UNSAFE AT ANY CHARGE: Why Financial Regulators Should Actively Mitigate Climate-Related Risk

REPORT BY **DAVID ARKUSH**
MAY 2021

ROOSEVELT INSTITUTE

ABOUT THE ROOSEVELT INSTITUTE

The Roosevelt Institute is a think tank, a student network, and the nonprofit partner to the Franklin D. Roosevelt Presidential Library and Museum that, together, are learning from the past and working to redefine the future of the American economy. Focusing on corporate and public power, labor and wages, and the economics of race and gender inequality, the Roosevelt Institute unifies experts, invests in young leaders, and advances progressive policies that bring the legacy of Franklin and Eleanor into the 21st century.

ABOUT THE AUTHOR

David Arkush is the director of Public Citizen's Climate Program and a fellow at the Roosevelt Institute. He is an expert on the climate crisis, financial regulation, and regulatory law and policy. Recently, he helped produce the Climate Roadmap for US Financial Regulation, a comprehensive set of policies for financial regulators to take on climate, and the Vision for Equitable Climate Action, a broad platform of strong, equitable climate policies within the US Climate Action Network. In a previous role, he helped strengthen, pass, and implement the Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010.

ACKNOWLEDGMENTS

The author is deeply grateful for insightful feedback from Gregg Gelzinis, Erik Gerding, Rhiana Gunn-Wright, Kristina Karlsson, Bill McKibben, Sarah Bloom Raskin, Yevgeny Shrago, and Graham Steele. Roosevelt staff Suzanne Kahn, Sonya Gurwitt, Matt Hughes, and Tayra Lucero also contributed to this report. The views presented here are those of the author.

INTRODUCTION

For many years, US financial regulators viewed climate harms and solutions as beyond their jurisdiction and responsibilities. Now, however, there is growing recognition that they must address climate-related risk because it poses significant threats to financial stability. In recent years, the discussion on how regulators should respond has moved with extraordinary speed toward more regulatory engagement and ambition. At the same time, regulators remain slow to act and reticent to intervene robustly on climate.

Despite significant progress in the policy conversation, the main responses under discussion still fall well short of what is needed. This is because they are, in essence, typical responses to normal risks. But many climate-related risks are materially different from other financial risks—more harmful, significantly more likely to materialize, and characterized by much more uncertainty in their particulars—and therefore need different responses. Financial regulation has yet to grapple fully with these problems.

The most prudent course of action is for financial regulators to begin shepherding the financial system toward the clean-energy transition—carefully letting the air out of asset bubbles that otherwise might burst spectacularly and mitigating the systemic risk that financial institutions create when they finance activities that are grossly misaligned with science-based climate targets.

The climate crisis has put the financial system on a difficult path, facing severe threats to financial stability that are inverse to one another. One set of threats stems from under-mitigated global warming, which is already causing an escalating cascade of crises and, in the absence of assertive policy responses, will pose existential threats sooner and more certainly than is widely appreciated. The solution to this problem is an economic transformation unprecedented in speed and scope toward a near-zero emissions economy——a transition that inherently threatens to disrupt financial stability in the absence of timely and effective oversight by financial regulators.

To fulfill their mission of maintaining the stability of individual institutions and the financial system, financial regulators must steer the system proactively through these extraordinary, inverse challenges.[1] Climate change is therefore central to their jurisdiction, not on the periphery as is commonly believed. And there is only one practical (or even acceptable) path through the challenges: to embrace the clean-energy transition.

The common framework for considering climate-related financial risk misses this point and treats the transition to a clean-energy economy as a problem—a *risk*—rather than a necessary solution. Financial regulators should reorient themselves toward facilitating the transition, rather than viewing it exclusively as a set of risks to be mitigated. They should not be expected to mitigate the climate crisis on their own, nor to lead on climate policy, but at a minimum they must not allow their own inaction to impede solutions. Their failure to prepare the financial system for a rapid shift to clean energy risks obstructing progress on climate goals, as a transition-induced financial crisis could draw attention and resources away from advancing climate policy.

> ***Financial regulators should reorient themselves toward facilitating the transition, rather than viewing it exclusively as a set of risks to be mitigated.***

Financial regulators also bear responsibility for mitigating the climate crisis because their own failures have contributed to it. They have allowed a carbon bubble (and likely other asset bubbles) to grow dangerously large, and financial institutions continue to play a critical role in fueling greenhouse gas pollution (Chenet et al. 2021; European Commission 2019). Regulators should not permit financial institutions to inflate asset bubbles in a manner that deepens climate-related financial instability or sets financial institutions, the system, and the broader economy on a course for guaranteed climate chaos. Stopping self-destructive behavior by financial institutions is a core part of regulators' supervision and prudential regulation missions. This principle holds whether institutions are harming themselves or the financial system.

---

[1] There are several entities to which aspects of this report apply: the Department of the Treasury, the Board of Governors of the Federal Reserve System, the Office of the Comptroller of the Currency (OCC), the Federal Deposit Insurance Corporation (FDIC), the National Credit Union Administration, the Securities and Exchange Commission (SEC), the Commodity Futures Trading Commission, and the Financial Stability Oversight Council (FSOC).

Most financial regulatory discussion about climate thus far has focused on responses that are apt for only a portion of climate threats: suggesting or requiring that private firms monitor and manage climate-related risk themselves; requiring better climate-related disclosures to enable the market to price the relevant risks more accurately; and collecting data and conducting better analysis, particularly quantitative, of climate-related risk so that private actors and regulators can develop better responses. The most involved of these responses is conducting stress tests or scenario analyses.

More detailed critiques of these policies follow below, but there are common themes. There is a limit to how much better information and analysis alone can accomplish regarding threats that are highly uncertain, are poorly understood, or cannot be modeled. Important gaps in knowledge and analysis of many significant climate threats are unlikely to be resolved in reasonable time frames, if at all, and climate threats are too grave and imminent to delay substantial regulatory intervention. To be clear, all the approaches discussed here are valuable, and all should be used as far as they go. But they do not go far enough, and they cannot be our only responses.

The most progressive voices have begun urging financial regulators to increase the amount of capital that banks must hold to offset fossil fuel assets, thereby reducing the incentive to finance fossil fuels, as well as counterbalancing the risks of contributing to the climate crisis and holding assets that may lose most of their value in the not-too-distant future (Gelzinis 2021; Arkush et al. 2021).[2] These rules are called capital requirements or capital charges and are collectively referred to as capital regulation.

Capital regulation, too, is valuable, but unlikely to prove sufficient. Capital rules require financial institutions to hold enough capital to offset the risks of their activities, without necessarily altering the activities much—in other words, to provide a safety buffer and then let the market to do as it will. They are not designed to guide the financial system through cataclysmic changes like a rapid

[2] A few notes on terminology: This report uses "banks" to refer to all financial institutions under the jurisdiction of relevant regulators, including nonbanks designated as systemically important. References to "fossil fuel" or "emissions-related" assets are generally used as shorthand for a broad set of assets or activities that contribute to rising atmospheric greenhouse gas levels, whether by causing emissions or diminishing natural sources of drawdown (for example through deforestation). Phrases like "clean-energy transition" are used to signify the broad set of economic and infrastructure changes involved in meeting science-based climate targets, which will require rapidly bringing greenhouse gas emissions as close to zero as possible across the entire economy. Finally, certain terms such as "clean" and "net-zero" are matters of debate or controversy. This paper uses them generally rather than technically and does not take a position on them, except the evidence-based position that there is vanishingly little role for greenhouse gas emissions in a future that is safe for the financial system (and for humanity).

clean-energy transition, nor to guard against the accelerating cascade of crises caused by greenhouse gas pollution, which have rightly been called "unhedgeable" (Bolton et al. 2020; Phillipponnat 2020) and "uninsurable" (Bolton et al. 2020; Medland 2015). Like other policies discussed here, capital regulation certainly should be used where it is a good fit. One notable possibility is to use it to smooth the implementation of more assertive interventions.

Responding adequately to climate-related financial risk begins with regulators taking seriously their mission to stop institutions from engaging in unsafe or unsound practices, whether the activities threaten individual institutions or the financial system. A core principle of supervision and prudential regulation is that unsafe and unsound activities should be prevented—and this includes activities that may pose high risks but cannot be evaluated adequately. This description is apt for a large swath of emissions-producing assets and activities that both contribute to climate harms and are endangered by climate solutions.

Regulators should respond with policies commensurate with the scale of the threats and aligned with regulators' safety and soundness mission. They should start by restricting and phasing down the riskiest and most harmful assets and activities. Then they should work to begin closing the wide gap between financial activity and policy- or science-based climate targets. Throughout this process, they will need to take care to maintain order and stability in the financial system, shepherding financial institutions and the system in a controlled and deliberate manner toward a transition that, if permitted to develop haphazardly, could produce disruptive financial shocks or a systemic crisis.

Many of the tools to implement this report's recommendations, especially those needed to get started, do not require new legislation. Maintaining safety and soundness in the face of climate-related risk is already at the core of financial regulators' statutory missions, and some of the most important tools for doing so are ancient as a matter of banking law. Much of what is needed is to apply long-standing concepts and tools to a new problem—and to take safety and soundness seriously in the context of climate threats. Regulators have a long record of failing to adapt to new circumstances, and history is littered with instances in which they could or should have done more to prevent crises. But the climate crisis is no place for such timidity.

This report discusses how the financial regulatory conversation has understated the severity of the climate crisis and ways in which the main regulatory policies

under consideration are likely to fall short. Then, it lays out a path to respond to the crisis more effectively. It proceeds as follows:

Section I argues that financial institutions and the financial system do not face mere "risks" from climate change but, in the absence of assertive regulatory intervention, nearly certain harms, the scale and urgency of which are deeply understated in the financial regulatory literature.

Section II summarizes shortcomings of the most commonly discussed regulatory responses, while affirming that each has a role to play.

Finally, Section III proposes recentering and taking seriously the safety and soundness mission, which means deploying a set of authorities capable of meeting the gravity and urgency of the climate crisis despite the uncertainty regarding many threats. Maintaining safety and soundness in the face of both an escalating climate crisis and the necessary but disruptive solution—an economic transition of unprecedented scale, speed, and breadth—will require substantial, proactive intervention by regulators. They should begin by curtailing financing for the expansion of fossil fuel production and the highest-emitting existing sources. Then, while maintaining order in the financial system, they should begin to narrow the wide gap between current levels of financing for emissions and climate targets set by other policymakers or recommended by climate scientists.

SECTION ONE

IT'S NOT RISK WHEN IT'S CERTAIN: PROBLEMS WITH THE CURRENT FINANCIAL REGULATORY APPROACH TO CLIMATE "RISK"

Climate disruption and the economic transition away from fossil fuels are both beginning to affect finance, and there is growing recognition that they can no longer be ignored by regulators. Most discussions of climate-related financial risks delineate two main risk categories: "physical" risk and "transition" risk. (Other risks have been acknowledged, but they are viewed as more minor or speculative [Bolton et al. 2020].) Physical risk refers to risk to financial assets from the real-world effects of climate change—such as wildfires, hurricanes, flooding, and drought—while transition risk refers to the possibility of a rapid devaluation of emissions-related assets, primarily as a result of climate policy but also due to technological and economic changes like the rapidly falling price and growing market share of renewable energy (Bolton et al. 2020; CFTC 2020). The financial regulatory literature deeply underestimates the likelihood, imminence, and severity of both types of risk, and these mistaken views have likely played a part in keeping regulatory urgency and ambition at dangerously low levels.

PHYSICAL AND TRANSITION RISK ARE INVERSE TO ONE ANOTHER

One way in which financial regulatory discussions underestimate climate-related threats is that they fail to grapple with a key characteristic of physical and transition risk: They are inverse to one another. The more physical risk we are willing to allow, the less transition risk we invite (at least in the near term); conversely, the best hope for preventing the most catastrophic climate disruption is to invite as much transition risk as possible, as quickly as possible, and manage it effectively. In other words, it is a misnomer to refer to physical and transition threats collectively as "risk." We may toss a coin and say there is a "risk of heads" and a "risk of tails," but we know the coin will land on one side or the other. Thus, in the absence of substantial regulatory intervention, the financial system does

not face "risks" from the climate crisis but rather near-certain—and escalating—harm. The better choice, of course, is not to leave the fate of financial institutions and the system to a coin toss between physical and transition threats, but rather to guide them through these challenges in the most orderly and least harmful manner possible.

> ***The more physical risk we are willing to allow, the less transition risk we invite (at least in the near term); conversely, the best hope for preventing the most catastrophic climate disruption is to invite as much transition risk as possible, as quickly as possible, and manage it effectively.***

Many specifics of the way these risks will play out are uncertain. The more granularly one attempts to project climate-related harms, the more uncertainty there is. But the broad picture is clear: Humanity is headed toward existential harm from climate chaos, and catastrophic harm may be much more imminent than is widely appreciated (more on these points in the following section). The only way to stop this progression is to halt greenhouse gas pollution by engineering the most rapid, wide-ranging, and therefore potentially disruptive economic transition in human history.

A set of scenarios published by the Network for Greening the Financial System (NGFS), a global network of central banks and supervisors, illustrates the trade-off between physical and transition risk. The ideal NGFS scenario from the perspective of transition risk, aptly named "Orderly," cuts carbon pollution by roughly one-quarter by 2030 and fails to achieve net-zero emissions until 2070, yielding a 67 percent chance of limiting global warming to 2°C (NGFS 2020). The slow transition away from fossil fuels in this scenario comes at great cost: a 33 percent chance of warming greater than 2°C, with a nontrivial possibility of outcomes catastrophic and beyond (3°C+) and no hope of limiting warming closer to 1.5°C. More problematic, the scenario relies on the "full availability" of carbon removal technologies, which have yet to prove feasible. In short, the best scenario from a financial stability perspective relies on technologies that are currently fantastical and provides too little climate mitigation, too late. But as a matter of transition risk, it is "orderly."

NGFS also provides what could be called a best-case scenario from a climate-mitigation perspective. In this scenario, with limited use of carbon removal technology, carbon pollution is cut by roughly 70 percent by 2030, reaching net-zero by 2050, which gives a 67 percent chance of limiting warming to 1.5°C (NGFS 2020). Eliminating nearly all emissions by 2050 is the common baseline of climate policy, with the real debate occurring around aggressive near-term targets.

The Intergovernmental Panel on Climate Change (IPCC) states that we need to cut carbon emissions roughly in half by 2030, and many progressives would increase that goal to address international equity concerns. Virtually all climate experts who are not associated with high-emission industries agree we should move as quickly as possible; the main disagreement is around how quickly we can move as a matter of technical and economic feasibility. NGFS makes clear that, at least under current regulatory regimes, the latter scenario presented—a close fit to what science requires and many progressives seek—is *highly* disorderly as a matter of transition risk (NGFS 2020).

The NGFS discussion highlights a further problem: The common view of climate-related financial risk holds that the clean-energy transition is not a necessary solution, but a problem—a "risk" to be mitigated. But a rapid transition is the only acceptable response to the climate crisis—the only solution that will protect the financial system, the broader economy, and humanity. Financial regulators must reorient themselves toward treating the clean-energy transition as a necessary solution rather than as a risk to be mitigated or avoided, and they must discern how to be productive partners to the policymakers who are primarily responsible for bringing it about.

There are other climate-related goals that financial regulators must recast as solutions too, such as promoting investment and access to financial services in historically underserved communities, many of which are on the front lines of climate harms. A traditional risk regulation framework might say that financial institutions should price products and services higher for, or even decline to serve, communities that are particularly vulnerable to climate risk. That outcome is unacceptable because it would compound and extend historical injustices, using the legacies of discriminatory financial practices and environmental racism to justify new hardships for the same communities. Here too, regulators must adopt a solution-oriented stance, in this case working to encourage investment and engagement while managing related financial risks. As with the clean-energy transition, this policy need is not just a matter of mitigating risk; regulators must act affirmatively to promote a good and navigate related tensions successfully.

CLIMATE-RELATED RISKS ARE DEEPLY UNDERSTATED IN THE FINANCIAL REGULATORY CONVERSATION

In addition to erroneously treating climate-related harms largely as ordinary, independent "risks," the financial regulatory literature deeply understates their gravity and urgency. Wide-ranging, extremely harmful climate-related financial threats have been called "green swans," an analogy to the "black swan" concept popularized after the 2008 financial crisis to signify catastrophic harms that are unpredictable or lurk in the tails of distribution curves (Bolton et al. 2020). But if any animal analogy is apt, it is that these threats are a *green elephant in the room*. Catastrophic climate harm is not low probability, but virtually guaranteed unless humanity responds appropriately (Bolton et al. 2020). And climate catastrophes are "more serious than most systemic financial crises" because "they could pose an existential threat to humanity" (Bolton et al. 2020). The following section briefly discusses projections of climate-related harms to illustrate that they are far more likely, graver, and more imminent than financial regulatory discourse reflects.

"Physical" or "disruption" harm

Accounts of climate-related "physical" risk in financial regulation typically address only obvious threats, such as the effects of sea-level rise on coastal real estate, drought on agriculture, or extreme heat on labor productivity (CFTC 2020; NGFS 2020; TCFD 2017; Board of Governors of the Federal Reserve System 2020a). But climate disruption will produce countless other harms, many of which are already occurring and are expected to intensify dramatically. The label "physical" itself understates the problem, as it fails to encapsulate numerous other significant climate threats that collectively will pose grave harm to financial systems, such as increased disease, human migration, ecosystem collapse and species extinction, terrorism and warfare, and political instability (DOD 2014).

The potential harms of under-mitigated climate disruption are both colossal and imminent, and they should be a major focus for financial regulators. Current policies put us on a path for 2.1°C to 3.9°C of warming by 2100 according to modeling that tracks government action and measures it against the Paris Agreement (CAT 2020b). This is the 68 percent range of the model's probability distribution, meaning it omits possibilities below the 16th or above the 84th percentile (CAT 2020a). Four degrees of warming by 2100—just the 84th percentile of current projections—would cause such extraordinary harm that we cannot

be certain most humans would survive (Potsdam Institute for Climate Impact Research and Climate Analytics 2012; IPCC 2014). Sixteen percent of the model's projections are even worse, although we do not know the specifics.[3]

The impacts of 3°C of warming—the midpoint of projections based on current policies—are better, but still catastrophic enough that they might threaten contemporary civilization. A combination of extreme weather and other climatic changes will lead to megadroughts and water scarcity; agricultural collapses and massive food supply disruptions will cause extreme food scarcity; extreme heat waves will expose over half the world's population to lethal temperatures and might render some heavily populated regions uninhabitable to humans (Im et al. 2017; Lynas 2020); illness from food- and insect-borne pathogens will increase; world-historic species extinctions and other ecological collapses that are already occurring will worsen terribly; and humanity will experience significantly increased migration, political instability, and violence, including both terrorism and warfare (Woetzel et al. 2020; Lynas 2020; Wallace-Wells 2019). Even meeting the strongest climate target under discussion, holding warming to 1.5°C, will yield a perilously altered world. To provide one example, researchers believe that 1.5°C may be the threshold beyond which the tropics, a roughly 3,000-mile-wide band around the equator that is currently home to 3 billion people, will begin to experience heat waves so deadly that the area becomes effectively uninhabitable (Fountain 2021).

Exceedingly grave harm may be much more imminent than is commonly perceived, and the window for effective responses smaller. There is uncertainty in temperature projections regarding both the amount of temperature rise and the timing (IPCC 2014). Not only is it possible that temperatures could rise well over 4°C by 2100; we also could hit 4°C before 2100. Indeed, we may reach 3°C by mid-century (Lynas 2020). And in virtually any 3°C or 4°C scenario, there will be no small amount of catastrophic harm in 2075—or even 2050 or 2035. Disruptions from climate chaos will escalate over time and are unlikely to grow linearly. It is also safe to assume that harms from the climate crisis will destabilize financial institutions and the system well before they threaten civilization.

In addition, developments in climate science typically worsen the outlook rather than improve it (Lynas 2020; Wallace-Wells 2019; Romm 2016). Numerous harms are already measurable at 1°C of warming, and new studies frequently find that climate impacts are progressing more rapidly than predicted (Ripple

[3] The modelers truncate the tails beyond the 68 percent range because there is too much uncertainty about them (Geiges 2021). This is common practice; the IPCC (2014) uses a 90 percent range.

et al. 2020). This is because projections of climate harms are much more likely to underestimate—rather than overestimate—the consequences of warming. The literature on the impacts of warming beyond 1.5°C or 2°C is young and has considerable gaps (Lynas 2020). The underlying climate science also has significant gaps, most of which render it conservative. Of major concern is a possible cascade of feedback effects that could push the climate inexorably toward a "hothouse Earth" scenario, in which global temperatures stabilize at levels 4°C to 5°C above pre-industrial levels, with humanity helpless to reverse course (Steffen et al. 2018). Many scientists believe these effects will be triggered at around 2°C degrees of warming, giving urgency to the Paris Agreement's goal of holding warming "well below" that level (UNFCCC 2015). But we do not know the precise boundaries.

Since the 2008 financial crisis, there is broad agreement that financial regulators should be concerned with tail risk—low-probability, high-impact harms.[4] But the tail risks of climate chaos are scarcely visible in climate literature, much less the financial regulatory literature. And existential harm from climate chaos is far from a low probability. Warming that could threaten much of humanity sits at just the 84th percentile of projected outcomes based on current policies, and warming at the *midpoint* of projections may be enough to end civilization or spark a "hothouse Earth" scenario of warming well above the 84th percentile prediction. These harms are not just high impact, but high probability. Indeed, some climate scientists are now urgently calling on their peers to speak out more plainly about the "ghastly future" toward which humanity is squarely hurtling and that it will have trouble avoiding (Bradshaw et al. 2021).

Large financial institutions are becoming aware of the scale of the threat. JPMorgan Chase privately warned clients in early 2020 that we are on track for 3.5°C of warming by 2100, that most public projections of economic and health losses are gross underestimates, and that "human life as we know it" could be threatened on our current pathway. (As of this writing, JPMorgan Chase remains the largest financer of fossil fuels globally, by a wide margin [RAN et al. 2021].) At the same time, financial regulators are just beginning to study climate-related risks and are focusing primarily on the relatively milder, most immediate, and obvious ones. For example, the first discussion of climate by the Federal Reserve Board (the "Fed") in its November 2020 Financial Stability Report addresses only "[a]cute hazards," like "storms, floods, droughts, or wildfires," and "public perceptions" of them (Board of Governors of the Federal Reserve System 2020a).

[4] This paper uses "tail risk" in the informal sense to connote low-probability events toward the ends of distribution curves, without defining precisely where "tails" begin.

There is a perversity in focusing primarily on the best-known and nearest-term climate-related risks, as these are the ones the market likely does the best job of pricing. However, it is widely believed that markets are pricing even these risks so inaccurately that sharp corrections could jeopardize systemic stability. This view is likely accurate—and it should motivate even greater concern over the countless climate harms about which private actors and regulators know far less.

Transition risk

Financial regulators also underestimate transition risk, in part because they tend to assume that there will be a relatively smooth transition to a clean-energy economy, with some potential for financial risks to materialize (Ceres 2020). This assumption is unfounded. We have more reason to believe the transition may cause financial disruption and instability than the opposite, especially if financial regulators do not manage it well. Major market changes often occur abruptly, with sudden shocks, and the likelihood of abrupt changes can only be heightened in the context of the broadest and most rapid economic transformation in human history.

Regulators should be attuned to the possibility of major transition shocks and should prepare for them. The Paris Agreement and climate science suggest not only that we should cut greenhouse gas pollution to zero by 2050, as is commonly recognized in finance (CFTC 2020), but that we should cut it *roughly in half by 2030* (IPCC 2018). The longer we wait, the more difficult and expensive mitigation becomes. And early cuts are the most important, as they are substantially more effective at reducing climate risk.

Meeting targets like a roughly 50 percent reduction in carbon emissions by 2030—or anything close—will involve a rapid devaluation of fossil fuel and other high-emission assets. There has been a massive carbon bubble for years, as 80 percent of known fossil fuel reserves cannot be burned if we are to limit warming to 2°C (Bos and Gupta 2019). And yet fossil fuel development continues apace, with oil and gas majors like Exxon projecting growth in emissions. At the same time, governments and even some private firms are increasingly adopting tougher targets and demonstrating credible intent to meet them (CAT 2020c; European Commission 2020). Indeed, the Biden administration recently announced an intention to cut US emissions economy-wide by 50 to 52 percent from 2005 levels by 2030 (White House 2021). Eventually, reality will strike the markets, and we may witness panic and fire sales.

Public opinion, election results, and policymaking will likely be the most important factors over the next decade in determining the timing and magnitude of transition risk (Wallace-Wells 2019). These factors are notoriously difficult to predict, but as with physical or disruption risk, the general picture is clear enough. Pressure for a rapid clean-energy transition is likely to intensify as climate harms mount, and soon it may approach inevitability (Vivid Economics et al. 2020). Policy choices, however, are not the only factors in transition risk. Advances and price declines in clean energy, particularly solar, wind, and batteries, have consistently beaten expectations for many years (Hunt 2020). At some point in the not-too-distant future, it is likely that some technologies will hit inflection points when their adoption rates accelerate dramatically and sharply alter markets, particularly those for fossil fuels. And although these developments are not occurring nearly rapidly enough to solve the climate crisis, they nevertheless demonstrate that we have consistently underestimated the pace of relevant technological and economic change and are thus vulnerable to similarly underestimating how it will exacerbate transition risk that results from policy decisions.

SECTION TWO

SHORTCOMINGS OF CURRENT FINANCIAL REGULATORY SOLUTIONS

Much of the regulatory toolkit under discussion is inadequate to respond to the full range of climate-related harms. Currently, the discussion centers around a few approaches. The most limited approach is requiring private firms to monitor and manage climate risk better; many regulators appear to believe their duty ends after this step (Stiroh 2020). On the spectrum of regulatory interventions, the next approach is to require better disclosure of information related to climate risks so that markets price them more accurately (CFTC 2020). Relatedly, many regulators want to collect more data to conduct better quantitative analysis and improve modeling of climate-related risk themselves (CFTC 2020). Moving further still, some regulators may integrate climate risk into stress tests of financial institutions (modeling exercises meant to expose relatively near-term risks to their solvency) (Bolton et al. 2020; CFTC 2020). Because modeling climate risk is difficult, and many climate risks are on a time horizon much longer than that of stress tests—30 to 40 years or longer as opposed to a few years—some regulators may instead (or in addition) require or conduct scenario analyses to illuminate broad, long-term trends (Bolton et al. 2020; CFTC 2020). Finally, some suggest that regulators should require firms to hold more capital against climate-related risks—most prominently against holding assets that could rapidly lose value in the clean-energy transition or that are most threatened by near-term physical climate harms like hurricanes, floods, or wildfires, but also potentially to mitigate risk from firms' contributions to climate change (Gelzinis 2021; Arkush et al. 2021).

To reach this point is an achievement, as it is a vast improvement over the discussion of even a few years ago. These measures all have value and should be used to accomplish as much as possible. However, they are still likely to fall short.

REGULATORS MUST PUT DISCLOSURE AND QUANTITATIVE ANALYSIS IN THEIR PROPER PLACE

As noted, one prominent set of responses to climate-related financial risk involves promoting or requiring better disclosures so that market participants and regulators can better analyze and price climate-related risk. These goals

have obvious merit and should be pursued. At the same time, regulators must be cognizant of the limitations of information and analysis in the context of climate threats.

Better disclosures for market actors are critical—but without additional measures, they will solve too little and might even introduce instability.

One motivation for requiring better disclosures is the expectation that it will allow markets to price climate-related risk more accurately and even resolve some risks (Board of Governors of the Federal Reserve System 2020a). Better disclosures are a critical early step in financial regulatory responses to climate. But relying on disclosures alone to solve a significant proportion of the problem would be a mistake.

First, if there is a massive carbon bubble or if, as some believe, the value of coastal real estate and other assets is at risk of collapse (Flavelle 2019), then to make pricing fully accurate without other regulatory measures could increase instability. This is not to say we should eschew climate-related disclosures—far from it. We need more accurate pricing as soon as possible. The longer we wait for corrections, the more significant they may be, and the greater the potential threat to stability. The point is that regulators must do more than facilitate better pricing. They also must work to bolster stability against climate-related risks. That work includes letting air out of the carbon bubble and other relevant asset bubbles in an orderly fashion, as discussed below.

At the same time, the potential harm to stability from improving disclosure should not be overstated, particularly in the near-term. The affirmative effect of disclosures will be limited due to significant knowledge gaps and uncertainties (more on these in a moment), as well as slow uptake and processing by market actors. Climate change has been called "the greatest market failure the world has ever seen" (Stern 2007; Bolton et al. 2020), and markets have reacted extraordinarily slowly to information about climate-related risks. Those who believe that providing more information alone will suffice to mitigate most climate-related financial risk bear a heavy burden of persuasion (recall, for example, that JPMorgan Chase believes humanity may be on course for extinction without sharp cuts in carbon pollution but remains the largest financer of fossil fuels in the world). Instead, the likely effect of measures to improve climate-related disclosures, as the Securities and Exchange Commission (SEC) is contemplating (Lee 2021), will be modest pricing improvements that bolster stability.

It may seem contradictory to say that improved pricing could have both too great and too little impact—that on the one hand it could spark financial instability and on the other it will do too little to improve market pricing. But climate-related risk is nothing if not complex.

There are additional reasons to require climate-related disclosures: to empower investors to mitigate risk in their portfolios and invest based on their values; to induce managers to make better-informed decisions; and to help the public and elected officials better understand the sources of, and investments in, climate-harming activity so that they can pressure and regulate those sources. It is appropriate for the SEC to require disclosures for these reasons—as environmental, social, and governance measures—as well as for stability purposes. These disclosures may have real effect, particularly if fiduciaries and other asset managers are required to align investments with their clients' and beneficiaries' preferences (Mésonnier and Nguyen 2021).

There are deep limitations on regulators' ability to gather information and conduct better analysis, particularly quantitative analysis.

Another reason to improve disclosure and data collection is to help financial regulators improve their understanding of climate-related risk so that they can formulate more effective responses. This goal is appropriate, but regulators must be mindful of the urgency of action and the sharp limitations on data and analysis. Financial regulators are accustomed to much of their supervision and prudential regulation (as well as the Fed's monetary authority) being driven by quantitative analysis, and therefore they expect the same in the climate context (Powell 2020a). They will need to alter this expectation significantly to account for the limitations of climate-related information. They may need to both develop new modes of quantitative analysis and grow more comfortable with qualitative decision-making.

Financial regulators lack adequate data in part because it does not exist. Financial regulatory discussions often assume the relevant climate science is mature and well-developed, and that the principal challenge for financial regulation is to discern the transmission channels from climate harms to finance (CFTC 2020; Powell 2020b). But this view is mistaken regarding a wide range of climate risks, including many of the most significant ones. It may be a long time before critical data gaps are filled, and scientists may never be able to produce a good deal of

what financial regulators want to know at the level of quality they desire. Recall that we do not even have the tails of the distribution curves on projections of temperature rise. There is extraordinary uncertainty about the particulars of climate impacts—the more narrowly one looks, the less reliable the analysis—even though the big picture is overwhelmingly clear.

The distinction between "risk" and "uncertainty" in economics and financial regulation is critical in the context of climate. The probability distribution of a *risky* event is knowable, which enables us to model and price the risk; the probability of an *uncertain* event is not knowable and cannot be modeled or priced (Armour et al. 2016; CFTC 2020; Bolton et al. 2020). Regarding uncertain events, "there is no reason to suppose that more data and more sophisticated models will improve the reliability of predictions" (Armour et al. 2016). Climate-related financial "risk" is fraught with uncertainty of precisely this type (CFTC 2020; Board of Governors of the Federal Reserve System 2020a), which the Bank for International Settlements has called "deep" or "radical" uncertainty (Bolton et al. 2020).

Many studies have attempted to project economic harms from climate change. One of the more comprehensive studies finds that warming of 4°C would yield economic damages of $23 trillion annually by 2100 (Kompas 2018). But recall that scientists believe it is possible that 4°C of warming could result in the death of most humans. Given that projection, a better approximation of potential economic damage is surely closer to $88 trillion, the size of the global economy (World Bank 2019). The wide gap between $23 trillion and $88 trillion is indicative of the chasm between projected climate harms and our ability to model their economic and financial impacts.

Even if all the data that financial regulators desire existed or could be created, there is too little time to gather it all and fine-tune financial models before acting. Regulators could bog themselves down for years working to develop better data sets and refine models, never to be satisfied that they are meeting typical evidentiary frameworks. Some regulators have questioned the likelihood that they will respond in a timely manner even to ordinary macroprudential risks (Dudley 2015). Moreover, although the financial regulatory literature is right to suggest that regulators and private actors will gain more information over time, it does not recognize that climate-related threats will continually grow in number and complexity—and therefore might always remain well ahead of our analytic capabilities. The uncertainty in climate-related financial projections, coupled

with the gravity and potential urgency of the risks, suggests that it would be inadvisable, if not outright irrational, to rely too much on quantitative decision-making tools in this context.

There are few indications that the financial regulatory community is aware of the magnitude of the problems with data and modeling or the extent to which they are insoluble on reasonable timelines. It is not uncommon for a discussion to emphasize the need for urgent action, then in its prescriptions focus heavily on data and analysis instead of more substantial interventions. The Commodity Futures Trading Commission (CFTC) Climate-Related Market Risk Subcommittee report, laudable in many respects, is a good example of this phenomenon (CFTC 2020).

Financial regulators need decision-making frameworks that are better matches for the uncertainty and the shrinking window for action on climate—ones that can support timely interventions commensurate with the threats. Part of the answer will be more qualitative or holistic decision-making (Philipponnat 2020; Bolton et al. 2020; Chenet et al. 2021). The goal of developing better understandings of climate-related risk cannot be just to refine quantitative models that determine regulatory responses. It must also be to enable supervisors and regulators to make wiser regulatory judgments, including judgments about their own decision frameworks and evidentiary needs.

Financial regulators need decision-making frameworks that are better matches for the uncertainty and the shrinking window for action on climate—ones that can support timely interventions commensurate with the threats.

This is not to say that regulators will lack adequate information or sufficiently robust analysis to justify strong actions to mitigate climate-related financial risk. The point is that however much they find through these methods, additional threats will lurk that require different analytic methods and additional regulatory responses.

OTHER COMMONLY CONSIDERED POLICY APPROACHES ARE ALSO LIKELY TO FALL SHORT

Further shortcomings of current policy ambition can be illustrated by examining the commonly discussed interventions beyond disclosure: stress tests, scenario analyses, and capital requirements.

In stress testing, financial institutions and regulators model the effects that adverse economic conditions would have on a financial institution over the next few years. If the model predicts that the institution would experience losses that cause it to breach its minimum capital ratios, then it may be required to hold more capital. One benefit of stress tests is that they have a tight nexus to regulatory action; if the stress test shows that a given risk poses too great a threat, mitigatory action follows naturally. There is clear value in ascertaining and incorporating whatever climate-related risks can fit into stress tests, and many nontrivial physical and transition risks will likely fit. However, the short time horizon of stress tests and our inability to model numerous climate harms mean that stress testing will fall short of producing full responses to climate threats.

One way to compensate for the shortcomings of stress tests is to conduct scenario analyses. In these exercises, regulators articulate a set of scenarios with a longer time horizon—typically 30 years—to enable assessments of the general challenges and opportunities those scenarios present. But while scenario analysis improves on stress testing by expanding the time horizon, it also renders the analysis far vaguer and breaks the chain of causation to regulatory responses (Brainard 2021). Most regulators contemplating or undertaking scenario analyses at present do not even include physical risk (Philipponnat 2020).

Despite their shortcomings, these exercises are worth undertaking even if only as educational tools. Indeed, it is possible that the most significant impacts of stress testing or scenario analysis will be secondary. They will focus more of the attention of regulators, financial institutions, and markets on potential climate harms and what is being done about them. And the effort to model these risks will, in addition to yielding some improvements in modeling, build more understanding of the limits of models (Davidson 2021). Better knowledge and awareness may in turn yield productive changes in decisions and behavior (Philipponnat 2020).

The strongest intervention under discussion, though not yet as prevalent as the others, is to incorporate climate-related risk into capital regulation (Philipponnat

2020; Gelzinis 2021; Arkush et al. 2021). Typical capital rules provide a safety buffer for assets based on their riskiness, requiring firms to hold more capital to counterbalance the riskier ones. The rules are based in part on modeling and therefore have strengths and drawbacks similar to those of stress tests. Like stress testing, capital regulation is a strong fit for nearer-term aspects of climate risk that can be modeled and priced sufficiently. Notably, the more physical risk is kept in check, the more capital regulation will be capable of responding to it. Another strong proposal is to use capital charges to counterbalance and deter the systemic risk that firms create by financing emissions (Gelzinis 2021). Capital rules also could be used to help maintain stability and order while regulators engage in other interventions, including restricting certain assets and activities, and phasing down the financing of emissions.

Regulators might also attempt to use capital rules directly for these latter purposes, effectively as activity limits. For example, perhaps they could set capital requirements that begin high for certain assets, even prohibitively high for some, and increase over time. A 2016 proposal by the Fed, for example, would have applied a 1,250 percent capital weight to certain exposures regarding which a bank "may have difficultly determining the extent of the losses" (Board of Governors of the Federal Reserve System 2016). Some have suggested similar approaches on climate, using capital weights of up to 1,250 percent for the riskiest climate-related assets (Philipponnat 2020; Gelzinis 2021). Again, this approach would effectively use capital rules as activity limits, albeit in capital regulation's clothing.

If either straightforward activity limits or capital rules designed to function as activity limits would have the same effect, then the choice between them involves important secondary considerations, such as which is more politically saleable and legally defensible, which can be employed more quickly and effectively, which puts less demand on regulators and provides them more flexibility, and which is more compatible with supervision to maintain stability. It may be simpler, more straightforward, and more legally defensible to restrict an unsafe or unsound activity outright than to permit it while setting a capital charge that is meant, effectively, to bar it, though it is difficult to make this prediction in the abstract. However, even if regulators can develop and defend capital rules that are intended to serve as activity limits, a final problem remains: There is no way to ensure that markets will react as intended. This is an inherent feature of capital regulation. It alters baseline market conditions by providing a safety buffer, then lets firms behave as they will. It does not require particular outcomes, which is precisely what is needed when it comes to many climate threats.

SECTION THREE

TAKING SAFETY AND SOUNDNESS SERIOUSLY

Due to the inverse nature and severity of physical and transition threats, as well as the near-certainty of escalating climate harm, the financial system does not merely face climate-related "risk" at the periphery of regulatory jurisdictions. It is in crisis—the climate crisis. Regulators must discern how best to navigate these circumstances by finding the least harmful, most orderly pathways to both weather and mitigate the financial storms that may be inevitable without their intervention.

A set of implications for regulatory policy flows from this view of climate-related financial risk. Regulators must engage substantially on climate and, at a minimum, work to prevent financial instability from standing in the way of climate solutions. Better, they should reduce both transition and physical threats by restricting the riskiest assets and activities and beginning to close the wide gap between the financing of emissions and climate targets set by policymakers or recommended by scientists. Rather than take minor steps and wait for crises to arise, regulators should begin advancing an orderly clean-energy transition for financial institutions and the system (Bolton et al. 2020).

REGULATORS HAVE AN OBLIGATION TO ENGAGE SUBSTANTIALLY ON CLIMATE-RELATED FINANCIAL RISK

Financial regulators must shake off remaining doubts over whether or to what extent it is their responsibility to respond to the climate crisis. One frequently hears that responding to climate change is not the job of financial regulators (Bolton et al. 2020); and the regulators themselves commonly distinguish between mitigating climate-related financial risk, which they believe is their responsibility, and seeking particular climate outcomes, which they believe is not (Smialek 2021; Stiroh 2020). But as the discussion above demonstrates, this distinction is false. To protect the financial system, regulators must help promote certain outcomes—namely a rapid but orderly decarbonization of finance.

Indeed, if transition-related financial crises occur, they will be caused in part by financial regulators' own failures. Regulators have allowed a "carbon bubble" (Mercure et al. 2018; Carbon Tracker Initiative 2011) to grow dangerously large by permitting overinvestment in an untold number of assets that involve high carbon emissions and are thus increasingly under threat. In 2011, the Carbon Tracker Initiative warned that a staggering 80 percent of known fossil fuel reserves exceeded the carbon budget for holding warming below 2°C and were therefore "unburnable" (Carbon Tracker Initiative 2011). A decade later, after having made far too little progress, we must cut carbon emissions roughly in half in less than a decade.

> ***To protect the financial system, regulators must help promote certain outcomes—namely a rapid but orderly decarbonization of finance.***

Even if most of the responsibility for this policy failure lies with other actors, the threat to the financial system from continuing overinvestment in fossil fuels has become too grave and imminent for financial regulators to shrug off. When rapid devaluations of emissions-related assets spark financial crises, some of the responsibility will lie squarely with them. The same is true regarding the assets most vulnerable to physical climate-related harms, in which financial regulators have allowed gross overinvestment without adequate safeguards.

The root causes of climate-related financial instability lie outside of the ordinary jurisdiction of financial regulators, but this does not diminish their duty to respond. When the COVID-19 pandemic caused markets to seize up, the Federal Reserve did not refuse to intervene because the underlying cause was a viral pandemic, which is the province of the White House, the Department of Health and Human Services, and Congress. When climate disruption or the clean-energy transition precipitates a financial crisis, there is little doubt that the Fed will intervene again as it deems necessary. It would be better to intervene much sooner, when the effort will be more effective, and as a preventative measure before largescale, avoidable harm is done.

Even physical climate threats are not exogenous to financial regulation. Financial institutions are not merely inflating asset bubbles and tolerating excessive physical climate risk around the edges; they are actively fueling the crisis. (It is no accident that the Paris Agreement, shortly after establishing climate targets,

commits parties to "making finance flows consistent" with them [UNFCCC 2015].) In doing so, these institutions are financing something virtually guaranteed to destabilize them and the financial system in the future.

Financial regulators are reticent to respond to climate-related threats in part because they believe they should be "market neutral" guardians of financial institutions and the system, indifferent to the course of market conduct. But market neutrality must end where financial instability begins. If banks were funding something guaranteed to destabilize themselves and the financial system in a few short years, and possibly destroy them outright, few would hesitate to say regulators should stop them. For example, there is widespread agreement that regulators should have intervened to deflate the subprime mortgage bubble before the financial crisis of 2008. Climate harms are different only in that the effects of today's decisions appear to be decades away. But the time for effective regulatory action to prevent those harms is the present—and therefore regulators have an obligation to act now.

Financial regulatory mandates are not, and should not be, limited to near-term harms. Regulators routinely attend to long-term concerns given that it is impossible to predict when many threats to stability will materialize, and sources of financial stress can persist for long periods, can be chronic in nature, and can grow over time (Board of Governors of the Federal Reserve System 2020b; Board of Governors of the Federal Reserve System 2020a; CFTC 2020). Indeed, the buildup of financial risk over time is a core concern of macroprudential regulation (Armour et al. 2016), and the Fed recently recognized that the buildup of climate risk is a concern for microprudential regulation (Board of Governors of the Federal Reserve System 2020b). For all these reasons, it is safe to say that regulators have an obligation to mitigate foreseeable, nearly certain harm, even if they believe it may not destabilize the financial system for many years—and particularly when it will soon become impossible to prevent the harm.[5] At the same time, as discussed above, destabilizing climate harms may be much more imminent than commonly recognized.

[5] The Fed's monetary policy mandate also is not time-limited, and climate-related risks undoubtedly pose grave threats to full employment and stable interest rates and prices.

REGULATORS MUST BE PROACTIVE, NOT REACTIVE

Proper preparation for potential climate harms requires regulators to affirmatively guide financial markets by initiating an orderly phaseout of high-emission activities.

Rather than wait for the carbon bubble to pop spectacularly, it is more sensible to begin letting air out deliberately. (And it is far more sensible to oversee a rapid, orderly transition away from greenhouse gas emissions than to remain on the path to global warming that could destabilize not just the financial system, but human civilization.) The most significant limit on the pace at which financial regulators should move is financial stability—not concerns around misallocating capital or creating market inefficiencies. If regulators are going to take macroprudential regulation seriously, they must be willing to err on the side of prudence, as systemic risk regulation is inherently anticipatory and involves uncertainty (Chenet et al. 2021; Steele 2020; Johnson and Weiss 2017). Furthermore, it should be easier to adopt a proactive, precautionary stance on climate than in most other contexts. The costs of under-responding to climate risks are orders of magnitude greater than those of over-responding, and we also know that most fossil fuel combustion is socially net-negative, as nearly the entire world committed to phase it out in the Paris Agreement. (One could argue that the Agreement does not specify technologies, but there is no realistic Paris-consistent scenario in which fossil fuels play more than a vanishingly small role.) Market forces are also moving in the direction needed for decarbonization, just not quickly enough. And both policymakers and markets would unquestionably be moving even more quickly were it not for rent-seeking and barriers to change erected by fossil fuel companies.

Parallel points apply to "physical" climate-related harms. For example, many economists believe there is an imminent risk of a collapse in coastal real estate values (Flavelle 2020; Flavelle 2019). Regulators should take affirmative steps to mitigate these harms, not wait for them to materialize. They cannot mitigate every imaginable systemic risk, of course, but the need to prioritize among harms is no reason for inaction. And if threats as grave as those posed by climate do not justify robust macroprudential intervention, then it is hard to imagine what would.

Regulators should prepare for the fossil fuel endgame.

At some point along the road to phasing out nearly all fossil fuel production, private actors may exit the sector. It is unrealistic to expect oil and gas companies to hold the pump, so to speak, until the last drop of their product is needed. Dramatic changes in the fossil fuel sector are also unlikely to occur smoothly or orderly. Financial regulators should prepare for sharp shocks, insolvencies of major companies, and demands for bailouts or nationalization to keep oil and gas flowing, even if only briefly.

Preparing for these eventualities will allow regulators to avoid the numerous problems that can occur in the event of hasty, unplanned, emergency rescues: inequities for affected communities, consumers, and taxpayers; the creation of moral hazard, including by rewarding reckless managers; and, in the case of fossil fuel production, the absence of a plan to phase the activity down as quickly and orderly as possible while advancing equity and justice for the workers and communities still reliant on the industry. There is no excuse for being unprepared for scenarios in which the fossil fuel sector is in disarray, yet some amount of its product will still be needed for a limited time. The Treasury Department and the Federal Reserve should collaborate on planning for these scenarios. They also should publish plans or principles that will guide their actions in an emergency and, to the extent feasible, establish rules or guidelines that bolster their credibility and deter moral hazard. If new authority is needed for sound solutions, then the regulators should report the need to Congress.

REGULATORS MUST RESPOND TO THE CLIMATE CRISIS IN A MANNER COMMENSURATE WITH THE THREATS

Most fundamentally, financial regulators must undertake more robust and reliable responses in addition to those already under consideration. A key underpinning of these responses is that they take safety and soundness seriously in the context of climate-related financial threats.

The authority—and the *obligation*—to stop institutions from engaging in unsafe or unsound practices is part of the bedrock of banking law (Menand 2019). It is a central mission of prudential regulation, supplying the basis for many implied

and expressly granted powers.[6] It originated in microprudential regulation but also has a macroprudential form, safeguarding the stability of the financial system. There is no serious debate among regulators that climate change raises safety and soundness concerns—even the Republican chairs of the Federal Reserve and the Federal Deposit Insurance Corporation (FDIC) agree (Condon 2020; McWilliams 2021; Guida 2021). The real question is what the safety and soundness mission requires.

As a general matter, it demands that regulators prohibit unsafe and unsound assets and activities—those that are unacceptably risky and those for which we cannot adequately assess (and therefore cannot mitigate) the risks. In the climate context, this means phasing down assets and activities that are vulnerable to grave transition threats or contribute to grave physical threats, as well as those that are characterized by high levels of uncertainty such that they cannot be rendered safe by other means.

To show that they are safe and sound, banks must demonstrate the adequacy of their capital, the quality of their assets, the soundness of their management, and so on (OCC n.d.)—all difficult to show in the context of "deep" or "radical" uncertainty surrounding climate-related threats. The failure to consider, analyze, and develop adequate responses to important risks is a textbook unsafe or unsound practice, as is engaging in activities for which the financial institution is incapable of providing these assurances (OCC 2019; Menand 2019). If regulators had good information on climate risk and required banks to submit capital plans that reflect their current levels of ignorance, their inability to model important threats, and so on, the plans would be rejected as nonstarters on qualitative grounds.[7] But regulators too lack adequate information or strong analytic capabilities in this context, and they are unlikely to develop these resources anytime soon. These deficits are no reason to delay responses—that the Federal Reserve's own analysis of climate-related financial risk would fail on qualitative grounds does not mean it should ignore similar deficiencies at large bank holding companies. To the contrary, the widespread uncertainty about potentially grave climate threats is grounds for acting quickly and assertively to start mitigating them.

---

[6] 12 U.S.C. § 1818; 12 U.S.C. § 1831p-1 and 12 C.F.R. § 364.101; 12 U.S.C. § 1843; 12 U.S.C. § 1844. See also 12 U.S.C. § 5330; 12 U.S.C. § 5362 (applying most of 12 U.S.C § 1818 to nonbanks designated for Fed supervision); 12 U.S.C. § 5365.

[7] Consider that the Fed has rejected capital plans on "qualitative" grounds when their analysis suffers from deficiencies such as the inability to project revenue and losses to material parts of operations (Board of Governors of the Federal Reserve System 2014).

A good deal of low-hanging fruit is in sight: Regulators should begin integrating climate risk into supervisory guidance and examination frameworks, as well as guidance on designations of systemically important financial institutions (SIFIs) (Arkush et al. 2021).[8] Financing, purchasing, or holding high-emission assets should weigh toward designation and, above certain levels of involvement, should likely be treated as dispositive. The need to bring all institutions that finance emissions into supervisory frameworks will only grow as regulators begin to reduce the involvement of more regulated entities. (If the Financial Stability Oversight Council does not designate systemically important nonbanks and the Federal Reserve does not supervise and regulate them appropriately, most of the dangerous financing may simply migrate to them.) Independently, the need for designations will increase over time as regulators work to maintain order throughout the financial system during the inevitable hastening of the clean-energy transition. Engaging properly in the steps outlined above could begin to curb some of the highest-risk financing of emissions.

The safest, most conservative, and most sensible response to these inverse, grave threats is to reduce their common source: the financing of emissions-generating assets and activities that are at odds with climate targets.

But more will likely be needed, and regulators should absorb a few lessons to guide further action. First, if we fail to phase out greenhouse gas emissions quickly, the climate crisis has a high likelihood of destroying the financial system (along with many other things). Second, effective responses to the climate crisis will create an extraordinarily high risk of financial instability in the absence of careful supervision and regulation. Third, the safest, most conservative, and most sensible response to these inverse, grave threats is to reduce their common source: the financing of emissions-generating assets and activities that are at odds with climate targets. Activity limits have a long history in banking law (Barr et al. 2018), and they could take multiple possible forms, under multiple authorities, including concentration limits, portfolio limits, capital regulation (as discussed above), the use of broad prudential powers under the Dodd-Frank Act, and direct authorities to prevent institutions from engaging in unsafe or unsound practices.

[8] Senator Diane Feinstein's "Addressing Climate Financial Risk Act" would require the regulators to integrate climate into supervisory guidance and guidance on SIFI designations (S. 588). The regulators already have authority to take these steps. But legislation requiring action may be merited as they have not exercised it yet.

Regulators should begin by focusing on the assets that are most vulnerable to transition risk and contribute the most to systemic climate risk, which will tend to be the same. Early priorities, therefore, are new fossil fuel development or expansion, as well as other long-term assets, and the dirtiest fossil fuel operations. Given the extraordinary peril from these activities; their gross misalignment with climate targets; and the deep uncertainty surrounding the specifics of when, where, and how related threats will materialize, it would be defensible for regulators to find that financing or purchasing them is unsafe and unsound and to work with institutions to phase them out as rapidly and orderly as possible.

Beyond this first cut, regulators should begin working to bring the financing of emissions toward closer alignment with targets established by policymakers, and ultimately those recommended by climate scientists (which might be enacted as policy). When total emissions grossly exceed policy targets, most emissions-producing assets are at high risk of sharp devaluation unless we can be certain they are already priced low enough; in addition, their risks are highly correlated, which increases the systemic threat. The financing of emissions that grossly exceed science-based targets also inherently poses a grave risk to the financial system due to its contribution to existentially threatening climate disruption. In addition to substantive concerns about the riskiness of these assets, the uncertainty regarding the threats they face makes it unlikely that financial institutions or regulators can ensure they are safe and sound. As noted above, capital requirements may be used to mitigate risks about which we understand more—and they could be used to facilitate an orderly phase down.

Safety and soundness authority directly comprises a broad set of authorities, including oral and written guidance, supervision, rulemaking, and enforcement. (It also undergirds many other tools of supervision and prudential regulation.) Regulators can use these authorities flexibly, along with what could be called "soft power"—their influence with regulated entities—to start on the pathway outlined above. They should do as much as possible using supervision, guidance, and soft power, as these approaches maintain flexibility and could reduce litigation. Supervision is also apt because the regulators will need to keep a close eye on stability throughout the process.

CONCLUSION

The financial system cannot safely proceed on its current course without substantial intervention by regulators. It is caught between two inverse harms—significant threats to financial stability from the rapid phaseout of greenhouse gas pollution or, if we fail to make that transition quickly enough, an escalating cascade of climate catastrophes that will soon destabilize financial markets and that could threaten humanity by the time today's young children reach their 80s. It is too late to avoid both sets of harm and, in fact, we are already beginning to experience both. From this point, we can only choose between them.

There is only one acceptable choice: We must embrace the clean-energy transition—that is, invite transition-related risk and manage it as effectively possible. Other policymakers and private actors are increasingly making this choice, and financial regulators must commit to the same path. To borrow a phrase, climate-related risks have rendered the financial system unsafe at any (capital) charge, and it will remain so until financial regulators actively shepherd it through the clean-energy transition.

Rapidly phasing down the financing of emissions while preventing financial instability is no small task. But the risks the climate crisis poses to the financial system and to humanity are far greater. And it will be much safer to engage in this transition carefully and deliberately, under the close supervision of regulators, than to allow it to occur haphazardly.

REFERENCES

Addressing Climate Financial Risk Act of 2021, S. 588, 117th Cong. (2021). https://www.congress.gov/bill/117th-congress/senate-bill/588/text?r=18&s=1.

Arkush, David, Ty Gellasch, Erik Gerding, Alexis Goldstein, and Heather Slavkin Corzo. 2021. *Climate Roadmap for US Financial Regulation*. Washington, DC: Public Citizen and Americans for Financial Reform. https://www.citizen.org/wp-content/uploads/Climate-Financial-Reg-Report.pdf.

Armour, John, Dan Awrey, Paul Davies, Luca Enriques, Jeffrey N. Gordon, Colin Mayer, and Jennifer Payne. 2016. *Principles of Financial Regulation*. Oxford, UK: Oxford University Press.

Barr, Michael S., Howell E. Jackson, and Margaret E. Tahyar. 2016. *Financial Regulation: Law and Policy*. St. Paul, MN: Foundation Press.

Board of Governors of the Federal Reserve System. 2014. *Comprehensive Capital Analysis and Review 2014: Assessment Framework and Results*. Washington, DC: Federal Reserve Board. https://www.federalreserve.gov/newsevents/press/bcreg/ccar_20140326.pdf.

Board of Governors of the Federal Reserve System. 2016. "Regulations Q and Y; Risk-Based Capital and Other Regulatory Requirements for Activities of Financial Holding Companies Related to Physical Commodities and Risk-Based Capital Requirements for Merchant Banking Investments." Federal Register volume 81, no. 190, Proposed Rules, September 30, 2016. https://www.govinfo.gov/content/pkg/FR-2016-09-30/pdf/2016-23349.pdf.

Board of Governors of the Federal Reserve System. 2020a. *Financial Stability Report*. Washington, DC: Federal Reserve Board. https://www.federalreserve.gov/publications/files/financial-stability-report-20201109.pdf.

Board of Governors of the Federal Reserve System. 2020b. *Supervision and Regulation Report*. Washington, DC: Federal Reserve Board. https://www.federalreserve.gov/publications/files/202011-supervision-and-regulation-report.pdf.

Bolton, Patrick, Morgan Despres, Luiz Awazu Pereira Da Silva, Frédéric Samama, and Romain Svartzman. 2020. *The Green Swan: Central Banking and Financial Stability in the Age of Climate Change*. Bank for International Settlements (BIS): Banque de France. https://www.bis.org/publ/othp31.pdf.

Bos, Kyra, and Joyeeta Gupta. 2019. "Stranded Assets and Stranded Resources: Implications for Climate Change Mitigation and Global Sustainable Development." *Energy Research & Social Science* 56 (October). https://www.sciencedirect.com/science/article/pii/S2214629618305383.

Bradshaw, Corey J. A., Paul R. Ehrlich, Andrew Beattie, Gerardo Ceballos, Eileen Crist, Joan Diamond, Rodolfo Dirzo, Anne H. Ehrlich, John Harte, Mary Ellen Harte, Graham Pyke, Peter H. Raven, William J. Ripple, Frédérik Saltré, Christine Turnbull, Mathis Wackernagel, and Daniel T. Blumstein. 2021. "Underestimating the Challenges of Avoiding a Ghastly Future." *Frontiers in Conservation Science* 1 (January). https://www.frontiersin.org/articles/10.3389/fcosc.2020.615419/full.

Brainard, Lael. 2021. "The Role of Financial Institutions in Tackling the Challenges of Climate Change." (Speech, 2021 IIF US Climate Finance Summit: Financing a Pro Growth Pro Markets Transition to a Sustainable, Low-Carbon Economy, hosted by the Institute of International Finance, Washington, DC, February 18, 2021.) https://www.federalreserve.gov/newsevents/speech/brainard20210218a.htm.

Carbon Tracker Initiative. 2011. *Unburnable Carbon: Are the World's Financial Markets Carrying a Carbon Bubble?* London: Carbon Tracker Initiative. https://carbontracker.org/reports/carbon-bubble/.

Ceres. 2020. *Financing a Net-Zero Economy: Measuring and Addressing Climate Risk for Banks*. Boston: Ceres. https://www.ceres.org/resources/reports/financing-net-zero-economy-measuring-and-addressing-climate-risk-banks.

Chenet, Hugues, Josh Ryan-Collins, and Frank van Lerven. 2021. "Finance, Climate-Change and Radical Uncertainty: Towards a Precautionary Approach to Financial Policy." *Ecological Economics* 183 (May). https://www.sciencedirect.com/science/article/pii/S092180092100015X.

Climate Action Tracker (CAT). 2020a. "Temperatures." Climate Action Tracker. Last updated December 2020. https://climateactiontracker.org/global/temperatures/.

Climate Action Tracker (CAT). 2020b. "The CAT Thermometer." Climate Action Tracker. Last updated December 2020. https://climateactiontracker.org/global/cat-thermometer/.

Climate Action Tracker (CAT). 2020c. "CAT Climate Target Update Tracker: China." Climate Action Tracker. Last updated December 12, 2020. https://climateactiontracker.org/climate-target-update-tracker/china/.

Climate-Related Market Risk Subcommittee, Market Risk Advisory Committee of the US Commodity Futures Trading Commission (CFTC). 2020. *Managing Climate Risk in the US Financial System*. Washington, DC: CFTC. https://www.cftc.gov/sites/default/files/2020-09/9-9-20%20Report%20of%20the%20Subcommittee%20on%20Climate-Related%20Market%20Risk%20-%20Managing%20Climate%20Risk%20in%20the%20U.S.%20Financial%20System%20for%20posting.pdf.

Condon, Christopher. 2020. "Fed's Powell Says Central Banks Must Help Address Climate Change." *Bloomberg Green*, November 12, 2020. https://www.bloomberg.com/news/articles/2020-11-12/fed-s-powell-says-central-banks-must-help-address-climate-change.

Davidson, Kate. 2021. "Treasury May Be Able to Facilitate Climate Stress Tests on Financial Firms." *Wall Street Journal*, February 22, 2021, sec. Economy. https://www.wsj.com/articles/treasury-may-be-able-to-facilitate-climate-stress-tests-on-u-s-financial-firms-11614004778.

Dudley, William C. 2015. "William C Dudley: Is the Active Use of Macroprudential Tools Institutionally Realistic?" (Panel Remarks presented at the Macroprudential Monetary Policy, 59th Economic Conference of the Federal Reserve Bank of Boston, Boston, MA, October 3, 2015.) https://www.bis.org/review/r151005d.htm.

European Commission. 2019. "Guidelines on Non-Financial Reporting: Supplement on Reporting Climate-Related Information." Official Journal of the European Union, June 20, 2019. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52019XC0620(01)&from=EN.

European Commission. 2020. "2030 Climate Target Plan." The European Union: Climate Action. Accessed April 2021. https://ec.europa.eu/clima/policies/eu-climate-action/2030_ctp_en.

Flavelle, Christopher. 2019. "Climate Risk in the Housing Market Has Echoes of Subprime Crisis, Study Finds." *New York Times*, September 27, 2019. https://www.nytimes.com/2019/09/27/climate/mortgage-climate-risk.html.

Flavelle, Christopher. 2020. "Rising Seas Threaten an American Institution: The 30-Year Mortgage." New York Times, June 19, 2020. https://www.nytimes.com/2020/06/19/climate/climate-seas-30-year-mortgage.html.

Fountain, Henry. 2021. "Global Warming's Deadly Combination: Heat and Humidity." New York Times, March 8, 2021. https://www.nytimes.com/2021/03/08/climate/climate-change-heat-tropics.html.

Geiges, Andreas. 2021. Email correspondence on climate analytics. March 4, 2021.

Gelzinis, Gregg. 2021. *Addressing Climate-Related Financial Risk through Bank Capital Requirements: A Path Forward*. Washington, DC: Center for American Progress. https://www.americanprogress.org/issues/economy/reports/2021/05/11/498976/addressing-climate-related-financial-risk-bank-capital-requirements/.

Guida, Victoria. 2021. "POLITICO Pro: FDIC Chairman Jelena McWilliams." *POLITICO Pro*, March 8, 2021. https://subscriber.politicopro.com/article/2021/03/politico-pro-q-a-fdic-chairman-jelena-mcwilliams-2038701.

Hunt, Tam. 2020. "Has the International Energy Agency Finally Improved at Forecasting Solar Growth?" *PV Magazine*, July 12, 2020. https://pv-magazine-usa.com/2020/07/12/has-the-international-energy-agency-finally-improved-at-forecasting-solar-growth/.

Im, Eun-Soon, Jeremy S. Pal, and Elfatih A. B. Eltahir. 2017. "Deadly Heat Waves Projected in the Densely Populated Agricultural Regions of South Asia." *Science Advances* 3, no. 8 (August). https://advances.sciencemag.org/content/3/8/e1603322.

Intergovernmental Panel on Climate Change (IPCC) Core Writing Team, Rajendra K. Pachauri, Leo Meyer, eds. 2014. *Climate Change 2014 Synthesis Report*. IPCC. https://www.ipcc.ch/site/assets/uploads/2018/02/SYR_AR5_FINAL_full.pdf.

Intergovernmental Panel on Climate Change (IPCC). 2018. *Global Warming of 1.5° C*. IPCC. https://www.ipcc.ch/site/assets/uploads/sites/2/2019/06/SR15_Full_Report_High_Res.pdf.

Johnson, Simon, and Antonio Weiss. 2017. *The Financial Stability Oversight Council: An Essential Role for the Evolving US Financial System*. Washington, DC: Peterson Institute for International Economics. https://www.piie.com/system/files/documents/pb17-20.pdf.

Kompas, Tom. 2018. "US $23 Trillion Will Be Lost If Temperatures Rise Four Degrees by 2100." *Phys.Org*, August 15, 2018. https://phys.org/news/2018-08-trillion-lost-temperatures-degrees.html.

Lee, Allison Herren. 2021. "Public Input Welcomed on Climate Change Disclosures." US Securities and Exchange Commission (SEC), March 15, 2021. https://www.sec.gov/news/public-statement/lee-climate-change-disclosures.

Lynas, Mark. 2020. *Our Final Warning: Six Degrees of Climate Emergency*. London: Harper Collins Publishers.

McWilliams, Jelena. 2021. "Statement by FDIC Chairman Jelena McWilliams at the Financial Stability Oversight Council Meeting." (Presented at the Financial Stability Oversight Council Meeting, Federal Deposit Insurance Corporation, March 31, 2021). https://www.fdic.gov/news/speeches/2021/spmar3121.html.

Medland, Dina. 2015. "A 2°C World Might Be Insurable, A 4°C World Certainly Would Not Be." *Forbes*, May 26, 2015. https://www.forbes.com/sites/dinamedland/2015/05/26/a-2c-world-might-be-insurable-a-4c-world-certainly-would-not-be/?sh=f0da59c2de08.

Menand, Lev. 2019. "Too Big to Supervise: The Rise of Financial Conglomerates and the Decline of Discretionary Oversight in Banking." *Cornell Law Review* 103, (March): 1527. https://scholarship.law.cornell.edu/clr/vol103/iss6/8/.

Mercure, J. F., H. Pollitt, J. E. Viñuales, N. R. Edwards, P. B. Holden, U. Chewpreecha, P. Salas, I. Sognnaes, A. Lam, and F. Knobloch. 2018. "Macroeconomic Impact of Stranded Fossil Fuel Assets." *Nature Climate Change* 8, (June): 588—93. https://www.nature.com/articles/s41558-018-0182-1.

Mésonnier, Jean-Stéphane, and Benoit Nguyen. 2021. "Showing off Cleaner Hands: Mandatory Climate-Related Disclosure by Financial Institutions and the Financing of Fossil Energy." Working Paper no. 800. Banque de France. https://www.banque-france.fr/sites/default/files/medias/documents/wp800.pdf.

Network for Greening the Financial System (NGFS). 2020. "NGFS Climate Scenarios for Central Banks and Supervisors." NGFS. https://www.ngfs.net/sites/default/files/medias/documents/820184_ngfs_scenarios_final_version_v6.pdf.

Office of Comptroller of the Currency (OCC). n.d. "Comptroller's Handbook." OCC Publications & Resources. Accessed April 2021. https://www.occ.treas.gov/publications-and-resources/publications/comptrollers-handbook/index-comptrollers-handbook.html.

Office of the Comptroller of the Currency (OCC). 2019. *Comptroller's Handbook: Examination Process: Large Bank Supervision Version 1.1., June 2018*. Washington, DC: OCC. https://www.occ.gov/publications-and-resources/publications/comptrollers-handbook/files/large-bank-supervision/pub-ch-large-bank-supervision.pdf.

Philipponnat, Thierry. 2020. *Breaking the Climate-Finance Doom Loop*. Brussels: Finance Watch. https://www.finance-watch.org/wp-content/uploads/2020/06/Breaking-the-climate-finance-doom-loop_Finance-Watch-report.pdf.

Potsdam Institute for Climate Impact Research and Climate Analytics. 2012. *Turn Down the Heat: Why a 4°C Warmer World Must Be Avoided*. Washington, DC: World Bank. http://documents1.worldbank.org/curated/en/865571468149107611/pdf/NonAsciiFileName0.pdf.

Powell, Jerome. 2020a. "Getting Back to a Strong Labor Market." (Speech to the Board of Governors of the Federal Reserve System, at the Economic Club of New York, via webcast, February 10, 2021). https://www.federalreserve.gov/newsevents/speech/powell20210210a.htm.

Powell, Jerome. 2020b. *Letter to the Honorable Brian Schatz*. Board of Governors of the Federal Reserve System, February 10, 2020. https://www.schatz.senate.gov/imo/media/doc/2.10.2020%20Federal%20Reserve%20Response.pdf.

Rainforest Action Network (RAN), Banktrack, Indigenous Environmental Network, Oil Change International, Reclaim Finance, and Sierra Club. 2021. *Banking on Climate Chaos: Fossil Fuel Finance Report 2021*. San Francisco: RAN. https://www.ran.org/bankingonclimatechaos2021/.

Ripple, William J., Christopher Wolf, Thomas M. Newsome, Phoebe Barnard, and William R. Moomaw. 2020. "World Scientists' Warning of a Climate Emergency." *BioScience* 70, no. 1 (January): 8—12. https://academic.oup.com/bioscience/article/70/1/8/5610806.

Romm, Joseph. 2016. *Climate Change: Whatever Everyone Needs to Know*. Oxford, UK: Oxford University Press.

Smialek, Jeanna. 2021. "The Fed Downplays the Chance That It Will Limit Banks from Oil and Gas Lending." *New York Times*, January 27, 2021. https://www.nytimes.com/2021/01/27/business/the-fed-downplays-the-chance-that-it-will-limit-banks-from-oil-and-gas-lending.html.

Steele, Graham. 2020. "Confronting the 'Climate Lehman Moment': The Case for Macroprudential Climate Regulation." *Cornell Journal of Law and Public Policy* 30, (March): 109—57. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3542840.

Steffen, Will et al. 2018. "Trajectories of the Earth System in the Anthropocene." *Proceedings of the National Academy of Sciences* 115, no. 33 (August): 8252—59. https://www.pnas.org/content/115/33/8252.

Stern, Nicholas. 2007. *The Economics of Climate Change: The Stern Review*. London: Cambridge University Press.

Stiroh, Kevin. 2020. "Kevin Stiroh: Climate Change and Risk Management in Bank Supervision." (Remarks by Mr. Kevin Stiroh at the conference Risks, Opportunities, and Investment in the Era of Climate Change, Harvard Business School, Boston, MA, March 4, 2020. https://www.bis.org/review/r200309b.pdf.

Task Force on Climate-related Financial Disclosures (TCFD). 2017. *Recommendations of the Task Force on Climate-Related Financial Disclosures*. TCFD. https://assets.bbhub.io/company/sites/60/2020/10/FINAL-2017-TCFD-Report-11052018.pdf.

United Nations Framework Convention on Climate Change (UNFCCC). 2015. *Paris Agreement*. Paris: United Nations. https://unfccc.int/sites/default/files/english_paris_agreement.pdf.

US Department of Defense (DOD). 2014. *Quadrennial Defense Review 2014*. Washington, DC: DOD. https://archive.defense.gov/pubs/2014_quadrennial_defense_review.pdf.

Vivid Economics, Energy Transition Advisors (ETA), and UN Principles for Responsible Investment (PRI). 2020. *The Inevitable Policy Response: Forecast Policy Scenario*. London: PRI. https://www.unpri.org/download?ac=9835.

Wallace-Wells, David. 2019. *The Uninhabitable Earth: Life After Warming*. New York: Penguin Random House.

White House. 2021. "Fact Sheet: President Biden Sets 2030 Greenhouse Gas Pollution Reduction Target Aimed at Creating Good-Paying Union Jobs and Securing US Leadership on Clean Energy Technologies." Statement/release, April 22, 2021. https://www.whitehouse.gov/briefing-room/statements-releases/2021/04/22/fact-sheet-president-biden-sets-2030-greenhouse-gas-pollution-reduction-target-aimed-at-creating-good-paying-union-jobs-and-securing-u-s-leadership-on-clean-energy-technologies/.

Woetzel, Jonathan, Dickon Pinner, Hamid Samandari, Hauke Engel, Mekala Krishnan, Brodie Boland, and Carter Powis. 2020. *Climate Risk and Response: Physical Hazards and Socioeconomic Impacts*. McKinsey Global Institute. https://www.mckinsey.com/business-functions/sustainability/our-insights/climate-risk-and-response-physical-hazards-and-socioeconomic-impacts#.

World Bank. 2019. "GDP (Current US$)." World Bank National Accounts Data and OECD National Accounts Data Files. Accessed April 2021. https://data.worldbank.org/indicator/NY.GDP.MKTP.CD.

ROOSEVELTINSTITUTE.ORG