussed climate-related issues, up until 31 December 2021. 5,960 speeches were given by central bank governors and board members in this period. To ensure coherence in the analysis of the speeches, the main topic of the speech had to be around climate change. Thus, only speeches where climate-related words<sup>15</sup> appeared in the title or the first paragraph are included in the sample. This totaled to 216 speeches from central bank governors and board members globally. However, given that this paper focuses on Western central banks, the sample was narrowed further down to 160 speeches. The speeches were then analyzed using a quantitative content analysis, based on a simple word frequency count in Nvivo to identify the words that occurred the most often. Based on the word count, the speeches were coded using Nvivo's automatic coding function, after which I ran a 'matrix coding query' to see the words that occurred most often in relation to the word 'climate'. Such a quantitative content analysis have many pitfalls (see for instance Bholat et al., 2015), and one has to be careful in drawing too many conclusions. However, it has been included in this paper as a robustness check of the findings from my interviews, to see if I could identify the overall patterns from in the interviews in the public communication from central banks as well. I will discuss the results of the content analysis in the next section.

# 4. Greening finance or financing green?

Many were surprised when Mark Carney in 2015 made the case that climate change falls under the remit of central banks. It was unexpected that such words should come from the governor of one of the world's largest central banks. Not least because recognizing that climate change could pose a risk to the financial system represented a break with neoclassical economic thinking, which up until that point had refuted the urgency of climate change with arguments that climate change would only happen far into the future, and it would mostly affect less developed countries. With such an ideational break, and with the use of unconventional monetary policies after the outbreak of the financial crisis, the debate around the role of central banks in addressing the climate crisis only heightened (Langley & Morris, 2020). Thus, at the very outset, it was far from settled whether central banks' engagement should be one of 'financing green' or 'greening finance'.

There are many avenues for central banks in turning towards 'financing green'. Svartzman et al. (2020) argue that since risks stemming from climate change is largely unhedgeable, central

<sup>&</sup>lt;sup>15</sup> Examples of such words are climate (change), sustainability, green, Paris Agreement, Net Zero, carbon neutrality, etc.

banks must become involved in policy coordination to ensure structural change in mitigating climate change in order to fulfil their mandate of financial stability. Chenet et al. 2021 calls for forward-looking policies favoring '*precautionary but active policies that avoid large losses across scenarios regardless of the likelihood of any given scenario*' legitimizing ambitious policy interventions to protect human health and the environment (Chenet et al., 2021, p. 7). If policymakers were to follow such a precautionary approach, the authors suggest to integrate climate risks into capital requirements, align climate risks with credit controls and credit guidance, and to integrate climate-related risks into monetary policy operations. Another tool is to make use of a 'tilting' approach for the asset purchase programs, whereby central banks can tilt their collateral frameworks and asset purchases towards low carbon assets. If the ECB followed a so-called 'medium tilt', it would have the potential to reduce carbon emissions by 55% in its portfolio without an impact of the transmission mechanism of monetary policy (Schoenmaker, 2021). In either case, it is argued that all these approaches fall within the mandate of central banks, and the mandate should therefore, in theory, not be an excuse for pursuing a strategy of financing green.

However, if we look at what central banks have actually been doing they have turned to marketcorrecting tools such as climate stress testing and adopting frameworks that ought to improve the disclosure of climate-related risks (Alogoskoufis et al., 2021; Bank of England, 2021; Vermeulen et al., 2018). Through the NGFS central banks have set out to map how climaterelated risks could impact financial stability, where the NGFS have ventured on 'the process of designing a climate regulatory regime that seeks to apply the (shades of) green/dirty to the entire universe of assets... to reorient credit from dirty to green activities' (Gabor, 2021, p. 444). These are policy tools which at best guide the markets towards green investments at a pace that is too slow in the midst of a climate crisis, and at worst induce regulated banks and insurance companies to use shadow banking as a 'spatial fix' for climate risks (Langley & Morris, 2020). One important exception is Schnabel's push for the argument that the principle of market neutrality reproduces market failures such as climate change, and that ECB therefore needs to move away from this principle in their pursuance of their asset purchase programs (Schnabel, 2020), which have so far yielded little concrete results. In other words, central banks have come to see their main task as one turning climate change into a calculable risk framework through tools of climate stress testing and scenario analysis and thereby a focus on 'greening finance'.

This focus on 'greening finance' becomes evident with a look at central bankers' speeches. The quantitative content analysis conducted for the sample of speeches confirms that when it comes to climate-related issues, the focus is largely on how to address so-called climate-related risks (see table 2). The word that is most often put in relation with 'climate' is 'risk' with the word 'financial' entering the second place. In comparison 'risk' is mentioned more than three times as often as 'green' or 'sustainability'. Since the word 'policies' figure on this list as well, it is worthwhile to look into what types of policies central banks discuss in their speeches. Climate policy is mentioned 110 times in 20 different speeches. Monetary policy, on the other hand, is mentioned 498 times across 80 different speeches, whilst financial stability is mentioned 470 times in 114 speeches.<sup>16</sup> Finally, fiscal policy, which were to play a role if the aim was to 'finance green', is mentioned only 22 times in eight speeches.

	A : Climate
1 : Economy	393
2 : Financial	918
3 : Green	321
4 : Market	298
5 : Need	418
6 : Policy	492
7 : Risk	1046
8 : Sector	369
9 : Sustainability	267
10 : Transition	405

Table 2: overview of words used most often in relation to 'climate'

Thus, it is clear that even though central banks would have different ways of addressing climaterelated issues that could more effectively address the structural changes required, central banks have taken the strategy of greening finance through market-correcting tools. However, such a risk-based approach has potential pitfalls, in the sense that it is difficult to account for tail-risks (Lockwood, 2015). It can also make risks seem governable, but at the same time make them more elusive as it shifts the focus away from the relevant entity (in this case climate change) to the management of future uncertainties (Kranke & Yarrow, 2019; Scheper & Gördemann, 2022). Such issues are not entirely irrelevant given the fact that with climate change we look into a future marked by great uncertainty in the form of complex chain reactions and cascade effects (Bolton et al., 2020). The next section will go on to explore how this risk-based attitude

<sup>&</sup>lt;sup>16</sup> Financial stability is included here as a proxy for financial sector policies that does not fall under monetary policy.

have impacted the way central banks have sought to acquire skills and knowledge on climaterelated issues.

# 5. Skilling up on climate change

Since central banks have reduced the work with climate-related issues to one of 'greening finance' through adequate risk measures, they also put climate change on par with other types of risks. As one interviewee explained, climate change was ultimately about tail risk stemming from an uncertainty in terms of policy and technological developments, and it was all a matter of how to account for this uncertainty, which is what economists usually do (interview 5). The task they as central bankers were faced with was to understand the economic and financial ramifications '*which is not completely unrelated to what we normally do*.' (interview 7). Another interviewee elaborated how it was a question of looking at factors such as taxation, public investment, and capital accumulation, which '*is quite the standard*' (interview 2). The customs and practices of the institutions weighted heavily: some interviewees described that they wanted to do more ambitious work, but were either censored by the senior management, or exercised self-censorship to maintain credibility inside the institution (interview 8 and 9). Thus, central bankers turned climate-related issues into a standard economic question that related to risk as well as monetary and financial stability.

Since central bankers considered these 'traditional' topics as the main issues related to climate change, they also found the most suitable way of starting this work was to have economists to work on the issue instead of climate scientists. Since it was a matter of modelling risks, they perceived it as easier for an economist to 'skill up in climate' compared to engaging systematically with climate scientists 'skilling up' in macroeconomics and financial stability.<sup>17</sup> When the work with climate-related issues was reduced to a matter of risk and the impact on the macro economy, economists were also the ones who were most capable of working with the issue. As one interviewee pointed out '*eventually the depth of what you need to master is greater on the macro and financial side* [vis-à-vis climate, red.]' (interview 3). In fact, rather than hiring new perspectives from the outside, the main approach in central banks was to ask people who already worked within the organization to take up the work in this agenda. This had the obvious advantage that they knew the institution, the particularities of central banks and how

<sup>&</sup>lt;sup>17</sup> This concept of 'skilling up' appeared during one of my interviews, and I have found it to be an illustrative metaphor for the process that has been happening in the central banks.

to navigate the stakeholders, which was perceived as just as important as getting actual analytical work done (interview 11).

In line with this thinking, in-house expertise on the finance-climate nexus was swiftly institutionalized in internal silos. Indeed, the main approach has been to have one person or a small group of people responsible for coordinating the work on climate change within the central banks. At the BoE they set up a Climate Hub with the task to coordinate the work on climate change with the other units within. The ECB has taken a similar approach with the establishment of the Climate Change Centre that was established with a coordinating role vis-à-vis the rest of the organization. In smaller central banks one person has been assigned the task of coordinating.

In common though is that the person-in-charge in the organizations I interviewed is an insider, primarily with a background in economics, but also in law. One was asked to take up the coordinating role when returning to the central bank after two years at the IMF. While seconded, he had worked with climate change as one issue amongst others, but he did not feel he had any prerequisites for taking up this position. Another was hired for the role as climate coordinator coming from another central bank. With a PhD in economics, he had no prior experience working with climate. As part of the hiring process the central bank looked for climate scientists or economists with expertise in natural resources or agriculture, but it was eventually concluded that they did not have a sufficient understanding of macroeconomic issues and financial stability. The head at the ECB Climate Change Centre, Irene Heemskerk, is not an economist, but has a background in law. However, she came to the ECB as a former advisor to Frank Elderson, then chair of the NGFS and now Executive Board Member at the ECB, and therefore counts as an insider as well. Making climate 'mainstream' internally in the organization was a particularly difficult and at times toxic topic, and thus the idea was to have people who were used to the jargon and the way of working in central banks. Especially when presenting these issues to senior management (interview 3 and 11).

Starting to work with climate-related issues as central bank insiders there was a recognition they did not have the expertise nor the capacity to deal with this issue. At the outset, they followed a two-pronged strategy. First, acquainting themselves with the literature they all found the best and most obvious place to start was the IPCC reports, which they thought of as well-established and trustworthy expert knowledge. Other sources included reports from IEA and sources such as

the well-established journal *Nature*. Acknowledging they had lacked the same kind expertise in climate science like they enjoyed in economics to deem what was 'good science', they started with the IPCC reports. This stemmed from the rationale that it consisted of a broad range of well-established scholars, who would not be part of the IPCC if they did not have a good reputation. Given that IPCC scientists are considered as well-established they are also seen as the *'least controversial'* experts (interview 1), and thereby a safe choice for the prudent central banks.

The second strategy was to have direct, yet unsystematic, interactions with climate scientists. This was a way for them to internalize external expertise and familiarize themselves with the topic. However, not knowing what makes 'good climate science', the first relevant question to ask here, is how central bankers decided who to collaborate with? Again, the IPCC plays a key role. In the answer to who to collaborate with, central bankers followed the same logic. Lacking the expertise within the organization, they went for the trusted and established expert knowledge and reached out to climate scientists who had worked on the IPCC reports, which freed them from the dilemma of evaluating what makes a good climate scientist. The 'renowned' and 'famous' IPCC scholars became the starting point for the collaboration stemming from the rationale that *'if everyone thought they were fundamentally wrong in what they were doing, they would not have that reputation.'* (interview 11). They then expanded their network from there, again to make sure that they got skilled up through external collaboration.

The central banks had different strategies for the external collaboration with climate scientists. Some climate scientists were invited for a single meeting or to give a single presentation to inform on a very specific phenomenon or question in terms of what kind of things they needed to think about or account for in their work, or to get access to a specific kind of data. One explained that as they ventured into the work with climate-related issues they held one meeting at a time with different climate scientists to be able to understand how climate change unfolds on the short term. They found that to be able to assess how climate-related risks unfold they needed to understand not just what the world would look like in 2050 or 2100, but what would happen on the way there. And so, the approach was to go from one connection to the other '*until the marginal cost of one meeting was greater than the marginal benefit*' (interview 3). Another explained how it was useful to have climate scientists to come in and give a presentation on a very specific phenomenon such as particular physical risks. The aim with such presentations was to talk senior people through the key issues on climate change, but they could not venture

into longer-term collaborations as they were not able to quantify how it would affect the economy (interview 11).

The other approach was to try to establish more long-term relationships with climate scientists. This was also an active strategy at the outset. But the central bankers found it was hard with the long-term relationships because the climate scientists found it difficult to understand the work they were doing. The feeling was that climate scientists were focusing on the bleak long-term picture to prompt action by governments, whereas the central banks needed knowledge on the 'short-term', i.e. 10 to 30 years.<sup>18</sup> The long-term collaborations that central banks deemed most valuable were with people who had a background in climate and finance:

If you take a pure climate scientist, they don't understand central banking. They don't understand economics, so it's actually quite hard to get them to tell us exactly the right things. So you sort of have to get the people who work at the cross roads of the knowledge we need, who can tap into the economics and finance side but still have the climate background. (interview 11)

Thus, there was a feeling that climate scientists did not understand economics and the particularities of central banking, and it was therefore difficult to establish a longer-term relationship with climate scientists.<sup>19</sup>

Hence, there appears to be a firm belief in the economic logic of reasoning, suggesting a hierarchy of sciences within central banks where economics dominates other types of sciences, even in cases where they are dealing with issues that are not purely economic. The emphasis on economic 'skills' over climate science 'skills' as well as the limited inclusion of climate scientists which only happened at the outset, suggest hard epistemic boundaries within central banks, which only becomes malleable to the extent that the issue can be dealt with through an economic logic of reasoning. This is even more evident when we look at how central bankers have approached the work of adapting the modeling framework.

<sup>&</sup>lt;sup>18</sup> This might be short term for a climate scientist, but what is interesting here is that 10 to 30 years is actually way beyond the time horizon for traditional macroeconomic forecasting, which typically looks at 2 years, at the outermost 5-10 years.

<sup>&</sup>lt;sup>19</sup> The exception here is the latest developments at the ECB who put up a job posting for a new position as climate scientist at the Climate Change Centre, with the explicit requirement to have a background in natural sciences (<u>https://talent.ecb.europa.eu/careers/JobDetail/Climate-Scientist-Climate-Change-Centre/4589</u>, accessed 10/3/22) to get science in house and to have the network to bring in relevant competencies from the outside (Interview 8). The climate scientist had not been hired as I conducted my interviews, and at the time of writing it is too soon to tell what impact this will have.

# 6. New uncertainties, new modeling approaches?

As part of adopting the work in central banks to climate-related issues, a large part of the resources invested in the work have gone into the development of models that can tell about the impact of physical and transition risk on the macro economy and financial stability. In order to better account for climate-related risks these had to be reflected 'in the central bank workhorse models to account for their interactions with other, more standard risks within the usual monetary policy horizon' (Drudi et al., 2021, p. 67). In other words, central banks have set themselves on the task of setting up a cognitive infrastructure to be able to work with climaterelated issues. The problem, however, was that there was no preexisting model that could account for both. Similar to the work on macroprudential regulation a lot of time and energy have been devoted in the central banks to update and accommodate the modelling framework (Kranke & Yarrow, 2019; Thiemann et al., 2020). First, they are seeking to adopt their traditional macroeconomic models that deal with inflation, growth, technological developments and so on so forth to include climate-related issues. Second, work is undergoing in terms of developing scenarios used to predict future mitigation and adaptation pathways, stemming from the realization that backward looking data cannot be used when it comes to climate-related issues (Bolton et al., 2020).

The work on adapting the existing macroeconomic modelling framework aimed at combining existing macroeconomic models with climate models. This is work-in-progress within the central banks, where the method is to look through the existing modelling framework and thereby 'rebuild new models that are fit for macroeconomics at the time of climate change' (interview 3). This however, proves to be quite challenging, since there is a 'disconnect' between climate models and macroeconomic models (Drudi et al., 2021), patching together 'two things that are not meant to be patched together' (interview 3). A first issue pertains to the time horizon, where the traditional horizon for central bank forecasting is 2-5 years. When it comes to climate change, modelers in the central banks are now forced into experimenting with how to incorporate much longer time horizons and look into decades and not years. This poses a challenge not just to the modelling exercise, but also because the long-time perspective opens up to other types of discussions which can be hard to justify in terms of the remits of central banks:

I think this is difficult and something we have been grappling with internally which is once you bring into the prudential toolkit a 10-year horizon, why only climate? Why

don't we talk about other things such as pandemics, wars, digitalization, or demographic change? (interview 7)<sup>20</sup>

A second issue relates to the level of complexity. Knowing that not one model can include all factors and variables, it is unclear how best to approach this. Central bankers run experiments with different existing models such as DSGE models that is traditionally used in central banks (see Helgadóttir, 2021 for further explanation) but is weak on the climate components. An alternative model is the newer G-Cube model which is more rich on the climate-economy-finance nexus, but which in turn is too broad brushed: *as you know, any model has to be a simplification of a complex reality, otherwise you're asking, like in the 1970s, for these massive models that are meant to explain everything, but they are subject to the Lucas critique' (interview 7). Thus, economists within the central banks work within the epistemic boundaries, as the models need to follow that of economic reasoning, while being careful in not opening up for other avenues for discussion, knowing that they are trying to 'patch together' different modeling approaches. Henceforth, there is not an acceptance of the fact that working with climate-related issues might require a more multifaceted modelling framework as it seeks to depict a complex reality.* 

At the NGFS the focus has been to develop so-called scenario analysis. Scenario analysis is a way to explore the financial impact of different possible outcomes for climate change and climate policies under different timeframes (Network for Greening the Financial System, 2019, p. 21) allowing to account for the *multiplicity of climate change outcomes* in a given realization of the future (Chenet et al., 2021). The turn to scenario analysis represents an important break with the reliance on historical, backward looking data stemming from the realization of *'the uncertain and forward-looking nature of climate-related risks'* (Bolton et al., 2020, p. 21). The development of scenario analysis is interesting because this is where the work with climate-related issues is most pertinent. The design of the scenario analysis implies that central banks through the work of the NGFS have developed an analytical framework that account for possible climate futures taking into consideration possible transition pathways, climate policies as well as changes in climate, weather conditions and natural catastrophes.

In designing these scenarios, it was quickly agreed within the NGFS to come up with a common framework that could be used by all members. Within NGFS it was decided that the task needed to be outsourced to external organizations, and NGFS received a grant from Bloomberg

<sup>&</sup>lt;sup>20</sup> Similar observation in 1

Philanthropies and ClimateWorks Foundation to develop this work. Following the same approach as that of 'skilling up' they again looked to the IPCC and chose to work with a specific group of modelers known for their work on Integrated Assessment Models (IAMs). NGFS chose this group of modelers because they were most widely used by the IPCC and therefore considered as the 'least controversial' group of scientists and type of model (interview 1). However, this type of model also have a tendency to rule out radical uncertainty in terms physical and transition risks (Svartzman et al., 2021). NGFS thereby outsourced the work on designing scenarios to three external organizations: PIK, IIASA and GCAM<sup>21</sup> with the goal of developing 'a more detailed data-driven narrative and quantitative parameters as a foundation to these scenarios.' (Network for Greening the Financial System, 2019, p. 21). What is interesting to note here is the emphasis on data-driven and quantitative parameters, which is often used to legitimize and justify interventions (Thiemann et al., 2020).

The process, however, saw little direct involvement from the central banks. The central bankers in the NGFS secretariat acknowledged they did not have a sufficient level of knowledge in terms of engaging in detailed discussions on climate change, despite the fact that the assumptions built into these scenarios are open to contestation (Taylor, 2022). As a result, discussions were kept at a more general level, for instance in terms of the extent to which the IAMs relied on carbon capture technology (interview 1). The discussions of the scenarios within the central banking community have also been limited to one of ensuring an ever higher level of granularity in terms of sectors and geographical distribution (Alogoskoufis et al., 2021)(interview 1 and 10). The current focus of the NGFS consortium is to refine the scenarios by 'adding further sectoral granularity' (NGFS, 2021, p. 45). Indeed, the aim is to have granular data that can show how the risks unfold geographically, at different times and under different climate change scenarios (interview 5). The logic is that granularity is key in order to be able to assess how the green transition affects the different parts of the economy as well as the different regions of an economy, ultimately down to the individual firm to be able to identify financial exposures.<sup>22</sup> Thus, the discussion around scenario analysis has been reduced to one of access to data, which frees the involved economists for discussions around climate-related issues to which they are alien.

<sup>&</sup>lt;sup>21</sup> The interviewee explained that the GCAM goes under the name of the model (GCAM) and not the institutional affiliation (like PIK and IIASA). GCAM is developed by the Pacific Northwest National Laboratory based at the University of Maryland.

<sup>&</sup>lt;sup>22</sup> Participant observation at Green Finance Research Advances in Paris, December 2021.

Taken together, the work with adapting the existing modelling framework and the development of new forward-looking scenarios demonstrate how the work with climate-related issues became subject to an economic logic of reasoning with an emphasis on quantification and data access, previously shown in the literature to legitimize intervention (Skovgaard, 2021; Thiemann et al., 2020). It ensured that central banks could address climate-related issues with the tools already part of their existing toolbox such as stress testing, while at the same time avoiding deciding on *'the right policy mix'* (interview 11) and dealing with the *'important trade-off between climate action and inequality'* (interview 7). Scenario analysis come in particularly handy here, as it is a way for the central banks to show what *can* happen and demonstrate the worst-case scenarios without having to argue which way is the better way to deal with such circumstances (interview 1).

Even though the design of the scenarios has involved external climate expertise, it ultimately represents an economic idea of stress testing that has been widely used since the financial crisis. The work was commissioned by central banks stemming from the reasoning that revealing the risk level will incentivize the financial system to accommodate accordingly, when the urgency of climate change calls for much more drastic measures (Chenet et al., 2021; Christophers, 2017; Tarim, 2022). In short, the perfect tool for depoliticizing the discussion around climate-related issues (Stahl, 2021). Instead of acknowledging the fact that the economy is embedded in the environment which calls for an entirely new approach to modelling, which embraces complexity and the use of non-equilibrium models (Svartzman et al., 2021), the work with models and scenario analysis has become subject to a simplification of reality, because this is the reasoning behind economists' way of modeling.

# 7. Conclusion

This paper presents a case of how central banks deal with non-economic issues such as climate change, and how they deal with such an issue with no previous experience or prerequisites. I find that central banks claim institutional expertise on such a matter by making climate change subject to an economics logic, more particularly one about risk, which means that they can deal with these issues using the skills and tools they traditionally make use of. At the same time, central bankers have outsourced the parts of the work that required core climate science competencies to external actors (the development of scenario analysis), choosing the 'least controversial' type of model, acknowledging that they had little expertise to call judgement in

this matter. Thus, central banks have outsourced all the climate aspects of climate-related issues, to make sure that they only have to deal with the risk aspects which fall under their competencies. However, this is not without consequences. These so-called IAMs are ill fit for capturing tail risks (Svartzman et al., 2021), which is quite a paradox as this is exactly the purpose of stress tests. In fact, it is openly spoken of that some of these models are too optimistic, but modelers use it anyhow because this is the one used by NGFS.<sup>23</sup>

These findings suggests that there are hard epistemic boundaries within central banks, where central banks are only susceptible to new ideas when they are presented as being economic in nature. This is evident in the predominance of the idea of climate-related *risks*, the insistence that it requires economic training to deal with such issues, as well as the way central bankers seek to adapt their existing modelling framework to address this new type of risk. I thereby show how there is a strong hierarchy of sciences within central banks, with an economic science ethos being at the very top, dominating to such an extent that it is considered second to none even in the case where central banks are dealing with an issue of non-economic character. Thus, I have argued in this paper how central banks are only open to external ideas to the extent that ideas are presented by economists, and represent an economic logic, adding this as a scope condition to the existing literature for ideas to travel within central banks.

It is beyond the scope of this paper to determine what led to this focus on climate change as a risk issue in the first place. I have only argued here that there is a predominant economic science ethos, which leads to a very particular way of dealing with non-economic issues in central banks. It is left for future research to discuss whether the risk framing occurred because of central banks' mandate or simply because this is what they can do within central banks in terms of skills. Such research would resemble a discussion of whether the chicken or the egg came first, but it would nevertheless be important for further advancements in the literature around central banks. I have also disregarded the emerging, nevertheless important, emerging discussion on issues related to biodiversity in central banks. I leave it to future research to explore whether the emphasis on economic reasoning that is outlined in this paper would also hold in the case of biodiversity. A final important limitation of this paper is that it only focuses on so-called Western central banks, pointing to the ironic observation that the title of this paper is somewhat overstated, as it only seeks to uncover how Western central banks see climate

<sup>&</sup>lt;sup>23</sup> Participant observation at Green Finance Research Advances seminar in Paris, December 2021.

change. Research conducted on Peoples Bank of China suggests PBoC has taken a different approach with a focus on green bonds and credit guidance (Dikau & Volz, 2021), and thus there is more potential to discover this 'seeing like' approach in full. What this paper has done is to show that for an idea to enter a Western central bank it must take the form of an economic idea, and whether the same holds for central banks in other parts of the world remains to be explored.

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# Appendix 1: Overview of coding scheme

Code	Subcode
Work with models	Scenario analysis
	IAMs
Risk	Physical risks
	Transition risks
Prefers economic skills	
Climate skills	
Mandate	Climate is for democratically
	elected governments
	Financial stability
	Price stability

# *Paper III*. Managing Climate Risks: How Climate Scenarios Entered Central Bank Policymaking

# Managing Climate Risks: How Climate Scenarios Entered Central Bank Policymaking

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#### Abstract:

With the creation of the NGFS scenarios, the Network for Greening the Financial System (NGFS) has embarked on the project of creating scenarios based on economic, energy, land-use, and climate models to map climate-related risks. Yet in doing so, the NGFS has chosen to use the so-called Integrated Assessment Models (IAMs). Models that are ill-equipped to account for uncertainties and tail risks, which both inevitably follow from climate change. Building on interviews, participant observation, and a close reading of documents and central bank speeches, this paper analyzes why central banks, despite the well-known pitfalls of IAMs, chose to use this group of models. The paper argues central banks found a group of like-minded peers in the IAM community, as the two communities share modeling approaches and worldviews. The paper identifies four factors that led to this collaboration: legitimacy, continuity, versatility, and community. As these two like-minded technocracies join forces, the result is the creation of scenarios with a specific and narrow understanding of climate change, which can lead to an underestimation of climate-related risks with consequences not just to financial stability, but also to the broader decarbonization agenda.

Keywords: central banks; green central banking; transnational wormhole; NGFS; economic models; integrated assessment models

As an economist and central banker, I have a soft spot for models and scales. Klaas Knot, President of the De Nederlandsche Bank, September 2022

# 1. Introduction

June 2020, June 2021, and September 2022 represent milestones in the relatively brief history of the Network for Greening the Financial System with the publication of the hitherto three vintages of the so-called NGFS scenarios. The NGFS was established in December 2017 with the aim to share best practices and contribute to the development of climate risk management in the financial sector (NGFS, 2017). The NGFS scenarios are a cornerstone in this work as the scenarios are designed for the conduct of climate stress testing to 'provide a common starting point for analysing climate risks to the economy and the financial system' (NGFS, 2020, p. 5). The importance attached to these scenarios calls for shining light on the creation of the scenarios and what this can tell us about the approach to the risk management of climate-related risks.

One way to analyze climate-related risks would be to acknowledge that climate change represents a fundamentally different type of risk. In the now famous 'Green Swan' report published by the Bank for International Settlements (BIS) in January 2020, the authors argued for epistemological breaks in the approach to risk management that would require the use of non-equilibrium models, sensitivity analysis, and qualitative case studies along with the use of scenarios analysis. An idea that was advocated by the very inner circle of the emerging green central banking community as two out of the five authors were from the NGFS Secretariat at Banque de France while another author was no other than Deputy General Manager at the BIS Luiz Awazu Pereira da Silva. Even though these ideas were present in the very inner circles, the approach to managing climate-related risks through the creation of the NGFS scenarios has largely followed a business-as-usual approach and represents a situation of incremental change as seen after the financial crisis (Johnson et al., 2019; Moschella & Tsingou, 2013) and not the kind of epistemological break advocated by the authors of the Green Swan.

Yet, in the creation of the NGFS scenarios, the NGFS has chosen to use the so-called Integrated Assessment Models (IAMs) that combine economic, energy, land-use, and climate modules into one modeling framework. A set of models largely constructed around neoclassical economics and a cost-efficiency logic as well as a belief in the quantification of climate-related risks. IAMs are a set of models used for instance in the IPCC reports to show different mitigation pathways

or by US policymakers to evaluate climate policies by calculating the social cost of carbon (Weyant, 2017). These IAMs, however, have attracted a lot of criticism for the overall modeling framework, especially regarding the models' abilities to analyze problems of deep uncertainty and extreme risks (Carton, 2020; Dooley et al., 2018; Pindyck, 2013; Stern et al., 2022). These pitfalls can lead to a poor understanding of climate-related risks and 'grossly misleading' policy recommendations on climate-related financial regulations (Svartzman et al., 2021, p. 6). As the abovementioned authors of the BIS Green Swan report concluded, IAMs *'will remain unable to capture many forces triggered by climate change'* (Bolton et al., 2020, p. 27). The question then is how central banks motivate the use of IAMs as they seek to understand the broader macroeconomic implications of climate change.

Following the trajectory of incremental change after the financial crisis, what Helleiner (2014) called 'the status quo' crisis, one would not expect fundamental changes in the approach to modeling climate-related risks. The development is nevertheless puzzling for two reasons. Firstly, you have a small group of well-positioned central bankers in the NGFS and BIS advocating for an epistemological break. The situation thus resembles the post-crisis macroprudential shift, where a similar centrally placed group of actors in the BIS succeeded in mainstreaming macroprudential ideas (Baker, 2013), only this time it is a continuation of the status quo. Secondly, it is the core value of the NGFS to recognize climate change as a risk to the financial sector. This represents a break with neoclassical economic modeling, traditionally used in central banks, which predicts a negligible impact from climate change. As William Nordhaus explained at his Nobel Prize lecture in 2018, the DICE model estimates damages to be 2% of output at 3°C global warming, and 8% of output at 6°C of global warming.<sup>24</sup> If one takes these figures seriously climate change will not pose a risk, let alone a systemic risk, to the financial system. Thus, it is puzzling that the NGFS breaks with neoclassical economics in recognizing that climate change is a risk to the financial system, while at the same time using models that are constructed around neoclassical economics to understand how climate change may impact the financial system.

The main argument of the paper is that the central banking community, represented by NGFS, found a group of like-minded peers in the IAM community. It is not just central bankers who have 'a soft spot for models and scales' as stated above by Knot, President of the DNB. So do

<sup>&</sup>lt;sup>24</sup> https://www.nobelprize.org/uploads/2018/10/nordhaus-lecture.pdf

integrated assessment modelers, and the paper identifies four factors that explain how central banks have motivated the use of IAMs: *legitimacy, continuity, versatility,* and *community.* To elaborate, the IAMs represent an approach to the conduct of modeling that to a large extent is coherent with the approach taken within central banks and thereby aligns with the existing 'governability paradigm' in macroeconomics (Braun, 2014). Since the IAMs follow neoclassical economic theory and are driven by a cost-efficiency rationale, they provided a formalization and operationalization of the existing macroeconomic vision in a time of climate change, assembled into one coherent modeling framework. Thus, history appears to repeat itself as central banks subsume the management of climate risks into the current modus operandi leading to a suboptimal policy outcome (Braun et al., 2022; Fligstein et al., 2017; Golub et al., 2015).

To understand how central banks act as a collective technocracy, the paper builds on Johnson's (2016) theoretical conceptualization of the central banking community as a 'transnational wormhole', meaning central banks collaborate in a network of transnational interaction and socialization that restrict access by outsiders, and they enjoy a similar training and worldview and interact regularly within the network, which reinforces the perception of distinctness as a transnational community. While this wormhole organization is well suited for transmitting knowledge and ideas within the network, it makes it more difficult for community members to interact with non-members or acknowledge alternative views from outside the network (Johnson, 2016, p. 5). Yet, in creating the NGFS scenarios, the NGFS turned to three integrated assessment modeling institutions Potsdam Institute for Climate Impact Research (PIK), the International Institute for Applied Systems Analysis (IIASA), and the University of Maryland (UMD) to advance this work, leading to an unusually close collaboration between central banks and an external scientific expert community.

In contrast to Johnson's work on the transnational wormhole, which theorizes technocratic communities as relatively closed around themselves, this paper shows how technocratic communities such as central banks, can be open to the influence of external expertise under certain circumstances. In this case, central banks needed external expertise to be able to model the macroeconomic impact of climate change and therefore turned to the IAM community. As the four factors show, in choosing integrated assessment modelers, the NGFS chose a group of experts that align with their worldview and normative assumptions to maintain the (illusory) sense of stability and control that comes from using existing central bank models (Braun, 2014).

The consequence is that the NGFS fails to explore alternative models and explanations, which may lead to overlooking or underestimating risks (Fligstein et al., 2017; Golub et al., 2015).

The paper contributes to two well-established literatures in IPE, namely the literature on the influence of models on policymaking (Braun, 2014; Clift, 2019; Coombs, 2020; Heimberger et al., 2020; Helgadóttir, 2021a, 2021b; Henriksen, 2013; Lockwood, 2015), and how central banks maintain status quo and subsumes this new policy field of climate risk management under the existing modus operandi (Braun et al., 2022; Fligstein et al., 2017; Golub et al., 2015; Johnson et al., 2019; Moschella & Tsingou, 2013). Models reduce uncertainty, make the future statistically calculable, and give an impression of objectiveness, which are all important to central banks to uphold their legitimacy (Heimberger et al., 2020; Henriksen, 2013; Lockwood, 2015). The literature on models tells us that these are important objects of study because the technicalities around modeling efforts are often telling of the underlying normative assumptions and political economy principles (Clift, 2019). While the literature appears to disagree in terms of whether models can act as a catalysator for ideational change (Clift, 2019; Henriksen, 2013) or maintain the status quo (Braun, 2014; Helgadóttir & Ban, 2021; Mudge & Vauchez, 2019), it is yet to be uncovered how economic actors, such as central banks, seek to model non-economic issues such as climate change, which leads to the second argument of this paper. That central banks subsume everything under their current modus operandi whether it is the interpretation of anomalous information prior to the financial crisis (Fligstein et al., 2017; Golub et al., 2015), meddling in labor market reforms, or fiscal policy to ensure governability of the financial system (Braun et al., 2022; Diessner & Lisi, 2019), or, as in this case, modeling the macroeconomic impact of climate change.

Empirically, the paper offers new insights into the emerging literature on climate change and climate-related risks, by shining light on NGFS and the making of climate scenarios with the use of IAMs. The first empirical contribution is the focus on the NGFS, a hitherto understudied institution within IPE. Founded in 2017 by eight central banks and supervisors, the NGFS now has 121 members and 19 observers and enjoys widespread support within the international central banking community. While the NGFS merely identifies itself as 'a coalition of the willing' it has been much more active in the discussions on how to green the financial system and address climate-related risks than established institutions such as BIS and FSB. The second empirical contribution concerns the IAMs, a modeling framework that has clear limitations with broader socio-economic consequences, such as social and geographical inequalities (see for

instance Buller, 2022). It shows a limited integration of instruments from the climate policy field as it has to fit the modus operandi of the central banks, which in turn has led to a specific and narrow understanding of climate change that may in turn lead to an underestimation of the urgency of economy-wide decarbonization initiatives.

The outline of the paper is as follows. The next section gives a brief introduction to IAMs. The third section introduces the data and methods. The fourth section analyses the overlapping characteristics of the IAM community and the central banks which includes legitimacy, continuity, versatility, and community. The following section discusses how short- and long-term policy implications and what this means for the governance of green finance more broadly. The final section seeks to conclude.

## 2. Models, risk assessment and climate change

If we want to understand how central banks approach the work with climate change, unpacking the black box of modeling climate-related risks can be an important gateway. It is important to understand models and the methods and assumptions these models rest on, as they can act as sites of contestation, which can either lead to ideational change (Clift, 2019) or maintain the status quo as changes in assumptions or methods can challenge the overall macroeconomic framework (Helgadóttir & Ban, 2021). As Helgadóttir (2021a, pp. 21-22) notes, '*Models embody assumptions about what constitutes legitimate knowledge production... about how discrete phenomena interact and about what forces animate such interactions*.'. Thus, economic models influence policymaking, as they can serve as a transmission device between economic paradigms and policy programs (Heimberger et al., 2020). This is not to say that models alone can induce (or resist) policy change (Henriksen, 2013), but they provide an important gateway to understanding the underlying assumptions and normative framework of a policy paradigm.

#### 2.1 Integrated assessment models: a short explainer

In the first report published by the NGFS in April 2019 'A call for action' one of the three pledges made was to develop 'voluntary guidelines on scenario-based risk analysis'. The work with the scenarios has led to the creation of six scenarios in close collaboration with the modeling consortium of integrated assessment modelers from PIK, IIASA, and UMD. Sarah Breeden who has led this work for the NGFS calls it *'a truly interdisciplinary effort'* (Breeden, 2021). The scenarios represent a harmonized set of transition pathways, physical climate change

impact, as well as macroeconomic global indicators (Monasterolo et al., 2022; NGFS, 2022a). The transition pathways, which are the backbone of the scenarios, are based on the IAMs from PIK (REMIND-MAgPIE), IIASA (MESSAGE-GLOBIUM), and UMD (GCAM).

IAMs are models that seek to convey how future climates develop under different types of climate change policies with the purpose of providing policymakers with an idea of the implications of various policies (Weyant, 2017). IAMs show the different mitigation pathways and model the complex relationship between social, economic, and biophysical systems with the aim of achieving cost-optimal mitigation outcomes through the pricing of carbon (Beck, 2018; Dooley et al., 2018; Stanton et al., 2014). Indeed, the analytical strength of the IAM framework rests on the ability to integrate information from various scientific disciplines into one framework in combining macroeconomic, agriculture and land-use, energy, water, and climate systems into a coherent framework (NGFS, 2022a; van Beek et al., 2020).

IAMs have come to play an increasingly important role in climate policymaking and are now an integrated part of the IPCC's assessment reports. The first IAM was introduced in the 1970s by William Nordhaus one of the first economists to integrate climate and economic models with the DICE model, the most well-known IAM, for which he was awarded the Nobel Prize arguing that a 4°C increase in temperature would be optimal from an economic perspective. The DICE model has caused a lot of debate and controversy (Buller, 2022; Keen, 2021; Stern et al., 2022) but DICE is just one among many different IAMs. IPCC Working Group III, the working group that runs these modeling exercises, applies a total of 32 global, regional, and national IAMs (IPCC, 2022), including the three IAMs used for the NGFS scenarios. The IAMs used by IPCC belong to the group of 'process-based IAMs' which are models that, in contrast to the simpler cost-benefit IAMs such as the DICE model, are more detailed and show the different transformation pathways towards the temperature target. The 'cost-benefit IAMs' are highly aggregated and seek to estimate the optimal mitigation levels (van Beek et al., 2020; Weyant, 2017). Thus, there are large differences between IAMs in terms of detail, complexity, and interconnectivity of these models (Weyant, 2017). Whereas the cost-benefit IAM is not part of the IPCC, process-based IAMs are now the backbone of IPCC scenario analysis (van Beek et al., 2020).

Yet, the IAM framework has been exposed to a wide range of critiques regarding unrealistic assumptions, not being able to account for uncertainties, and being too optimistic in terms of the

severity of climate catastrophes. Some people argue that the widespread application of IAMs is problematic because 'their use suggests a level of knowledge and precision that is simply illusory, and can be highly misleading' (Pindyck, 2013, p. 862). Others acknowledge that despite their uncertainties the IAMs provide 'a good place to start in terms of basic principles and rough numbers to use in developing short-term... policies and research priorities.' (Weyant, 2017, p. 129). The main points of critique of IAMs concern the underlying assumptions in the calculation and assessment of the discount rate and the so-called damage function, and the (in)ability of IAMs to account for tails risks and uncertainties. While the former raises important issues, especially regarding intragenerational questions (see Pindyck 2013, Stern et al. 2022 and Weyant 2017), the latter is of the most relevance in this case, as the purpose of the conduct of scenario analysis and climate stress testing is to understand the impact of tail risks and extreme scenarios.

As we seek to understand how climate change unfolds, we cannot do away with uncertainty, as climate scientists cannot predict how and when events will occur. There is generally a great deal of uncertainty around how climate change will unfold in terms of timing, the extent of the damages, and whether there are tipping points, feedback loops, and cascade effects that are not currently accounted for in the existing modeling frameworks (Bolton et al., 2020; McKay et al., 2022; Rockström, 2022). This means that low-probability, yet costly climate change events cannot be ruled out (Pindyck, 2013; Stanton et al., 2014). The problem is not the uncertainty as such, but that IAMs are ill-fitted to account for these uncertainties and extreme risks. The IAM framework is designed in such a way that modelers use central or average estimates through their equilibrium-based optimization, it maximizes expected utility, and it rests on the assumption that market mechanisms will coordinate the activities of all agents even though agents will not maximize expected utility under great uncertainty (Stern et al., 2022; Svartzman et al., 2021).

The fact that IAMs are ill-equipped to account for catastrophic outcomes takes the focus away from the possible impact of disastrous and damaging events, which ultimately questions the relevance of using this framework for financial policymaking (Stern et al., 2022; Svartzman et al., 2021). This raises the question of whether NGFS chose to use IAMs because there were no other credible options. The answer to this is, to the contrary. There are alternatives and alternatives that have been used by other international economic organizations.

#### 2.2 Alternative approaches to the scenario exercise

There is precedence for central banks and international organizations like the IMF or the World Bank to adapt their modeling framework. After the financial crisis, the IMF adapted their models to better account for fiscal multipliers (Ban, 2015; Clift, 2019), central banks have also been found to discuss radically different modeling approaches after the financial crisis (Helgadóttir & Ban, 2021). When it comes to modeling climate-related risks, there are other modeling approaches that provide viable alternatives such as stock flow consistent models that would better capture the complexities of climate change. Alternatively, the NGFS could have embraced the epistemological break to modeling as advocated by the authors of the previously mentioned 'Green Swan' report from the BIS. Such alternatives might seem like radically different alternatives, but it is important to note that stock flow consistent models are used by the World Bank (World Bank, 2022) and the argument for the 'epistemological break' was pushed forward by a small group of central bankers from BdF and BIS.

Stock flow consistent models present an alternative approach to mapping out climate-related risks. This type of model is generally better at accounting for agents' heterogeneity and adaptive behavior and can account for macro-financial feedback (Monasterolo et al., 2022). One example is the DEFINE model, which is an ecological stock flow consistent model (Dafermos et al., 2018). The DEFINE model is interesting because it, unlike IAMs, integrates the financial system into the macro economy, and it has a depletion channel meaning that growth will deplete finite natural resources (Dafermos et al., 2018). Another stock flow consistent model is the EIRIN model which focuses on the feedback loop between the climate and the financial sector (Monasterolo & Raberto, 2018). The EIRIN model is particularly interesting as it has been applied in other institutions. First, it is part of the suite of models used by the World Bank for climate policy analysis (World Bank, 2022). Secondly, the EIRIN model was used by the ECB to run an exercise on the double-materiality (i.e., how finance impacts the climate) of climate-related financial risks and finds that a late and disorderly transition *'fosters banks' financial instability'* (Gourdel et al., 2022). This shows how stock flow consistent models are accepted within other institutions.

A second alternative approach is to embrace the epistemological breaks needed to understand climate-related risks. The first epistemological break called for by the authors of the Green Swan report is to embrace forward-looking, scenario-based methodologies, which is largely

what the NGFS has been doing with the development of the NGFS scenarios. Yet, they also find that this is not sufficient as IAMs cannot fully capture the ways in which climate change will unfold. Thus, a second epistemological break is needed, one that represents 'a move from an epistemological position of risk management to one that seeks to build the resilience of complex adaptive systems that will be impacted in one way or another by climate change.' (Bolton et al., 2020, p. 43). This involves a new approach to forward-looking risk management which includes the use of non-equilibrium models, sensitivity analysis, and case studies along with a closer institutional involvement between monetary and fiscal authorities to support the systemwide transition of the economy. While the NGFS has largely recognized the first epistemological break, there has been little discussion with regard to the second epistemological break, even though this is essential if the aim is to have a comprehensive understanding of climate-related risks.

In sum, there are alternative models to IAMs and the current quantitative approach to risk management of climate-related risks. These alternatives have been used by international organizations such as the World Bank or have been advocated from within, but have failed to get widespread acceptance.

### 3. Methods and data

Important to the research design of the paper has been to conduct interviews with relevant stakeholders to get insights from those involved in the process. The paper draws on data from 20 interviews with 17 interviewees (see table 1). Of the 17 interviewees, 12 of them are central bankers, five interviews have been conducted with climate modelers and six of the interviewees have been involved with the NGFS consortium. Since this paper concerns the design of climate scenarios, it has been crucial to the research design to get perspectives from central banks as well as climate modelers to have a more complete set of perspectives on the work with the NGFS scenarios. The interviews followed the semi-structured interview technique, which provided an overall framework for the interview, while at the same time allowing for an open and flexible discussion (Kvale & Brinkmann, 2008; Marta, 2021). The sampling method used for the collection of interviews is a mix of strategic sampling and snowball sampling. For the strategic sampling interviewees were selected if they had been involved in work with the NGFS scenarios (based on the acknowledgments), had previously given presentations on the subject, and/or were involved with climate-related issues in a central bank. The questions discussed

during the interviews concerned how central bankers make judgment calls on climate-related expertise, how central bankers have approached the modeling of climate-related risks, how it was for the climate modelers to collaborate with central banks, and if they found they had anything in common.

		No. of	Part of NGFS
Position of interviewee	Organisation	interviews	secretariat/IAM
Senior central banker	Banque de France	2	Yes
Junior central banker	Banque de France	1	Yes
Senior central banker	ECB	1	No
Senior central banker	Banque de France	2	Yes
Senior central banker	Nationalbanken	2	No
Former senior central banker	Bank of England	1	No
Former senior central banker	Bank of England	1	No
Senior central banker	ECB	1	No
Junior central banker	Banque de France	1	Yes
Senior central banker	Bank of England	1	Yes
Senior central banker	ECB	1	No
Senior central banker	Norges Bank	1	No
Fellow	CEP	1	No
Postdoc	PIK	1	No
Senior scientist	PIK	1	Yes
Professor	French University	1	No
Senior lecturer	UK University	1	No

Table 1: overview of interviews (CEP is short for Council on Economic Policies)

In addition to the interviews with central bankers and climate modelers, the paper draws on data from NGFS documents on scenario analysis and participant observation at webinars hosted by the NGFS and the integrated assessment modelers, as well as speeches from central bank governors from the BIS database (see table 2). The sample of speeches has been created from the BIS database through a word search on 'NGFS and scenarios' which gave a sample of 117 speeches. The paper draws on these multiple sources of data for two reasons. It serves the purpose of triangulation and, given that the NGFS scenarios represent quite recent developments, the sample comes close to the completeness of the overall sample as the paper builds on the different types of communication from the NGFS and central bankers.

Data sources	Detailed description	Use in analysis
		The interviews with the central bankers provided
	A total number of 20	insights on central bankers' reasoning on the use of
	interviews with 17	scenario anlaysis and why they chose IAMs. The
Interviews	interviewees. 15 interviews	interviews with the climate modelers gave important
	with central bankers and 5	insights into the way they had approached the work
	interviews with climate	with the NGFS scenarios and the links between climate
	modelers.	and economic modeling.
		A close reading of the three vintages of the NGFS
		scenarios have shown the developments of the
	Documents published by	scenarios from when they were first introduced in June
Documents	the NGFS on the	2020 until the third vintage was published in September
Documents	scenarios, which includes	2022. The reports show how the NGFS secretariat and
	the three versions of the	IA modelers have approached the work with the
	NGFS scenarios as well as	scenarios, and thereby the types of priorities that have
	supporting documents.	been important in this work.
		Participating in the webinars where the NGFS
		scenarios were presented by the people involved in
		working on the scenarios, where central bankers and
Participant	Participant observation at	modelers have presented collectively. This has given
observation	the public presentations of	insights to the work distribution within the NGFS
	NGFS scenarios vintage	consortium and the types of questions from the
	two and three held as	audience have given an impression of how the work on
	online webinars.	the scenarios was received.
Speeches by central bankers	Speeches from the BIS	
	database of speeches about	The speeches were used to trace the official position of
	the NGFS scenarios.	central bank governors and board members.
	Career information from	These additional sources were used for information of
Supplementary	LinkedIn and	the modelers involved with the work on the NGFS
data	personal/institutional	scenarios to obtain information about education and
	websites	involvement with the IPCC.

#### Table 2: overview of data

The four factors derived to analyze how central banks justify the use of IAMs, namely legitimacy, continuity, versatility, and community have been identified following the principle of abductive reasoning. Abduction is a logic of reasoning that moves between systematically collected observations and extant knowledge and then uses this to develop a plausible explanation of the observed phenomena (Giese & Schnapp, 2021). The four factors have been identified by traveling between the empirical observations and the theoretical work on central banks as a 'transnational wormhole' by Johnson (2016) to understand the commonalities between the two communities of central bankers and integrated assessment modelers. Johnson

(2016) sets out four interlocking characteristics for the central banking community: widely shared principles and practices, a unique professional culture, a transnational infrastructure, and relative insulation from outsiders. These are not mirrored one-to-one in this case, but together with the empirical observations it provided the framework for the abductive reasoning that led to the identification of the four factors. The next section will unfold these four factors and show the overlapping commonalities between central banks and integrated assessment modelers and how this was key for the justification of the use of IAMs.

# 4. The use of IAMs for scenario analysis: four enabling factors

As the NGFS set out to create the scenarios they chose to use IAMs with little further justification but the fact that they were 'world leading climate scientists' and part of the IPCC (NGFS, 2021). However, we know from the literature that models are more than a technical issue, models also say something about the underlying normative assumptions and political economy principles (Clift, 2019). Thus, as this paper seeks to analyze how central banks justify the use of IAMs, it is important to go beyond this argument. As this section sets out to explore the underlying normative assumptions and political economy principles, it analyzes the coming together of two wormholes, as it is a group of two like-minded expert communities reaffirming each other's worldviews.

This paper has identified four factors that explain how central banks justify the use of IAMs. The first factor is the legitimacy of the modelers, where the three institutions enjoy a high level of academic credibility due to their close involvement with the IPCC. The second factor is continuity in the sense that the IAMs relied on a similar economic modeling framework that was already used within central banks. The third factor is versatility, where the IAM modeling framework proved to be versatile as it could be adapted to macroeconomic variables and indicators, and the IAM community was versatile since it had a long tradition of calibrating its models to the need of policymakers. The fourth factor is how the integrated assessment modelers represented an established and coherent community that had close collaborations prior to the work with NGFS.

#### 4.1 Legitimacy

Central banks are bound by their mandates of ensuring price stability and financial stability, but they are highly dependent on their legitimacy to fulfill this role (Best, 2019; Lombardi &

Moschella, 2016). As noted during one of the interviews central banks do not 'start a new adventurous thing for the sake of having fun' (interview 11), so the involvement with climate-related issues and the ensuing initiatives would have to be considered carefully. There are two explanations here. Firstly, the IAM community enjoyed strong academic credentials from their involvement in the IPCC assessment reports which provided scientific legitimacy to the creation of the scenarios. Secondly, central banks found scenario analysis to be a handy tool in the sense that they could set up a technical modeling framework around future climate trajectories and thereby avoid involvement in discussions around climate policies more generally while at the same time upholding their technocratic approach.

When central banks first started to look into climate-related issues they stepped into an entirely new field, and it was therefore essential for them to find a way of engaging with this issue in a way that would not compromise their institutional legitimacy. An approach that proved to be useful in the implementation of macroprudential policies (Thiemann et al., 2020). At the same time, the central bankers found themselves in a situation where they had neither training nor knowledge about climate-related issues. It was therefore clear to the people involved that they needed to find a well-established and highly regarded scientific partner, even though these were different stakeholders than they usually worked with. It was important to have a framework that was true to climate science because otherwise 'it would undermine the whole effort' (Interview 14). A message that has also been repeated by Ravi Menon, chairman of the NGFS who argued 'This is an especially technical area of work where the principle of being science-based cannot be overstated.' (Menon, 2022). The NGFS then found themselves in the position of having to identify experts outside of their own field of expertise. As one of the interviewees with the NGFS explained they 'wanted people who are quite renown in their own field, partly because we are trying to get expertise where we cannot judge how good they are because it is outside our area of expertise' (interview 4).

Within the NGFS they identified PIK, IIASA, and UMD as renowned modelers based on the latest IPCC report, with the argument that the models developed by these three institutions represented the majority of the scenarios in the latest IPCC report (interview 4, 13, 16). Yet, these modeling institutions and their models only represent a fraction of the total number of models used in the latest IPCC report which included a total of 32 international, regional, and national IAMs (IPCC, 2022). All three organizations enjoy a strong representation in the IPCC and are central to the network around the IPCC WGIII (Corbera et al., 2016; Hughes &
Paterson, 2017). Given the three institutions were involved with the IPCC they were also considered as being 'the least controversial modelers' and were therefore seen as the safe choice within the NGFS:

We wanted to have respected, non-contestable modelers for climate science. We are criticized on one side because the scenarios are not realistic enough, not severe enough for climate activists. But we decided to outsource to what we feel are representative experts. (Interview 13)

Bringing in the IAM community was therefore an important strategy for legitimating the development of the scenarios, and the fact that the IAM community enjoyed close relations with the IPCC was a key motivation for choosing these three institutions. Indeed, of the 13 modelers who have been involved in the work on the scenarios, six of them have been or are involved with the work in IPCC WGIII, and four of them have been (coordinating) lead authors on one or several chapters (see table 3). This, however, raises the question and points to a fallacy of technocracy; if technocrats, who are granted autonomy to lead by their expertise and thereby make informed decisions based on thorough analysis (Braun et al., 2021), make decisions based on what is 'least controversial' and most 'well-known', then what are technocracies good for?

Name	Institution	IPCC involvement
Cornelia Auer	PIK	No
Christoph Bertram	PIK	Contributing author AR6 WG3
Leon Clarke	UMD	Coordinating lead author AR6 and AR5
Ryna Yiyun Cui	UMD	Contributing author AR6
Jae Edmonds	UMD	Lead author AR6 (lead author on AR 1-5)
Jérôme Hilaire	PIK	No
Elmar Kriegler	PIK	Lead author AR6 WG3 (lead author AR5 WG3)
Jihoon Min	IIASA	No
Franziska Piontek	PIK	No
Joeri Rogelj	IIASA	Lead author AR6 (involved in AR5 as well)
Bas van Ruijven	IIASA	No
Sha Yu	UMD	No
Oliver Richters	PIK	No

Table 3: modelers involved in the NGFS scenarios (based on acknowledgments in the NGFS scenario reports) who have also contributed to work in IPCC.

At the more general level, the scenario analysis was useful for the central banks because it was a tool that could uphold the impression that central banks were engaging in this new field with their traditional technocratic approach and center the discussion around the traditional questions

they are dealing with. It is in many ways a continuation of the widening of the risk imagination that has been ongoing since the financial crisis (Morris 2018). As one interviewee explained:

'We allow central banks to operate in the space of really understanding the risks and pushing forward our understanding of this... We create scenarios without stepping into political space and that has actually worked really nice for us.' (Interview 4)

Thus, scenario analysis allowed central banks to strike the balance of acting while at the same time upholding that they are not interfering with climate policies. In that sense scenario analysis presented itself as 'comfortable' because it lays out possible future trajectories that can be either 'adverse or ambitious', but central banks do not have to argue for one or the other because they are possible trajectories and not forecasts (interview 13, presentation of NGFS scenario 3). The central bankers as well as the modelers involved in this exercise have indeed emphasized that these are not forecasts, but that they represent plausible futures, that are neither the most probable nor desirable (NGFS 2022, p. 6), which maintains the 'neutrality' of the exercise.

With the creation of the NGFS scenarios, the focus has been on the creation of a framework that 'includes nearly 1000 economic, financial, transition and physical variables across six different scenarios... created through a suite of models' (NGFS 2021, p. 2). In doing so the discussions around the NGFS scenarios have been turned into a technocratic exercise of quantification and modeling, even though there are clear limitations to such a quantification approach (Diaz & Moore, 2017; Keen, 2021). Such an exercise is key to central banks as the models bring throughput legitimacy because the perceived impartiality of the model makes the decisionmaking process appear 'transparent' and 'objective' (Heimberger et al., 2020; Schmidt, 2020). This is evident when you look at the envisioned next steps in the three NGFS scenarios which concern issues of how to combine a suite of models in a coherent way, improving the data quality to ensure sectoral granularity and geographical coverage at the country level, quantify the impact of physical risks, and adding additional macroeconomic transmission channels (NGFS scenarios 1, 2, 3). In short, it is a promise of more of the same. These envisioned next steps are by no means accidental but ensure that the discussions are centered around quantification and modeling which work to strengthen the impression that this is a technocratic discussion for experts, which is supposed to strengthen the output legitimacy of the project.

#### **4.2 Continuity**

An important characteristic of the IAMs is that the economic 'leg' rests on the neoclassical economic framework which leads to important synergies between the IAMs and the macroeconomic models traditionally used in central banks, including the DSGE model, which is the macroeconomic workhorse model in central banks (Helgadóttir, 2021b), and therefore represents a sense of continuity in the modeling approach. The central banks and IAM community have at the basic level the same approach to modeling economic effects and the use of neoclassical economic models implies that they apply similar assumptions which include an efficient allocation of capital, use of equilibrium models (or partial equilibrium), assumptions about rational agents and work from a cost-efficiency rationale (Carton, 2020) (interviews 1, 2). Central banks could thereby easily relate to the overall modeling framework of the IAMs. It had the practical implication that they could continue the use of the same models and could thereby pursue business as usual in treating questions related to climate change. As Klooster (2022, p. 775) notes, one of the reasons for the increasing power of technocratic actors has been the emphasis on this sense of continuity: By suggesting continuity while also successfully addressing new problems, monetary technocrats minimize legislative involvement and avoid politicization. A balance which is maintained with the creation of the NGFS scenarios.

Even though IAMs came from an entirely different subject area, the models used the same modeling framework building on neoclassical economics, which has dominated economists' approach to climate change for decades, and therefore, importantly, did not challenge the dominant worldview within central banks. Since Nordhaus first introduced his work on climate change and economics in the 1970s, which led to the introduction of the DICE model as the first IAM, Nordhaus has effectively acted as a gatekeeper in the academic debate on the economics of climate change, and the 2°C target in the Paris Agreement can be attributed to his work (Buller, 2022; Keen, 2021). As noted by an interviewee, the NGFS scenarios are self-contradictory because in one way they represent a break with Nordhaus' work by acknowledging that climate change can have a severe impact on the broader economy, but in terms of modeling this impact, they fall back on the neoclassical modeling approach.

The IAMs were considered convenient since they were consistent with the modeling frameworks that were already used in the central banks, and some of the IAMs even build on models that were used in central banks already such as DSGE models (interviews 1, 2, 11). The

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IAMs were therefore perceived as consistent and coherent because they aligned well with the existing modeling framework, and as was argued during an interview it also gave a sense of robustness which was missing in alternative models such as the agent-based models (interview 11). This is an important factor since models such as the DSGE model dominate macroeconomic analysis and have been considered as the mainstream model in international organizations such as the IMF and central banks (Helgadóttir, 2021b). While there has been critical debate and assessment of the DSGE model within the IMF (Clift, 2019), it has proved surprisingly resistant within central banks even as it failed to foresee the financial crisis and the Eurozone crisis (Mudge & Vauchez, 2019). As Mudge and Vauchez (2019, p. 268) conclude in the case of the ECB, the DSGE model has proved resistant as it was 'grounded in a network of modelers and, more importantly, in the transnationalized world of central banking, thus far DSGE modeling has proven to be too embedded to fail.'. In short, the overlap of the modeling frameworks gave a sense of continuity where no fundamental changes had to be made.

Another important factor is the IAMs rested on similar assumptions and worldviews, and central bankers could therefore rely on their existing expertise in economic modeling, which is also reflected in the expected outcome of the scenarios as exemplified in a speech by the governor of the Spanish central bank: 'Scenarios need to capture the aggregate effects of climate change and their transmission channels through to the macroeconomic variables.' (Hernández de Cos, 2021). They were not able to assess the IAMs for the climate part of the model, because they simply lacked the training. As one interviewee explained, this aspect was largely a black box to them, especially at the outset. Yet, given they could use existing models such as the DSGE model, they could also use the models in which they are trained and with which they were familiar (interview 2). The majority of central bankers are trained in orthodox economics and they are therefore used to working with these specific models (interview 11). It is not, however, that central bankers are not willing to learn. They have adapted new modeling approaches with the implementation of macroprudential regulation (Thiemann et al., 2020), and central bankers should not be considered a homogenous group (Ban & Patenaude, 2019). As one of the modelers explained, people in the financial stability department are more open to alternative ideas than people in the macroeconomic department (interview 16). Nevertheless, IAMs allowed for continuous use of the DSGE model, which meant that central bankers could work from their existing economic expertise on which their authority is highly dependent, which in turn led to a focus on how to govern the model and not the complex reality (Best, 2022).

Another contributing factor to ensure continuity is how IAMs are built around a cost-efficiency logic and the main outcome of the model is a suggested social cost of carbon, which again is familiar to central bankers. At the overall level, the purpose of IAMs is to show a range of different pathways and point to those that are the most cost-efficient, which again relates to the discussion amongst integrated assessment modelers to make policy-relevant knowledge. The outcome of IAMs is therefore to assess the level of the carbon price. This is relevant for two reasons. At the general level, pricing carbon is the preferred mechanism for mitigating climate change amongst orthodox economists (Buller, 2022; Popp Berman, 2022), which also includes economists within central banks. Second, and most importantly, the outcome of the carbon price is relevant because central banks can use this as a proxy for any type of climate policy. As explained in the NGFS scenarios the carbon price is presented as a shadow emissions price, which is by no means coincidental: 'shadow emissions prices are a proxy for government policy intensity' (NGFS, 2020, p. 14). As one interviewee explained:

'You really quickly get into a big debate about what the right policy mix is, and then modeling how different policies affect the economy, and it's a different question, it's not actually the question we are trying to answer, and the question is not for us to answer but for governments to answer' (Interview 4)

Thus, the focus on a shadow carbon price in the IAMs was useful for central banks because it was an outcome they could relate to and it aligned with their view as economists of how best to mitigate climate change, but also because it was a tool that allowed them to steer clear of discussions around climate policy instruments, reflecting how it is in the interest of central banks to keep the discussion at a technical level, and not a matter of finding the right policy mix.

#### 4.3 Versatility

Another key characteristic of the IAMs and the IAM community is versatility, which is to be understood in two ways: First in terms of the flexibility in the ways in which IAMs can be combined with other models. The structure of the general IAM framework allows for a high degree of flexibility in the sense that there are no strict theoretical prescriptions in terms of how to combine the different models which allow for multiple models to be coupled together into an IAM. Second, versatility is observed in the way that the IAM community is accustomed to calibrating their models to produce policy-relevant knowledge. The IAMs were thus convenient because they could be combined with macroeconomic models that were already used in central banks such as NiGEM and G-Cubed (interview 16).

The work of combining NiGEM with the IAMs in the NGFS scenarios is a particularly illustrative case of this versatility. NiGEM is a model developed by the National Institute for Economic and Social Research (NIESR) in the UK and was brought into the project for the second vintage of the scenarios with the purpose of producing macroeconomic variables as a supplement to the work conducted by PIK, IIASA, and UMD. While NiGEM is not a DSGE model, it is 'Based on a broadly New Keynesian structure with many of the characteristics of DSGE models' (NGFS, 2022a, p. 38). The IAMs could not develop the macroeconomic output needed in terms of the impact on traditional macroeconomic indicators such as GDP, inflation, and unemployment. In the second vintage of the NGFS scenarios, they had therefore included NiGEM which 'was shocked using transition inputs from IAMs and estimates of chronic physical risks' (NGFS, 2021, p. 35). For the third vintage of the NGFS scenarios, it was shown graphically how the impact of chronic physical risk and transition risk as well as the evolution in temperature from the IAMs were translated into the impact on GDP and inflation, which predicted a fall in GDP between -4% and -8% in 2050 under the different scenarios (NGFS, 2022b, p. 13). The fact that the modelers have been able to conduct this integration of the IAMs and NiGEM shows the extent of flexibility, and indeed the versatility of the IAMs.

The second aspect of the versatility concerns how integrated assessment modelers are deeply concerned with delivering policy-relevant knowledge. Indeed, the work with the NGFS scenarios is not the first time the IAM community collaborate with policymakers. They have a long tradition of doing so. Looking at the development of IAMs more generally, from the very first IAM was first published in the 1970s and up until the Paris Agreement in 2015, van Beek et al. (2020, p. 10-11) find that they had a strong impact on climate policymakers: 'modelers were not only reactive to the developments in science and policy; at crucial moments they were able to anticipate (and sometimes even helped to generate) policy makers' future demands.' (emphasis in original). The integrated assessment modelers also played a crucial role in adapting the 1.5°C target that was adopted in the Paris Agreement in calibrating their models to fit this new political reality and thereby legitimizing the new climate goal (Dooley et al., 2018; van Beek et al., 2022). The assertiveness to political trends and the willingness to accommodate the models have also been the case with the NGFS scenarios. As one of the interviewed modelers explained:

We realized with the Paris Agreement there was this clause of aligning the investment flows, and then there was the TCFD initiative by Mark Carney and this

was basically how we discovered this was important to track, and we saw there were unresolved questions that were important to understand better. Obviously, it was clear that the best partner for us as a state-funded research institute would be one from the public side also interested in building a public good. We then understood that this was something central banks were also thinking about. (Interview 17)

Thus, there is attentiveness within the IAM community to make policy-relevant knowledge, and the NGFS scenarios are the latest example of this. Taken together this suggests that IAMs are versatile, and they can be adapted to encompass different models as well as the demands of policymakers, which have proved to be useful to central bankers in the NGFS.

### 4.4 Community

The IAM community has been characterized as an epistemic community with shared practices and close collaboration, also prior to the collaboration with the NGFS (Cointe et al., 2019). A key explanation here is how the community has arranged research projects and practices around the IPCC assessment reports, which saw an intensification during the preparation of the IPCC AR5 (from 2005-2014) where the modeling community got an increasingly important role in outlining possible pathways to the 2°C target (van Beek et al., 2020). The IAM community, which is mostly dominated by institutions in the Global North (Corbera et al., 2016), now constitutes the backbone of the WGIII community through their construction of scenarios and transition pathways.<sup>25</sup> As the IAM community came to enjoy a larger degree of influence in preparation for the IPCC AR5, they became more professionalized and organized themselves into more formal collaborations to intensify their research (Cointe et al., 2019). However, it is not because there is a unifying theoretical principle of IAM research. The raison d'être is rather one of representing complex systems through a combination of disciplinary insights and an ambition to deliver policy-relevant knowledge, where research, collaborations, and publication strategies are centered around the IPCC assessments reports (Cointe et al., 2019; Hughes & Paterson, 2017).

Social network analyses of the scientific community of the IPCC AR5 WGIII, which is constituted by the IAM community, also suggest a tightly-knit community of scholars. The working group is dominated by a dozen institutions mostly based in the Global North, which enjoys close levels of interinstitutional collaborations, with leading institutions being primarily UK and US universities, as well as international organizations such as the World Bank, and IIASA (Corbera et al., 2016). These collaborations are led by scholars who are mostly male,

<sup>&</sup>lt;sup>25</sup> More specifically through the creation of the so-called socio-economic pathways (SSPs).

European, and trained as economists (Hughes & Paterson, 2017). The IPCC has a declared goal of drawing on a broad range of knowledge from scholars and research institutions, yet Hughes and Paterson (2017) still find that when you look at the entire number of citations it is dominated by European and North American authors (a total of 81% of citations). A similar pattern appears to repeat itself for the involved modelers in the NGFS scenarios (table 2). All the involved modelers are trained at European or US-based research institutions, 9 of the 13 modelers are men, while the dominance in training in economics and engineering is less pronounced (5 out 13) compared to the findings from Hughes and Paterson (2017).

Name	Institution	Educational background	Educational institution	Gender
Cornelia Auer	PIK	PhD in data analysis and scientific visualization	FU Berlin	F
Christoph Bertram	PIK	PhD in economics	Technical University Berlin	М
Leon Clarke	UMD	PhD in management science and engineering	Stanford University	М
Ryna Yiyun Cui	UMD	PhD in environmental policies	University of Maryland	F
Jae Edmonds	UMD	PhD in economics	Duke University	Μ
Jérôme Hilaire	PIK	PhD in atmospheric chemistry and radiative forcing	Manchester Metropolitan University	М
Elmar Kriegler	PIK	PhD in physics	University of Potsdam	Μ
Jihoon Min	IIASA	PhD in engineering and public policy	Carnegie Mellon University	М
Franziska Piontek	PIK	PhD in astrophysics	University of Potsdam	F
Joeri Rogelj	IIASA	PhD in climate science	ETH Zurich	М
Bas van Ruijven	IIASA	PhD in energy science	Utrecht University	Μ
Sha Yu	UMD	PhD in energy policy	University of Maryland	F
Oliver Richters	PIK	PhD in economics	Carl von Ossietzky University	М

Table 4: modelers involved in the NGFS scenarios (based on acknowledgments in the NGFS scenario reports), showing educational background and gender

Based on a dataset of the scholars involved in the AR5 working group, Hughes and Paterson (2017) identify the 44 most cited and central scholars in this network of scientists. Of these 44 scholars, 7 scholars are from institutions involved in the NGFS scenarios (IIASA, PIK, and UMD), and 2 of these scholars are directly involved in the work on the NGFS scenarios: James 'Jae' Edmonds from UMD and Elmar Kriegler from PIK. This shows that the institutions are not only placed centrally within the IPCC but that there have been interinstitutional collaborations prior to the involvement with the NGFS scenarios. Indeed, the interinstitutional collaboration between the three institutions was widespread through the collaboration for EU grants and they knew each other well:

"...we have a very close collaboration with IIASA and UMD and as our peers we can judge whether they are the best collaborators for us in this project and therefore we also wanted to join forces with them..." 'We have definitely known each other for a long time, also personally. For example, Bas van Ruijven at IIASA used to be in the US, but we knew him back then already, and we also know his other colleagues at IIASA from other collaborations.' (Interview 17)

The interinstitutional collaborations have mostly happened within existing institutions established around the IAM community. In an attempt to professionalize the collective organization of IAM research a range of projects and institutions were created throughout the 2000s, which included the Integrated Assessment Modeling Consortium (IAMC) established in 2007 and the spread of model intercomparison projects (Cointe et al., 2019). A look at these shows the close connection that these institutions have had historically, and how these existing institutional structures have been leveraged in the work for the NGFS. The model intercomparison projects work as main venues for collaboration across teams, and it is important to be a member of such a team to be part of the community and to have your model recognized (Ibid.). In the NGFS scenarios, they use data and models from the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP). ISIMIP provides a database that is used in the NGFS scenarios to estimate chronic climate impacts from physical risks. The project was established by PIK and IIASA in 2012, and it has expanded to over 100 modeling groups. Institutional support from PIK and IIASA is still key,<sup>26</sup> which is telling for the extent of the cross-institutional involvement for these two organizations.

While ISIMIP has seen close collaboration between PIK and IIASA, PIK and UMD have been closely involved through the IAMC. PIK and UMD founded the IAMC along with 5 other institutions, and today PIK, UMD, as well as IIASA, are all part of the scientific steering committee, with Jae Edmonds as the UMD contact person, and Elmar Kriegler as the contact person for PIK. Under the IAMC, Jae Edmonds and Elmar Kriegler are also co-chairing the scientific working group on Scenarios for Climate-related Financial Analysis that had its first meeting at the IAMC annual meeting in December 2019. The working group was established with the aim to facilitate dialogue and exchange information for the potential use and development of scenarios used to assess climate-related financial risks.<sup>27</sup> Taken together, the interinstitutional involvement within ISIMIP and IAMC shows the close bonds within the IAM community and how they draw on and expand existing institutional structures in the work with the NGFS scenarios.

<sup>&</sup>lt;sup>26</sup> See <u>https://www.isimip.org/supporters/#institutional-support</u>

<sup>&</sup>lt;sup>27</sup> See <u>https://www.iamconsortium.org/scientific-working-groups/financial-analysis/#1642787830353-bbc830b0-aaef</u>

## 5. The NGFS scenarios as a suboptimal policy outcome

Despite credible alternative modeling approaches that would mitigate the criticism of the failure to deal with uncertainties and extreme risks that characterize climate-related risks, the central banking community resorted to the use of IAMs in the creation of the NGFS scenarios. Rather than building this exercise around a sound evaluation of the different models available, the modeling framework was deemed relevant because it aligned with the worldview of central bankers and used the same modeling approaches, while the affiliation with the IPCC has been used to legitimize the overall project. Thus, the process of creating the scenarios has involved two expert communities represented by a few central bankers and climate modelers with little transparency or oversight; an illustration of the increasing power technocratic institutions have gained since the financial crisis (van 't Klooster, 2022).

This collaboration of two technocracies in creating the NGFS scenarios has resulted in a closedoff process with limited possibilities of intervention by actors external to the process and a lack of transparency. There is no clear justification for why PIK, IIASA, and UMD were set up with this task, other than they are 'world leading climate scientists and modeling groups' (NGFS, 2021). While there is no doubt that these institutions bring important contributions to the IPCC, the sixth IPCC report is based on 20 global IAMs, and 12 national and multi-regional IAMs (IPCC, 2022), and there has been little justification for why PIK, IIASA, and UMD were better equipped for this compared to other modeling groups. The process has seen little transparency and has largely happened on an ad-hoc basis. It was for instance not possible to conduct a call for tender because NGFS as a loosely organized network does not have a legal existence (Interview 11). Also, there has been no publication of policy papers followed by consultations with external stakeholders that you usually observe when the Basel committee issues new standards. The scenarios have for now seen three rounds of updates, but there has been no systematic public engagement with stakeholders outside the NGFS apart from open webinars with short Q&A sessions. The discussions of future developments of the scenarios only suggest more of the same, which is a focus on better modeling of physical risk, and better sectoral and regional granularity (NGFS, 2020, 2021, 2022b).

This has important policy implications both in the short and long term. A short-term policy implication is the degree of applicability of the scenarios. The fact that the creation of the NGFS scenarios has involved only a small group of central bankers and climate modelers has led to a

situation where the scenarios are largely black-boxed, which in turn hampers the applicability for central banks at the periphery of the wormhole. From the scenarios, you only have the outputs, and it is difficult to understand what goes into the models, which impedes the applicability. As a climate modeler, who had held capacity-building courses for developing and emerging economy central banks, explained:

'We only have the output, and the problem is that the policies in the scenarios are not feasible, which makes it difficult because it is an abstract model that does not necessarily fit with the local economy. Just because the model works for the UK does not mean it works for Malaysia.' (Interview 15)

Thus, one of the main ambitions behind the creation of the scenarios, to have scenarios that are largely comparable and consistent, is at best questionable. The idea may sound appealing to the institutions at the center of the wormhole (Johnson, 2016) and the creation of models is crucial to establish cognitive authority in capacity building at the periphery to ensure that economic problems are understood and analyzed in a particular way (Broome & Seabrooke, 2015). However, it leads to challenges for those who are not core members of the network. On the one hand, they know they will end up using models that are unable to capture their national or regional macroeconomic dynamics and thereby achieve a sub-optimal outcome, but on the other hand, if they use these models they can keep their status as credible members of the wormhole.

The longer-term policy implication is that it will re-enforce the tendency to group think that already exists within central banks (Fligstein et al., 2017; Golub et al., 2015). With the use of IAMs, the central banks have resorted to continuing the use of the existing modeling frameworks within central banks, although this modeling framework is ill-equipped to deal with climate-related risks. It is well-established in the political ecology literature that integrated assessment modelers tend to focus on questions related to economic and technological developments while disregarding broader social and environmental questions (Beck, 2018; Beck & Krueger, 2016; Carton, 2020). That these worldviews are re-enforced is problematic because it can lead to narrowmindedness and groupthink:

I also find these scenarios on the optimistic side. I don't think it will actually happen. This is a projection that is based on assumptions. It may be optimistic, but we are trying to have internally consistent scenarios. (Central banker at the presentation of NGFS scenarios vintage 3)

This shows how expert communities used to work on the same kind of models are caught up with details around modeling and prioritize model consistency. Indeed, this focus on modeling

within central banks becomes a way to compensate for the lack of expertise and thereby uphold the authority, which leads to a situation of governing the model and not the complex reality (Best, 2022). They may thereby overlook or disregard signs of risk outside their worldview as was the case in the years leading up to the financial crisis (Fligstein et al., 2017). Because of this lack of imagination and the lack of willingness to engage with modelers who would have an alternative approach, central banks will have a very narrow, and most likely inadequate, understanding of climate change and how climate change will unfold in the future.

In sum, the process has demonstrated how the technocratic process can lead to suboptimal policies. It has led to a set of models that are ill-fit for central banks outside the center of the 'wormhole', and it confirms the pre-existing quantifying approach and dominant worldview of central banks thereby increasing the risk of overlooking climate-related risks that are not captured within the current models. But, perhaps most importantly, it raises the principal question of what technocracies are good for if technocrats fail to make well-informed and thoroughly analyzed decisions based on their 'expert' judgment, but instead, make decisions based on what is 'least controversial' and most 'well-known'.

## 6. Conclusion

When the NGFS was established in December 2017 it was set up as an informal organizational network, 'a coalition of the willing' as the NGFS likes to call itself, and free of any legal formalities or obligations. Even though the NGFS has been ambitious at the outset and set itself upon the task of greening the financial system, the framework for the NGFS scenarios suggests otherwise. Instead of taking the design of the scenario analysis as an opportunity to leave behind a modeling approach that is not adept to deal with climate change, the NGFS did exactly the opposite. This is not surprising, however. The NGFS is an organization established by central banks and run by central banks. It has therefore been created in their own image. While the NGFS concluded that they needed external climate expertise to be able to solve the task of creating climate scenarios, they found a group of like-minded peers in the IAM community. This community was not just equipped to model climate change and transition pathways, but they could do so in a way that made it legible to central bankers who found the outcomes of these models could be used to show the impact on the macroeconomic variables such as GDP, inflation, and interest rates which they are concerned about.

As this paper shows, the IAM community was not just any group of climate modelers. It has been shown here how there are four overlapping factors of the two expert communities, defined here as 'wormhole networks'. The first factor is that the three modeling institutions enjoyed a high degree of legitimacy from being involved with the IPCC, which was important as it also provided legitimacy to the overall project. Second, the use of IAMs allowed for a continuation of business as usual as the IAMs build on the same modeling framework as the one already used in the central banks. The third factor concerns the versatility that characterizes the IAMs, both in terms of combining IAMs with the macroeconomic model NiGEM, but it was also important that integrated assessment modelers were used to collaborate with policymakers. The final factor represents the IAM community as a coherent and well-established community and the three institutions had collaborated on several occasions before the work with the NGFS which implied they knew each other well.

The close collaboration between these two wormhole networks has turned the creation of the NGFS scenarios into a technocratic modeling exercise that has seen little transparency or involvement of external actors beyond the two wormhole networks. The result, this paper argues, is a sub-optimal outcome and an increased likeliness of groupthink. It is not the first time that central banks can be accused of sub-optimal outcomes as a result of their narrow technocratic focus (Baker, 2018; Braun et al., 2022), nor that their ways of organizing lead to groupthink (Fligstein et al., 2017). Yet, it is highly problematic that central banks appear to be repeating the mistakes of the past, especially as an underestimation of the level of risk. Creating a tool that by design will underestimate climate-related risks will be harmful to the legitimacy of central banks, and they may be accused of greenwashing, which is exactly what they seek to avoid (Knot, 2022). At best greenwashing can be said to be a side effect and by no means intentional. At worst one could argue that the scenario exercise is constructed to look virtuous by design, but not make any difference as they represent climate futures that are too optimistic. It is important for future research to closely watch the developments of the scenarios to determine whether it is the former or the latter.

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Money was worthless if there was no civilization to back it, no civilization to make things to buy – things like food. So even if central bankers were regarding their task in the very narrowest terms, as stabilizing prices and helping the unemployment rate, and more than anything else, preserving the perceived value of money itself – to do that now, they had to leave their unusual monetarist silos, and regard themselves as what they were. The not-so-secret government of the world.

Kim Stanley Robinson (2020, p. 289), The Ministry for the Future

# Concluding remarks

In this dissertation, I have examined how central banks have approached the work with climate change and whether central banks have been repurposed as they have faced up to the consequences of the climate crisis. In carrying out this study, I have used a qualitative, microlevel perspective with the intention of discovering how central banks engaged in a new policy area. I have concentrated on three factors: practices, expertise, and legibility. To understand how central bankers have approached climate change I have analyzed practices primarily in the form of climate stress testing and modeling of climate-related risks. I have examined the types of expertise that have been invoked in the central banks' work with climate change, where field arbitrageurs managed to frame climate change as a risk issue, and shown how central bankers turned to the IAM community as these climate models, build on neoclassical models, were the most familiar to central bankers. Finally, I have analyzed how central bankers have made climate change 'legible', where climate change was treated as a risk issue by field arbitrageurs and central bankers, and in doing so central bankers used their existing expertise to treat climate change as a risk issue and adapt their existing modeling framework to deal with climate change. In sum, despite the fact that climate change represents an entirely different scientific field and policy area, we have seen that central bankers have approached their work with climate change like any other issue they traditionally deal with.

It is against this background that I conclude that central banks have not been repurposed, but have continued to use the same type of practices and expertise. While I acknowledge there has been a discursive shift in the way central bankers discuss climate change, and where it is clear that climate change has become a mainstream issue for central bankers to discuss (Deyris, 2023;

Siderius, 2022; Thiemann et al., 2022) central bankers have largely maintained a status quo in their major policy decisions and operations. Central bankers have treated climate change as a risk issue, they engage very little with climate scientists or ecological economists, and the tools and measures they implement are a continuation of existing tools; climate stress testing follows the post-crisis focus on stress testing, and climate models, instead of being considered unique, are simply adapted to fit into existing neoclassical economic models such as the DSGE model. While central banks' work with climate change continues, I have shown in this dissertation that the climate crisis may be yet another 'status quo crisis' (Helleiner, 2014). After the financial crisis, we did not see the kind of transformative changes in the governance of the financial system many were hoping for, and with respect to the climate crisis I have shown that we are far from transformative changes yet again. Thus, history appears to repeat itself. As scholars of International Political Economy, we should therefore ask ourselves if neither the financial crisis nor the climate crisis can lead to a repurpose of central banks and the financial sector more broadly, then what can? More broadly we need to ask what are the consequences of central banks' resistance to change?

Central banks took an outsized role in the wake of the financial crisis. They have now become the dominant actors in the governance of the financial system and the broader macroeconomy, a role they reaffirmed at the outbreak of the pandemic with the establishment of swap lines and purchase of junk bonds (Tooze, 2021). In this light, we need to expect more of central banks. With their history as lenders of last resort and even market makers of last resort in recent years, central banks are now in a position to act as 'climate governors of last resort' (Langley & Morris, 2020). But only if they wanted to, and with current market-based approach of disclosing risks the outlook is bleak. The need for more ambitious intervention is clearly evident, and major actors within the financial system all know this. Indeed it was Carney's main argument when he spoke publicly about this issue for the first time, almost eight years ago, to break the tragedy awaiting at the horizon. Similarly, the then CEO and chairman of the AXA insurance group, one of the world's largest insurance groups, also warned in 2015 that 'A 2°C world might be insurable, a 4°C world certainly would not be', with catastrophic consequences. 'Without the ability to insure against catastrophic loss, the global credit system as we know it would simply cease to function' (Tooze, 2019). This takes us back to Mary, from the fictional Ministry for the Future, and her dire warning that money is worthless if there is no one to spend money.

As I have demonstrated, the risk-based approach by central bankers will have negative consequences, as it can hinder the necessary decarbonization and render indications of risk levels that are inadequate and possibly outright incorrect. The central banks' risk-based approach seems to follow the popular trend toward improving the quality and quantity of information and increasing transparency. Indeed, the purpose of climate stress testing, for instance, is to have a framework that can disclose the level of climate-related risks, following the assumption that markets will adapt if they are informed about risk exposures. The problem, however, is that this approach outsources the green transition to private capital, which has so far failed to adapt and reallocate capital at the pace needed (Kedward, Gabor, et al., 2022). Another issue is how to quantify climate-related risks because of the uncertainties and complexities of the cascade effects and tipping points that characterize climate change (Bolton et al., 2020; Dafermos, 2022). If the models that are used to calculate climate-related risks are inadequate or too optimistic, as I have shown in this dissertation, it will lead to an underestimation of the level of climate-related risks. Policymakers may be giving too much trust in these estimates and thus step into the climate crisis blindfolded, with dire consequences.

A first step to overcome the limitations of this risk-based approach would be to follow a 'precautionary approach' to monetary and financial policy as advocated by Chenet et al. (2021). Were central bankers to follow 'precautionary principles' in their decision-making, it would mean that in the case of uncertainty, policies must be preventative in order to protect human health and the climate (Chenet et al., 2021). Even though I have shown that their mandate does not prohibit central banks from engaging with climate change, this precautionary approach is within the current conservative interpretation of the central bank mandate, in so far as it is a means of ensuring maximum financial stability.

Among additional measures that central banks could take that would do even more to speed up the pace of decarbonization would be more active credit policies to steer private and public capital toward strategically important green sectors (Bezemer et al., 2021; Kedward, Gabor, et al., 2022; Monnet, 2018). Such measures could include indirect allocative credit policies like adjusting lending volumes through a 'green TLTRO' scheme (see van 't Klooster & van Tilburg, 2020). More direct allocative measures that intervene directly by setting the price of credit would be to set lower interest rates for green activities. The central banks of Bangladesh and South Korea have already implemented such measures (Kedward, Gabor, et al., 2022, p. 20). Thus, central banks could become active players in coordinating between monetary and

fiscal policies (Svartzman et al., 2021). Again, the pandemic showed us this could happen. The extent and pace of BoE's buy-up of gilts during the pandemic led commentators to openly talk about monetary financing of the UK government's rescue packages, so much so the BoE Governor Andrew Bailey had to publicly deny this (Tooze, 2021).<sup>28</sup> However, as I have shown here, such policies are unlikely to be implemented any time soon, especially in the current context of rising inflation.

## Contributions to state of the art

There are three overall contributions from this dissertation that I would like to highlight: (1) a theoretical contribution to the field of IPE, (2) the contribution to emerging green central banking research, and (3) a set of empirical contributions.

In this dissertation, I have argued for an analytical framework that brings in a micro-level perspective to understand the work conducted by central *bankers*. I have sought to unpack the black box of central banks' activities as they pertain to the climate change issue. I argue that if we want to understand how central bankers have approached the climate policy domain, the micro-level perspective has been a fruitful first step. Building on a range of research contributions on central banking (Adolph, 2013; Ban & Patenaude, 2019; Johnson, 2016; Riles, 2019) and other relevant studies (Broome & Seabrooke, 2012; Helgadóttir, 2021a; Scott, 1998) I have explored three factors that are not traditionally covered in this literature: practices, expertise and legibility. In taking such a micro-level perspective, I have been able to go beyond the discussions around central bank mandate and the sterile discussion of whether or not acting on climate change falls under the mandate of central banks. Instead, I have talked directly with the central bankers, listened to their subjective approach, and examined the kinds of tools and measurements they have used. I have sought to show how the central bankers' worldview and underlying normative assumptions influence their daily professional work on climate-related issues.

This is not just the clichéd 'resistance to change' that has been the fallback explanation for explaining anomalies. The central banks in fact have their own cultural assumptions, which they use to integrate climate change into their conventional neoclassical framework. As I have shown, this micro-level perspective can help us understand central bankers' work with climate

<sup>&</sup>lt;sup>28</sup> See also *Financial Times* 5 January 2021 'Investors sceptical over Bank of England's QE programme'

change. However, climate change is only one topic central bankers must address. Central bankers also face looming pressures emanating from the crisis in biodiversity and threats to cybersecurity, where the latter is becoming an increasingly pressing issue as central banks seek to implement digital currencies (Fanti et al., 2022; Kedward, Ryan-Collins, et al., 2022).

Inspired by the emerging green central banking literature, I seek to move beyond discussions of possible tools and policies (Chenet et al., 2021; Dafermos, 2022; Dafermos et al., 2018; Kedward, Gabor, et al., 2022) and the discussions around the central banks' mandate (Baer et al., 2021; Dikau & Volz, 2021a; Oman et al., 2022; van 't Klooster & de Boer, 2022). With the important exceptions of Siderius (2022) and Deyris (2023), little work has been done to understand how and why climate change became a mainstream issue in central banks, and while Siderius analyzes the DNB and Deyris the ECB, I have in this dissertation examined a broader set of central banks including ECB, BoE, BdF and DNB. With a focus on these four central banks, the identified front-runners in this agenda, we have obtained a fuller understanding of the dynamics at play amongst the central bankers.

I have also sought to advance the debate in this field by looking at the tools and measures already implemented. While there is a tendency in the green finance literature to discuss the possible tools that central banks can or should use, it is more important to explore the tools and measures central banks are already implementing. This real-time focus enables us to understand the type of problems central bankers see in relation to climate change, what their choices might be overlooking, ignoring or concealing, and what kinds of normative assumptions lie behind the dese decisions. Understanding the choice already made is thus an essential first step in outlining alternative policy tools and whether these can actually be implemented by central bank actors.

If we consider IPE more broadly, this research has added an important empirical case to the central banking literature in terms of what happens when central bankers deal with a policy domain outside their immediate knowledge remits. To the best of my knowledge, there is no precedent for such a case. While we have gained new insights about central banks after the financial crisis, and it forced central banks to experiment it was after all within their overall area of expertise. Even though macroprudential regulation implemented after the financial crisis represented a radically different idea (Baker, 2013, 2018), it remained within the realm of economic decision-making. The case of climate change thus provides us with an important understanding of the scope of reasoning in central banks. What I have demonstrated in this

dissertation is that central banks will only approach an idea or issue if they can 'translate' it into something economic in nature. Hence, the case of green central banking has been used to elucidate some key issues. One of these issues is to show via diachronic analysis of the 'climate shift' how central bankers started to engage with climate change, and I found that this engagement started well before Mark Carney's famous 2015 speech. Another issue is that of climate stress testing and climate-risk modeling and the degree to which these methods tend to disregard uncertainties to an extent that central bankers might underestimate the level of risk related to climate change. Finally, I have examined the NGFS and its everyday operations. While the NGFS has received little attention in the literature, it is nevertheless the key institution in the governance of green central banking and therefore deserves more scrutiny.

### **Future research**

This dissertation has tried to fit a few pieces into a large and complex puzzle: the puzzle of how central banks confronted an entirely new policy area, that of climate change. We have only been able to fit a few pieces into this puzzle. More research needs to be done within this area. First, as I have taken a micro-perspective in order to understand how central banks have approached their work and their scope of reasoning, the next step is to explore the consequences at the macrolevel. As Blyth and Matthijs (2017) argue, it is important to consider the interconnectedness of the current crises in order to understand how they emerged and what they mean for current and future policies. The current crises are not 'black swan' events. They feed into a larger chain of reactions. Analyzing these developments from a macrolevel perspective would be an important contribution, not only to the climate change and central banks research agenda, but to the field of IPE as a whole.

Taking a macrolevel perspective relates to a second research agenda, which is to raise the question of risk to whom? When central banks talk about 'risk to financial stability', they see only a very particular type of risk and risk to a very particular set of people. From the central bankers' perspective, those at risk are businesses, primarily in the financial sector, and those with financial assets who belong to people in the Global North. The central banks' narrow understanding of risk overlooks the impact of the climate crisis in developing countries, although it is these countries that are hardest hit by the climate crisis. As Christophers (2017) explains, the financial risk stemming from rising sea levels is close to zero if (or more likely when) sea levels rise on a Pacific island and destroy homes and crops. But from the central

banks' point of view, these citizens are not 'at risk' because they are not involved in the global financial system; they have no mortgages nor property insurance. If sea levels rise in Manhattan, of course, there is certainly a risk to financial stability, but the human tragedies in both the Pacific and Manhattan, the effect on individual citizens, would be the same, if not less in Manhattan because rich countries have safety nets and financial relief that a Pacific island does not have. Further research is therefore needed in order to explore how the central banks more limited risk-based approach, their ignoring of larger non-financial risks, feeds into and exacerbates existing global inequalities.

Thirdly, future research should consider a much broader range of central banks, including central banks in developing countries, and examine whether there are lessons to be learned from those central banks that have taken a more activist approach in steering credit towards green industries. Some scholars have started this work (Dikau & Volz, 2021b; Larsen, 2022; Macaire & Naef, 2022), but applying the micro-based perspective from this dissertation to a broader range of central banks would further our understanding of how central bankers engage with the challenge of climate change. In addition to central banks in developing countries, scholars of central banking cannot ignore the Fed. We need to understand the Fed's lack of action, in as much as the Fed has usually been a first mover amongst central banks in so many other areas. An important question in this regard is whether the Fed's inaction can be attributed to the general resistance to climate policies in the US, such that the Fed is simply reacting to, or being intimidated by, trends in society. What can the Fed's inaction tell us about central bank independence? Such an exploration could bring an important contribution not just to the research area of central banks and climate change, but also to the broader literature on central banks within IPE.

Finally, my findings from this dissertation should lead us as scholars of IPE to reflect upon the kind of knowledge we need about climate science as we seek to study policy areas that are increasingly affected by climate change. If we expect policymakers such as central bankers to engage with climate scientists, we as researchers ought to discuss how to collaborate with climate scientists. Only with such collaboration can we ensure that we ourselves understand the complexities and nuances inherent in the technical aspects of climate science, such as climate modeling, that I have discussed in this dissertation. Such inter-disciplinary collaboration would demonstrate that we as scholars of IPE take climate change seriously and would help advance the field of IPE.

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